Section 1 General Background

1.0 Introduction

This section sets the stage for the discussion of the options available to the Nassau-Suffolk Region in coping with the management of its waste treatment over the next two decades. The planning boundaries are described, followed by a brief description of the physical characteristics and the problems of growth resulting from three decades of rapid urbanization. One of the key problems readily apparent is the need to protect and properly manage the groundwater—the sole source of potable water for the two counties. In addition, the quality of fresh and marine surface waters must be protected for both commercial and recreational use. The response to these needs are the essence of this report.

A description of the institutional setting, and a capsule summary of the work elements designed to produce a workable plan follow. The last segment discusses the key water quality and quantity issues.

1.1 Planning Boundaries

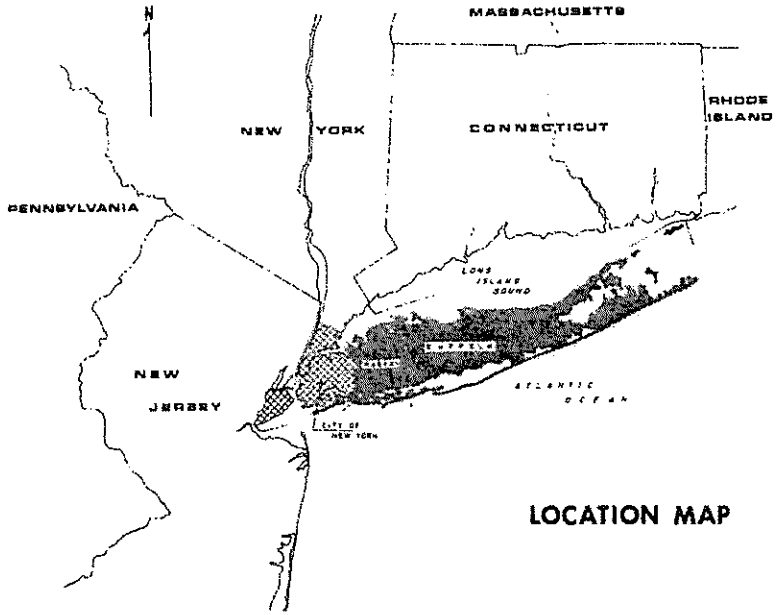
1.1.1 Location. Nassau and Suffolk Counties, occupying one-sixth of the land area of the New York Metropolitan Region, have been two of the fastest growing counties in the United States since the end of World War II. In 1960, the combined Nassau and Suffolk population of two million persons was one-eighth of the total Regional population of sixteen million. It is projected that 25 percent of the additional six million persons that will inhabit the Region by the year 1995 will be living in these two counties. The projected growth of the two counties indicates a potential increase in the impacts on the environment.

The counties, with their streams, lakes, rivers, ocean, bay and Sound frontages exceeding 1,000 linear miles in total, are familiar natural attributes to millions of persons interested in resort and recreation opportunities. Long Island Sound on the north and the Atlantic Ocean on the south and east afford a decidedly unique advantage for the proper development of marine resources. The south shore is paralleled by barrier beaches, which create bays between the south shore of the Island and the ocean from Long Beach on the west to the Hamptons in the Town of Southampton; Jones, Fire Island, Moriches and Shinnecock Inlets connect these bays to the ocean. This portion of the Long Island peninsula is over 100 miles long and 20 miles wide at its widest point, which is near the Nassau-Suffolk boundary. The major land area extends eastward from the Queens-Brooklyn and Nassau County border for approximately 60 miles to Riverhead. East of Riverhead two forks or peninsulas continue eastward, separated by the waters of Peconic and Gardiners Bays. The northern fork terminates at Orient Point and is approximately 27 miles in length. The southern fork terminates at Montauk and is about 44 miles long. The land areas of the two counties is approximately 1,200 square miles. Figure 1-1 depicts the municipal boundaries within the Region.

1.2 Geography

1.2.1 Physical Characteristics. A high ridge of glacial origin running approximately east and west from the northwesterly corner of Nassau County and then running in a southeasterly direction through Nassau from the North Shore reaches an elevation of about 300 feet above sea level. North of the ridge the topography is generally abrupt with an overall slope to Long Island Sound. South of the ridge is a long gentle slope terminating in the marsh and meadow land which borders the bays on the south. Four main river watersheds are located in Suffolk County. These are the Nissequogue in the Town of Smithtown, Connetquot in the Town of Islip, Carmans in the Town of Brookhaven and the Peconic in the Towns of Riverhead, Brookhaven and Southampton.

The area is mainly composed of unconsolidated deposits of sand, gravel and clay laid down in more or less parallel beds on a hard bedrock surface. The rock floor is tilted downward in a southeasterly direction, so



KEY TO MUNICIPALITIES IN NASSAU AND SUFFOLK COUNTIES

VILLAGES IN NASSAU COUNTY

Town of Hempstead

1. Atlantic Beach
2. Bellerose
3. Cedarhurst
4. East Rockaway
*5. Floral Park (North Hempstead)
6. Freeport
7. Garden City
8. Hempstead
9. Hewlett Bay Park
10. Hewlett Harbor
11. Hewlett Neck
12. Island Park
13. Lawrence
14. Lynbrook
15. Malverne
16. Rockville Centre
17. South Floral Park
18. Stewart Manor
19. Valley Stream
20. Woodsburgh

Town of Oyster Bay

21. Bayville
22. Brookville
23. Centre Island
24. Cove Neck
25. Farmingdale
26. Lattingtown
27. Laurel Hollow
28. Massapequa Park
29. Matinecock
30. Mill Neck
31. Muttontown
32. Old Brookville
33. Oyster Bay Cove
34. Sea Cliff
35. Upper Brookville

Town of North Hempstead

36. Baxter Estates
*37. East Hills (Oyster Bay)
38. East Williston
39. Flower Hill
40. Great Neck
41. Great Neck Estates
42. Great Neck Plaza
43. Kensington
44. Kings Point
45. Lake Success
46. Manorhaven
47. Mineola
48. Munsey Park
*49. New Hyde Park (Hempstead)
50. North Hills
*51. Old Westbury (Oyster Bay)
52. Plandome
53. Plandome Heights
54. Plandome Manor
55. Port Washington North
56. Roslyn
57. Roslyn Estates
*58. Roslyn Harbor (Oyster Bay)
59. Russell Gardens
60. Saddle Rock
61. Sands Point
62. Thomaston
63. Westbury
64. Williston Park

CITIES IN NASSAU COUNTY

65. City of Glen Cove
66. City of Long Beach

VILLAGES IN SUFFOLK COUNTY

Town of Huntington

67. Asharoken
68. Huntington Bay
69. Lloyd Harbor
70. Northport

Town of Babylon

71. Amityville
72. Babylon
73. Lindenhurst

Town of Smithtown

74. Head of the Harbor
75. Nissequogue
76. Village of the Branch

Town of Islip

77. Brightwaters
78. Ocean Beach
79. Saltaire

Town of Brookhaven

80. Bella Terra
81. Belport
82. Lake Grove
83. Old Field
84. Patchogue
85. Poquott
86. Port Jefferson
87. Shoreham

Town of Southampton

88. North Haven
89. Quogue
*90. Sag Harbor (East Hampton)
91. Southampton
92. Westhampton Beach

Town of Southold

93. Greenport

Town of Shelter Island

94. Dering Harbor

Town of East Hampton

95. East Hampton

*Incorporated Villages situated within two towns

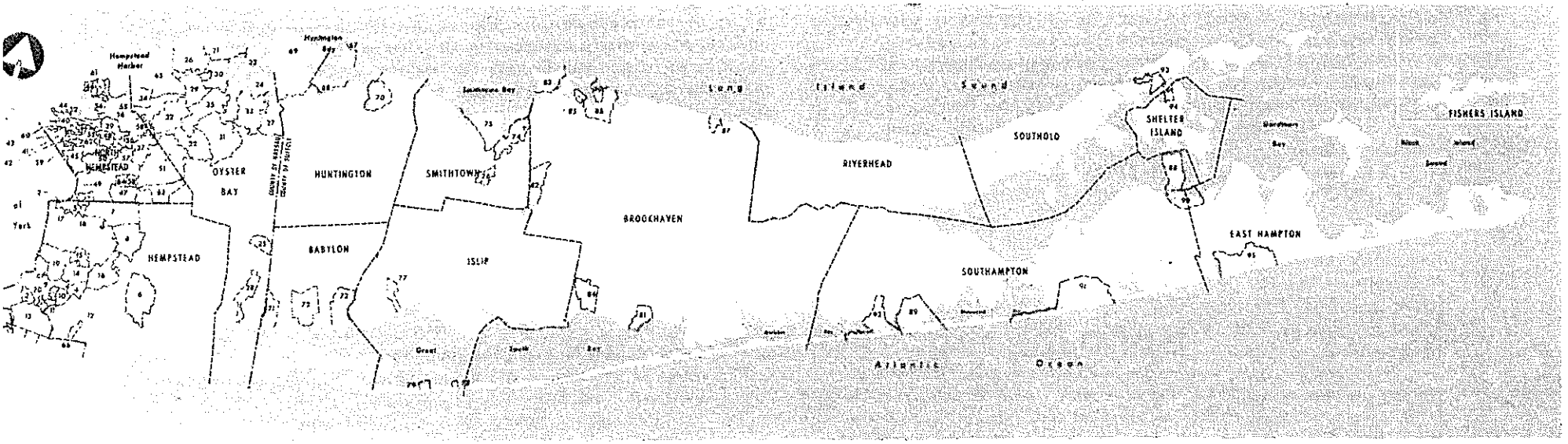


FIGURE 1–1 *Nassau and Suffolk Counties—Municipal Boundaries*

that from a position of surface outcroppings in the northwest end of Long Island (Queens County) it reaches a depth of 2,100 feet below sea level beneath Fire Island. The subsoil is generally sandy and yellow colored except on the ocean side of the south shore dunes, which are of light gray sea sand. The topsoil is particularly suited for agricultural uses in various parts of the Region. Elsewhere the ground is generally covered with scrub growth, mostly oaks and pine. North of the glacial ridge there is an abundance of flora including many of the hardwoods as well as evergreen cover.

Estuarine marshes and the off-shore waters abound in a variety of shell- and finfish. The inland fresh waters, particularly in Suffolk County, have an abundance of trout and other important sport fish.

The water supply for the Nassau-Suffolk Region is obtained entirely from groundwater. Natural replenishment of this supply is derived solely from precipitation (*i.e.*, rain, snow and sleet) which averages 44 inches per year. It has been estimated that approximately 50 percent of the precipitation is lost due to evapotranspiration and other factors, so that only about half of the precipitation reaches water-bearing strata.

1.2.2 Problems of Growth. Obviously, Long Island is an area where the quality of life and large segments of the economy are related to and dependent on the quality of its environment. Tourism, agriculture, seasonal homes and residential communities, thrive in areas of healthy and aesthetically attractive natural settings. There are a number of major surface and groundwater pollution problems. Marine water problems include excessive nutrient enrichment and the closing of beaches and shellfishing areas due to bacterial contamination, which is attributed to both point and non-point sources of pollution. Some portions of the fresh water streams have dried up and others are threatened because of lowered groundwater levels due to sewering and excessive well pumpage. Groundwater quality has been degraded by nitrates, chlorides and other contaminants from fertilizers, recharge of domestic and industrial wastewater, landfill leachate, and stormwater recharge. Water quality—both potable and marine—is the key to Long Island's future. Planning for the orderly growth of these communities and the management of their wastes is the linchpin that will determine the quality of the future.

In response to earlier perceived growth problems, *e.g.*, residential sprawl, transportation deficiencies, rapidly changing community characteristics, increased deterioration of older downtowns and housing, and shortages of community facilities, the Boards of Supervisors of Nassau and Suffolk Counties created the Nassau-Suffolk Regional Planning Board in 1965. This agency's prime task was the preparation of a comprehensive plan that would serve as a guide for all units of government in the two counties for coping with future growth and for reversing the negative aspects of past development.

The Comprehensive Land Use Plan was completed in July, 1970. In essence, it recommended controls on the ultimate size of growth, location and form of development, and institutional changes necessary to achieve implementation. Based on environmental data extant at the time, it was apparent that the most obvious limit to growth was the availability of potable water. It was also apparent that some degradation of these waters had already occurred. However, the projected total population of 3.3 million people by 1995, was less than 60 percent of the estimated population that could be sustained, and it was assumed that the Plan was environmentally prudent.

The Nassau-Suffolk Regional Planning Board also recommended that additional funds be sought to conduct water quality studies in order to insure that the two counties' sole source of potable water not be jeopardized. The advent of the 1972 Amendments to the Water Pollution Control Act (PL 92-500), and particularly the Section 208 planning provision, furnished the answer to this quest. In the next section, a brief discussion of the planning program will indicate the nature of the designation process and the organization of the technical staff and will identify the major substantive elements in the Program.

1.3 Institutional Setting

1.3.1 Designation. The 1972 Amendments to the Act provide that the Governor may designate regional planning agencies to engage in 208 planning. Where such agencies are not designated, the State is required to assume the planning responsibility. Several of the operating agencies in Nassau and Suffolk Counties, and the Nassau-Suffolk Regional Planning Board expressed interest in this designation. The two County Executives agreed that the Board should be the applicant.

All agencies that wished to be eligible for 100 percent funding had to receive designation before January 1, 1975 and receive contractual approval from EPA prior to July 1, 1975. In late November 1974, a preliminary work program was quickly assembled and a designation request was made to the Governor. On December 28th, Governor Malcolm Wilson gave the first designation in the State of New York to the Board.

1.3.2 Technical Staffing. The Program represents a joint effort of the Board and various regulatory, operating and planning agencies in Nassau and Suffolk Counties. A Technical Advisory Committee (TAC), with seven voting members, was formed. The Nassau Departments of Health, Public Works, and Planning were matched by representatives from the Suffolk County Water Authority and the Departments of Health Services and Environmental Control. The Executive Director of the Board, who is Project Director for the Program, serves as the Chairman of the TAC.

In addition, the New York State Department of Environmental Conservation, Region II of EPA, and the Interstate Sanitation Commission also provide representatives to serve as non-voting resource persons. The TAC is composed totally of professionals. It was organized in this fashion with the recognition that the agencies with the responsibilities for carrying out portions of the Plan should have the opportunity to participate in its formu-

lation. Also these participants represented the cumulative local expertise and knowledge base at the onset of the Program.

Preparation of a detailed work program was the initial work conducted by the TAC. At first, a list was compiled of each agency's recommended projects. Much culling, additions, deletions and alterations occurred as the items were compared with the requirements and/or limitations of the Act. The document finally submitted to EPA and the State for contract approval was reduced from $17 million to $5.2 million during this iterative design stage, and quite faithfully adhered to the requirements in the Act.

A secondary concern during this pre-planning period was expressed in regard to the work to be conducted by consultants where specialized talents and equipment were needed. The TAC followed the procedure mandated by the Board, and sole source contracts were awarded only to those governmental and/or academic institutions that had a unique talent. In all other cases, the TAC prepared "Requests for Proposals," which were advertised nationally. This procedure was followed in order to secure the best talents in the country. Although this technique was time-consuming and often onerous, it has proven meritorious. The consultants were selected by the voting members of the TAC based on the technical merit of their proposals. Budget information was kept sealed until each selection was made.

1.3.3 Work Elements. The general goals of the Program to achieve water quality criteria established by Federal and State laws require an extensive knowledge of: the existing and proposed land uses and demography of the Region; the quantity, quality and hydrology of the ground and surface waters, including inter-relationships between both; the types, sources, amounts and impacts of contaminants entering the waters; the alternative technologies best suited to address any specific problems; the legal, fiscal and institutional arrangements, and the laws, agencies and regulations needed to implement the completed Plan. This aspect will be discussed in the implementation section of this report.

The Comprehensive Land Use Plan released by the Nassau-Suffolk Regional Planning Board in 1970 still serves as the basic guideline for growth in the two counties until 1985–1990. The Plan has been updated over the past three years as a result of a United States Department of Housing and Urban Development assisted project that involved the development and testing of a methodology for the integration of coastal zone science with the planning process. Fortuitously, only minor modifications were indicated to enable the Plan to meet specific environmental needs. This affords a strong advantage to the two counties' likelihood of producing a workable waste management plan—the land use plan already exists. Thus it is much easier to develop and test two major management approaches. If we assume that the land use plan will be realized, then it becomes a task of estimating the contamination loadings that will result from the various land uses and recommending treatment facilities, *e.g.*, sewers, treatment plants, etc. Conversely, the land use plan can be modified and population densities altered to avoid the need for structural solutions. Both approaches are examined in this Program.

Comprehensive water supply studies were conducted in each county during the 1960's and early 1970's. These studies evaluated the possible changes in groundwater quantity that might result from the implementation of various wastewater treatment proposals. The United States Geological Survey, which was chosen as one of the public agency consultants by the Board because of their extensive knowledge of Long Island's groundwater, has conducted studies in the bi-county area for many decades. During recent years, the Survey developed an electric analog model, which simulates the physical characteristics of the groundwater system. This model was used in the 208 Study to simulate water level responses to a number of hypothetical water-management options.

Water quality problems are usually of significantly greater complexity than questions of water levels or of water quantity. Investigations and monitoring programs are generally conducted for the purpose of providing information on ambient groundwater conditions, as well as of examining the adverse effects of known or suspected sources of pollution, and to assess water quality improvements attributable to correction measures (*e.g.*, sewers). For example, in the past, studies have been conducted addressing the impacts of individual on-lot sewage disposal systems, landfill leachate, detergents, sewage treatment effluent recharge, stormwater recharge, meteorological conditions, fertilizers and pesticides. The pollutants monitored were limited to those considered relevant to public health and natural resources, for which reliable monitoring procedures were available.

During the past few years, the increasing awareness of the presence of additional hazards to public health and natural resources, as well as the continuing development of sampling and analysis techniques, have resulted in the monitoring of additonal substances, *e.g.*, viruses and organic chemicals. The 208 Program included a study of organic chemicals, heavy metals and viruses in wastewater and groundwater in the bi-county area. Water sample locations were carefully selected to reflect the influence of various types of land use and wastewater activities. Samples were analyzed for heavy metals, organics in trace amounts and viruses.

In order to provide simulation capabilities for water quality evaluations, the Department of Civil Engineering of Princeton University was retained to adapt and apply existing digital models (one, two and three-dimensional) to simulate the impacts of various groundwater levels on saltwater intrusion, and further groundwater pollution. The modeling runs are paralleled with quality evaluations based on empirical data and related literature. The work also included a digitization of the Geological Survey's analog model to facilitate the testing of management alternatives.

Similar emphasis was placed on questions of surface water quality. Various estuarine steady-state and time-variable models were applied to specific bodies of water to estimate the effects of various waste treatment

schemes on receiving water quality.

The reliability of model results bears a direct relationship to the accuracy of pollutant loadings input into them. Point sources of contamination have been routinely identified and tested. In the past this was sufficient because wastewater studies were directed towards engineering solutions to these sources of contamination. Much of the current planning effort is also concerned with non-point sources of pollution—stormwater runoff, sedimentation, uncontrolled deposits of animal wastes, etc. Several responses to these more pervasive and usually unquantified sources were included in the Work Program. The Cooperative Extension Service conducted field studies and literature searches to identify and evaluate the volumes of pesticides, fertilizers and other home and agricultural chemicals used in the two counties. The impact of nitrogenous fertilizers, relative to other sources, was evaluated in part by means or a preliminary regional nitrogen balance. The Suffolk County Soil and Water Conservation District identified other non-point pollution problems associated with various animal populations, runoff and sedimentation. In addition, the two County Health Departments, the Suffolk County Department of Environmental Control (which was already engaged in a study of fertilizers), the Suffolk County Water Authority, and the Town of Islip Department of Environmental Control, all contributed substantially to the sampling and analysis of non-point sources.

The information gathered from the sampling and analysis programs served as inputs for the determination of engineering and non-structural alternatives for the achievement of water quality objectives. This approach afforded the broadest possible array of policy choices as to method, location, timing and cost of solutions.

The alternatives and their consequences have been considered by the TAC for the purpose of selecting the most viable combinations of solutions—structural and non-structural—that in the aggregate form the Comprehensive Areawide Waste Treatment Management Plan for Nassau and Suffolk Counties. The Citizens Advisory Commitee (CAC) has also reviewed and contributed to the final product. In some instances where more than one solution is viable, or where a consensus was not achieved, this report mentions the array of choices.

1.4 Regional Ground and Surface Water Considerations

Within the overall framework of the 208 Program, major technical issues have arisen which have had to be addressed as part of the Study. This segment of Section One includes a discussion of the major considerations. It relies upon the previous segments to describe the regional setting and then discusses ground and surface water uses, and quantity and quality problems. The segment is concluded by generalized descriptions of management options, which may be applicable to the Bi-county Region. It is presented to effect a transition between the planning issues and the scientific/engineering considerations.

1.4.1 Groundwater

1.4.1.1 Major Uses. Groundwater beneath Nassau and Suffolk Counties is the only source of potable water for almost three million people. Pumpage and use characteristics within the Region are complex and fragmented. The user of groundwater can be a single facility operating its own domestic well on a small parcel of land, a large water district with a dozen individual high capacity wells located miles apart in several different communities, a private water company with a single well field serving one subdivision, or an industry partially supplied by its own well system and partially dependent on a local utility. Thus, pumpage for different well owners can range from a few hundred gallons to many millions of gallons per day.

The use of water withdrawn is equally varied. Groundwater pumpage satisfies not only domestic requirements, such as drinking water, but also must meet the needs of industry, commerce, agriculture and recreation.

Water supplies are developed principally from two major water-bearing units: the Upper Glacial and Magothy aquifers. A relatively unexploited third aquifer, the Lloyd, lies beneath the upper two formations, and is separated from them by a thick, confining bed of clay. Total withdrawal from all aquifers now approaches 400 MGD (million gallons per day).

The pattern of pumpage is not uniform. The development of multiple sources of supply, even when not necessitated by fragmented supplies, was deliberate in order to more uniformly withdraw from the system and then minimize the disruption of equilibrium conditions. Major concentrations of pumpage have been developed near areas of dense population, leaving other portions of the subsurface reservoirs underutilized. This has resulted in a pronounced east-west imbalance in pumpage distribution. Also, degradation of water quality in the Upper Glacial aquifer beneath urbanized areas has led to the abandonment of shallow wells, in favor of withdrawing water from progressively deeper aquifer zones. Thus, the principal water supply aquifer in Nassau County and western Suffolk is the Magothy, whereas the principal water supply aquifer in eastern Suffolk County is the Upper Glacial.

Groundwater discharge supports streamflow for most of each year. The volume of groundwater underflow discharged to surrounding saltwater bodies can affect surface water salinity. Relatively small fluctuations in water table elevations, on the order of a few feet, can cause pronounced changes in stream discharge. On the other hand, underflow to saltwater bodies is not very sensitive to such fluctuations. It has been estimated that substantial changes in consumptive use of groundwater in the Region would be required to significantly affect underflow.

A certain amount of underflow is also needed to maintain the fresh-salt water interface at an equilibrium position. The position of the boundary between fresh and saline groundwater is dependent upon changes in water levels in the various aquifers. However, the fresh-salt water interface is generally some distance offshore in the confined aquifers of Long Island. Therefore, changes in head at the interface, resulting from reductions in

natural recharge or increases in pumpage and consumptive water use, are generally small and localized. Inland movement of saline groundwater is very slow, even in areas where the interface is already on shore and in close proximity to centers of pumpage.

1.4.1.2 Existing Quality. The quality of groundwater in the aquifers of Long Island is dependent upon a number of factors. In undeveloped areas, recharge from relatively good quality rainfall, together with whatever natural treatment and pollutant retention is provided by the vegetation, soils and geologic sediments have resulted in the availability of very high quality groundwater in the underlying aquifers. Where the land has been subjected to heavy use or modification by man, groundwater quality has been degraded. The degree of degradation is dependent upon the type of land use; the location of individual sources of contamination, such as cesspools and landfills; the characteristics of the contaminants; and the length of time that the waste disposal practice has been in existence.

Groundwater quality is also extremely dependent upon hydrogeologic factors. Recharge to the Magothy from the water table or Upper Glacial aquifer occurs over a large area along the central east-west corridor of the Island. This region, where groundwater movement is generally vertically downward and unimpeded by intervening clays, is commonly referred to as the Magothy recharge area. Therefore, sources of contamination discharging to the water table can migrate downward to the underlying Magothy.

Deep flow also occurs in portions of the Upper Glacial deposits to the north of the limits of the Magothy recharge area in Nassau and western Suffolk.

Along the South Shore and parts of the North Shore groundwater movement is generally horizontal or upward, and intervening clays inhibit downward movement of groundwater, even where heavy pumping is taking place. This region is referred to as the Magothy discharge area. Groundwater quality is considerably more vulnerable to land use changes and sources of contamination in recharge areas than in discharge areas.

Another factor affecting groundwater quality over the long term is the slow movement of groundwater, especially in the vertical component. Under natural conditions, it takes about 100 years for water from the surface to reach the lower portion of the Magothy in the center of the Island. Heavy pumpage in the Magothy can reduce this time period to about twenty years. Thus, sources of contamination can be eliminated (for example septic tanks and cesspools replaced by sewers) but the effects on deeper aquifers may not be noticeable for many decades. In the Upper Glacial aquifer the effects of pollutants and of remedial measures are realized much faster.

Actual groundwater quality problems in the 208 Region have been characterized by a significant rise in nitrate concentrations in portions of the recharge area of the Magothy aquifer. Also of importance is the discovery of organic chemicals in sections of the two counties in both shallow and deep aquifers. Several independent analyses of nitrate trends in shallow groundwater and in the Upper Glacial aquifer were completed during the period in which the 208 Program was conducted. From this work, it is difficult to make clear-cut generalizations regarding statistically calculated trends, especially with respect to making distinctions between sewered and non-sewered areas. However, there is general agreement that nitrate concentrations are decreasing in many shallow wells in southwestern Nassau County where sewering took place in the 1950's and early 1960's. In unsewered eastern Nassau, one of the analyses also found generally decreasing nitrate trends, while another failed to find a trend. Water in shallow wells in southwestern Suffolk has generally increasing concentrations of nitrate. On the basis of limited data, it appears that the quality of the underlying Magothy has not improved. In Nassau County, the Magothy has apparently sustained an overall decline in water quality.

Individual sources of contamination, such as landfills and industrial waste recharge basins, have developed discrete bodies of contaminated groundwater. These plumes of contaminated water are isolated, but are of extreme importance locally. Analysis of organic chemicals is a new effort, and, thus far, no trends can be developed from the very limited data collected.

1.4.1.3 Contamination Sources and Identification of Control Needs. There are many sources and causes of contamination in the 208 area. Basically, these can be divided into four categores (Table 1–1). The first two categories include discharges of contaminants that are derived from solid and liquid wastes. The third category concerns discharges of contaminants that are not related to wastes, and the fourth category consists of those causes of groundwater contamination that are not discharges at all.

The variety and type of controls available for each category differ. For example, some Category I causes may require a discharge permit, whereas others may be controlled by restrictions on land use. Sources under Category II may require satisfaction of specified construction standards, such as the lining of landfills and the installation of leachate collection systems. Guidelines and manuals (*e.g.*, tons/lane-mile limits on highway deicing salts) may be the only tools available for dealing with Category III. Special types of regulatory controls are available for the causes of groundwater contamination listed under Category IV. An example is the current system of groundwater diversion applications and hearings employed to minimize saltwater encroachment. Another is the continued licensing of drilling contractors in order to upgrade waterwell construction practices.

The protection of groundwater quality involves both the elimination or mitigation of existing problems, and the prevention of new ones. Control needs will vary depending upon the nature and location of the source of pollutants, and upon the prevailing background or baseline conditions.

In the case of an established industrial source, the imposition of effluent controls and monitoring to assure compliance may be the best approach. Where the pollutant generating activity is a necessary one that is not readily controlled by traditional permitting systems, as in the case of landfills,

TABLE 1–1
CLASSIFICATION OF SOURCES AND CAUSES OF GROUNDWATER CONTAMINATION USED IN DETERMINING LEVEL AND TYPE OF CONTROL

Category I	Category II	Category III	Category IV
Systems, facilities or sources designed to discharge waste or wastewaters to the land and groundwaters.	Systems, facilities or sources not specifically designed to discharge wastes or wastewaters to the land and groundwaters.	Systems, facilities or sources that may discharge or cause a discharge of contaminants that are not wastes to the land and groundwaters.	Causes of groundwater contamination that are not discharges.
Domestic on-site waste dispoal systems	Sanitary sewers	Highway deicing and salt storage	Airborne pollution
Sewage treatment plant effluent	Landfills	Fertilizers and pesticides	Water well construction and abandonment
Industrial waste discharges	Animal wastes	Product storage tanks and pipelines	Saltwater intrusion
Stormwater basin recharge	Cemeteries	Spills and incidental discharges	
Incinerator Quench water		Sand and gravel mining	
Diffusion wells (heat)			
Scavenger waste disposal			

relocation to an area where the aquifer is already degraded, and no longer used for water supply, may be appropriate. The prevention of degradation in relatively pristine areas may require a management program that employs a combination of land use and other non-point source controls to prohibit or severely restrict the development of potential pollutant sources.

1.4.2 Surface Water

1.4.2.1 Major Uses. Surface waters on Long Island provide a variety of beneficial uses. Fresh waters, including streams and lakes, are used for aesthetic enjoyment, swimming, fishing and boating. Marine waters, including bays and estuaries, are used for both commercial and recreational purposes. Shellfishing and finfishing are major commercial enterprises in bays and estuaries. Recreational use includes shellfishing, sportfishing, swimming and boating. In addition, the assimilation capacities of surface waters may allow their use as a major receiving system for waste disposal.

In recognition of the variety of, and sometimes competing, beneficial uses, Long Island marine waters have been classified by the New York State Department of Environmental Conservation as to their potential best usage in the public interest.

The New York State Department of Environmental Conservation classification of best usages for marine waters, in decreasing order of water quality requirements, comprises the following four classes:

- SA Waters suitable for shellfishing for market purposes and primary[1] and secondary[2] contact recreation.
- SB Waters suitable for primary and secondary contact recreation and any other use except shellfishing for market purposes.
- SC Waters suitable for fishing and all other uses, except for primary contact recreation and shellfishing for market purposes.
- SD Waters not primarily suitable for recreational purposes, shellfish culture, or development of fishlife and which cannot meet the requirements of these uses.

Notes 1. Primary contact recreation means activities where the body may come in direct contact with raw waters to the point of complete submergence (*e.g.*, swimming, diving, water skiing, skin diving and surfing).

2. Secondary contact recreation means activities where contact with the water is minimal and ingestion of water is not probable (*e.g.*, fishing and boating).

These specific uses are dependent upon naturally functioning marine ecosystems which are commonly characterized by a number of water quality parameters. Two major parameters are dissolved oxygen and coliform bacteria concentrations. Adequate dissolved oxygen is essential to the growth and reproduction of finfish and shellfish. Dissolved oxygen is also required in the natural decomposition of organic wastes. Current public health standards call for low coliform bacteria concentrations since the presence of such bacteria is regarded as an indication of potentially pathogenic contamination due to human or animal wastes.

1.4.2.2 Existing Quality. The tidal flushing of Long Island's North Shore bays is substantially greater than in the South Shore bays or the Peconic Estuary. Because of the greater tidal range in Long Island Sound, a parcel of fresh water or waste discharged to a North Shore bay will be flushed out within one to three days, whereas from one to three months may be required in eastern Great South Bay.

The dispersion and flushing of pollutants within any bay is generally maximum for discharges near the inlet and decreases with distance away from the inlet. Localized pollution problems generally exist where streams or municipal waste discharges enter a bay at a point well away from the inlet.

Within each bay, constituent concentrations are modified by biochemical processes. The parameters of primary concern, which reflect the net result of complex processes, are coliform bacteria and dissolved oxygen

concentrations. Levels of these constituents have been established for each bay system by the New York State Department of Environmental Conservation. In addition to these parameters, salinity levels, and the concentrations of non-point sources, are a major source of contaminants to the surrounding marine waters. The degree of contamination derived from a particular stream will depend upon the volume of streamflow, the rate and degree of pollutant input, and the degree of mixing of stream and bay waters. Other sources of marine surface water contamination include pointsource discharges from sewage treatment plants, subsurface inflow from groundwater, discharges from boats, and inputs from adjacent marine waters. In any particular bay, the degree of contamination attributable to those sources depends upon the rate of input of the pollutant and its rate of removal from the system by physical and biological processes.

1.4.3 Management Options

1.4.3.1 Introduction. There are many approaches that can be utilized to manage the ground and surface water quality problems of the Bi-county Region. The more traditional type of program has reacted to existing water quality problems by constructing facilities to ameliorate them. Less traditional approaches are to guide growth and to develop various types of programs which prevent water quantity or quality problems from occurring or to develop solutions which do not include facilities. The former approach can be defined as a structural set of solutions while the latter approach is non-structural in nature. The recommendations of the 208 include implementation of both types of programs.

The 208 has identified and evaluated numerous options and approaches. In some cases, only general evaluations could be performed while at other times, detailed studies were possible. However, the intent throughout has been to identify a viable set of options, both structural and non-structural, which should be studied in detail in more localized studies. This is the key to the relationship between 208 and the more detailed studies (*e.g.*, 201 Facilities Plans) in the Nassau-Suffolk area. The 208 must identify the structural and non-structural alternative approaches which are viable on a regional level. The more detailed local studies must start with the regionally satisfactory options and screen them as to their applicability at the local level.

1.4.3.2 Structural Approaches. The structural approach to wastewater management begins with collection of the waste. Water carriage has been and will continue to be the method of waste transportation in the Nassau-Suffolk Region for all wastes except certain special hazardous wastes. Sewers will be used whether the wastes are conveyed to large regional facilities or to smaller local or sub-regional plants. Modifications such as pressure or vacuum systems may be used in local situations.

The 208 Program has analyzed alternative collection concepts and has determined that vacuum and pressure collection systems should be evaluated in local studies. The comparison to traditional gravity collection should be made on the basis of construction cost, operation and maintenance costs and on operational reliability. A concern of the 208 is the energy consumption, on a continual basis, of pressure or vacuum systems. As energy costs continue to increase, and as energy resources become increasingly limited, vacuum or pressure collection systems become increasingly less attractive.

Structural treatment options are generally grouped according to the types of wastes that they process. Domestic sewage, for example, is one type of waste, industrial waste, another. A number of processes, both biological and physical/chemical, are available for the treatment of domestic sewage (activated sludge, activated carbon filtration, etc.) and other systems have been proposed or tried on an experimental basis (*e.g.*, spray irrigation, marsh-pond system, etc.). It is worth noting that all biological systems, including conventional biological treatment as well as spray irrigation and marsh-pond, are variations on a single theme, differing in design details such as scale, layout and treatment efficiency.

Industrial liquid wastes can be divided into two categories: toxic and non-toxic. The non-toxic wastes can be handled in the same manner as domestic sewage. The toxic wastes are almost exclusively handled by physical/chemical treatment processes.

Stormwater runoff is difficult to treat by structural approaches because of high and variable flow rates. Sedimentation and disinfection may be feasible options.

The 208 Program has investigated various treatment options and has determined that two of the newer concepts should be tested in a situation where the processes would receive no more than normal operating attention. The marsh-pond treatment process will be tested by Suffolk County at the Village of Greenport sewage treatment plant site (1978 funds approved). Although design procedures and criteria will be obtained during this test, normal operation by plant personnel rather than control by an engineering staff will be used. Similarly, improved septic tank systems, which de-nitrify the waste, should be tested in a small development. Once these systems have operated satisfactorily through all seasonal conditions, and procedures for design and implementation are obtained, their use as potential alternatives to conventional systems can be considered.

The treated effluent and sludge, which includes domestic industrial and hazardous wastes, must be disposed. The normal disposal methods for treated effluent are sea or bay disposal, recharge to the ground, stream augmentation or land surface application. The options available for sludge disposal include barging, various types of incineration and land disposal either on Long Island or outside the area. EPA regulations, however, call for the cessation of ocean dumping of sludge by 1981. The selection of any of these disposal techniques depends upon the toxicity of the waste, cost-effectiveness and the degree of desired protection of ground and surface water quality.

1.4.3.3 Non-Structural Management Options. Non-structural management options identified in this Program relate to the control of potential

sources of pollution. They may be categorized as follows:

a. Options to prevent the establishment of sources
b. Options to better manage existing sources
c. Options to eliminate existing sources.

Land use controls can be used to prevent new sources of pollution from arising. An activity may be prohibited, or it may be permitted to develop in a controlled manner consistent with environmental objectives.

Good management practices can minimize pollution discharges. For example, in areas of low soil permeability, septic systems may malfunction as a result of septage not being periodically pumped from the tank. Hence an appropriate management policy may be to require pumping according to a formally required procedure. Likewise, wastes from domestic animals on streets and highways may constitute a major source of contamination in storm drainage water. A non-structural option may be to prohibit littering or to require owners of dogs not to allow their dogs to defecate where water pollution might result. Regular sweeping of streets would also limit the amount of pollutants transported in stormwater.

Another management practice that may be particularly relevant to Long Island is to encourage the use of fertilizers and pesticides at levels not exceeding the requirements of cultivation. Thus householders could be encouraged to adopt "low maintenance" methods of cultivating lawns as opposed to growing species of grasses that demand high levels of water and chemicals for their maintenance.

If use of inorganic fertilizers by householders were to be banned outright, the ban would constitute an example of the total elimination of a potential source of contamination. Such bans are difficult to implement. However, Suffolk County's recent prohibition of the sale of non-biodegradable synthetic detergents is an example of a successful management attempt to eliminate an existing pollution source. Likewise the prohibition of chronically toxic and persistent pesticides such as DDT has begun to reduce the levels of these chemicals in the environment. Similarly, certain organic materials should also be controlled. The substitution of less harmful materials in place of such organic chemicals may provide a partial, non-structural solution.

1.4.3.4 Legal/Institutional. Another set of possible management options deals with the formulation of legal and institutional programs. These types of approaches might include:

—strengthening of existing laws or regulations
—enacting new laws or regulations
—restructuring of existing county and town level agencies
—establishment of new agencies
—elimination of existing agencies
—redefinition of responsibilties.

The thrust in these types of management options is to ensure that proper regulatory power exists, that regulation and operation of facilities do not conflict, and an adequate system of monitoring and control is available.

An institutional approach recognizes that improvements can be made in the administration and implementation of water quality management programs. It recognizes the need for improved communication between operating agencies and for a clear definition of responsibilties.

1.5 Summary

Nassau and Suffolk Counties together form a region of about 1,200 square miles, having a total of more than 1,000 miles of ocean and bay shoreline, lakefront and river edge. The area's subsoil is mostly sandy, and groundwater is the sole source of potable water. Precipitation averages 44 inches per year, of which approximately one-half is lost to the atmosphere and to the surface waters by evapo-transpiration and runoff.

Long Island's environment possesses a particular importance, because the area is an important place of resort for vacationers and sportsmen of all kinds. Its waters and marshes abound in shellfish and finfish of many varieties, and its coastline offers esthetic pleasure to many.

The quality of this environment, however, is beginning to suffer from problems due to growth. In areas of more intense development, marine water quality is deteriorating from the discharge of excessive quantities of nutrients. Beaches and shellfishing areas have been closed to the public because of bacterial contamination. In certain locations, heavy pumping of groundwater and the installation of sewers with disposal to marine surface waters have caused a permanent drop in the water table, with the resulting drying up of parts of streams. Groundwater quality, in parts of the Region, has been degraded by pollutants from excessive fertilizer application, the recharge of domestic and industrial wastes, landfill leachate and stormwater recharge.

The dangers of uncontrolled development have been recognized for a long time, and the Nassau-Suffolk Regional Planning Board issued a Comprehensive Land Use Plan in 1970. Since then, Congress has recognized the need for more detailed studies of water pollution problems in many areas, and, in 1972, passed the Federal Water Pollution Control Act Amendments. Under Section 208 of this act, funds have been made available to study the Region's waste disposal and water supply problems, and to devise a plan for their solution.

The plan will include a combination of many management options, which can be categorized under the following three headings:

a. Structural, *e.g.,* the installation of collection and treatment systems, etc.
b. Non-structural, *e.g.,* passing ordinances for the control of animal wastes, instituting special practices for minimizing runoff at construction sites, carrying out public education programs concerning the correct use of certain materials in agriculture and in the home, and so on.

c. Legal/Institutional, designed to improve the administration and implementation of water quality management programs.

Some of these options will have areawide applicability, others will be determined by the specific needs of each locality. In combination, they will protect the Bi-county Region's esthetic and recreational values, and ensure a healthy and adequate water supply for the foreseeable future.