environmental assessment manual

ENVIRONMENTAL PROTECTION AGENCY REGION 1

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION I

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To: Federal, State and Local Officials; Engineering, Planning and Environmental Consultants; and Interested Citizens and Environmentalists

This manual has been prepared by EPA, Region I, to provide guidance in preparing Environmental Assessments on Wastewater Facility Plans in the New England States.

The construction of wastewater facilities utilizing Federal grants under the Federal Water Pollution Control Act Amendments of 1972 constitutes one of the major public works activities now underway in New England. Pursuant to the National Environmental Policy Act of 1969 and subsequent EPA regulations, an Environmental Assessment is required as part of the wastewater facility planning process. The Environmental Assessment is directed at determining the nature of primary and secondary environmental impacts of the proposed project and those alternatives which may have been considered in preparing a wastewater facility plan.

I wish to stress that this manual does not constitute a policy statement by Region I on how to do an Environmental Assessment. Our environment, particularly in New England, is so diverse that it would be impossible to expect one document to cover all possibilities.

Furthermore, we anticipate that your comments and suggestions presented during the workshops will be useful in developing a methodology which will result in assessments tailored to local and state needs as well as Federal regulations.

Sincerely,

Rebecca W. Hanmer

for William R. Adams, Jr.
Regional Administrator

Enclosure

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CHAPTER 1 - OVERVIEW

1.0 INTRODUCTION

This "Environmental Assessment Manual - Wastewater Facilities" has been developed to provide guidance to grant applicants in preparing Environmental Assessments (EAs) for EPA funded wastewater facilities. The manual has been prepared by Region I of EPA and is directed at conditions common to the New England region.

The manual does not constitute a statement of Region I policy in the preparation of EAs. It is intended as a guide for use by towns and cities, their consultants, and state administrators. The procedures outlined herein will have application to many situations. There are, however, many unique conditions which may require original and innovative procedures.

The topics included for discussion do not cover all of the environmental concerns addressed in a typical EA. The concentration is in those areas which have been problems throughout the region or have been mandated by recent EPA regulations.

The format of the manual is such that sections may be revised or added as new methodologies are developed or regulations issued.

1.1 THE ENVIRONMENTAL ASSESSMENT PROCESS

Under the Federal Water Pollution Control Amendments of 1972, Federal grants are available for a broad range of wastewater collection and treatment facilities. As a prerequisite for receiving grants, amounting to up to 75 per cent of eligible costs, a three step planning, design and construction process is required. These steps are as follows:

Step 1 - Facility Planning
Step 2 - Detailed Design
Step 3 - Construction

Pursuant to the requirements of the National Environmental Policy Act of 1969 (NEPA) all Federally funded construction projects which will significantly affect the human environment are subject to an environmental review process. The specific procedures to be followed in assessing environmental impacts are promulgated by each Federal agency. EPA's regulations are 40 CFR Part 6, "Preparation of Environmental Impact Statements" (April 1975).

The basic environmental procedures, as they apply to EPA's wastewater facility grants in Region I are contained in the following:

"Guidance for Preparing a Facility Plan" EPA/MCD, (May 1975).

"Guides to Environmental Planning, Assessments and Impacts for Water Quality Management Plans and Municipal Wastewater Treatment Projects", Region I, EPA, Revised August 1975.

The environmental assessment is part of the documentation known as the Facility Plan and prepared during Step 1. The environmental assessment provides a basis for evaluating the significance of the environmental impacts of the various alternatives considered in preparing the Facility Plan..

If EPA concurs in an EA finding that the proposed facility plan will not have any significant adverse effects, a Negative Declaration is issued. If EPA finds that a project may have significant adverse effects or is very controversial, EPA will issue a Notice of Intent to prepare an Environmental Impact Statement (EIS).

An EIS is more comprehensive than an EA and concentrates its analysis on those areas with a potential for significant environmental degradation.

1.2 RECENT ENVIRONMENTAL ASSESSMENT EXPERIENCE - REGION 1

In most cases in New England the EA has been prepared by the firm engaged by a community or sewer authority to prepare a Facility Plan. No accurate records are maintained by EPA, but it is estimated that over the past five years an average of $2,000 to $10,000 has been allocated for the EA portion of Step 1. An overwhelming majority of the assessments have reported no significant adverse impacts.

Increasingly, however, EPA and/or the public have been challenging the Environmental Assessment findings. Due to a number of reasons such as the inadequacy of the significant impact analysis or the significant nature of the potential adverse impacts, EPA has found it necessary to prepare the second level of analysis--an Environmental Impact Statement. The issuance of a Notice of Intent to prepare an EIS can mean a year's delay in completing facility planning.

One method being used in several EPA regions and recently initiated in Region 1 is the "piggyback" EIS. Under this procedure an EIS is prepared concurrently with the facility plan by an independent consultant. "Piggybacking" can avoid the delays inherent in first doing an EA and then following it with an EIS.

As noted above, some EIS's have been needed because of the inadequacy of the EAS's analysis or because the sewer needs documentation has not been sufficient. In instances this can be traced to the very limited funds allocated to EA work.

In others the EA has been viewed as a nuisance assignment; there is a reluctance on the part of the engineering firm to state that the impacts are significant. Sewer authorities, state agencies and engineering consultants don't relish environmental complications which can further delay a project.

1.3 IMPROVING THE ASSESSMENT PROCESS

A recent study by the GAO contained a number of recommendations for improving the environmental analysis procedures under NEPA for several Federal agencies, including EPA. The key recommendation was for an early identification of significant impacts so that the EIS process, where required, could proceed concurrently with Step 1 facility planning.

A more smoothly functioning facilities planning process can be encouraged by improving the environmental assessment analysis. Three results could be realized:

1. The environmental analysis of any key issue would be sufficient to convince the public and/or EPA that, in fact, the impacts are not significant, or

2. The environmental analysis would, at an early stage, identify a significant impact or impacts which would warrant a "piggyback" EIS.

3. The environmental analysis could identify problem areas and alert officials to measures for alleviating mitigating adverse impacts, thus turning a potentially significant issue into an environmentally benign one.

In New England and throughout the United States the environmental assessment often has been viewed as just another Federal application requirement. The days of considering the assessment as a document justifying the proposed facility plan are numbered and were never intended in the various EPA regulations.

Today there is a growing public awareness that the size, capacity and location of wastewater facilities have a significant impact on the direction and rate of community growth. A number of community development experts now contend that public facilities such as sewers can be more important in determining land use patterns than zoning.

It is the premise of this manual that the environmental assessment process be utilized in developing wastewater facility plans which are consistent with local objectives. Under no condition should the facility plan direct or induce development in a manner which is contrary to local goals and plans.

1.4 CASE STUDY COMMUNITY PROFILE

Tinkersville, New England is an imagined community which has been created to facilitate discussions of some of the environmental assessment methodologies presented in this manual. FIgure 1-1 shown the major streets and natural features of the town. Additional maps and descriptive text are contained in a number of the chapters of the manual.

The following sections provide a profile of the community. Tinkersville is located in central New England approximately 15 miles east of Summerfield, a moderately sized industrial and commercial city of 60,000.

1.41 Economy

Tinkersville serves as the major shipping and commercial center for five or six surrounding towns.

The major commercial center is located along Old State Road in West Village.

Tinkersville is the only significant employment center in the immediate area. Major industries include the old Nutrient Products Factory in South Village and several electronics industries located on either side of New State Road on the east side of Town.

Nutrient Products, which is locally owned, developed to serve the original farming community. Although the company still serves the remaining agricultural activities in Tinkersville and surrounding towns, it has diversified into new products and is showing steady growth.

The electronics industries are divisions of nationally recognized manufacturers who located in Tinkersville because of its central location with respect to the New England market, good highway and rail access, a surplus of trainable and skilled labor, and the natural living amenities of the area. All are prospering and anticipate expansion to serve a growing market for their products.

Very few residents commute to jobs outside of Tinkersville. The median family income in 1978 is estimated to be $15,000.

Agriculture is still important in Tinkersville. The area south of the Green River is made up of a number of operating dairy farms.

1.42 Population

In 1978 the population was 15,000. Prior year populations were: 1970 – 12,000; 1960 – 9,000; 1950, 6,000. Virtually all of the town's growth can be attributed to the expansion of existing industries and the attraction of new industry to town.

1.43 Natural Features

The terrain is gently rolling and there are no significant areas of excessive slope or high elevation.

The Green River by-passes the older developed section of the town and fortunately has been retained in a relatively natural state.

1.44 Urban Development

Urban development consisting of small and large lot single family homes, commercial uses and industry are concentrated in the central section of town. Due to the lack of sewers there has been no multi-family housing except for some large home conversions and units over stores in West Village. The surrounding land areas contain scattered homes, farms or woodlands. Public water is supplied to the urbanized sections of town.

1.45 Water Resources

A reservoir in the northeast section of town provides an adequate water supply for the town. With some expansion it can serve some of the future needs of the community.

An additional water resource is a major unutilized groundwater aquifer on the north side of the Green River.

1.46 Population Projection

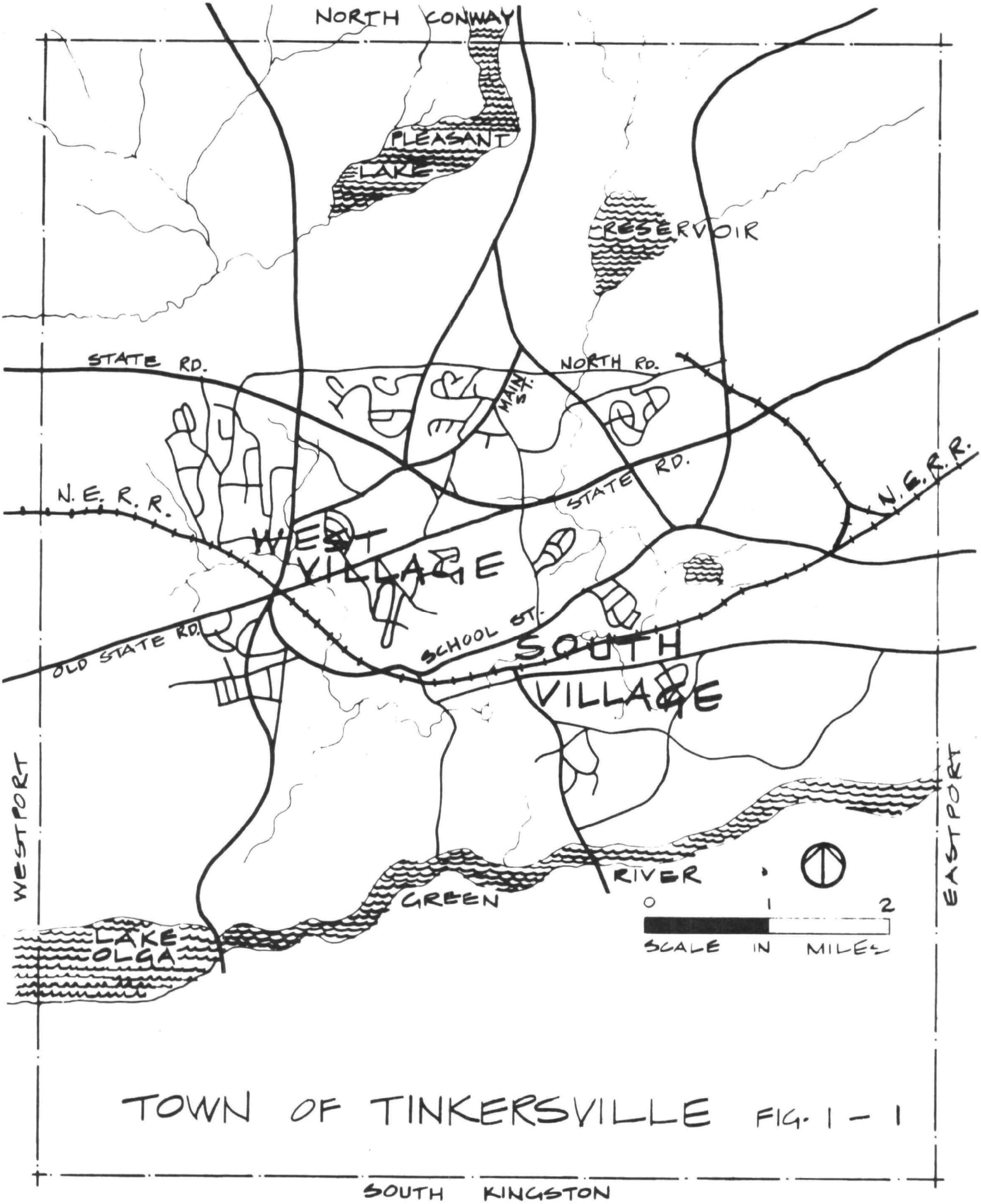
The Green River Regional Planning Commission, in collaboration with the State Planning Office has made the following population estimates (assuming no sewer construction) for Tinkersville:

1980	-	16,000
1990	-	19,000
2000	-	22,000

These estimates have been accepted by the local Chamber of Commerce and Planning Baord.

1.47 Local Plans

In 1971 the Planning Board prepared a Master Plan to guide the Town's future growth. The plan generally encouraged future growth at densities of one half acre/lot or more south of New State Road, north of the Green River and west



TOWN OF TINKERSVILLE FIG. 1 – 1

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of South Village. Because the soils in the above area had, according to SCS criteria, limitations for on-site septic systems it was suggested that sewering would be appropriate along with the sewering of the older sections of West Village and South Village.

Due to the continued strong influence of Nutrient Products in local affairs, the plan did not propose sewer extensions to help attract additional industry in the new industrial area on the east side of town.

There has been continued bickering over the contention that the plan is not reflective of community's desire to attract new industry to provide a more balanced tax base.

1.48 Municipal Finances

The extensive subdivision activity during the past twenty years to provide housing to serve new residents attracted by the new and growing local industries has placed a severe strain on the school system. Schools represent 60% of the local municipal budget. Additional schools will be required in the near future.

Other municipal services have expanded to meet the needs of a growing population. The per capita cost of these services, however, has grown at a rate which exceeds the inflation rate for the area.

1.49 Growth Regulations

The Town has adopted strong regulations which render construction in wetland areas almost impossible and the development of flood plains or high water table areas not economically attractive.

These regulations, however, provide few restrictions or controls covering land development adjacent to wetlands and streams.

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needs analysis

2. needs analysis

CHAPTER 2 - NEEDS ANALYSIS

2.0 INTRODUCTION

In 1976, the U.S. Environmental Protection Agency conducted a survey of 258 facility plans from 49 states. Of the total, 83 were for completely new collection and treatment systems. Three-quarters of the 83 plans indicated costs in excess of $100 per household per year. At the time of the survey, the median family income in the U.S. was approximately $13,000. Considering that in small communities the median income was less, the anticipated burden of the annual costs for the new collection and treatment systems on the average homeowner can be appreciated.

Most facility plans are well prepared and propose reasonable solutions to wastewater disposal problems. Some plans, however, have proposed socially and economically burdensome projects. The consequences are defeat by the voters or an order to prepare an EIS. A major shortcoming of many of these projects is in the preliminary work - the definition and documentation of sewer needs. If need for the project is better substantiated, then the costs, although occasionally high will be better understood and consequently more apt to be accepted by the voters.

This chapter of the Environmental Assessment Manual deals with the basic reason for the recommendations found in a Facilities Plan, that is, the documentation of need for the proposed project. This section presents some background information on regulatory requirements and past practices, and includes a suggested methodology for the preparation of an adequate needs analysis.

The objective of the presentation of this chapter is the documentation of the need and a suggested methodology for the preparation of a needs analysis. The suggested methodology is not specifically required by EPA policy or program requirements but is presented as an aid to the engineer who has to meet EPA program requirements.

In many cases, water pollution and public health problems have been identified by the EPA "Needs Survey"; the NPDES Permit process; the State Priority List development; or prior state or local sanitary surveys. The methodology for further identifying and documenting such problems will be presented in this chapter.

The needs analysis portion of facility planning is necessary to establish the nature of wastewater disposal problems and to develop reasonable alternatives. It is also helpful in preparing an Environmental Assessment of the proposed project by providing documentation of problems and justification for the proposed actions.

2.1 REGULATORY STATUS

Several years after the implementation of Public Law 92-500 and the rules and regulations promulgated under Section 201 of the Act, EPA administrators became acutely aware of the problems encountered by small communities which were unable to meet the high costs of wastewater collection and treatment facilities. In response to the problem, John T. Rhett, in an August 18, 1976 memorandum to EPA's Regional Administrators, presented a draft Program Requirements Memorandum (PRM) which required that Facility Plans include a complete and careful cost-effectiveness analysis of:

- -- septic tanks, holding tanks and package treatment plants (which are all eligible for federal funding) for small clusters of houses;
- -- "honey wagons" and septage treatment facilities (also eligible for federal funding) to serve a group of individual family systems; and
- -- new systems serving only an individual family (though this alternative is not eligible for federal funding).

Though still a draft PRM the Rhett memorandum is being used as a guide to EPA policy. In further response to the problem of costly collection and treatment facilities and to clarify EPA policy on the funding of collection systems, Douglas Costle, EPA Administrator, issued PRM 77-8 on June 21, 1977. Section 111-B of PRM 77-8 required that the cost-effectiveness of collector sewers must be proven when compared to the alternatives presented in the Rhett memorandum. The section also required the specific documentation of health, groundwater and discharge problems of existing disposal systems and the documentation of site characteristics which restrict the use of existing disposal systems. Section 111-C of the same PRM required public disclosure of the costs of any collection system project including:

- -- the estimated monthly charge for operation and maintenance,
- -- the estimated monthly debt service charge,
- -- the estimated connection charge, and
- -- the estimated connection charge to a typical residential customer for the new collection system and any other associated wastewater facilities required.

The most recent response to the collection system cost problem comes from Congress in the form of the Federal Water Pollution Control Act Amendments of 1977 which adds sub-section (h) to Section 201. Sub-section (h) allows grants for the construction of "privately owned treatment works serving one or more principal residences or small commercial establishments constructed prior to, and inhabited on, the date of enactment, of the sub-section.

2.2 PAST PRACTICES

In the past, engineers were inclined to presuppose "needs" when a community hired them to do a Sewerage Feasibility Study or Facility PLan, though the local desire might have been the stimulation of industrial development or a transfer of the "problem" of individual sub-surface disposal systems from the local Board of Health to a Sewer Authority. Funding programs have until recently helped to promote this lack of real "needs analysis."

Prior to enactment of PL 92-500, HUD planning loans were often used to prepare engineering reports in anticipation of public works projects. Often times these reports were written in accordance with "Guides for the Design of Wastewater Treatment Works" prepared by the New England Interstate Water Pollution Control Commission, wherein it is stated that the engineer's report should include a "brief description of project including statement of need".

The enactment of PL 92-500 made funds available for the projects created under the HUD planning program but led to the establishment by EPA of "Facility Plans." These Facility Plans" often became rewrites of the old engineering reports with the addition of infiltration/inflow studies, industrial cost recovery and user charge systems and an environmental assessment. Because Section 201 of the Act allows funding for the construction of wastewater collection and treatment facilities, such projects were often recommended and built.

2.21 Objections to Past Practices

Recently, voters facing ever increasing taxes, high inflation and dwindling disposable income have been opposing sewer construction by voting down bond referenda. In addition, environmentally conscious citizens, fearing dramatic environmental and social changes, work to defeat sewer proposals or push for Environmental Impact Statements.

The concern of voters over the high cost of new collection and treatment systems is not imagined. Table 2.1 is an example of how many factors affect the cost comparison of on-site disposal versus collection and treatment under three conditions.

It should be noted that the information presented in Table 2-1 conforms with an important requirement of Section 111-C of PRM-77.8 in that both private and public costs are included. The differentiation of costs in addition to several other concepts that are relevant to the cost effective analysis is illustrated in Figure 2-1. The figure schematically shows the entire wastewater system and includes all potential costs such as repiping of house plumbing, the house collection sewers, the interceptor and the treatment plant. The figure also shows that the largest portion of the wastewater system's cost lies in the collection system in the case of sewers and the future operation, maintenance and repair for an on-site approach. Thus, the greatest potential in minimizing cost to the community lies in either reducing the cost of the collection system or in minimizing the cost and frequency of future on-site failures.

TABLE 2-1

COST COMPARISON OF
ON-SITE DISPOSAL VS. COLLECTION AND TREATMENT

ALTERNATIVE I - SEWER CONSTRUCTION

	Case 1	Case 2	Case 3
Lot size	200 x 100	100 x 100	75 x 100
Sewer length per lot	122.5	72.5	54
Cost per lot @ $45/L.F.	5512	3262	2430
Cost per lot for STP & Interceptors	875	875	875
House Connection	750	750	750
TOTAL CAPITAL	7137	4887	4055
P.W. of $35/yr O&M over 50 yrs. @ 6.5%	525	525	525
TOTAL PRESENT WORTH	$7622	$5412	$4580

ALTERNATIVE II - SYSTEM REHABILITATION AND MAINTENANCE

Repair cost	2000	3000	5000
Immediate cost/unit	400	600	1000
Anual failure rate	3%	4%	5%
Annual repair cost/unit	60	120	250
Annual O&M/unit	30	30	30
P.W. of annual cost over 50 yrs. @ 6.5%	1350	2250	4200
TOTAL PRESENT WORTH	$1750	$2850	$5200
Ratio cost of sewers to cost of rehabilitation	4.4	1.9	0.88

The preceding table and figure clearly demonstrate that wastewater collection and treatment is generally more costly than on-site disposal. Many engineers and regulatory officals, however, feel that although on-site disposal may be less costly, it is only a temporary measure and not as effective as the more "modern" collection and treatment alternative. This cost difference, the new program requirements and the new funding opportunities, however, require a detailed analysis and documentation of existing disposal system problems or "needs analysis" to justify the construction of wastewater collection and treatment facilities. The engineer must, then, commit himself to as much time for "needs analysis" and evaluation of alternatives to collection as he would spend in the more "glamourous" work of evaluating AWT alternatives. This implies that the engineer develops a methodology for the needs analysis and includes it in his Plan of Study (POS) prior to initiating the Facilities Plan. A suggested needs analysis methodology follows.

2.3 SUGGESTED METHODOLOGY

The suggested methodology is not new. It does not replace the past practices of many engineers but adds to them, broadens them and makes them more responsive to the public.

The facility planning process, (Step 1), is a three phased process.

Phase 1, analysis of needs, includes:

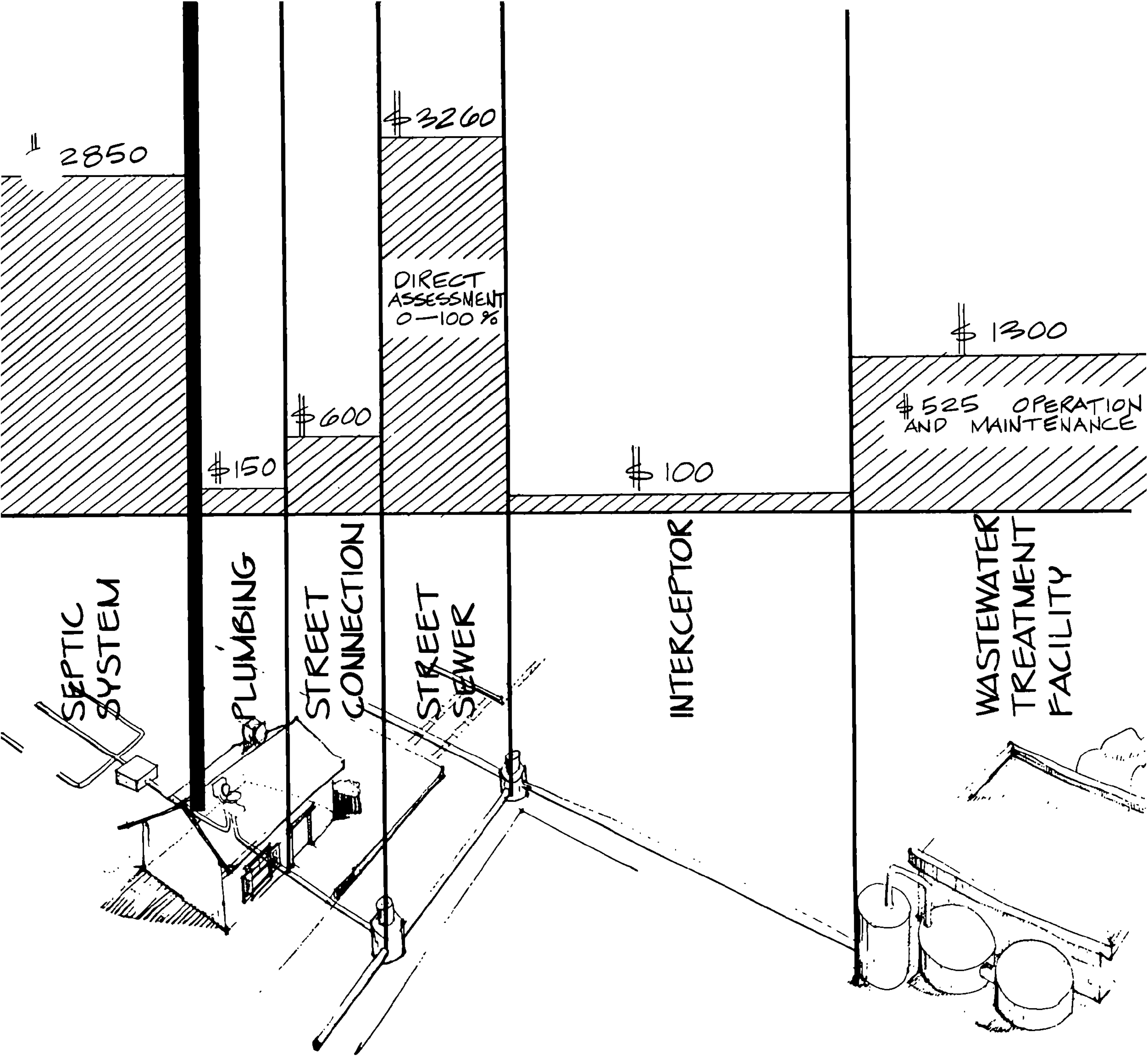
- -- gathering information
- -- analyzing the information
- -- definition of problem

Phase 2, alternatives evaluation, includes:

- -- Development of alternatives and implementation plans
- -- analysis of alternatives and implementations plans
- -- evaluation and ranking of alternatives and implementation plans

Phase 3 selection of recommended alternative includes:

- -- the gathering of public opinion
- -- selection of recommended alternative and implementation plan
- -- preparation of the Facilities Plan and Environmental Assessment



COST COMPONENTS — SEWERING VS ON SITE SYSTEMS
FIG. 2—1

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The needs analysis portion of the facility planning process is the major topic of this chapter.

2.31 Information Gathering

In performing a needs analysis, it is necessary to gather and store, in a recoverable manner, as much meaningful information as possible which relates to the identification of pollution control problems and potential health hazards and compliance with local or other pollution abatement orders. There are generally four categories of sources available, these are:

1. Meetings with concerned and involved individuals and organizations
2. Existing data and records
3. New data
4. The public

2.311 Meetings With Concerned and Involved Individuals and Organizations.

The first category of sources is usually brought into the process early in order to determine the location and extent of the existing data and records. Concerned and involved organizations and individuals include:

-- The local government unit which could be the Town Council, Board of Selectmen, Mayor, Town Manager, etc. These people as the elected or appointed representatives of the community often are quite aware of the existence of wastewater problems and can help make access to other information much easier.

-- The local and regional planning agency and/or commission are occasionally aware of wastewater problems. Most regional agencies have been involved with 208 plans. These generally are more helpful in providing inventory information and plans for land uses such as apartment or industrial sites which may require wastewater facilities.

-- The Building Inspector is in some instances aware of wastewater problems and can help determine whether problems could be caused by construction practices.

-- The Board of Health or Health Department generally oversees the installation, maintenance and repair of on-site systems and is usually a good source of records of such. They usually receive and often record complaints of overflows or failures.

-- Septage pumpers and landfill operators or sewage treatment plant superintendents usually know where most of their business is or keep records of septage pumping and dumping.

-- Local environmental or conservation groups which are usually helpful in establishing an environmental background for the facility plan, may also be aware of wastewater problems and areas of poor soils or high groundwater.

All of the above sources are tapped by personal interview and are thus subject to all of the human errors in both the transmission and reception of information. Each person has a varying level of competence and bias regarding on-site systems and their inherent characteristics. The interviewer cannot simply ask, "Where are your on-site problems?" the problem should be defined through further questioning in an attempt to filter out bias and over simplification. The additional questions could include:

- -- What is the nature of the problem?
- -- How many or what percent have problems?
- -- Are problems seasonal?
- -- Was the construction in the area with problems in conformance with current rates and regulations?

The engineer must keep in mind that wastewater disposal problems come in two types. Surface waters of a quality less than that set by a regulatory agency are "physical" problems which can be easily located and quantified by the engineer. The other type, however, is the "emotional" problem, the potential public health threat from sewage overflowing in the backyard or down the street which makes homeowners and local officials terribly excited and often brings a cry for sewers. There are also those officials and groups who are vehemently opposed to sewers. For these reasons and to quantify the problem, it is not enough to simply interview interested and concerned individuals in gathering information.

2.312 Existing Data and Records

The next source in the information gathering phase of the needs analysis is to consult existing records and data. These include:

-- Water quality data usually collected by the Water Department, Board of Health Department. These are occasionally accompanied by stream belt or shore line surveys to find discharges. The water quality information alone is usually not conclusive when trying to establish whether inadequately treated wastewater is overflowing into waterways. For that reason, they should be supplemented with field surveys. Groundwater quality information can be obtained from the Health Department or Water Resources Division of the State. This information and the location of existing and proposed well sites will help develop potential and existing problem areas.

-- The U.S. Soil Conservation Service usually has information on each town which includes an evaluation of various soil types and conditions which can limit the suitability of a site to on-site disposal. Due to the nature of survey work producing this information, such data must be viewed as a general guide to soil types. Occasionally, the SCS classification of a soil type as having "severe" or "very severe" limitations to on-site disposal may be misleading in that it actually applies to only the upper three or four feet of the soil and doesn't take into account unconventional alternatives such as mound systems.

-- Installation, repair, maintenance and failure records for on-site disposal systems are extremely useful in establishing the existence and extent of wastewater disposal problems. Installation, repair and failure records are generally available from the Board of Health, Health Department or Engineering Department. Installation records can provide a list of locations on which sub-surface disposal systems have been approved and/or disapproved. Repair and failure records (usually a list of the location of overflow complaints) will help locate problems and, if extensive enough, establish a failure rate for such systems.

-- Land use and demographic data are usually available from the local planning agency and the U.S. Census Bureau. The information will help determine the location of high density development, areas with high tenancy rates or low property values.

-- Septage haulers usually consider a listing of the problem areas as proprietary market information and do not quickly help anybody that may recommend a municipal sewer. However, many towns now have septage treatment facilities and require some basic information regarding the source of the pumpage which can then be used to great advantage by the engineer.

-- Past engineering or planning reports often provide substantial data, records and results of field work which provide a valuable data baseline for ongoing work or as a basis of comparison to establish trends and document changes.

2.313 New Data

If the existing information is not adequate it may be necessary to collect additional information on the community. This may include:

-- Additional water quality samples.

-- Subsurface explorations with a hand auger to allow the engineer to expand the SCS data through either a shot-gun approach or through a detailed survey in neighborhoods with suspected problems. This approach will establish site specific information.

-- Windshield surveys either townwide or in specific neighborhoods help the engineer get a feel for the community and establish the location of old, poor or high density neighborhoods. The windshield survey works best when the observer is a passenger and not the driver. This approach can also be coupled with the house to house survey.

-- The house to house survey is most helpful in gathering information. It usually suffers from lack of extent because of the cost and time involved. It is best suited to specific neighborhoods as back-up to other sources.

2.314 The Public

The last and perhaps most important source of information is the public. Public participation has been cited as a particularly important part of the facility planning process, in general, and is specifically important in the needs analysis phase (See Chapter 3, Community Involvement). Because the people of a community are the ones experiencing wastewater disposal problems and are the final decision makers in the approval of an alternative, it is necessary to obtain information on problems as well as their opinions on alternatives. Public participation in the needs analysis can be accomplished in at least three ways.

-- Public workshops can be used at several points in the facility planning process. An effective tool is to separate attendees into a number of groups which individually prepare a map of problem areas in the community. The workshop can also be used later in the needs analysis to present preliminary findings and alternatives. Thus, the workshop can be used for both "give and take" in an informal setting.

-- Public meetings are usually more formal than the workshop and although some of the attendees willingly present their views, many will not. Therefore, the public meeting is more effective as a means of presenting information.

-- Questionnaires distributed to all residents in the planning area will usually produce a much larger and more representative participation than a workshop or public meeting. When thoughtfully prepared, the questionnaire can produce a large amount of information in a useful form. Recent experience on Environmental Impact Statements, in Region 1, which have included questionnaires, has found response rates ranging from 15% to over 40%. A sample questionnaire is included as Appendix 2.6.

2.32 Data Analysis

The next phase in the needs analysis is the synthesis of the information gathered from the above sources. The most effective tool is a map of the study area. It is suggested that the map be of large scale and contain street names. It is useful to prepare a number of copies of the base map as a work map. Information, such as the location of homes which have septic tanks pumped more often than once a year is plotted on the work maps and then transferred to overlays. The overlays can then be combined into a composite map (See Figure 2-2) which may be compared with other overlays. This comparison will produce correlations (e.g. frequent septage pumping in older neighborhoods) which help define the problem. The maps and overlays produced in the analysis of the information are also suitable (when of large scale) for public meetings and workshops and can be reduced to a suitable size for the Facilities Plan.

When presenting the analysis it is often useful to present the maps which indicate no correlations. For example, a community with extremely good soils (i.e. permeable soils and low groundwater) may have an area with a high concentrtation of overflow complaints. The overlay procedure will produce no correlation between soils and overflows but will indicate that the overflow (or failure) of an on-site system is not due exclusively to physical conditions. This bit of information presented in the report will demonstrate that the analysis was performed and will help dispel possible misconceptions.

2.33 Problem Definition

The final step in the needs analysis is the definition of the problem. More often than not the problem will be in more than one form and if properly defined will guide the development of alternatives. It is important to note a few interesting findings from some recent facility plans and Environmental Impact Statements prepared in Region 1.

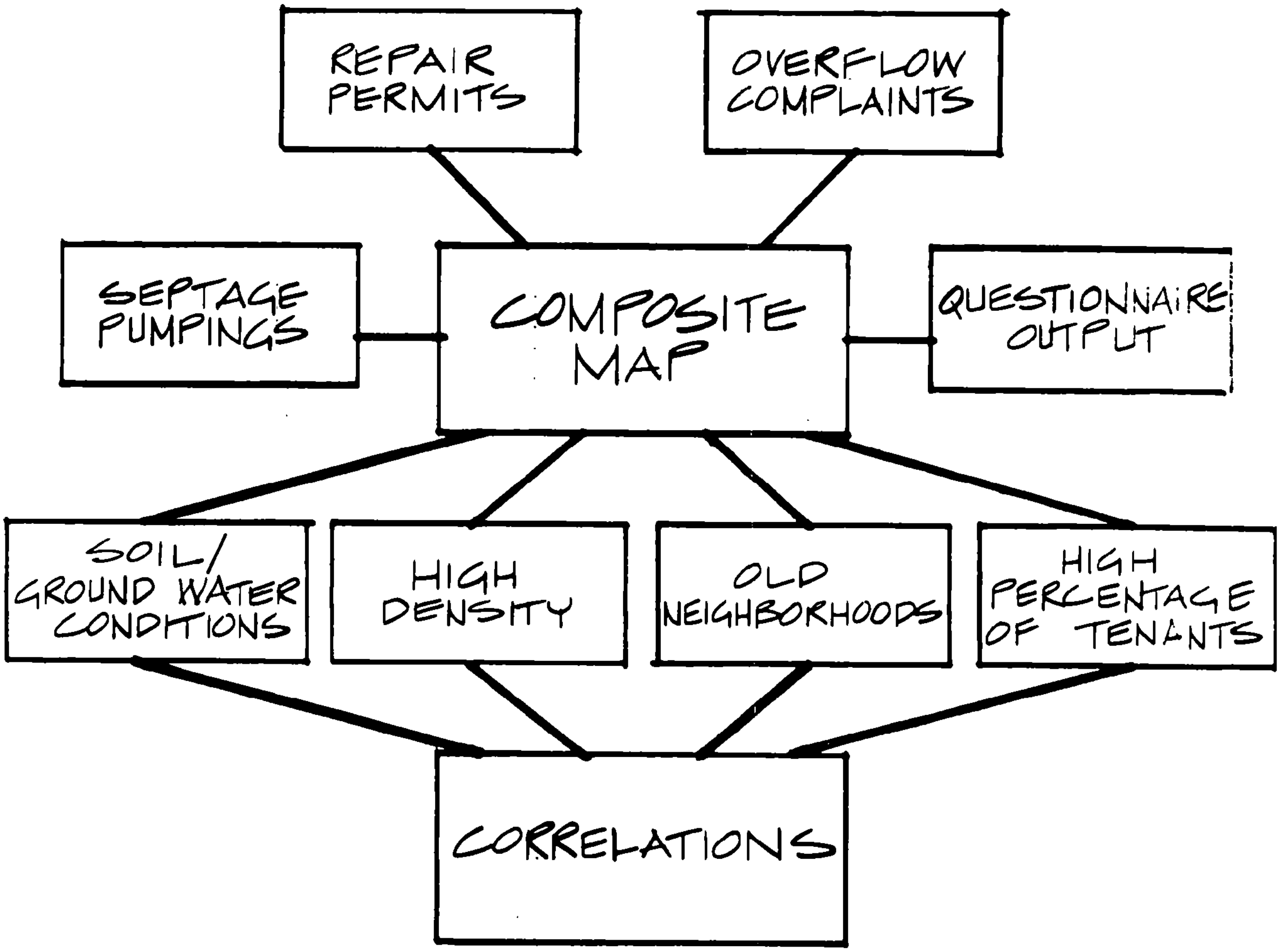
-- In one plan, it was found that the complaints of disposal system overflows (failures) were located in a pattern. Comparison of this pattern to various characteristics of the community indicated that this pattern corresponded to an area which was old, of high density, had a relatively low average property value and a high percentage of rental units. The analysis indicated that rehabilitation of on-site systems was not feasible and sewer construction, though cost-effective, would probably produce an adverse effect on residents who would have to pay either directly or through increased rents. In order to lessen the financial impact on the taxpayers, a supplemental source of funding is now being developed which will use HUD Community Development Block Grants.

-- The needs analysis conducted as part of an EIS prepared for a project which included sewering most of a then unsewered community indicated that septage pumpings and repairs, which were used as justification for the project, were actually only routine maintenance and that an overwhelming majority of respondents to a town-wide questionnaire felt that their existing disposal systems were not a problem.

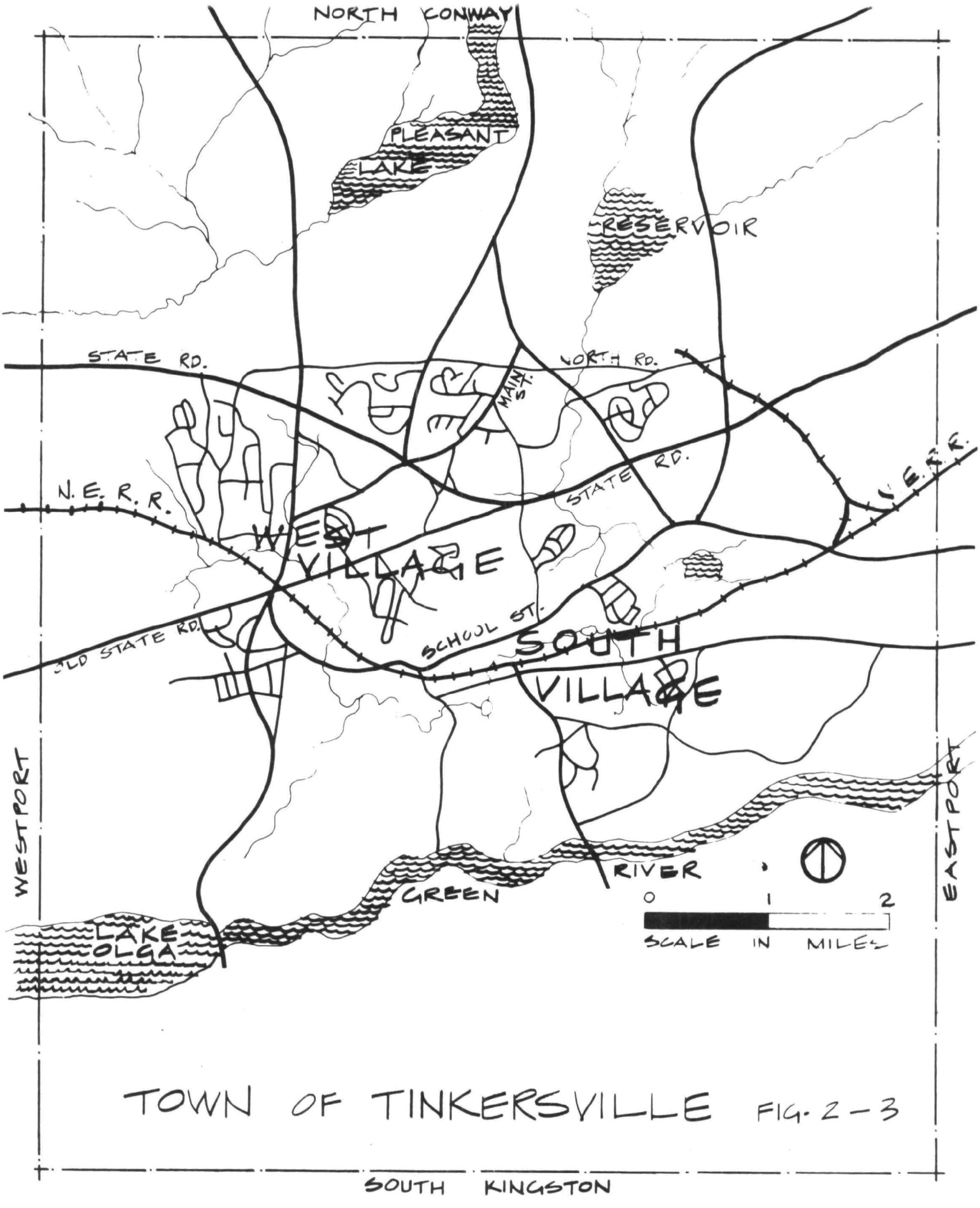
-- In another EIS needs analysis, it was found that the high fecal coliform counts found in the town's major stream and used as a justification for a town-wide sewer system, were caused by farming activities within the watershed.

2.4 CASE STUDY

In 1977, "Consultant Inc. of Westport, New England" was contracted to prepare a Step 1 Facilities Plan for the town of Tinkersville, a small community of 15,000 located just east of Westport. The needs analysis of the Tinkersville Facilities Plan is described here because the consultant's study produced some very interesting results.



NEEDS ANALYSIS MAPPING FIG. 2-2



TOWN OF TINKERSVILLE FIG. 2-3

environmental assessment manual
region 1 : environmental protection agency
anderson-nichols technical consultant

Prior to World War II, Tinkersville was a small farming/-industrial community with two major village centers. South Village, located at the intersection of Main Street and the New England Railroad, is the older of the two villages. West Village located at the intersection of Old State Road and the railroad developed during the mid 1930's. With the completion of new State Road came additional development to the north of West Village and more recently, the approval of major subdivisions throughout town.

2.41 Location of Problems

The first phase of Consultant's sewerage needs analysis was location of problems. Consultant, Inc. held a series of early meetings with the town government unit, the town planning unit, the local board of health, the State Department of Health, and interested citizens. At these meetings a great deal of information was gathered concerning the history of on-site disposal system installation, operation, maintenance and failure. This information was used to locate potential problem neighborhoods for house to house surveys. These survey results plus streambelt surveys conducted by the State and consultant were used to produce the Problem Location map (Figure 2-4). Problems include: septic tanks which require pumping more than once each year (this recognizes the distinction between preventative maintenance pumping and problem pumping), confirmed overflows reported by the Board of Health and raw discharges reported by the State Health Department and the consultant's survey.

2.42 Map Soil Data

The next phase of the consultant's needs analysis was the mapping of soil data obtained from the U.S.D.A. SCS and the consultant's house to house survey. Figure 2-5 shows areas with seasonal high groundwater within three feet of the surface and areas with slow permeability. The map could also show areas with shallow bedrock and areas with steep (greater than 15%) slope. Comparison of the Problem Location map and the Soils Data map indicates that only a few problems are caused by high groundwater or slow permeability. This fact was confirmed by the results of a town-wide questionnaire and the first public workshop.

2.43 Age of Development

The consultant next mapped the relative age of development. This information was obtained from old U.S.G.S. maps which showed individual buildings in existence prior to the date of the map. Comparison of Figure 2-6 with the Problem Location map indicates that a number of problems in West

Village can be correlated with age of development. It should be noted that if the town's records were extensive enough the consultant could correlate individual failures with the age of the system. This technique was used by Frink and Hill in Glastonbury, Connecticut[1] to determine a half life of 27 years for on-site disposal systems (i.e. 50% of all systems studied failed within 27 years).

2.44 Land Use Analysis

As part of the problem definition phase of the needs analysis, the consultant made use of the town planning unit's Land Use Map and his own survey information to map potential need areas (i.e. commercial developments and industrial sites) and constraints to on-site rehabilitation (e.g. small lot residential development). This information was mapped for correlation with the Problem Location map.

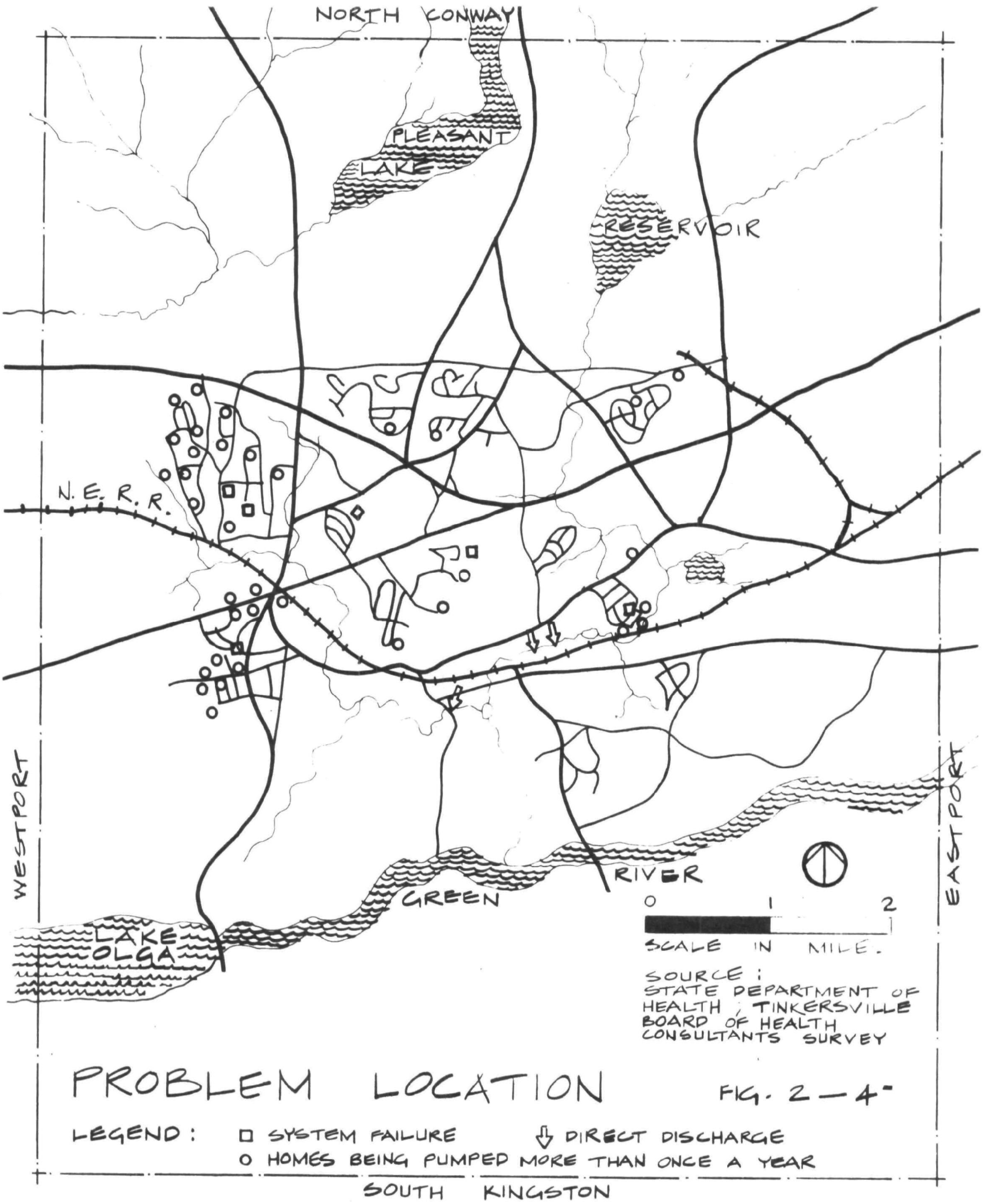
2.45 Problem Definition

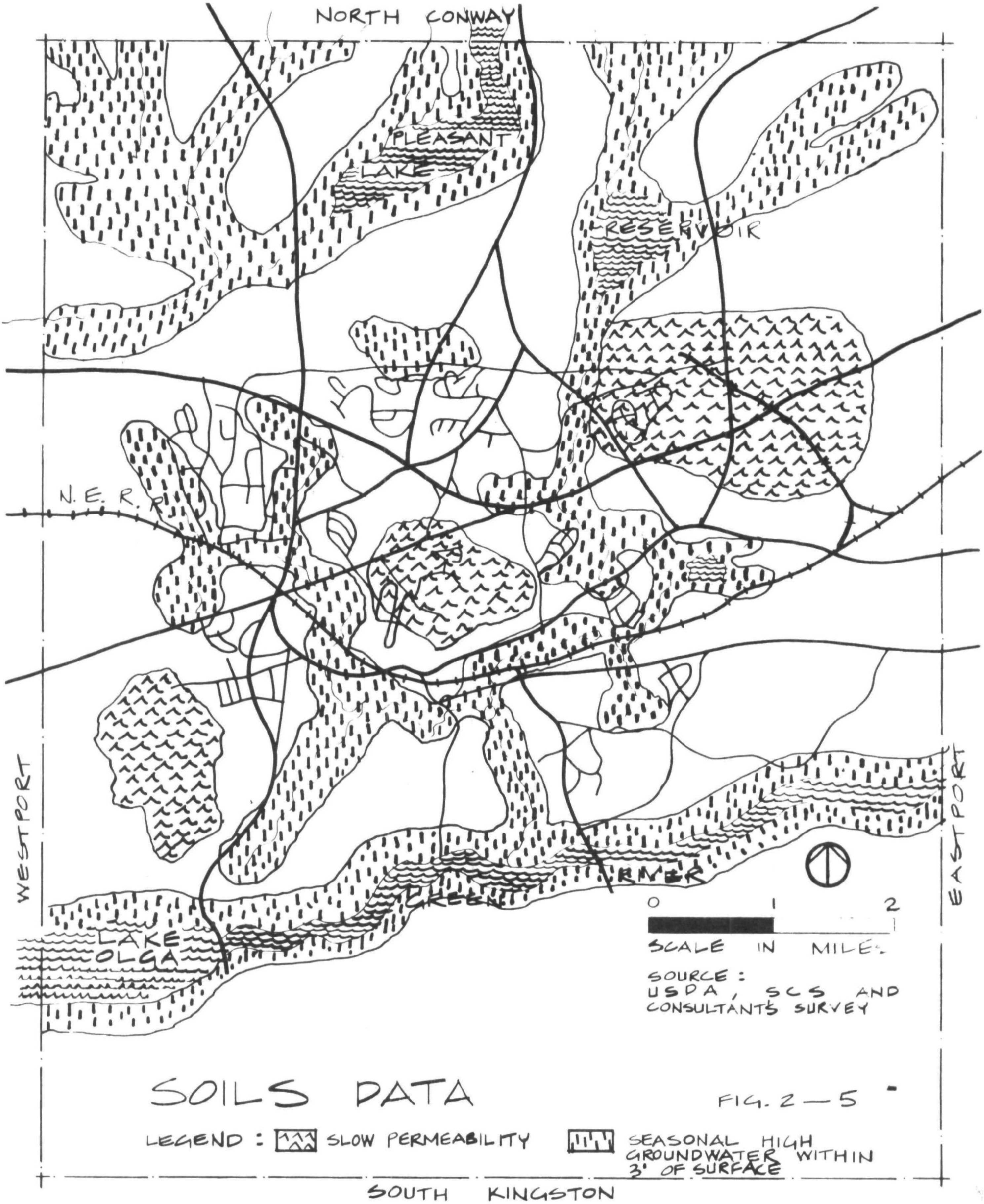
The Problem Definition map is one of the intermediate outputs prepared for the second public workshop. This map shows three distinct problem areas. Area A, the old high density residential and commercial development in West Village, is one area of chronic on-site disposal problems. The needs analysis indicated that problems in this area are due to the age (and probably the nature) of the systems. There are no severe soil limitations preventing on-site disposal, but rehabilitation could be difficult due to the high density of the development.

Area B, the newer residential development in West Village, is another area of chronic on-site disposal problems. The needs analysis indicated that problems here are not caused by soil conditions or age of development (reflecting a change in town zoning after the earlier development in West Village). Earlier meetings with the public health officer did inform the consultant, however, that the code for on-site disposal was changed (improved) after development in this area and that problems in Area B are probably due to underdesigned systems.

Area C, a recent residential development to the east of South Village, has on-site disposal problems due to high groundwater as a result of poor installation supervision. This area, however, is not troubled by high density and has potential for on-site system rehabilitation.

(1) "Longevity of Septic Systems in Connecticut Soils", D.E. Hill and C. R. Frink, Bulletin 747, June 1974, The Connecticut Agricultural Experiment Station.


NORTH CONWAY
PLEASANT
LAKE
RESERVOIR
N. E. R. R.
WESTPORT
EASTPORT
GREEN
RIVER
LAKE
OLGA
0
1
2
SCALE IN MILE
SOURCE :
STATE DEPARTMENT OF
HEALTH ; TINKERSVILLE
BOARD OF HEALTH
CONSULTANTS SURVEY
PROBLEM LOCATION
FIG. 2—4
LEGEND : □ SYSTEM FAILURE ⇩ DIRECT DISCHARGE
○ HOMES BEING PUMPED MORE THAN ONCE A YEAR
SOUTH KINGSTON

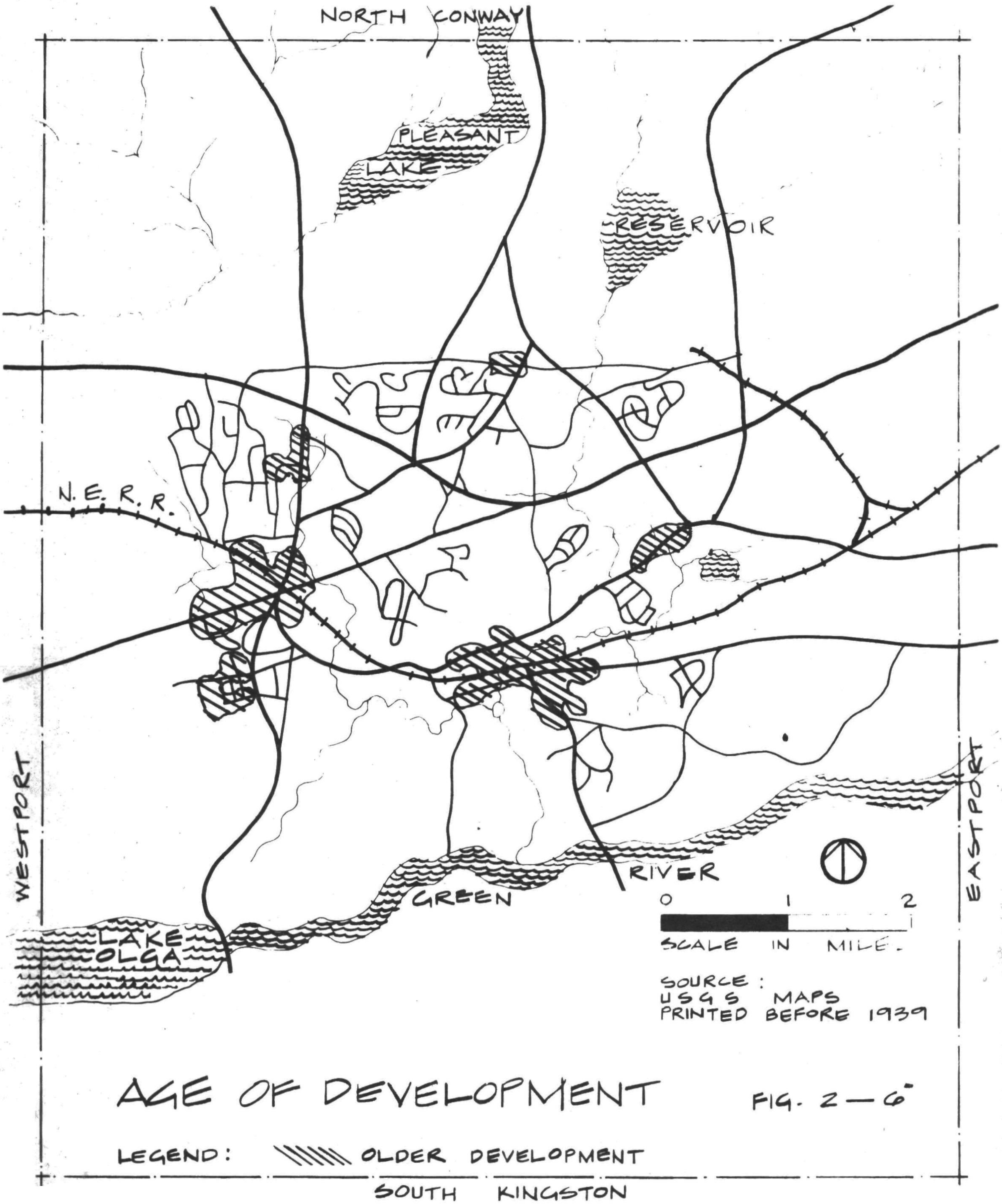


SOILS DATA

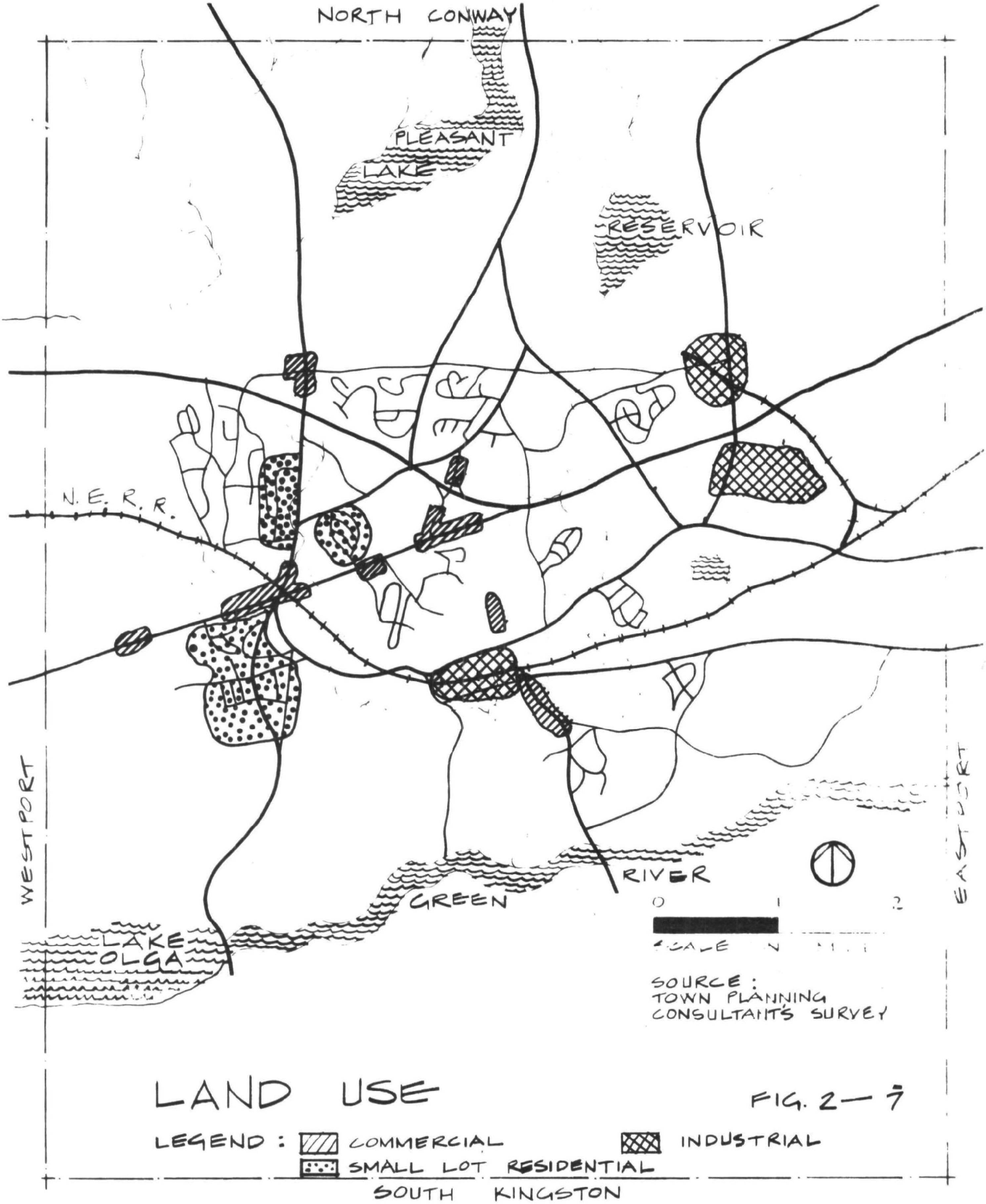
FIG. 2—5

LEGEND : SLOW PERMEABILITY SEASONAL HIGH GROUNDWATER WITHIN 3' OF SURFACE

SOUTH KINGSTON



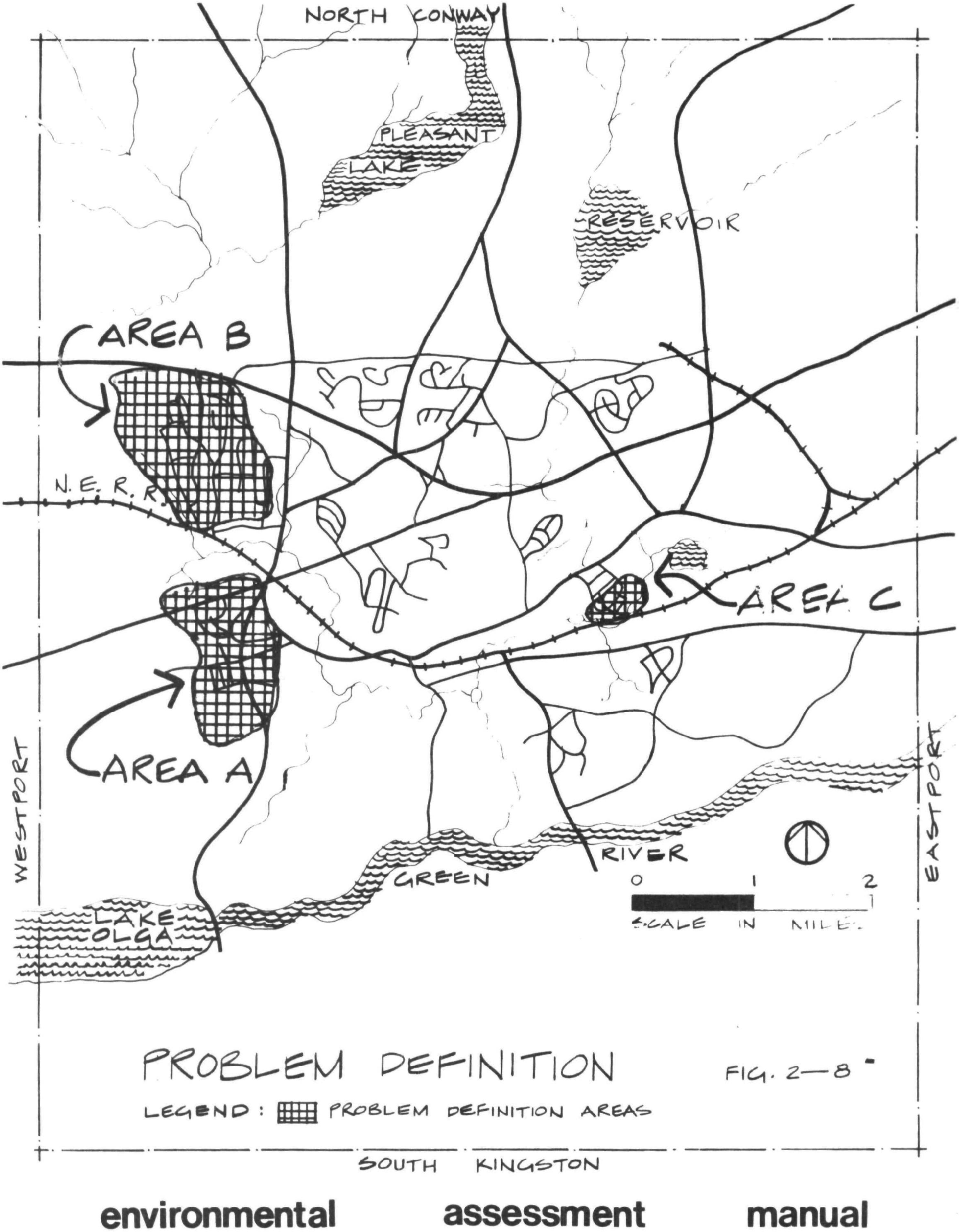
AGE OF DEVELOPMENT FIG. 2—6



LAND USE

FIG. 2—7

LEGEND : COMMERCIAL INDUSTRIAL SMALL LOT RESIDENTIAL



PROBLEM DEFINITION FIG. 2—8

LEGEND: ▦ PROBLEM DEFINITION AREAS

It should be noted that individual problems in areas of slow permeability did not indicate problem areas. Also, untreated waste discharges to streams were discovered by the consultant's streambelt survey and ordered corrected by the public health officer.

Consultant's study concluded that different solutions were feasible for each of the problem areas defined. More important, however, by documenting their needs analysis and involving the public from the start of the Facilities Plan, they found that:

- -- they recommended the most cost-effective, technically feasible alternatives,
- -- the alternatives were both politically and publicly acceptable, and
- -- as a result of their detailed analysis, they produced a high quality Environmental Assessment as part of their Facilities Plan.

2.5 LEVEL OF EFFORT

The facility planning consultant hired to perform the needs analysis described above should give some careful thought to the level of detail and manpower required for each case. It is suggested that the needs analysis performed on a study area of approximately 300 dwelling units would not require a questionnaire mailing but would rely on information developed by the house to house survey if problems are suspected after the preliminary analysis. For the needs analysis performed on a study area of 3000 dwelling units, the questionnaire would be used as part of the preliminary analysis and then a house to house survey would be performed in neighborhoods found to be potential problems.

To establish a range of values, it is assumed that between 20% and 100% of the house to house survey will be required.

TABLE 2-2

NEEDS ANALYSIS LEVEL OF EFFORT

ITEM	TASK DESCRIPTION	ESTIMATED MAN DAYS
1	Preliminary - strategy planning	5.0
2	Meetings with town officials and department heads	1.5
3	Review existing records and reports	
	- Board of Health	2.0
	- Planning Department	2.0
	- Engineering/Building Inspector	1.0
	- State Reports	2.0
	- Soils Data, interpretation/mapping	2.0
	- Old U.S.G.S. maps	1.0
4	New Data	
	- Water quality sampling, testing and evaluation if existing information is inadequate	
5	- Windshield survey	2.0
6	- Preliminary analysis	5.0
7	- House-to-house survey, preparation of forms, questionnaires	3.0
	Total estimates time per house 2.0 hours plus downtime for no answer, inconvenienced or uncooperative home owners and travel between houses; say 3 houses per day. Therefore, for a survey of 300 houses estimate 100 days	100.0
8	- Final mapping of survey data	2.0
9	- Initial workshop to precede house to house survey	2.0
10	Questionnaire used in larger town to screen neighborhoods prior to house to house survey	

TABLE 2-2 (Cont.)

ITEM	TASK DESCRIPTION	ESTIMATED MAN DAYS
-	Preparation	3.0
	- Printing/mailing list/postage assume 28¢ each and 3000	
	- Preliminary analysis	5.0
11	Further analysis of questionnaire	
	- Develop coding system	3.0
	- Sorting, 3 minutes/response 33% return or 100 responses	6.5
	- Return postage - 18¢ each	
	- Keypunch - 20¢ each	
	- Computer time - 20¢ each	
	- Analysis/interpretation	4.0
	- Map output	3.0
12	Problem Definition	
	- Write text to accompany maps	5.0

Case 1. Community of 1000 people, 300 houses estimate based on Items 1-9 and 12.

Low end of range based on house to house survey of 20% of the houses and no water quality sampling required.

55 man days

Upper end of range based on house to house survey of all houses and a water quality sampling program.

135 man days
plus sampling

Case 2. Community of 10,000 people, 3000 houses estimate based on Items 1-12.

Low end of range based on house to house survey of 20% of 300 houses and no water quality sampling required.

80 man days
plus questionnaire costs

Upper end of range based on house to house survey of 300 houses and a water quality sampling program.

160 man days
plus questionnaire costs
plus sampling

2.6 APPENDIX

WASTEWATER MANAGEMENT ADVISORY COMMITTEE

FOR OFFICE USE ONLY

REQUEST FOR INFORMATION

1-4 ____ Please complete as much of the requested information as possible, fold, staple, affix stamp,

5-7 ____ and drop in the mail box.

8-11 ____ 1. Name________________________________Street Address______________________________

12 2. Do you _________________Own ___________________________Rent

13 3. Is this a one____, two____, three____, or more ____ family house? (Check one)

14 4. Number of people occupying the house __________.

15-16 5. What is the date of septic system installation or the last major renovation? ____________

17 6. The answer to Question No. 5 is _____ known _____ approximate _____ uncertain

18-22 7. How large is your lot? __________square feet __________acres

23-26 8. What appliances do you have connected to your septic system?

____Clothes Washer ____Garbage Grinder ____Sump Pump ____Dishwasher

27-31 9. Check any of the following operational problems you have with your wastewater disposal system?

____Sewage odors ____System backups/Slow system drainage

____Sewage flowing on ground surface ____Other ________________________Specify

32-35 10. If operational problem(s) is indicated in Question No. 9, at what time of year does this problem occur? Check as many blocks as appropriate: Spring___ Summer___ Fall___ Winter___

36 11. Do you have a routine maintenance program for your wastewater disposal system? __Yes __No

37-38____ 12. If yes to Question 11, describe the maintenance performed and indicate the time interval

39-43____ between maintenance procedures. ____

____

____

44-46 13. What is the average annual maintenance cost for your system?____________________

47 14. If the cost were reasonable, what is your opinion on public sewers? (Check one)

___Strongly in favor ___In favor ___No opinion ___Opposed ___Strongly opposed

48 15. Are you familiar with composting toilets such as clivus multrum, ecolet, etc.? ___yes ___No

49 16. If yes to Question No. 15, what is your opinion on installing a composting toilet in your home?

___Strongly in favor ___In favor ___No opinion ___Opposed ___Strongly opposed

50 17. What is your opinion on the Town assuming the responsibility for maintenance and repair of all individual septic systems as a municipal service funded from general revenue?

___Strongly in favor ___In favor ___No opinion ___Opposed ___Strongly opposed

51 18. What is your opinion on requiring the installation of water-saving toilets, showers, and other devices for all new and replacement installation?

___Strongly in favor ___In favor ___No opinion ___Opposed ___Strongly opposed

52-53 19. Do you have any comments or suggestions?____________________________________

____

____

environmental assessment manual

community involvement

3. community involvement

CHAPTER 3 - COMMUNITY INVOLVEMENT

CHAPTER 3 COMMUNITY INVOLVEMENT

3.0 INTRODUCTION

Community involvement is perhaps the most crucial aspect of the facilities planning process, even though it is often taken for granted. Technical reports, maps and engineering plans to be worth anything at all must be understood and accepted by the citizens in a community. The best means of ensuring understanding and acceptance is by having the citizens share in the development of alternatives and recommendations for their community through an effective community involvement program. Community involvement is really communication--two-way communication--and it makes good planning sense.

This chapter provides facility planners and those conducting environmental assessments with practical advice and information on how to make community involvement an integral part of their efforts. First, the regulatory status of public participation in facilities planning/ environmental assessment is reviewed. Then there is a brief discussion of current practice as well as EPA's expectations for the future. Next, evaluating the effectiveness of community involvement is addressed and then communication and organization skills are discussed, with particular emphasis on "scoping" a community involvement program. This is followed by a list of techniques and "guides" noting how they best fit into the facility planning/assessment process. Finally, two "case studies" provide examples of how the careful application of skills and techniques can bring about effective community involvement.

3.1 REGULATORY STATUS

In the Federal Water Pollution Control Act Amendments of 1972, Congress declared:

"Public participation in the development, revision and enforcement of any regulation, standard, effluent limitation, plan or program under the Act shall be provided for, encouraged, and assisted..." (Section 101e)

Regulations to implement Section 101e of the Water Pollution Control Act Amendments of 1972 on public participation were published in the Federal Register, August 23, 1973 (40 CFR, Part 105) and are incorporated in the Construction Grants Regulations, published February 11, 1974 (40 CFR, Part 35 917-5) their "intent...is to foster a spirit of openness and sense of mutual trust between the public and the State and Federal agencies in efforts to restore and maintain the integrity of the Nation's waters."

In addition, Section 5 of EPA's Guidance for Preparing a Facility Plan states that "the public should participate from the beginning in facility planning so that interests and potential conflicts may be identified early and are considered as planning proceeds." Several measures for involving the public are then listed.

Finally, early public involvement in the NEPA process is required by CEQ Guidelines (40 CFR, Part 15) and EPA Regulations (40 CFR, Part 6).

3.2 PAST PRACTICES/FUTURE DIRECTIONS

Traditionally, the only mechanism used to involve citizens in facilities planning has been a formal public hearing held near the end of the planning process. While the engineering consultant may have been in regular contact with an official board or commission, the only communication with community interest groups and residents has occurred at this hearing. In many cases adversary relations and conflict have developed because major decisions have been made without consulting major community interest groups.

In an attempt to bring about earlier communication with the public in the facilities planning process, EPA Region 1 is encouraging additional community involvement measures. While recognizing the importance of flexibility in developing appropriate community involvement measures, Region 1 expects that a few basic elements will be carried out for specific kinds of Step 1 projects. For "first time" community projects; for projects which involve significant expansion of a sewer service area or treatment plant; for projects which involve reconstruction of a treatment plant on a new site; and for multi-community projects the following elements will be expected as a minimum community involvement program:

A. Informational materials distributed to the public and media at key points in the planning process.

B. At least two well publicized public meetings or workshops held prior to the formal public hearing. The first meeting should be held early in planning to review and discuss community goals and wastewater treatment needs. The second meeting should be held when alternative solutions are being analyzed.

C. A public hearing, also well publicized in advance, should be held after all the alternatives have been analyzed. The purpose of the hearing is to record community preferences for consideration in selection of the final plan.

The sections which follow discuss criteria, skills and techniques for adequate community involvement in facility planning.

3.3 SUGGESTED METHODOLOGY

3.31 Evaluation of Adequate Community Involvement

If fifty citizens come to a public hearing on a facility plan, it may mean only that fifty chairs were used. What did the people have to say? What did they know before they came to the hearing? Were they representative of all the major interests in the community? Were citizens' comments considered in the environmental assessment of the final plan? Did the final plan gain general support in town meeting or a bond issue referendum? Only by asking these questions can we determine whether community involvement in a given project was adequate. Community Involvement does not guarantee wide acceptance of a facility plan. It only guarantees that the plan WILL be as suitable to local conditions and as widely understood as possible.

There is no question that documenting the "success" of a community involvement program is difficult. However, good record keeping throughout the planning process can be very useful when the time comes for plan review. It is strongly recommended that those conducting facilities planning and environmental assessments keep a thorough and accurate file with records of each contact with the public during the planning process. This file could include summaries of meetings, results of surveys and questionnaires, fact sheets, brochures, newsletters and press clippings. Most important it should demonstrate responsiveness to public questions and preferences. It is also recommended that EPA and the State be kept informed of community involvement activities and of problems which arise.

Finally, in terms of EPA's expectations, it should be remembered that a "summary of public participation shall be submitted as part of the facility plan. Each summary of public participation shall describe the measures taken by the agency to provide for, encourage, and assist public participation in relation to the matter; the public response to such measures; and the disposition of significant points raised.

Basically EPA will want to be sure that appropriate measures are taken to inform the community throughout the planning and to elicit ideas and viewpoints from community residents. In addition, EPA will want to see how and why these views and preferences are or are not used in project decisions.

3.32 Skills Required to Conduct a Community Involvement Program

A good community involvement specialist is a good organizer and a good communicator. The good organizer finds representatives of the various publics in the community and gets them interested in serving on an advisory committee and/or attending meetings and workshops. The good organizer knows how to run committee meetings, public meetings and public hearings; how to identify and clarify issues; how to get opposing factions to reason together; how to build and use a mailing list; how to organize a press conference or other event for the news media.

The good communicator writes clearly, speaks convincingly and listens accurately. The communicator absorbs technical information and reduces it to non-technical English without distortion; accurately summarizes public comments; conducts personal interviews in a pleasant, competent manner; understands the needs of the news media and provides press releases, news conferences and interviews that meet these needs; understands the use of news letters, fact sheets and other mailings and handouts to keep the public informed and interested; knows the value of controversy as a means of heightening interest in the issues, and knows how to mediate controversy or break a deadlock.

Where to find such people and how to put them to work? First, EPA will pay the reasonable costs of organized public participation. Some consulting engineering firms have public participation specialists on their staffs. But this is not the only way to go. The necessary skills can be hired on a temporary or part-time basis. Professional public relations counselors with experience in community relations often are available. The regional planning agency to which the community belongs can be retained, or the community's planning staff might possess the requisite skill and experience. Free-lance writers and even news reporters can be hired for the writing jobs without conflict of interest, provided the individual is not also assigned to write about the project for a newspaper or broadcast station. A local citizen experienced in community organizing may be an ideal choice.

In many cases it may not be possible to obtain additional staff to plan and manage the community involvement activities, and the consultant will have to use existing staff, with or without special communication and organization skills. The following section is meant to help the consultant in such a position to "scope out" or design a community involvement program which is best suited for each local situation.

3.33 Designing a Community Involvement Program

When putting together a community involvement program, keep in mind that good program design and management mean more than planning a series of required informational materials and meetings. Community involvement must be of a vital part of the overall planning program.

Three basic steps are necessary in program design: (1) development of a community profile which identifies issues, key persons and constituencies, (2) analysis of the community profile and (3) definition of program scope, emphasis and methods. These steps are described in more detail below.

3.331 Developing a Community Profile

First, identify whether the community is likely to experience the following impacts as a result of the project: a significant change in land use; a significant increase in treatment plant interceptor capacity; substantial cost to users; a new treatment plant; a significant increase in sewered area; a significant adverse impact on environmentally sensitive areas; intermunicipal agreements with neighboring communities; a significant impact on local population growth. Next, identify and interview by phone or in person representatives of local boards and committees related to the project.

Solicit from those interviewed their opinion on how the program should address the issues you have identified; their identification of town residents and organizations or interests who are actively concerned with these issues; their opinion on whether any of the issues identified will be controversial; their identification of important issues which you have not mentioned; their preferences as to how they would like to be involved in the program; information on communication resources available in the community (e.g., an organization's newsletter for information, a grange hall for workshops, an active representative to an advisory committee). Next interview those residents identified for you by the officials and ask them the same questions. These people should represent a cross-section of community interests. The local reporter is usually an important resource. Note that while the primary purpose of interviewing is to obtain information about issues, secondary results of the interview process include informing key people in the community about the project and finding out about local resources which could be of assistance in the program. The interviews will also provide key people with a first impression of the program and their role in it.

3.332 Analysis of Community Profile

Try to form an overall impression of how the concerned interests and individuals will react to each phase of the program.

3.333 Definition of Program Scope, Emphasis, and Methods

A. Scope: The amount of resources invested in a community involvement program should be directly related to the significance of the issues involved and to the extent of public interest anticipated. If the interviews demonstrate that the impacts of the project will be substantial and if they also indicate that there is a lack of public understanding of these impacts or no community consensus on the issues, the community involvement program described on page 3:3 should be expanded. In other words, if apathy or controversy exist on an important project, a more extensive community involvement program is required.

B. Emphasis: Once the scope or level of community involvement has been determined, it is essential to recognize the four functions of effective community involvement activities: (1) information giving, (2) community liaison, (3) listening and (4) decision-making. The next step is to define the decision points in the program. Use the results of interviews to determine when extra information, community organizing or listening will be required in relation to the decision points. Keep in mind the two problems of apathy and controversy in deciding <u>how</u> and <u>when</u> in the program each of the four functions should be stressed. For example, community residents are often relatively unconcerned about program impacts initially but will find alternative solutions very controversial once presented. This community forecast suggests that an early emphasis on information and community liaison techniques, followed by workshops which facilitate listening, could help to prevent both apathy and controversy.

C. Methods: Use guides like Figures 3-1 and 3-2. First list the decision points. Next, list the four functional elements which must precede each decision: information, community liaison, listening and decision making. Finally, using knowledge of the community and the required scope and emphasis, select appropriate methods for each function listed. (See Section on Techniques - page 3:8). Be aware that generally the easiest task is to inform the public about the project. Also, well established political procedures in the community will usually dictate the formal decision-making process for the project. However, community liaison and listening (which includes responding to community concerns in decision-making) require more community knowledge and the greatest ability to work with people. These functions should normally receive special attention because they are the most difficult to manage.

3.34 Planning Guides (Figures 3-1 and 3-2)

The two guides are provided to help you plan the use of community involvement techniques to meet these standards. Brief descriptions of these common techniques are discussed in the following section.

3.35 Techniques for Getting the Community Involved

A. The Mailing List (community organizing)

This is one of the first steps in organizing a community involvement program. It is needed for sending notices and invitations, fact sheets, summaries of task force reports, progress reports, news letters and copies of news releases, etc. A mailing list starts with official boards, commissions and committees of the community and the unofficial civic, business, fraternal, environmental and recreational clubs and organizations. The list should include individuals known to be interested in water quality and environmental improvements as well as members of the news media. The list grows as additional organizations and individuals make themselves known by signing up at meetings, calling up or writing in with questions and comments.

B. Depositories (information giving)

A complete collection of documents about the wastewater facility plan must be available for inspection at a central and easily accessible place such as the community library. Here a citizen should be able to read the basic laws and regulations applying to the project, along with reports, plans, maps, press releases, brochures, newsletters, illustrations, displays and similar material. Not many will use the depository unless it is publicized. Its existence can be mentioned at all meetings and referred to in printed material and news releases, and an attractive poster can be displayed at the site of the depository.

C. Publications (information giving)

Brochures, fact sheets and technical bulletins can be prepared for general public information. They may be placed in

FIGURE 3-1

Community Involvement Planning Guide

Planning Phases And Decisions	Functions	Methods
Prepare Plan of Study; Community Involvement Program Design	Information Giving: Community Liaison: Listening: Decision Making:	
Determine Needs and Problems (Assess Current and Future Situations)	Information Giving: Community Liaison: Listening: Decision Making:	
Develop and Evaluate Alternatives (Environmental Assessment and Cost Effective Analysis)	Information Giving: Community Liaison: Listening: Decision Making:	
Determine whether EIS is needed	Information Giving: Community Liaison: Listening: Decision Making:	
Select Plan	Information Giving: Community Liaison: Listening: Decision Making:	
Costs	Personnel (man days): Printing and Mailing: Meeting and Hearing Expense: Other (specify):	

FIGURE 3-2

Community Involvement Planning Guide

TYPICAL EXAMPLE

* INDICATES EMPHASIS DEMONSTRATED BY COMMUNITY PROFILE

Planning Phases And Decisions	Functions	Methods
Prepare Plan of Study; Community Involvement Program Design	* Information Giving:	INFORMATIONAL MAILING; ESTAB. PROJECT DEPOSITORY
	Community Liaison:	DEVELOP MAILING LIST; FORM ADVISORY GROUP; HOLD FIRST A.C. MEETING
	Listening:	INTERVIEWS; LIAISON WITH COMMUNITY GROUPS
	Decision Making:	PREAPPLICATION CONFERENCE
Determine Needs and Problems (Assess Current and Future Situations)	Information Giving:	PRESS RELEASE; ADVISORY COMMITTEE MEETING
	* Community Liaison:	INTERVIEWS; ADVISORY COMMITTEE MEETING
	Listening:	QUESTIONNAIRE; ADVISORY COMMITTEE MEETING
	Decision Making:	ADVISORY COMMITTEE MEETING
Develop and Evaluate Alternatives (Environmental Assessment and Cost Effective Analysis)	Information Giving:	INFORMATIONAL MAILING; PUBLIC MEETING
	Community Liaison:	PUBLIC MEETING
	* Listening:	PUBLIC MEETING
	Decision Making:	PUBLIC MEETING
Determine whether EIS is needed	* Information Giving:	INFORMATIONAL MAILING
	Community Liaison:	MEETINGS; PUBLIC AND ADVISORY COMMITTEE
	Listening:	MEETINGS; PUBLIC AND ADVISORY COMMITTEE
	Decision Making:	MEETINGS; PUBLIC AND ADVISORY COMMITTEE
Select Plan	Information Giving:	INFORMATIONAL MAILING
	Community Liaison:	FIELD TRIP
	Listening:	PUBLIC HEARING FOLLOWED BY A.C. MEETING; PRESS RELEASE
	* Decision Making:	PUBLIC HEARING FOLLOWED BY A.C. MEETING; PRESS RELEASE
Costs	Personnel (man days):	
	Printing and Mailing:	
	Meeting and Hearing Expense:	
	Other (specify):	

the depository, handed out at meetings, enclosed with mailings and supplies to the news media. A brochure describes the need for the project, the state and federal laws and regulations and the planning phases. Fact sheets deal with single planning issues such as secondary impacts, septic system maintenance, treatment methods, and analysis of alternatives, using laymen's language. Technical bulletins do likewise, but in detail for those with the necessary knowledge of the subject. Publications should be readable and attractive.

D. Newsletters (information giving)

Unlike the other publications, a newsletter is a periodical. Published at regular intervals, it is used to announce meetings, report progress, outline planning issues and generally build interest in the plan. Again, the newsletter should be designed and written to get and hold attention. It can be sent to the mailing list as a separate piece, or along with other mailings, used as a slip sheet in the mailings of other organizations, and handed out at meetings. A newsletter will prove to be one of the best ways to get new names for the mailing list, because people will get interested and ask to be kept informed. Typical newsletter topics are feature articles explaining alternative plans and technologies; notices of meetings; letters to the editor; interviews with key citizens and officials; summaries of hearings and workshops; position statements; maps and illustrations.

E. News Media (Information giving)

News must be important information. Important to enough readers to make it worth publishing or broadcasting. Readers like to know how the nation and the world are going, but most of all they need to know about events or plans that will affect their financial condition or their avocation/life style. This can never be forgotten in working with the news media. People, and news media, are interested in whether or not a river or lake can be used for fishing and boating and swimming, whether well water will be affected by septic tanks, how much a treatment system will cost and how much of this will be on the tax/mill rate, whether industry can tie into a treatment system and save jobs.

With this basic principle in mind, the techniques are

-- Media list. More than a mere list of newspapers and broadcast stations and their addresses, the list should include deadlines, names of editors and reporters, region covered by the signal or paper deliveries, special requirements of each (especially TV stations). Do not overlook weekly newspapers, magazines, college papers and business or institutional house organs.

-- News Conferences. Consult newspapers and broadcast stations on date and hour. Hold a news conference only if you are expecting questions and are prepared to answer them. Do not hold one just to make an announcement or issue a statement. Send press releases and other background information to those news organizations that do not attend the conference, as well as to those who do. Keep direct quotes to 100 words or less to avoid destructive editing.

-- News releases. Put your most interesting and important information in the first paragraph. Example: "Plans for a sewage treatment plant that may cost the city $6 million and up to one dollar on the tax rate will be reviewed at a public meeting tonight in the high school." Leave out the money and watch the crowd dwindle.

-- Public service spots. Their greatest value is in repetition. Try to have them played on the air for several weeks. Make sure that public service announcements do not go on playing after the event.

-- Radio and TV interviews and talk shows. Talk plain English. Use short, familiar words. Eschew complexity. If the law and regulations are complex, or the equipment is elaborate, talk about the intent of the law and the things the equipment can do. On TV, wear makeup, and pastel colors, avoid fine patterns in clothing, sit straight, look at your interviewer or at the designated spot off camera, and talk in a conversational manner as you would in a private home.

-- Feature stories. Timeless articles which can be used to dramatize environmental issues; profile of an activist, description of a new treatment process, interview with an expert. The planning agency can write the article and submit it with pictures, or talk to the editors about assigning a reporter and photographer.

-- Special events. A canoe trip or "fishing contest" in a dirty river will get a lot of press and broadcast coverage. These are useful to build support for a bond issue or other referendum question and increase general awareness, rather than to encourage more active participation at meetings and hearings. Consult the media on timing and logistics.

F. Interviews (listening and community liaison)

The planner should get to know the people and agencies most affected by wastewater treatment plans, establish rapport, and obtain information, ideas and opinions. Members of agencies, boards and active citizen groups can provide insights into the political feasibility of various alternatives. Very early in the project, interviews with local officials, citizen leaders and news reporters can produce much valuable information on the community, including local controversies, general community attitudes, a list of key participants and suggestions for the public information and participation program. These interviews can also establish a rapport with important people in the community.

G. Questionnaires and Surveys (listening)

Less personal than interviews, questionnaires and surveys provide an opportunity to gauge public opinion on important community issues on a broad scale. A general survey, conducted by mail or through the local media, can help to pinpoint community values and preferences regarding proposed treatment alternatives. Questionnaires can also be used to determine the nature and extent of existing pollution or public health problems in specific areas of the community. (See Chapter 2 - Needs Analysis).

H. Contact with Citizen Groups (community liaison, listening, info giving)

Many organized citizens groups can make a contribution to the planning of treatment facilities if good liaison is provided. Some organizations will encourage their members to participate in the planning and publish articles on planning issues in their newsletters. Those involved with conservation, recreation, land development and economic development issues, as well as civic associations, taxpayer's groups and service clubs are the most likely to take an interest.

I. Advisory Commttttee (community liaison, listening, info giving & decision making)

A thoroughly representative advisory committee can bring constructive advice from important community interests to the planning process and, at the same time, serve as interpreter and advocate for the plan in these same sectors. A typical advisory committee may comprise official representatives from the sewer commission, board of health, planning board, conservation commission, finance committee, industrial development board and citizens representing major interests in the community such as environmental protection and economic development. The advisory committee can tell the planner what the public is thinking and at the same time be the forum for achieving a consensus on what the community should do. To get the most out of an advisory committee, adopt simple, clear bylaws on how it will function. (For details on advisory committees see Working Effectively with Advisory Committees -Bibliography at the end of this Chapter.)

J. Public Meetings (comm. liaison, listening, info giving & decision-making)

Public meetings afford an opportunity to stimulate interest in the wastewater treatment study and give concerned citizens a chance to raise questions and present varying points of view. Meetings should be scheduled as needed throughout the planning process to provide information and sound out citizens' opinions. It is especially important to have public discussion early in each phase of the planning process, so that strongly-held preferences can be taken into account in the ensuing technical work. Discussion is also timely near the end of planning phases before recommendations are made.

Public meetings can be elaborate conferences, consuming most of a weekend, and located on a university campus; they can be extensions of the selectmen or council meeting; the sponsor may be a civic association, or coalition of organizations which makes a major effort to bring citizens to the meeting.

Appropriate publications, fact sheets, technical reports, brochures and newsletters should be available at the meeting. Public meetings are also opportunities to secure additional names for the project's mailing list. The news media should always be invited. (For details see Effective Public Meetings - Bibliography at the end of this chapter.)

K. Workshops (comm. liaison, listening, info giving & decision making)

Workshops are particularly useful in the middle stages of the planning process when the basic facts are known, but the alternative proposals have not yet hardened into their final form.

A typical workshop sequence may be:

-- Problem-Setting: Short presentations ending with a charge to the working groups to discuss particular problems and come back with a report.

-- Small Working Groups: These small discussion groups are given specific agendas to cover and/or group leaders are briefed in advance so as to hold the workshop on course. A reporter is selected to speak for the group during the whole group session.

-- Whole Group Session: Reporters feed back salient features of the small group discussion to the whole group. Often a single speaker will be asked to observe and sum up the small group reports.

L. Public Hearings (decision-making, information giving and listening)

Public hearings may be held early in the planning process so that interested people can convey both facts and opinions about wastewater treatment to the hearing officer. A hearing must be held late in the process on alternative plans, evaluation, and the environmental assessment.

Publish the formal announcement at least thirty days in advance and begin preparations well in advance of the meeting date. Build public interest in the hearing with newspaper articles, letters to interested groups, citizens and officials. Information on alternatives should be made available to the public well in advance of the hearing and at the hearing a clear set of alternatives should be presented.

The place of the hearing should be convenient for as many people as possible and familiar to the citizens. A school auditorium or community center is a good choice. If possible, hearings should be held in the evening or on a weekend to give the greatest number of people an opportunity to attend.

Local and State laws may require a set format for a local government's formal public hearing on a facility plan. If so, the Federal requirement that a public hearing be held before a plan is selected can probably be satisfied by the hearing required under State or local law, providing other Federal requirements are met too.

Interested persons may well come to the hearing with a prepared statement. Written statements should not be required, but are always welcome.

Remarks by local government officials should be as brief as possible to allow time for comments, questions, and suggestions from the public. The hearing should be an opportunity for the public and the local government to learn from each other. Try to respond to all questions. If you don't have the answer at hand, tell the questioner you will get the information and send it along as soon as possible.

If the project covers a large and heavily populated area, the local government should consider holding more than one hearing in different locations within the project area.

Do not be disappointed if only a few people turn out for the hearing. In the absence of controversy, many public hearings on proposed facility plans are attended by only a few dedicated souls. Moreover, a thorough public education and information program may satisfy many members of the public in advance and make them decide not to attend the hearing.

3.36 Costs

An effective community involvement program requires a significant commitment of resources--approximately three to six weeks of one person's time, depending upon the size of the community and the complexity of the issues. Use of an advisory committee requires extra staff time but can result in enlisting volunteer help to compliment staff effort.

To some extent the level of finances required depends upon how many free resources are available in the community, for instance a meeting place or mailings by a civic group. Every effort should be made to use these resources when they are available. Assuming no free help is provided, printing, distribution of informational materials and meeting and hearing expenses will cost between $2500 and $5000. These costs could be higher depending upon the nature and extent of the informational materials (drafting, clerical, secretarial time) and how they are distributed (first class mail, bulk mailing, town distribution of data).

3.37 Conclusion

There is unfortunately no precise "formula for success" for a community involvement program. As has been suggested here, each community is different and community involvement programs should reflect these individual situations. There is a need for flexibility even when the core program is applied. However, a performance standard is necessary to assess the adequacy of community involvement in facility plans. At the beginning of the facility planning process, evaluators will look for measures to carry out the four functions discussed above (information giving, listening, community liaison and decision-making) throughout the program. At the conclusion of the facility planning process, the community involvement program will be assessed in terms of whether the final product reflects the needs, concerns and preferences of the community's residents.

3.4 CASE STUDIES

3.41 Exeter, New Hampshire

The following example illustrates how a public hearing can be made interesting. In order to be sure that the residents of Exeter, New Hampshire were well aware of the issues involved in modifying their facilities plan, the State used the services of an experienced public information/participation specialist. Due primarily to his efforts, fifty-six well-informed people came to the hearing on a very stormy winter night. The effort was a "success" not because the room was filled, but because the citizens in attendance knew the alternatives, were able to ask relevant, important questions, and could discuss the key issues. Although a hearing summary is not yet available, the hearing resulted in a general endorsement of the Modified Holding Pond Alternative.

The hearing was held on December 14. The following is a brief outline of the work schedule of the public information/participation specialist prior to the hearing.

-- 1st week of November: draft official hearing notice, distribute to area papers and post.

-- 2nd week of November: meet with Exeter sewer committee and town manager to discuss alternative plans and town issues. Draft feature news article based on above discussions.

-- 4th week of November: Feature article placed in area papers. PSA's distributed to area radio. Slide show prepared on two alternatives. Informational materials distributed locally.

-- 1st week of December: follow-up on press placement.

-- December 14 Hearing: intro by selectmen; general discussion of alternatives by WSPCC staff, including handouts and overhead slides; slide show on the existing problem and alternatives to it; open hearing to discussion.

This example includes the following material:

- -- a formal hearing notice (Figure 3-3)
- -- two pre-hearing news stories based on the feature article (Figures 3-4)
- -- two handouts which were distributed at the hearing (Figures 3-6 and 3-7)
- -- two follow-up news articles describing the hearing (Figures 3-8 and 3-9)

NOTICE OF ENVIRONMENTAL PUBLIC HEARING
EXETER, NEW HAMPSHIRE
PROPOSED COMBINED WASTEWATER
POLLUTION CONTROL FACILITIES

Notice is hereby given that a public hearing will be held by the Board of Selectmen of the Town of Exeter, N.H., at the Lincoln Street Elementary School, 35 Lincoln St., on the 14th day of December, 1977, at 7:30 p.m.

The purpose of this hearing is for the consideration and discussion of the proposed plan for abating the overflows of combined wastewater to the Squamscott River estuary. It is proposed to reduce both the existing hydraulic and organic loadings to the existing stormwater holding ponds by extending the proposed Railroad Interceptor from Salem St., Southwest to Rockingham St., separating the existing combined sewer on High St. and separating the combined system in the Hobart-Crestview-McKinley St. area. The stormwater treatment system as proposed would require the construction of a low-lift pumping station adjacent to the holding ponds which would return the stored combined wastewater to the Town's Pollution Control Facility for complete treatment and disinfection.

One of the purposes of the hearing is to discuss the potential environmental impact of the proposed stormwater treatment system and the alternatives to the recommended plan.

The Environmental Assessment Statement, plans, and other detailed information which will include a complete description of the works, costs, and alternatives to the proposed works, are available for public inspection at the Office of Selectmen in the Exeter Town Hall during normal business hours.

All interested persons, businesses, industries, groups, organizations, and agencies, both public and private, are encouraged to participate in this hearing. Questions and statements relative to the project will be welcomed.

Written statements concerning the project addressed to the Board of Selectmen will be accepted up until midnight of the 7th calendar day after the day of the hearing, and if pertinent to the hearing will become part of the hearing record. Signed statements received prior to the close of the hearing will be read at the hearing.

Representatives of the New Hampshire Water Supply and Pollution Control Commission and the Town's consulting engineers will be in attendance at the hearing to assist the Board in answering questions concerning the project.

This hearing is in compliance with the National Environment Policy Act of 1969, the Federal Water Pollution Control Acts of 1972, and subsequent rules and regulations adopted by the United States Environmental Protection Agency.

Minutes of the Hearing, including all properly submitted written statements, will become part of the required Environmental Assessment to be submitted by the Town to the State and Federal agencies, pursuant to the aforementioned National Environmental Policy Act, as part of the Application for State and Federal Construction Grants for the proposed project.

Dated this eighth day of November, 1977.

Ethel Doe, Clerk,
Board of Selectmen.

EXETER, N. H.—PUBLIC HEARING NOTICE
FIG. 3—3

Exeter to hold hearing on water

EXETER — Local townspeople will have an opportunity to improve the water quality of the Squamscott River and may save $500,000 in the bargain.

A public hearing will be held Dec 14 at 7:30 p.m. in the Lincoln Street elementary school to discuss a proposed modification to the town's plan for treating overflows of combined wastewater to the Squamscott River estuary.

At issue is a modification of a state and federally-approved facilities plan which would require complete separation of the town's sewage and stormwater. Town officials are proposing a modified plan which would require only partial stormwater separation.

According to local officials complete separation under the present plan would mean tearing up many of the streets in Exeter to install new storwater sewers. The costs for complete separation would approach $2 million. The town's share of these costs would be approximagtely $616,000.

The modified plan, which was developed in cooperation with the N.H. Water Supply and Pollution Control Commission, would require only partial separation of the stormwater and would eliminate 90 per cent of the street excavation. Partial separation would cost the town approximately $172,000.

The most important issue, according to Town Manager Donald Chick, is water quality. "The primary goal is to meet federal and state standards for water quality in the Squamscott River," said Chick. "We must do that or we'll be in violation of both state and federal regulations, as we are now.

"Qualified engineers have said that either system is going to meet those standards, and we must now line up the advantages and disadvantages of total separation versus partial separation. That's what we want to discuss at the hearing."

One of the major disadvantages of total stormwater separation is cost, according to Charles Knibbs, a member of the Exeter sewer committee. "There's no comparison," said Knibbs. "If we go to total separation, we're talking better than $616,000 in costs to the town. If we go to partial separation, we're in the best economic position. We're spending $172,000 as opposed to at least $616,000."

And, according to Knibbs, the $172,000 for the costs of partial separation is already available in a special town sewer fund.

"We have the money in the bank now through our sewer fund," he stated. "We aren't asking the townspeople to produce dollars. We're asking them for an opinion as to whether this is a practical approach to our problem and whether it is sufficient to satisfy state and federal clean water standards."

Chick emphasized that Exeter was fortunate to be able to utilize partial separation as an alternative and still meet water quality standards. "Nobody knows how fortunate we are that we're not being compelled to go to total stormwater separation," he said. "We could be told to separate, or else. Exeter is fortunate in being one of the few communities in the state which can go to partial separation and still meet state and federal clean water standards.

"But," Chick stressed, "we have to have a good turnout at the Dec. 14 hearing to demonstrate to state and federal officials that partial separation is what the citizens of Exeter want."

EXETER, N.H.—PRE-HEARING NEWS ARTICLE
FIG. 3—4

Exeter Hearing on Stormwater Plan Called

EXETER — Exeter citizens will have an opportunity to improve the water quality of the Squamscott River and may save $500.000 in the bargain on Wednesday, Dec. 14.

A public hearing will be held at 7:30 that evening in the Lincoln Elementary School to discuss a proposed modification to the town's plan for treating overflows of combined wastewater to the Squamscott River estuary.

At issue is a modification of a state and federally-approved facilities plan which would require separation of the town's sewage and stormwater. Town officials are proposing a modified plan which would require only partial stormwater separation.

According to local officials, complete separation under the present plan would mena-mean tearing up many of the streets in Exeter to install new stormwater sewers. The costs for complete separation would approach two million dollars. The town's share of these costs would be approximately $616.000.

The modified plan, which was developed in cooperation with the N.H. Water Supply and Pollution Control Commission, would require only partial separation of the stormwater and would eliminate 90 percent of the street excavation. Partial separation would cost the town approximately $172.000.

The most important issue, according to Exeter Town Manager Donald Chick, is water quality. "The primary goal is to meet federal and state standards for water quality in the Squamscott River," said Chick. "We must do that or we'll be in violation of both state and federal regulations, as we are now.

"Qualified engineers have said that either system is going to meet those standards, and we must now line up the advantages and disadvantages of total separation. That's what we want to discuss at the hearing."

One of the major disadvantages of total separation is cost, according to Charles Knibbs, a member of the Exeter Sewer Commission. "There's no comparison," said Knibbs. "If we go to total separation, we're talking better than $616.000 in costs to the town. If we go to partial separation, we're in the best economic position. We're spending $172.000 as opposed to at least $616.000."

And according to Knibbs, th $172,000 for the costs of parti separation is already available a special town sewer fund. "V have the money in the bank kn through our sewer fund," he stated. "We're not asking the townspeople to produce dollars. We're asking them for an opinion as to whether this is a practical approach to our problem and whether it is sufficient to satisfy state and federal clean water standards."

Other sewer commissioners also favor partial stormwater separation as the best alternative. "Complete separation is just prohibitive in cost," said one commissioner. "To do this we would have to dig up most of the streets in town to put in new sewer lines. It's more than the town can afford to pay. Total separation just isn't practical."

EXETER, N. H.—PRE-HEARING NEWS ARTICLE

FIG 3—.5

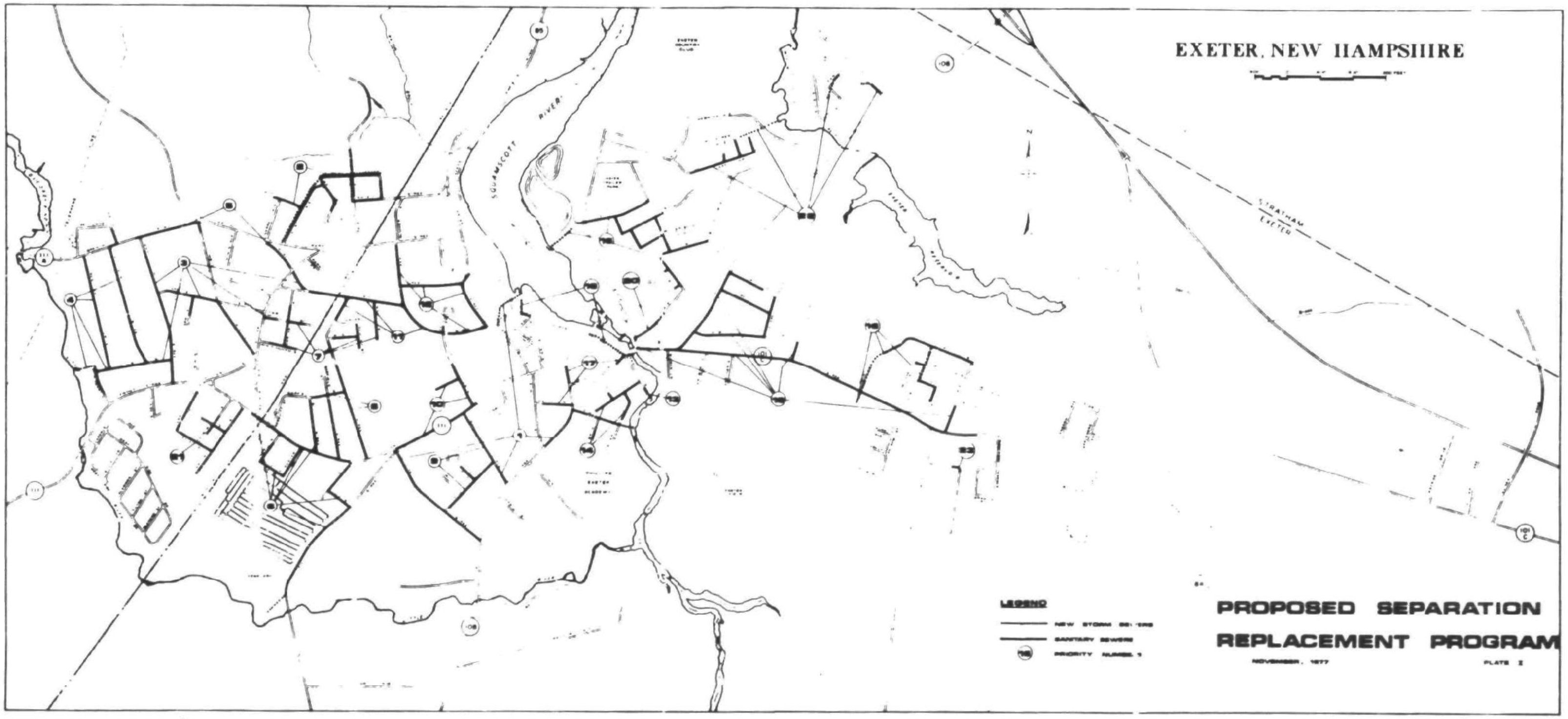
• SEPARATION ALTERNATIVE •

PROS

- *MANY OF THE TOWNS OLD SEWERS WOULD BE REPLACED BY SEPARATION.*
- *O&M COSTS ARE APPROXIMATELY $18,000 PER YEAR LESS THAN THE HOLDING POND ALTERNATIVE.*
- *SOME LONG TERM IMPROVED CAPABILITY FOR DRAINING TOWN STREETS DURING STORM EVENTS.*
- *NO POTENTIAL FOR ODOR PROBLEMS*
- *NO "CLEANING ON DEMAND" SERVICES REQUIRED.*
- *THE TOWNS SHARE OF THE CAPITAL COST COULD BE APPROPRIATED ON A PHASED BASIS THROUGH 1982.*

CONS

- *WATER QUALITY STANDARDS WOULD NOT BE MET UNTIL 1983.*
- *SUBSTANTIAL DISRUPTION TO TRAFFIC PATTERNS AND TOWN STREETS DURING SEPARATION PROJECTS.*
- *MAXIMUM POLLUTION IMPACT ON ESTUARY DUE TO URBAN RUNOFF.*
- *TOWNS SHARE OF THE CAPITAL COST IS APPROXIMATELY $500,000 MORE THAN THE HOLDING POND ALTERNATIVE.*



EXETER, N.H. — PUBLIC HEARING HANDOUT

FIG. 3 — 6

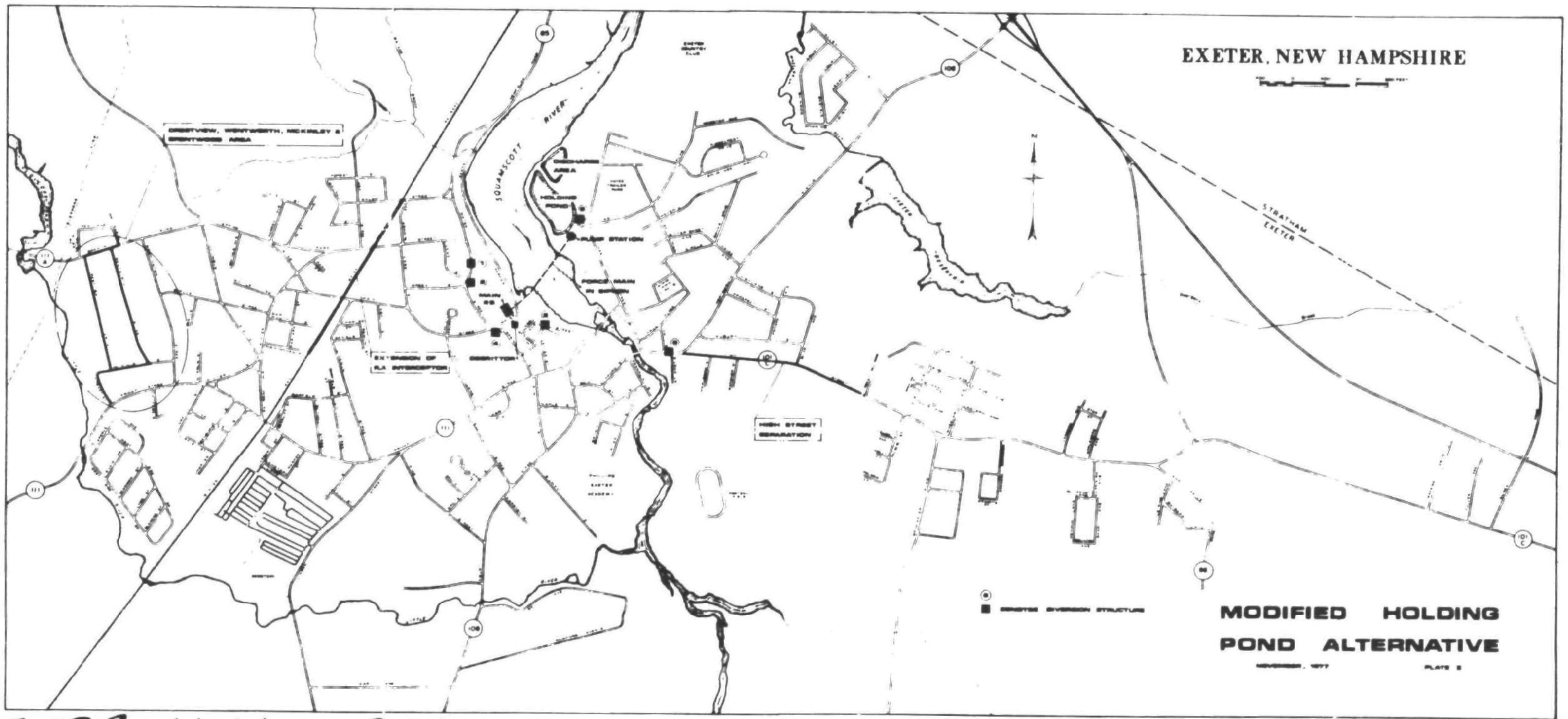
• MODIFIED HOLDING POND ALTERNATIVE •

PROS

- *ENABLES SQUAMSCOTT RIVER TO MEET WATER QUALITY STANDARDS BY 1981*
- *MINIMAL DISRUPTION TO TRAFFIC PATTERNS & TOWN STREETS DURING CONSTRUCTION.*
- *TOWNS SHARE OF CAPITAL COST IS APPROXIMATELY $500,000 LESS THAN THE SEPARATION ALTERNATIVE.*
- *MINIMIZES POLLUTION IMPACT OF URBAN RUNOFF TO THE SQUAMSCOTT RIVER ESTUARY.*

CONS

- *MAY CAUSE ODOR PROBLEMS DURING PROLONGED PERIODS OF WARM WEATHER.*
- *RESULTS IN ONLY NOMINAL IMPROVEMENT CAPABILITY FOR DRAINING TOWN STREETS DURING STORM EVENTS.*
- *O&M COSTS APPROXIMATELY $18,000 PER YEAR MORE THAN THE SEPARATION ALTERNATIVE. (A PORTION OF THE ADD'NL. O&M COST IS RELATED TO THE REQ'D. "CLEANING ON DEMAND" OF THE OVERFLOW STRUCTURES.)*
- *THE TOWNS SHARE OF THE CAPITAL COST MUST BE APPROPRIATED BY 1979.*



EXETER, N.H. — PUBLIC HEARING HANDOUT

FIG 3-7

environmental assessment manual
region 1: environmental protection agency
anderson-nichols technical consultant

Stormwater Separation Plan Outlined at Exeter

EXETER — A proposed modification in Exeter's plan for treating overflows of combined wastewater to the Squamscott River estuary was presented to residents here Wednesday evening at a public hearing in the Lincoln Elementary School.

Nearly 50 residents braved the elements to hear the plan which would improve the water quality of the Squamscott River and save taxpayers nearly $500,000.

Town officials are proposing a modification of a state and federally-approved facilities plan requiring separation of the town's sewage and stormwater. Under the modified plan, only partial stormwater separation would be required.

The modified plan, which was developed in cooperation with the NH Water Supply and Pollution Control Commission, would require only partial separation of the stormwater and would eliminate 90 percent of street excavation in the original project.

Complete separation, according to local officials, would mean tearing up many streets in Exeter to install new stormwater sewers.

The costs for complete separation would approach $2 million with the town's share of the cost to be approximately $616,000, while partial separation would cost the town approximately $172,000.

"The primary goal is to meet federal and state standards for water quality in the Squanscott River," said town manager Donald Chick. "We must do that or we'll be in violation of both state and federal regulations, as we are now."

Robert Cruss of the NH Water Supply and Control Commission yesterday said he felt the meeting went well and that there was "general agreement with the whole concept."

Engineers have told town officials that either system would meet the federal and state standards, according to Chick, who said "we must now line up the advantages and disadvantages of total separation."

One of the major disadvantages of total separation is cost according to Charles Knibbs, a member of the Exeter Sewer Commission.

"There is no comparison," he said. "If we go total separation, we're talking better than $616,000 in costs to the town. If we go to partial separation, we're in the best possible economic position. We're spending $172,000 as opposed to at least $616,000."

Knibbs noted the costs for partial separation is alre[ady] available in a special town se[wer] fund.

"We have the money in bank now through our se[wer] fund," he said. "We're not as[king] the townspeople to proc[ure] dollars."

Most of the residents atten[ding] the hearing questioned tow[n of]ficials concerning the effect project would have on the budget and if the modified would be sufficient to s[atisfy] state and federal clean standards.

Cruss said the next step [in the] project is for the town sel[ectmen] to request the NH Water and Control Commission [ap]proval and to forward the the Environmental Pr[otection] Agency for approval.

EXETER, N.H.—ARTICLE DESCRIBING HEARING

FIG. 3- ·8

Exeter has choice of sewer plans

EXETER — The town has to improve its sewer system but at least it has a choice of two ways to do it.

This point came out at a public hearing here Thursday on one of the alternatives.

Robert Cruess of the state's Water Supply and Pollution Control Commission staff explained that in 1975, a facilities study plan for Exeter had called for new aerated lagoons and also separation of storm and wastewater systems.

The town manager and the sewer study committee had reservations concerning separated systems, Cruess continued, and as a result, the WSPCC made a study to see if there were any alternatives to separation. The staff came up with one alternative, the modified holding-pond alternative.

Another member of the state staff, Paul Heirtzler, a sanitary engineer, said rain and snow contribute to pollution. They can scour pollutants from the surface of the earth as they move to catch-basins.

In Exeter, said Heirtzler, there is an excess amount of water during storms and this bears a relation to sewer and pump capacity. (Storm and wastewater are in a combined system at this point.)

Currently the holding pond is used for combined overflows in cases where the pump is at capacity. However, sea water comes into the pond, mixes, and is allowed to be flushed out, he explained.

Cruess said the problem is that stormwater is discharged directly into the estuary, which violates water quality standards.

(The Squamscott River will have to meet certain water quality standards mandated by the federal government.)

Cruess said the water quality for which the town is aiming is Class B — "you should be able to swim" in it.

Gordon Hoffman, head of the local sewer committee, said the committee endorsed the modification or holding-pond concept for several reasons.

The holding pond would be used; the town would avoid digging up miles of streets; the town would have an interceptor line through which waste would travel by gravity to the treatment plant, thus the town will be pumping one-third less sewage, and eventually the interceptor will serve two-thirds of the town; the town will save approximately $500,000 in capital costs by choosing the holding-pond alternative plan instead of the plan which involves large-scale separation of storm and wastewater.

Cruess said the plan with the holding-pond would produce better water quality, especially in the upper part of the river estuary, than would the separate system.

He said the interceptor line proposed to run along the railroad tracks from Salem to Rockingham Streets would provide the opportunity for the town in the future to drain a marshy area.

Heirtzler explained the alternative plan as follows: The holding pond would be used as a holding pond, and the discharge structure would be sealed. The stormwater, after being held, would be pumped back to the pump station and then sent to the treatment lagoons off Rt. 101 (the lagoons having been upgraded).

Even under the alternative plan, two places in town would have separate storm and wastewater lines, High Street and the McKinley-Wentworth-Hobart area. The latter area already experiences overflow, and separation here would take pressure off the Front Street pump station.

Cruess said High Street had a large number of catch-basins and a lot of the load going to the holding pond could be eliminated by separating storm and wastewater on that street.

Upgrading the lagoons, where waste will be treated, is an idea that officials agree is a good one.

Sherman Chester, chairman of the local selectmen, said the upgrading is in the design phase by Jones & Beach Engineers Inc., Stratham.

On the issue of the hearing, the cost differences are that separation would cost more initially but there wouldn't be a yearly cost, whereas the holding-pond alternative would cost less to establish but would involve yearly operation and maintenance costs of approximately $18,000.

Capital costs are $2,062,700 for the separated system as compared with $1,200,000 for the alternative system, Cruess said.

Of these, the town's share would be $616,000 in the separated system and $172,000 in the modified holding-pond alternative.

Answering a question on odors were the holding-pond alternative plan chosen, Cruess said odor probably would be 35 to 40 percent less than last summer.

(With a separated system, the holding pond is eliminated and with it, the potential for odor, but there would be discharge into the river for a period while the system was being installed, so that water quality standards wouldn't be met until 1983. In the case of the holding-pond alternative, the river would meet the standards by 1981, as the federal government wants.)

Donald Chick, town manager, said the town has more than $213,000 set aside for capital improvements and pollution abatement. The figures given by the state for the cost of capital improvements are based on calculations two years ago when the 1975 study came out.

There probably wouldn't be a bond issue for the town for the holding-pond alternative, Chick said.

To have the separated system, the town probably would have to have a bond issue, he said.

To install a separated system would involve digging up 19 miles of streets, as it is figured by town officials. Chick made the point that this might be better sewer planning if the town thought to extend the sewer system, but it would involve digging up streets, many of which had been paved recently.

Cruess mentioned that storm drainage would be put in at the town's expense — 100 percent.

The town will start construction of aerated lagoons probably in 1979, said Chick, and the town's share of that appears to be $100,000.

Cruess said if the town agrees with the modified holding-pond alternative, the plan would be submitted to the federal Environmental Protection Agency to see if it would agree to it (in place of the system involving large-scale separation).

A report will be made, which includes a recommendation by the state, and if the town officials concur, the plan will be sent to EPA, according to Cruess.

EXETER, N.H. — ARTICLE DESCRIBING HEARING

FIG. 3—9

3.42 The Torrington Experience

A Wastewater Facilities Plan for Torrington, Connecticut called for the reconstruction of a central interceptor (the back-bone of the existing system) and interceptor extension to the north of the central business district. Substantial controversy relating to the interceptor extension was evident before the Environmental Impact Assessment began.

The City's consultant, having had experience with controversial projects, recommended a public participation program. The program was to be initiated with a workshop designed to identify the specific concerns of the public. The Impact Assessment could then be prepared with these concerns in mind. The Federally mandated public hearing at the conclusion of the Impact Assessment could later be used as a forum to describe how controversial issues were dealt with.

A workshop, held before environmental analysis began, confirmed that an impasse had been reached between City officials and opponents of the project. The desirability of the central interceptor was recognized by all participants. Interceptor extensions to the northeast and northwest were strongly opposed, however. The northeast interceptor was opposed by labor groups who feared that it would have the secondary effect of attracting large numbers of new residents, presumably adding to the labor force. The need for this interceptor was also questioned by many. The northwest interceptor was opposed by environmental interest groups who questioned the need for the facility and the ecological effects of increased development induced by the project.

The participants were advised that their concerns would be carefully addressed in the Impact Assessment. During preparation of the Impact Assessment special emphasis was placed on the evaluation of wastewater collection needs and induced population growth along both interceptors, analysis of residential and labor market effects in the vicinity of the northeast interceptor and the forecasting of ecologic impacts in the vicinity of the northwest interceptor. The Impact Assessment determined 1) that no major adverse primary or secondary impacts would arise from the northeast interceptor and 2) that existing or future conditions did not support the need for a northwest interceptor.

The consultant's statement at the public hearing reported that the initial proposed action had been modified as a result of the Impact Assessment and citizen participation. The conflict with opponents of the northwest interceptor was resolved when plans for the northwest interceptor were shelved. The conflict with opponents of the northeast interceptor was resolved when it was reported that suspected adverse environmental impacts would not occur.

When plans for the northwest interceptor were shelved, conflict was resolved with a large number of citizens. This action had the potential of creating conflict with those in support of the northwest interceptor. Since proponents of the northwest interceptor were small in number, no further conflict was articulated.

Conflict with the opponents of the northeast interceptor was resolved because the Environmental Impact Assessment was a credible document and the majority of opponents chose to believe its findings.

3.421 Letter from Torrington Mayor

The following letter of invitation was sent out by the Mayor of Torrington to invite interested citizens to the Environmental Assessment workshop:

Dear ____________________:

The City of Torrington is preparing an Environmental Assessment for the proposed expansion of wastewater collection facilities. The area of study includes the proposed extensions of the existing sewerage service area northeast to Burrville and northwest to Drakeville.

We are planning a workshop meeting that is intended to assist us in determining issues of critical concern relating to alternate measures for collecting and treating wastewater.

The workshop is scheduled for Wednesday, August 11, 1976 at 7:30 P.M. in the City Hall auditorium.

You and a number of other community leaders are being invited by letter to attend the workshop. Your participation will be invaluable to us. Our consultants, Anderson-Nichols and Company, Inc., of Boston, have developed an interesting format for this workshop.

We look forward to meeting with you on August 11th.

Very truly yours,

Mayor of Torrington

3.422 Torrington Workshop Agenda

The following agenda was used at the Torrington Environmental Assessment Workshop:

WORKSHOP AGENDA - AUGUST 11, 1976.

CITY OF TORRINGTON, CONNECTICUT
WASTEWATER FACILITIES ENVIRONMENTAL ASSESSMENT

INTRODUCTION

- STATEMENT OF PURPOSE
- PARTICIPANTS
- SUMMARY PRESENTATION

WORKSHOP INSTRUCTIONS

SMALL GROUP DISCUSSIONS

GROUP REPORTS

QUESTIONNAIRE

ADJOURN

3.423 Torrington Questionnaire

The following questionnaire was filled out by all Environmental Assessment workshop participants following the presentation of group reports:

TORRINGTON QUESTIONNAIRE

1. ARE YOU AWARE OF ANY OF THE FOLLOWING POSSIBLE SEPTIC SYSTEM PROBLEMS IN YOUR NEIGHBORHOOD? (IF SO, THEN PLEASE INDICATE THE NEIGHBORHOOD IN WHICH YOU LIVE. IF APPROPRIATE, CHECK MORE THAN ONE.)

   ________ ODORS
   ________ WATER AT SURFACE IN LEACHING FIELD AREA
   ________ WELL CONTAMINATION
   ________ FREQUENT PUMPING REQUIRED
   ________ RECENT RECONSTRUCTION
   ________ WATER USE RESTRICTED
   ________ DIRECT CONNECTION TO WATERCOURSE

2. ARE YOU AWARE OF ANY POLLUTION PROBLEMS ELSEWHERE IN THE CITY? (IF SO, THEN PLEASE INDICATE WHERE AND THE NATURE OF THE PROBLEM.)

   ____

   ____

3. WHAT IS YOUR OPINION REGARDING NEED FOR SEWERS IN THE BURRVILLE SECTION? (IF APPROPRIATE - CHECK MORE THAN ONE.)

   ________ NEEDED NOW
   ________ WILL BE NEEDED IN FUTURE
   ________ WILL NEVER BE NEEDED
   ________ SHOULD BE DISCOURAGED BY STRICT ZONING CONTROLS AND SANITARY CODE ENFORCEMENT
   ________ SHOULD BE USED AS CATALYST FOR NEW INDUSTRIAL GROWTH
   ________ DON'T KNOW

4. WHAT IS YOUR OPINION REGARDING NEED FOR SEWERS IN THE DRAKEVILLE (NORTHWEST) SECTION? (IF APPROPRIATE - CHECK MORE THAN ONE.)

   ________ NEEDED NOW
   ________ WILL BE NEEDED IN FUTURE
   ________ WILL NEVER BE NEEDED
   ________ SHOULD BE DISCOURAGED BY STRICT ZONING CONTROLS AND SANITARY CODE ENFORCEMENT
   ________ DON'T KNOW

5. WHAT IS YOUR OPINION REGARDING THE NEED FOR CONSTRUCTION OF THE CENTRAL INTERCEPTOR AND REHABILITATION OF THE EXISTING SEWER SYSTEM?

_______ NEEDED
_______ NOT NEEDED

6. WHAT DO YOU FEEL WOULD BE THE MAJOR IMPACT(S) OF A SEWER SYSTEM SERVING THE BURRVILLE AREA (RANK BY IMPORTANCE - 1 - MOST IMPORTANT, 2 - SECOND, ETC.)

_______ NONE
_______ INDUCE RAPID GROWTH
_______ ENCOURAGE INDUSTRIAL DEVELOPMENT
_______ CHANGE COMMUNITY CHARACTER
_______ INCREASE COSTS TO PROPERTY OWNERS
_______ ENCOURAGE HIGHER HOUSING DENSITIES
_______ CORRECT SURFACE WATER POLLUTION
_______ CORRECT GROUND WATER POLLUTION
_______ OTHERS (PLEASE LIST)

7. WHAT DO YOU FEEL WOULD BE THE MAJOR IMPACT(S) OF A SEWER SYSTEM SERVING THE DRAKEVILLE AREA. (RANK BY IMPORTANCE, 1 - MOST IMPORTANT, 2 - SECOND, ETC.)

_______ NONE
_______ INDUCE RAPID GROWTH
_______ CHANGE COMMUNITY CHARACTER
_______ INCREASE COSTS TO PROPERTY OWNERS
_______ ENCOURAGE HIGHER HOUSING DENSITIES
_______ CORRECT SURFACE WATER POLLUTION
_______ CORRECT GROUND WATER POLLUTION
_______ OTHERS (PLEASE LIST)

8. WOULD YOU BE IN FAVOR OF THE NORTHWEST INTERCEPTOR EXTENDING ONLY SO FAR AS TO SERVE THE UNIVERSITY OF CONNECTICUT CAMPUS?

_______ YES
_______ NO
_______ DON'T KNOW

9. DO YOU THINK SEWERS WOULD ACCELERATE GROWTH IN BURRVILLE AND DRAKEVILLE SECTIONS OF TORRINGTON?

_______ YES
_______ NO
_______ DON'T KNOW

10. WOULD YOU FAVOR STRICTER ZONING AND SANITARY CONTROLS AND ENFORCEMENT AS AN ALTERNATIVE TO SEWER CONSTRUCTION?

_______ YES
_______ NO
_______ DON'T KNOW

11. IN CONSTRUCTING SEWERS, PRIORITY SHOULD BE ASSIGNED TO THE FOLLOWING: (IF APPROPRIATE - CHECK MORE THAN ONE.)

_______ SERVING PROBLEM AREAS
_______ ENCOURAGING NEW BUSINESS AND INDUSTRY
_______ BROADENING HOUSING OPPORTUNITY

12. ANY ADDITIONAL COMMENTS (PLEASE FEEL FREE TO ADD ANY REMARKS OR CONCERNS YOU MAY HAVE WHICH HAVE NOT BEEN ADEQUATELY COVERED BY THIS QUESTIONNAIRE.)

____

____

____

3.424 Torrington Workshop Summary

On Wednesday, August 11, 1976, a Citizen's Environmental Workshop was held to discuss the proposed expansion of wastewater collection facilities in Torrington. Community leaders and decision makers were notified and invited to the meeting by written announcement from the Mayor's office. All other interested citizens were notified and invited by press.

The purpose of the Workshop was to help the consultant determine the areas of critical public concern relating to alternative measures for collecting and treating wastewater.

Anderson-Nichols & Co., Inc. prepared an agenda, including a brief introduction to explain the work on the proposal to date. Participants were randomly seated around several large tables, forming five discussion groups of four to eight people, and for the next hour, these groups were asked to consider five discussion questions designed by ANCo to identify the issues and areas of significant public concern. A chairperson of each table was to be selected by the table members to direct the discussion and summarize the discussion on the five questions after one hour of discussion. During the hour of discussion, ANCo representatives circulated from table to table to answer any questions or provide assistance. After the reports from the chairmen of the tables, each participant was asked to fill out a questionnaire prepared by the consultant. A general question and answer period followed, after which the meeting was adjourned.

It was explained at the beginning of the meeting that a workshop is not the same as a public hearing, but is a preliminary means of monitoring the opinions and concerns of the public to be affected. The consultant felt the workshop format would allow for public input during the process of writing the impact assessment, rather than after it was completed at the time of public hearing. Such a preliminary public workshop is not required or suggested by the guidelines for writing impact assessments, but the consultant found it a practical and valuable way to incorporate public concern into the assessment rather than to contact it for the first time at public hearing with the assessment completed. The proceedings of the workshop were instrumental in the development of the assessment. Copies of the agenda, the questionnaire and the letter of invitation sent by the Mayor's office were presented in the three preceding sections (3.421, 3.422 and 3.423).

There were five discussion groups with a total of 29 people taking part. Present were city officials, Chamber of Commerce members, Conservation Commission members, citizens, health officials, League of Women Voters, and labor representatives.

The results of the discussion questions showed that three of the five groups felt a present need for all three (NW, NE, Central) interceptors; one of the five groups said only the central is necessary now; one cited a present need for the northeast and Central only.

Regarding future need, three groups mentioned Drakeville as an area of need; two groups mentioned Burrville; one group said there is no future need for the northwest interceptor.

In regard to favoring stricter development controls, such as zoning, subdivision or sanitary codes to minimize future sewer needs, four of five groups said they would not favor stricter controls.

Major concerns regarding the extension of interceptors from Torrington to Burrville and Drakeville include: finance, lack of provision for growth of industry and residential development if interceptors are not built, whether Torrington is ready for the growth interceptors would induce, and how it will control such growth.

Areas which the groups felt required special attention in the environmental assessment include: University of Connecticut, Norfolk Road, wetlands along Route 8, Central City, Burrville, Torringford West Street.

In response to the written questionnaire, there were 26 replies: In answer to the question on septic failures by neighborhood, 21 people said they were not aware of any; four said they were aware of such problems and listed odors, water at surface in leaching field area, well contamination and recent reconstruction. One person could not answer. In response to pollution problems in the city outside of home neighborhood, ten people did not know of any, one could not answer, and 15 cited areas including:

Norfolk Road (7 people)
Drakeville (4 people)
Torringford West St. (3 people)
Burrville (4 people)
West Branch Naugatuck River (2 people)
Litchfield Road (1 person)
Sewage Treatment Plant (1 person)
Newfield Road (1 person)

Regarding need for sewers in the Burrville section:

19 people said they were needed now.
10 people said they should be used as a catalyst for new industrial growth
6 people said they would be needed in the future.
1 person said they will never be needed.
1 person said they should be replaced by strict zoning controls and sanitary code enforcement.

Regarding need for sewers in the Drakeville section:

17 people said they were needed now.
10 people said they would be needed in the future.
3 people said they would never be needed.
1 person answered "don't know."

Regarding the need for construction of the Central Interceptor and rehabilitation of the existing sewer system:

26 people said it was needed.
None said it was not needed.

When asked whether they would be in favor of the northwest interceptor extending only so far as to serve the University of Connecticut campus:

14 people said they were in favor.
8 people said they would not favor such an extension.
8 did not know, and one person did not answer.

When asked if they thought sewers would accelerate growth in Burrville and Drakeville sections of Torrington:

20 people said yes.
4 people said no.
2 people did not know.

In response to the question of whether they would favor stricter zoning and sanitary controls and enforcement as an alternative to sewer construction:

5 people said yes.
20 people said no.
1 person did not answer.

In a question to determine the priorities for sewer construction:

23 people named "serving problem areas" a priority issue.

20 people named "encouraging new business" a priority issue.
11 people named "broadening the housing opportunity" a priority issue.
22 people had no added comments. Of the four people who did add comments:

1 wanted controlled growth of industry only.
1 called for the building of the Central only saying that even if funds were available for the NE and NW, it would be foolish to build them if there is really no need for them. One commented that the citizens of Torrington do not want growth. One reemphasized the future need of sewers on Newfield Road.

In addition to the workshops, opportunity for public participation was provided at public hearings.

3.5 BIBLIOGRAPHY

Working Effectively With Advisory Committees

Working With The Media

Effective Public Meetings

These guides prepared by EPA Headquarters for use in the 208 Program offer excellent, practical advice. They are available from EPA Region I's Public Participation Project.

A Manual for Communities on Public Participation in Planning for Wastewater Treatment

This manual, prepared by EPA Region I, discusses a full range of public participation issues and techniques.

environmental assessment manual

land application

4. land application

CHAPTER 4 - LAND APPLICATION

4.0 INTRODUCTION

The environmental assessment of land application systems requires consideration of probably the broadest range of environmental considerations of all the alternatives in the wastewater treatment field. The three basic land application methods: spray irrigation; overland flow; and rapid infiltration can affect the subsurface and groundwater environments as well as surface and air environments. Public health, social and economic aspects must also be evaluated for each land treatment alternative and further emphasizes the importance of developing both accurate and timely environmental assessments during the facilities planning stage. Early warning indicators of potentially significant environmental impacts that can be identified during the initial phases of a facilities plan are, perhaps, the most useful tool of the environmental impact assessment of land application systems. Furthermore, if these potentially significant land application impacts are identified early in the facilities planning process, a smooth coordination of planning and/or Environmental Impact Statement efforts can be instituted to concentrate on and resolve major environmental issues associated with the land treatment alternatives under consideration.

Therefore, it is the purpose of this chapter to provide both a checklist of the potential impacts of land application systems,as well as early warning indicators by which these impacts may be identified and possibly resolved.

4.1 REGULATORY STATUS

4.11 Federal Regulatory Status

The statutory basis for consideration and funding of land application systems for the treatment of municipal wastewater is the Federal Water Pollution Control Act Amendments of 1972 (Public Law 92-500). This is solidly reinforced by the recent passage of the 1977 Amendments (PL 95-217).

In addition to the legislation contained in Public Law 92-500 and 95-217, a number of regulations have been issued pertaining to land application. They are:

4.111 Areawide Waste Treatment Management (Section 208)

The regulatory basis for Section 208 is contained in 40 CFR 35, subpart F, published in the Federal Register, May 13, 1974. As one policy variable required by this regulation, land application systems could be a significant part in development of areawide planning management alternatives. Also, disposal of residual waste using land application should be considered.

4.112 Grants for Construction of Treatment Works (Section 201)

Sets forth procedures for award of grant assistance and includes land application as an alternative waste management system.

4.113 Guidance for Facilities Planning (May 1975)

Provides guidance for planning and evaluation of various waste management alternatives which include an assessment of the environmental impacts of the alternatives.

4.114 Cost-Effectiveness Analysis Guidelines

Regulations for cost-effectiveness analysis are 40 CFR 35, Appendix A published in the Federal Register on September 10, 1973. Information on cost-effectiveness screening of waste treatment alternatives is given, including systems using land or subsurface disposal techniques.

4.115 Secondary Treatment Information (Section 304(d)(f))

Information on, and requirements for, secondary treatment (40 CFR 133) were published in the Federal Register on August 17, 1973 and include land application systems with point source discharges.

4.116 Alternative Waste Management Techniques for Best Practicable Waste Treatment (Section 304 (d)(2))

Required publically-owned and funded waste treatment works (POTW) to utilize best practicable waste treatment works and contains information on best practicable waste treatment technology (BPWTT). The proposed (BPWTT) for land application was published in the Federal Register on February 11, 1976, and specifically requires that land application systems, where the effluent results in permanent groundwaters which can potentially be used for drinking water shall not contain organic or inorganic pollutants above those specified in the National Interim Primary Drinking Water Regulations.

4.117 Other Related Federal Laws and Resolutions

In addition to the existing Federal statutes and regulations, the Administrator of the EPA, in his letter of October 3, 1977, has further defined EPA policy on land application. In this letter, he requires regional administrators to <u>preferentially</u> consider land application as an alternative wastewater management technology; if an applicant for construction grant funds does not recommend a method that encourages water reclamation and reuse, then the applicant should be required to provide complete justification for the rejection of land treatment.

The previously listed Federal statutes, regulations and policy guidelines attributable to PL 92-500 and PL 95-217, emphasize both the requirements and overall need for accurate and timely environmental assessments of the land application waste treatment alternative in meeting the goals and objectives of those Acts.

Other related federal laws which affect the feasibility of the land application waste treatment alternative are:

A National Environmental Policy Act (PL 91-190)
B Safe Drinking Water Act (PL 93-532)
C Toxic Substances Control Act (PL 94-469)
D Resource Conservation and Recovery Act (PL 94-580)

4.12 State Regulatory Status

The individual states within Region 1 have also adopted a wide range of technical requirements in reviewing land application systems. In most cases, however, specifics of these requirements are not published and approval of land application systems is on a case-by-case basis. A summary of state agencies in Region 1 which are involved in review and approval of land application waste treatment systems are given in Table 4-1.

4.2 PAST PRACTICES

A review of approved facilities plans recommending land application of municipal wastewaters indicates that a wide range of efforts have been used in the preparation of environmental assessments. A "typical" environmental assessment, however, usually has involved approximately 3-4 man-weeks of labor performed at the end of the facilities planning effort and, therefore, relies heavily on data already developed in the plan. Also, conclusions and recommendations of the facilities plan, at this stage, are fairly well set and so environmental assessments have tended to emphasize justification of the chosen alternative rather than a systematic evaluation of potential environmental impacts.

In order to utilize the environmental assessment procedure more fully in the development of cost-effective and environmentally sound land application wastewater treatment alternatives, a concurrent planning and impact evaluation system

TABLE 4-1
SUMMARY OF MAJOR STATE REGULATORY REQUIREMENTS FOR
LAND APPLICATION WASTE TREATMENT SYSTEM
REGION 1

Region 1 State Water Pollution Control Agencies	* Current State Regulatory Requirements (1978)		
	Spray Irrigation	Overland Flow	Rapid Infiltration
A. Connecticut Water Compliance and Hazardous Substances Dept. of Environ. Protection State Office Building 165 Capital Avenue, Rm. 129 Hartford, CT 06115 (203) 566-7168	Case by Case	Case by Case	Case by Case
B. Maine Bureau of Water Quality Control Department of Water Quality Control State House Augusta, ME 04330 (207) 289-2591	Case by Case (State License Required)	Case by Case	Case by Case
C. Massachusetts Department of Environmental Quality Division of Water Pollution Control 110 Tremont Street Boston, MA 02108 (617) 727-3855	Case by Case	Case by Case	Case by Case
and Division of Environmental Health 600 Washington Street Boston, MA 02111 (617) 727-2655	Based on the results of hydrogeological investigation	Based on the results of hydrogeological investigation	Based on the results of hydrogeological investigation

* Major current requirements only - subject to State Legislative and regulatory changes.

TABLE 4-1 (cont'd)
SUMMARY OF MAJOR STATE REGULATORY REQUIREMENTS FOR
LAND APPLICATION WASTE TREATMENT SYSTEM
REGION 1

Region 1 State Water Pollution Control Agencies	* Current State Regulatory Requirements (1978)		
	Spray Irrigation	Overland Flow	Rapid Infiltration
D. New Hampshire New Hampshire Water Supply and Pollution Control Commission P.O. Box 95 - 105 Loudon Road Concord, NH 03301	1. Max. application rate, 2"/week 2. Buffer Zone (case by case) 3. Pretreatment - secondary disinfected effluent 4. Min. storage - 8 months 5. Max. Spray season - 20 weeks 6. Max. Slope - 10%	Case by Case	Case by Case
E. Rhode Island Rhode Island Department of Environmental Management Division of Water Pollution Control Health Building Davis Street Providence, RI 02903 (401) 271-2234	Case by Case	Case by Case	Case by Case
F. Vermont Agency of Environmental Conservation Department of Water Resources Montpelier, VT 05602 (802) 828-3345	1. Max. application rate - 2"/week 2. Buffer zone 200' (around wetted area) 3. Pretreatment - well oxidized disinfected secondary effluent 4. Min. storage 3 months 5. Max. spray season winter spraying allowed	Case by Case	1. Max. application rate - 8 gpd/ft^2 2. Tertiary pretreatment 3. No storage

* Major current requirements only - subject to State Legislative and regulatory changes

is required. As a minimum for the land application alternative, the process should include at least the following elements:

A Early identification of potential land application sites and their required capacities.

B Early identification of potential adverse environmental impacts from land application.

C Early incorporation of more detailed facilities planning effort or environmental impact statement methods to resolve any potential adverse impacts attributable to land application during the facilites planning process.

4.3 ENVIRONMENTAL ASSESSMENT EVALUATION PROCEDURES AND CASE STUDY

This section presents a summary of potential environmental impacts of land application systems and an early warning procedure for identifying and assessing probable severe impacts.

The steps in the procedure are:

A. Preliminary development of land application alternatives.

B. Preliminary identification of land application environmental impacts.

C. Assessment of the probable degree of adversity or benefit of each potential impact.

D. Employment of measures to resolve the most potentially severe impacts.

It should be emphasized that this procedure is intended only to highlight potential environmental impacts and methods for their assessment to be considered by the environmental planner during the facilities planning stage and should not be used as an all inclusive summary of planning or design criteria.

4.31 Preliminary Development of Land Application Alternatives

The first step common to both the environmental assessment process and facilities planning efforts, is the preliminary development of waste treatment alternatives. In the case of land application, this can be further divided into "process" alternatives and "system" alternatives. Land application process alternatives refer to the basic process, i.e., spray irrigation, overland flow, etc. System alternatives, on the other hand, include all elements and unit processes of the land application facility, i.e., storage, transmission, etc.

In addition, the final means of disposal can include discharge to ground, surface waters, or combinations of land application process prior to final disposal. Figure 4-1 illustrates schematically, these various "process" and "system" alternatives.

4.311 Land Application Process Alternatives

The preliminary development of land application alternatives can be simplified in the early stages of the assessment effort by considering only the three major process alternatives:

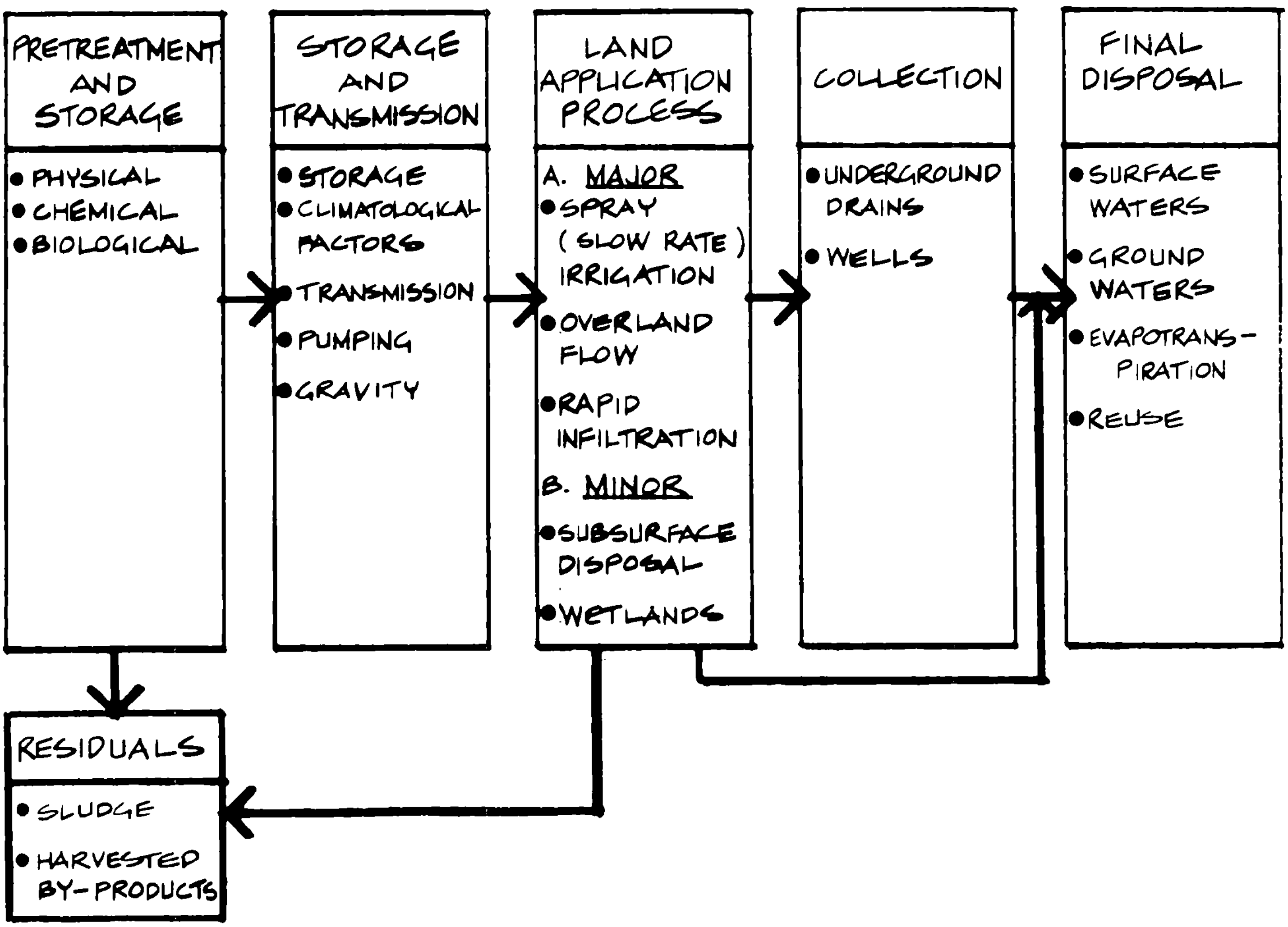
--spray (slow rate) irrigation
--overland flow
--rapid infiltration

The land application of wastewater can employ all three process alternatives, while sludge disposal is usually limited to the use of slow rate irrigation and overland flow. In addition, sludge can be applied in either the liquid or moist solid form. A brief description of these major land application processes is given below (1,2,3,4):

A Spray Irrigation or Slow Rate Irrigation

The most common method of land treatment in use today is spray irrigation or slow infiltration. Irrigation is usually defined as the controlled discharge of wastewater effluent on land for ultimate uptake by the soil matrix and plant biosystems, loss to the atmosphere by evapotranspiration, and/or percolation to the groundwater environment. Irrigation has been used for three distinct purposes: optimization of crop yields, maximization of effluent application, and landscape irrigation. Three application techniques employed in irrigation systems are spraying, ridge and furrow, or flooding.

Spraying involves the discharge of partially treated effluent above the ground either through nozzles or sprinkler heads. Spray systems are best suited for a uniform flow distribution of effluent wastewater and have a high degree of flexibility. They may be either portable or permanent, stationary or moving. A major disadvantage with spray irrigation systems is that high wind can lower the efficiency of distribution and spread aerosol mists.



LAND APPLICATION SYSTEM ALTERNATIVES

FIG. 4—1

Ridge and furrow irrigation is the application and flow of wastewater effluent by gravity through furrows which allows the wastewater to seep into the soil. This method is usually used on relatively flat lands which have had extensive site preparation. Ridge and furrow irrigation is normally used in conjunction with row crops which can adapt to periods of inundation. The main disadvantage of the ridge and furrow method of irrigation is the lack of application flexibility and uniform distribution of the wastewater.

Irrigation by flooding, as the term implies, is the inundation of land by wastewater to a certain depth. The site has to be fairly level so that a uniform depth can be maintained. In addition, the crop grown has to be able to withstand periodic flooding.

All three methods of irrigation can generally be expected to have a high potential for renovation of the effluent applied by removal of most wastewater pollutants by uptake in the harvested crops.

Spray irrigation or slow rate treatment is generally capable of producing the best results of all the land treatment systems and is suitable on both crops and forest lands.

Organics are reduced substantially by biological oxidation within the top few inches of soil. Filtration and adsorption are the initial mechanisms and biological oxidation is the ultimate treatment mechanism in BOD removal. Filtration is the major removal mechanism for suspended solids. Volatile solids are biologically oxidized and fixed, or mineral solids become part of the soil matrix.

Nitrogen is removed primarily by crop uptake, which varies with the type of crop and the crop yield. To remove the nitrogen effectively, the portion of the crop that contains the nitrogen must be physically removed from the field. Denitrification can also be significant, even if the soil is in an aerobic condition most of the time.

Phosphorus is removed from solution by fixation processes in the soil, such as adsorption and chemical precipitation. Removal efficiencies are generally very high for spray (slow rate) irrigation systems and are usually more dependent on the soil properties than on the concentration of the phosphorus applied. A small portion of the phosphorus applied is taken up and removed with the crop. Because of required lower loading rates, the spray (slow rate) irrigation process utilizes the largest land area. As a result, however, adverse impacts to the soil and vegetation are minimized by the wide dispersion of pollutants. Since irrigation systems rely heavily on crop renovation efficiencies, the actual application periods for this process will coincide with the growing season. The particular nutrient needs of the selected crops must be consistent with the effluent characteristics and the desired water quality objectives. This limitation generally results in larger storage and agricultural monitoring requirements, thus increasing the overall operating cost of the system.

B. Overland Flow

Overland flow is the controlled discharge, usually by spraying, of wastewater effluent onto the upper reaches of a slope which results in renovation of the wastewater as it flows down the hill. The runoff is collected at the bottom of the slope for ultimate discharge to a surface waterbody or reuse. This is usually a substantial portion of the originally applied effluent. The remaining wastewater is lost to evapotranspiration and infiltration.

The major renovation mechanism of the overland flow process is the filtration and oxidation of wastewater as it passes over the soil surface and through the vegetative litter. The normal plant cover used is grass which serves both to protect the soil from erosion and to maximize wastewater renovation potential by physical, chemical, and biological means.

Biological oxidation, sedimentation, and grass filtration are the primary removal mechanisms for organics and suspended solids.

Nitrogen removal is attributed primarily to denitrification resulting from an aerobic-anaerobic double layer that exists at the surface of the soil and allows both nitrification and denitrification to occur. Because this process depends on two stages of microbial activity, it is sensitive to environmental conditions. Plant uptake of nitrogen can also be a significant removal mechanism, however, permanent nitrogen removal by plant uptake is only possible if the crop is harvested and removed from the field. Ammonia volatilization can be significant if the pH of the wastewater is above 7.

Phosphorus is removed by adsorption and precipitation in essentially the same manner as with the slow rate method. Treatment efficiences are somewhat limited because of the incomplete contact between the wastewater and the adsorption sites within the soil. Increased removals may be obtained by chemical treatment prior to appplication. Since the overland flow method of land treatment relies heavily on biological mechanisms and does not have the buffering capacity and time lag benefits of processes utilizing passage through the soil profile, it provides only limited renovation of wastewater pollutants. As is the case with other biological treatment steps, the overland flow process is subject to temperature effects and shock loads. Overland flow, therefore, may not be a feasible alternative in areas with cold climates unless storage is provided to retain wastewater flows during cold weather. Overland flow is typically used on 2 to 8 percent slopes. Soils which are well drained are usually better suited to other land treatment alternatives.

C. Rapid Infiltration.

Unlike the spray (slow rate) irrigation and overland flow methods of land treatment described above, rapid infiltration is primarily a method of wastewater disposal by recharging the groundwater resource. Higher loading rates are used with rapid infiltration systems than with the irrigation process. The wastewater is applied to rapidly permeable soils, such as sands and loamy sands, by spreading in basins or by spraying and is treated as it travels through the soil matrix, which may have a vegetative cover. In spreading the wastewater effluent, several basins are used and are subjected to alternate periods of flooding and drying (resting). Spraying is normally used with a water tolerant plant species to protect the surface of the soil and prevent runoff at the higher application rates encountered. The rapid infiltration process allows wastewater to infiltrate at a relatively high rate through the surface root system and soil matrix with some loss due to evapotranspiration. Because of this high infiltration rate there is only a minimal potential for removal of wastewater pollutants. Removals of wastewater organic and solid constituents are primarily accomplished by biological oxidation and the filtering and straining action of the soil. Nitrogen removals are generally poor due to the lack of significant plant uptake. It should be noted, however, that although total nitrogen removals may be poor, rapid infiltration is an excellent method for achieving a nitrified effluent and so nitrate contamination of groundwater aquifers is a prime concern. Phosphorus removals are dependent on the physical and chemical characteristics of the soil. As with spray irrigation systems, the primary phosphorous removal mechanism is adsorption with some chemical precipitation, so the long-term wastewater renovation capacity is dependent on the mass of soil in contact with the wastewater. Removals are related also to the residence time of the wastewater in the soil and the travel distance. Heavy metal removal may be limited by the physical/chemical properties of the soil structure.

A well-drained soil and a permeable subsurface environment are critical to the success of rapid infiltration land treatment schemes. Rapid infiltration requires the least land area of all land treatment alternatives.

Extensive site groundwater control in the form of underdrains or wells may be needed, however, to ensure hydraulic functioning of the system and to protect groundwater quality where best practical waste treatment technology (BPWTT) standards prevail.

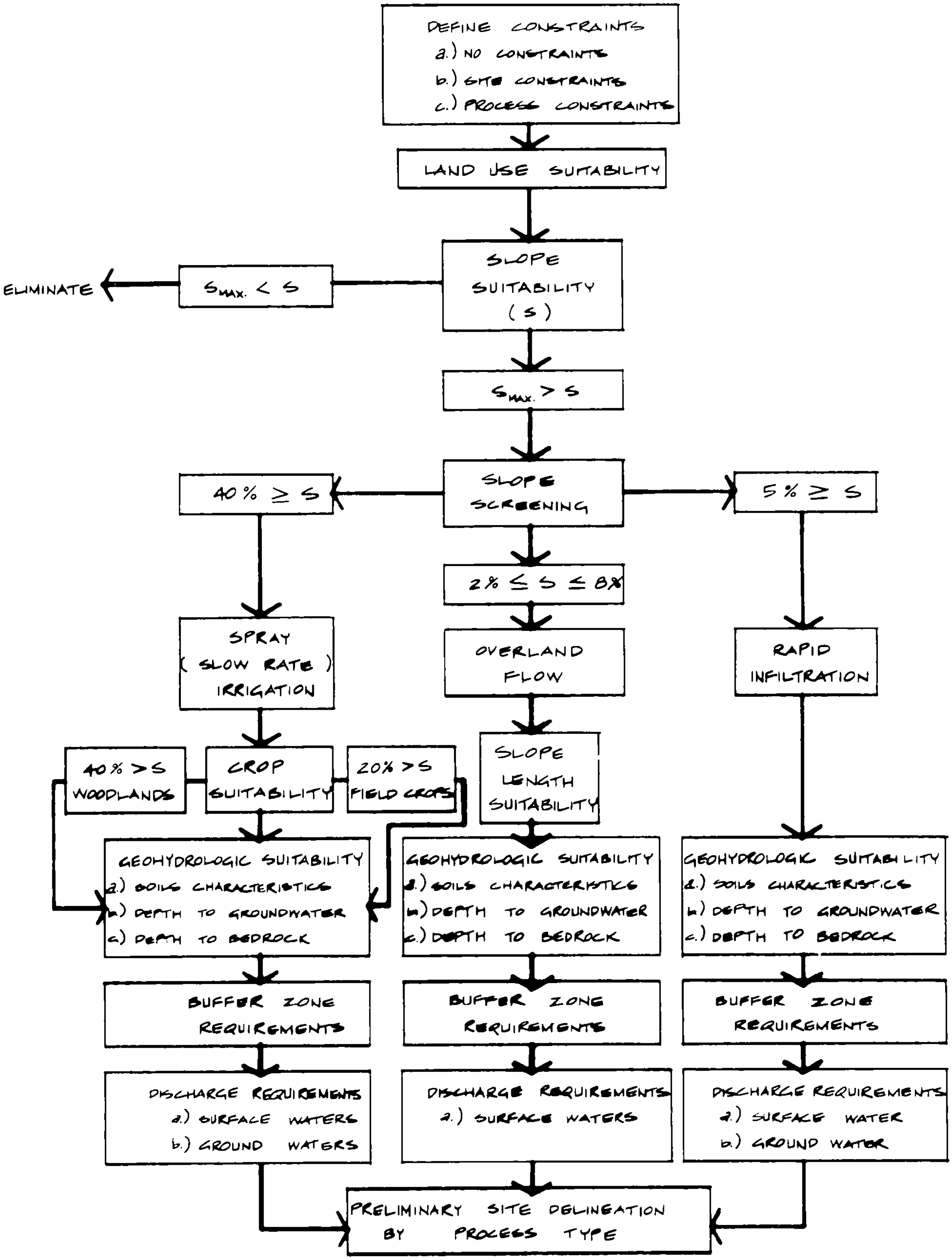
Other, less common land application processes available today are the use of wetlands, peatlands and subsurface disposal. These are special cases of the basic processes and so will not be listed separately in the preliminary screening procedure.

4.312 Preliminary Identification of Land Application Sites

It is apparent by inspection of Figure 4-1 that there can be many variables and options associated with land application thereby requiring use of a general but systematic approach to initially identifying potential land application sites.

An outline of such an approach is shown schematically in Figure 4-2. It is important to remember that the first screening of potential sites should utilize broad and general suitability criteria, with emphasis on including as many "potential" sites as possible, and leaving detailed judgments of each site for the latter phases of the environmental assessment/facilities planning procedure. Also, the subsequent steps in the environmental assessment evaluation procedure can be used as tools to focus in on the most promising of land application sites as well as provide early warning indicators of the methods and study efforts which will be needed to fully evaluate each site.

The key features of the preliminary site identification procedure shown in Figure 4-2 are the emphasis on categorizing sites initially by process suitability i.e. spray irrigation, overland flow, etc., as well as their general suitability to meet water quality discharge requirements and land use constraints. The quantitative screening elements of the procedure, i.e. slopes, soils characteristics etc., will be dependent on continuing advacements in the state-of-the art of land application as well as unique features pertinent to specific study areas. The environmental planner, therefore, can incorporate more or less detailed site selection criteria within the basic screening methodology. A summary of published operational data on the three major land application processes is given in Table 4-2 and may be used as a baseline guide by the environmental planner in the initial site identification procedure. A brief description of the key elements of the preliminary site identification procedure and relevent features pertinent to New England (Region I) follows.



IDENTIFICATION OF SUITABLE LAND APPLICATION SITES FIG. 4-2

TABLE 4-2
SUMMARY OF PUBLISHED SITE OPERATIONAL DATA
FOR
LAND APPLICATION PROCESSES
(Source: References 1, 2, 3, 4)

Process Operational Data	Spray Irrigation (Slow Rate)	Overland Flow	Rapid Infiltration
I. Site characteristics			
a) Soil			
Texture	clay loams to sandy loams	Clays and clay loams[1]	Sands and sandy loams
Permeability (in/hr)	0.06 - 20.0	0.2	2.0 - 20.0
Cation exchange capacity (meg/100g)	13 - 27	22 - 63	0 - 6.0
b) Topography			
Slope	0 - 20% cultivated 20 - 40% non-cultivated	2 - 8%[3]	5%[2]
Relief	Varies	Varies	Varies
Flood potential	Minimal	Minimal	Minimal
Vegetation	Field and forage Crops Woodlands	Perennial Grass	N/A
c) Geology			
Depth to Bedrock	5.0' min.	2.0' min.	15.0' min.
Depth to groundwater	2.0' min.	N/A	10.0' min.
d) Land Use			
Buffer zones	May conflict 200 - 1000'	May conflict 200 - 1000'	May conflict 200 - 1000'
II. Wastewater Loading			
a) Annual Applica-cation Rate (ft/yr)	2 - 20	10 - 70	20 - 560
b) Weekly application Rate (inches)	0.5 - 4.0	2.5 - 16.0	4.0 - 120.0
c) Storage (months)	3 - 8	3 - 8	Usually none

1. Requires impervious strata at shallow depths.
2. Greater slopes are possible but require extensive earthwork.
3. Overland flow slope lengths typically 120 to 150 feet long.

A. Define constraints on the development of land treatment alternatives

No constraints: All land within the study area can be evaluated for the entire range of land application processes and various system combinations.

Site constraints: Only predetermined sites can be used and land application processes are evaluated to match the given sites.

Process constraints: The study begins with a limitation on the land application processes which can be used and potential sites are identified only for those processes.

B. Land Use Suitability

Sites should not conflict with existing land use but should reinforce land use patterns. The drainage basins of surface water supplies, national parks, heavily used recreational areas, developed urban areas and historic sites may be areas of exclusion for land application systems because of committed land use or sensitive environments. Political boundaries may also represent possible areas of exclusion due to the uncertainty of implementation authority. Local conditions, such as Indian land claims, historical commissions and recreational preserves can pose additional legal uncertainties to the land use suitability of potential land application sites.

C. Identify Potential Sites by Process Suitability

The next step in the preliminary site identification procedure requires relating specific features of potential sites to major land application process suitability according to the following basic characteristics:

Soils

Physical properties

Permeability (hydraulic capacity)

Chemical properties

Crop feasibility

Topography

Relief

Flood potential

Geology

Bedrock

Groundwater levels

General soil, physical, chemical and hydraulic properties should be identified within the planning area. Important physical properties are texture, structure and soil depth while important hydraulic characteristics include infiltration rates and permeability (1). Chemical characteristics that may be useful in relating process suitability to potential sites include: pH, cation exchange capacity, nutrient levels and adsorption and filtration capacities for various inorganic ions. The Soil Conservation Service, as the coordinating agency for the National Cooperative Soil Survey, is the primary source of information on soil properties and geologic formations within New England. The SCS also provides information on the general suitability for most kinds of crops grown within a specific area. In addition, Hill (6) has classified a number of Connecticut soils as to their wastewater renovation potential and suitability for land application.

Since many of the New England soils are generally categorized as either products of glacial action or outwash deposits of glacial meltwaters, technical reports on the general suitability of specific soils for land application in one state may be easily related to soils characteristics and suitability in the other New England states.

Key topographic features that affect land application suitability include: slope, relief and susceptibility to flooding. Excessive slopes encountered in New England increase surface run-off and erosion and may make crop cultivation difficult. Relief, or the difference in elevation between parts of a land application system, directly affect the cost of pumping wastewater to potential sites. Flood potential or the location of land application sites within flood plains can be either a benefit or a liability. On the one hand flood damage and uncertain drainage characteristics seem to preclude use, while delta formations and alluvial deposits may provide the only deep soil formations within a given area for land application of wastewater. The United States Geological Survey (USGS) is a primary source of information on hydrologic and topographic characteristics within the New England States. Also the Department of Housing and Urban Development (HUD) has completed a number of Flood Insurance Studies which delineate topographic features and flood boundaries within many of the communities in New England.

Geologic and groundwater characteristics which are important to the preliminary site selection process include: depth of soil above bedrock, discontinuities in the bedrock, fractured or crevassed bedrock (limestone, etc.) occurence of impervious layers (hardpan, etc.) or perched water tables, and the depth to the seasonal high groundwater table. Hardpan layers and perched groundwater at shallow depths are a fairly common occurence in the glacial tills of New England which significantly affect the feasibility and suitability of many sites for land application processes. Outwash sand deposits which may be suitable for rapid infiltration systems can be found along major river beds throughout New England but these same deposits are frequently also the primary groundwater resources for an area. The USGS and State Geological Surveys have completed studies and maps of key geologic and groundwater characteristics of many areas throughout New England which are readily available to the environmental planner.

D. Define Buffer Zone Requirements for Potential Land Application Sites

Buffer zones are usually provided around land application sites for aesthetic purposes and/or protection from pathogenic transmission via aerosols or run-off wastewater.

Although detailed information on prevailing wind direction, wind speed, down wind development, disinfection practices, irrigation system design and local and state regulations are normally used to determine final buffer zone requirements, the environmental planner should include an approximate allowance for buffer zones around the preliminary land application site locations under study. Typical values of buffer zones for land application sites in New England range from 200 to 400 feet.

E. Water Quality Standards and Discharge Limitations

In the case of the climatological conditions in New England (i.e., precipitation exceeds evapotranspiration), the two major receiving waterbodies for the effluent from land application systems are the groundwater and surface water environments. The quality of land application effluents must logically meet the prevailing discharge standards for each receiving waterbody if water quality goals are to be met. Table 4-3 presents a summary of current surface water discharge limitations for wastewater effluents and Table 4-4 contains effluent limitations for groundwater discharges. Although detailed analyses are required to determine if a given land application site can produce an effluent in compliance with specific water quality standards and discharge limitations, the following preliminary land application discharge criteria may be used in the initial site development procedure to generally evaluate potential sites for water quality suitability:

In general, all land application processes will produce an effluent of secondary quality suitable for discharge to major water courses.

TABLE 4-3

SURFACE WATER DISCHARGE LIMITATIONS FOR LAND APPLICATION SYSTEMS

I. "Water Quality Limiting" - Effluent discharge limitations to be determined by federal and state agencies.

II. "Effluent Limiting" - Effluent discharge to be at least secondary treatment level.

SECONDARY TREATMENT STANDARDS

Parameter	Average 30 Consecutive Days	Average 7 Consecutive Days
BOD_5 (mg/l)	30	45
Suspended Solids (mg/l)	30	45
Fecal Coliform (#/100 ml)	200	400
pH	6-9	6-9

TABLE 4-4

GROUNDWATER DISCHARGE LIMITATION FOR
LAND APPLICATION SYSTEMS

I. Permanent, groundwaters which result from land application effluents and can potentially be used for drinking water shall meet the National Interim Primary Drinking Water Regulations for organic and inorganic chemicals.

NATIONAL INTERIM PRIMARY DRINKING WATER REGULATIONS

Parameter	Maximum Level (mg/l)
Arsenic	0.05
Barium	1.0
Cadmium	0.01
Chromium	0.05
Copper	1.0
Iron	0.3
Lead	0.05
Manganese	0.05
Mercury	0.001
Nitrate (as N)	10.0
Nickel	No Standard
Selenium	0.01
Silver	0.05
Zinc	5.0

II. Permanent groundwaters which result from land application effluents and which will have uses other than drinking water will have standards established by the Regional Administrator of the EPA.

III. The provisions of the Clean Drinking Water Act prohibit any discharge to the groundwater which could potentially contaminate a "sole source" aquifer used for drinking water supplies.

Water quality limiting water courses of medium to small size are most probably suitable for spray (slow rate) irrigation and rapid infiltration discharges.

Small environmentally sensitive water bodies including Class A streams, lakes and groundwater aquifers most probably can receive effluents from spray (slow rate) irrigation systems which utilize harvested crops for maximum renovation of applied wastewater.

It should be emphasized that the above general screening criteria are only a tool which may be of use during the preliminary site identification procedure and should not be the basis for final exclusion of any given site.

F. Climatological Factors

An evaluation of climatic factors, such as precipitation, evapotranspiration, temperature and wind is used during the facilities planning effort to determine the water balance, length of growing season, down time of the land application system, storage requirements and quantity of stormwater to be expected. Since New England is generally characterized by long cold winters, warm summers and abundant precipitation where "changeability" is the major feature of each season, certain general climatological considerations can be incorporated in the preliminary site identificaiton and development procedure. In general, land application sites which utilize crop or plant uptake for wastewater renovation (i.e, spray irrigation, overland flow) will limit wastewater application to the growing season. Also, those processes which may be adversely affected by freezing must operate during the warmer periods of the year.

These climatological factors in essence require storage of wastewater during certain periods of the year with actual loading or treatment of wastewater occuring during suitable periods. The end result is higher wastewater or sludge loadings on potential sites than that which would be dictated by annual average flow rates. This effect and its impact on the evaluation of the land application alternative within the planning area will be covered in more detail in the following sections.

G. Construct a Composite Site Selection Map

The combined effects of land use, soils, topographic, geologic and hydrologic characteristics and water quality limitations of an area can be simply organized to determine the suitability of land application sites, on a preliminary basis, using three basic map overlaps as tools:

a. United States Geological Survey Quandrangle Maps

b. Soil Conservation Service Soil Maps

c. Land Use Maps

The first overlay, constructed from the USGS quadrangle map, will provide topographic, water resource and general location data. This overlay may also serve as a composite site selection and evaluation map on which other important land application suitability criteria can be consolidated, thus simplifying the subsequent facilities planning and environmental assessment procedures.

SCS soil surveys maps of the planning area will delineate the boundaries of various soil types giving general descriptions of texture and certain other physical, chemical and engineering properties of the parent soils. The soils map overlay can consolidate soils by major soils series or major soils groups.

Land use maps of a planning area include aerial photographs, zoning maps, USGS quadrangle maps and land use maps from regional and state planning agencies.

A grid system will normally prove useful in transfering data from the individual map overlaps to the composite site selection map.

4.313 Preliminary Development of Wastewater or Sludge Loading Rates

Wastewater or sludge quantities and quality must be accurately determined during the planning effort in order to fully assess the suitability and environmental impact of the land application disposal sites which have been previously identified. However, since both the quantity and quality of municipal wastewater and sludges can vary from location to location, an approximate estimate of the more significant items will be used in this initial assessment procedure. Table 4-5 and Table 4-6 contain a summary of the more important "typical" constituents in domestic wastewater and sludge respectively.

The relationship between wastewater or sludge applied to a given site and the probable degree of severity of potential environmental impacts are covered in the following sections.

TABLE 4-5
TYPICAL WASTEWATER QUALITY AND
QUANTITY CHARACTERISTICS
(Source: Reference 1, 5)

I. QUANTITY

Wastewater Flow - 100 gallons per day per capita

II. QUALITY

Constituent	Untreated Wastewater (mg/l)	Primary Effluents (mg/l)	Secondary Effluents (mg/l)
BOD_5	200	140	30
Suspended Solids	200	140	30
Total Nitrogen (as N)	40	35	30
Total Phosphorus (as P)	10	9	8
Arsenic	0.003	0.002	0.005-0.01
Cadmium	0.004-0.14	0.004-0.028	0.0002-0.02
Chromium	0.02-0.700	0.001-0.30	0.010-0.17
Copper	0.02-3.36	0.024-0.13	0.05-0.22
Iron	0.9-3.54	0.41-0.83	0.04-3.89
Lead	0.05-1.27	0.016-0.11	0.0005- 0.02
Manganese	0.11-0.14	0.032-0.16	0.021-0.38
Mercury	0.002-0.044	0.009-0.035	0.0005-0.0015
Nickel	0.002-0.105	0.063-0.20	0.10-0.149
Zinc	0.030-8.31	0.015-0.75	0.047-0.35

TABLE 4-6
TYPICAL SLUDGE QUALITY AND
QUANTITY CHARACTERISTICS
(Source: Reference 5, 7)

I. QUANTITY

SLUDGE GENERATED

Primary sedimentation - .125 lbs dry solids/capita/day
Biological secondary - .225 lbs dry solids/capita/day
Chemical precipitation - 0.330 lbs dry solids/capita/day

II. QUALITY

Sludge

Constituent	Range ($lb/10^6$ lb. dry solids)	"Typical" ($lb/10^6$ lb. dry solids)
Total Nitrogen (as N)	16,600-60,000	30,000
Total Phosphorus (as P)	6,600-17,600	11,000
Arsenic	10-50	10
Boran	200-1430	430
Barium	nd-3000	1500
Cadmium	nd-1100	90
Cobalt	nd-800	350
Chromium	22-30,000	1800
Copper	45-16,030	1250
Lead	80-26,000	2000
Manganese	100-8800	1200
Mercury	0.1-89	7
Nickel	nd-2800	410
Strontium	nd-2230	440
Selenium	10-180	26
Vanadium	nd-2100	510
Zinc	51-28,360	3500
Refractory Organics	nd	--
Patrogens	nd	--
Radioactive Substances	nd	--

4.32 Preliminary Identification of Potential Environmental Impacts

The second phase of the initial environmental assessment procedure requires a thorough listing of the potential environmental impacts of the land application alternatives. Table 4-7 can be used as a guide in developing and identifying these impacts (3). As was the case in initially identifying potential land application sites, the emphasis in the initial listing of potential environmental impacts should be to include as many impacts, both positive and negative as possible, leaving detailed judgments and evaluations for the later phases of the planning effort.

TABLE 4-7

POTENTIAL ENVIRONMENTAL IMPACTS FROM LAND APPLICATION OF WASTEWATER AND SLUDGE

MAJOR ENVIRONMENTAL IMPACT COMPONENTS	DESCRIPTION
A. Environmental Effects	
1. Soil	Changes in groundwater levels, drainage areas, local climate, organic/inorganic effects on soil hydraulic capacity, soil chemistry and toxic elements
2. Vegetation	Toxic effects, changes in groundwater levels, local climates, reduced growth due to hydraulic loadings or poor aeration
3. Groundwater	Effect groundwater levels, rate and direction of flow, changes in quality and build up of toxic contaminants
4. Air Quality	Formation of Aerosols and odors
5. Animal and Insect Life	Disrupt food chain, migratory routes and habitats of certain species, alter groundwater tables, encroach sites of rare and endangered species
6. Climate	Increase local hudidity and decrease temperature, changes in microclimate near application site
7. Surface Water	Increases or decreases in rates of flow, changes in water quality, change in drainage basin hydrological characteristics
8. Geologic Formations	Transmission of contaminants through bedrock discontinuity creation of discontinuity by percolating wastewater
B. Public Health Effects	
1. Groundwater	Build up of toxic contaminants, pathogens, heavy metals, reduction in quantity of potential drinking water supplies
2. Insects and Rodents	Contamination of insects (mosquitoes) and rodents from wastewater/sludge contaminants, breeding pathogenic vectors
3. Site Runoff	Contamination of populated areas
4. Aerosols and Odors	Transmission of pathogens in aerosols, odor effects on general health
5. Crops/Food Chain	Build up of toxic contaminants in the food chain via direct consumption or food chain intermediate (i.e. pigs, beef)
6. Noise and Traffic	Crop harvesting activities, primary and secondary growth effects, pretreatment facilities
7. Surface Water	Changes in quality and quantity of potential surface drinking water supplies
C. Social/Aesthetic Effects	
1. Land Use	Possible conflicts with surrounding land use: residential, commercial, industrial, recreational, urban, agricultural, wilderness and green belts
2. Community Growth	Increases in growth due to sewer system availability, decreases in growth due to resource or local services, committments
3. Relocation of Residents	Possible relocation of residential, commercial and farm buildings, schools, cemeteries and churches
4. Greenbelts/Open Space	Disruption of local scenic character, enhancement of local scenic character
5. Recreational Activities	Effects on wild and scenic rivers, archeological, historical and geological sites
D. Economic Effects	
1. Loss of Tax Revenues	Loss of taxable land as a result of governmental purchase
2. Land Devaluation	Change in value of land used or adjacent land
3. Energy Committment	Pretreatment facility, transmission of wastewater to application area, harvesting crops
4. Resource Committment	Land, chemicals, supplemental fertilization
5. Groundwater	Increase or decrease in quantity of groundater, change in quality of groundwater
6. Surface Water	Increase or decrease in quantity of surface water, change in quality of surface water
7. Revenues	Sales of crops, renovated water, irrigation water or leaseback of purchased land
E. Legal Effects	
1. Water Rights	Conflicts with Riparian, appropriative or combination water rights of natural watercourses, surface waters, percolating groundwater
2. Implementation Authority	Ability to purchase and use land application area, conflicting or overlapping political jurisdiction, public information and acceptance
3. Existing Regulations and Plans	Possible conflicts with comprehensive master plans, zoning, wastewater treatment regulations and standards

4.33 Early Assessment of the Probable Degree of Severity of Potential Environmental Impacts

As outlined in the previous sections, the land application alternative can include an extensive list of options and areas for investigation. In order to insure that sufficient efforts are focused on significant land application impacts at an early stage in the facilities planning/environmental assessment process, a systematic but flexible early warning system should be developed and used as a "tool" to optimize planning efforts rather than as an additional planning requirement.

The first step in the early warning procedure requires development of a single map of the planning area and adjacent communities with overlays of the following basic characteristics.

-- Location of preliminary land application sites and suitability by process type(s).

-- Approximate boundary of major developed areas by land use.

-- Location of surface and groundwater drinking water supplies and surface drainage divides.

-- Approximate downstream center of the wastewater collection system.

Secondly, establish preliminary wastewater quality and quantity projections and approximate loading on land application sites using the data in Tables 4-5 and 4-6 unless other information is readily available. A reasonable percent increase in population (such as 50%) can be assumed during the planning period for this initial assessment procedure. It should be emphasized that this initial population projection is for preliminary assessment procedures and that detailed projections of wastewater and sludge quantities will be performed during the facilities planning effort. Major industrial or commercial wastewater loadings must be included even if extremely rough estimates are used. Wastewater pollutant and hydraulic loadings on land application sites in New England can be roughly approximated by using a hydraulic loading factor (H.L.F.) as described below:

H.L.F. = Wastewater Applied/Unit average daily flow equivalent loading of application site.

A. Wastewater Applied

-- Spray Irrigation

-- Overland Flow

-- Rapid Infiltration

} = Annual Average daily flow rate

B. Unit Average Daily Flow Equivalent of the Application Site

The equivalent hydraulic capacity, in terms of the annual average daily flow, of the application site area if wastewater was applied at 1 inch per week during the application period.

Spray (slow rate) irrigation, 6 month application period - 1940 gpd/acre

Overland Flow, 6 month application period - 1940 gpd/acre

Rapid Infiltration, 12 month application period - 3880 gpd/acre

Adjustments to the unit average daily flow equivalent values can be easily made to account for shorter application periods (i.e., specific crop growing seasons, state requirements etc.) by using the following relation.

Unit Average Daily Flow Equivalent = $A \times \frac{B}{26}$ where:

A = Unit Average Daily Flow Equivalent for a 6 month (26 week) application period (i.e. 1940 gpd/acre).

B = Assumed application period in weeks

Table 4-8 was developed on an approximate guide in relating environmental impact components to the H.L.F. Environmental impact identification factors, in Table 4-8 indicate increasing degree of adversity of the various impacts on a scale from 1 to 3 with "+" or "-" for emphasis. Beneficial impacts are indicatd with a value of 1.

It should be noted that the H.L.F. is essentially the application rate in inches per week which would be required on a specific site area to dispose of hydraulically the average daily wastewater flow from a given community. A similar relation for sludge loading of a land application site can also be developed, perhaps in terms of a solids loading factor (S.L.F.) in which annual application of sludge in tons of solids per acre per year is calculated for each potential site and from which another set of environmental impact identification factors can be assessed. It should also be emphasized again that the early warning rating system is basically a subjective tool and not a substitute for detailed facilities planning analyses. As such, the environmental planner may modify the basic procedure as he feels necessary to more accurately reflect actual conditions in a given planning area. The results of this procedure, however, will both highlight potential environmental impacts early in the facilities planning stages of evaluating land application alternatives as well as provide direction to optimize the subsequent planning efforts.

TABLE 4-8

EARLY ENVIRONMENTAL IMPACT IDENTIFICATION FACTORS*
FOR REGION 1 - NEW ENGLAND

Major Environmental Impact Components	Spray Irrigation (Slow Rate)			Overland Flow			Rapid Infiltration		
	H.L.F. ≤ 1	H.L.F. 1-4	H.L.F. ≥ 4	H.L.F. < 5	H.L.F. 5-10	H.L.F. > 10	H.L.F. ≤ 20	H.L.F. 20-40	H.L.F. > 40
A. Environmental Effects									
1. Soil	1	2	3	1	1	2	2	2	3+
2. Vegetation	1	2	3	1	2	3	1	1	1
3. Groundwater	1	2	3	1	1	1	2	3	3
4. Air Quality	2	2	3	1	1	2	1	1	2
5. Animal and Insect Life	2	2	3	2	2	2	1	1	2
6. Climate	1	1	2	1	1	1	1	1	1
7. Surface Water	1	1	2	3	3	3+	1	1	1
8. Geologic Formations	2	2	3	1	1	1	2	2	3
B. Public Health Effects									
1. Groundwater	2	2	3	1	1	1	2	3	3+
2. Insects and Rodents	2	2	3	2	2	3	1	2	3
3. Site Run-off*	1	1	2	2	3	3+	1	1	1
4. Aerosols and Odors	2	3	3+	1	2	2	1	1	2
5. Crops/Food Chain	2	2	3	2	2	2	1	1	1
6. Noise and Traffic	2	2	3	2	2	3	2	2	3
7. Surface Water	1	2	3	3	3	3	2	2	2
C. Social/Aesthetic Effects									
1. Land Use	3	2	2	2	3	3	1	2	2
2. Community Growth	2	2	3	2	2	3	2	2	3
3. Relocation of Residents	2	2	2	2	2	2	1	1	2
4. Greenbelts/Open Space	2	2	2	2	2	2	2	2	2
5. Recreational Activities	2+	2+	2+	2+	2+	2+	1	1	2
D. Economic Effects									
1. Loss of Tax Revenues	2+	2+	2+	2	2	2	1	1	1
2. Land Devaluation	2	2	3	2	2	2	2	2	2
3. Energy Commitment	2	2	3	2	2	3	2	2	2
4. Resource Commitment	2	2	3	2	2	3	2	2	2
5. Groundwater	2	2	3	1	1	1	2	3	3
6. Surface Water	1	2	2	2	3	3	1	2	2
7. Revenues	1	1	1	1	1	1	2	2	2
E. Legal Effects									
1. Water Rights	3	3	3	2	3	3	3	3	3
2. Implementation Authority	2	2	3	2	3	3	2	3	3
3. Existing Regulation and Plans	2	2	2	2	2	2	2	2	2

* Rating values will vary with socio economic and site location factors. Environmental impact identification factors indicate increasing degree of adversity from 1 to 3 with + or - added for emphasis. Beneficial impacts are indicated with a value of 1.

TABLE 4-9

(SOURCE: REFERENCE 2

INFORMATION NEEDS AND SOURCES FOR
LAND APPLICATION OF WASTEWATER

INFORMATION NEEDS \ INFORMATION SOURCE	LOCAL					COUNTY					STATE						REGIONAL					
	Consultants	Municipal/Community Planning	Chamber of Commerce	NOAA, U.S. Weather Station	Library	Agricultural Extension Service	County Planning	Public Health	Assessor	U.S. Soil Conservation Service	Environmental Protection and/or Public Health	Historical Society	State Geological Survey	State Div. or Dept. of Water Resources	State University Extension Specialists	State Planning Office	Corps of Engineers	U.S. Forest Service	U.S. Geological Survey	USDA, Agricultural Research Service	U.S. Environmental Protection Agency	Planning Agency (COG, River Basin Resource Management Districts)
Climatic Data				●		●									●							
Soil Classification - Mapping	●	●					●			●												
Soil Infiltration-Permeability	●					●				●					●					●		
Soil Depth 0 - 5 Feet										●												
Soil Drainage & Water Table < 5 Feet										●												
Soil Properties (Chemical & Physical)	●					●				●					●							
Agricultural Land Use Capability	●	●				●	●			●												
Depth to Bedrock										●			●						●			
Unconsolidated Materials													●						●			
Bedrock Type & Structural Characteristics													●						●			
Jointing & Permeability of Rock	●												●	●					●			
Rock Outcrops										●			●						●			
Surface Slope, Categories (ex. 0 - 3%)										●									●			
Flood Plain, Flood Hazard	●	●					●							●			●		●			
Streamflows														●					●			●
Ground Water Yield	●												●	●					●			●
Ground Water Elevation & Contours	●												●	●					●			
Ground Water Aquifers	●						●						●	●					●			●
Irrigation Methods	●					●				●					●					●		
Crops	●					●				●					●			●		●		
Interpretation of Soil Suitability	●					●				●					●					●		
Interpretation of Ground Water	●												●	●					●			
Land Use		●					●		●							●						●
Land Values	●	●	●			●	●		●													●
Guidelines for Land Application	●							●			●						●				●	
Sensitive Environmental Areas	●	●					●				●	●				●					●	●
Socioeconomic Factors	●	●	●				●		●							●						●
Institutions (any organization)			●		●		●							●		●						●
Aesthetics		●			●		●															
Biota	●	●			●		●															●

4.34 Measures to Resolve Environmental Impacts

Once the relative probable degree of severity of land application environmental impacts has been rated, the subsequent planning efforts can focus on those deemed most severe. Data needs and sources for the various impact components are given in Table 4-9. In addition, specific references in the Appendix are cited which contain additional information on the various impact components. In some cases, however, the results of the preceding early identification procedure will indicate the need for an increase in the scope of the facilities planning effort or the need for a concurrent environmental impact statement (EIS) analysis to successfully resolve any environmental, public health or socioeconomic issues which were noted during the preliminary evaluation of the land application alternatives. The following hypothetical case study will demonstrate the use of the early warning procedure described on the foregoing pages.

4.4 CASE STUDY

4.41 Case Description

Tinkersville, New England is a rapidly growing town in the northeast section of the state. The town is currently under federal and state orders to cease raw sewage discharges to the Green River. Also, since the Green River eventually flows into Lake Olga, a eutrophic waterbody which is presently experiencing seasonal algal blooms, wastewater treatment requirements include removal of nitrogen and/or phosphorus. Land application, therefore, is considered a viable wastewater treatment alternative as are the various modes of the activated sludge process. Land application of sludge from the activated sludge alternatives will also be considered in the facilities planning work. Key environmental, socioeconomic and geographical features of the planning area are shown in Figure 4-3 and briefly described below.

4.411 Population and Wastewater Flows

Tinkersville has a current population of 15,000 people. The major employer in town is Nutrient Products, Inc., an industry which will discharge approximately 0.2 million gallons per day (MGD) of nitrogen-laden process wastewater to the new collection system.

4.412 Water Quality and Discharge Standards

The Green River is a Class B waterbody and effluent limiting. Pleasant Lake, a hydroelectric water storage reservoir, is owned by Tinkersville Utilities and is classified as a

Class A waterbody (no wastewater discharges allowed). Water supply to Pleasant Lake is by tributary streams and natural groundwater inflow. A number of small streams and brooks characterize the northeast section of town and are considered Class A waterbodies. Major water resources include a groundwater aquifer in the southern part of town and a regional surface water supply reservoir in the northern section. The northern drainage basins are potential future water supplies.

4.413 Geographical and Legal Considerations

A regional water supply authority owns and operates the water supply reservoirs within the town boundaries. Tinkersville Utilities owns water rights to Pleasant Lake for hydroelectric power.

4.42 Environmental Assessment Procedures

A preliminary map overlay of the planning area was developed according to the early impact identification procedure described in the previous section and is also shown in Figure 4-3. Potential land application sites, drainage divides and the approximate downstream center point of wastewater collection are shown as are radial distances to potential land application sites. Preliminary wastewater flow projections are given below:

Design Flow - 10,000 x (1.5)* x 100 gpd/capita = 1.5 MGD

*Population Increase of 50% Assumed

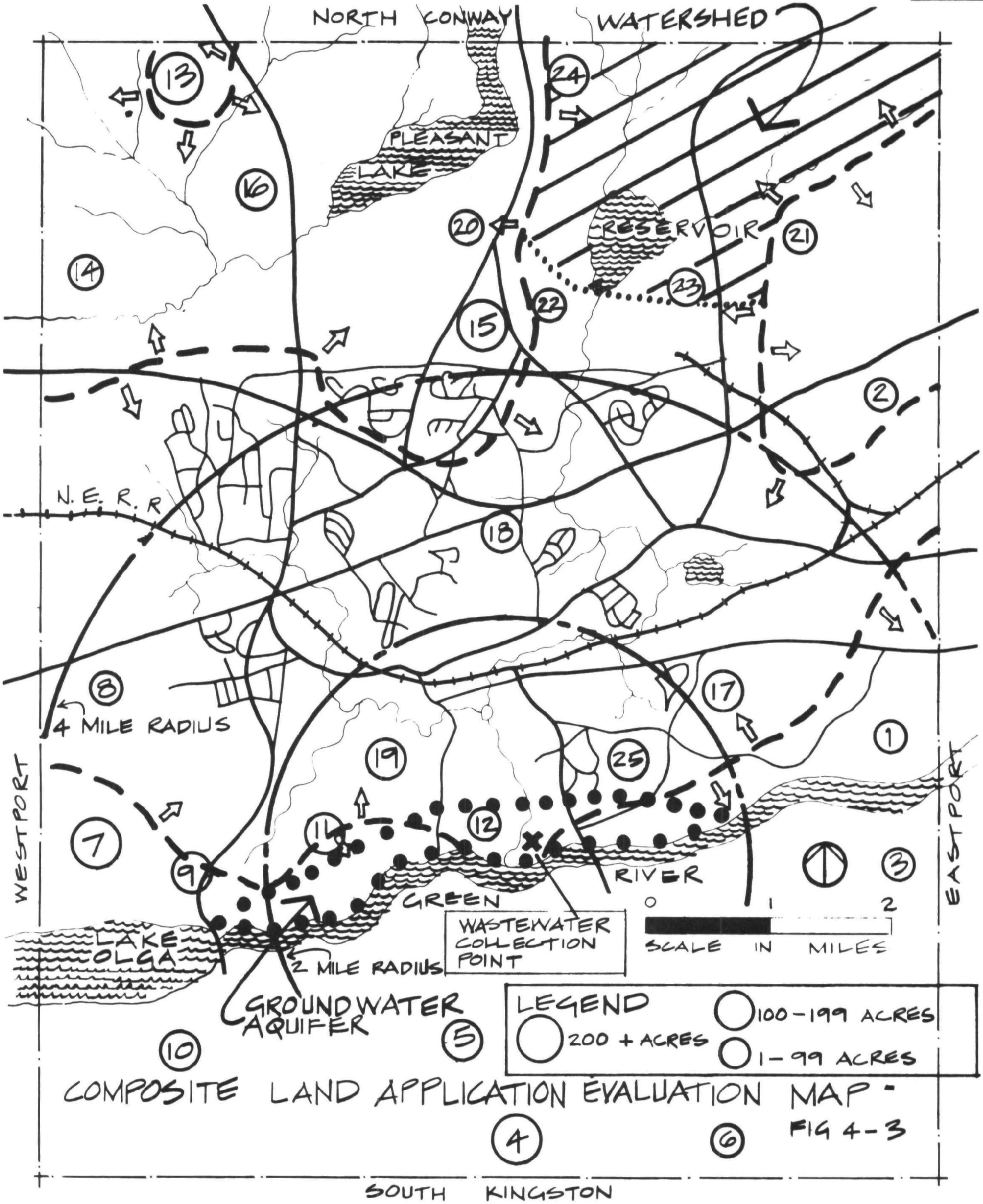
Major Industrial Flow = 0.2 MGD

Total Annual Average Daily Flow = 1.7 MGD

An early warning impact rating of each potential site within the georgraphical boundaries of Tinkersville is shown in Table 4-10.

Using site No. 4 as an example the table values were determined as follows:

a. Area - 200 acres
b. Process Suitability - Spray Irrigation (slope, soils)
c. Hydraulic loading factor (H.L.F.)
   H.L.F. - Wastewater applied/unit average daily flow equivalent loading of application site



COMPOSITE LAND APPLICATION EVALUATION MAP - FIG 4-3

$$H.L.F. = 1.7 \text{ MGD} \times 10^{6} / (1940 \text{ gpd/ac.}) (200 \text{ AC}) = 4.4$$

Site No. 4 is a moderately high hydraulically loaded site, far distant from the main wastewater collection area, surrounded by small brooks and streams of excellent quality. The site will recharge percolating groundwater outside of the drainage basin of the existing ground water supply.

The results of the environmental impact early warning procedure, as shown in Table 4-10, for all the sites identified in Tinkersville, highlights the following preliminary assessment components as having potentially severe impacts worthy of detailed study during the facilities planning effort.

A. Environmental Effects

Soil - high wastewater loadings
Vegetation - high wastewater loadings
Groundwater - increased levels, changes in basin and directed flow
Air Quality - Aerosols and odors
Surface Waters - Class A stream discharge standards

B. Public Health

Groundwater - drinking water supplies
Insects and Rodents - high wastewater loadings
Surface water - existing and future drinking water supplies

C. Social and Aesthetic

Land Use - urban areas, abutting states and towns
Community growth - potentials to accelerate and retard growth with various sites

D. Economic effects

Loss of Tax Revenues - high community land values
Energy Commitment - remote sites, high energy demanding pumping requirements

E. Legal

Water Rights - land application sites will change water balance in potable groundwater supply drainage basins. Abutting towns and states surface waters.

Implementation Authority - Abutting towns near highly developed areas.

4.43 Future Study Areas and Methods to Resolve Potentially Severe Environmental Impacts

The results of the environmental impact early warning procedure (Phase 1) shown in Table 4-10 indicate the major study areas which should be focused on during the detailed environmental assessment/facilities planning efforts (Phase 2) for Tinkersville, New England. In addition, the results of the procedure also indicate, on a preliminary basis, that rapid infiltration sites 16 and 17 and spray irrigation site 7 are the most promising land application alternatives to be investigated. In order to fully evaluate sites 7 and 17, a comprehensive and detailed wastewater and soils renovation analysis will most likely be required to insure protection of the groundwater aquifer to the south. A similar effort is indicated for site 16 to insure protection of the small Class A streams and future surface water supplies. Energy demands and operational costs are also highlighted at site 16.

The extent and degree of detail to which these study efforts are employed may require an amendment to the existing facilities planning engineering contract or implementation of a concurrent environmental impact statement (EIS) to resolve adequately the major socio-economic or technical issues involved. In either event, the environmental planner has the basic tools for early environmental impact assessments of land application systems for a given area and firm guidelines to assist in judging the most environmentally productive directions in which these additional efforts should proceed.

TABLE 4-10

SUMMARY OF ENVIRONMENTAL IMPACT EARLY WARNING

INDICATORS FOR TINKERSVILLE

Site I.D.	Acres	Suitability	SI OF	RI	ENVIRONMENTAL IMPACT COMPONENTS (A) Environmental 1 2 3 4 5 6 7 8	(B) Public Health 1 2 3 4 5 6 7	(C) Social Aesthetic 1 2 3 4 5	(D) Economic Effects 1 2 3 4 5 6 7	(E) Legal 1 2 3
1	70	SI	12.5		3+ 3+ 3 3 2 2 2+ 3	3 3 2+ 3 3 2 3+	2 3+ 2 2 2	2 2 3+ 2+ 2 3+ 1	3+ 3+ 2
2	65	SI	13.5		3+ 3+ 3 3 2 2 2+ 3	3 3 2+ 3 3 2 3+	2 3+ 2 2 2	2 2 3+ 2+ 2 3+ 1	3+ 3+ 2
3	50	SI	17.5		3+ 3+ 3+ 3 2 2 2+ 3	3 3 2+ 3 3 2 3	2 3+ 2 2 2	2 2 3+ 2+ 2 3+ 1	3+ 3+ 2
4	200	SI	4.4		2+ 2+ 3 3 2 2 2+ 2+	3 2 2+ 2+ 2+ 2 3	2 2 2 1 2+	2+ 2 3+ 2+ 2 3+ 1	3+ 3+ 2
5	120	OF	7.3		2 2 1 1 2 1 3+ 1	1 2 3+ 2 2 2 3+	2 2 2 2 2+	2+ 2 3+ 2+ 1 3+ 1	3 3+ 2
6	60	SI	14.6		3+ 3+ 3 3 2 2 2+ 3	3 3 2+ 3 3 2 3+	2 3+ 2 2 2	2 2 3+ 2+ 2 3+ 1	3+ 3+ 2
7	312	SI	2.8		2 2 2 2 2 1 1+ 2	2 2 1 3 2 2 2	2+ 2 2+ 2 2+	3 2+ 3+ 2 2 2+ 1	3 2+ 2
8	90	OF	9.7		2 2 1 1 2 1 3 1	1 2 3+ 2 2 2 3+	2+ 2 2 2 2+	2+ 2 3+ 2+ 1 3+ 1	3 3 2
9	100	SI	8.7		3+ 3+ 3 3 2 2 2+ 3	3 3 2+ 3 3 2 3+	2 3+ 2 2 2	2 2 3+ 2+ 2 3+ 1	3+ 3+ 2
10	80	OF	11.0		2 3 1+ 2+ 2 1+ 3+ 1+	2 3+ 3++ 3 2 3 3+	3 3 2 2+ 2+	2 3 3+ 3 1+ 3++ 1	3 3 2
11	110	OF	8.0		2 3 1 2+ 2 1+ 3++ 1+	2 3+ 3++ 3 2 3 3++	3+ 3+ 2+ 2+ 2+	2 3 3+ 3 1+ 3++ 1	3 3+ 2
12	90	OF	9.7		2 3 1 2+ 2 1+ 3++ 1+	2 3+ 3++ 3 2 3 3++	3+ 3+ 2+ 2+ 2+	2 3 3 3 1 3 1	3 3+ 2
13	220	SI	3.9		2+ 2+ 3 3 2 2 2+ 2+	3 2 2+ 2+ 2+ 2 3	2 2 2 1 2+	2+ 2 3+ 2+ 2 3+ 1	3 3 2
14	70	SI	12.5		3+ 3+ 3 3 2 2 2+ 3	3 3 2+ 3 3 2 3+	2+ 3+ 2 2 2	2 2 3+ 2+ 2 3+ 1	3 2 2
15	275	SI	3.2		2+ 2+ 2+ 2+ 2+ 1+ 1+ 2	2+ 3 2 3+ 2+ 2 2+	3+ 3 3+ 2 2+	3 3+ 3 2 2+ 2+ 1	3 3++ 3
16	150	R.I.		2.9	2 1 2 1 1 1 2 2	2 1 1 1 1 2 2	2 2 1 1 2	2+ 2+ 3+ 2 2+ 1+ 2	3 2+ 2+
17	160	R.I.		2.7	2 1 2 1 1 1 2 2	2 1 1 1 1 2 2	2 2 1 1 2	2+ 2+ 2 2 2+ 1+ 2	3 2+ 2+
18	140	OF	6.3		1+ 2 1 2 2 1 3 1	1 2+ 3+ 2+ 2 2 3+	3+ 2 3 2 2+	3+ 3 1 2 1 3 1	3+ 3++ 2+
19	120	SI	7.3		3+ 3+ 3+ 3+ 3+ 2+ 2+ 3+	3+ 3+ 2+ 3+ 3+ 3+ 3+	3 3 3+ 2 2+	3+ 3+ 2 2 3+ 2+ 1	2 3+ 3
20	80	SI	10.9		3+ 3+ 3+ 3+ 3+ 2+ 2+ 3+	3+ 3+ 2+ 3+ 3+ 3+ 3+	3 3 3+ 2 2+	3 3 2 2 3 2 1	3 3 3
21	65	SI	13.5		3 3 3 3 2+ 2 2+ 3	3 3 2+ 3 3 2 3+	2 3+ 2 2 2	2 2 3+ 2+ 2 3+ 1	2 3+ 2+
22	40	SI	22		3+ 3+ 3+ 3 2+ 2+ 2+ 3	3 3 3 3 3 3 3+	3 3 3 3 3	2+ 3 2+ 2+ 3 3+ 1+	3 3+ 2+
23	150	RI		2.9	2 1 3 1 1 1 2 2	2 1 1 1 1 2 2	2 2 1 1 2	2 2 3 2 2 1 2	3 3 3
24	160	SI	5.5		3 3 3 3 3 2 2 3	3 3 2 3 3 3 3	3 3 2+ 2+ 3	3 3 3 3 3 2 1	3 3+ 2+
25	120	SI	7.3		3 3 3+ 3+ 2 2+ 2+ 3+	3+ 3 2+ 3+ 3 3 2+	3 3 3 3 3	3 3 2+ 3 3+ 2 1	3 3+ 2+
PRELIMINARY MAJOR IMPACTS					* * * * (1–4), * (7)	* * (1–2), * (7)	* * (1–2)	* (1), * (3)	* * (1–2)

* SI - Spray Irrigation
OF - Overland Flow
RI - Rapid Infiltration

4.44 Level of Effort

In order for the environmental planner to properly evaluate the land application alternative for a given community, adequate budgets should be established for both the facilities planning elements as well as the concurrent environmental assessment efforts. Also, New England (Region 1) poses unique budget requirements for the evaluation of land application alternatives particularly with regard to site specific characteristics including soil, groundwater and bedrock conditions.

Table 4-11 was developed to emphasize the relationship, in terms of manpower and resource commitment, between the Phase 1, preliminary development of land application alternatives and the subsequent Phase 2, detailed evaluations of specific sites. The range of values shown in Table 4-11, roughly corresponds to communities with sewered populations of less than 1000 to greater than 30,000 for the Phase 1 tasks as well as Phase 2, detailed sited investigations for application areas of less than 50 acres and land treatment processes without storage to application areas of 500 acres, utilizing processes that do require wastewater storage. It should be noted that any given site chosen for Phase 2 evaluation may not require all the tasks indicated in Table 4-11 and conversely other sites within a given study area may require additional study efforts. In any case the environmental planner must include sufficient levels of efforts in evaluating the land application alternative to define both the technical and environmental feasibility of the land application alternative as well as its viability as practical wastewater treatment alternative.

TABLE 4-11
CONSULTANT AND SUBCONTRACTOR MANPOWER COMMITMENT
FOR THE EVALUATION OF THE LAND APPLICATION ALTERNATIVE

ITEM	FACILITIES PLANNING BUDGET	ENVIRONMENTAL ASSESSMENT BUDGET
Phase 1, Preliminary Site Screening and Development	10-20 man days	5-10 man days
*Phase 2, Detailed Site Evaluations: Surveys; Borings; Cadastral; Quantify Wastewater Characteristics; Soils Mapping; Groundwater Mapping; Bedrock Mapping; Soils Renovation Capacity; Soils Hydraulic Capacity; Report; Public Hearing	230-1400 man days	30-110 man days

*Includes an approximate range of manpower effort to completely evaluate a single site

REFERENCES

1. "Process Design Manual for Land Treatment of Municipal Wastewater", U.S. Environmental Protection Agency, U.S. Army Corps of Engineers, U.S. Department of Agriculture EPA 625/1-77008 (COE1110-1-501) October 1977.

2. "Design Seminar for Land Treatment of Municipal Wastewater Effluents - Design Factors, Part II", U.S. Environmental Protection Agency, September 1975.

3. "Evaluation of Land Application Systems", U.S. Environmental Protection Agency, Office of Water Program Operations, Technical Bulletin EPA 430/9-75-001, March 1975.

4. "Wastewater Treatment and Reuse by Land Application - Volume II", U.S. Environmental Protection Agency, Office of Research and Development, EPA-660/2-73-006b, August 1973.

5. "Wastewater Engineering, Collection, Treatment and Disposal", Metcalf & Eddy, Inc., McGraw-Hill Book Company, New York, New York, 1972.

6. Hill, David E., "Evaluation of Wastewater Renovation Potential in Litchfield County Soils", Connecticut Agricultural Experiment Station, New Haven, Special Bulletin Soils 32.

7. "Municipal Sludge Management: EPA Construction Grants Program - An Overview of the Sludge Management Situations", U.S. Environmental Protection Agency EPA-430/9-76-009, April, 1976.

environmental assessment manual

secondary impacts

5. secondary impacts

CHAPTER 5 - SECONDARY IMPACTS

CHAPTER 5 SECONDARY IMPACTS

5.0 INTRODUCTION

The environmental assessment process for wastewater collection and treatment facilities involves an evaluation of both primary and secondary impacts. EPA's Rules and Regulations for the Preparation of Environmental Impact Statements (April 14, 1975) define primary and secondary impacts as follows:

-- Primary Impacts

Primary impacts are those that can be attributed directly to the proposed action. If the action is a field experiment, materials introduced into the environment which might damage certain plant communities or wildlife species would be a primary impact. If the action involves construction of a facility, such as a sewage treatment works, an office building or a laboratory, the primary impacts of the action would include the environmental impacts related to construction and operation of the facility and land use changes at the facility site.

-- Secondary Impact

Secondary impacts are indirect or induced changes. If the action involves construction of a facility, the impacts would include the environmental impacts related to:

Induced changes in the pattern of land use, population density and related effects on air or water quality or other natural resources.

Increased growth at a faster rate than planned for or above the total level planned by the existing community.

The distinction between primary and secondary impacts is clearly stated in the previous definitions. A major difference between the two, as stated in EPA's Program Guidance Memorandum #50 is "Secondary effects can be of great importance to the environment but normally are much more difficult to predict in advance than primary impacts".

It should be pointed out that a secondary impact is accompanied by an impact, either positive or negative, in another area. That is, induced growth in one area takes the place of growth that would have occurred elsewhere. Sewers do not create growth, they only influence the geographic distribution of development in a given economic area.

This chapter of the manual will provide guidance in practical ways to predict induced changes or increased growth as part of the environmental assessment process for wastewater facility planning.

5.1 REGULATORY STATUS

The following legislation and regulations apply to the evaluation of secondary impacts:

5.11 Federal Regulations/Guidelines (EPA)*

5.111 Guidance for Preparing a Facility Plan EPA/MCD-46, (May 1975)

5.112 Program Guidance Memo No. 50, Consideration of Secondary Environmental Effects in the Construction Grants Process (June 1975)

5.113 Land Use and New England's Environment, Region 1 EPA (1975). Strong statement regarding evaluation and protection of New England environment.

5.114 Guides to Environmental Planning, Assessments and Impact Statements for Water Quality Management Plans and Municipal Wastewater Treatment Projects, Region 1, EPA, Revised August 1975.

5.115 EPA Policy on Secondary Impacts

The essential document covering EPA's policy on secondary impacts is Program Guidance Memorandum 50. The major provisions of this memorandum may be summarized as follows:

A. Localities must identify and assess potential secondary impacts as an integral part of the Step 1 facilities planning process, using "best available data and analytical techniques."

B. The critical determination is whether or not any potential secondary impacts will result in contravention of any existing Federal, state or local environmental law or regulation, or any plan or standard required by such laws or regulations.

*NOTE: Many of the Federal regulations cited elsewhere in this manual have application to secondary impacts.

C. Where secondary impacts resulting from a wastewater treatment facility "can reasonably be anticipated" to contravene an environmental law or regulation, plan or standard, the EPA Regional Administrator shall withhold approval of Step 2 or Step 3 construction grants until the local applicant either (a) revises the Step 1 facilities plan, (b) initiates steps to mitigate the adverse effects, or (c) agrees to special grant conditions requiring actions to minimize the effects. Furthermore, the locality must demonstrate "good faith" and be "clearly moving toward proper mitigative action" before a Step 2 grant is awarded.

D. Any special grant conditions imposed by the EPA Regional Administrator must be "reasonable", and the local applicant must possess the requisite authority to fulfill the conditions.

E. EPA follow-up of grantee compliance with any special conditions is required once the Step 2 grant is awarded. If an applicant fails to abide by grant agreement conditions, the Regional Administrator may take a number of actions, including:

- withholding grant payments
- refusing to process subsequent grant applications from the locality
- refusing to approve grants for future phases of the same project
- entering an injunction against the grantee
- suspending all work on the project
- terminating the grant and recovering unexpended EPA funds

5.12 State/Local Legislation

Each New England State has a variety of environmental or environmentally related legislation. Specific legislation relating to secondary impacts are discussed in the related chapters of this manual. The preparation of an environmental assessment in accordance with EPA's requirements should satisfy most state or local regulations concerning secondary impacts.

5.2 PAST PRACTICE

In 1974 Urban Systems Research and Engineering, Inc., under contract to the Council of Environmental Quality, prepared a two volume study entitled "Interceptor Sewers and Suburban Sprawl: The Impact of Construction Grants on Residential Land Use." Their conclusions after studying a number of assessments were as follows:

"In most of the projects studied, the assessment of the environmental impact of the interceptors was inadequate. In only a few instances were Environmental Impact Statements prepared--in the vast majority of projects a negative declaration was made on the basis of a superficial environmental impact assessment prepared by project engineers. In most cases, the engineers disregarded all secondary land use effects in this assessment in order to enable EPA to render a negative declaration of environmental impact. Even in those few instances where EPA prepared an Environmental Impact Statement, adverse secondary impacts were given scant consideration, and appeared to have no influence over EPA's decision to fund the project."

As a result of the issuance of Program Guidance Memorandum 50 and other EPA regulations and reports subsequent to 1974, more attention has been given to the consideration of secondary impacts in the environmental assessment process. On the whole, however, the results have been uneven.

Where growth related issues are of local concern the assessment process has given limited attention to the changes to be induced by a wastewater facility. Where these concerns are not raised or the implications of sizing the facility or pipe are not perceived as controversial by the local community, secondary impacts generally are given lip service in the assessment.

There appears to be a need to even out the process so that good professional judgment rather than the sophisticated nature of the community become criteria for a thorough evaluation of secondary impacts.

A key constraint in the past has been the limited funds which many of the New England states have authorized for environmental assessments during the Step 1 facility planning. Over the past 5 years the average fee for preparing an EA ranged between $2,000 and $10,000. It is safe to assume that less than 10 per cent of these amounts covered secondary impact evaluations.

The major corrective measures proposed are:

A. More adequate funding for EA's. (This now appears to be taking place.)

B. The use of sound and uncomplicated methodologies which allow the identification of secondary impacts and their quantification.

C. The development of procedures which will allow early identification of significant secondary environmental impacts warranting a switch to a "piggyback" EIS.

5.3 SUGGESTED METHODOLOGY

The purpose of this section of the manual is to provide overall guidance in assessing the secondary impacts of wastewater treatment or collection facilities to be constructed using funds under the Water Pollution Control Act Amendments of 1972. Although this section is directed at a wide range of projects, it of necessity focuses on the typical community situation to be faced by a consulting engineer, planner or state or Federal official in New England. In general these fall into the following categories:

-- A suburban community in a metropolitan area with its own existing or proposed collection and treatment system or its own existing or proposed collection system with treatment in adjoining communities.

-- A small or moderately sized town or city which is located outside a metropolitan area with its own existing or proposed collection and treatment system or its own existing or proposed collection system with treatment in adjoining communities.

The secondary assessment techniques discussed herein are not directed at the large regional treatment facilities or trunk sewers which may be constructed in a major metropolitan area. For the most part such facilities will require the preparation of an Environmental Impact Statement and generally will not be evaluated at the Environmental Assessment level.

5.31 Facilities With Potential For Secondary Impacts

The following types of facilities and/or environmental conditions generally will have the potential to generate secondary impacts:

-- Construction of a new or expanded treatment facility to serve, or with a potential through expansion to serve sewering needs in excess of needs generated by present development within the service area.

-- Construction of or replacement of collection facilities to serve or with a potential to serve, due to under-utilized capacity or extensions, areas where development presently is constrained by topography, soil conditions, sewer moratoria, zoning, or local or state regulations requiring sewers.

-- Construction of collection or treatment facilities to serve areas adjacent to or including sensitive areas such as wetlands, water bodies, ground water recharge areas, flood prone areas, archaeological or historic sites and prime agricultural lands.

As a general rule of thumb it can be concluded that most collection systems have a capacity to induce growth.

Facilities such as the following generally have limited potential for generating secondary impacts:

-- Upgrading of treatment facility from primary to secondary or advanced treatment.

5.32 Step by Step Incremental Analysis

The procedures outlined below represent a general methodology that can be utilized by the engineer, planner or environmentalist in predicting the induced changes or induced growth that can be anticipated from the construction of a wastewater facility. Several overall guidelines are in order at the outset. They are:

-- The proposed procedures do not represent an EPA Region 1 policy in the evaluation of secondary impacts.

-- The reader must check to determine if Program Requirements Memoranda issued after the effective date of this manual would alter any of the procedures.

-- The determination of induced growth is not a science. It relys heavily upon good professional judgments utilizing readily available information.

-- The procedures require the utilization of simple mapping techniques and require contact with individuals and agencies concerned with and, knowledgeable in an area's growth and development.

5.321 Step 1, Describe Facility Alternatives.

For each proposed treatment or collection alternative the following information is required:

-- Description of proposed treatment facility and its expansion potential.

-- Description of and a map overlay (on USGS or other comparable base maps being used in planning) showing interceptor and collector sewer system and existing and future service area of the collection system.

Answer the following questions:

-- Does the proposed or potentially expandable treatment facility have the capacity to serve needs in excess of needs generated by present development within the service area?

-- Does the proposed or potentially extendable collection system have the capacity to serve needs and/or areas where development is constrained by the lack of sewers?

-- Do the proposed or expanded service areas include or abut sensitive environmental areas such as wetlands, flood plains, reservoir watersheds or prime agricultural lands?

A yes answer to any of the above questions would indicate a potential for secondary impacts.

A no answer to all of the above questions would indicate the impacts are primary in nature and the subsequent steps described below need not be performed.

5.322 Step 2, Determine "Prime Area" of Potential Secondary Impacts.

The "prime area" of potential secondary impacts is defined to include the proposed service area of the facility alternative and such competing areas within a larger economic area from which growth may be attracted because of the facility.

The actual delineation of a "prime area" of potential secondary impacts calls for a combination of good judgment and common sense. There is no single scientific methodology which can be used as every area will have its own unique characteristics.

Step 2, therefore, will generally be accomplished by following the procedures outlined below:

-- Review USGS maps, topography constraints, land use patterns, recent construction trends and local or regional planning studies and regulations to form a general opinion of how the area has grown and how it might be expected to grow in future.

-- Talk with local developers, realtors, businessmen, and newspaper publishers to obtain their opinions on any potential redistribution of private investment activities as a result of a facility alternative.

-- Talk with local and regional planning agencies. Virtually the entire New England area is covered by and served by a regional planning agency. These agencies, due to their regional perspective, can provide valuable assistance in defining the overall economic growth area for a particular community and the prime area of potential secondary impacts.

-- Use USGS or similar maps of the subject community or communities, and such adjoining communities as may reasonably be considered to be within the same market area for development, to show prime areas suggested by information review and interviews.

-- Using a series of overlays or various colored pencils on a print of the maps being used, develop a general concensus line which represents the assessors best judgement of a "prime area" of potential secondary impacts.

The following guidelines are suggested:

-- Wherever possible the prime area delineations should be coterminous with municipal boundaries. This will facilitate the review of population and building trends as called for in subsequent steps.

-- In many regions, particularly within an SMSA (Standard Metropolitan Statistical Area as delineated by the U.S. Census Bureau) there will be sections or corridors, generally following major highways, which constitute market areas for economic and residential growth. These market areas might include one or more communities. Such market areas have potentials for different rates or distribution of growth depending on many factors - including the availability of sewers.

-- For a smaller economic growth area outside of an SMSA (generally a core community, and possibly several surrounding towns) the entire economic area may be the prime region within which the spatial distribution of development will be influenced by a wastewater facility.

-- In considering "prime area" definition the possibility of "leap-frog" development should not be overlooked. "Leap-frogging" can occur when a combination of lower land costs and the availability of a facility such as sewers, which ease construction constraints, attract development at a distance somewhat removed from employment centers. In the process closer-in areas with a potential for growth may be by-passed. This situation applied in a recent assessment of secondary impacts in the Danbury, Connecticut region. Due to the high cost of housing south of and immediately adjacent to Danbury (partially due to the influence of the New York City and lower Fairfield County economic activities) it was anticipated that middle income housing development would be attracted by sewer facilities proposed in New Milford, some 12-15 miles from major employment centers.

The potential for inducing "leap frog" development complicates the delineation of the "prime area". In order to keep the analysis manageable in the steps which follow, it is suggested that the prime area not include the more distant communities from which "leap frog" development might be attracted. The "leap frog" area should be shown in a general nature on a regional map. In most cases it may represent a larger and possibly overlapping economic area. The delineation of the larger surrounding "leap frog" area will facilitate the rough environmental growth approximating called for in step 6B below.

5.323 Step 3, Map Potential Growth Areas

This step includes the mapping of potential growth areas within the previously defined prime area of potential secondary impacts.

As a general rule of thumb, land with the following characteristics can be considered as potential growth areas:

-- Slopes ranging from 0 to 10 per cent.

-- Soil conditions suitable for development as determined by SCS or similar studies.

-- Private ownership.

-- Absence of water related constraints such as wetlands, flood plains or a high ground water level.

-- Absence, particularly in the case of housing, of nearby adverse influences such as an airport, dump site or heavy industry.

-- Reasonable access to existing road system and community facilities.

The potential growth areas can be shown on USGS maps or similar type maps which may have been used in the preceding steps.

The most useful documents in undertaking this analysis are USGS maps, SCS soil surveys, zoning regulations and local or regional planning studies. In many cases the planning studies will have carried out an analysis and a mapping of future growth areas. Recently completed 208 studies may prove to be an invaluable resource.

5.324 Step 4, Map Growth Constraint Areas

This map will identify those portions of the potential growth areas mapped in Step 3 where growth should be constrained but is not presently constrained by existing zoning or other adopted development regulations. Examples might include:

-- Prime agricultural land. A dwindling but potentially valuable resource in New England.

-- Flood plains where development may be allowed if certain building requirements are met. (See chapter 6)

-- Sites proposed for public facilities by local, regional or state agencies but not as yet acquired for same.

-- Lands adjacent to important wetlands. (See Chapter 7)

-- Aquifer recharge areas. (See Chapter 6)

-- Endangered species habitats.

-- Valuable archaeological resource sites. (See Chapter 8)

The potential growth constraint areas should be identified with a color on the growth areas map prepared in Step 3.

5.325 Step 5, Determine Current Carrying Capacity of Growth Areas.

The current carrying capacity represents the amount of growth that can take place under existing zoning. It will be estimated and reported as follows after making appropriate deductions for roads and public facilities such as schools and playgrounds;

USE	ACRES/UNITS			
	GROWTH AREA		GROWTH CONSTRAINT AREA	
	UNITS	ACRES	UNITS	ACRES
Residential				
Single				
Multiple				
Commercial				
Industrial				
TOTAL				

5.326 Step 6, Prime Area of Secondary Impact Incremental Growth Analysis.

This step is directed at providing answers to the following questions:

-- What will be the projected growth and distribution of growth within the service area and the secondary impact area without the proposed facility within 10 and 20 years?

-- What will be the projected growth and distribution of that growth within the service area and the secondary impact area if the proposed facility is constructed.

The projected growth without the facility can be accomplished as follows (Step 6A):

-- Review growth experience in "prime" area of potential secondary impacts using census documents and community regional or state-wide population studies.

-- Determine if there are any factors such as the completion of a new highway, a shortage of water supplies, the introduction of new industry, closing of a military establishment, high or low vacancy rates (low vacancy rates often indicate a strong housing market stimulating residential development), which could alter past growth trends in secondary impact area.

-- Review present status of planning and zoning in secondary impact area and known proposals for new subdivisions, PUD's, industrial parks, etc. Determine if existing planning and zoning reflect present public sentiments toward growth. (This can be determined at the time businessmen and planning agencies are contacted during the preceding steps and as part of a community participation process described in Chapter 3) Has there been a history of granting zoning variances allowing increased densities not originally planned for?

-- Determine if prior community master plans call for the introduction and/or expansion of wastewater facilities.

-- If more than two communities are located within an area of potential secondary impact it is important to determine if any other community has, is or will be preparing a wastewater facility plan.

-- Review population projections for secondary impact area made by local, regional or state planning agencies, utilities (electric, telephone, etc.) and chambers-of-commerce. (Note: most population projections are made for political areas such as towns or cities. If the "prime" secondary impact area is not coterminous with municipal boundaries estimate the percentage of growth which might be attributed to the secondary impact area.

-- Determine if the projections prepared by others are generally consistent with and reflective of present conditions as determined above. Recent trends in building permits, for example, might reveal a marked change over longer period trends. If the projections are deemed to be inconsistent with present conditions, prepare revised population projection for ten and twenty year periods. It is important that such revisions be accompanied by a listing of the assumptions which were made in revising the projections. (Note: It is anticipated that EPA will soon establish procedures for disaggregating state population forecasts at the regional, community and facility planning level for the years 1980, 1990 and 2000. Any deviations from the state projections will undoubtedly require a check and approval by the responsible state agency).

-- Using three overlays of the map of potential growth areas prepared in Step 3 estimate growth and its distribution for 1980, 1990 and 2000. This growth should be differentiated as follows:

  o Growth within proposed service area of facility.
  o Growth outside proposed service area of facility.
  o Growth within growth constraint areas mapped in Step 4.
  o Growth within proposed sewer service area but outside of previously defined potential growth areas. (This is land which may be opened for development due to availability of sewers.)

The projected growth if a wastewater facility is constructed can be accomplished as follows (Step 6B):

-- Utilizing the three overlays developed in 6A above, reallocate growth between proposed service area and balance of "prime" secondary impact area. The assumptions made in any reallocation should be identified. Examples could include the following:

  o There are potentials for lower cost housing, at greater densities with fewer environmental constraints. Studies have shown that sewers represent approximately

25 per cent of the total influence on development. It is important to realize that the decisions on where and what will be built are made by developers. It is vital to talk with development firms operating in the area to determine how the proposed wastewater facilities might influence future decisions. Their key determinants on where to build are land availability and price. Two of the most influential determinants of land price in a development area are sewer service and allowable development densities.

- There are potentials for increased land values. As a rule of thumb, sewered land is worth four or five times unsewered land. Often land values will begin to increase in anticipation of sewering and lead to pressures for development and changes in land ownership.
- There may be potentials for the development of land which, because of soil, slope or other characteristics, would have been difficult to develop without sewers and was not shown as a potential growth area in Step 3.
- There may be potentials for attracting job generating commercial or industrial development due to sewer availability.
- "Leap frog" development from outside the prime area (See Step 5). This will require some knowledge of development trends in the "leap frog" impact area previously defined in Step 5.

5.327 Step 7: Growth Increment Analysis

As a result of the growth analysis conducted in "6" above, it will be possible to determine the location of and increments of growth estimated to be attributed to the proposed wastewater facilities. A form of tabular summary is recommended.

If the induced growth is slight or insignificant (less than 10 per cent redistribution of growth), it can be assumed that impacts with and without the project essentially are the same and no secondary impacts of consequence are likely to be attributed to the proposed facility.

If the difference is greater than 10 per cent it can be assumed that there are opportunities for induced secondary impacts. Given such a finding, the assessor should proceed to Step 8.

The 10 per cent figure is not a hard and fast threshold for determining if secondary impacts will be of consequence. Under certain conditions the threshold could be higher or lower. The assessor has to use the known facts or conditions to determine a reasonable point for discontinuing or continuing the analysis.

5.328 Step 8: Determine Applicable Categories of Secondary Impact

With a finding of a potential for secondary impacts in Step 7, the task now becomes one of determining the type and severity of impacts induced by the proposed facility alternative. The following is an illustrative listing of many of the more common secondary impact categories along with examples of the nature of the impact and potential mitigating measures.

A. FLOODPLAINS (See Chapter 6)

-- Nature of Secondary Impacts

Project may encourage development within defined 100-year floodplains.

-- Mitigating Measures

Limit sewer hook-ups in floodplain area.

B. WETLANDS

-- Nature of Secondary Impacts

Induced development adjacent to wetlands may overwhelm or diminish ability of wetland to deal with erosion or runoff.

Induced development may cause fill-in of wetlands depending on regulations of individual communities or states.

-- Mitigating Measures

Impose strict controls on regulating runoff and erosion on lands adjacent to wetlands. These are sometimes referred to as buffer area controls. The buffer area may vary in width depending upon the sensitivity or productivity of the wetlands (See Chapter 7).

C. COASTAL AREAS

-- Nature of Secondary Impacts

Development will be induced in coastal zone area defined by state CZM Agency, which is inconsistent with proposed or adopted Coastal Zone Management Program of State CZM Agency.

-- Mitigating Measures

Prepare acceptable alternative or controls in cooperation with State CZM Agency.

D. SENSITIVE DEVELOPMENT AREA

-- Nature of Secondary Impact

Induced development may occur in unstable hillside areas with resulting erosion, siltation, alteration of natural drainage pattern, and loss of aesthetic resources.

Induced development may occur in earthquake or similar type of special hazard area.

-- Mitigating Measures

Adopt slope/density provisions which state in effect - the greater the slope - the less the development.

Adopt regulations precluding any intense development in known hazard areas.

E. WILDLIFE HABITATS/ENDANGERED SPECIES

-- Nature of Secondary Impacts

Wildlife habitat may be encroached upon by induced development in adjacent lands and/or in habitat areas which brings more intensive human activity (single family homes with children, cats and dogs), fertilizers and pesticides and other activities which could alter species diversity or stability.

-- Mitigating Measures

Consult with regional office of the Fish and Wildlife Service, State and local conservation agencies and State fish and wildlife agencies.

F. AGRICULTURE

-- Nature of Secondary Impact

Prime and unique farm lands will be subjected to development or development pressures which increase property values or taxes.

Increased taxes from development pressures may render farming non-economic.

Non-point pollution might be reduced due to conversion from agricultural to more intensive use.

-- Mitigating Measures

Acceptance of special taxing measures to prevent tax increases on agricultural land.

Adoption of special agricultural zoning provisions.

G. PARK LANDS

-- Nature of Secondary Impact

Induced development may occur in areas designated for parks or recreation but not publicly acquired or protected for such use.

Increased land values resulting from induced growth may render acquisition by a public agency more difficult.

Induced development may tax carrying capacity of limited supply of parks to serve community recreational needs.

-- Mitigating Measures

Develop capital budget programs to schedule park acquisition well in advance of sewering.

Direct growth towards areas which may have underutilized park lands.

H. HISTORICAL, ARCHITECTURAL, ARCHAEOLOGICAL, OR CULTURAL VALUES

-- Nature of Secondary Impact

Induced growth will impact properties or districts listed in the National Register of Historic Places or eligible for such listing by changing the surrounding environment with intrusions inconsistent with the setting or encouraging actions leading to new construction on the site and the destruction of above or below-ground resources.

-- Mitigating Measures

Alter elements which would induce growth on the site.

Develop preservation measures in cooperation with State Historic Preservation Officer.

I. WILD AND SCENIC RIVERS

-- Nature of Secondary Impact

Induced growth will occur adjacent to designated river segment (exceptional natural, scenic, recreational or other quality worthy of protection) with potentials for damaging aesthetic qualities, impacting soil and water quality, increasing traffic/noise/air pollution, and increased recreational use.

-- Mitigating Measures

Limit sewer hook-ups in adjoining areas to thwart growth.

J. WATER QUALITY/QUANTITY (See Chapter 6)

-- Nature of Secondary Impacts

Induced construction activities and new development will increase non-point source pollution and sedimentation.

Induced growth may exacerbate existing or potential water shortage.

Urban development increases peak and total runoff volumes.

-- Mitigating Measures

Regulations eliminating or retarding non-point source pollution during or following construction are adopted.

If water supply is a limiting factor on growth, reduce growth projections and scope of project.

Institute water conservation measures.

K. AIR POLLUTION

-- Nature of Secondary Impacts

Induced growth could increase pollution from automobiles, residential heating and new industries.

-- Mitigating Measures

Encourage concentrated growth to reduce pollution from excessive automobile travel.

Amend zoning to preclude industries with an adverse impact on air quality.

Allow development which is consistent only with the States Air Quality Maintenance Area (AWMA) plans.

L. NOISE (See Chapter 10)

-- Nature of Secondary Impacts

More intensive noise producing development could be induced adjacent to sensitive receptors.

Induced development could be encouraged in areas with high noise levels such as near airports or adjacent to highways or railroads.

-- Mitigating Measures

Preclude intensive induced development which would increase noise levels adjacent to sensitive receptors where possible.

Direct induced growth away from areas known to have high ambient noise levels.

M. SOLID WASTE

-- Nature of Secondary Impacts

Collection costs may decline if induced growth results in a more concentrated growth pattern.

Existing solid waste facilities may be over-taxed by increased solid waste generated by induced growth.

-- Mitigating Measures

Provide for expansion/replacement of solid waste facility which is consistent with anticipated growth.

Revise zoning to preclude certain types of solid waste producing industries.

N. ENERGY DEMANDS

-- Nature of Secondary Impact

Induced development resulting in higher proportion of multi-family development may reduce overall energy demands for heating and cooling and may reduce vehicle miles travelled or increase use of mass transportation.

Induced development resulting in substantial amounts of low density housing could increase energy demands.

Leap-frog induced growth could increase travel/energy requirements between home and work.

-- Mitigating Measures

Adopt sewer extension/growth strategy which discourages sprawl. As a general rule-of-thumb energy demands decrease as density and concentration of development increases.

Develop coordinated regional housing strategy to prevent leap-frogging.

O. TRANSPORTATION

-- Nature of Secondary Impact

Induced growth may place a strain on the capacity of the present road system.

Higher density residential development adjacent to community facilities may reduce need for vehicular travel.

Induced, intensive residential growth may occur in vicinity of local airport.

-- Mitigating Measures

Stage sewer extensions to coincide with street construction and/or widening.

Lower densities to relate traffic flow to traffic capacities.

Adopt regulations to preclude higher density residential use in vicinity of an airport.

P. SOCIO/ECONOMIC (See Appendix of this Chapter)

-- Nature of Secondary Impact

Property values will increase in anticipation of growth induced and served by sewers.

Options for higher density housing to serve low or middle income housing may be opened.

Concentrated development in sewered areas may provide for more efficient provision of community services.

Induced growth or leap-frog development that comes to the community because of sewer availability may generate vital service costs (schools, protection, utilities, snow plowing, waste collection, etc.) or new construction which will strain the fiscal resources of the community.

-- Mitigating Measures

Reduce scale of project. Develop growth strategy which provides a balance of growth and a combination of uses which gives the community fiscal stability.

The above listing certainly is not all inclusive but will give the reader a general conception of secondary impacts.

Table 5-1 is proposed as a first-cut to determine if any of the potential secondary impacts apply to the alternative being evaluated. Most of the categories are self-explanatory.

The observant assessor who has carried out the preceding steps should have a fairly good knowledge if any of the categories apply to the alternative under consideration. In filling out Table 5-1 it is suggested that a yes answer be checked if there are doubts as to the impact. The validity of that decision can be checked further in the following step. Obvious decisions such as location outside of the coastal zone or the absence of a scenic river can be handled expeditiously.

5.329 Step 9, Secondary Impact Evaluation

If "yes" is checked for any of the categories on Table 5-1 the assessor should prepare Table 5-2. This form is to be used in conjunction with any of the maps and data developed in preceding steps along with applicable materials developed as suggested in other chapters of this manual. A separate form is used for each of the categories checked. In some categories the nature of the impacts may warrant more than one form -i.e., water quality and water quantity.

The form is directed at determining if in fact there is a secondary impact and the degree or severity of the impact. The rating of the impact must of necessity be a subjective evaluation tempered by consultation with public officials and discussions carried out at community participation workshops.

It should be noted that the form calls for a rating without mitigating measures as well as with suggested mitigating measures which might preclude or lessen the impact. It also should be noted that impacts may be beneficial or adverse.

On the final page of Table 5-3, the assessor is asked to make a judgment if the nature of the impact warrants the preparation of a "piggy back" EIS. A yes answer is justified if the impact would still be significant with the adoption of mitigating measures.

5.3210 Step 10, Secondary Impact Profile

The final step is the completion of Table 5-3, secondary impact profile, for each alternative. If certain categories of impact show significant impacts with or without mitigating measures for all alternatives it can be assumed that a "piggy back" EIS is warranted. Significant impacts which apply to one or several alternatives may not require an EIS but will help the engineer to eliminate a project with a capacity to inflict significant harm on the natural or man-made environment.

TABLE 5-1

WASTEWATER FACILITIES

ENVIRONMENTAL ASSESSMENT

SECONDARY IMPACT DETERMINATION

ALTERNATIVE______________________

CATEGORY OF IMPACT	APPLICABLE TO ALTERNATIVE YES	NO	BASIS FOR DETERMINATION
A. FLOODPLAINS			
B. WETLANDS			
C. COASTAL AREAS			
D. SENSTITIVE DEV. AREAS			
E. WILDLIFE/ENDG. SPECIES			
F. AGRICULTURE			
G. PARK LANDS			
H. HIST/ARCHAEOLOGICAL			
I. WILD & SCENIC RIVERS			
J. WATER QUALITY/QUANTITY			
K. AIR POLLUTION			
L. NOISE			
M. SOLID WASTE			
N. ENERGY DEMANDS			
O. TRANSPORTATION			
P. SOCIO/ECONOMIC			
OTHER:			
--			
--			

TABLE 5-2

WASTEWATER FACILITIES
ENVIRONMENTAL ASSESSMENT

SECONDARY IMPACT EVALUATION FORM

ALTERNATIVE ____

ESTIMATED INDUCED GROWTH:

AMOUNT:

____________________ 1980-1989

____________________ 1990-1999

____

GEOGRAPHIC IMPLICATIONS

____

____

____

____

____

____

POTENTIAL SECONDARY IMPACT:

NATURE OF IMPACT:

____

____

DESCRIPTION OF IMPACT:

____

____

____

ENVIRONMENTAL LAWS/PLANS CONTRAVENED:

FEDERAL ____

____

____

(Table 5-2 cont'd)

STATE

LOCAL

SPECIAL DISCUSSION

DEGREE OF IMPACT (WITHOUT MITIGATING MEASURES BEYOND THOSE PRESENTLY REQUIRED BY LAW OR REGULATION):

________ NONE

________ NEGLIGIBLE

________ MINOR

________ SIGNIFICANT

BASIS FOR RATING

(Table 5-2 cont'd)

DEGREE OF IMPACT (WITH MITIGATING MEASURES DESCRIBED BELOW):

__________ NONE

__________ NEGLIGIBLE

__________ MINOR

__________ SIGNIFICANT

PROPOSED MITIGATING MEASURES

____

____

____

____

EIS WARRANTED: YES ______ / NO ______

DISCUSSION

____

____

____

____

____

PREPARED BY:

____

DATE:

____

TABLE 5-3

WASTEWATER FACILITIES
ENVIRONMENTAL ASSESSMENT

SECONDARY IMPACT PROFILE

ALTERNATIVE____________________

A - Adverse Impact
B - Beneficial Impact
0 - No Impact

CATEGORY OF IMPACT	DEGREE OF IMPACT WITHOUT MITIGATING MEASURES					DEGREE OF IMPACT WITH MITIGATING MEASURES				EIS WARRANTED
	NONE	INSIGNIFICANT	MINOR	SIGNIFICANT		NONE	INSIGNIFICANT	MINOR	SIGNIFICANT	
A. FLOODPLAINS										
B. WETLANDS										
C. COSTAL AREAS										
D. SENSITIVE DEV. AREA										
E. WILDLIFE/ENDG. SPECIES										
F. AGRICULTURE										
G. PARKLANDS										
H. HISTORICAL/ARCHAEOLOGICAL										
I. WILD & SCENIC RIVERS										
J. WATER QUALITY/QUANTITY										
K. AIR POLLUTION										
L. NOISE										
M. SOLID WASTE										
N. ENERGY DEMANDS										
O. TRANSPORTATION										
P. SOCIO/ECONOMIC										
OTHER:										
--										
--										

5.4 CASE STUDY

The maps on the following pages have been prepared for the discussion of secondary impacts at the workshops scheduled in the various New England States. A brief summary of the Tinkersville case study is presented.

5.41 Alternative 1

Figure 5-1 shows one of the alternatives developed to meet Tinkersville's wastewater needs. It follows the recommendations of the Master Plan calling for sewer service to the older sections of the community and undeveloped areas on the west side of town with soil limitations for on-site septic systems.

The proposed treatment plant would serve an existing population of 10,000 and one major industry, Nutrient Products. The capacity of the treatment facility would be 1.2 MGD with a potential for expansion to 2.2 MGD.

5.42 Prime Area of Potential Secondary Impacts

Figure 5-2 indicates that most development with or without Alternative 1 will occur within the municipal boundaries of Tinkersville. This was determined in accordance with the procedures discussed earlier in this chapter.

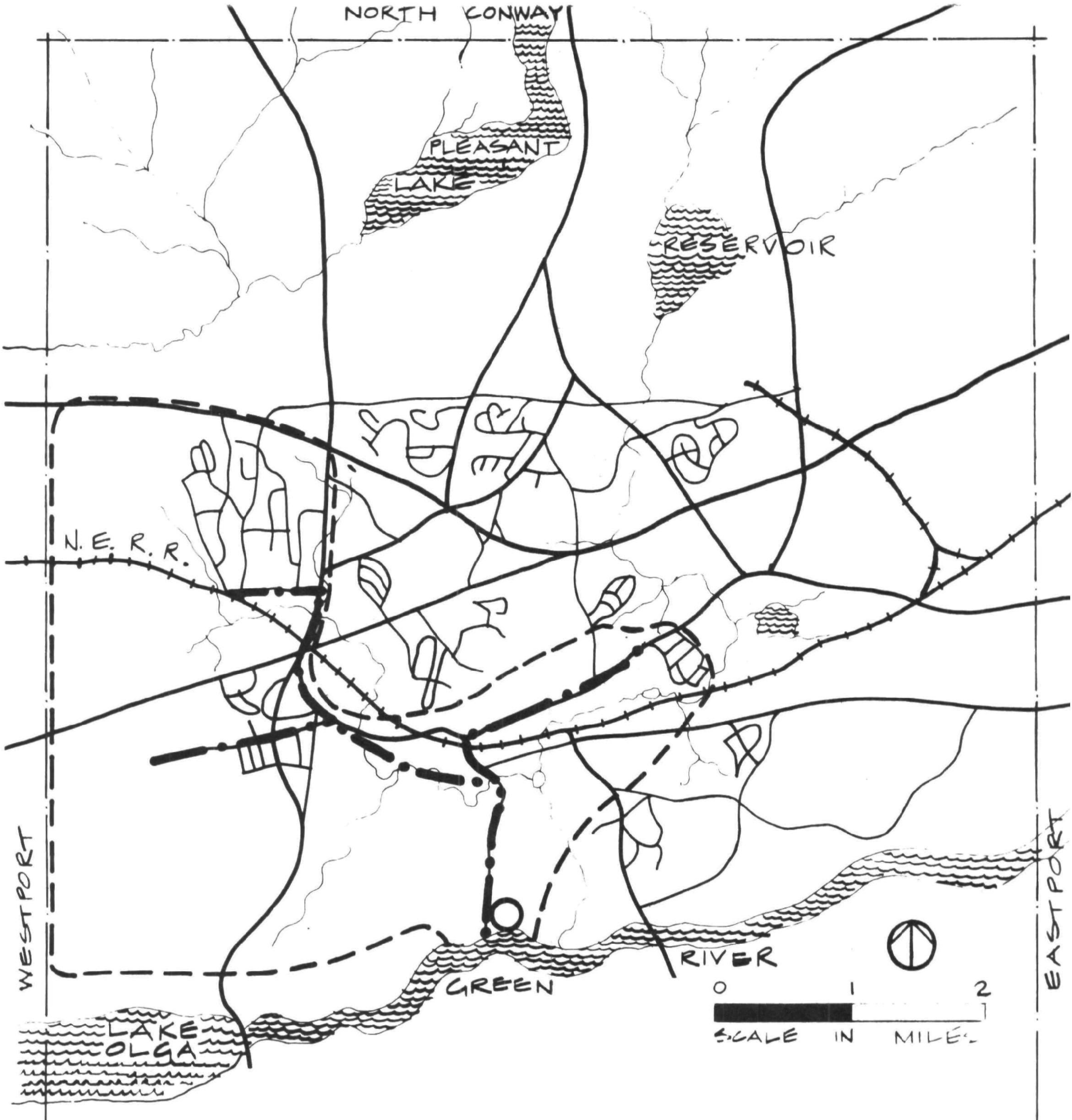
There is, however, a potential for some induced "leap frog" development. Discussions with developers indicate that most of the small towns between Summerfield, the major city to the west, and Tinkersville have adopted large lot zoning which limits moderate income housing opportunities. Sewering along with reduced lot sizes in Tinkersville would be a real attraction even though the travel times to job centers to the west would be unusually high for that section of New England.

5.43 Growth and Growth Constraint Areas

Figures 5-3 and 5-4 show the growth and growth constraint areas in Tinkersville as delineated in accordance with the 10 step process. The central section of the community is almost completely developed or undevelopable due to streams, wetlands and flood plains. Figure 5-3 also shows the present zoning in the growth areas.

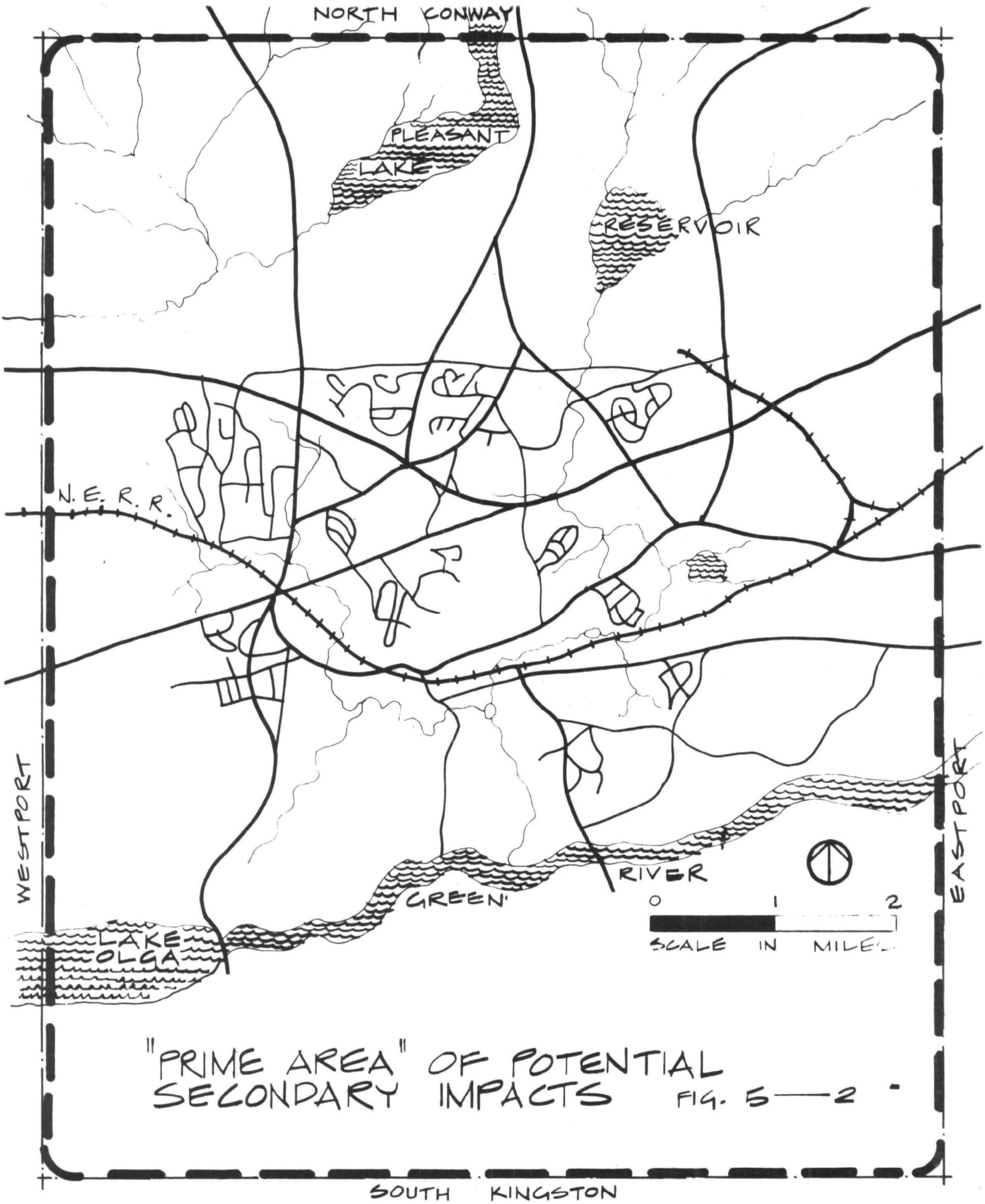
5.44 Potential Growth

Figure 5-5 and 5-6 show potential growth without and with Alternative 1. Without the alternative growth would continue expanding to the north and east. With the alternative growth would be redirected towards the west side of town in accordance with the Tinkersville Master Plan.



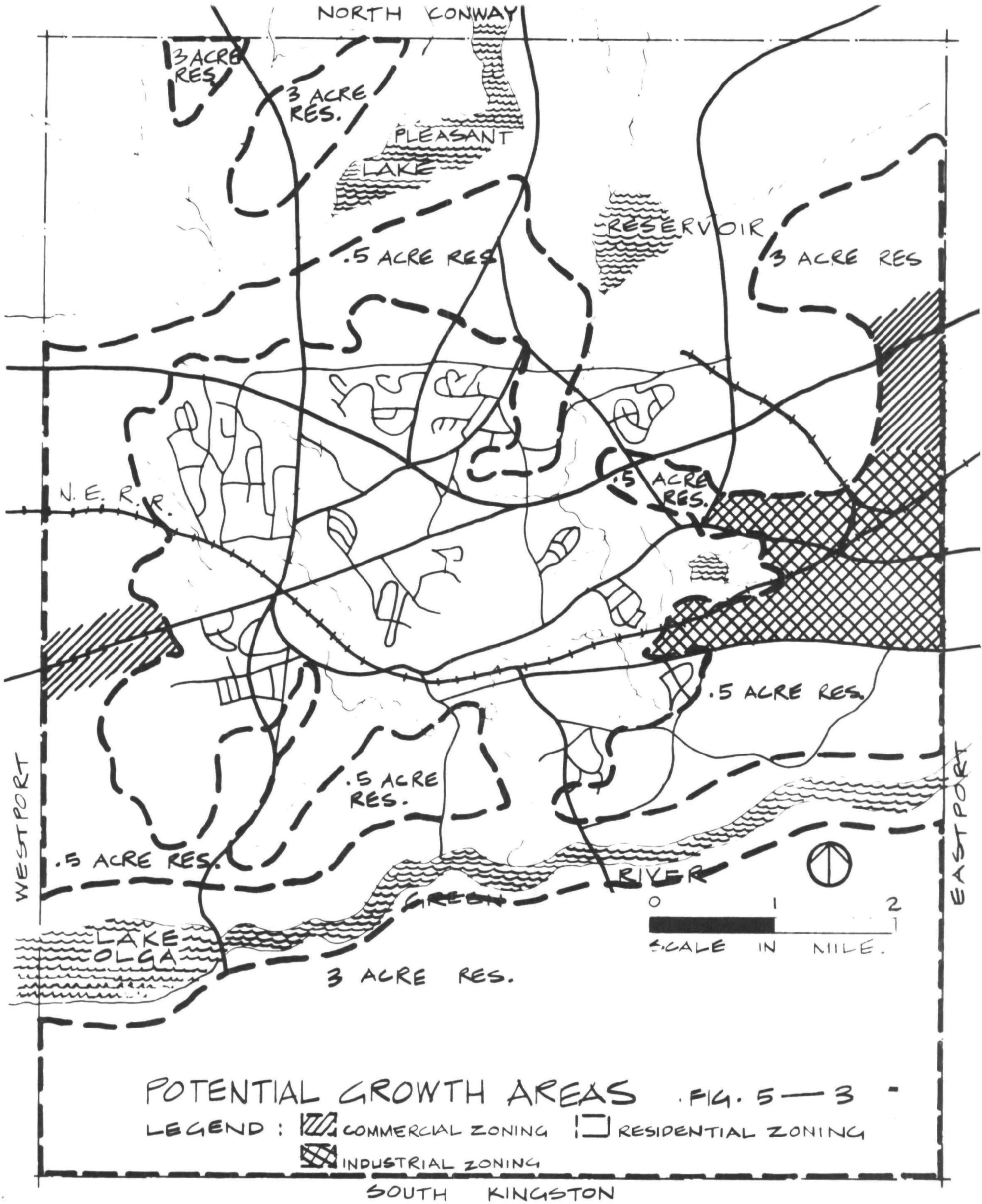
COLLECTION & TREATMENT SYSTEM
ALTERNATIVE—1
FIG. 5—1

LEGEND: ○ TREATMENT PLANT SITE
— · — INTERCEPTOR SEWER
ULTIMATE SEWER SERVICE AREA

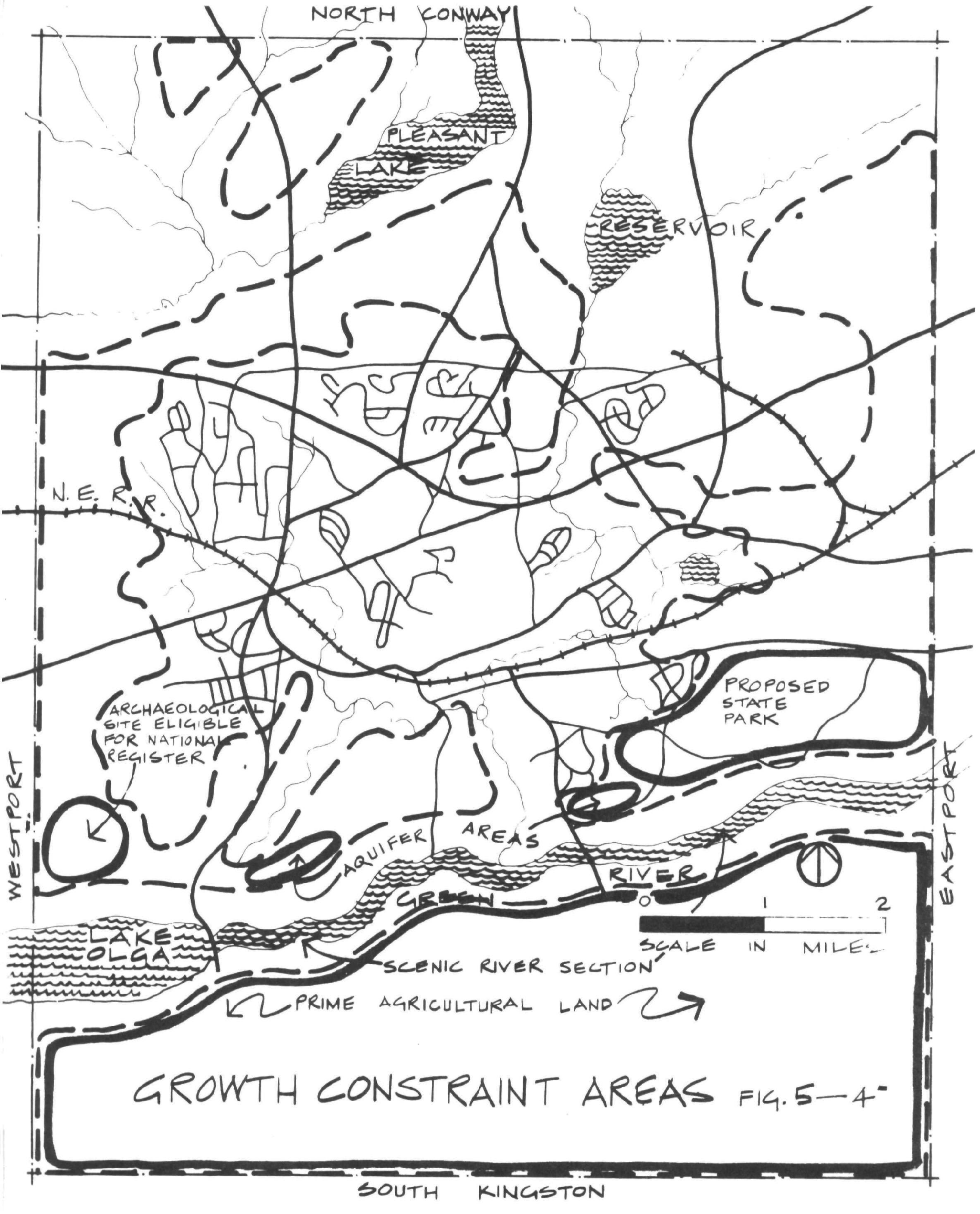


"PRIME AREA" OF POTENTIAL SECONDARY IMPACTS FIG. 5—2

environmental assessment manual
region 1 : environmental protection agency
anderson-nichols technical consultant



POTENTIAL GROWTH AREAS FIG. 5—3



GROWTH CONSTRAINT AREAS FIG. 5–4

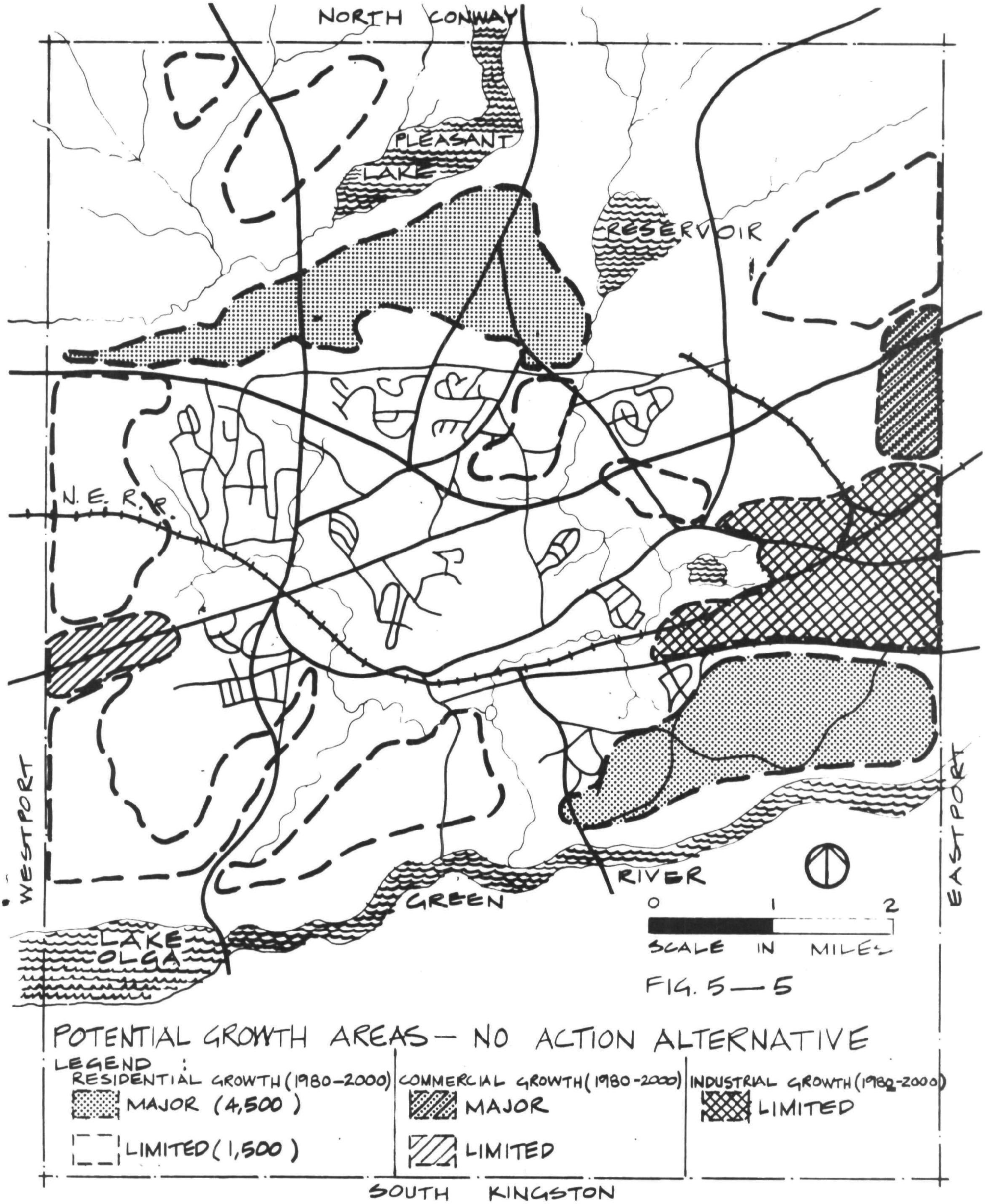


FIG. 5—5

POTENTIAL GROWTH AREAS — NO ACTION ALTERNATIVE

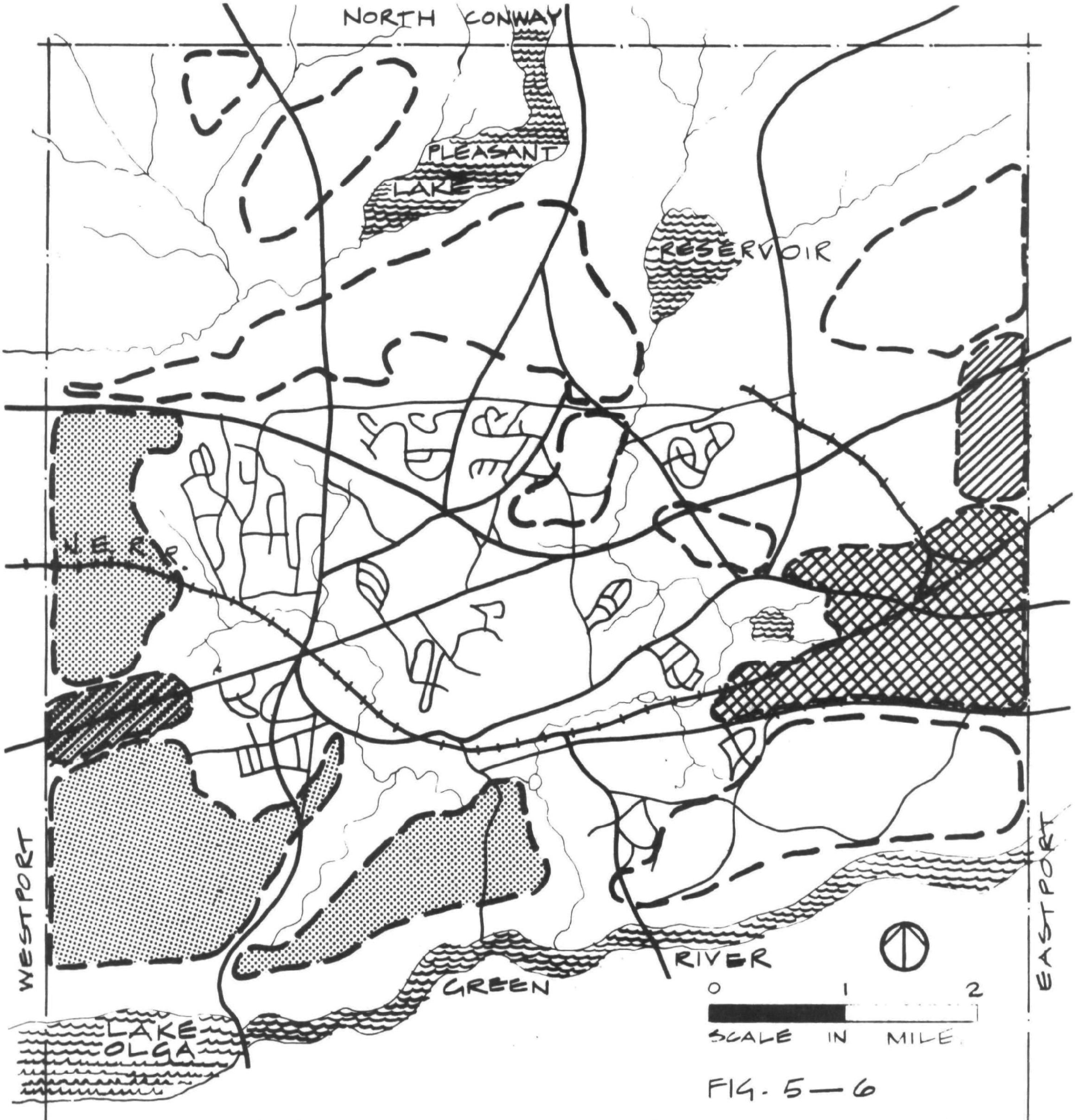


FIG. 5—6

POTENTIAL GROWTH REALLOCATION—SYSTEM ALTERNATIVE-I

LEGEND:

RESIDENTIAL GROWTH (1980-2000)	COMMERCIAL GROWTH (1980-2000)	INDUSTRIAL GROWTH (1980-2000)
MAJOR (6,000)	MAJOR	LIMITED NEW INDUSTRY
LIMITED (1,500)	LIMITED	

In addition new growth, not attributable to local economic expansion could be anticipated under Alternative 1. This would be in the form of lower cost single family housing to serve an unsatisfied demand between Summerfield and Tinkersville.

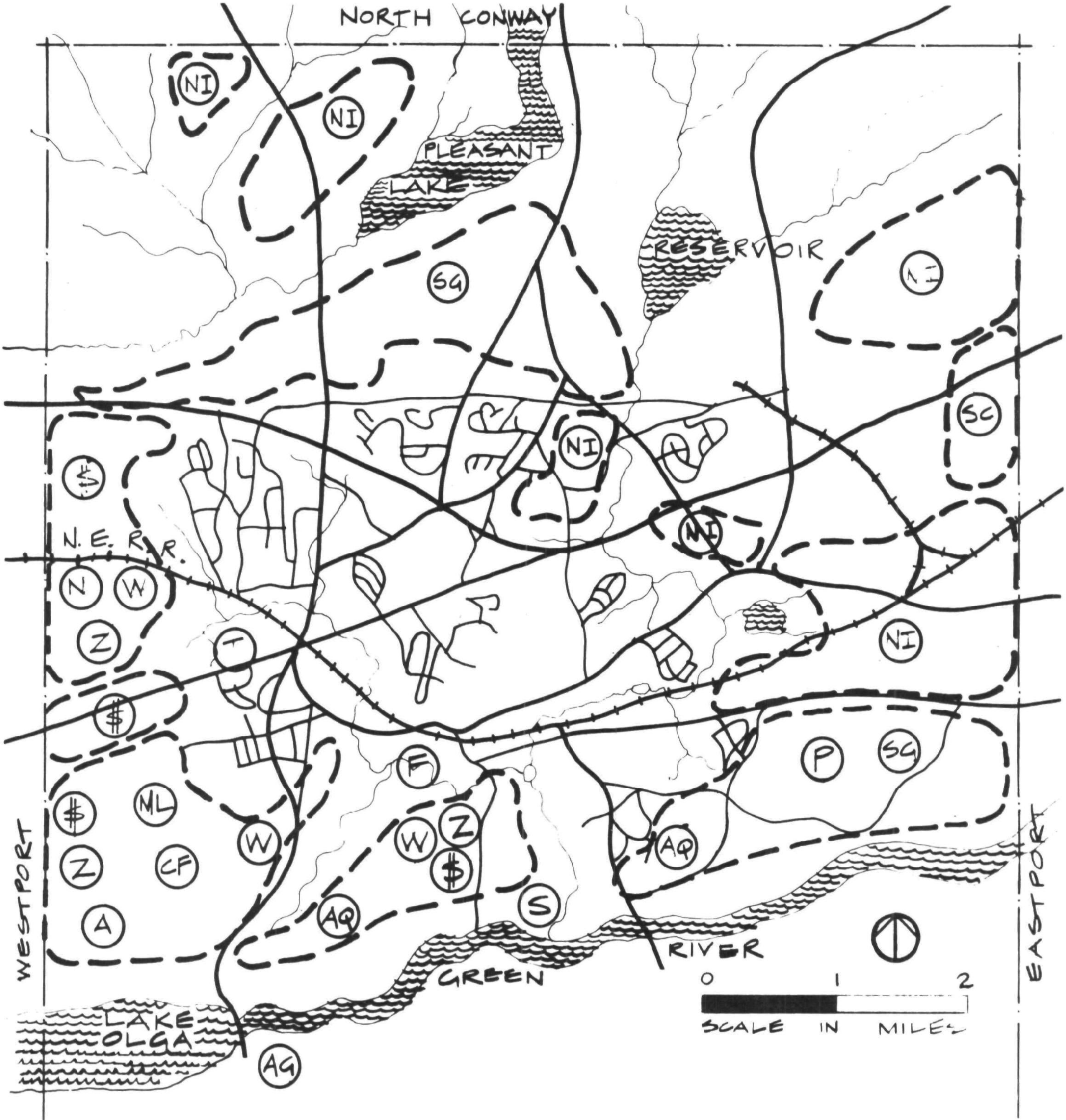
5.45 Secondary Impact Potentials

Figures 5-7 and 5-7A show in graphic form the impacts which would be identified using Tables 5-1, 5-2 and 5-3.

Using Table 5-3 it was concluded that under this alternative an EIS would be warranted. This conclusion was based on the increased school and municipal service costs which would be reflected in an induced growth of 1,500 over and above the natural growth estimated by the Green River Regional Planning Commission.

5.46 Level of Effort

The consulting firm doing the Tinkersville assessment estimated that about 15 man-days were related to the secondary impact evaluation. Much of this effort consisted of activities which related to normal facility planning and included some of the efforts described in other chapters of this manual.



SECONDARY IMPACT POTENTIALS — SYSTEM ALTERNATIVE - 1

LEGEND - SEE FIGURE 5-7A

FIG. 5—7

LEGEND :

(NI) NO SIGNIFICANT IMPACT

(SG) SLOW GROWTH

(Z) REZONING PRESSURES

(W) WETLAND DEGRADATION

($) INCREASE PROPERTY VALUES

(AQ) AQUIFER AREA

(F) SMALL STREAM FLOODING

(AG) AGRICULTURAL LAND ENCROACHMENT

(P) PROPOSED PARK PROTECTION

(CF) NEED FOR SCHOOLS / ETC.

(T) TRAFFIC CONGESTION

(S) SCENIC RIVER ENCROACHMENT

(ML) MARGINAL LAND DEVELOPMENT

(N) RAILROAD NOISE

(A) ARCHAEOLOGICAL SITE

LEGEND FOR FIGURE 5-7

FIG 5-7A

environmental assessment manual

hydrologic impacts

6. hydrologic impacts

CHAPTER 6 - HYDROLOGIC IMPACTS

6.0 INTRODUCTION

An Ad Hoc Panel on Hydrology of the Federal Council for Science and Technology has defined hydrology as

> "...that science which studies the waters of the Earth, their occurrence, circulation, and distribution, their chemical and physical properties, and their reaction with their environment, including their relation to living things."

Traditionally, the occurrence, circulation, and distribution of water have been portrayed through consideration of the natural "hydrologic cycle," which can be summarized simply as the movement from ocean to atmosphere to surface and subsurface to ocean. Figure 6-1 illustrates the key elements of the basic cycle.

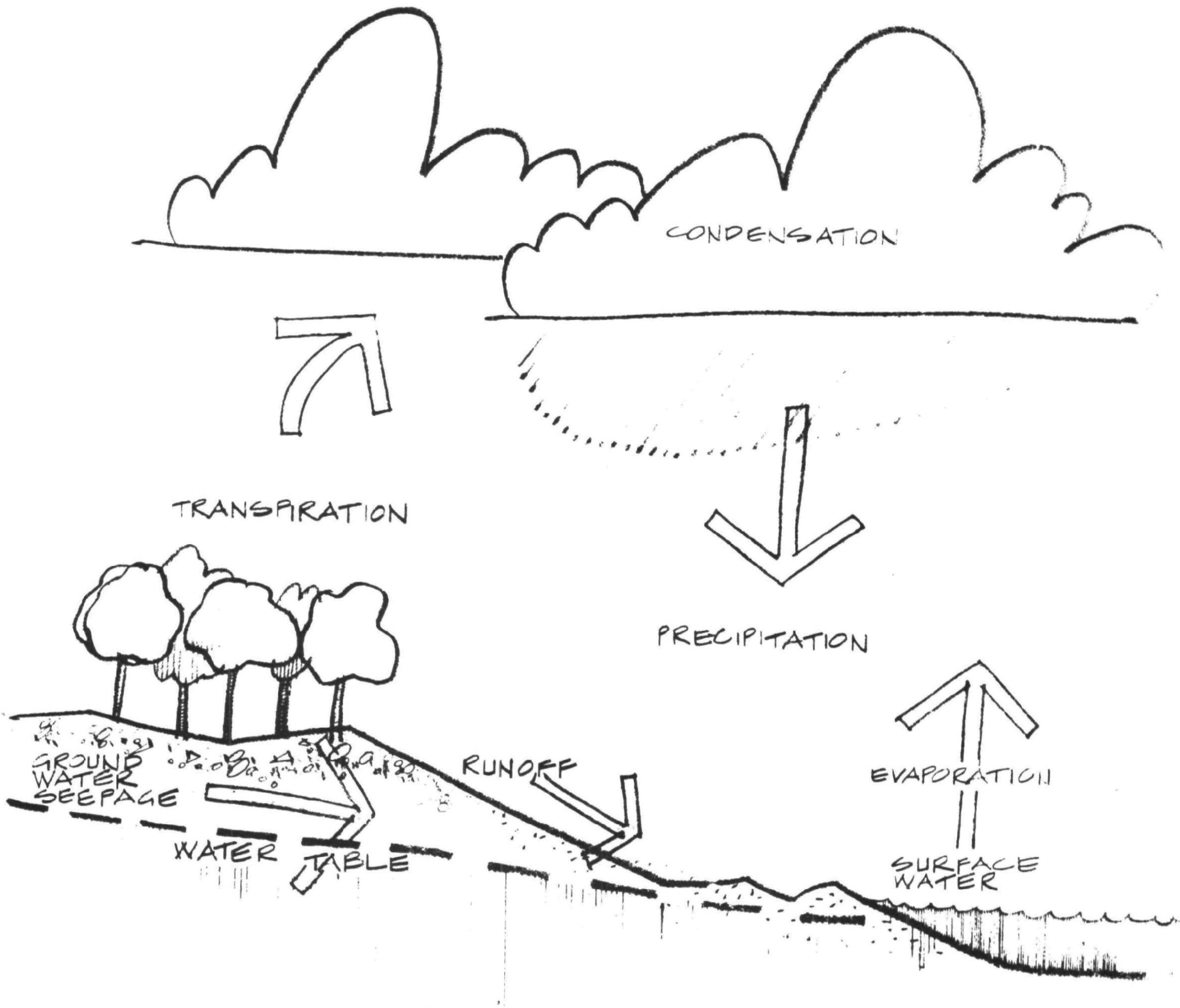
It is well recognized that many of man's activities can have a substantial impact on different elements of the hydrologic cycle. Although quantitative procedures exist to estimate the magnitude of these impacts, it is important to remember that no one element of the cycle can be substantially altered without causing adjustments in most of the other elements. Therefore, when evaluating a proposed sewage collection and treatment facility, or any other major construction project, the engineer must attempt to evaluate how the proposed project will modify all existing hydrologic conditions both in the vicinity of the project as well as elsewhere.

So often in the past, facility planners and designers have side stepped the hydrologic issues when preparing environmental assessments on proposed wastewater facilities. This avoidance has then provided legitimate grounds for challenging the viability of the project by environmental groups or EPA. Thus, the engineer must address the hydrologic issues related to any project early in its development. This section of this manual is intended to aid in that evaluation.

Four key areas of hydrologic concern are examined in this chapter. They are: (1) Increased Rate of Runoff, (2) Interbasin Transfer, (3) Modification to Water Table, and (4) Transport of Groundwater Contaminants.

6.1 REGULATORY STATUS

The regulatory requirements for consideration of the hydrologic impacts of any federally funded project are based upon the National Environmental Policy Act of 1969, the Federal



THE HYDROLOGIC CYCLE FIG. 6—1

Water Pollution Control Act Amendments of 1972, the National Flood Insurance Act of 1968 as amended, the Flood Disaster Protection Act of 1973, and subsequent Executive Orders implementing various provisions of these acts.

More specifically, the issue of increasing peak runoff is related to the problem of non-point source pollution addressed in Section 208 of the Water Pollution Control Act and directly tied to Executive Order 11988 relative to Flood Plain Management.

Interbasin transfer is an issue considered as part of the 208 regional wastewater planning program under the Water Pollution Control Act. Impacts on the quality of groundwater aquifers are considered in the Water Pollution Control Act, Section 304, and in the Safe Drinking Water Act.

6.2 PAST PRACTICES

Hydrology as a topic has all too often been relegated to the periphery of planning processes when designing sanitary sewer networks and treatment facilities. The general practice has been to consider hydrologic factors only when designing storm sewers or hydraulic structures such as dam spillways. Groundwater hydrology was considered relevant to the development of well fields but irrelevant to sewer design. These limited perspectives have neglected the close inter-relationship that exists among all the water resources of an area, whether pure or contaminated, and the significant linkage between groundwater aquifers and stream flow.

In the past, major development projects were designed to move runoff away from the development site with no real consideration for conditions downstream. Freshwater and wastewater have been transported in and out of major watersheds without full recognition of the resulting change in the water balance both in the supplying and recipient basins. Sewer trenches have served as effective drains to lower water table elevations from their pre-sewered levels, and wastewaters and sludges dumped onto the ground to dry without a full understanding of the subsequent contamination of the groundwater reservoir below the dumping site.

The damage done by past projects can only be rectified slowly, if at all, but we can try to learn from these experiences and apply this insight to future jobs. The purpose of this chapter is to aid the facilities planner in identifying hydrologic impacts that must be considered as part of an environmental assessment. The key to satisfying prior deficiencies is for each designer to better appreciate the close inter-relationships that make up the hydrologic cycle and assess each proposal in light of how it will interact with the area's water cycle and budget.

6.3 SUGGESTED METHODOLOGY

6.31 Impact Identification

6.311 Increased Rate of Runoff

Sanitary sewers do not directly result in an increase in peak runoff, but they provide the potential for increased peak runoff due to the higher density development that has historically followed introduction of sanitary sewers into an area. Smaller lot sizes generally are permissible in sewered areas and industrial and commercial facilities are more likely to develop. The increase in peak runoff is dependent on the density of development prior to sewering, the saturation densities permissible under existing or amended zoning ordinances, and construction code specifications for on-site retention basins, etc., required for new construction.

In order to determine whether a given facility will result in impacts to the runoff characteristics of a given area, the following list of questions should be asked:

A. Within the service area, what is the current density of development?

B. Within the service area under existing zoning regulations, what is the maximum potential density of development? Any restrictions on the type of development?

C. Are there any construction code requirements to maintain the existing runoff hydrograph, i.e. retention basins, etc., for all new construction within the watershed?

D. What percentage of the total drainage area contributing to the main stream of the basin being sewered will be included in the service area?

E. Are there any areas of development within designated flood-prone areas downstream of the service area?

F. Are there any known stream constrictions downstream where flooding typically occurs under current conditions?

If it is determined that due to the combination of existing development density and restrictions on development that no increase in population density is anticipated, (i.e., the sewers contain no excess capacity), then it may be concluded that no significant impact on runoff characteristics will exist as a result of the sewer facility plan. This determination is very closely tied to the concept of Secondary Impacts as discussed in Chapter 5.

If it is determined that the construction code requires adequate on-site retention facilities as part of all new construction within a community, it may be concluded that no significant impact on runoff characteristics will exist as a result of the sewer facility plan.

When the majority of a service area lies within one drainage basin and only minor peripheral areas lie in adjacent basins, the impact on the adjacent basins may be concluded to be non-significant if the land area to be sewered is only a minor portion of the contributing drainage area to the nearest major stream.

If it cannot be concluded immediately that there will be no impact, it is necessary to evaluate the significance of the impact as discussed in section 6.321 below.

6.312 Inter-Basin Transfer

The issues under consideration in this topic are generally related to development of large regional wastewater collection and treatment facilities. As noted in other chapters, the larger regional facilities will, in many cases, be covered by an EIS rather than an EA. Each drainage basin can be viewed as a control volume under natural conditions. The inputs are precipitation plus any subsurface inflow, and the outputs are evapotranspiration, streamflow, and aquifer discharge at the basin boundaries. When sewer lines are installed to remove wastewaster from a given basin and transport it to another basin for discharge, there is a net loss to the sewered basin. The extent of the "loss" is adjusted by the source of the domestic water supply for the area. If the source is internal to the basin, the loss is more severe than if the domestic water is imported to the basin initially.

In order to determine whether a given facility plan will result in an impact on the total water balance of a given basin the following list of questions should be asked:

A. Will the outfall of the treatment plant be located within the basin being sewered or will the collected wastewater be transported outside the basin for disposal?

B. What is the source of domestic water supply? Is the water supply imported from outside the basin?

C. What is the current volume of wastewater subjected to on-site disposal?

If the wastewater treatment plan is located within the same drainage basin as the service area, then it may be concluded that there will be no significant impacts regarding inter-basin transfer of water.

If the wastewater disposal site is located outside the drainage basin being serviced, then it is necessary to evaluate the impact of this inter-basin transfer as discussed in section 6.322.

6.313 Modification to Water Table

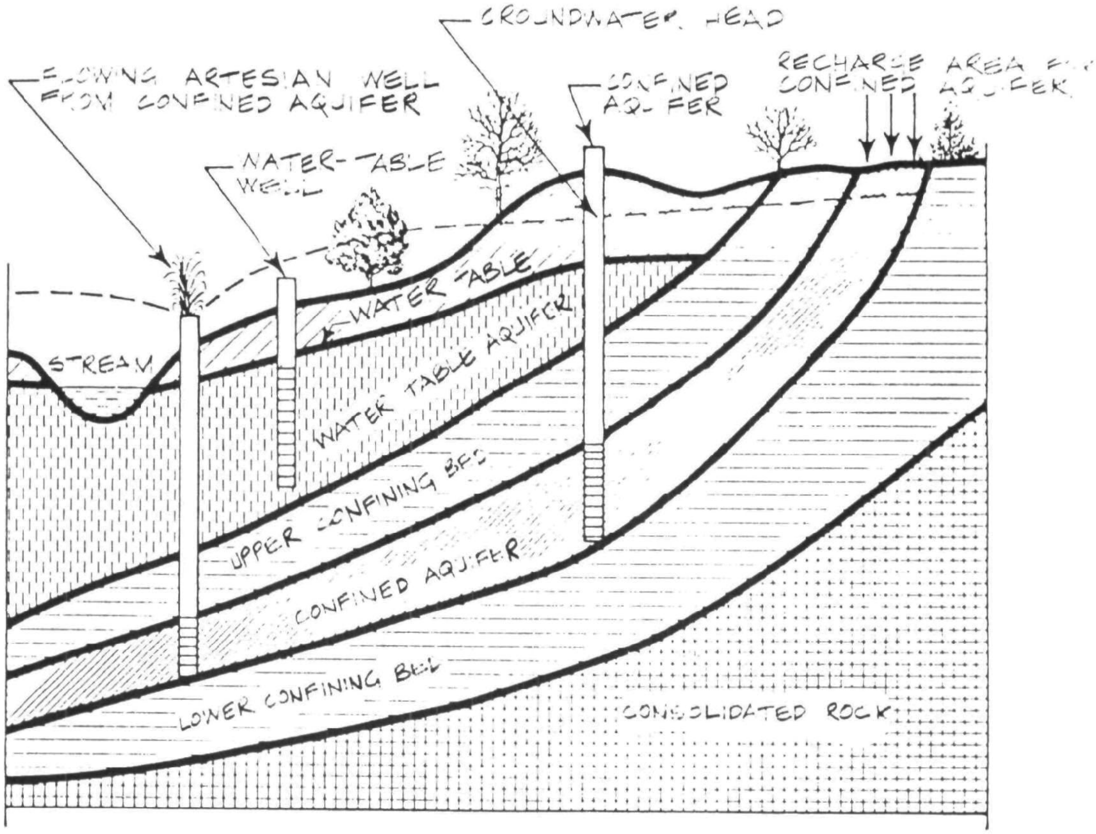
The freshwater aquifers of the earth underlie the surface at varying depths and in two basic categories. There are free surface or water-table aquifers and confined aquifers. The water surface of a water table aquifer is representative of the actual elevation of the groundwater, usually measured above some arbitrary datum. A confined aquifer's head is reflective of the pressure head within the aquifer and represents the elevation to which water would rise in an unpumped well. (See Figure 6-2)

The heads of both confined and free surface aquifers are significant since they represent the elevation from which water would need to be pumped in order to utilize the aquifer as a fresh water supply and thus determine the energy cost of using the water.

The water table elevation is also significant in terms of leakage into the basements of structures and the preservation of existing foundation systems, especially wooden piles. Saturation of a previously dry area or dewatering of a saturated area can adversely affect soil stability and increase the rate of deterioration of subsurface structures.

The heads are relatively constant with time. Water tables of unconfined aquifers will rise and fall with the seasons responding to varying levels of precipitation, but the changes are generally small; limited to less than 5 feet in most cases.

In order to determine whether a given facility plan will impact the water table of a given area the following list of questions should be answered:



GROUNDWATER HEAD FIG. 3—2

A. Is land application proposed for the final wastewater disposal scheme?

B. Will sewer lines and the trenches open to lay the sewers fall below existing water table elevations?

C. What was the total volume of on-site wastewater effluent prior to sewering the area? Was this waste evenly distributed throughout the area or were there some highly developed areas of high concentration?

If the water table is located well below the elevation of the proposed sewer lines, and land application is not proposed, and there were no areas where on-site disposal application rates exceed natural recharge, it can be concluded that no significant impact will result from the proposed facility plan. If, however, these conditions are not met, an evaluation of the potential impact must be made. (See section 6.323.)

6.314 Groundwater Transport of Pollutants

The final area of hydrologic impact is tied closely to the water quality considerations discussed elsewhere. This issue is how to evaluate the impact of pollutants once they enter the groundwater system. The sources of pollution associated with sewage treatment plants are normally land application sites of wastewater and/or sludge-drying filter beds.

The central problem is that we cannot readily watch or monitor groundwater flow in a manner similar to riverine flow. In addition, groundwater is not confined to a channel, and thus, the aquifer can be as wide as it is long, and the pollutant may spread in all directions. Finally, the rate of dispersion of the pollutant depends in part on the chemical make-up of the soil through which it is passing.

To determine whether or not there is a potential for impacts on groundwater quality, the following list of questions should be answered:

A. Will land application of treatment plant effluent be used as part of the facility plan?

B. Will sludge be applied to sand filter beds for drying?

C. If sludge drying on filter beds is included, will there be under drains to carry leachate back to the treatment plant?

If land application and sludge drying are not included as part of the facility plan, it may be concluded that no impact on groundwater quality will occur. If sludge drying is proposed, and the drying filter design includes an underdrain system to intercept the leachate, it may be concluded that no impact to groundwater quality will occur.

If, however, these conditions are not met, an evaluation of the impact of the project on the groundwater quality must be undertaken as discussed in section 6.324.

6.32 Impact Evaluation

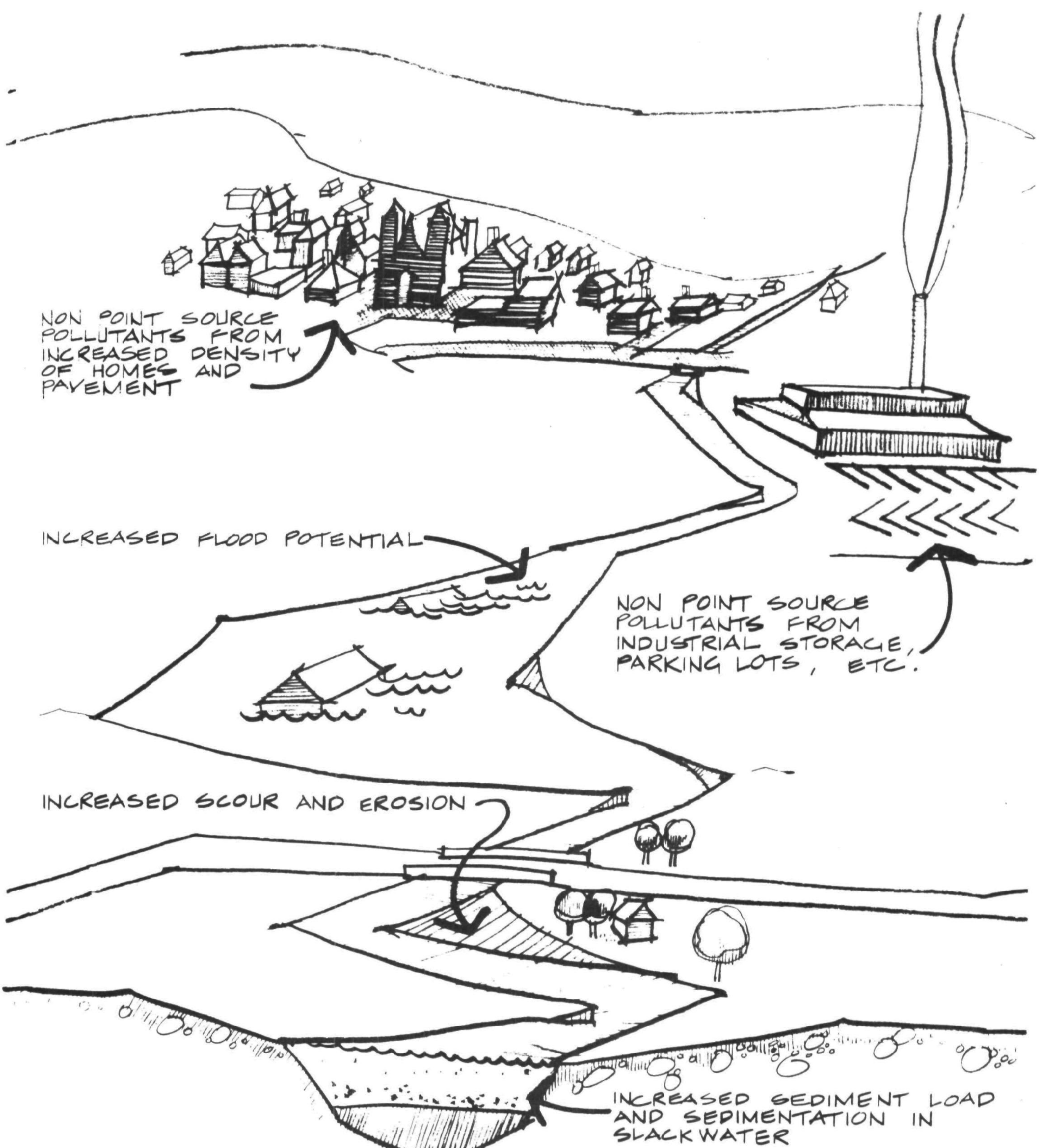
6.321 Increased Rate of Runoff

As stated earlier, the construction of new sewer lines do not directly result in an increased rate of runoff. The increased rate of runoff results from changes in the hydraulic character of the land surface that accompany secondary development that often follows introduction of sewers into an area.

The extent of the induced development area relative to the total drainage area of the stream in question will determine to a significant degree the net impact of a particular project. In order to estimate the impacts of a project it is necessary to estimate the extent of likely future development as a result of the sewering, and the influence of construction codes, which will be enforced during the construction. The literature contains various techniques for estimating the effects of changed land-use conditions on natural flood hydrographs. The use of these procedures at best provides approximate answers since the true effects are so dependent on the proper assumptions concerning the nature and extent of the hypothesized future development. The chapter on secondary impacts includes a suggested methodology to estimate induced growth and its geograpical distribution.

The impacts that result from an increase in peak runoff are basically two-fold. The first is the potential for increased structural damage from flooding and erosion of the stream channel (and subsequent downstream deposition) due to higher flows. The second is the problem of increased pollution in the runoff due to the increase in potentially contaminated impervious surfaces and the increased runoff velocities which can transport more contaminated suspended material. (See Figure 6-3).

In order to evaluate these impacts it is necessary to determine an estimate of the increase in peak runoff that will result from the secondary growth. To do this, certain assumptions must be made and parameters established.



POTENTIAL IMPACTS FROM INCREASED PEAK RUNOFF DUE TO INDUCED GROWTH WITHOUT ONSITE HYDROLOGIC CONTROLS FIG 6-3

A. Establish the density and type of development expected at some future date in the basin.

B. Select the critical hydraulic constriction downstream of the service area where comparisons in flow rates should be made.

C. Develop peak runoff estimates at the point of comparison for both current conditions and the hypothesized future conditions.

The following notes on methodology are offered to aid the facility planner in determining current and future peak runoff values.

If the area is relatively small (less than 1-2 mi^2) and the engineer intends to use a common approach such as the Rational Method for determining peak runoff, the best procedure could be to perform the calculations twice. The first time represents current conditions and the runoff coefficients or "CC" values are weighted according to current land use patterns. For the second evaluation to represent future conditions the runoff coefficients are based on the assumed mix of land use patterns that will develop in the future following introduction of sewers.

If the engineer uses a regional peak flow equation such as those developed by the USGS, it may be possible to adjust for future development within the formulation. (In the New England area this is true of the peak flow equations for Connecticut but not for the other states.) For example, the Connecticut formulation includes a parameter called "percent of area serviced by storm sewers," which is usually indicative of the degree of urbanization and can be estimated for future conditions.

In those areas for which no specific equations have been developed to provide estimates of peak runoff changes, a review of various research studies performed in different sections of the country can yield some rough approximations.

The table below was developed from relationships given in references 1 and 2 and indicates the sensitivity of flow to percent impervious cover. The percentages given are the increases relative to natural conditions expected for each level of percent imperviousness.

Percent Impervious	Recurrence Interval of Peak Flow: 10 Year	50 Year	100 Year
	Percent Increase from Natural Peak Flow		
0	0	0	0
10	18	14	13
20	33	25	33
30	47	35	31
40	60	45	39
50	73	54	47
60	86	63	55
70	98	72	62

As an example, if under current conditions the estimated peak flow for the fifty-year recurrent interval was 1500 cfs and the current percent impervious area was 20%, the future peak with 40% impervious could be estimated as follows:

Future 50-year flow with 40% impervious will be 45% greater than the natural 50-year flow for the basin. Qf = 1.45 Qn where Qf is future flow with 40% impervious area and Qn is natural flow with 0% impervious area.

The current peak flow has been estimated as 1500 cfs with 20% impervious area. To find the natural flow Qn we use the relationship that a 20% impervious area yields a 25% increase in 50-year peak flow.

$$Qc = 1.25\ Qn \text{ where } Qc = \text{current flow}$$
$$Qc = 1500 = 1.25\ Qn$$
$$\therefore Qn = \frac{1500}{1.25}$$

Substituting in the equation for future flow we have:

$$Qf = 1.45\ Qn = 1.45\left(\frac{1500}{1.25}\right)$$
$$Qf = 1740 \text{ cfs}$$

Increase in peak runoff due to development as a percentage of the natural flow is lower for storm events with lower probability and thus longer recurrence intervals. Stated more simply, development will have a greater impact on a 10-year event than on a 100-year event. Thus, when evaluating the impacts of increased runoff, the facility planner must establish what recurrence interval will serve as the critical test. The National Flood Insurance Program has been based upon a 100-year flood profile. Most New England communities are basing flood plain zoning ordinances on the 100-year flood elevation. Thus, the 100-year event is a logical choice from an administrative viewpoint, but from the impact viewpoint more noticeable changes would be likely to occur at the 5- or 10-year recurrence level.

The best route to follow is to select the recurrence interval(s) for consideration following consultation with local officials and planners.

The test of significance for the impact is site dependent, depending on the geometry of the stream under consideration and the extent of flood plain development downstream. At constrictions to flow, the depth of water must be determined for both current peak runoff and predicted future peak runoff.

To determine flood depths at a given location basic hydraulic calculations for open channel flow must be performed. At a natural valley section this is a normal depth calculation. At a dam or weir the calculation is to determine the driving head behind the dam using the weir equation. At a bridge the calculation may be either a normal depth, an orifice calculation or a weir calculation, depending on whether the given flow is found to cause pressure or weir flow.

If the increase in water surface elevation is sufficient to inundate areas with development that under current conditions are outside the flood plain, the impact is significant. If the increased flow is still contained within the undeveloped flood plain or at least no additional developed areas are flooded, the impact is not significant.

6.322 Inter-Basin Transfer

The impact of an inter-basin transfer of wastewaters can only be evaluated on a site-specific basis. The main concern is whether or not minimum flows in surface streams can be maintained and the sufficiency of those flows. In addition, any adjustment to the water table elevation must be considered, and this adjustment will be more fully discussed in the next section. Regarding the minimum stream flow, the types of issues involved are: pollution concentrations from discharges are based on an assumed minimal flow, cooling water requirements of industry assume a minimal flow, aquatic biota systems may be adversely affected if stream flows drop below given threshold (see wetlands chapter).

Basically, a water balance for the inputs and outputs to a given basin should be developed. (See Figure 6-4) The inputs include precipitation, domestic water supplied from outside the basin, and any groundwater flow that crosses from one surface water basin to another. The outputs are streamflow, evapo-transpiration, groundwater outflow, and any wastewaters exported to another basin for treatment.

Under current conditions, the wastewater was adding to stream flow either directly from outfalls, or indirectly as base flow from the aquifer which was being partially recharged by on-site disposal systems.

If the existing total wasteflow approaches the deserved stream flow during dry periods, it can be concluded that removal of all wastewaters from the basin will significantly impact the stream flows during periods of low flow. If the reduction in flow is significant due to cooling requirements or aquatic biota systems, then the inter-basin transfer must be considered to have a significant impact.

6.323 Modification to Water Table

When evaluating the impact on the water table of a sewer project, these questions must be answered:

A. Is a water table map available for the project area? (See Figure 6-5)

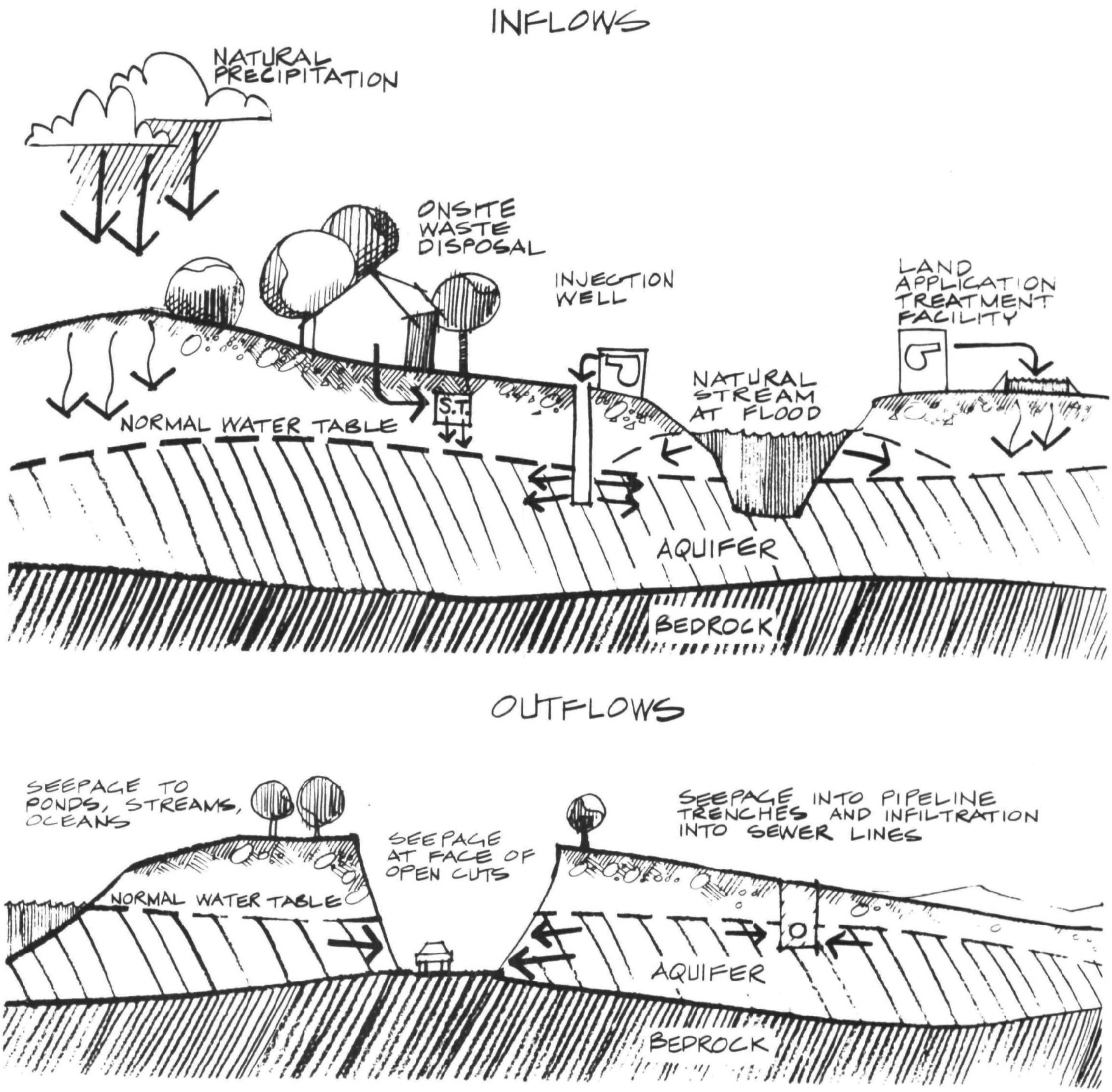
B. Are soil samples from boring logs or well logs available to provide subsurface information on soil types?

C. Where are the nearest ponds or streams that may interact with the aquifer?

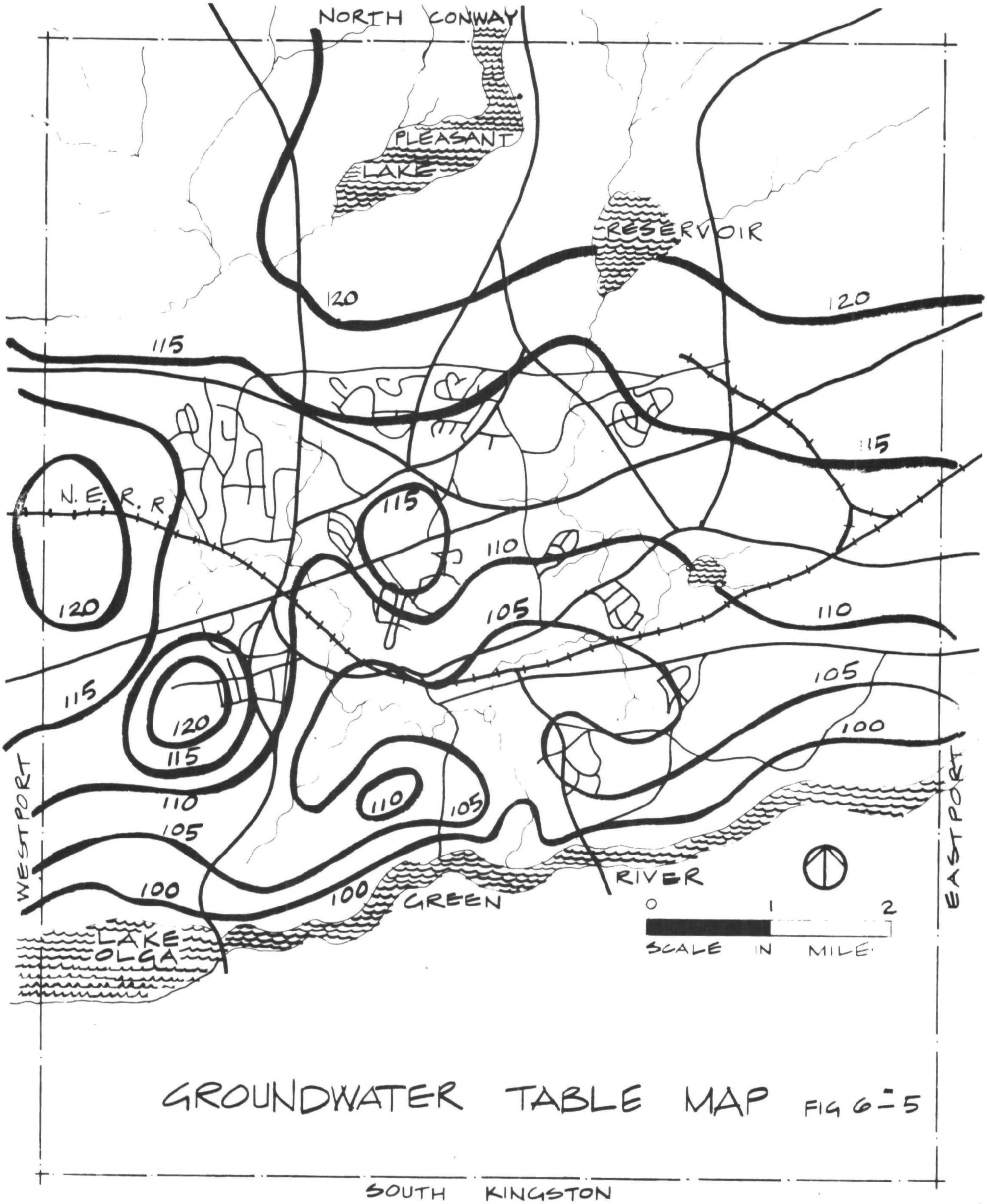
D. If land application is proposed, what is the application rate and where is the application site relative to domestic water supply wells or natural groundwater springs?

E. Have any groundwater studies on regional flow patterns been performed by U.S.G.S. or a state agency?

To obtain data on the water table elevations it is necessary to seek out the existence of any observation wells. An observation well is simply a hole through which it is possible to measure the depth to water. A pumped domestic supply well does not serve this purpose since the water table is drawn down around a well that is regularly pumped. The USGS may have some observation wells in the area of concern, the local water department will have them if they are pumping from the aquifer, and abandoned private domestic wells can serve as well. If there are no observation wells available, the next best estimate is to compare the elevations of natural as opposed to man-made ponds and assume that the ponds reflect the water table in their vicinity.



WATER TABLE BALANCE FIG. 6-4



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The soils data is normally obtained from well logs and can be supplemented by construction site borings if they are sufficiently deep. When evaluating the soils data, the primary objective is to determine how much clear stratification exists and whether or not any of the layers are impermeable to water and thus function as aquicludes above which the groundwater is perched. Naturally, the deeper the soils data, the better; but in some cases local data will not penetrate to bedrock or any other obvious aquiclude. In these cases it will be necessary to estimate the aquifer thickness based on a regional literature search or collect additional field data including some deeper holes.

The level of detail necessary to pursue with the basic data is naturally dependent on the factors associated with the proposed project. The potential projects can be subdivided categories: (a) projects where the anticipated impact is limited to a lowering of the water table, (b) projects where land application is anticipated to raise the water table at the application site in conjunction with lowering it in newly sewered areas.

For the first group of projects the key question is whether the sewer lines and surrounding trenches will serve as drains. This would occur if the natural water table changes rapidly along the direction of the proposed sewer and the natural undisturbed soils are very compact with low permeability. The sewer trench would then represent a path of less resistance for the groundwater at the higher elevation, and it would flow out along the trench. To determine whether or not this is likely to occur a map of the sewer network should be laid over the best groundwater map available. Invert elevations of each manhold should then be compared to the water table elevation to establish which portion of the sewers are located below the water table. Whenever the water table map indicates that a significant hydraulic gradient exists along the direction of a sewer trunk, groundwater flow in the trench can be anticipated.

The significance of the potential for a drop in water table depends on the use and character of the aquifer affected. If the water table is connected to a wetlands area (see the Wetlands section), the impact may be major. If any old structure were built on wooden piles, a lowering of the water table can severely shorten the life of the foundation. If local residents are pumping domestic water from shallow wells for household use or yard use, a drop in water table may prohibit the use of suction pumps. Quantifying the size of the drop in water table requires more detailed analysis than an environmental assessment would permit, thus the evaluation is limited to whether or not the potential for a drop in water table exists and whether if a drop occurred it would impact structures, wetlands, or users of the aquifer.

For those projects that include land application of waste-water at a centralized facility it is necessary to conduct a more thorough and involved analysis of the impacts of the project. Any type of land application will result in a large increase in recharge over a limited area. This concentration will result in a groundwater mound around the recharge point which can be thought of as the inverse of the "cone of depression" found at pumping wells. The magnitude of the mound will depend on the aquifer thickness, soil conductivity, and the application method and rate. There are empirical methods available to evaluate local mounding conditions. (Reference 3), but such methods cannnot evaluate the interaction between the recharge site, pumping wells, and discharge boundaries throughout the associated aquifer. The best methodology for attempting to evaluate the entire new equilibrium condition under alternative scenarios is to develop a digital (or analog) groundwater simulation model. This level of effort, however, is beyond the scope of an Environmental Assessment, and thus, if land application is evaluated as a viable alternative for the facility plan (see the Chapter on Land Application), a thorough analysis of the impact on the groundwater table must be called for as part of the overall project.

6.324 Groundwater Transport of Pollutants

Predictions of pollutant flow in an aquifer are at best estimates based on assumed dispersion and decay coefficients. No real data is likely to be available for a prospective site, and thus, all evaluations must be based on utilizing ranges of data available from research studies conducted at a limited number of sites.

The transport of a pollutant through an aquifer is the combination of two forces. The pollutant is being carried along with the main groundwater flow pattern (advection), and it is spreading out from areas of high concentration (polluted water) to areas of low concentration (clean water) which is the process of dispersion.

The only effective method of fully analyzing this complex situation is to solve second order differential transport equations utilizing a computer model. This type of analysis is beyond the scope of an Environmental Assessment. Thus, at the assessment level if land applications or sludge drying without underdrains is proposed, and any domestic wells or ponds or streams with high quality water lie down-gradient of the site, a thorough analysis of the impacts should be recommended prior to approval of the project.

6.4 REFERENCES

(1) Stankowski, Stephen J., Magnitude and Frequency of Floods in New Jersey with Effects of Urbanization, Special Report 38, prepared by U.S. Geological Survey in cooperation with State of New Jersey, Department of Environment Proection, Division of Water Resources, 1974.

(2) SCS National Engineering Handbook, 1972, Section 4-Hydrology, Chapter 16-Hydrographs

(3) Hantush, Mahdi S., "Growth and Decay of Groundwater Mounds in Response to Uniform Percolation," Water Resource Research, Vol. 3, No. 1, 1967.

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wetlands

7. wetlands

CHAPTER 7 - WETLANDS

7.0 INTRODUCTION

Each of the New England States has adopted regulations governing the protection of wetlands. Although the regulations and the extent of their enforcement varies, each state has recognized the functional values of wetlands in affecting water quality, water quantity and the natural ecology.

At the Federal level, Executive Order No. 11990 has been issued by President Carter, mandating a careful consideration of wetland impacts for all construction funded by the government. The EPA, Army Corps of Engineers and other federal agencies have issued new regulations designed to implement this order and minimize loss of wetlands.

Since many wetlands are located adjacent to streams or rivers, it is natural that they may be altered or impacted by proposed wastewater facilities. Gravity flow sewers are generally preferred, and the natural routes often cross wetlands. Treatment plants, too, are usually located near a stream or water body with a consequent potential for wetland impacts.

In addition to the primary impacts of construction there are the secondary impacts which result from development in the vicinity of wetlands. Such impacts can include sedimentation, siltation due to erosion, septic leaching, nutrient input and rapid runoff. The capacity of a wetland to deal with erosion and runoff from development may be overwhelmed if adequate precautions are not taken.

Wetlands are made up of a variety of physical and biological processes which interact in a complex, and often subtle, fashion. Sophisticated models have been developed to evaluate the environmental impact of development on such processes. Those, however, require an extensive data base and the use of computers.

The methodology proposed in this chapter has been developed to enable the engineer or planner preparing the environmental assessment to:

- -- determine the value of the wetlands in his planning area;
- -- identify the types of impacts that might occur; and
- -- assess the general significance of an impact to the wetland.

This methodology enables a qualitative judgment to be made on the significance of potential wetland impacts at an early stage in the facility planning process. Alternatives which minimize these impacts can be pursued in further detail and the entire wetland assessment process incorporated into Step I activities.

7.1 RELEVANT FEDERAL LEGISLATION INCLUDES THE FOLLOWING:

7.11 Federal Water Pollution Control Act (PL 92-500)

This Act established the program to clean up the nation's waters by providing facilities construction grants (Sec. 201) to communities for wastewater treatment plants. The Act also cites the crucial role of wetlands in serving several important environmental functions (see part 7.32 below). The maintenance of these functions is charged to the Army Corps of Engineers under Section 404 through permit review of dredge and fill activities.

7.12 Water Resources Development Act of 1974 (Sec. 73)

The Act requires that in the survey, planning or design by any Federal agency of any project involving flood protection, consideration shall be given to nonstructural alternatives to prevent or reduce flood damages, including the acquisition of floodplain lands for recreational, fish and wildlife and other public purposes.

7.13 Coastal Zone Management Act, 1972 (PL 92-583)

The Act includes tidal wetlands as one type of critical area to be preserved through state-managed CZM programs. Each New England coastal state is preparing draft management plans for submission to the National Oceanographic and Atmospheric Administration for approval and funding. At this writing, none have been officially approved, and most rely upon existing state wetland laws for implementation.

7.14 Executive Order No. 1190, May 1977

This Presidential Order reinforces earlier Orders which mandate the avoidance of wetlands unless there is no practical alternative. Federal agencies are required not to fund any construction activity unless there has been a thorough analysis of all possible options, and there are sufficient measures to minimize harm to wetlands which may be impacted.

7.15 Draft EPA Policy, August 1977

This draft PRM was circulated to indicate the policies being considered to implement Executive Order 11990 (Wetlands) and 11988 (Floodplains). Revised policies will be issued later in 1978. The draft policy requires consideration of alternatives outside of wetlands; evaluation of primary and secondary impacts to wetlands; mitigating measures for both primary and secondary impacts such as the effect of induced growth on wetlands; public notification of wetland impacts; and A-95 notice of impacts.

7.16 EPA Policy (38 FR 10834, May 2, 1973)

This policy statement, titled "Protection of the Nation's Wetlands," provides that funding may not be granted for construction that may interfere with the existing wetlands ecosystem unless no other alternative of lesser environmental damage is found to be feasible. If adverse impact may occur, the applicant must prepare an assessment that delineates alternatives that have been considered and the reasons for rejecting them.

7.17 National Environmental Policy Act regulations

NEPA regulations require full evaluation of any effects on wetlands. Under 4 CFR 6.510(b) an EIS is required whenever any major part of a treatment works is located in productive wetlands or will have adverse primary or secondary effects. The NEPA regulation (40 CFR 6.214(b)(1)) requires that if a project may affect wetlands, the Department of the Interior, Department of Commerce, and Corps of Engineers must be consulted during the enviromental review in order to determine probable impacts on the fish and wildlife resources and use of the area.

7.2 STATE LEGISLATION CONSISTS OF:

7.21 Connecticut Wetlands Protection (CGS Sec. 22a-32, 22a-36)

Any proposed dredging, filling or development of tidal wetlands requires a permit from the Commissioner of Environmental Protection (Section 221-32). The Inland Wetlands and Water Courses Act (Section 221-36) addresses the value of these areas as flood storage areas, wildlife habitats and recreation areas. Any dredging or filling and many types of development require a permit from the municipal inland wetlands agency, or, in its absence, the Department of Environmental Protection.

7.22 Connecticut Stream Encroachment Program (CGS Sec. 25-4a)

The establishment of "stream encroachment lines" along inland or tidal waterways beyond which, in the direction of the waterways, no obstruction or encroachment is permitted unless authorized is an additional protective mechanism for wetland areas managed by the Department of Environmental Protection.

7.23 Rhode Island Inland Wetlands regulation (RIGL Title 2, Chap. 1, Sec. 9)

Both local and state approval (from the Department of Natural Resources) are required prior to alternation of any fresh water wetlands. An inventory procedure and penalties for violations of rulings have been amended to the Act.

7.24 Rhode Island Coastal Wetlands Act (RIGL Title 2, Chap. 1, Sec. 13) and Intertidal Salt Marsh Act (RIGL Title 2, Chap 46, Sec. 1)

The Coastal Wetlands Act authorizes the Department of Natural Resources to issue restrictive orders to stipulate permitted uses. The Intertidal Salt Marsh Act requires permits for constructon activities in a narrowly defined area between the high and low tide line.

7.25 Massachusetts Wetlands Protection Act (MGLA Chap 131, Sec. 40)

A permit is required from the local conservation commission for any project which would occur within 100 feet of any wetland, river bank, beach, waterbody, marsh or bog. Notice of Intent is filed with the commission, local hearings are held, and orders of conditions are set to regulate the impacts of the proposed project.

7.26 Massachusetts Wetlands Restriction Program (MGLA Chap 131, Sec. 40a)

The Department of Environmental Management restricts the removal, filling, dredging or alteration of any wetland which it has mapped and designated under this program. Deed restrictions are filed with the county registries and become permanent for that parcel of property. Certain public projects are exempt.

7.27 Maine Coastal Wetlands Protection Act (MRSA Title 38, 471-478)

The Department of Environmental Protection, Board of Environmental Protection administers the dredging and filling of coastal wetlands under the Wetlands Act. A permit is required for dredging or filling, and will not be granted if such activities threaten public health, the value of adjacent lands, public water supply or fish and wildlife habitats.

7.28 Maine Stream Alteration Act (MRSA Title 12, Sec. 2205-2212)

The Act requires permits for any activity along streams or brooks and adjacent lands which would create soil erosion; interfere with streamflow; cause harm to fish or wildlife habitat; or affect water quality or water supplies. Exemptions are provided for public works related stream crossings where less than 150 linear feet on either bank (or a total of 300 feet) would be altered.

7.29 New Hampshire Wetland Protection Legislation (RSA 149:c4, 482:41e, 483-A, 488-A)

These Acts regulate the development of inland and coastal wetlands through local conservation commissions (where formed) and the Water Resources Board, Water Supply and Pollution Control Commission. Notification of any project that would affect a wetland must be sent to the town and to the Water Resources Board. Hearings are held on the proposal and permits issued for the project.

7.210 Vermont Act 250 (No. 250, Acts of 1969)

A permit is required from the Environmental Boards of the District Commissions for major development projects. Wetlands are one of the several factors which must be considered when impacts are assessed. The proposed projects must not cause "a reduction in the capacity of the land to hold water so that a dangerous or unhealthy condition may result."

7.2 PAST PRACTICES

For many years wetlands had been thought of as wastelands which hindered land development and posed health meances to local residents. Widespread drainage and "reclamation" projects have reduced the estimated original total of 127 million acres of wetlands in the continental U.S. to approximately 70 million acres.

Wastewater collection systems are designed to function in the most efficient and lowest cost manner possible. From the standpoint of sewer interceptor layout and design, this has entailed taking maximum advantage of existing topography to provide necessary pitch and run for the system. Because they lie in the lowest elevations along natural drainageways, wetlands have almost always been ditched for construction of gravity-flow sewer systems.

In certain instances the alignment of the interceptor, combined with the layout of attendant laterals, has resulted in the destruction of entire wetland systems. This has especially been true in many expanding urban areas.

In those neighborhoods that were constructed in low-lying areas, the natural drainage pattern was often under heavy stress to begin with. Wetlands had often been reduced to a fraction of their original size, with surface runoff velocities substantially increased. The wetland and surface water remnants were also seriously degraded by nonpoint wastes, pesticides, detergents, acids and alkalines. The density of the private, on-lot septic systems often exceeded the capacity of local soils to handle the effluent.

The design engineer responded to the public priority of alleviating the sewage disposal problem under the municipal and governmental priorities of minimum cost. The service areas were delineated. Then the most expeditious collection system was laid out, and the treatment facility was placed as far downstream as possible. The interceptors ran back up through the lowlands with the laterals running out to the adjacent neighborhoods along the route. The streams that may have meandered through the wetlands were deepended; straightened and rip-rapped to take the increased storm water flow. And the wetlands were generally drained to accommodate the new development which could now tie in to the sewer. So the wetlands were ditched, drained, filled, and forgotten.

Recent wastewater collection projects, however, have faced serious delays due to changing public priorities for wetlands protection. Many projects had proceded well into Step 2 - Detailed Design activities with portions of the system routed through wetland areas. Oftentimes, the preliminary reviews by state, sub-state regional planning agencies, and local boards had not indicated any problems. At the final public hearings on specific interceptor routes, however, citizen groups would begin to question the effects on this or that wetland. And, under recently passed state or federal legislation, their concerns had to be addressed. Projects ready to go out to bid had to be revised. Alignments had to be altered and interceptors re-routed. Service areas had to be juggled, and, sometimes, even portions of them lopped off in order to minimize potential harm to a swamp.

The delays were frustrating, and the revisions were expensive. The engineering time and the ecological surveys required by the new legislation were not covered by the original Step 2 grants. Complex renegotiations were required, and contract amendments had to be resolved. New procedures had to be established, tested, and revised as the new legislation was implemented. And when all was said and done, the revised facility design had minimized the wetland impacts, but the delay during redesign had generally cost the project dearly in both time and money.

7.3 SUGGESTED METHODOLOGY

The methodology developed in this chapter is designed to be incorporated directly into the Step 1 - Facilities Planning process. By doing so, it is anticipated that serious delays ca be eliminated from later design and construction phases. The wetland assessment methodology is a 4-step process in which you:

- -- Locate wetlands;
- -- Evaluate the wetlands;
- -- Identify the construction impacts; and
- -- Assess the significance of the impacts to the wetland.

The following three sections elaborate on each suggested step and provide references to supplemental sources of information. Although these suggested steps are not EPA requirements under the facilities planning process, they are consistent with draft wetland evaluation procedures being considered by the U.S. Army Corps of Engineers under their "Secton 404" wetlands permit program. As such, they are indicative of current state-of-the-art thinking by Federal agencies on wetland evaluation techniques.

7.31 Locate Wetlands

The definitions of "wetland" can vary somewhat in technical detail from state to state within New England. Each state has adopted some form of legislation which incorporates definitions for wetland preservation. The Massachusetts' "Wetlands Protection Act," for example, has a set of regulations which defines the specific vegetation communities which are found in various types of wetlands. These can be used to precisely establish the limit of any one type of wetland. Section 7-2 of this chapter lists these various state laws and regulatory programs. These state requirements and their local interpretations should always be incorporated as the first step in defining the wetland and its boundaries.

An excellent reference which sets the standard for delineating wetlands is Wetlands and Floodplains on Paper, prepared by the Massachusetts Audubon Society. This brief guidebook presents a clear and concise method for identifying and mapping wetlands. Because it is designed for local conservation commissions, it provides a useful tool to guide the preparation of documents which may come under review by local jurisdictions. It is consistent with many of the procedures used in other New England states.

"Wetlands on Paper" suggests that the least expensive means of determining the location of wetlands is to cull as much as possible from existing sources. Local planning reports, regional planning agency map atlases and certain state agencies will often have information on wetlands. The RPA (regional planning agency) may also have prepared fairly specific data under the "208" Areawide Wastewater Planning Program which sometimes cites wetlands of regional significance. Some communities may have had their wetlands mapped from aerial photographs onto assessor's sheets. These are the best and most accurate sources of data.

As a last resort, USGS quad sheets can be photographically enlarged to a scale of 1 inch to 500 feet to serve as base maps. However, the ten-foot contour intervals are generally much too vague and should be supplemented with more specific 2-foot contour maps, wherever available. SCS soils maps can be interpreted, where available, for soils where the water table is "at or near te surface for a significant number of months per year" and then photo-enlarged to a best fit with the quad sheet base map. If there are aerial photographs available through the town, regional planning agency, or state, they should be stereo-interpreted by texture, tone and patterns for wetland boundaries. This requires training and familiarity with air photo interpretation techniques, however.

Once all available information has been collected, it can be combined into a composite wetlands map (see Figure 7-1). The boundaries can be averaged and later, if need be, field checks can be made in the immediate vicinity of any potential interceptor route. The composite wetlands map should be prepared at a map scale that is consistent with other inventory maps prepared during the early phases of the facilities planning process. Examples of these other maps would include land use, topography, drainage areas and proposed service areas.

The proposed service area map is of critical importance to the next step: evaluating the wetlands. As is noted in the secondary impacts chapter of this Handbook, the service area (...and those areas which may have secondary growth induced by the facility) should be mapped very accurately.

Before going any further with wetlands analysis, the service area map should be overlaid with the wetlands map. If any wetlands are located within or continguous to a service area, this should raise a read flag to the facilities planning team (see Figure 7-2). Alignments which avoid the wetlands, yet still connect the service areas should be explored.

Alternative treatment techniques that may be available to specific "needs" areas (see Chapter 2, Needs Analysis) can also be considered where the wetlands make traditional gravity systems problematic. Once the various alternatives have been considered by adjusting the configurations to avoid the wetlands, those wetlands still within the service area or along a potential interceptor route should be carefully evaluated to determine their value to the local ecosystem. The following section presents one method of determining the importance of a wetland.

7.32 Evaluate Wetland

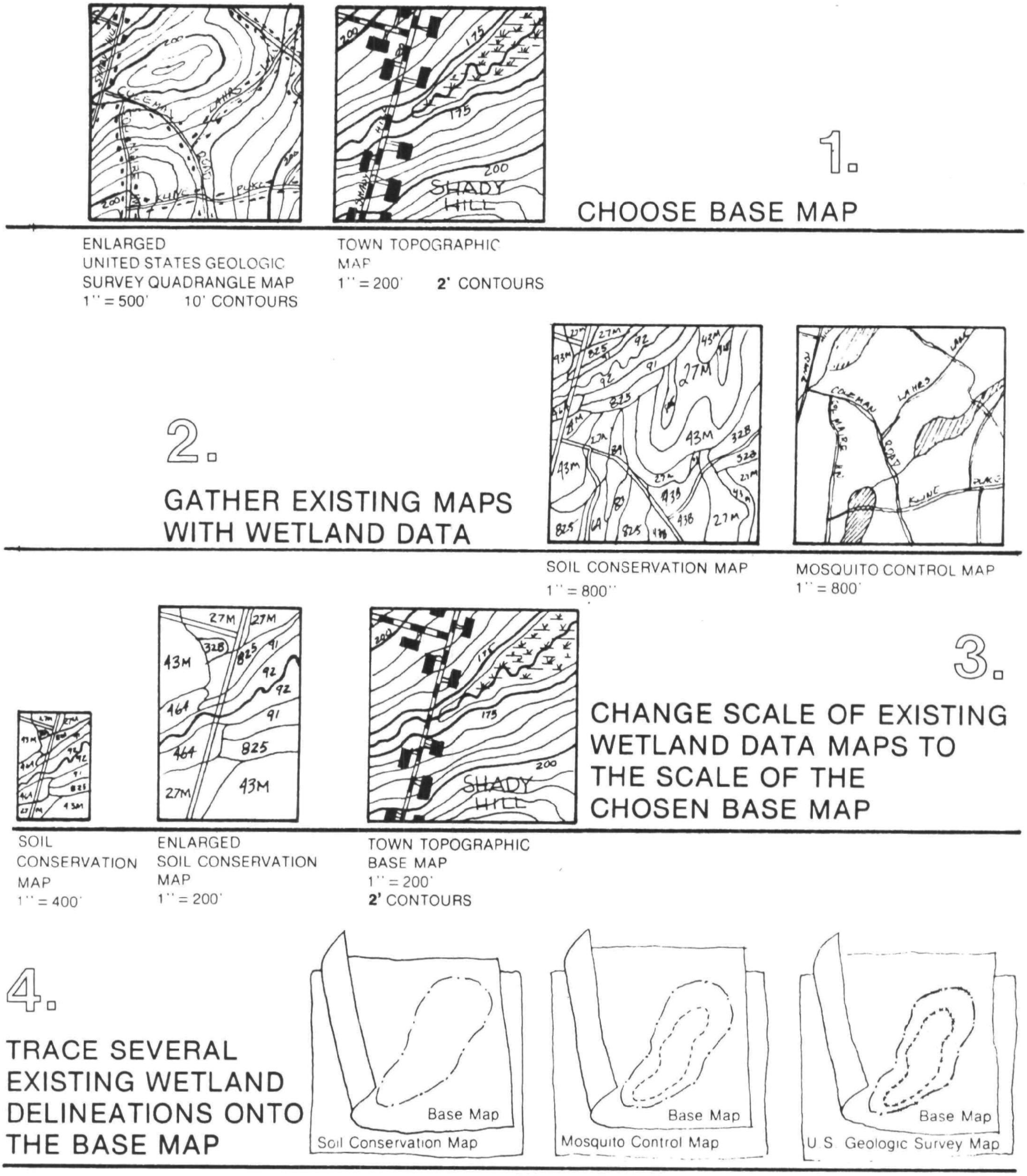
Once it has been determined that the potential design alternatives will overlap with a wetland area, the wetland should be evaluated to determine its functional importance. The U.S. Army Engineer Institute for Water Resouces has developed an excellent document which goes into great detail on wetland evaluation. Chapters 2 and 3 of the Army's Wetland Values, Interim Assessment and Evaluation Methodology have been adapted and streamlined for purposes of this manual. The simplified procedure presented here does away with much of the complex biological detail suggested in Wetland Values and, instead, focuses on the most widely accepted functional characteristics of wetlands.

The legislation which provides facilities grants for the clean-up of the nation's waters, Federal Water Pollution Control Act (PL 92-500), cites the following important public functions provided by wetlands:

A. Biological functions including food chain production general habitat, and nesting, spawning, rearing and resting sites for aquatic and terrestrial species;

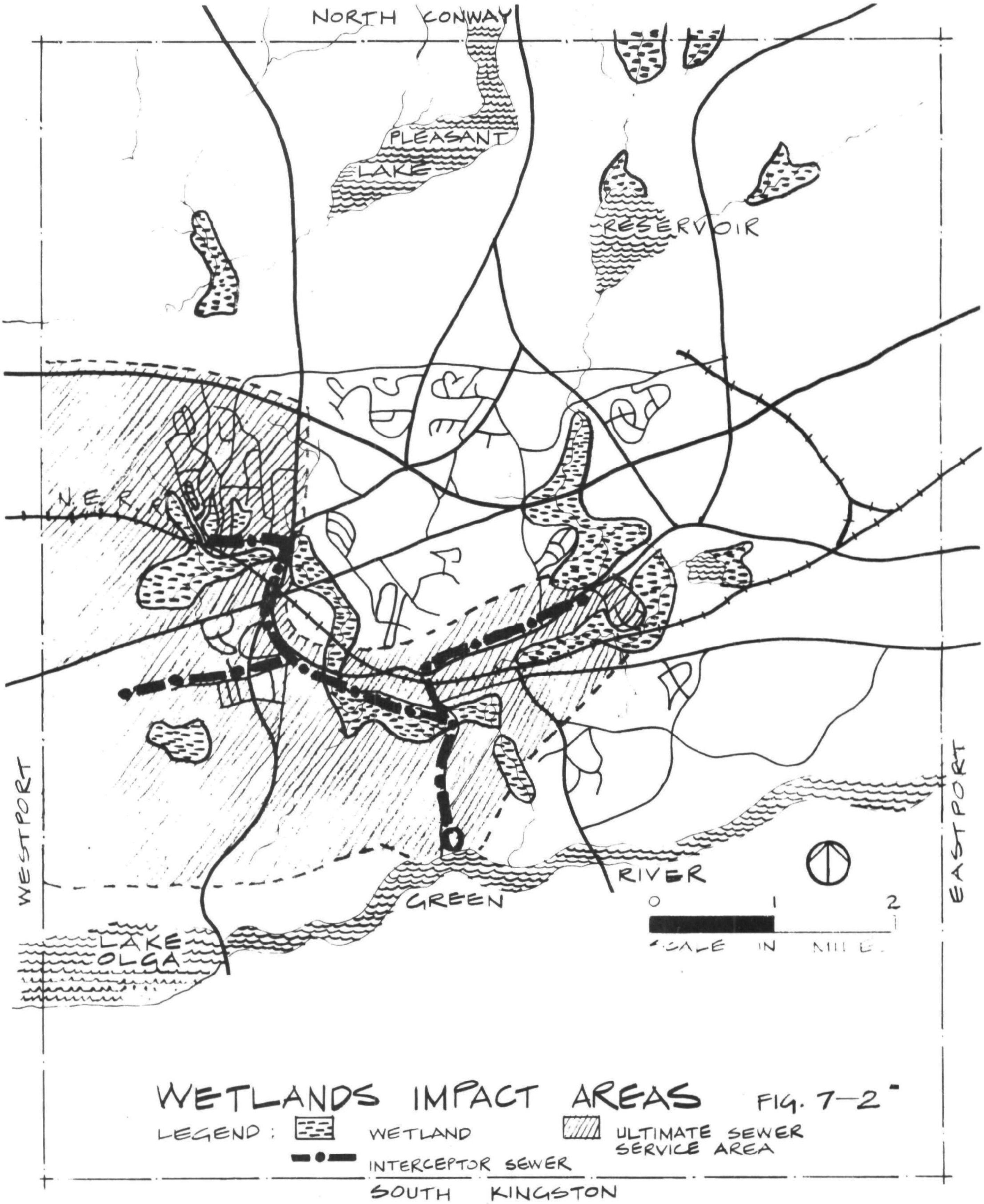
B. Functions which affect the natural drainage characteristics, sedimentation pattern, salinity distribution, flushing characteristics, or other environmental characteristics of critical environmental areas;

C. Functions which are significant in shielding other areas from wave action, erosion or storm damage such as those found or barrier beaches, islands, reefs and bars;



COMPOSITE WETLANDS SKETCH FIG. 7—1

SOURCE: MASS AUDUBON WETLANDS PROJECT



WETLANDS IMPACT AREAS FIG. 7-2

D. Functions which serve as valuable storage areas for storm and flood waters;

E. Functions which provide prime natural recharge areas where the surface and groundwater are directly interconnected; and

F. Functions which serve to purity water through natural water filtration processes.

While we can evaluate a wetland's functional value in terms of flood storage or shielding a house from wave impact, the "intrinsic" biological values are difficult to quantify. This presents a handicap to those decision-makers responsible for regulating construction activities in or near wetlands. The best that can be achieved at this point in time is the evaluation of wetlands on a case-by-case basis, using good, common sense and professional judgment to assess each function.

The recommended evaluation methodology groups the functions listed in the federal legislation into seven primary and six secondary characteristics. The method for determining the relative importance of each function is listed below and on the following Wetland Evaluation Worksheets, Tables 7-1A and 7-1B:

WETLAND EVALUATION WORKSHEETS

TABLE 7-1 A.

DESCRIBE AND EVALUATE EACH WETLAND CHARACTERISTIC AND FUNCTION

1. IMPORTANCE TO WATERSHED :	QUALITATIVE VALUE :
2. NATURAL VALLEY STORAGE :	QUALITATIVE VALUE :
3. SHIELDING FROM WAVE DAMAGE :	QUALITATIVE VALUE :
4. AQUATIC SANCTUARY/REFUGE :	QUALITATIVE VALUE :
5. HABITAT & PRODUCTIVITY :	QUALITATIVE VALUE :
6. WATER FILTRATION :	QUALITATIVE VALUE :

WETLAND EVALUATION WORKSHEETS

(School Street Swamp)

TABLE 7-1 A.

DESCRIBE AND EVALUATE EACH WETLAND CHARACTERISTIC AND FUNCTION	
1. IMPORTANCE TO WATERSHED: School Street Swamp is part of an important local watershed and drainageway. There are wetlands immediately up and down-stream. Further downstream, Muddy Brook connects to a smaller wetland. School St. Swamp is one of the largest wetlands in the Muddy Brook watershed.	QUALITATIVE VALUE: Very Important
2. NATURAL VALLEY STORAGE: The Swamp covers about 165 acres; it averages 5 feet deep; the storage capacity is about 33 million cubic feet which appears to be about 1/3 of the watersheds wetland storage capacity. Total land area in the watershed is about 16 sq. mi. There is older urban development downstream at South Village which is located in the flood plain (see 6:4 — Hydrology)	QUALITATIVE VALUE: Very Important
3. SHIELDING FROM WAVE DAMAGE: (Not applicable)	QUALITATIVE VALUE:
4. AQUATIC SANCTUARY/REFUGE: Not applicable — Nearest sanctuary is 3 miles Northeast at private waterfowl refuge.	QUALITATIVE VALUE: None
5. HABITAT & PRODUCTIVITY: Is wooded wetland; subject to seasonal flooding. No data on wildlife. Residents note wood ducks nest there. No data on biological productivity, but vegetation appears healthy, no stagnation or odors, wildlife habitats seem stable, large number of birds. Residents have annual turtle races at summer fair.	QUALITATIVE VALUE: Moderate to Fair
6. WATER FILTRATION: Nutrient Processing discharges into lower end of swamp at Muddy Brook. There may be upstream non-point pollution problems but lab tests are not available yet on Muddy Brook water samples. Streamflow is approximately — cfs to — cfs (spring & late summer)	QUALITATIVE VALUE: Unknown at Present

WETLAND EVALUATION WORKSHEETS TABLE 7-1 B.

(School Street Swamp)

7. GROUDWATER RECHARGE : Wetlands account for about 500 acres of total 10,200 acres (approx) in entire watershed, or 2.0%. Another 10% is high water table soils (FIG. 2-[illegible]), 5% is slowly permeable soils. No major public water supply aquifers ([illegible]). 2 industrial wells operated by Nutrient Products.	QUALITATIVE VALUE : Minor
8. COMMERCIAL FISHERIES : (Not applicable)	QUALITATIVE VALUE : —
9 RECREATION : Occasional hunting and trapping in swamp. Some ice skating during winter. Nearby hunting and fishing areas in Green River are more actively used.	QUALITATIVE VALUE : Minor
10. AGRICULTURE / AQUACULTURE : No agriculture	QUALITATIVE VALUE : None
11. CULTURAL IMPORTANCE : None in immediate vicinity.	QUALITATIVE VALUE : None
12. AESTHETICS : No noticeable odors except immediately below Nutrient Products discharge pipe. Noise from railroad is audible due to whistling for School Street grade crossing. Dense red maple stand makes closed visual env.	QUALITATIVE VALUE : Minor
13. SPECIAL VALVES : Provides a greenbelt for South Village. South Village ice skating club at School St Pond at south end of swamp.	QUALITATIVE VALUE : Locally Important.

WETLAND EVALUATION WORKSHEETS TABLE 7-1 B.

7. GROUNDWATER RECHARGE :	QUALITATIVE VALUE :
8. COMMERCIAL FISHERIES :	QUALITATIVE VALUE :
9 RECREATION :	QUALITATIVE VALUE :
10. AGRICULTURE / AQUACULTURE :	QUALITATIVE VALUE :
11. CULTURAL IMPORTANCE :	QUALITATIVE VALUE :
12. AESTHETICS :	QUALITATIVE VALUE :
13. SPECIAL VALVES :	QUALITATIVE VALUE :

7.321 Primary Functional Characteristics

A. Importance to Watershed - Is the wetland contiguous to other wetlands which cumulatively form a larger surface water drainage system? If so, describe the overall linkage from one wetland to another; the location of the subject wetland relative to the system; its size in acreage relative to others up- and downstream. If the wetland is isolated and not connected to a larger drainageway, say so.

B. Natural Valley Storage - Determine the importance of the wetland's storage capacity of flood water by estimating:

1. its size in acres and average depth in feet;
2. the approximate area of the watershed;
3. the capacity (depth X size) for the flood storage;
4. approximate percentage of the total watershed's storage; and
5. is any downstream land use located in the flood-plain?

C. Shielding from Wave Damage (Coastal Wetlands) - If you are dealing with a coastal wetland: how wide is it? What type of vegetation does it support? How much land use is located along its landward side? Is there a significant length of open water fetch offshore? Is there a local history of coastal flooding and property damage?

D. Aquatic Sanctuary or Refuge - Is there any information on whether the wetland is used or has been formally designated as a waterfowl or wildlife sanctuary? Are there others of a similar type nearby? If so, how close are they and how large?

E. Habitat ad Productivity - What type of wetland is it: bog, wet meadow, deep or shallow march, shrub swamp, wooded swamp, salt marsh, dune, beach, barrier beach? Is it ever subject to coastal storm flowage or riverine floods? Is there any indication of the type of wildlife habitat present? (See U.S. Fish and Wildlife Circular 39) Is there any information on the productivity of the wetland? Is there regular flushing by tides, currents or streamflow? Is there any information on the vitality of the vegetation and wildlife? (See Figure 7-3).

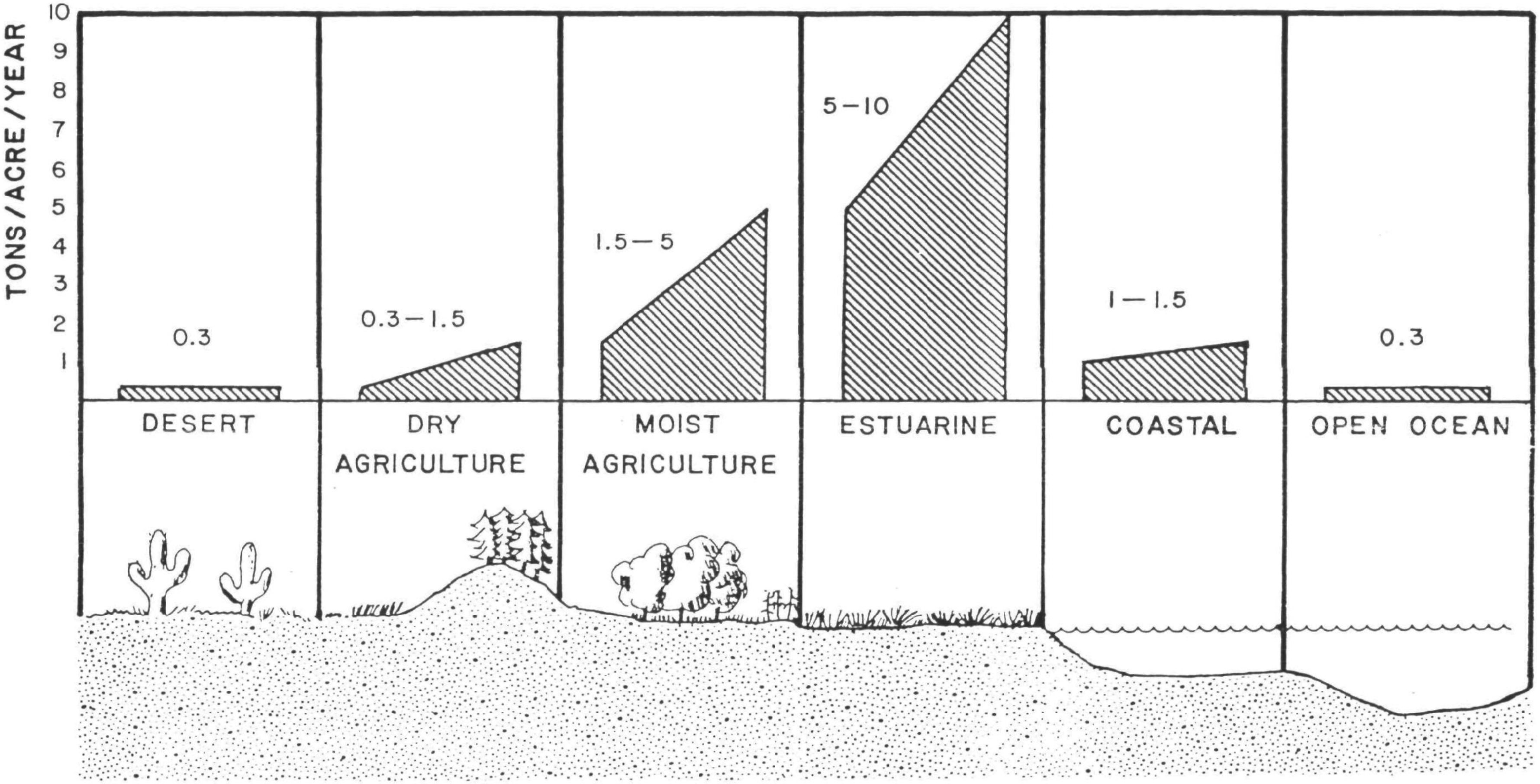


Figure 7—3 Comparison of the levels of organic matter production in different types of ecosystems. (After Teal and Teal, 1969). Coastal wetlands, with annual production rates of 5-10 tons per acre, are the most productive areas on earth.

F. Water Filtration - Are there significant upstream point or non-point discharge problems? Is there a significant BOD loading? What is the approximate range of streamflow? Include the type and size of the method from 1 and 5, above. Describe the flushing pattern from 5, above. Is there any change in downstream water quality?

G. Groundwater Recharge - What percentage of the total watershed area is made up of wetlands? What are the water uses in the watershed: water supply, wastewater assimilation, fishing, swimming, boating, wildlife? What is general porosity of soil, permeability, transmissability foreground water recharge potential? What are porjected water supply needs of community, industry, agriculture?

7.322 Secondary Values

A. Commercial Fisheries - Type of estuarine habitat? Food chain productivity function? (See E above) presence of estuarine-dependent commercial species: flounder, shad, alewives, clams, shrimp, menhaden, sea bass, striped bass, salmon, etc.

B. Recreational Activities - Type of recreational activity if any: hunting, fishing, canoeing; frequency of use: heavy or infrequent? Level of significance: neighborhood, townwide, etc.

C. Natural Resource Extraction - Is the wetland used for either:

1. agriculture use: crops, woodlot, pasture, etc.?
2. aquaculture: oysters, lobster, scallops, etc.?

D. Cultural Importance - Historic-Archaeological Importance:

1. Federal (National Register properties nearby)?
2. State historic sites?
3. Locally significant sites?

E. Aesthetics - Presence of detracting effects:

1. Odors, fumes?
2. Noise from nearby land use activities?
3. Conflicting adjacent uses (junkyards, dumps)?
4. Visual character?

F. Special Values - Unusual or otherwise significant features: rare or endangered species? Locally recognized values?

Once these thirteen potential functions have been examined (and there may not be too much to say for some of them) the overall importance of the wetland can be summarized in a sentence or two. By stressing the salient functions and establishing their relative importance to their watershed system, the value of that particular wetland can be determined fairly accurately.

7.33 Identify Construction Impacts

Once the value of the wetland has been generally established, the types of impacts need to be identified. Depending upon the configuration of the service area and the alignment of the collection system of interceptors and laterals, these impacts may be either direct or indirect, long-term or short-term. The effects of any construction activity fall into three general time-related categories:

A. Direct and immediate results which take place during the construction process;

B. Effects which occur during the period of stabilization following completion of the construction; and

C. Long-term permanent changes brought about by the construction itself or by secondary land use that is induced by the constructed facilities.

This section will deal primarily with the direct impacts of constructing the sewer pipeline through a wetland. The Secondary Impacts and Hydrology chapters deal wth increased urban runoff and other effects associated with induced growth. The impacts for each category of construction activity can be described in the following general terms:

-- The initial survey and other preconstruction activities result in removal of some vegetative cover and possibly some increase in erosion and surface runoff. Considering the limited nature of such operations, the effects must be temporary and highly localized, except in steep terrain where the effects could be considerable.

-- The initial clearing of the land removed the vegetative cover and permits the rainfall to strike the bare land surface. Any subsequent digging will remove topsoil and expose deeper soil layers. Mounds of loose soil may temporarily accumulate within or adjacent to the construction site. All of these activities lead to increased surface

TABLE 7-2

CONSTRUCTION ACTIVITES

- Initial Survey
- Clearing and grubbing
- Earthwork
- Delivery of pipe
- Equipment parking
- Ditch excavation/dredging
- Pipe laying
- Backfill
- Appurtenances and special construction
- Disposition of excavated materials
- Site restorations

TABLE 7-3

CONSTRUCTION IMPACTS

Modification of wetland vegetation and habitat
Modification of wetland bottom topography
    Creation of channels (surface and subsurface)
Modification of water circulation patters (surface and subsurface)
    Lowering of water table
    Increased runoff velocity
    Increased erosion and siltation
    Increased downstream flood levels
Increased turbidity of water
    Increased oxygen demand
    Reduced light penetration
    Reduced photosynthetic oxygen production
    Release of toxic organic compounds
    Release of pesticides, heavy metals, and hydrogen sulfide
    Increased temperature
Bottom siltation with very fine sediments

runoff and severe erosion, and the effects will be accentuated in steep terrain and in rainy weather. In dry weather considerable quantities of soil may be raised as dust clouds which will be transported at a later date when the rains fall. Runoff and erosion will add a great deal of soil solids into wetland areas in the form of greater water turbidity and increased sedimentation.

-- Ditch excavation for the placement of sewer lines in wetlands can cause significant increases in sediment loads and substantial disruption of water table and biological processes. Wetlands are areas of surface as well as subsurface water movement. Where the wetland is associated with a stream, the ditch will serve to alter streamflow, both during and after construction. Fluctuation in the level of ground water will result in erratic streamflow rates and increased velocity during wet weather. The stream bed may be cut deeper, the banks will be undercut, and the stream section will be widened. Riffles may disappear and pool areas fill.

Branches and other debris are washed downstream.

Increased sediment loads released during excavation will clog the interstices of riffles, fill the pools, and cover the bottom generally with a layer or inorganic silt. Bottom sedimentation may persist far downstream from the construction site. Bottom habitat diversity is essentially eliminated. Accompanying the increased flow rates there is an increase in water turbidity. This lowers the light penetration of the water, increases oxygen demand (both chemical and biological oxygen demand), and modified the chemical characteristics of the water in other ways. Loss of vegetative cover and increase in turbidity both serve to elevate the temperature of the water (as much as 10°F).

During dry weather stream flow slacks off, and it may cease entirely, since the stream now receives less ground water inflow than before. Clearing and dredging sewer trenches may also alter the local hydrological regime that formerly perennial streams may approach or become intermittent. Since deep pools tend to be reduced or lost, the aquatic habitat may become severely restricted or dried up between floods. Any water that remains in the stream bed is now subject to more rapid and extreme temperature fluctuation in response to prevailing atmospheric conditions.

The cutting and digging action of the dredging operation breaks through the thin oxidized layer of the submerged soil and exposes the deep unoxidized layer. Furthermore, most of the sediments placed in suspension are removed from this layer and, hence, are in the chemically reduced state. Such materials have a very high chemical and biological oxygen demands.

Turbidity, per se, reduces light penetration and interferes with photosynthetic production of oxygen, and it tends to elevate water temperatures. Eventually the suspended material settles to the bottom either near the dredging site or far downstream. Thus, there is a redistribution of sediments together with whatever nutrients and chemical pollutants which they may contain, and this may result in modified bottom topography and altered patterns of water circulation. Such sedimentation problems are greatly accentuated when dredge spoil is placed back into the water.

-- Pipe-Laying is generally accompanied by heavy machinery, the maneuvering of which can compact the soft, organic soils and create additional blockage to subsurface flow. These activities tend to remove the native soil and vegetation, stimulate bank soil erosion, lower the water table, and provide for increased surface flow velocities. When the water eventually enters the stream it may carry heavy loads of sediment, and considerable erosion has been noted where heavy machinery has operated within wetlands and next to streams.

-- Backfill and Compaction. Coupled with the sewer pipe itself, can alter both surface and subsurface water movement in a wetland and may greatly influence downstream conditions. Drainage is accelerated by funneling subsurface flow downstream along the backfilled trench. Around water levels are lowered and wetlands can gradually convert to dry land. It also tends to lower the water table of the adjacent, higher land. This reduces or eliminates the annual flood, prevents the replenishing of any remaining wetlands, and cuts off the sediment load normally deposited in such environments. Aquifer and ground water recharge is also reduced. Large quantities of nutrients and valuable fresh water is lost, eventually to estuaries or to the sea. Also, becuase the sewer and compacted backfill can act as subsurface dams to underground water movement, drainage coming down off of adjacent high ground can be blocked and diverted from the wetland, further lowering its water level.

In coastal marshes the matter is considerably more complex because of the intermixing of fresh and saltwater and the natural process of saline instrusion. Freshwater enters the estuary as regular streamflow and runoff from the upriver watershed. As it approaches the estuary, there is a gradual gradient from freshwater to the more brackish waters of the estuary. River overflow and build-up of organic matter on the marshes help to maintain the delicate land-sea, and freshwater-saltwater balances.

-- Dredging and pipe-laying in marshes accelerates the rate of freshwater runoff, and it may lower the water table of the soil drying out the higher areas of the marsh. This can cause the marsh to become segmented, with siltation and shoaling taking place in the quieter backwaters. Water circulation may be greatly affected with altered patterns of tidal exchange and mixing. Direction, velocities and seasonal programming of currents may be changed. Extensive shoaling may reduce flushing and lead to closure or reduction of the inlets connecting with the sea. Since the passage of fresh-water is accelerated through the estuary, the penetration of saline bottom waters increases into the bay or estuary. This would increase the sale concentration and sharpen the salinity gradient.

The preceeding list of potential impacts is highly generalized, not necessarily complete and would obviously not apply to every sewer line that happened to be laid out through a wetland. As stated earlier, each action and each wetland must be analyzed on a case-by-case basis. These examples are only indications of what could happen under certain circumstances. Common sense dictates the degree to which they are a problem, or whether the resulting impacts are significant.

7.34 Assess the Significance of the Impacts

The preceding two sections described: 1) how to determine wetland values by analyzing the importance of its functions; and 2) what impacts are associated with sewer construction. The final step is to bring the two parts together to assess the significance of the impacts on the functional characteristics of the wetland.

The most important impact of construction activity upon aquatic environments is wetland habitat loss. This is occasioned primarily by draining, filling, damming, ditching, and channelization of the wetlands.

The second most sever impact is the addition of suspended solids to aquatic environments, resulting in increased turbidity and wide-spread siltation of wetland bottoms. The increase in suspended and sedimented material is known to have eliminated various species in streams and to have produced devastating effects upon certain ecosystems in small streams for many miles downstream of the point of entry. The results of bottom siltation are often cumulative, especially if peak stream flow (hence, flushing) has been reduced.

The third most important impact of construction activities upon wetland environments is the alteration of stream flow patterns. This may take the form of reduced flow, (through water loss), reduced flow during critical low water seasons, reduction of peak flow (by water retention and channel deepening), reduction of flood plain flooding (through leveeing and peak flow reduction), and modification of seasonal flow regimes (through water retention and programmed release from reservoir and from increased surface runoff and reduced water storage within riparian environments). The downstream effects of flow pattern alterations may severely damage the natural ecosystems of streams; riparian wetlands; coastal marshes, swamps, and estuaries; and ocean beaches.

Various mitigating measures can be taken to reduce the effects of each of the three significant types of impact: (1) Habitat loss; (2) Turbidity; and (3) Alteration of streamflow. Obviously, the best way to avoid loss of habitat is to avoid the wetland whevenver practicable and by selecting an alternate alignment. If there is absolutely no other route available for the sewer, then the right-of-way should be restored quickly to as original a configuration as is possible. Backfill around the pipe should be compacted to approximately the same degree as the surrounding area with the same materials as were originally present. This would at least minimize the long-term disruption to subsurface and bottom-dweller habitats. If the alignment requires clearing a swath through a wooded wetland, an irregular edge condition would increase the habitat along the wooded margin for wildlife foraging (see Figure 7-4).

Levels of turbidity and siltation can be reduced by excavating during period of low flow and by constructing temporary cofferdams or siltation ponds to trap sediment. Quick replanting and stabilization of exposed gravel banks should also be done to minimize erosion of material into the wetland or watercourse. Temporary soil stabilizing mats can also be placed to minimize runoff and erosion during construction of the system.

Alteration of streamflow should be avoided by limiting any permanent placement of fill within the wetland and by back-filling with impervious clay saddles when an interceptor runs downstream from a wetland. Filling in the wetland decreases the floor storage capacity and contributes to increased velocity of flow downstream of the project. It also could increase backwater elevations upstream of the project. Backfilling with clay at regular intervals would limit the subsurface flow out of the wetland along the interceptor trench. The clay would maintain the groundwater level within the wetland and preserve minimum streamflows during times of drought.

7.341 Assessment Charts/Tables

The following charts are intended to assist with the determination of significance by relating construction activities and impacts to the functional values described earlier. Table 7-4 summarizes the activities associated with construction of sewer lines and relates them to the physical and chemical effects of constructing sewer lines in wetlands. Table 7-5 relates the physical and chemical effects to the list of wetland functions which were outlined on the earlier evaluation forms. By assessing the degree of the physical and chemical effect on any one function and by checking the value of that particular function on the earlier evaluation sheets, the significance of that impact can be deduced. A qualitative statement of the significance of that impact can then be developed as a notation on the Impact Assessment Work Sheets, Tables 7-6A and 7-6B.

The deductive statement which assesses the significance of the impact on any one function should take the following factors into account:

A. Duration: short-term or long-term.

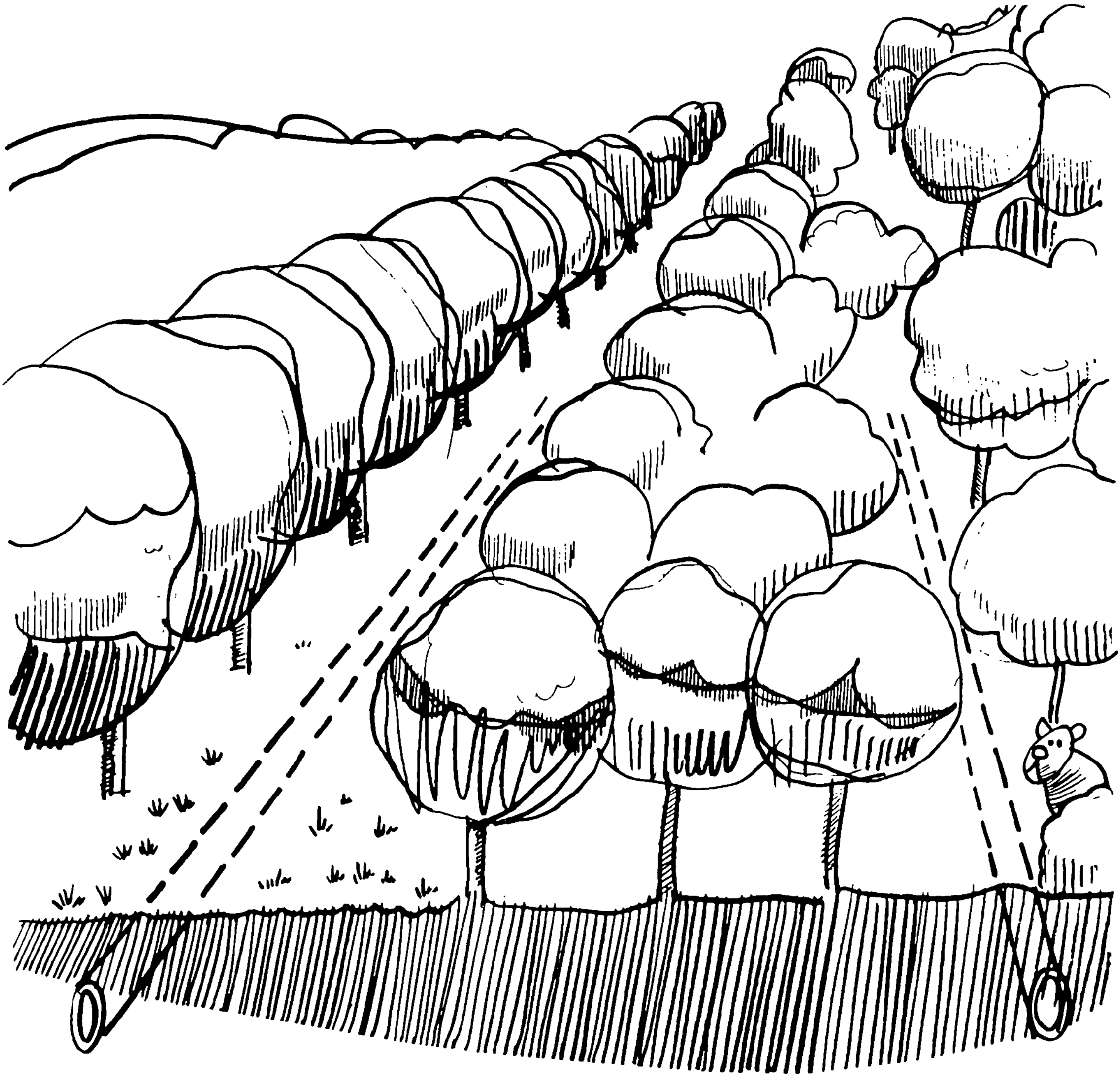
B. Frequency: how often over time.

C. Location: where the impact occurs; number of acres, etc.

D. Severity: irreversible, major, moderate, minor-insignificant.

7.342 Costs

The approximate costs of performing a desk top assessment of wetland values and a preliminary assessment of the significance of potential impacts are presented on Table 7-7.



REGULAR vs IRREGULAR R.O.W. CUTTING FIG. 7-4

TABLE 7-4
IMPACTS OF CONSTRUCTION ON PHYSICAL/CHEMICAL WETLANDS CHARACTERISTICS

Construction Activity / Physical and Chemical Impacts	1. Loss of natural cover (vegetation)	2. Loss of topsoil	3. Faster runoff	4. Lowered water table	5. Increased erosion	6. Violent fluctuation in stream flow	7. Violent fluctuation in water levels	8. Increased downstream flooding	9. Increased sediment loads	10. Increased bottom sedimentation	11. Increased turbidity	12. Loss of wetland habitat	13. Reduction in light penetration	14. Modified chemical composition	15. Increased oxygen demand	16. Modification of salinity gradients
Clearing and Grubbing	x								x	x	x					
Earthwork	x	x	x		x				x	x	x	x	x			
Equipment Parking	x		x		x			x	x	x	x	x	x	x	x	
Ditch Excavation	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Pipe Laying			x		x				x	x	x	x	x	x	x	x
Backfill				x		x	x	x	x	x	x		x	x	x	x
Appurtenances and Special Construction					x	x	x	x	x	x	x	x	x	x	x	x
Disposition of Materials	x	x							x	x	x		x	x	x	
Site Restoration	x		x									x		x		x
Long Term Effect	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

TABLE 7-5
RELATIONSHIP OF IMPACTS TO SPECIFIC WETLAND FUNCTIONS

Wetland Functions \ Construction Impacts	1. Loss of natural cover (vegetation)	2. Loss of topsoil	3. Faster runoff	4. Lowered water table	5. Increased erosion	6. Violent fluctuation in stream flow	7. Violent fluctuation in water levels	8. Increased downstream flooding	9. Increased sediment loads	10. Increased bottom sedimentation	11. Increased turbidity	12. Loss of wetland habitat	13. Reduction in light penetration	14. Modified chemical composition	15. Increased oxygen demand	16. Modification of salinity gradients
1. Natural Biological Functions																
a. Food Chain Productivity	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
b. Habitat	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
2. Study Areas Sanctuaries, Refuges	(as appropriate, if affected)															
3. Contiguous Wetlands, Eco-System Support Function			x	x		x	x	x	x	x	x	x	x	x	x	x
4. Shielding From Waves, Erosion, Storm Flooding	x		x		x	x	x	x				x				
5. Floodwater Storage			x			x	x	x	x	x						
6. Ground Water Recharge			x	x		x	x									
7. Water Purification			x	x	x	x	x		x	x	x		x	x	x	x
8. Commercial Fisheries Support											x	x	x	x	x	x
9. Recreation, Fish & Wildlife Utilization	x					x	x		x	x		x		x	x	x
10. Agriculture, Aquaculture	x	x		x		x	x		x	x		x		x	x	x
11. Cultural, Historic, Archaeological		x						x								
12. Visual, Aesthetic	x	x				x	x		x	x	x	x	x	x		
13. Special Local Values	(as appropriate to local perspective)															

WETLANDS IMPACT ASSESSMENT WORKSHEET

(School Street Swamp)

TABLE 7-6 **A.**

DESCRIBE AND EVALUATE IMPACTS TO EACH WETLAND FUNCTION

1. IMPORTANCE OF WATERSHED: School Street Swamp is part of locally-important drainage system. Disruption of drainage pattern could affect downstream areas by altering seasonal discharge to Muddy Brook. Seasonal fluctuations in water table could result in erosion, turbidity, increased peak flow causing impacts to local and downstream wetlands.	QUALITATIVE ASSESSMENT: Moderate to Major Impact
2. NATURAL VALLEY STORAGE: Loss of corridor 35 ft wide x 5000 ft long (4 acres) of flood storage equals 2% of School St Swamp capacity. Some minor increase in flood flows possible during 5-10 year events. Induced growth in upstream watershed could increase rate of runoff causing potential impacts on downstream land uses.	QUALITATIVE ASSESSMENT: Moderate Impact
3. SHIELDING FROM WAVE DAMAGE: (Not applicable)	QUALITATIVE ASSESSMENT: –
4. AQUATIC SANCTUARY/REFUGE: (not applicable)	QUALITATIVE ASSESSMENT: –
5 HABITAT & PRODUCTIVITY: Disruption and potential loss of wood duck nesting habitat and wetland wildlife along R.O.W. (turtle, woodchuck, etc) 4 acres. Fluctuations in water table could cause stress to ecosystem resiliency and possible loss of productivity	QUALITATIVE ASSESSMENT: Moderate
6. WATER FILTRATION: Impacts would have unknown effect	QUALITATIVE ASSESSMENT: Unknown at Present

WETLANDS IMPACT ASSESSMENT WORKSHEET

TABLE 7-6 B.

7. GROUNDWATER RECHARGE: Ground water flow would be intercepted by backfilled sewer trench and diverted from wetland and recharge of industrial wells. Potential low flow conditions in Muddy Brook during summer droughts could be worsened. Lowered water table in wetland area could have significant effect on ecosystem	QUALITATIVE ASSESSMENT: Major Impact
8. COMMERCIAL FISHERIES: (Not applicable)	QUALITATIVE ASSESSMENT:
9. RECREATION: 4 acres of local hunting area altered. Altered stream flow could affect downstream fish spawning pools as a result of siltation. Other, more important hunting, fishing areas nearby.	QUALITATIVE ASSESSMENT: Minor Impact
10. AGRICULTURE / AQUACULTURE: None in immediate area or downstream. 4 acres of potential woodlot lost to sewer R.O.W.	QUALITATIVE ASSESSMENT: No Impact
11. CULTURAL IMPORTANCE: No known sites in immediate area.	QUALITATIVE ASSESSMENT: No Impact
12. AESTHETICS: Sewer R.O.W. opens vista to nearby ½ acre residential neighborhood south of School St. Swamp. Visual character of School St. and enclosed approach to South Village altered.	QUALITATIVE ASSESSMENT: Major Impact
13. SPECIAL VALUES: Disruption of greenbelt functions. Altered streamflow could affect ice skating at South Village.	QUALITATIVE ASSESSMENT: Moderate Impact

WETLANDS IMPACT ASSESSMENT WORKSHEET

TABLE 7-6 **A.**

DESCRIBE AND EVALUATE IMPACTS TO EACH WETLAND FUNCTION	
1. IMPORTANCE OF WATERSHED:	QUALITATIVE ASSESSMENT:
2. NATURAL VALLEY STORAGE:	QUALITATIVE ASSESSMENT:
3. SHIELDING FROM WAVE DAMAGE:	QUALITATIVE ASSESSMENT:
4. AQUATIC SANCTUARY/REFUGE:	QUALITATIVE ASSESSMENT:
5 HABITAT & PRODUCTIVITY:	QUALITATIVE ASSESSMENT:
6. WATER FILTRATION	QUALITATIVE ASSESSMENT:

WETLANDS IMPACT ASSESSMENT WORKSHEET

TABLE 7-6 B.

7. GROUNDWATER RECHARGE :	QUALITATIVE ASSESSMENT :
8. COMMERCIAL FISHERIES :	QUALITATIVE ASSESSMENT :
9. RECREATION :	QUALITATIVE ASSESSMENT :
10. AGRICULTURE / AQUACULTURE :	QUALITATIVE ASSESSMENT :
11. CULTURAL IMPORTANCE :	QUALITATIVE ASSESSMENT :
12. AESTHETICS :	QUALITATIVE ASSESSMENT :
13. SPECIAL VALUES :	QUALITATIVE ASSESSMENT :

TABLE 7-7

APPROXIMATE EFFORT FOR WETLANDS ASSESSMENT

ITEM	TASK	ESTIMATED MAN DAYS
1	Preliminary Organization	0.5
2	Data Gathering Meeting with local officials review local and State legislation	2.5
3	Review Existing Material - Conservation Commission - Planning Board - Assessor's Maps - Engineering Department Maps/Photos - Soils Reports - USGS Maps - State/Regional Reports	
4	Locate Wetlands Preliminary Mapping Photo Enlarge/Reduce Data to constant scale.	3.0
5	Identify Potential Conflicts Overlay proposed facility plan and wetland system. Explore alternative service areas or alignments for interceptors. Identify unavoidable impacts.	1.5
6	Site Visit, establish boundaries of affected wetlands with local officals.	1.0
7	Final mapping of boundaries	0.5
8	Evaluate Functions of Affected Wetlands - Importance to watershed - Natural valley storage - Shielding from wave damage (coastal) - Aquatic sanctuary or refuge - Water filtration - Groundwater recharge - Fisheries - Recreation - Agriculture - Historic/archaeological - Aesthetic - Special values	2.0

TABLE 7-7 (continued)

ITEM	TASK	ESTIMATED MAN DAYS
9	Identify Construction Impacts	1.0
10	Assess Significance of Impacts to the Affected Wetland	1.0
11	Write Wetland Assessment Report	1.0
	TOTALS:	15 Man days

environmental assessment manual

archaeology

8. archaeology

CHAPTER 8 - ARCHAEOLOGY

Prepared by: Dr. Charlotte W. Thomson

8.0 INTRODUCTION - ARCHAEOLOGY IN NEW ENGLAND

There is in New England a great lack of knowledge of American Indian history. The native Americans had no written language, which is where the problem begins. Therefore all evidence of the Indians who lived here before us must come from the records of the first colonists, or from the meticulous excavation of buried sites.

When the first settlers came to this country, they purchased or appropriated the very locations that the Indians used. Modern settlements as well are put in the places the Indians favored: low-lying lands near fresh water and communications routes. Thus it is a rare occurrence to find an Indian site that has not been built upon or disturbed.

In addition, the soil in New England forms very slowly. In most situations, perhaps one inch of topsoil forms every 100 to 300 years. This means that traces of Indian history in New England are generally found in the top 24 inches of soil, and are extremely vulnerable to any digging or disturbance.

Projectile points, the attached stone tips of spears, arrows and darts, are the most durable and abundant artifacts left by the Indians. The techniques of chipping these stone points, and their shapes and materials, changed throughout the Indians' long occupation of New England. The basic chronology for the Indians cultures was first derived from study of the projectile points.

As the science of archaeology matures, sophisticated techniques of laboratory analysis allow archaeologists to analyze nearly invisible evidence, such as pollen grains, in order to reconstruct the life-ways of the people of the past. This means that every fragment of material in an archaeological site is of potential value to the professional archaeologist.

8.01 The Paleo-Indian Period, 10,000 - 7,000 B.C.

The formation, change in mass, and disappearance of glaciers are responses to changes in climate. In New England, the last great ice sheet reached its maximum southern extent at about 16,000 B.C. covering Martha's Vineyard and Nantucket and touching points on Long Island. Ocean levels were drastically lowered - some 300 feet lower than at present - because of net loss of ocean water by evaporation and storage of the water in glacier ice. Sea levels rose after 16,000 B.C. as the glacier melted and retreated northward.

Vast areas of land were opened up by the northward retreat of the glacier, and plant cover and animal populations adapted to artic climates quickly inhabited the newly exposed land, preparing the way for human communities.

Evidence of the earliest man in New England comes from the Bull Brook site in Ipswich, a twenty-acre site with a scattering of some 45 hearths that yielded several thousand artifacts, including the period's distinctive fluted projectile points. The date of the Bull Brook site may be as early as 10,000 B.C. Current opinion sees this site as a camp of hunters located above a stream bed where migratory caribou crossed in numbers. It is assumed that Paleo-Indian man in New England was a big game hunter, but this supposition remains to be proved.

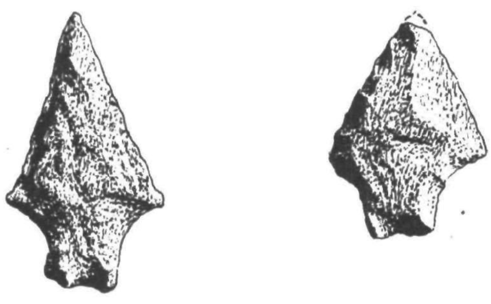
FLUTED POINT

There is a Paleo-Indian site near the jasper quarry in Saugus, Massachusetts, and fluted points of Saugus jasper have been excavated at a lakeside site in Middleboro.

8.02 Early and Middle Archaic, 7,000-3,000 B.C.

The earliest Archaic period artifacts to be found in New England are called Palmer, Kirk and Charlestown corner notched projectile points. These are rare, and thinly scattered and date to the eighth millennium B.C.

Projectile points of the seventh millennium B.C. are known as bifurcate base points. With the exception of a large concentration of this point type in the Taunton River Basin, this also is a rare artifact.



MIDDLE ARCHAIC PROJECTILE POINTS

From 6,000 to 4,000 B.C. the key artifact types are Kanawha, Neville, Stark and Merrimack projectile points, their sequential ordering known from the Neville site in New Hampshire.

The resource orientation of human groups is explicit for the first time in the latter part of the Middle Archaic. Site distribution - riverside, lakeside and bogside locations - indicates that these Indians were capitalizing upon spring runs of spawning fish and seasonal migrations of fowl. These exploitations were possible because the seasonal migrations of birds and fish were set in their modern patterns at this time.

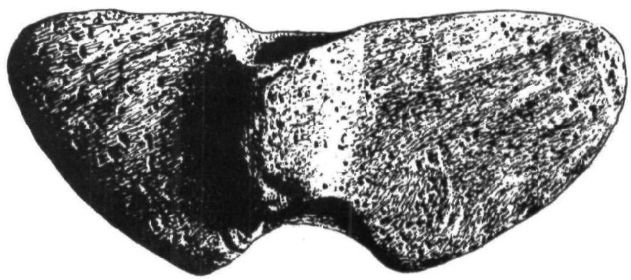
Additionally, the eastward extension of the continental shelf, exposed by lowered sea levels, may have been the most hospitable location for human communities. It would have been warmer than inland areas, and its soils would have been enriched by sediments deposited by the glaciers. Subsequent inundation of the coastal plain by rising sea level has probably biased our understanding of site distribution at this time.

8.03 The Late Archaic Period 3,000-500 B.C.

In the time since the retreat of the glaciers, temperature had been gradually rising, as had sea level, the latter as a consequence of the continued melting of the remaining continental and mountain glaciers. By 3,000 B.C. the climactic warming had reached its maximum, achieving temperatures a few degrees warmer than those of today. Oak and hickory forests provided an abundance of nuts, which easily fed both human and animal populations. Stone pestles for grinding nuts are first found in the archaeological sites of the Late Archaic.

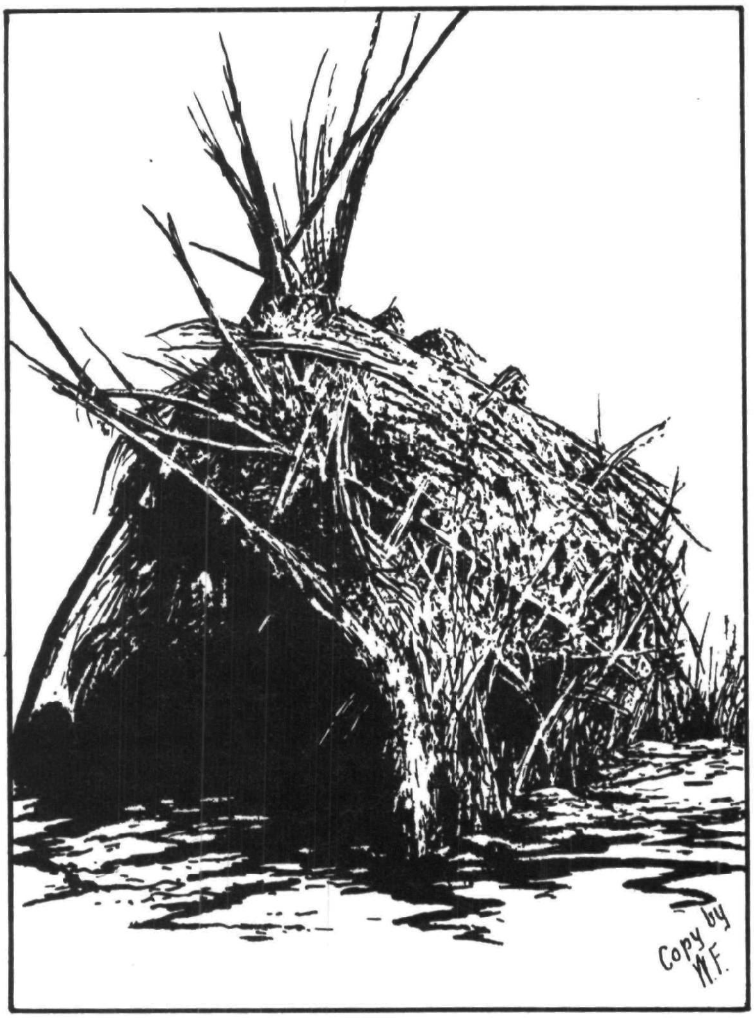
Three distinct traditions of stone projectile point manufacture are found in the Late Archaic; the Laurentian, the small point tradition, and the Susquehanna. The small point tradition seems to be a development out of local antecedents. The small points, which may have been arrow or dart points, are often hastily and crudely flaked, as compared to the finely worked projectile points of preceding times. They are abundant at sites all over New England, and represent an economic tool, in that they were quickly, cheaply and easily manufactured, usually of the abundant local white quartz.

Typical also of the Late Archaic is elaborate burial ceremonialism, evidenced by red paint burials under stone slabs with large numbers of artifacts. Also in the last centuries of the Late Archaic period, the Indians of New England made and exported numbers of large handsome steatite bowls. Quarry sites from this time are common.



WING WEIGHT
BEAR SWAMP SITE
BERKLEY, MASSACHUSETTS

In the last centuries of this period, the New England shoreline stabilized at or near its present limits, as sea level ceased to rise. Stabilization of the seacoast created intertidal mudflats which become a reliable source of sustinence in the form of clams, oysters and mussels.



BRUSH
SHELTER

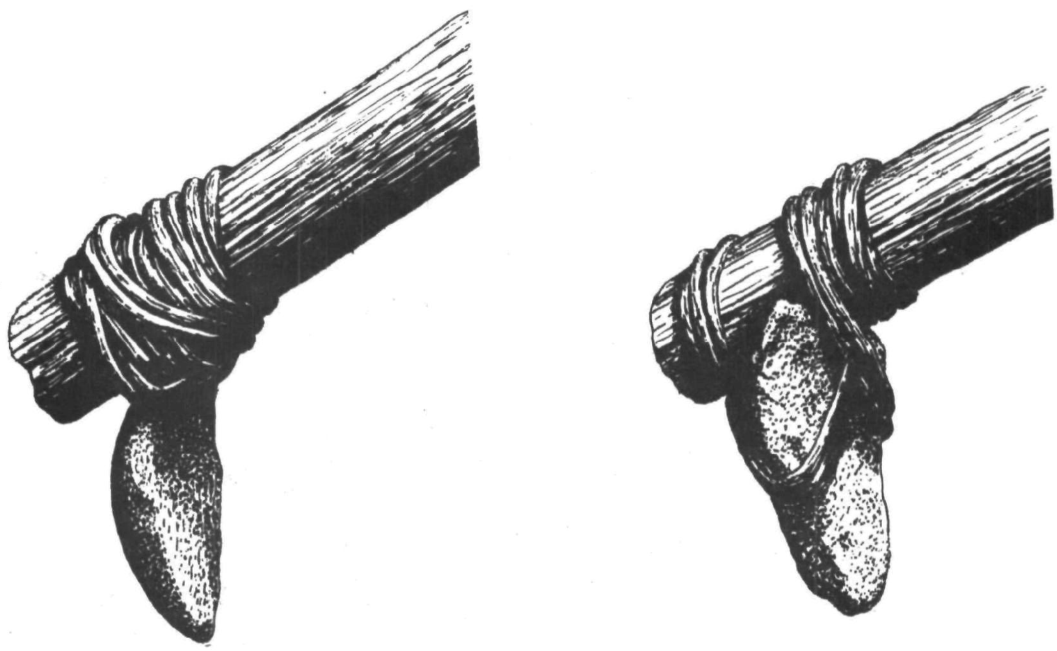
8.04 Early and Middle Woodland, 500 B.C.- 850 A.D.

Not a great deal is known about the inland occupations of this period; the coastal settlements are better understood. The coastal settlements and shellheaps represent adaptions to the harvest of bivalves such as clams, oysters and mussels. This may have been a period of population decline.

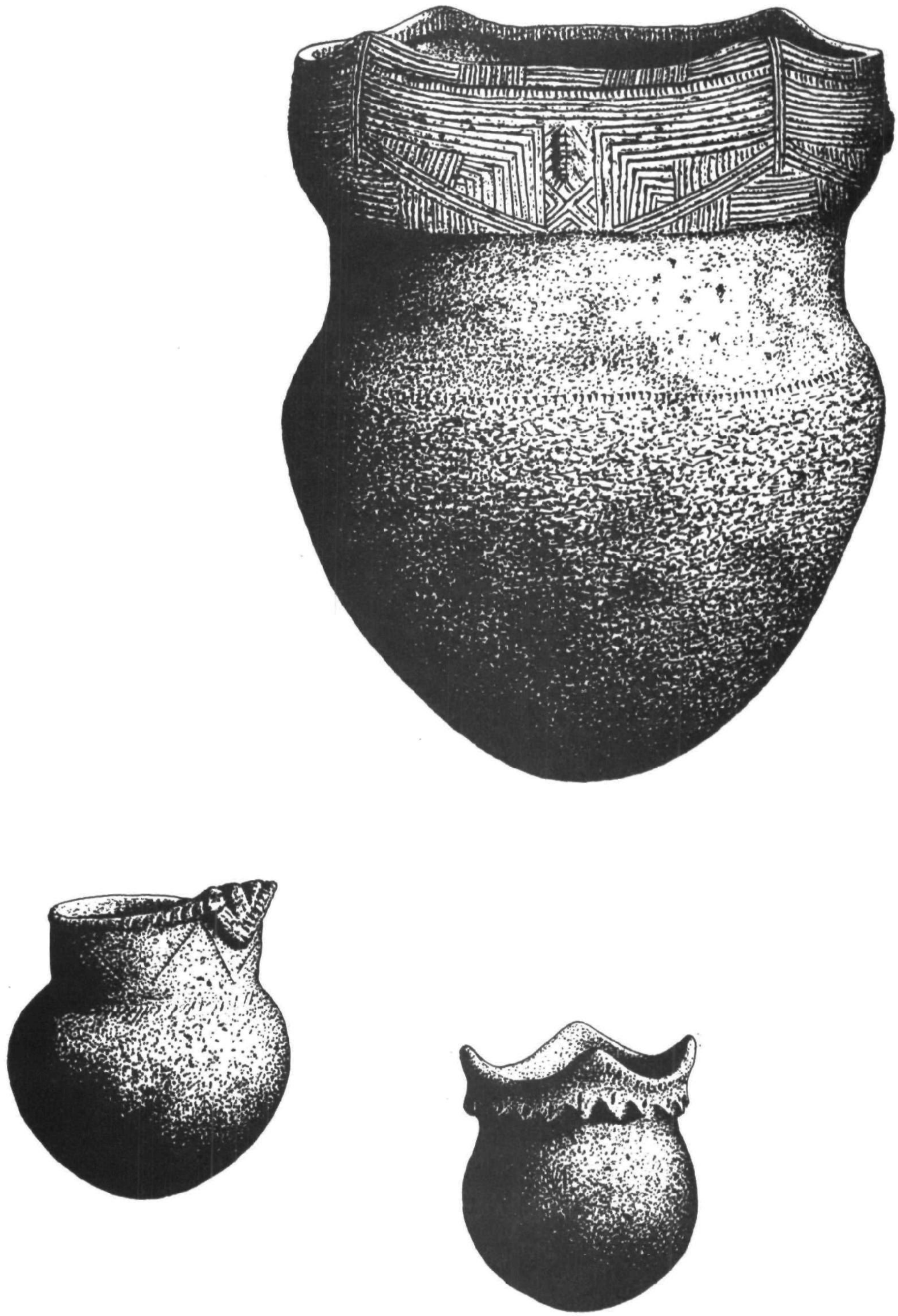
In the centuries just before A.D. 500, pottery making techniques were introduced into New England, with pottery vessels replacing the large steatite vessels of the Late Archaic.

8.05 Late Woodland Period, 800-1,600 A.D.

In this time period population densities in New England increased, presumably as a result of the introduction of agriculture. Maize, bean and squash plants rapidly became major food sources for the Indians. The largest sites from this time seem to be located at the heads of estuaries and at falls or rapids on major rivers.



TRIANGULAR HOE , STEM HOE



" LATE WOODLAND PERIOD "
POTTERY VESSELS

8.06 Historic Period, 1500-Present

It has been estimated that in 1610 the Indians of New England and southeastern New York numbered 72,000. This was approximately one hundred years after contact with European settlers. In that hundred years the Indians had been subjected to warfare and new strains of disease, and their numbers had been severely reduced.

This history of Colonial New England is also the history of the reduction and extinction of the native Americans.

From the historic period sites may be Indian villages; or forts, mills, and later, buildings and districts of importance to American history.

All of the preceding possibilities are taken into account when one studies a piece of land or a land corridor for the purpose of locating and identifying archaelogical sites.

8.1 REGULATORY STATUS

The ultimate goal of Federal and state antiquities laws is to preserve for study America's cultural heritage, whether that be documents, historic buildings, or the very fragile record of former inhabitants that is left in the earth and interpreted by archaeologists.

Publicly funded construction projects are subject to a body of laws which have their beginning in this country with the Antiquities Act of 1906 (PL 209).

Relevant legislation includes the following:

8.11 National Historic Preservation Act (PL 89-665, 16 USC 470-1966)

This act established a national historic preservation program through the creation of the National Register of Historic Places. The National Register, maintained by the Secretary of the Interior, is the official list of all districts, sites, buildings, structures and objects significant in national, state or local history, architecture, archaeology and culture.

Section 106 of this act specifies that any federal agency must take into account the effect of a federally funded or licensed project upon any property listed in the National Register.

8.12 Executive Order 11593 (16 USC 470) - 1971

A presidential directive of May 1971, Executive Order 11593 expanded the concept of Section 106 by extending the protection afforded to National Register properties to all of those properties eligible for listing in the National Register. Criteria for listing in the Nationa; Register were published in the Federal Register by the National Park Service (36 CFR 800).

Federal agencies must survey and nominate to the National Register all historically or archaeologically significant properties under federal ownership or jurisdiction. Federal agencies also are responsible for identifying any significant cultural resources, public or private, which would be affected by a federally funded or licensed project.

It has been estimated that the National Register survey may be only 20 percent complete. Therefore this directive has considerable importance because it mandates protection for all those properties which are not formally identified, but which meet National Register criteria. With respect to archaeological sites, this order places the responsibility of identification, and therefore survey, on the Federal agencies funding a project.

8.13 National Environmental Policy Act (PL 91-190, 42 USC 4321) - 1969

The National Environmental Policy Act mandates review procedures for all federal agencies in determining the effect of projects and programs on all aspects of the environment. One of the six enumerated goals in NEPA is the preservation of historic and cultural aspects of the national heritage.

8.14 Procedures for the Protection of Historic and Cultural Properties (36 CFR VIII 800) - 1972

These procedures published by the Advisory Council on Historic Preservation are designed to assist federal agencies in complying with the legislation cited above. The first step in the Advisory Council procedures is the identification of those properties both listed and eligible for listing in the National Register. These procedures call for the close cooperation of the State Historic Preservation Officer, local Federal agency officials and the Advisory Council.

8.15 The Archaeological Conservation Act (PL 93-291) - 1974

This law, known as the Moss-Bennet bill while it was before Congress, provides that a federal agency may expend funds for the recovery of archaeological resources which otherwise might have been destroyed as a result of the project.

8.2 PAST PRACTICES

The usual practice in the past was for the consulting engineer on a clean water project to check "NO" in the appropriate box on the environmental assessment form in the hopes that the archaeological problem would go away. To the best of his knowledge, there were no sites in the project area.

The usual response from the SHPO was that the information supplied was insufficient to make a determination, and that an archaeological survey would be necessary.

8.3 SUGGESTED METHODOLOGY

Archaeological sites, unlike water mains, gas lines, septic systems and other underground obstacles are an unknown quantity to the clean water engineer.

The laws on antiquities and archaeological sites apply to both visible and invisible (buried) sites. The laws place the responsibility of surveying for unknown sites on the federal agency funding a project; in the case of clean water projects, the EPA bears this responsibility.

For the environmental assessment, the engineering consultant or archaeologist should consult state records of archaeological sites and submit project plans for an informal response from the state. The state antiquities officer can then tell the engineer or archaeologist whether there are known sites in the project area.

The possibility of unknown, buried archaeological sites usually cannot be dismissed without further study.

The decision to be made is whether to hire an archaeological consultant to do a full-scale archaeological survey at the time of the environmental assessment.

If the project entails excavating undisturbed land near fresh water, an archaeological survey will probably be necessary prior to receiving a federal grant. In that case it might be well to initiate the survey as part of the environmental assessment.

The archaeological consultant is hired to do location studies, which seek to point out where, within the project area, presently unknown archaeological sites might be likely to be buried.

8.31 <u>Areas Not Likely to Have Archaeological Sites</u>

The most commonly overlooked initial job of the archaeological consultant is to eliminate from study those areas of the project where sites are not likely to occur.

The following topographic situations generally do not have archaeological sites:

8.311 Slopes Steeper than 15%

Prehistoric peoples in New England might have utilized steep grades if there were cave shelters or stone quarries. Walkover survey can disclose whether either of these resources is present. If not, it is safe to assume that archaeological resources are not present.

Topographic sheets and walkover surveys help the archaeological consultant to make this decision.

8.312 Wetlands

Swamps, marshes, wetlands and saturated ground would not have been used for encampment by prehistoric peoples. Ground that is wet now may not always have been wet in the past. However it is not effective or practical to try and analyse remains that may be found in wet ground, because of the difficulty of defining site features.

Soil maps, boring logs and walkover surveys allow the consultant to make this decision.

8.313 Filled Land

Areas of landfill preclude further archaeological study, unless excavated areas are to go deeper than the fill. However landfill is often found on swampy ground, wetlands or steep declivity.

Topographic sheets, boring logs, soils data and walkover surveys help the consultant to eliminate filled land from further study.

8.314 Disturbed Land

This includes land that has been plowed, cleared, graded, or excavated for construction or the placement of septic tanks, underground utilities, water transmission lines and the like.

Road profile sheets, walkover surveys and consultation with utilities companies and landowners help the archaeological consultant to estimate the degree of prior disturbance to a piece of land or a land corridor.

8.32 Elimination of Areas

In each of the above listed situations the archaeological consultant will have to document his observations for the State Historic Preservation Officer. This means informing the SHPO how the judgment was made: on the basis of walkover survey, map study, consultation with utility companies, etc.

This initial elimination of areas from further study is critical because it then allows the archaeological consultant to focus his efforts in trying to locate significant sites in areas of high potential.

Any maps, boring data, soils information, utilities plans or hydrologic data that the applicant can supply the archaeological consultant at this point will greatly expedite this first step.

8.33 Background Research

At this point the archaeological consultant does a thorough search of several different kinds of records, in order to find out what sites may have been recorded as lying in the area of proposed construction.

This research is usually begun by checking site files of the National Register of Historic Places, the State Archaeologist, the SHPO, and those of universities, colleges and individual professors known to be active in archaeological research in the area under study.

In addition, collections of local and regional museums should be checked to see if any prehistoric artifacts have been collected from the study area. The local library and local historical society are also consulted. Local histories often reveal Indian place names or the routes of Indian paths, all of which can be used to make informed decisions on the likelihood of finding archaeological sites.

Town clerks, local land owners, operators of earth-moving machinery, construction workers, collectors of Indian artifacts - these and many other sources of information help to round out the picture of land use in prehistoric times.

8.34 Theoretical Considerations

After locating known sites, the next step is to focus on those project areas where unknown archaeological sites are likely to occur.

In New England, past experience has suggested four criteria for the likelihood of finding archaeological sites. These are:

A. Proximity to a supply of fresh water (for drinking, washing, cooking, watering crops and animals).

B. Well-drained ground (so that terrain underfoot not be sodden after a rain).

C. Southern exposure (South facing ground is warmer and drier than that of other exposures. In addition to heat, southern exposure is more practical for time-telling, protection from winter winds, star-watching, etc.)

D. Level ground, or very slight slope (a slightly inclined piece of ground facing south will drain better and dry faster and retain more heat than ground of any other exposure).

Having looked for these situations in the project area, the consulting archaeologist can then decide the degree of likelihood of archaeological resources being found under the ground in different areas of the proposed project.

8.35 Field Testing

Location studies for unknown archaeological sites are done by sampling the area of potential impact.

Based on the presence or absence of the above criteria, the consulting archaeologist decides on the sampling interval to be applied to different areas of the project; that is, how far apart to make a test. In areas where archaeological sites are deemed likely, he may want to test the ground every ten feet. In other situations, tests fifty feet apart might be judged appropriate.

The consulting archaeologist also has to decide which means of testing are appropriate. Some of the techniques used in New England are shovel test pits, soil coring and chemical testing (usually for phosphate).

8.36 Reporting to the SHPO

The archaeologist's report to the SHPO should include a copy of the USGS 7.5 minute quadrangle within which the project area lies. This allows the reviewing agent to locate easily the project area in relation to features on his own maps.

If the project is judged to have no impact on any or all of the area under consideration, this judgment must be explicitly argued and documented for the SHPO. Only when opinions are documented is the SHPO able to have a high level of confidence that the project will have no effect on historic or archaeological sites.

8.37 If a Site is Found

Should archaeological or historic sites be encountered in a survey of the area, it is the responsibility of the consulting archaeologist to advise the SHPO on the nature, extent and significance of those sites, and to recommend inclusion in the National Register of Historic Places.

Because the finding of sites is often unexpected, these decisions may not be able to be arrived at within the framework of the original contract to assist on environmental assessment. In this case, the archaeologist may have to recommend further work in order to research adequately the site or sites in question. In such a situation the archaeologist will make specific recommendations detailing the time and expense of further study.

'Significance' is the key word when considering responsibility to an archaeological site. Not all sites are considered significant.

If a site is determined by the SHPO to be significant, there are several means, other than excavating the site, by which the engineer can fulfill his responsibility to the laws. Preservation of a site in place is currently considered the best way to respect the information about the past that the site contains. Sites can also be selectively sampled, rather than fully excavated. They can be avoided if time and costs allow the engineer to alter his plans. However, these decisions usually come further down the road than the assessment process, and are given here only as suggestions.

8.38 Costs

Archaeology is included in the Environmental Assessment for the very specific purpose of making the grant applicant and the professional engineer aware of their responsibilities to the historic preservation process. As a result of the investigation necessary for the Environmental Assessment, they can plan to incorporate archaeological considerations into the normal work flow of the project.

For the assessment what is needed is a calculation of the likelihood of prehistoric and historic archaeological sites within the project area. This judgment has to be informed: otherwise the SHPO will request more information and a decision on whether or not to do a full-scale archaeological survey will be delayed.

In order to minimize delays and cost escalation, it is advisable to have the SHPO or a professional archaeologist analyse the project area for the Environmental Assessment. This analysis will show whether there are known sites in the project area, and whether buried sites are likely to be encounterd. For the average Environmental Assessment the costs to engage a professional archaeologist will be in the range of $600 to $800.

If sites are known, or judged likely to be buried, full-scale survey should be begun so that the problem can be resolved before, or concurrent with, the Step 2 application.

8.4 TINKERSVILLE: ARCHAEOLOGY AND THE ENVIRONMENTAL ASSESSMENT

During background research for the Environmental Assessment, two archaeological sites were located.

Site 1 is a large village of the Woodland Period, located on well-drained land sloping south to Lake Olga. This site has been on the State site records since the 1940's. Collections of artifacts from the site can be seen in the Tinkersville Public Library. The SHPO has determined that this site is eligible for the National Register of Historic Places.

Site 2 was located as a result of conversation with Mr. Homer Boone, a member of the Tinkersville Historical Society. Mr. Boone and others collected arrowheads from Site 2 over a thirty-year period from the 1940's to the 1970's. Mr. Boone's collection is housed in boxes in the basement of his residence. Site 2 is located in the interceptor right-of-way on the east side of Muddy Brook, approximately 2000 feet north of where the brook drains into Green River.

Inspection of the artifacts in Mr. Boone's collection revealed 56 Neville type projectile points and 22 fish vertebrae, probably of shad, and one burned turtle vertebra.

Walkover survey of the site was conducted in April of 1978, with Mr. Boone and the project engineer accompanying the archaeologist.

It was found that the Northeast Sand and Gravel Company had removed earth in the area of the site.

Seven test pits dug north and south of the excavated area at twenty-foot intervals failed to disclose any charcoal, artifacts of faunal remains. For that reason, in consultation with the SHPO, it was decided that archaeological Site 2 did not exist in sufficient integrity to be eligible for inclusion in the National Register of Historic Places.

The site, datable to the Middle Archaic period, 6000-3000 B.C., by the presence of the Neville points, was described for the State records and entered on the SHPO's site record maps.

A memorandum of agreement was written with the SHPO stating that the site had been destroyed by earth-moving machinery, and the sewage project was judged not to have any impact upon the site.

8.5 APPENDIX

8.51 EPA Region 1 - Historic Commission Officers

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environmental assessment manual

air quality

9. air quality

CHAPTER 9 - AIR QUALITY

9.0 INTRODUCTION

This chapter presents guidance on methodology and techniques for conducting an environmental assessment of air quality impact from wastewater facilities. The material presented considers both primary and secondary impacts which can arise.

Supporting information supplied with this chapter includes a bibliography of references, and an appendix of air quality standard attainment/non-attainment maps for New England. A separate instruction manual for the secondary impact model will be supplied at the Workshops.

9.1 PRIMARY IMPACTS ON AIR QUALITY

With the implementation of EPA's final regulations for the "Preparation of Environmental Impact Statements" [1], a new and different outline for the preparation of environmental assessments is now required. A guideline for satisfying these requirements relative to municipal wastewater treatment facilities has been prepared by EPA Region 1 [2]. The following sections provide information on available techniques and methodologies for conducting the required analyses relative to air quality impact.

9.11 Applicable EPA Regulations

9.111 National Ambient Air Quality Standards

In April 1971, EPA issued the first National Ambient Air Quality Standards (NAAQS) for sulfur oxides, carbon monoxide, particulates, photochemical oxidants, hydrocarbons, and nitrogen oxides [3]. These standards are shown in Table 9-1 and represent minimums for all states to adopt. Primary standards are designed to protect the public health while secondary standards are set to protect the public welfare. These have been augmented recently with a preliminary national ambient air quality standard for lead which may be finalized by mid-1978.

9.112 Attainment and Maintenance of NAAQS

Under the Federal mandate [4], the EPA Region I Administrator formally designated on July 1, 1976 portions of New England as non-attainment for certain air quality standards and called for the states to undertake studies to determine the causes of the violations and to adopt the necessary programs, including revisions to State Implementation Plans (SIPs) needed to ensure attainment of standards. The "attainment and non-attainment" concepts are illustrated on Figure 9-1. The areas so designated are shown

TABLE 9-1

NATIONAL AIR QUALITY STANDARDS[a]

Pollutant	Averaging Time	Primary[b] Standards	Secondary[c] Standards	Reference[d] Methods
Sulfur Dioxide	Annual Arithmetic Mean	80 ug/m^3 (0.03ppm)		
	24 hours	365 ug/m^3 (0.14ppm)		Pararosaniline Method
	3 hours	---	1300 ug/m^3 (0.5 ppm)	
Particulate Matter	Annual Geometric Mean	75 ug/m^3	60 ug/m^3 [e]	High Volume Sampling Method
	24 hours	260 ug/m^3	150 ug/m^3	
Carbon Monoxide	8 hours	10mg/m^3 (9ppm)	Same as Primary Standards	Non-Dispersive Infrared Spectroscopy
	1 hour	40mg/m^3 (35ppm)		
Photo-Chemical Oxidants (corrected for NO_2 & SO_2)	1 hour	160 ug/m (0.08ppm)	Same as Primary Standard	Gas Phase Chemiluminescent Method
Hydrocarbons (corrected for Methane)	3 hours	160 ug/m^3 [e] (0.24ppm)	Same as Primary Standard [e]	Flame Ionization Detection Using Gas Chromatography
Nitrogen Dioxide	Annual Arithmetic Mean	100 ug/m^3 (0.05 ppm)	Same as Primary Standard	Gas Phase Chemiluminesence

a. National standards other than those based on annual arithmetic means or annual geometric means are not to be exceeded more than once per year.

b. National Primary Standards: The levels of air quality necessary, with an adequate margin of safety, to protect the public health.

c. National Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant.

d. Reference method as described by the EPA. An "equivalent method" means any method of sampling and analysis which can be demonstrated to the EPA to have a "consistent relationship to the reference method".

e. Guideline to be used assessing implementation plans.

in Appendix A. Under the provisions of the 1977 amendments to the Clean Air Act, these revisions must be forwarded to EPA by January, 1979.

9.113 Prevention of Significant Deterioration

SIP provisions for prevention of significant deterioration enable states to protect the air quality of areas cleaner than the National Ambient Air Quality Standards [5]. The mechanism to prevent significant deterioration is preconstruction review. The criteria for approval of a source is based on an allowable emissions increment rather than an ambient air quality standard. The allowable increments differ depending upon which of three classes an area is designated as shown in Table 9-2.

9.114 New Source Performance Standards

National air pollution standards for discharges from municipal sludge incinerators have been promulgated [6] which limit emissions of particulates (including visible emissions) from incinerators used to burn wastewater sludge as follows:

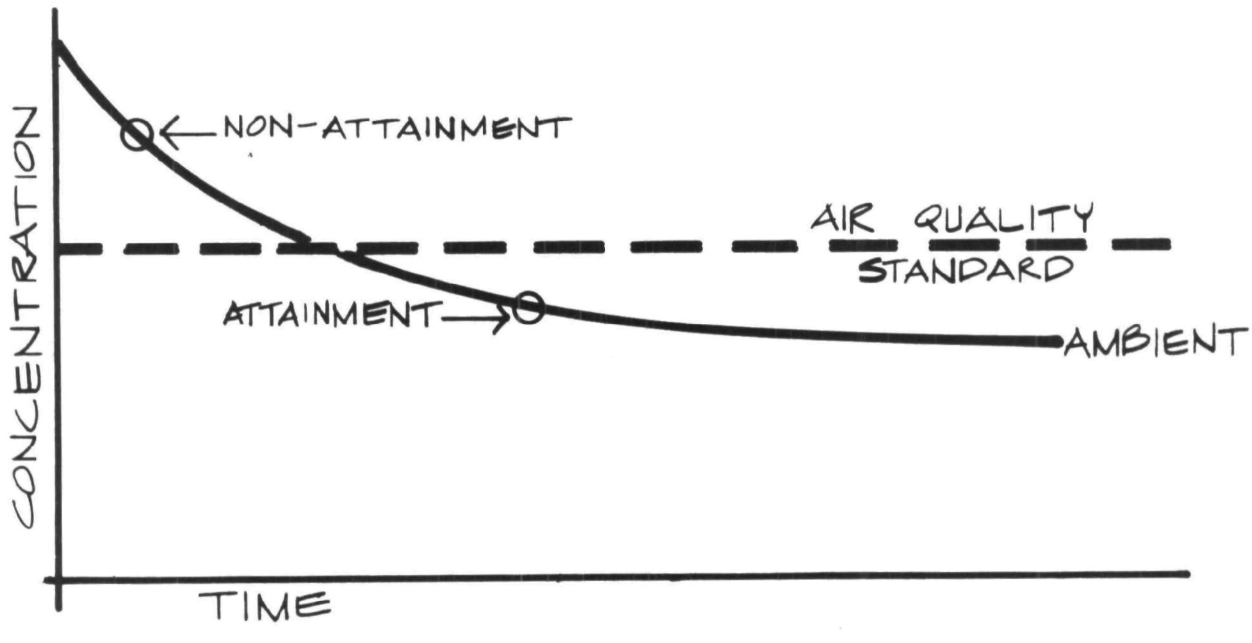
- No more than 0.65 g/kg dry sludge input (1.30 lb/ton dry sludge input),
- Less than 20 percent opacity.

Visible emissions caused solely by the presence of uncombined water are not subject to the opacity standard.

9.11 <u>Hazardous Materials</u>

National emission standards have been promulgated [7,8] which limit the emissions of certain hazardous materials from incinerators used to burn wastewater sludge as follows:

- No more than 10 g of beryllium over a 24-hour period, or an ambient concentration limit of 0.01 µg/m3, averaged over a 30-day period.
- No more than 3200 g of mercury over a 24-hour period.



ATTAINMENT – NON ATTAINMENT DEFINITION CONCEPT FIG. 9-1

TABLE 9-2
SIGNIFICANT DETERIORATION INCREMENTS

Pollutant	Maximum Allowable Increase (μg/m3) Class I	II	III
Particulate Matter:			
Annual Geometric Mean	5	19	37
Twenty-Four-Hour Maximum	10	37	75
Sulfur Dioxide:			
Annual Arithmetic Mean	2	20	40
Twenty-Four-Hour Maximum	5	91	182
Three-Hour Maximum	25	512	700

9.12 Air Pollutant Emissions From Sewage Sludge Incineration

9.121 General Characteristics

Incineration is becoming an important means of disposal for the increasing amounts of sludge being produced in sewage treatment plants. Incineration has the advantages of both destroying the organic matter present in sludge, leaving only an odorless, sterile ash, as well as reducing the solid mass by about 90 percent. Sludge incineration systems usually include a sludge pretreatment stage to thicken and dewater the incoming sludge, an incinerator, and some type of air pollution control equipment (commonly wet scrubbers).

The most prevalent types of incinerators are multiple hearth and fluidized bed units. In multiple hearth units the sludge enters the top of the furnace where it is first dried by contact with the hot, rising, combustion gases, and then burned as it moves slowly down through the lower hearths. At the bottom hearth any residual ash is then removed. In fluidized bed reactors, the combustion takes place in a hot, suspended bed of sand with much of the ash residue being swept out with the flue gas. Temperatures in a multiple hearth furnace are 600°F (320°C) in the lower, ash cooling hearth; 1400 to 2000°F (760 to 1100°C) in the central combustion hearth, and 1000 to 1200°F (540 to 650°C) in the upper, drying hearths. Temperatures in a fluidized bed reactor are fairly uniform, from 1250 to 1500°F (680 to 820°C). In both types of furnace an auxiliary fuel may be required either during startup or when the moisture content of the sludge is too high to support combustion.

Incineration of sludge presents an inherent potential for air pollution and an impact on the environment. However, an EPA task force on sludge incineration [9] concluded that properly designed systems can produce acceptable emissions of particulate matter, sulfur oxides and odors. This group also found that small but measurable qualities of specific metals which are known to be toxic at certain levels are present in stack emissions as well as specific organic chemical compounds which are known to accumulate in the human system. Thus it is essential that the potential for the impact on air quality from these systems be examined as part of the environmental assessment process.

9.122 Particulate and Gaseous Emissions

Because of the violent upwards movement of combustion gases with respect to the burning sludge, particulates are the major emissions problem in both multiple hearth and fluidized bed incinerators. The quantity and size of particulate leaving the furnace of an incinerator varies widely depending on such factors as the sludge being fired, operating procedures and completeness of combustion. To satisfy particulate emission standards, sludge incinerators in the U.S. are equipped with scrubbers of varying efficiency ranging from 95 to 99+ percent.

Gaseous pollutants which could be released by sludge incineration are hydrogen chloride, sulfur dioxide, oxides of nitrogen, and carbon monoxide. Carbon monoxide is no threat if the incinerator is properly designed and operated. Hydrogen chloride would be generated by decomposition of certain plastics if they are present. Consideration of the possibility of SO_2 and NO_x pollution is aided by examination of the sulfur and nitrogen content of sludges. Unterberg, et al [10] give the following average analyses of four sludges:

% Ash	22.6
% C	50.3
% H	5.7
% S	0.67
% N	3.07

Sulfur content is relatively low; in addition, much of this sulfur is probably in the form of sulfate, which originated in the wastewater. Sulfur dioxide is not emitted in significant amounts and generally not is expected to be a serious problem.

The temperature in sludge incineration is typically less than 1800°F. At these temperatures, formation of oxides of nitrogen from the nitrogen in the air is low. However, sludge typically has a high nitrogen content, probably from proteinaceous compounds and ammonium ion. Data are not available for predicting whether a high proportion of these materials will be converted to oxides of nitrogen on combustion. Farrell [11] has examined limited data available and noted that concentration of oxides of nitrogen from sludge incineration were less than 100 ppm. Considering this low concentration, he concluded that the production of oxides of nitrogen will probably not limit the use of incineration for disposing of sludge.

Average emission factors for sludge incinerators published by the EPA are shown below [12] and appear in schematic form on Figure 9-2:

Pollutant	Emissions*			
	Uncontrolled**		After scrubber	
	lb/ton	kg/MT	lb/ton	kg/MT
Particulate [13-15]	100	50	3	1.5
Sulfur dioxide [15]	1	0.5	0.8	0.4
Carbon monoxide [13,15]	Neg	Neg	Neg	Neg
Nitrogen oxides [15] (as NO_2)	6	3	5	2.5
Hydrocarbons [15]	1.5	0.75	1	0.5
Hydrogen chloride gas [15]	1.5	0.75	0.3	0.15

9.123 Emission of Metals

Metals in sludge which have been found and which could be very toxic include lead, cadmium, beryllium, arsenic, mercury, vanadium, nickel, manganese, and chromium. Unfortunately, very little information is on hand with respect to amounts of metals being discharged into the atmosphere as a result of incinerating sludge. Cross, Drago, and Francis [16] reported the following mass emission rates of 7 metals per ton of mixed sludge plus refuse burned:

EMISSION RATE: GRAMS/TON OF MATERIAL INCINERATED

Incinerator Loading Condition		Total Particulates	Cu	Ni	Zn	Fe	Pb	Cr	Cd
Refuse and	Wt.Ratio 3.5 to 1	3282 g/ton	25.9	2.2	81.7	34.0	43.6	4.1	0.26
Sludge		100.0	0.79	0.061	2.5	1.0	1.3	0.12	0.008

The data show that, although the particulate loading is low relative to the charge, metals probably originating from industrial waste or sludge are present in noticeable quantities in the particulates. The date do not permit a reliable estimate to be made of the contribution of the sludge to the metal found in the particules.

* Unit weights in terms of dried sludge.
** Estimated from emission factors after scrubbers.

POLLUTANT EMISSIONS FROM SEWAGE SLUDGE INCINERATORS FIG. 9-2

environmental assessment manual
region 1 : environmental protection agency
anderson-nichols technical consultant

Mercury is an example of a substance which presents special problems during incineration. High temperatures during incineration decompose mercury compounds to volatile mercuric oxide or metallic mercury. Fortunately, the quantity of mercury involved is small ($\sim$0.01 mg/g).

The forms in which metals are found in sludge will influence their behavior on incineration. For example, if cadmium is present in sludge in solution as cadmium chloride, it would volatilize upon incineration. If it is present as a precipitated hydroxide, it would probably decompose to the oxide, but would not volatilize at the temperatures of incineration. The chemistry of the metals in sludge needs investigation. However, it is felt that most of the toxic metals with the exception of mercury will not disproportionately appear in stack gases because of volatilization, but will be converted to oxides and appear in the particulates removed by scrubbers or electrostatic precipitators and in the ash.

9.124 Other Toxic Substances

Atmospheric emission of other toxic substances can arise due to the content of pesticides or other organic compounds in the sludge. Unfortunately, very limited data are available on the concentrations of these materials in municipal sludges or their fate in an incinerator. Data reported by the Sludge Incinerator Task Force [9] showed pesticides and PCB's in the raw sludge (in low concentrations) but not on the ash nor in the inlet or outlet scrubber water.

Since these materials do not appear in the ash or scrubber water, they are either destroyed by the incineration or remain as vapors in the waterscrubber (and cooled) gas stream. Rapid thermal degradation of most pesticides has been shown to begin at approximately 500°C with near total destruction at 900°C. PCB's are more thermally stable, but experiments have shown that 99 percent destruction is possible at 1,600 to 1,800°F in 2.0 seconds.

9.125 Odors

Odors can be a problem in multiple hearth systems as unburned volatiles are given off in the upper, drying hearths, but are readily removed when afterburners are employed. Odors are not generally a problem in fluidized bed units as temperatures are uniformly high enough to provide complete oxidation of the volatile compounds. Odors can also emanate from the pretreatment stages unless the operations are properly enclosed.

9.13 Air Quality Modeling

Air quality models provide a convenient method for arriving at judgements on the impact of new emission sources relative to air quality levels and their potential for contribution to violations of NAAQS. However, the diversity of the region's topography and climate, and variation in source configurations and operating characteristics dictate against a routine "cookbook" analysis. There is no single model capable of properly addressing all conceivable situations. Any modeling effort should be directed by highly competent individuals with a broad range of experience and knowledge in air pollution meteorology and coordinated closely with specialists in emissions characteristics and data processing. The judgement of well-trained professional analysts is essential. This section does not constitute a substitute for such professional judgement but presents relevant guidelines for air quality modeling analysis. Much of the information presented in this section has been extracted from the recent EPA Intermin Guidelines on Air Quality Models [17], which should be consulted for more complete guidance. An overview of the factors and steps which should be considered to applying an air quality analysis is shown in Figure 9-3.

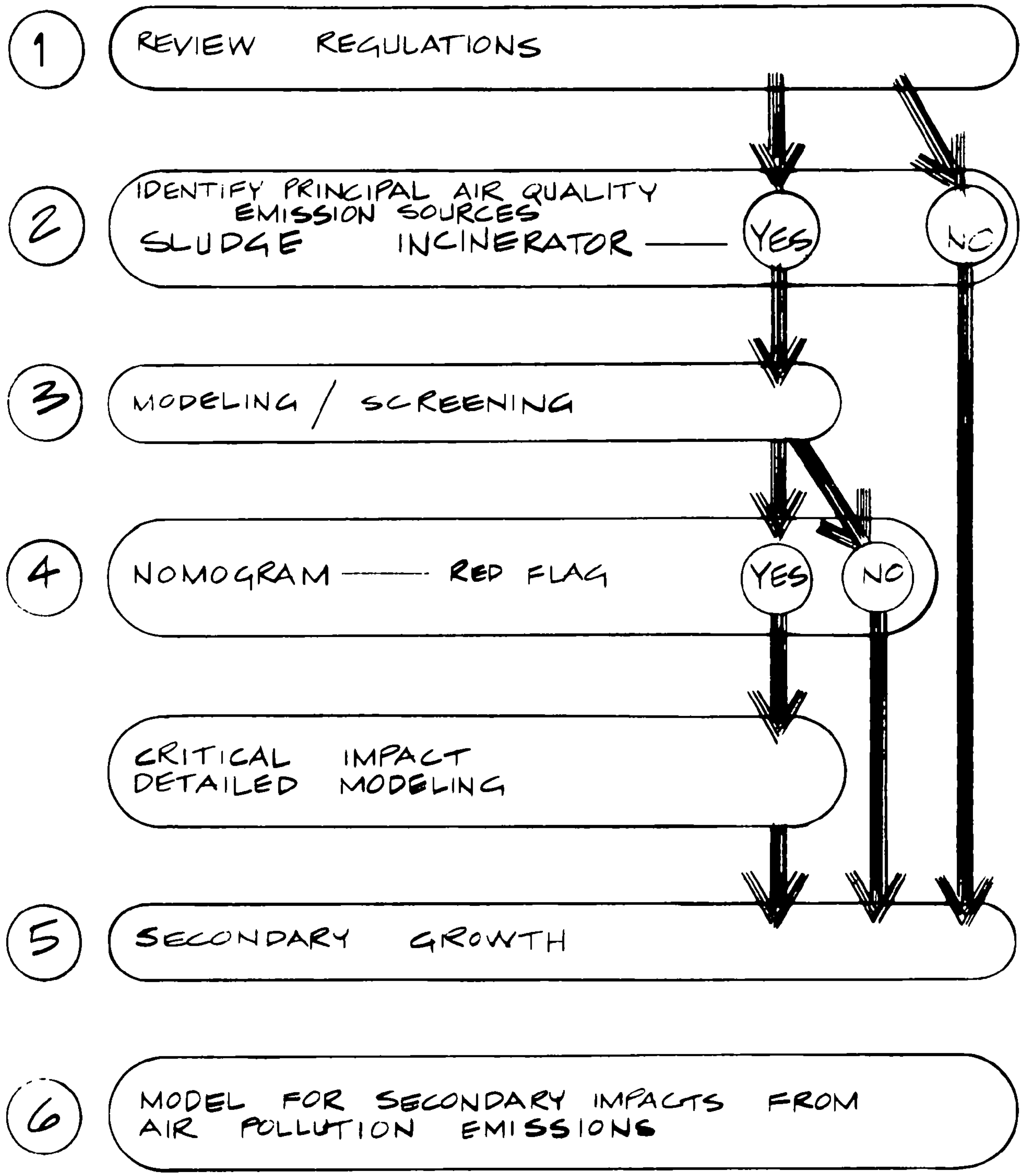
9.131 Requirements for Concentration Estimates

An air quality impact analysis should determine if the source will (1) cause or exacerbate violations of a NAAQS or (2) cause air quality deterioration which is greater than allowable increments. The requirements for those assessments are summarized below.

A. Meeting Air Quality Standards

The determination of whether or not the source will cause an air quality violation should be based on (1) the highest estimated concentration for annual averages and (2) the highest, second-highest estimated concentration for averaging times of 24-hours or less. The most restrictive standard should be used in all cases to establish the potential for an air quality violation. Background concentrations from other emission sources in the area should be added in assessing the source's impact. The two exceptions to the shorter-term averaging times may apply which preclude use of these modeling estimates viz., monitored data with higher concentrations and inadequacies in data bases or model.

In some cases the new source may be (1) located in a nonattainment area or (2) may be in an attainment area but



PROCEDURE FOR CONDUCTING AIR QUALITY ANALYSIS FIG. 9-3 is expected to exacerbate air quality violations known to occur in a nearby nonattainment area. In such situations, the expected incremental increase in pollutant concentrations should be estimated for meteorological conditions which accompany the existing violations. For all averaging times, the highest estimated concentration increments are used. The second highest is not used in the case of short-term concentrations since the incremental increase is added to a concentration which is already based on the highest, second-highest value.

B. Prevention of Significant Deterioration

Air quality models should be used in all significant deterioration evaluations. Allowable increments for sulfur dioxide and particulate matter are set forth in the Clean Air Act Amendment of 1977 (See Table 9-2). These maximum allowable increases in pollutant concentrations may be exceeded once per year, except for the annual increment. Thus, in significant deterioration evaluations for short-term periods the highest, second-highest increase in estimated concentrations should be less than or equal to the permitted increment.*

9.132 Criteria for Significant Impact

A new major source of sulfur dioxide (SO_2), particulate matter (PM), or nitrogen oxides (NO_2**) located in an attainment area may cause or exacerbate a known existing air quality violation in a nearby nonattainment area. In this case it is necessary to determine if the air quality impact of the source is significant. The incremental increase in concentration at the location of a violation may be considered significant if it is greater than the following concentrations:

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* Where an exemption to the Class I increments is requested and approved pursuant to Section 165(d) (2) (D) of the Clean Air Act, the source may cause the Class I increments to be exceeded on a total of 18 days during any annual period. In this case it is necessary to select the highest estimated concentration in the field of receptors for each of the 365 days. These 365 values are then ranked and the 19th highest is used to determine emission limits. However, the highest, second-highest concentration may not exceed a somewhat higher increment specified in Section 165 (d) (2) (D) (iii).

**For simplicity, all emissions of nitrogen oxides are treated as if they are nitrogen dioxide (NO_2).

Pollutant	Annual	Averaging Time 24-Hour	3-Hour
SO_2	1 $\mu g/m^3$	5 $\mu g/m^3$	25 $\mu g/m^3$
PM	1 $\mu g/m^3$	5 $\mu g/m^3$	
NO_2	1 $\mu g/m^3$		

These incremental concentrations of SO_2, PM and NO_2 are partially based on allowable SO_2 increments for Class I areas. However, the annual concentration increment is reduced to 1 $\mu g/m^3$ since this value may be considered significant for a point source in an area which exceeds the NAAQS. All of these increments apply to the highest estimated concentration for all averaging times. The second highest is not used since the incremental increase in concentration is added to a concentration which is already based on the highest, second-highest concentration.

9.133 Selection of an Air Quality Model

The extent to which a specific air quality model is suitable for the evaluation of source impact depends upon several factors. These include (1) the detail and accuracy of the data base, i.e., emission inventory, meteorological data, air quality data; (2) the meteorological and topographic complexities of the area; (3) the technical competence of those undertaking such simulation modeling; and (4) the resources available. These factors should be considered in determining the suitability of a particular model application.

The data base required for air quality models includes source data, meteorological data and air quality data. Appropriate data should be available before any attempt is made to apply a model. A model applied improperly or with inappropriately chosen data can lead to serious misjudgements regarding the source impact. A model which requires detailed, precise input data should not be applied when such data are unavailable. However, assuming the data are adequate, the greater the detail with which a model considers the spatial and temporal variations in emissions and meteorological conditions, the greater the ability to evaluate the source impact and to distinguish the effects of various control strategies.

Most air quality models that describe atmospheric transport and dispersion apply to areas with relatively simple topography. However, areas subject to major topographic or marine influence experience meteorological complexities that are extremely difficult to simulate. In the absence of a model capable of simulating such complexities, only a preliminary approximation may be feasible until such time that better models and data bases become available.

Air quality models can be categorized into four generic classes: Gaussian, numerical, statistical or empirical, and physical. Gaussian models are generally considered to be state-of-the-art techniques for estimating the impact of nonreactive pollutants. Numerical models are more appropriate than Gaussian models for multi-source applications which involve reactive pollutants. However, they frequently require more extensive resources and are not as widely applied. Statistical or empirical techniques are frequently employed in situations where incomplete scientific understanding of the physical and chemical processes make the use of a Gaussian or numerical model impractical. Physical modeling, the fourth generic type, involves the use of wind tunnel or other fluid modeling facilities.

In addition to the various classes of models, two levels of sophistication may be considered. The first level consists of general, relatively simple estimation techniques that provide conservative estimates of the air quality impact of a specific source. The purpose of such techniques is to eliminate from further consideration those sources that clearly will not cause or contribute to ambient concentrations in excess of NAAQS or allowable concentration increments. The second level consists of those analytical techniques which provide more detailed treatment of physical processs, require more detailed and precise input data, and provide more specialized concentration estimates. As a result they provide a more refined and, at least theoretically, a more accurate estimate of source impact.

9.134 Preliminary Estimation Techniques

Simple estimation techniques can provide a preliminary estimate of concentrations for screening of new sources. If it is found from the screening technique that the source will cause a concentration that is more than one-half of an allowable air quality increment, then that source should be subjected to a more refined analysis.

For flat terrain situations that have no significant meteorological complexities, there are several standard publications [18-20] and computerized models [21] that can be used for screening. In addition Pooler [22] and Carpenter et al. [23] have discussed simplified techniques for estimating concentrations during inversion-breakup fumigation. Volume 10 of the Guidelines for Air Quality Maintenance Planning and Analysis, "Procedures for Evaluating

Air Quality Impact of New Stationary Sources" [24] has summarized in a format useful for screening, techniques applicable to both flat terrain and more complex situations; those techniques are recommended for use.

As an example of these techniques, initial estimates of maximum ground level concentrations arising from stack emissions of gaseous or particulate material can be made with the aid of the nomogram presented in Figure 9-4. The curves in this diagram are based on the Gaussian plume model and a number of simplifying assumptions [20]. Figure 9-4 gives the distance to the point of maximum concentration (x_{max}), and the relative maximum concentration ($\chi_{max} \mu/Q$) as a function of the effective height of emission and atmospheric stability. The maximum concentration can be determined by multiplying ($\chi_{max}\ \mu/Q$) by the emission rate (Q) and dividing by the wind speed (u).

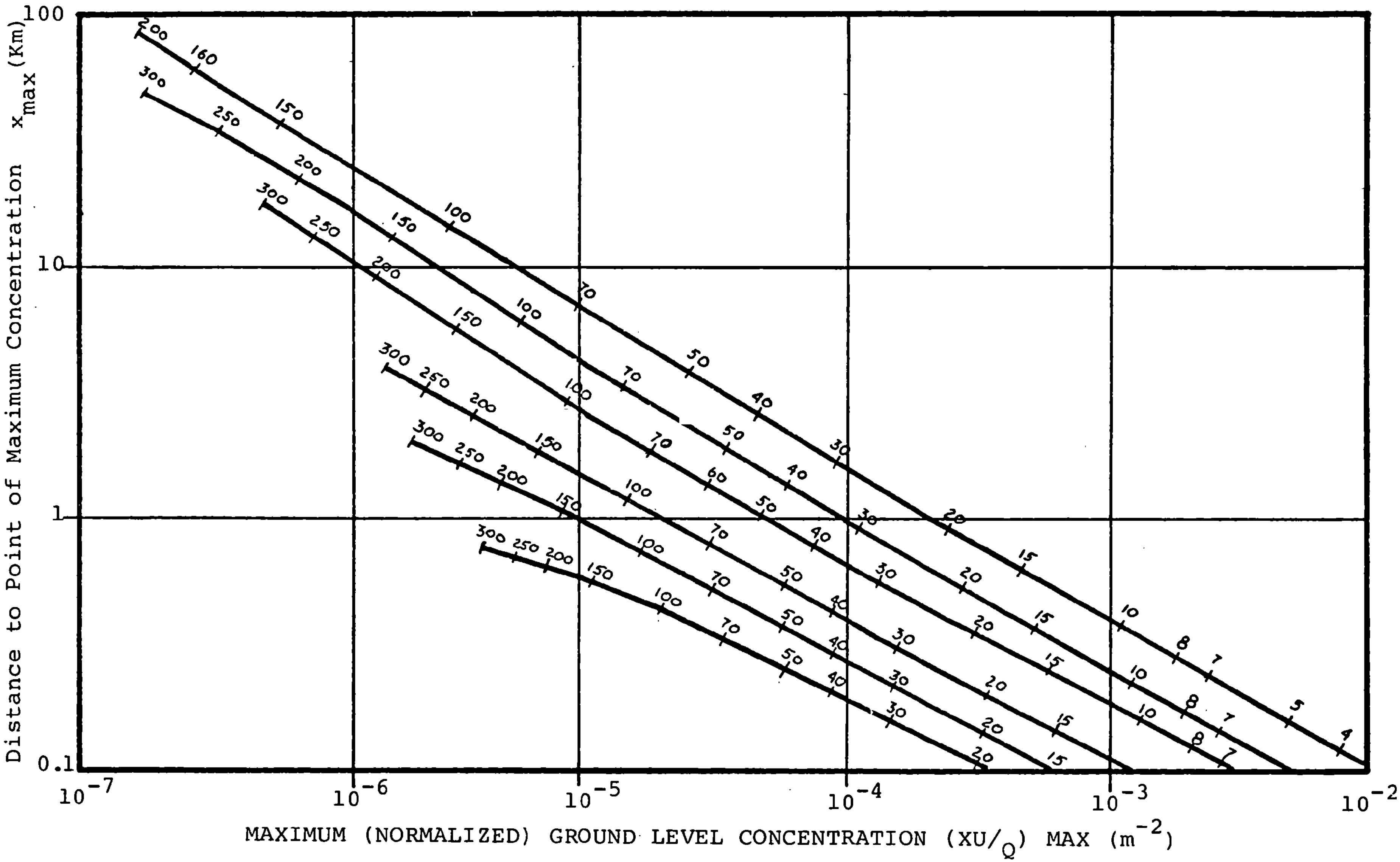
In the application of this nomogram, two parameters must be determined, vis., effective height of emission and atmospheric stability. Stability categories (in six classes) are defined below in Table 9-3 with Class A as the most unstable and Class F the most stable.

TABLE 9-3
KEY TO STABILITY CATEGORIES

Surface Wind Speed (at 10 m), m sec^{-1}	Day: Incoming Solar Radiation			Night	
	Strong	Moderate	Slight	Thinly Overcast or $\geq$4/8 Low Cloud	$\leq$ 3/8 Cloud
< 2	A	A-B	B		
2-3	A-B	B	C	E	F
3-5	B	B-C	C	D	E
5-6	C	C-D	D	D	D
> 6	C	D	D	D	D

The neutral class, D, should be assumed for overcast conditions during day or night.

Strong insolation (radiation received from the sun) corresponds to a solar altitude (above the horizon) greater than 60° with clear skies, and slight isolation corresponds to a solar altitude from 15° to 35° with clear skies. Cloudiness will generally decrease insolation and should be considered along with solar altitude in determining insolation. Insolation that would be strong with clear skies might be expected to be reduced to moderate with broken middle clouds and to slight with broken low clouds. Night refers to the period from one hour before sunset to one hour after sunrise. The neutral category, D, should be assumed for overcast conditions during day or night.



Distance of maximum concentration and maximum xu/Q as a function of stability (curves) and effective height (meters) of emission (numbers). Figure 9-4

Effective height of emission is the altitude at which the stack plume becomes level. Rarely will this height correspond to the physical height of the stack since the plume generally experiences additional rise due to the velocity of the emission and stack gas temperatures higher than the ambient. A number of procedures are available for estimating this plume rise and are described by Turner [20].

9.135 Detailed Models

The models specified in the following subsections are also applicable to other pollutants, provided these pollutants can be assumed to behave as a gas. Included in this is modeling for the metals from incinerator emissions.

A. Point Source Model for Sulfur Dioxide and Particulate Matter (All Averaging Times)

In those cases where a more refined analysis is required and there are no significant meteorological or terrain complexities, the Single Source (CRSTER) Model [25] is recommended for use. If meteorological or terrain complexities cause substantial uncertainties, then a model that is more detailed or more suitable than the Single Source (CSTER) Model should be applied. No refined, widely available models applicable to complex situations are identified. It is recommended that each complex situation be treated on a case-by-case basis with the assistance of expert advice.

If the data bases required to apply the Single Source (CRSTER) Model are unavailable, or if other refined models applicable to a complex situation do not exist, then it may be necessary to base estimates of source impact on only the estimates provided by the screening techniques. In such cases, an attempt should be made to acquire or improve the necessary data bases and to develop appropriate analytical techniques.

B. Multi-Source Models for Sulfur Dioxide and Particulate Matter (Annual Average)

Due to the complexity of most multi-source situations and the wide acceptability of several models, a screening process is not generally conducted.

The Climatological Dispersion Model (CDM) [26,27], the Air Quality Display Model (AQDM) [28] and the Texas Climatological Model (TCM) [29] are recommended for evaluating the long-term impact of incinerators within an urban multi-source complex. In regions with major meteorological or topographic complexities, more detailed or suitable models may be used. If the meteorological or topographic complexities are such that the use of any available air quality model is precluded, an attempt should be made to acquire or improve the necessary data bases and to develop appropriate analytical techniques.

C. Multi-Source Models for Sulfur Dioxide and Particulate Matter (Short-Term Averages)

The Real-Time Air Quality Simulation Model (RAM) [30] is recommended for evaluating the impact of incinerators within a multi-source complex on air quality averaged over short-term periods. It is applicable to both urban and rural situations. The Texas Episodic Model (TEM) [31] may be used if the data bases required to apply RAM are unavailable, the CDM, AQDM, or TCM may be used to estimate short-term concentrations of SO_2 and particulate matter.

In areas with major meteorological or topographic complexities, more detailed or suitable models may be required.

D. Models for Nitrogen Dioxide

The recommendations for point source screening techniques and models are also applicable to evaluate point sources of nitrogen oxides (NO_x) under limited circumstances. Specific refined modeling techniques are not recommended here. Situations that require more refined techniques should be considered on a case-by-case basis with the use of expert consultation.

E. Special Situations

The administration of the national prevention of significant deterioration policy may require that the air quality impact of a source be estimated for great distances downwind. Models with a wide applicability are not generally available for dealing with long-range transport, deposition, and unique topographic or meteorological circumstances, e.g., complex terrain, aerodynamic downwash. Special guidance may be required in these situations.

9.136 Data Requirements

It is essential that appropriate source and meteorological data be used with any recommended model. Such data, and related procedures for estimating these data, constitute an integral part of the model. It is often overlooked that few of the variables input to a model are directly measured or routinely available. Submodels must appropriately convert the available source and meteorological data to a form that the air quality model can accept. It is also important that a variety of charge/emissions conditions, and that a wide range of meteorological conditions based on several years of data, be considered in determining source impact for new source reviews, including prevention of significant deterioration. In addition, there is a need to judiciously choose receptor sites and to specify background air quality.

A. Emission Source Data

The following are minimum emission source data requirements for new source review. Design process rate conditions must be considered in determining pollutant emissions. Other operating conditions that may result in high pollutant concentrations should also be identified. A range of operating conditions, emission rates, and physical plant characteristics based on the most recently available data, should be used with the multiple years of meteorological data to estimate the source impact.

For new source reviews, the impact of growth in emissions from other sources should only be considered for the period prior to the start-up date for the facility. Such changes in emissions should consider increased area source emissions, changes in existing point source emissions which would not be subject to preconstruction review, and emissions due to sources with permits to construct.

B. Meteorological Data

For a dispersion model to provide useful and valid results, the meteorological data used in the model must be representative of the transport and dispersion conditions in the vicinity of the plant that the model is attempting to simulate. The meteorological data required as a minimum to describe transport and dispersion in the atmosphere are wind direction, wind speed, atmospheric stability, mixing height or related indicators of atmospheric turbulence and mixing. SIte-specific data are preferable to data collected off-site.

It is preferable for the meteorological data base used with the air quality models to include several years of data. Such a multi-year data base allows the consideration of variations in meteorological conditions that occur from year to year. Where representative meteorological observations are not available, the concentration estimates may be limited to consideration of worst case conditions. Due to the uncertainties of this approach, the use of the highest estimated concentration (as opposed to the highest, second-highest concentration) to determine source impact may be justified until such time that a better data base becomes available.

C. Receptor Sites

A receptor site is a location for which an air pollution concentration is estimated. The choice of locations for receptor sites significantly affects the evaluation of source impact. It is most important to identify the location where the maximum concentrations occur, both short- and long-term. The receptor grid must allow sufficient spatial detail and resolution so that the location of the maximum or highest, second-highest concentration is identified.

D. Background Air Quality

To adequately assess the significance of the air quality impact of a source, background concentrations must be considered. Background air quality relevant to a given source includes those pollutant concentrations due to natural sources and distant, unidentified man-made sources. For example, it is commonly assumed that the annual mean background concentration of particulate matter is 30-40 g/m^3 over much of the Eastern United States [32]. Typically, air quality data are used to establish background concentrations in the vicinity of the source under consideration. However, where the source is not isolated, it may be necessary to use a multi-source model to establish the impact of all other nearby sources during dispersion conditions conducive to high concentration.

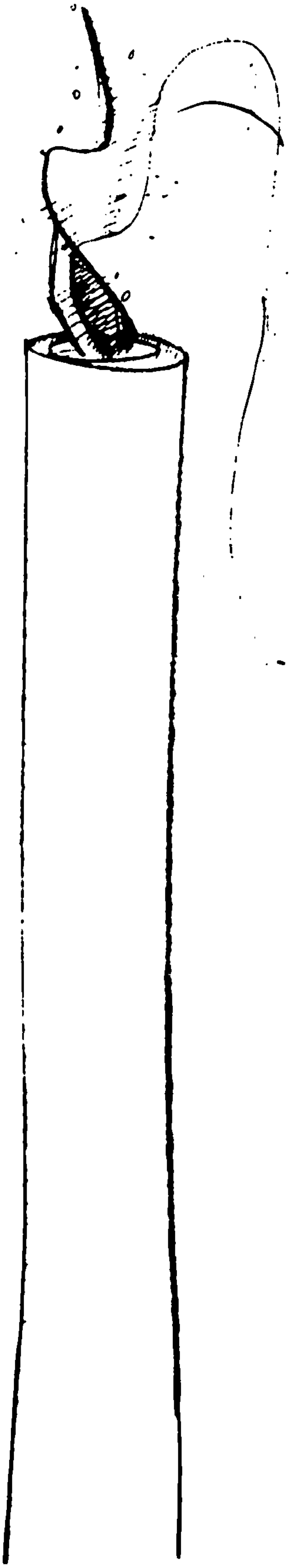
9.137 Case Study

Figure 9-5 presents a sample dispersion calculation for a prototypical sludge incinerator. The methodologies for completing the steps in solving the equation will be discussed at the workshop. The sample is presented here as an illustration of how the preceding factors can be integrated into a formula for determining maximum ambient concentrations of particulates downwind from an emission source.

9.2 SECONDARY IMPACTS ON AIR QUALITY

9.21 Statutory Requirements

Evolving EPA policy and certain statutory requirements provide impetus for preparing land use and environmental analyses for infrastructure investments. In fact, CEQ guidelines for preparing environmental impact statements, which EPA must follow in funding wastewater treatment facilities, recognizes that secondary impacts are often more substantial than the primary effects of the original action and state that they should be analyzed [33]. For



10	EMISSION STRENGTH — GRAMS OF PARTICULATE PER HOUR (gm/hr) OR (lbs/hr)	Q
5	WIND SPEED (m/sec.) OR (10 mph)	μ
C	ATMOSPHERIC STABILITY (C = SLIGHTLY UNSTABLE)	C
70	PLUME HEIGHT (m)	H

χ = AMBIENT CONCENTRATION

$$\frac{\chi \mu}{Q} = 3 \times 10^{-4}$$

$$\chi = 3 \times 10^{-4} \left(\frac{Q}{\mu}\right)$$

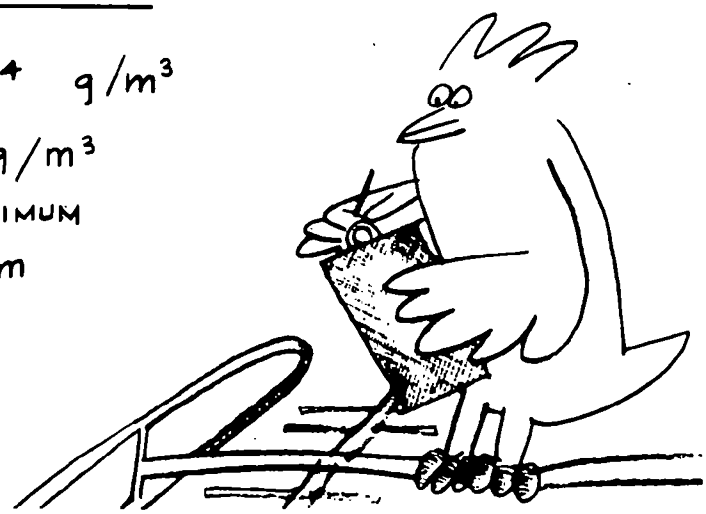
$$\chi = \frac{3 \times 10^{-4} \times 10}{5}$$

$$\chi = 6 \times 10^{-4} \ g/m^3$$

$$\chi = 60 \ \mu g/m^3$$

DISTANCE TO MAXIMUM

$$\chi = 0.8 \ km$$



SAMPLE DISPERSION CALCULATION FOR MAXIMUM DOWNWIND CONCENTRATION FIG. 9-5 example, EPA requirements to analyze secondary development impacts are found in [34-48]. Most recently, the 1977 amendments to the Clean Air Act specifically mandate this requirement in Section 316 relative to sewage treatment grants. Specifically, in the case of construction of a treatment plant in an area, the quantification of emissions from this facility "...shall include the emissions of any such pollutant resulting directly or indirectly from areawide and nonmajor stationary source growth (mobile and stationary) for each such area". Consequently, the effects of secondary growth on air quality is a requirement of the environmental impact assessment.

9.22 Methodology

Land use patterns and their attendant activities have a significant impact upon the type and amount of air pollution generated in a region. To the extent that land use can be associated with the discharge of pollutants, it is necessary to plan future land use and transportation that is compatible with acceptable levels of air quality. Comprehensive planning has in the past been relatively insensitive to air quality considerations. New air quality management procedures require that the planning community generate and use analytical tools to incorporate air quality constraints into the planning process. At the present time, several agencies, including EPA and the Department of Housing and Urban Development (HUD), are developing procedures to reflect this expanded concept.

A recent review of the state-of-the-art in models relating land use planning to air quality considerations examined studies such as the Hackensack Meadowlands Air Pollution Study [39] and concluded that existing techniques are limited in application by the area-specific data base on which they are developed and their inability to disaggregate projected pollutant emissions by land use category. Thus, there is a need for a generalized analytical tool that can (1) predict land use development induced by major projects by category type, and (2) convert such detailed land use projections into pollutant emissions for use in air quality management analyses.

Research has been conducted on the development of methodologies for secondary air quality impacts [40,41]. These approaches have proven to be less than innovative, since they generally use the design population projection for a sewage treatment plant as the basis for simple growth effects assessments. The most recent research currently being conducted utilizes path analysis techniques as a method for examining direct and indirect cause and effect relationships [42]. This work has produced a model which is complex in the development but simple in the application. The structure of this model is shown in Figure 9-6. The predictive land use equations serve as the first element of the general secondary impact assessment procedure. These predictions of future land use are translated into stationary source emissions for all criteria pollutants using land use based emission factors developed specifically for the nine land use categories in the model (43). Second, a simple traffic model estimates vehicle miles traveled, and hence mobile source emissions, generated by activity associated with each land use category. These two emission components are then summed to give the user the total emissions associated with induced development within the legal service area of the wastewater major project.

Secondary impact assessment by means of this model has been recently formalized into a simple worksheet procedure. Input data required to complete the analysis with these worksheets is commonly available from the municipality or local/regional planning agency. A list of these impacts is presented in Appendix B. Instructions for the application of the methodology, as well as a sample case study, are provided in a separate manual to be distributed at the workshops.

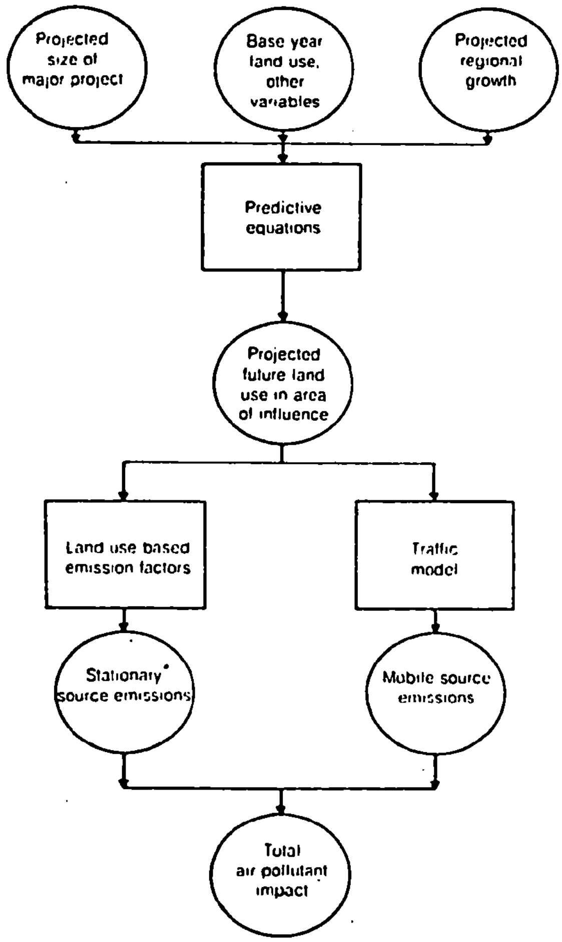


Figure 9-6 Overview of Secondary Land Use and Air Quality Impact Assessment Procedure

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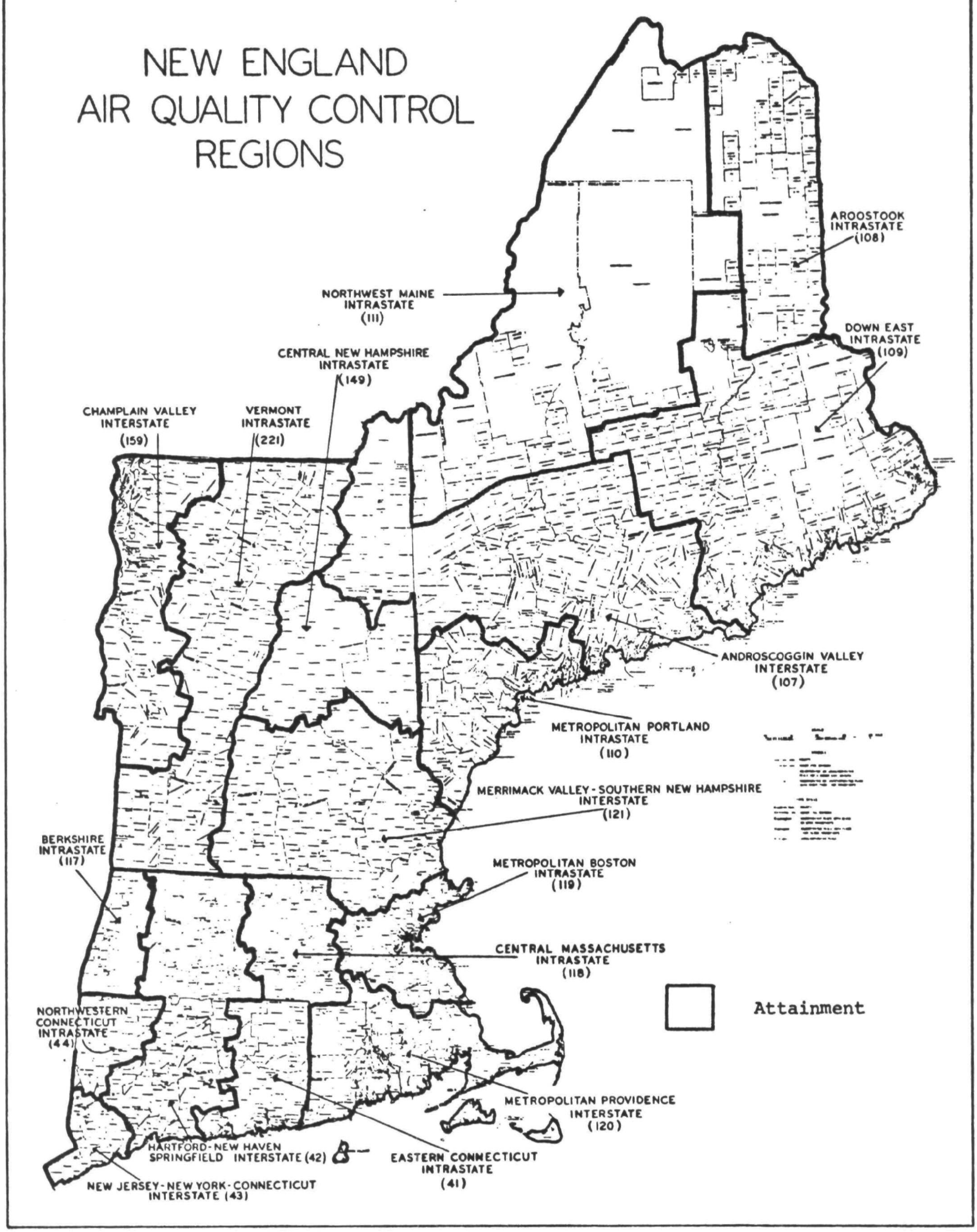
APPENDIX A
ATTAINMENT/NON-ATTAINMENT STATUS IN NEW ENGLAND



SO_2 Attainment/Non-attainment Status

Figure 9-7

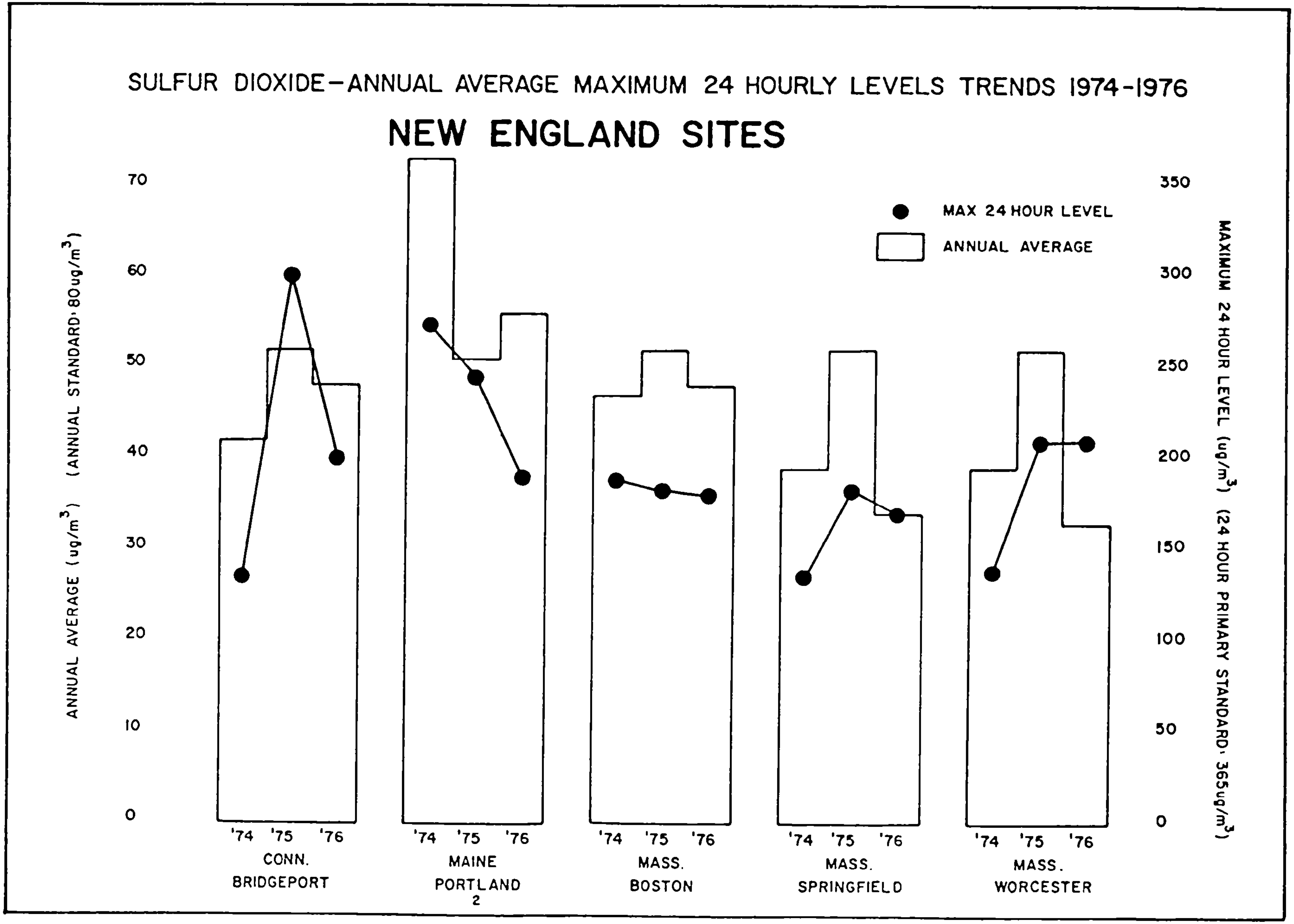
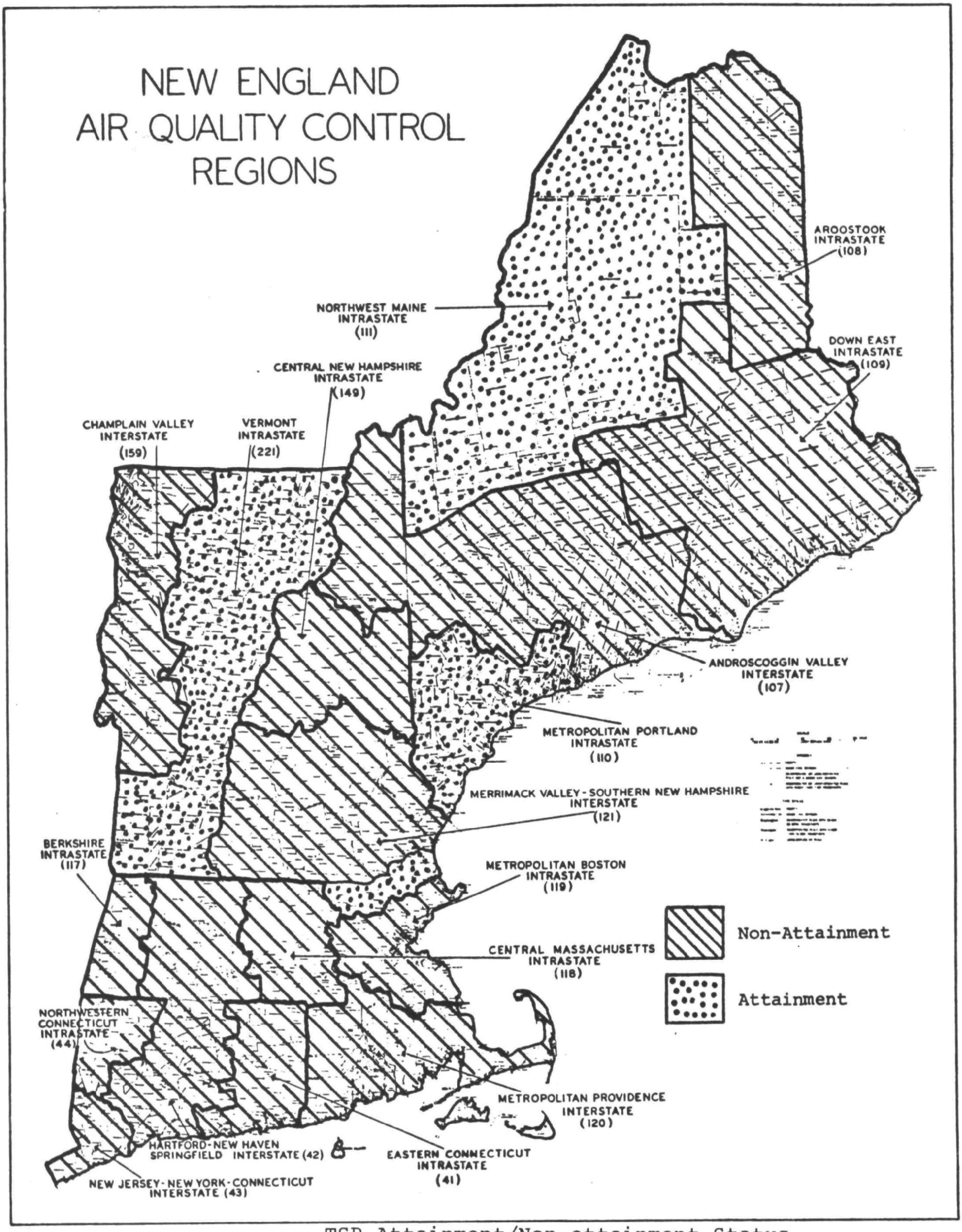
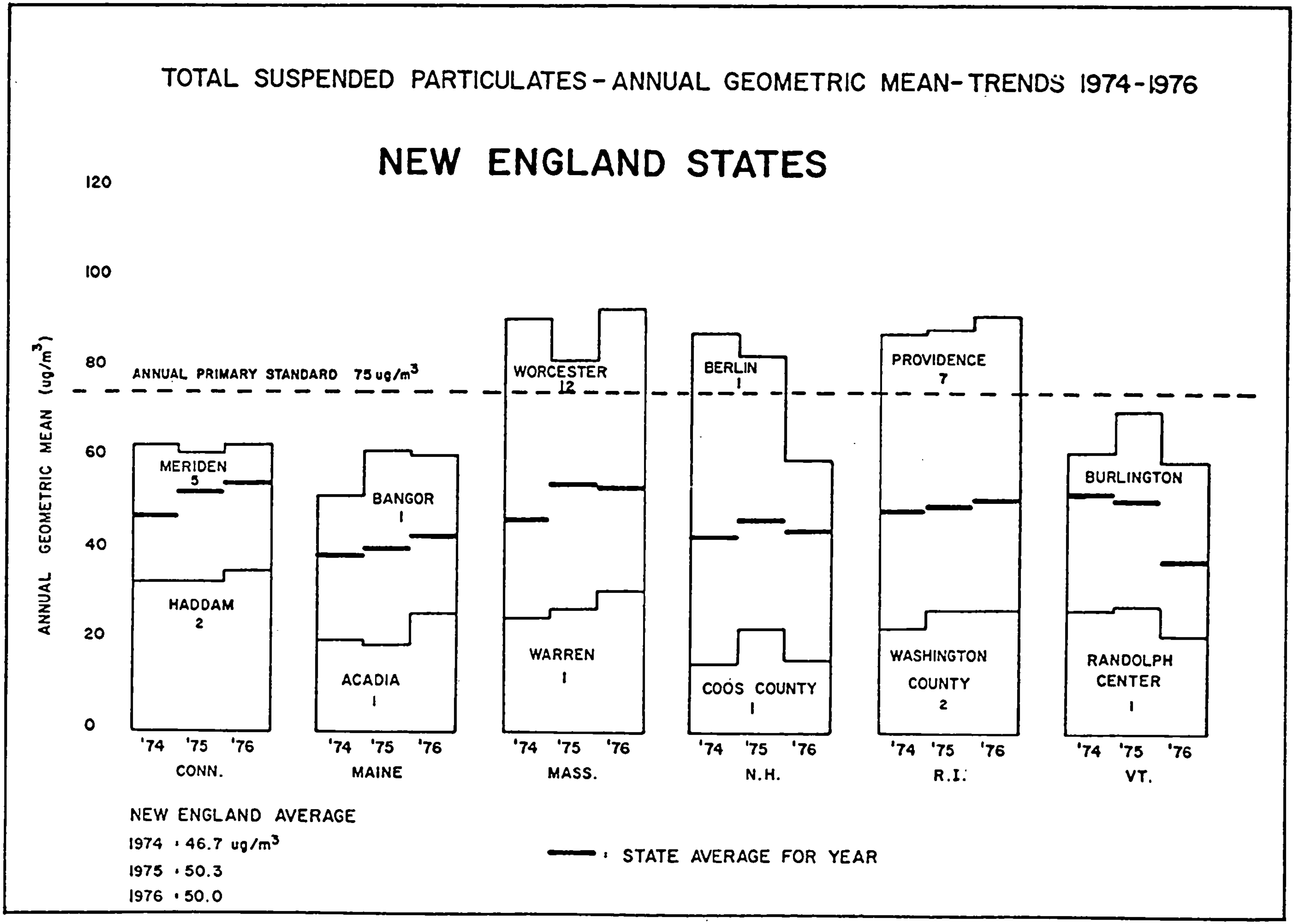

SULFUR DIOXIDE–ANNUAL AVERAGE MAXIMUM 24 HOURLY LEVELS TRENDS 1974-1976
NEW ENGLAND SITES
MAX 24 HOUR LEVEL
ANNUAL AVERAGE
ANNUAL AVERAGE (ug/m3) (ANNUAL STANDARD · 80ug/m3)
MAXIMUM 24 HOUR LEVEL (ug/m3) (24 HOUR PRIMARY STANDARD · 365ug/m3)
0
10
20
30
40
50
60
70
0
50
100
150
200
250
300
350
'74 '75 '76
CONN.
BRIDGEPORT
MAINE
PORTLAND
2
MASS.
BOSTON
MASS.
SPRINGFIELD
MASS.
WORCESTER

Figure 9-8



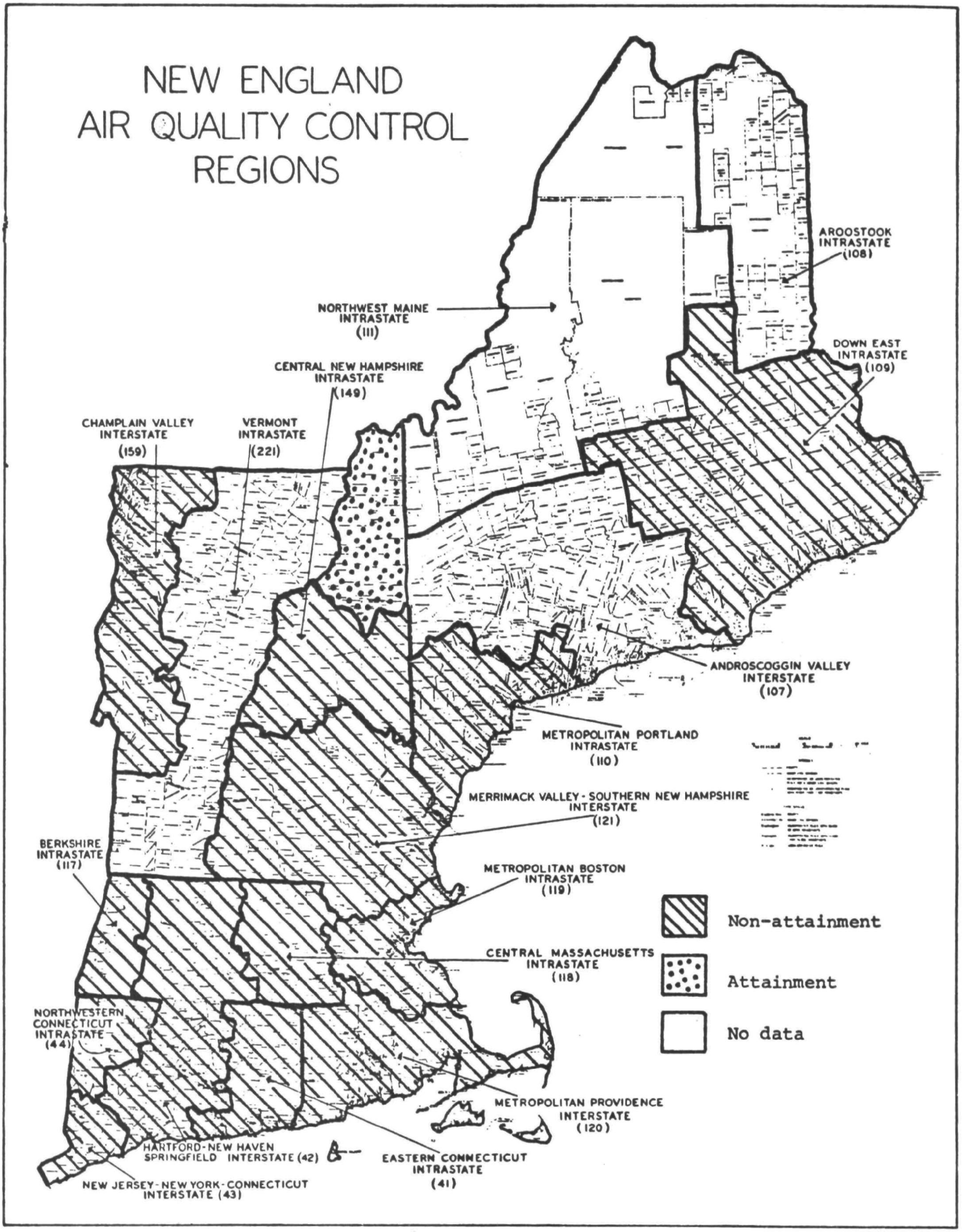
TSP Attainment/Non-attainment Status

Figure 9-9



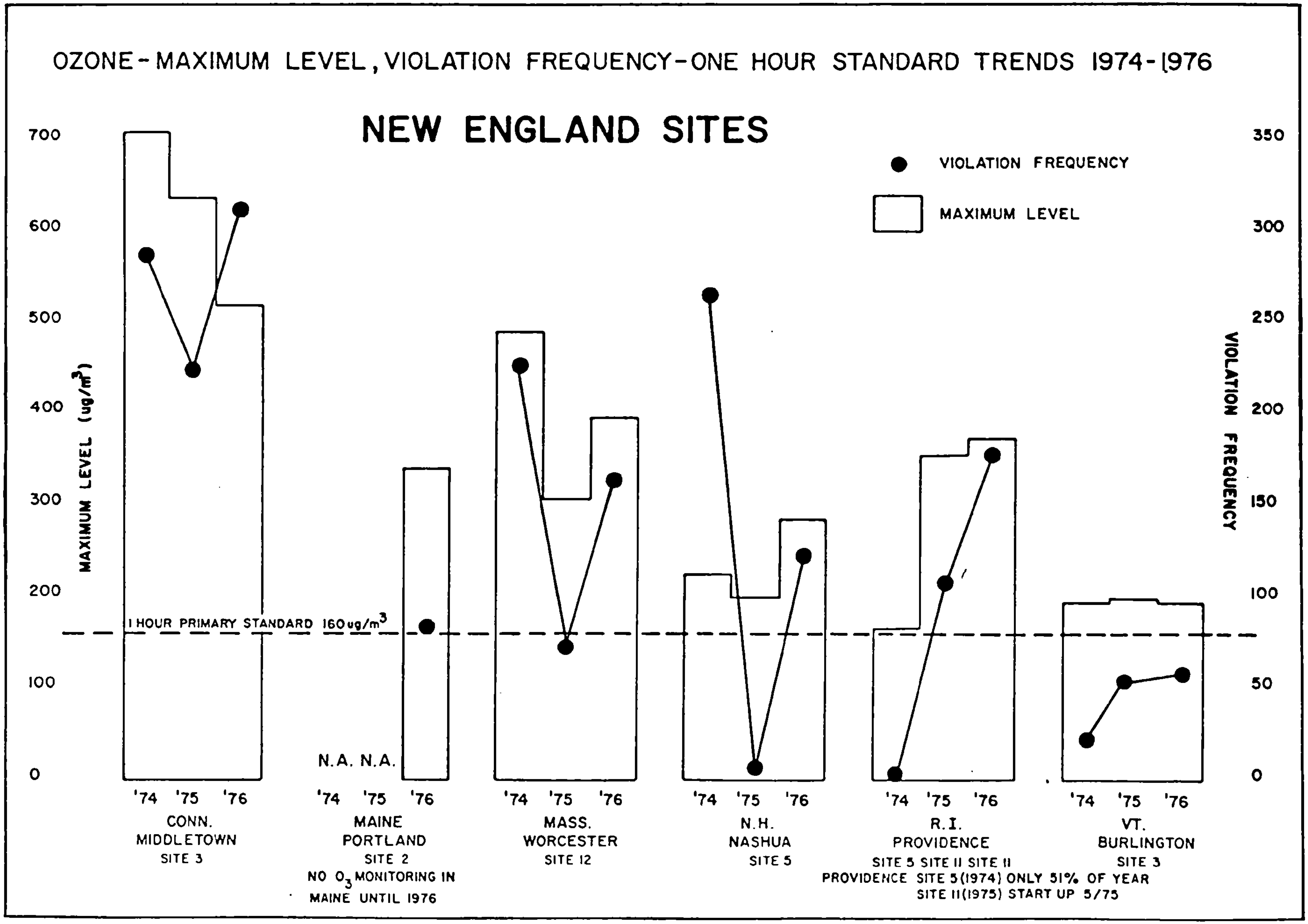
TOTAL SUSPENDED PARTICULATES - ANNUAL GEOMETRIC MEAN - TRENDS 1974-1976
NEW ENGLAND STATES
ANNUAL GEOMETRIC MEAN (ug/m3)
120
100
80
60
40
20
0
ANNUAL PRIMARY STANDARD 75 ug/m3
MERIDEN 5
HADDAM 2
BANGOR 1
ACADIA 1
WORCESTER 12
WARREN 1
BERLIN 1
COOS COUNTY 1
PROVIDENCE 7
WASHINGTON COUNTY 2
BURLINGTON
RANDOLPH CENTER 1
'74 '75 '76
CONN.
MAINE
MASS.
N.H.
R.I.
VT.
NEW ENGLAND AVERAGE
1974 : 46.7 ug/m3
1975 : 50.3
1976 : 50.0
: STATE AVERAGE FOR YEAR

Figure 9-10



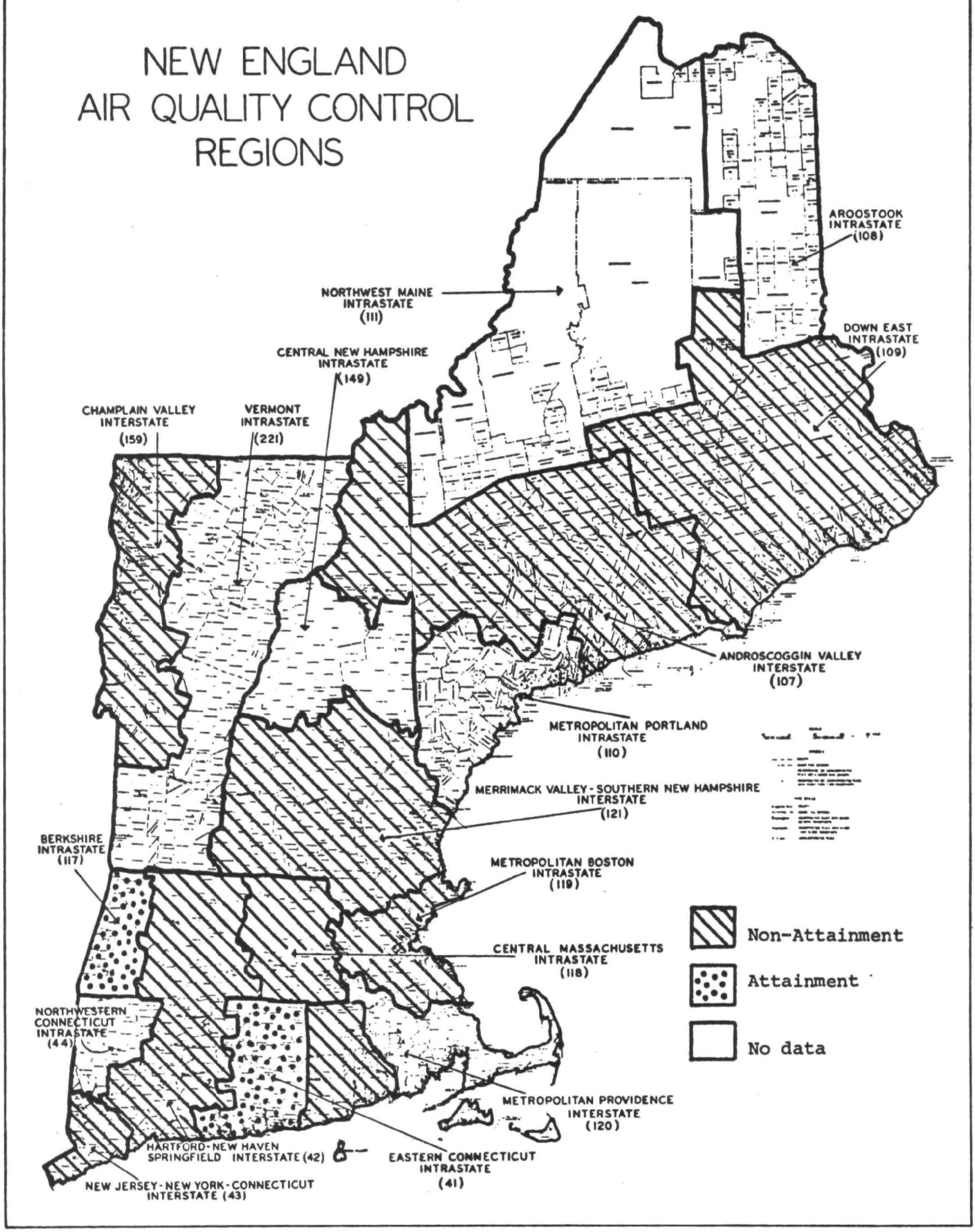
Ozone Attainment/Non-attainment Status

Figure 9-11



OZONE-MAXIMUM LEVEL, VIOLATION FREQUENCY-ONE HOUR STANDARD TRENDS 1974-1976
NEW ENGLAND SITES
VIOLATION FREQUENCY
MAXIMUM LEVEL
MAXIMUM LEVEL (ug/m3)
VIOLATION FREQUENCY
700
600
500
400
300
200
100
0
350
300
250
200
150
100
50
0
1 HOUR PRIMARY STANDARD 160ug/m3
N.A. N.A.
'74 '75 '76
CONN.
MIDDLETOWN
SITE 3
MAINE
PORTLAND
SITE 2
NO O3 MONITORING IN
MAINE UNTIL 1976
MASS.
WORCESTER
SITE 12
N.H.
NASHUA
SITE 5
R.I.
PROVIDENCE
SITE 5 SITE 11 SITE 11
PROVIDENCE SITE 5 (1974) ONLY 51% OF YEAR
SITE 11 (1975) START UP 5/75
VT.
BURLINGTON
SITE 3

Figure 9-12



CO Attainment/Non-attainment Status

Figure 9-13

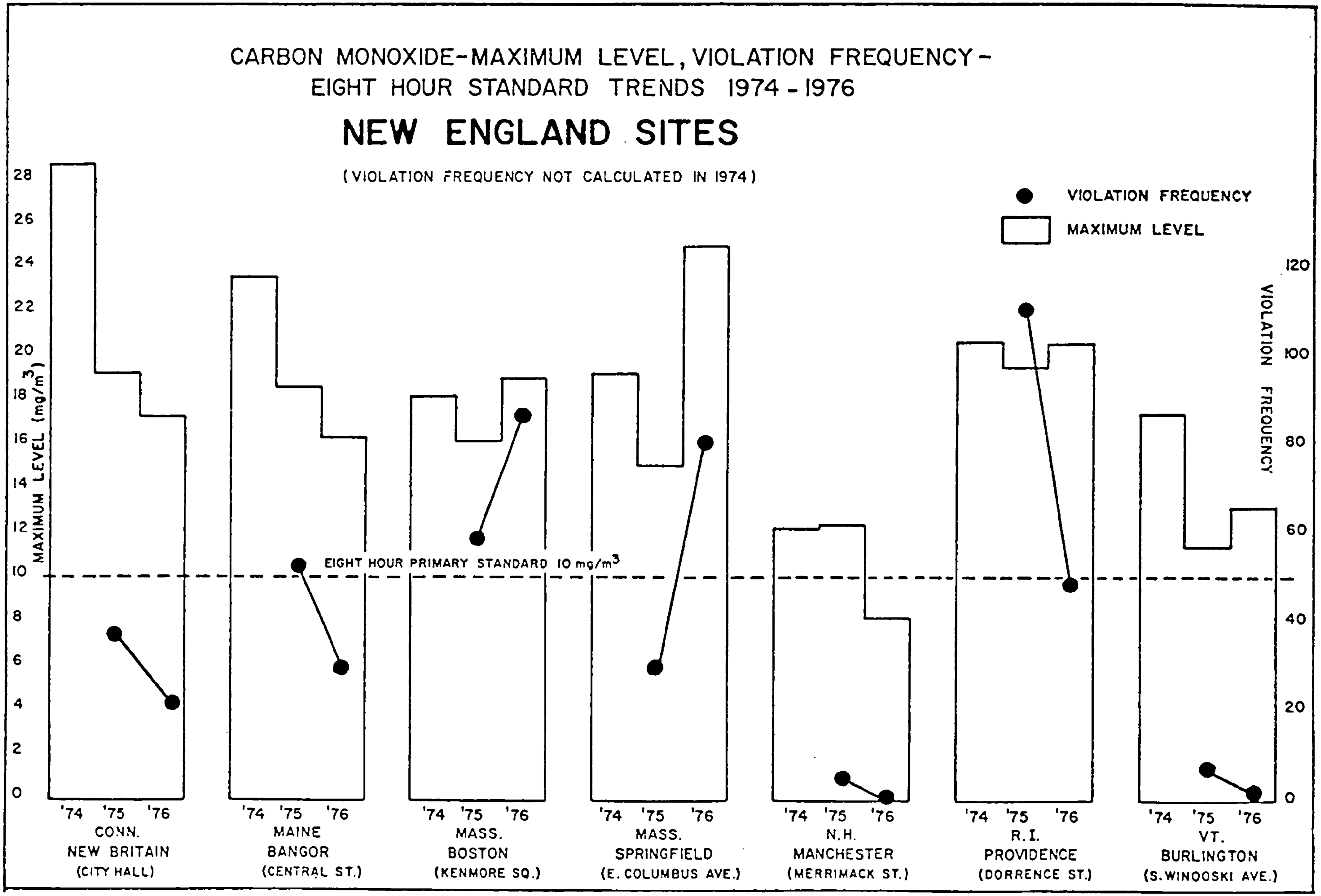
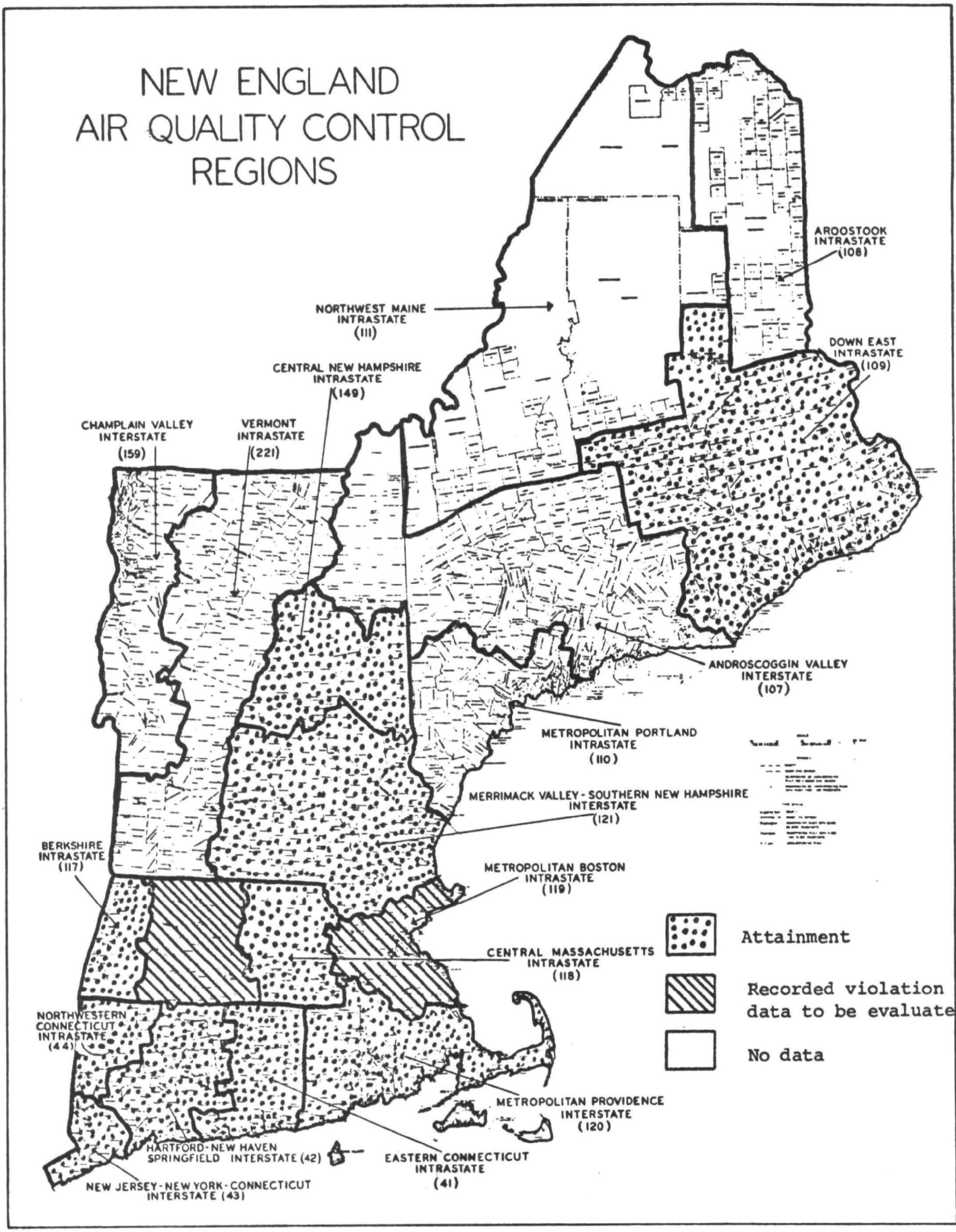

CARBON MONOXIDE-MAXIMUM LEVEL, VIOLATION FREQUENCY-
EIGHT HOUR STANDARD TRENDS 1974 - 1976
NEW ENGLAND SITES
(VIOLATION FREQUENCY NOT CALCULATED IN 1974)
VIOLATION FREQUENCY
MAXIMUM LEVEL
MAXIMUM LEVEL (mg/m3)
VIOLATION FREQUENCY
EIGHT HOUR PRIMARY STANDARD 10 mg/m3
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
120
100
80
60
40
20
0
'74 '75 '76
CONN.
NEW BRITAIN
(CITY HALL)
MAINE
BANGOR
(CENTRAL ST.)
MASS.
BOSTON
(KENMORE SQ.)
MASS.
SPRINGFIELD
(E. COLUMBUS AVE.)
N.H.
MANCHESTER
(MERRIMACK ST.)
R.I.
PROVIDENCE
(DORRENCE ST.)
VT.
BURLINGTON
(S. WINOOSKI AVE.)

Figure 9-14



NO_2 Attainment/Non-attainment Status

Figure 9-15

APPENDIX B
INPUT DATA REQUIREMENTS FOR SECONDARY IMPACT ASSESSMENT MODEL

TABLE 9-B1

INPUT DATA REQUIREMENTS FOR SECONDARY IMPACT ASSESSMENT MODEL

Variable Name	Description (English Units)	Data Source
Area of Analysis	Area of analysis (in acres)	Facility Plan or River Basin Commission
Vacant Developable	Vacant developable acreage in area of analysis for the year t[2]	Planning Agency
Vacant Undevelopable	Vacant undevelopable acreage in area of analysis for the year t	Planning Agency
Median Price	Median price of vacant residential land ($/acre) in area of analysis for the year t	Planning Agency or Realtor
Median Income	Median income of families ($) in county[3] for the year t	Census[4]
Collection Capacity	Total hydraulic design capacity of wastewater major project collection system (in million gallons per day) for the year t (or up to 5 years later if a phased project)	Facility Plan
Peak Flow	Anticipated peak flow in the wastewater major project collection system (in mgd)[1] for the year t	Facility Plan
Manufacturing Workers	Manufacturing employment (in 100s) census tracts for the year t	Census[4]
Tract Area	Area of census tracts[5] (in square miles)	Census

[1]mgd = million gallons per day.

[2]t is the year of major project initiation.

[3]County containing most of the area of analysis.

[4]All census data for the year t should be based on the most recent U.S. Census. If such data is more than 5 years older than year t, it should be updated using OBERS projections

[5]Census tracts which most closely approximate the area of analysis.

TABLE 9-B1 (CONTINUED)

INPUT DATA REQUIREMENTS FOR SECONDARY IMPACT ASSESSMENT MODEL

Variable Name	Description (English Units)	Data Source
Nonmobility	Percent[1] of families in year t who were in the same house in year (t-5)	Census
Drivers	Workers who drive to work (in 100s) for the year t in the county	Census
County Area	Area of county (in square miles)	Planning Agency
Sewered Land	Acres of land within 5,000 ft. of the major project interceptor sewer in the area of analysis for the year t	Facility Plan
School Kids	Population 0-14 years of age (in 100s) in census tracts for the year t	Census
Dwelling Units	Census tract housing units (in 100s) for the year t	Census
Limited Access	Number of limited access interchanges expected in the area of analysis for the year t+5	Planning Agency
Current Employment	Total SMSA employment (in 100s) for the year t	Census
Future Employment	Projected SMSA employment (in 100s) for the year t+10	Planning Agency
SMSA Area	Area of SMSA (in square miles)	Census
Track	Miles of railroad tract in area of analysis for the year t	USGS Topographical Map
Zoned Office	Acres of land zoned for office use in area of analysis for the year t	Planning Agency
Zoned Industrial	Acres of land zoned for industrial use in area of analysis for the year t	Planning Agency
Population Growth	Percent[1] change in regional population projected between years t and t+10	Planning Agency
Office Vacancy	Percent[2] of vacant office buildings in area of analysis for the year t	Planning Agency or BOMA
Airport Distance	Miles from centroid of area of analysis to centroid of nearest commercial airport for the year t	USGS Topographical Map

[1]A value of 0.10 = 10%

[2]A value of 10 = 10%

TABLE 9-B1 (CONTINUED)

INPUT DATA REQUIREMENTS FOR SECONDARY IMPACT ASSESSMENT MODEL

Variable Name	Description (English Units)	Data Source
Office Workers	Office employment (in 100) in census tracts for the year t	Census
Future Population	Projected SMSA population (in 100s) for the year t+10	Planning Agency
Unemployment	Percent[1] unemployment in area of analysis for the year t	Census
Income	Projected median family income in SMSA for the year t+10	Planning Agency
Government	Total county expenditures (in millions of $) for the year t	Census
Interceptors	Running length of interceptor sewer lines (in miles) going through relatively undeveloped land[2] in area of analysis for the year t	Facility Plan
Poverty	Percent[1] of total families with income below the poverty level in area of analysis for the year t	Census
Onsite Restrictions	Categorical variable to indicate the severity of governmental restrictions in on-lot sewage disposal during the years t to t+10. Coded as follows: 4 = on-lot disposal prohibited 3 = prohibited except on large lots 2 = permitted but percolation test required 1 = permitted but package plants prohibited 0 = no restrictions	Planning Agency or Local Government
County Growth	Percent[1] change in county population projected for the years t to t+10	Planning Agency
Project Cost	Total major project construction cost (in thousands of $)	Facility Plan
Federal Funds	Federally funded share of major project cost (in thousands of $)	Facility Plan
Index One	Consumer Price Index[3] for the year t	U.S. Dept. of Labor[4]

[1]A value of 0.10 = 10%

[2]Less than one dwelling unit per acre

[3]1947-49 = 100.0

[4]Or, Statistical Abstract of the United States

TABLE 9-B1 (CONTINUED)

INPUT DATA REQUIREMENTS FOR SECONDARY IMPACT ASSESSMENT MODEL

Variable Name	Description (English Units)	Data Source
Index Two	Consumer Price Index for the year of federal funding	U. S. Dept. of Labor
Population Served	Population served by the major project facility for the year t	Facility Plan
Treatment Capacity	Total hydraulic design capacity of the major project wastewater treatment plant (in mgd) for the year t	Facility Plan
Vacant Houses	Percent[1] vacant available dwelling units in area of analysis for the year t	Census
County Interchanges	Number of limited access interchanges in county for the year t+5	Planning Agency
Zoned Residential	Acres of land zoned for residential use in area of analysis for the year t	Planning Agency
Current Income	Median family income ($) in SMSA for the year t	Census
Current Hospitals	Hospital employment (in 100s) in SMSA for the year t	Census
Future Hospitals	Projected hospital employment (in 100s) in SMSA for the year t+10	Planning Agency
Current Houses	Total housing units (in 100s) in SMSA for the year t	Census
Future Houses	Projected housing units (in 100s) in SMSA for the year t+10	Planning Agency
Restriction Years	The number of years between year t and year t+10 that it is expected that any on-site sewage disposal restrictions will be in effect (i.e., a value of 0 to 10)	Planning Agency or Local Government
Phasing	Categorical variable to indicate whether the completion of the collection network will be phased over several years 1 = phasing will occur 0 = no phasing	Facility Plan

[1]A value of 0.10 = 10%

TABLE 9-B1 (CONTINUED)

INPUT DATA REQUIREMENTS FOR SECONDARY IMPACT ASSESSMENT MODEL

Variable Name	Description (English Units)	Data Source
Transit Stops	Number of transit stops (bus and commuter rail) in area of analysis for the year t	Planning Agency
CBD Distance	Distance (in miles) from centroid of area of analysis to centroid of nearest central business district for the year t	USGS Topographical Map

environmental assessment manual

noise

10. noise

CHAPTER 10 - NOISE

10.0 INTRODUCTION

This section of the manual gives a general overview of the community noise problem plus some techniques to use in forming a preliminary and informal environmental noise assessment of waste water treatment facilities. Purposely, the presentation here has been kept simplified and essentially non-technical in nature. It was felt that this approach offers the best possibility of success in terms of providing the reader with pertinent information and ideas directly applicable to his or her immediate problem.

More detailed discussions of the technical aspects of noise measurement and control may, of course, be found in textbooks and technical journals. A particularly useful source, dealing specifically with municipal waste water treatment works, has recently been published by the U.S. Environmental Protection Agency (A)*.

10.1 OVERVIEW OF COMMUNITY NOISE PROBLEMS

This section provides some very general background information on the nature of community noise and is intended to be an aid to the non-expert reader. The material presented is, of necessity, cursory in nature and the reader interested in a more detailed presentation should refer to the sources listed in the REFERENCES section. The "Report to the President and Congress on Noise" (B) and "Community Noise" (C) are particularly useful as introductory reading.

10.11 Characteristics of Community Noise

Noise is usually defined as "unwanted sound". The word "unwanted" suggests that noise is subjective in nature, and that what is noise to one person may be a pleasant or at least a not unpleasant sound to another listener. The second part of the definition implies that noise is basically an acoustic phenomenon.

Acoustic signals or airborne sounds, are small and rapid fluctuations of air pressure about the mean atmospheric pressure (29.92 inches Hg, or more appropriately, 105 N/m2.) As acoustic signals propagate through the air, they exhibit four general characteristics:

A. The magnitude of the fluctuation. Subjectively, the magnitude of the pressure fluctuation is perceived as the loudness of the sound.

* Letters in brackets refer to sources listed in REFERENCES section.

B. The rate at which the fluctuations take place or the frequency of the fluctuations. Different frequencies of oscillation are subjectively perceived as different tonal qualities or differences in pitch. Rapid frequencies of oscillation are sensed as high-pitched sounds and the lower frequencies are sensed as low-pitched sounds.

C. The temporal nature of the fluctuation. Most environmental noise signals change with time, both in the short term (minute to minute) and in the long term (hour to hour and day to day). The manner in which these temporal variations occur can, to some degree, influence the subjective annoyance of a given noise signal.

D. The directional nature of the sound as it propogates from the source to the receiver. Because we have two ears, we hear stereophonically and have a very acute sense of directional perception.

Because of their importance in the measurement and assessment of noise levels, it is helpful to consider each of these general characteristics in somewhat greater detail.

10.111 Magnitude Characteristic

The magnitude characteristic of an acoustic signal is measured in terms of its decibel (dB) level. The decible scale is logarithmic rather than linear with 0 dB corresponding to the approximate threshold of hearing (2 x 10-5 N/m2). When an acousitc signal is expressed in decibels, the numerical dB value is referred to as a sound pressure level or SPL, the word "level" denoting that the decibel scale is being used. Because of the logarithmic nature of the dB scale, SPL values cannot be added in the usual manner. For example, if chain saw A and chain saw B each produce of SPL of 70 dB at a given microphone when operating singly, then operating A and B simultaneously will produce a combined SPL of 73 dB and not 140 dB as might be expected. Similarly, 10 chain saws, each of which produced 70 dB when operated individually, when all are operating together will produce a sound pressure level of 70 + 10 = 80 dB. And going from 10 to 100 chain saws would only increase the noise level an additional 10 dB to a SPL of 90 dB. This rule for adding sound pressure levels can be summarized as "increasing the number of identical contributing sources by a factor of 10 corresponds to raising the SPL by 10 dB."

In general, when a listener moves away from a source of noise, the magnitude of the noise level sensed by the listener is reduced. If the source of noise acts as a "point source," for example, a parked truck with its engine idling, the reduction in noise with distance follows the spherical spreading law, i.e., a six dB reduction in SPL with each doubling of the distance (-6 dB/DD). If the noise source acts as a "line source," a heavy and constant flow of traffic on a very long and straight roadway, for example, the sound signal spreads vylindrically and only produces a 3 dB reduction with each doubling of distance from this "line source" (-3dB/DD).

10.112 Frequency Characteristic

The frequency of a particular sound signal is measured in cycles per second or Hertz (Hz), with the range of audible frequencies extending from approximately 30 Hz to about 15,000 Hz. The human ear does not, however, respond equally to sounds of different frequencies. Hearing is most acute in the mid-frequency range with considerably less sensitivity at the lower frequencies. The change in hearing sensitivity with frequency follows what is called the "A scale" characteristic.

Most of the sounds heard in a typical community do not consist of a single frequency, but rather they contain a broad band, or spectrum, of different frequencies. While the detailed frequency spectrum of a given sound can be measured and the spectral content can be used to rate the subjective "loudness" or "annoyance level" of the given sound, this approach is seldom used in community noise measurements. The method commonly used consists of passing the measured microphone output voltage through an electrical filter which has a frequency response characteristic identical to that of the A scale characteristic. The filtered signal is then measured on a meter calibrated to read in dB and the resultant dB value is said to be the "A-weighted sound pressure level", or the "SPL in dBA." The letter "A" in the "dBA" abbreviation indicates the A scale filtering has been employed in the measurement. The use of A scale weighting in making community noise measurements has two significant advantages:

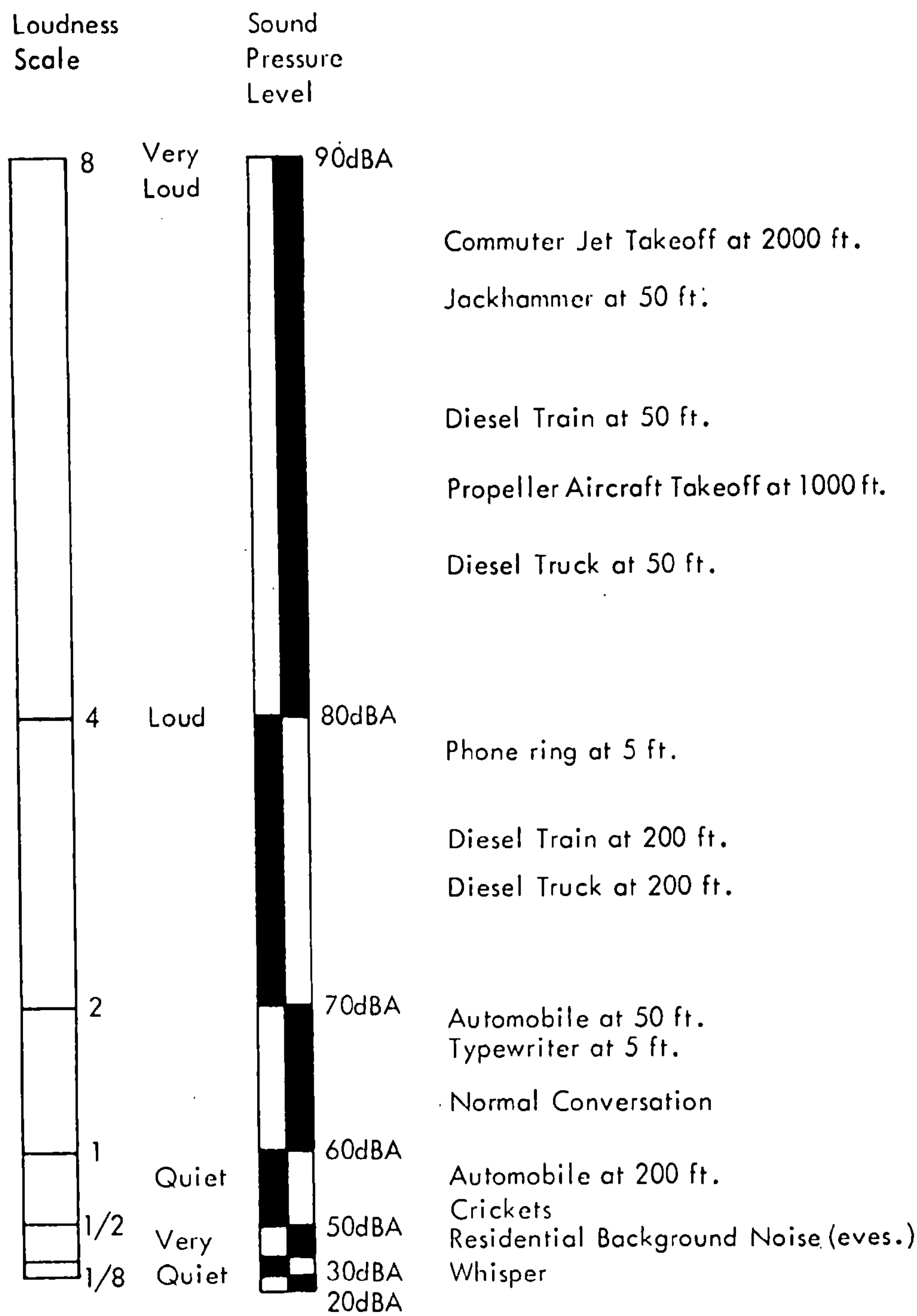
1. It is easier and more convenient than measuring the complete frequency spectrum of a given noise.

2. The A-weighted measurements of different types of sound show a good correlation with actual human response to these sounds (D).

To give the reader some indication of what the measured dBA values mean, Figure 10-1 shows the dBA levels of some typical indoor and outdoor sounds.

10.113 Temporal Characteristic

While a single dBA measurement can adequately describe a steady sound at a given instant in time, most community noise levels are changing with time in a quasi-random, or stochastic manner. The temporal variation of typical community noise levels is due to the multiplicity of noise sources contributing to the



dBA LEVEL AND RELATIVE LOUDNESS OF TYPICAL INDOOR AND OUTDOOR NOISES FIG. 10—1 total noise signal at a particular microphone location. These typical contributions include traffic, industrial activities, human activities, wind, birds and other sources. While these contributors may collectively produce a total sound which is relatively constant from moment to moment, over a time-frame of several hours both the natural and the man-made noise sources can be expected to change their individual noise outputs. In addition to these slowly changing background noise levels, there are also many short duration but identifiable events, such as horns honking, aircraft fly-overs, trains passing, dogs barking and other such phenomena which contribute to the total noise signal.

Since multiple sources combine in a quasi-random manner, the total sound signal itself changes with time in a stochastic manner. To describe the changing SPL it is, therefore, necessary to employ some type of statistical analysis of the time varying SPL signal. Typically, a sound level meter is set up at a single microphone location and records the A-weighted SPL at fixed intervals in time (e.g., every 10 seconds) until a predetermined number of dBA readings are obtained. These readings are then processed by a data reduction program to generate a continuous energy equivalent or LEQ level. The LEQ represents the dBA level of a constant SPL which, over the same time period, carries the same acoustical energy as the sampled signal.

To quantatively define the noise climate at a particular location within the community, it is convenient to use an observation period of 24 hours and to compute the LEQ level for this 24 hour period. This 24 hour statistical indicator is called the "24 hour LEQ" and denoted as LEQ(24).

Another commonly used community noise indicator is the day-night equivalent energy level, or LDN. The LDN is identical to LEQ(24) except that the LDN includes a 10 dB penalty imposed on the SPL values during the nighttime hours of 10 PM to 7 AM.

10.114 Directional Characteristic

The fourth characteristic of propagating acoustic signals is the directional nature of the sound as it travels from source to receiver. Typical directional effects include the reduction of noise levels due to barriers between the source and the receiver, excessive echos in hard-walled rooms, and increased noise levels due to reflecting surfaces (other than the ground) close to the measuring microphone. Most of these and other directional effects can be minimized by selecting measurement locations which are free of nearby reflecting surfaces and barriers. It is, therefore, not normally necessary to consider these directional effects in measuring community noise levels.

Directional effects are, however, of extreme importance in the design and analysis of effective noise reduction barriers. Barrier walls, berms, and other sound blocking structures all exhibit a crucial dependence on the geometry of the particular situation in which they are used. Proper consideration should be given to the limitations of the various barrier noise attenuation theories (E) and to the possibly detrimental ground effects (F) before recommending the use of barriers as noise abatement measures. Waste water treatment plants are particularly difficult to control by means of barriers, due to the generally large source dimensions, large source-to-receiver distances, and various source heights typically involved.

10.12 Community Noise Criteria

People are affected by three general noise impacts:

A. A subjective impact producing annoyance and mild or strong dissatisfaction;
B. An impact which causes task or activity interference, e.g. speech, sleep or learning interference;
C. A physiological impact ranging from slight startle to permanent and irreparable loss of hearing.

A thorough review of these noise impacts can be found in References (G) and (H).

It is important to recognize that the problem of correlating an actual measured community noise level to any of the above listed impacts (e.g. what dBA level causes permanent hearing loss?) is an extremely difficult one. The difficulties stem from two major factors: first, there is a problem of quantifying the noise level due to the amplitude, frequency, and temporal variations which can be expected in typical community noise signals; secondly, there are the problems associated with establishing a quantitative description of a basically subjective response in humans. For these reasons there is no completely satisfactory criteria for evaluating or predicting the subjective effects of noise on people.

There are, however, some general relationships which can be cited as an aid to understanding the response of humans to environmental noise:

A. Except in controlled laboratory experiments, an increase of one dB in the A-weighted noise level cannot be noticed by an average listener.

B. Normally, a 3 dB increase in A-weighted noise level would be barely noticeable in a typical community situation.

C. A 10 dB increase in A-weighted noise level would be sensed as a doubling of loudness by an average listener. (See Figure 10-1).

In addition to the above general relationships, several more specific noise assessment criteria can be found in regulations and guidelines adopted by various government agencies. Of particular interest to the waste water treatment plant problem are the assessment criteria used by the Department of Housing and Urban Development (HUD), and those used by the Environmental Protection Agency (EPA). The HUD noise standards (I) are based on a 24 hour cumulative measure of four categories of acceptability, as indicated in Table 10-1. As shown in the table, the HUD standards use "over 65 dBA for more than 8 out of 24 hours" as the cut-off point between acceptability and non-acceptability. If a new waste water treatment facility, for example, is estimated to cause a continuous noise level of 66 dBA at nearby residential receptors, then these receptors, in the view of HUD, would be subjected to a DISCRETIONARY-NORMALLY UNACCEPTABLE noise level. And even though HUD may not be involved with the proposed treatment plant, or the nearby residential receptors, the HUD standards do provide a mechanism for evaluating the severity of the possible noise impact. In the case of our example, the HUD criteria could be cited as a valid reason for applying noise abatement measures to the proposed plant.

The EPA uses another approach to quantifying the acceptability of a given noise climate. This approach is carefully explained in the EPA report entitled: "Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety" (J) and is summarized in Table 10-2. The EPA criteria, which in the strict sense is neither a regulation or a standard, specifies both indoor and outdoor levels for various types of receptors and also specifies both activity interference and hearing loss consideration noise levels. For most residential areas the appropriate receptor category would be "Residential with Outside Space and Farm Residences" and the appropriate noise levels would be an outdoor LEQ (24) of 70 dBA for hearing loss consideration together with an exterior LDN of 55 dBA to protect against activity interference.

TABLE 10-1

HUD NOISE EXPOSURE STANDARDS FOR NEW CONSTRUCTION

(From Reference 1)

CHART: EXTERNAL NOISE EXPOSURE STANDARDS FOR NEW CONSTRUCTION SITES (Measurements and projections of noise exposures are to be made at appropriate heights above site boundaries)

GENERAL EXTERNAL EXPOSURES dB(A)	AIRPORT ENVIRONS CNR ZONE */	AIRPORT ENVIRONS NEF ZONE */
UNACCEPTABLE		
Exceeds 80 dB(A) 60 minutes per 24 hours Exceeds 75 dB(A) 8 hours per 24 hours	3	C
(Exceptions are strongly discouraged and require a 102(2)C environmental statement and the Secretary's approval)		
DISCRETIONARY -- NORMALLY UNACCEPTABLE		
Exceeds 65 dB(A) 8 hours per 24 hours Loud repetitive sounds on site	2	B
(Approvals require noise attenuation measures, the Regional Administrator's concurrence and a 102(2)C environmental statement)		
DISCRETIONARY -- NORMALLY ACCEPTABLE		
Does not exceed 65 dB(A) more than 8 hours per 24 hours		
ACCEPTABLE		
Does not exceed 45 dB(A) more than 30 minutes per 24 hours	1	A

TABLE 10-2

EPA IDENTIFIED NOISE LEVELS REQUISITE TO PROTECT THE PUBLIC HEALTH AND WELFARE WITH AN ADEQUATE MARGIN OF SAFETY (From Reference J)

YEARLY AVERAGE* EQUIVALENT SOUND LEVELS IDENTIFIED AS REQUISITE TO PROTECT THE PUBLIC HEALTH AND WELFARE WITH AN ADEQUATE MARGIN OF SAFETY

	Measure	Indoor: Activity Interference	Indoor: Hearing Loss Consideration	Indoor: To Protect Against Both Effects (b)	Outdoor: Activity Interference	Outdoor: Hearing Loss Consideration	Outdoor: To Protect Against Both Effects (b)
Residential with Outside Space and Farm Residences	L_{dn}	45		45	55		55
	$L_{eq(24)}$		70			70	
Residential with No Outside Space	L_{dn}	45		45			
	$L_{eq(24)}$		70				
Commercial	$L_{eq(24)}$	(a)	70	70(c)	(a)	70	70(c)
Inside Transportation	$L_{eq(24)}$	(a)	70	(a)			
Industrial	$L_{eq(24)}$(d)	(a)	70	70(c)	(a)	70	70(c)
Hospitals	L_{dn}	45		45	55		55
	$L_{eq(24)}$		70			70	
Educational	$L_{eq(24)}$	45		45	55		55
	$L_{eq(24)}$(d)		70			70	
Recreational Areas	$L_{eq(24)}$	(a)	70	70(c)	(a)	70	70(c)
Farm Land and General Unpopulated Land	$L_{eq(24)}$				(a)	70	70(c)

Code:

a. Since different types of activities appear to be associated with different levels, identification of a maximum level for activity interference may be difficult except in those circumstances where speech communication is a critical activity. (See Figure D-2 for noise levels as a function of distance which allow satisfactory communication.)
b. Based on lowest level.
c. Based only on hearing loss.
d. An $L_{eq(8)}$ of 75 dB may be identified in these situations so long as the exposure over the remaining 16 hours per day is low enough to result in a negligible contribution to the 24-hour average, i.e., no greater than an L_{eq} of 60 dB.

Note: Explanation of identified level for hearing loss: The exposure period which results in hearing loss at the identified level is a period of 40 years.

*Refers to energy rather than arithmetic averages.

10.2 MAKING A PRELIMINARY ENVIRONMENTAL NOISE ASSESSMENT

The purpose of the preliminary noise assessment should be to ascertain if there will be a possible noise problem with a new or expanded facility. If the preliminary analysis indicates that such a possibility does exist, the detailed noise study should be conducted by noise specialists. Noise surveys usually require sophisticated sound measuring and signal processing instrumentation. Data reduction requires consideration of statistical validity, and recommendations for noise abatement measures require some familiarity with the types of equipment involved. For these and other reasons it is almost mandatory that knowledgeable and technically trained personnel conduct any complete environmental noise impact assessment study.

A preliminary assessment can, however, be conducted without specialized equipment, techniques or personnel. The purpose of this section of this manual is to describe how such a preliminary noise impact assessment can be carried out.

10.21 The Three Elements to Consider

The preliminary noise impact assessment, like any environmental impact assessment, should cover three main points:

A. The existing situation
B. What the situation will be after the proposed facility is in operation.
C. What the impact will be.

In terms of environmental noise, these points can be translated as follows:

A. What is the existing noise climate?
B. What will the noise climate be when the proposed facility is operational?
C. What impact will the increased noise levels have on the surrounding community?

Each of these three questions must be addressed, and each requires a different approach before an answer can be given. The following sections should illustrate some of the differences.

10.22 The Existing Noise Climate

To define the existing noise climate at the site of the proposed facility, it is highly desirable that the person responsible for making the preliminary assessment actually visits the site. If a site visit by the assessor is not possible, secondhand evaluations of the noise climate at the location can be used, although such impressions are of limited value only. The existing noise climate can also be estimated by the equation (K):

LDN = 22 + 10 log p where LDN = day-night energy averaged noise level, dBA
p = population density, people per sq. mile.

This equation is only valid for typical rural, suburban and urban communities and should always be viewed as only an estimate. In situations where the equation does provide a valid approximation, it is probably also safe to say that the LEQ(24) level is numerically equal to the LDN value and that the nighttime (10 pm to 7 am) LEQ value is about 10 dB less than the LDN level. These approximations are, again, to be viewed with caution and are best used in conjunction with an actual site visit.

If it is possible to visit the site, by all means do so, and try to accomplish the following items when at the site:

A. Make a sketch, approximately to scale, of the proposed facility location. Identify on the sketch all nearby receptors, by type (single family residences, apartments, schools, etc.), and with approximate distances to the facility location. Also show on the sketch terrain features (ground cover, trees, hills and other characteristics) which might not appear on the map of the area.

B. Identify all audible noise sources (roads, factories, shopping areas, etc.) which are nearby and show these sources on the sketch. Get numerical information on these sources where possible:

--Short duration traffic counts, trucks and cars, on roadways.
--Number of vehicles in parking lots.
--Number, height and diameter of fans or ventilators, etc. on nearby buildings.

C. Listen for at least ten uninterrupted minutes to the existing noise climate. Describe in words (and in writing) the relative amplitude, frequency content, temporal and directional characteristics of each individual noise source.

D. Using the noise level scale of Figure 10-1 make an estimate of the major source dBA levels. If the noise levels fluctuate, try to estimate the dBA range of the fluctuation.

E. If it is possible to do so, borrow a small hand-held sound level meter and learn how to use it for outdoors dBA readings. Take representative readings on the SLM at various locations around the proposed facility. A good location to use is the property line of the nearest receptor. Note the average reading plus the range of dBA levels at each location measured. Indicate the measurement locations on the sketch of the site.

F. If there is an obviously time carying noise signal (e.g. intermittent automobile traffic, a loading dock, etc.) the following technique can be used to estimate the LEQ level:

--Turn on the SLM to read dBA and let it run, switching the gain control only as needed to allow a visual reading of the dBA level.

--Using a sweep second hand on a watch, observe the dBA level at 10 or 15 second intervals and jot down the observed levels until 50 readings are taken.

--Find the L10 noise level (the level exceeded 10% of the time) by noting the fifth highest recorded level. This fifth highest reading is the L10 level and is normally within two or three dB of the LEQ level.

--The L10 level can then be used as the LEQ level to characterize the time varying signal being measured.

G. Wind conditions, temperature, time of day, precipation and other general weather conditions should always be noted and written down when using a sound level meter. It is a good idea to record these general weather conditions even if a sound level meter is not being used. The model and serial number of the SLM plus the dial settings used should, of course, also be recorded.

H. A battery-operated cassette recorder (particularly one without an automatic gain control feature) can also be put to good use. Sample recordings should be taken at various locations around the site. Use a voice-over to identify the locations on the tape or gaps in the taped signal (use the advance button or disconnect the microphone to provide the gap). Keep a written record of footages, control settings and other pertinent information as an aid when playing back the tape. While a typical cassette recorder is not a suitable instrument for sound level recordings, a cassette recording can still provide useful information about relative levels, changes in noise level, fluctuation rates and other qualitative features of the noise climate.

I. If, while carrying out the above tasks, you are interrupted by curious bystanders, explain briefly what you are doing and ask them to please be quiet if you are tape recording or reading the SLM. Ask these people their impressions of the noise levels in the immediate area and in the surrounding community. If they are nearby residents, ask about nighttime noise levels and major sources of noise in the community.

J. Take a camera along and take enough pictures to give a total stranger a good idea of the total location. It is useful to take views both of and from the site.

K. If at all possible, visit the proposed location late at night as well as during the daytime hours. This is particularly important if there are residential receptors nearby, as nighttime residential noises are typically 10 dB or so less than normal daytime levels. If the proposed waste water treatment facility is to operate on a 24 hour basis, the noise impact will be most severe during the nighttime due to the possible sleep interference effects. It is, therefore, necessary to quantify the existing community noise level during the critical nighttime period. If a night visit cannot be made, the observed daytime levels should be reduced by 10 dB to estimate the existing nighttime noise level.

If the above suggestions are followed in a thorough and conscientious manner, a good deal of useful information and data will have been generated. In addition, the person making the site visit should be able to describe, in qualitative terms at least, the characteristics of the existing noise climate at the proposed site.

10.23 The Estimated Future Noise Climate

Predicting the noise level to be expected from a facility not yet constructed and to estimate how this expected noise will change the existing noise climate is, at best, a somewhat dubious endeavour. If approached properly, however, a reasonable estimate of what to expect can be generated. The proper approach should include the following points:

A. Compile pertinent written information about the general configuration of the proposed facility. A map and layout drawing of the plant, description of its operation, and its rated and operating capacities are typical of the type of general information needed.

B. Identify major items of equipment, ventilation systems, loading facilities, falling water and other possible noise sources on the plant drawing and pick off approximate distances from these potential sources to the nearest receptors.

C. Obtain performance data (motor HP, fan CFM and speed, water GPM rates etc.) for each major source, if possible. Information on emitted noise levels is, of course, desirable.

D. If possible, visit an operating facility similar to that being assessed (or from your own experience with other waste water works) and estimate the type of noise that can be expected. This estimate can be subjective, but it should include the following:

--What level of noise will the plant generate at some reference distance. A subjective evaluation - loud (65 dBA or higher), audible (50 to 60 dBA), or just noticeable (less than 45 dBA) - at some known distance from the approximate center of the plant, is suitable here.

--What frequency content can be expected. Fans, motors, pumps and other rotating or reciprocating machinery will have pure tone components - usually at the fundamental blade passage rate for fans and compressors. The frequency content of various noises can also be described by phrases such as "clanging," "whish," "dull roar", etc. which give useful hints about the frequency content.

--What temporal variations can be expected. Seasonal variations in operations, number of hours per day and days per week of operation, plus types of noises - continuous, intermittent, or impulsive -should be noted. Nighttime operations are particularly important, if residential receptors are involved. Summer, versus winter characteristics, are also important, due to windows being open during the warmer weather.

--Directional characteristics should also be noted if they are obvious. Does an operating facility sound the same on all four sides, or are different sources audible in different locations? This type of information can be obtained by just walking around the outside of an operating plant and carefully listening to the noise signal at different locations.

E. Translate the above observations and information to the facility being assessed. Distance adjustments can be applied using the -6 dB per doubling of distance rule. Rated capacity or HP differences can be accounted for, using a rule of thumb adjustment of +3 dB for each doubling of capacity or HP.

If the above steps are carried out, it should be possible to estimate what the noise levels and operating characteristics around the proposed facility will be. This estimate may be based on subjective evaluations, but a rough idea of the actual dBA levels (within - 10 dBA) should be available by referring to Figure 10-1.

In addition to the tasks outlined above, any other sources of pertinent information should also be utilized. Taking a camera, hand-held sound level meter, and cassette recorder and using them in the manner described earlier would be useful if an actually operating facility were visited. Asking the contractor or project engineer to supply information on emitted noise levels should give some additional data. If the plant layout drawings indicate the use of mufflers, sound barriers, or other noise abatement measures, some sort of noise analysis has probably been carried out during the design phase of the project, and the results of this analyis should be reviewed.

10.24 Assessing the Impact

The previous sections have described some techniques for estimating both the existing and projected future noise levels. If numerical noise levels have been obtained for each case, the first step in assessing the noise impact can be accomplished. This first step is, of course, a comparison of the existing and future noise levels.

The extent of the noise impact can be qualitatively judged by using the following criteria:

INCREASE IN LEQ(24) or LDN LEVEL	EXTENT OF IMPACT
0-5 dBA	slight
5-15 dBA	moderate
15 mor more dBA	severe

The above criteria give a rough indication of the extent of the noise impact and whether or not a more detailed analysis is needed. If, for example, the existing and projected future noise levels have both been carefully estimated, and the increase is found to be less than 5 dBA, then it is probably not necessary to proceed to a further noise impact study. And if the estimated levels indicate a 15 dBA or greater increase in the noise level at the nearest receptor, a more detailed study of the possible noise impact should definitely be conducted. The 5-15 dBA increase presents a more difficult decision, but if funding and manpower requirements can be met, it would probably be worthwhile to do a full noise study in this situation as well, or at least solicit a few additional opinions.

A simple comparison of the existing and projected future noise levels does not, however, complete the assessment process. The general type of neighborhood, and the associated noise climate, in which the proposed facility is to be placed, also need to be considered. For example, a 12 or 13 dBA increase in the nighttime noise levels in a quiet residential area will be noticed by almost all residents and should be viewed as a significant and perhaps a severe noise impact. The same 12 or 13 dBA nighttime increase in an industrially zoned area might be considered only a slight noise impact, particularly if all the other industries in the vicinity were not operating at night. The general characteristics of the noise generated by the proposed plant, e.g. frequency content and temporal variations and any possibly annoying characteristics of the noise, should be described and considered as part of the total impact.

Fortunately, the noise levels generated by most waste water treatment plants are not too severe, typically about 45 to 65 dBA at distances of 100 feet. If properly designed and constructed, and particularly if sited properly, a waste water treatment plant should not cause more than a slight noise impact on the surrounding community. If the preliminary noise impact assessment, carried out in the manner outlined above, indicates more than a slight noise impact, the person performing the preliminary impact assessment is probably in a good position to say what the particular problem might be. If this indeed is the case, the preliminary noise assessment has been successfully carried out.

10.3 REFERENCES

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