Section 3 Alternative Wastewater Management Programs

3.0 Introduction

This section outlines alternative wastewater management programs in terms of the following:

1. objectives
2. source control alternatives (both point and non-point), and
3. methods by which objectives may be met, using a combination of traditional and innovative structural and non-structural alternatives.

3.1 Objectives

The various alternative wastewater management programs all have as their general objective the development of a comprehensive management plan for the treatment and disposal of waste to protect the public health and natural resources of the Long Island 208 Region.

3.1.1 Public Health Objectives. The major public health objectives may be met by (a) the continued protection and restoration of the quality of the water-table aquifer, and the deeper aquifers, in order to assure the availability of potable water, and (b) the maintenance and/or improvement of water quality of both fresh and marine surface waters so as to ensure their use for swimming, fishing and other recreational and commercial purposes.

A. Protection of Groundwater. There is a wide range in the types and locations of the sources of groundwater contaminants. Landfills, industrial discharges, sewage treatment plant recharge basins, accidental spills, process and incinerator wastewater, cesspools, rainwater and stormwater recharge are important sources of pollutants for Long Island groundwater.

Just as the sources of contamination vary widely, the materials contributed by each source also vary. Inorganic and organic nitrogen, halogenated hydrocarbons, heavy metals, pesticides, deicing salts, coliform bacteria and viruses are all contributed by these sources. Nitrate and organic chemical contamination are of particular concern in the Long Island area.

Within this category, items that impact the public health include failing cesspools, leakage from faulty or failing sewer collection systems, overloaded treatment systems, physical breakdown of wastewater treatment facilities and inactivation of treatment systems by plant upset. These conditions result in the contamination of ground and surface waters with nitrogen, coliform bacteria, viruses, inorganic ions, heavy metals and organic compounds.

B. Maintenance of Surface Water Quality. Shoreline development places the source of contamination due to human activities immediately adjacent to vital water resources. The erosion of stream banks and the destruction of marsh edges increase surface water contamination from fertilizers, silt, animal wastes and other pollutants. The location of sewage treatment plant outfalls may cause localized degradation of surface waters to levels that prevent their utilization for shellfishing and water-intensive recreational activities. In general, non-point sources contribute the greater part of the pollutant loading that endangers public health.

3.1.2 Natural Resources Objectives. The natural resource objectives include (a) the protection of critical environmental zones such as primary recharge areas, marine and freshwater wetlands, and unique wildlife habitats; and (b) the protection of biological resources, especially fin and shellfish populations in the marine environment and the protection of biological diversity.

A. Protection of Critical Environments. While public health aspects that relate directly to human diseases are obvious concerns to be addressed in a wastewater management plan, the protection of unique environmental zones has often been overlooked, or its importance underestimated. Development or loss of natural recharge areas increases non-point source contaminants in groundwater, such as nitrates, metals and organic chemicals. It also reduces the partial removal of nitrates in rainwater, which normally occurs in naturally vegetated areas. The loss of wetlands such as marshes, swamps and low-lying areas adjacent to streams increases erosion, siltation and the

runoff of nutrients and coliform bacteria to surface waters. Furthermore, these areas are highly productive and of the greatest importance in the food chain. The protection of these unique habitats is required by several Federal and State regulations.

Beyond the effects of the physical dislocation of these critical areas, their degradation due to quality changes resulting from adopted management philosophies must be considered. Strategies that result in the maintenance of public health but allow wholesale changes in the physical or chemical characteristics of surface waters can easily lead to loss or changes in unique natural resources. For example, decreases in groundwater levels can result in changes or losses of marshes, swamps and bottomland zones, with the resulting problem of erosion and runoff. Decreases in the streamflow may affect salinity regimes in the tidal portion of streams and the receiving waters of bays, possibly resulting in changes in spawning and nursery areas for marine organisms.

B. Protection of Biological Resources. The loss or change of existing populations of marine and freshwater organisms, while not necessarily directly affecting man's use of the marine zone, or impacting public health, could indicate a severe alteration in the physical and chemical properties of these waters. Any loss of these resources would also have serious economic consequences affecting the shellfish, sportfish and tourist industries. It must be remembered that, while the natural population of a marine organism such as the hard clam may be maintained, if it cannot be utilized because of contamination by coliform bacteria or viruses, then the population is effectively "lost" to commerce.

The maintenance of existing biological resources implies the prevention of any changes that will affect the normal functioning of the ecosystem. Furthermore, changes in phytoplankton density will result in alterations in dissolved oxygen levels, with subsequent effects on all animal populations in the area. These algal populations are highly dependent upon nutrients such as nitrogen and phosphorus. Any significant increases in nutrient levels may result in large scale changes in phytoplankton.

Decreases in streamflow may result in salinity changes, affecting the growth and reproduction of many marine organisms. Included here are dislocations of finfish populations due to the shifting of optimal salinities in nursery areas. Mid-bay outfalls may give rise to local salinity changes and increases in coliform bacteria levels, which may affect the health and marketability of shellfish. Stormwater runoff contributes coliform bacteria, heavy metals, pesticides, nitrogen and other contaminants to surface bays, and may severely impact the biological resources of these areas.

3.2 Identification of Wastewater Management Needs

Table 3–1 lists the main sources of contaminants and the wastewater management objectives that they impact. Table 3–2 lists the major types of pollutants they contribute to the environment, and the possible types of control options available. A number of conclusions can be drawn from these tables. It is obvious that a number of sources impact both public health and natural resource objectives. It is also apparent that the contaminants that are of major concern are common to a wide variety of sources. State and Federal standards exist for coliform bacteria, certain organics and heavy metals in drinking water. There exists a Federal drinking water standard of ten milligrams NO_3–N per liter. Nitrogen is the only parameter common to almost all public health and natural resource concerns for which total loadings can be calculated. Control of this contaminant from each source will in many cases lead to reduction or elimination of other pollutants. (There are, of course, some specific exceptions to this, as in the case of coliform bacteria,

Table 3–1

CONTAMINANT SOURCES AND IMPACTS ON PUBLIC HEALTH AND NATURAL RESOURCES

	Impacted Factors			
	Health		Resources	
Contaminant Source	**Ground Water**	**Surface Water**	**Critical Environments**	**Biological**
Animal wastes	X	X		X
Cesspools	X	X		X
Stormwater runoff	X	X	X	X
Rainwater	X			X
Leakage from sewer systems	X	X		X
Shoreline development		X	X	X
Development of recharge areas	X		X	X
Loss of wetlands		X	X	X
Changes in streamflow		X	X	X
Landfills	X	X	X	X
Recharge basins	X			
Industrial process water	X	X	X	X
Spills	X	X	X	X
STP* operation	X	X		
Siting of STP*		X	X	X
Siting of outfalls		X	X	X
Siting of collection systems			X	
Residuals	X		X	X
Hazardous wastes	X	X	X	X

X – adverse impact *STP = sewage treatment plant

Table 3–2

WATER CONTAMINANTS, BY SOURCE AND TYPE OF CONTROL

Contaminant Source	Contaminant: Coliform Bacteria	Nutrients (Nitrogen)	Organic Chemicals	Metals	Other	Control: Structural	Non-Structural	None
Animal Wastes	X	X			Viruses	X	X	
Cesspools	X	X	X		Viruses	X		
Stormwater runoff	X	X	X	X	Viruses	X	X	
Rainwater		X		X	Acids			X
Leakage from sewer systems	X	X	X	X	Viruses	X		
Shoreline development	X	X	X		Sediments		X	
Development of recharge areas		X	X	X	Viruses	X	X	
Loss of wetlands	X	X	X	X	Sediments		X	
Changes in streamflow					Sediments	X	X	
Landfills	X	X	X	X		X	X	
Recharge basins		X	X	X			X	
Industrial process water	X	X	X	X	Variable	X	X	
Spills					Variable		X	
STP* operation	X	X	X	X			X	
Siting of STP*	X	X			Viruses	X		
Siting of outfalls	X	X			Viruses	X		
Siting of collection systems					Sediments	X		
Residuals	X	X	X	X		X		
Hazardous wastes			X	X	Variable	X	X	

*STP = sewage treatment plant

X — adverse impact

organic chemicals and viruses.) It is for this reason that nitrogen has been selected as the primary parameter upon which the following treatment alternatives have been developed. However, it should be understood that other treatment may be required to remove specific contaminants not directly affected by nitrogen removal processes. In addition, the impacts of parameters not historically monitored, and therefore not specifically treated, require further evaluation.

A primary question is what levels of nitrate-nitrogen are consistent with both the public health and natural resource objectives. As described previously, groundwater is the sole source of drinking water on Long Island. Therefore, if the public health standard is to be satisfied, the nitrate-nitrogen concentration in groundwater should not exceed ten milligrams per liter. Regulations require that, if a water supply reaches this concentration, the purveyor must immediately notify all customers.

Groundwater quality on Long Island is highly variable both in time and from place to place. In order, therefore, to satisfy the drinking water standard, this variation should be accommodated. A statistical analysis of groundwater data, obtained from wells in Nassau and Suffolk Counties, indicated that if the *mean* nitrate-nitrogen concentrations in the Upper Glacial aquifer are six milligrams per liter, then there is a 90 percent chance that well samples will contain levels of nitrate-nitrogen less than ten milligrams per liter.

Although this result is preliminary, it is a useful criterion for managing the Region's nitrogen sources in a manner that ensures that the drinking water standard of ten milligrams per liter will probably not be violated in the Upper Glacial aquifer.

Surface water quality analyses, undertaken within the 208 Program, have demonstrated that levels of oxygen are largely determined by algal respiration and photosynthesis, and by the utilization of oxygen in the bacterial decomposition of dead algal material and other detritus. Large diurnal fluctuations of oxygen are highly undesirable. In particular, larvae of shellfish and other juvenile fish are vulnerable to low levels of oxygen. Given the dependence of algal production on nitrogen, it follows that controls that limit nitrogen will in turn reduce the range of oxygen fluctuations.

From data obtained during the 208 Program, an approximate relationship between nitrogen, chlorophyll a and levels of oxygen was computed, and a nitrogen guideline for the determination of waste load allocations for

marine receiving water was developed. An outline of the method of calculation is given in Section B of the Areawide Waste Treatment Management Plan. The results show that a total nitrogen concentration of 0.4 milligrams per liter or less will generally maintain chlorophyll a levels below 40 micrograms per liter, and will minimize diurnal fluctuations in dissolved oxygen levels. Although this recommended standard can only be regarded as preliminary, the limited data available supports the hypothesis that accelerated eutrophication will not occur where this concentration of chlorophyll a is not exceeded.

3.2.1 The Hydrogeologic Zones. As previously indicated, there are two broad public health objectives, one dealing with groundwater and the other with surface water. The primary objective in protecting the quality of groundwater is to maintain the resource as the regional water supply.

The major patterns of groundwater flow are such that the Region's deep groundwater reservoirs are mainly replenished over a broad area in the central part of the Bi-county Region, as shown in Figure 3–1. Recharge water entering this central area affects the quality of the middle and lower supply. The area outside the central area may be less critical in terms of water supply. On this basis, and considering the use of the groundwater, wastewater management zones can be defined in the Bi-county Region (Table 3–3 and Figure 3–2). It should be recognized that deep flow also occurs to the north of the northern limit of the Magothy in both Nassau and Suffolk. This flow occurs in the deeper portion of the Upper Glacial deposits which are the hydrologic equivalent of the Magothy in this area. In addition, the Upper Glacial aquifer is still utilized as a source of drinking water. Therefore, precautions should be taken to preserve or restore this aquifer as a source of potable water.

One approach to wastewater management is that of identification and protection of critical watersheds. In the Bi-county Region, the greater part of the Magothy aquifer may be identified as the prime source of future water supply. Those areas contributing to this aquifer should be subjected to the strictest management controls.

Zone I covers areas characterized by a deep flow system, which generally contribute water to the middle and lower portions of the Magothy. This zone is a primary source of drinking water in both counties. Point and non-point source controls should be implemented in this zone to protect the public health.

Zone II has experienced serious groundwater quality problems in the Magothy in recent years, primarily due to organic chemicals. Most of the zone is included in Nassau County Sewage Disposal District Three, it is already highly developed, and is presently being sewered. Until the extent of the contamination is determined, all sources of groundwater pollution should be controlled in a manner similar to those in Zone I. Control of non-point sources of pollution will be necessary for reasons of public health.

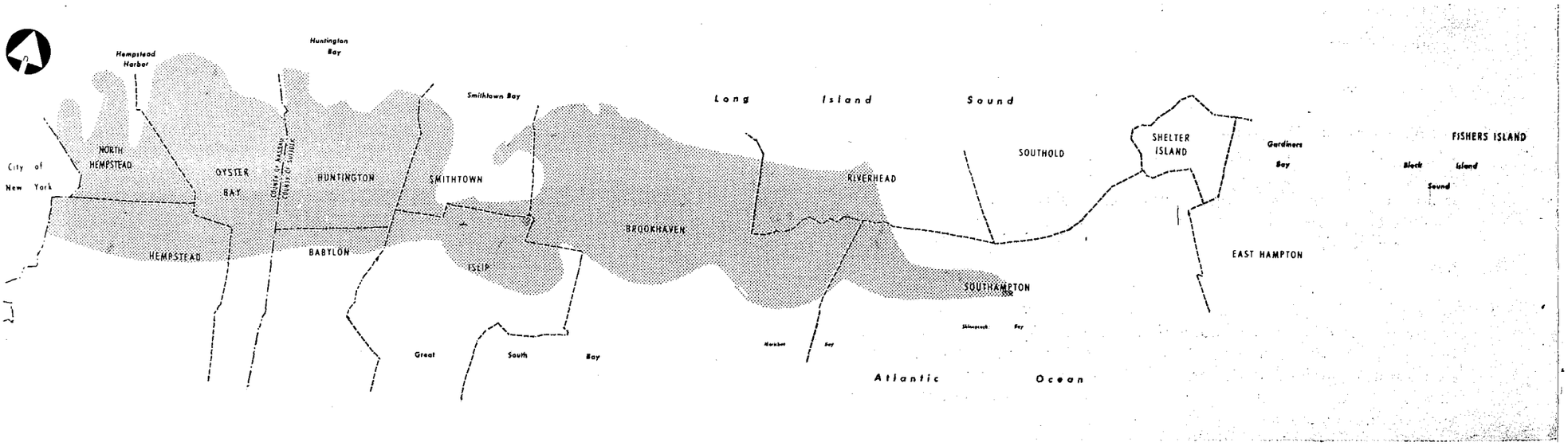


FIGURE 3–1 *Deep Flow Recharge Area*

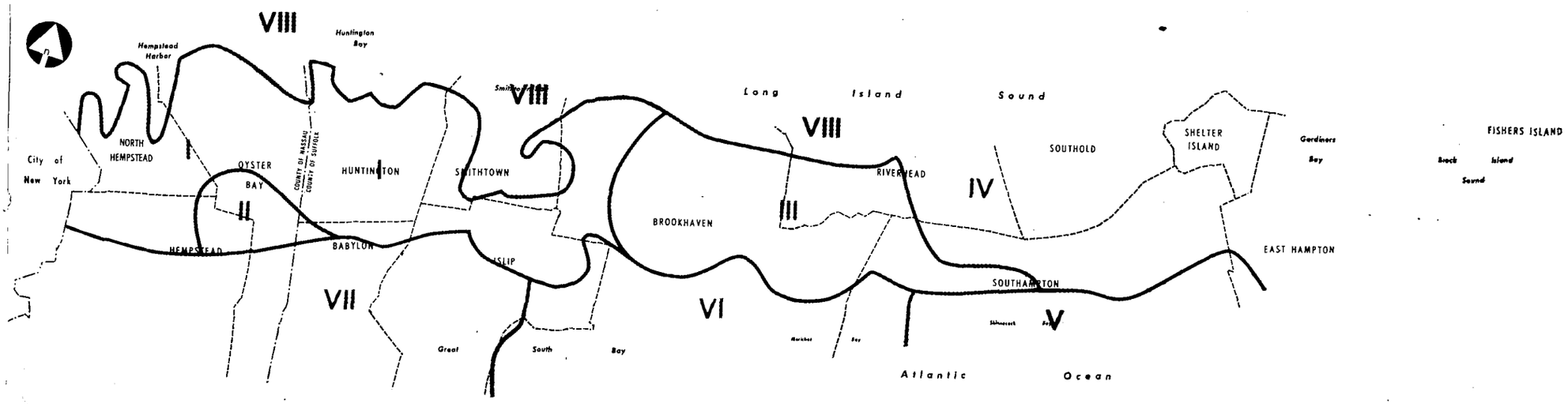


FIGURE 3–2 *Hydrogeologic Zones in the Nassau-Suffolk 208 Study Area*

Zone III is an area that still has good quality groundwater in both the Upper Glacial and Magothy aquifers. Median nitrate-nitrogen concentrations in water from wells in this area have always been low. Moreover, since the hydraulic conductivities of both aquifers are high, there is considerable potential for water supply development in this zone. Much of the area is in low density, primarily non-agricultural, land use. This zone should be protected by applying land use restrictions, as well as strict pollution source controls. In this zone, control of non-point sources is necessary for the protection of the resource itself, and the entire zone should be governed by non-degradation regulations.

Zone IV comprises the North Fork and the eastern part of the South Fork. This area has unique groundwater conditions, and special management alternatives apply to it. Intensive agricultural activities have resulted in nitrate-nitrogen concentrations in wells located in agricultural areas that are above six milligrams per liter, with many observations exceeding ten milligrams per liter. Although groundwater underlying agricultural areas shows definite signs of nitrogen-related contamination, the residential areas still have good quality water, and statistical examination of over 300 analyses from domestic wells located on the North Fork indicates that almost all have nitrate-nitrogen concentrations of less than three milligrams per liter. High chloride concentrations (over 250 milligrams per liter) have been found in a few areas on the North Fork, in New Suffolk, and along both shores of Great Hog Neck and Little Hog Neck. Public supply wells in the Greenport area have experienced saltwater upconing where pumpage was concentrated at one site. While there are many areas with acceptable water quality, any expansion of farming, without the adoption of proper fertilizer management procedures, will lead to increased nitrate contamination of groundwater. However, reduction or elimination of farm acreage and subsequent residential development may result in water supply problems, because most groundwater beneath these agricultural areas already contains very high nitrate concentrations. Based on assessments of the groundwater development potential in each of these areas, there appears to be sufficient available groundwater to support projected land uses, if pumpage is properly developed and managed. This conclusion is supported by the results of a detailed hydrologic model study of the South Fork, conducted as part of the 208 Program. However, because of the limited depth of fresh water on the forks, wastewater management controls must protect those areas that still have acceptable groundwater quality if the areas are to remain self-sufficient in water supply. Failing this, alternative engineering solutions based on water importation or large-scale renovation, will be extremely expensive. Public health questions in Zone IV are related to nitrate concentrations in groundwater. The protection of resources, both natural and recreational, is related to the quality of marine waters. Non-point source controls are relevant to both.

Zone V comprises the southwestern portion of the South Fork not

Table 3–3

HYDROGEOLOGIC ZONES IN NASSAU AND SUFFOLK

Zone No.	Type or Location of System	System Characteristics
I	Deep Flow (Magothy recharge area)	Deep recharge with vertical flow.
II	Deep Flow (Magothy recharge area)	Area of substantially impaired groundwater quality.
III	Deep Flow (Magothy recharge area)	Higher grade reservoir. Exceptionally high quality water with high potential yield.
IV	North Fork and Eastern South Fork	Local water quality problems, but with potential for development, particularly on South Fork.
V	Western South Fork	As previous, but little agricultural input.
VI	Surface Water Impact Area	Polluted groundwater has major impact on surface water, due to long residence time in bays.
VII	South Shore Shallow Flow System	Generally shallow and horizontal flow.
VIII	North Shore Shallow Flow System	Generally shallow and horizontal flow.
	Shelter Island and Fishers Island*	

**Shelter Island and Fishers Island were considered separately.*

included in Zone IV. It differs from Zone IV in having less agricultural activity and, consequently, less of a fertilizer runoff and leaching problem. In all other respects, Zone V shares the characteristics of Zone IV.

Zone VI is that portion of the groundwater system that discharges to Moriches Bay and the eastern portion of Great South Bay. Because the flushing rate in eastern Great South Bay is so low, contaminant concentrations are not sufficiently dispersed and diluted.

The shoreline of Zone VI has valuable recreational resources, and the adjacent bay has important shellfish resources. This zone should be covered by non-degradation regulations.

Zone VII and VIII are areas which are likely to contribute water only to the shallow groundwater flow system. This flow system discharges to streams and saltwater bays, and hence will affect the quality of the surface water. Zone VII groundwater flows into the Nassau County South Shore bays, and has a more significant impact on marine water quality than the groundwater from the areas marked Zone VIII. The latter enters North Shore bays, whose water quality is more dependent on Long Island Sound.

Zones VII and VIII differ geologically. In Zone VIII areas, the Magothy formation has been completely eroded away and replaced by a deep glacial aquifer. The zones are also differentiated on the basis of sewering options. Zone VII is predominantly committed to comprehensive sewering, whereas Zone VIII areas are generally not. Possible exceptions to the shallow flow concept discussed here include those areas of heavy pumping such as in southwestern Nassau, where local reversals of gradient occur. Areas immediately surrounding high capacity supply wells situated in the shallow flow region could also act as local recharge zones. In addition, abandoned wells or wells with faulty construction can serve as conduits for contaminated water and allow movement from shallow to deep systems.

Mean concentrations of nitrates in shallow well water might be allowed to reach six milligrams per liter in Zone I areas, whereas concentrations in Zone VIII might be allowed to approach ten milligrams per liter without contravening surface water standards. In Zone VII, the eastern portion of the zone presently has low groundwater nitrogen concentrations. Increases in groundwater nitrogen in this area will increase the nitrogen loading to eastern Great South Bay. Nitrogen loadings from the western portion of Zone VII do not have as large an effect on eastern Great South Bay, due to the proximity of Fire Island Inlet. The boundary lines separating Zone I and Zones VII and VIII are not meant to be definitive, because there is a lack of data in some areas. The northern boundary of Zones V, VI and VII corresponds roughly to the limit of the Gardiners Clay or equivalent clays. These zones also are areas where available head data between the Magothy and the Upper Glacial indicate essentially horizontal flow in the Upper Glacial aquifer. The southern boundary of Zone VIII on the North Shore was determined using existing information on head distribution near the coastline and interpolating between these points. Flow in the upper aquifer in Zone VIII is, again, essentially horizontal. The area in Zone VIII near Smithtown coincides with the extent of the Smithtown Clay. Further investigation is required to evaluate the flow relationships in most areas before specific management schemes can be implemented. These especially include the Smithtown and Shoreham areas, as well as the southeast portion of Suffolk County.

In some localities, Zones VII and VIII are similar, in that they have a high water table and soils of low permeability.

3.2.2 Surface Waters. Fresh waters in the Nassau-Suffolk Region include several lakes, four major streams and numerous ponds and minor streams. Freshwater quality is a function both of groundwater quality and of the nature and volume of the pollutants carried in runoff originating in the immediate watershed. Freshwater streams contribute locally significant amounts of nitrogen and coliform bacteria to the bays.

These pollutants affect not only public health but also environmental resources. Abnormal changes in the volume of streamflow, such as might be expected to result from sewage collection and discharge of effluent to marine

waters, can be expected to produce changes in stream corridor and bay ecosystems. In the first instance, the changes will occur because of lowered water levels or disappearance of the streams; in the second, because of increased salinities resulting from reduced quantities of fresh water reaching the bays as streamflow and underflow.

In order to protect the marine surface waters and biological resources of Nassau and Suffolk Counties, nitrogen and coliform bacteria have been selected as the two key pollutants to be controlled. Nitrogen is contributed to the bays by point sources (principally municipal treatment plant discharges) and non-point sources. The non-point sources include groundwater underflow, stream base flow, stormwater runoff and direct rainfall. For each Long Island bay, the relative loading of each source varies. The response of each bay to a given loading also varies due to the different flushing rates of each bay. It is also true that the effect of a nitrogen loading to a bay varies, depending on the exact location of the discharge. The individual bays are discussed below, in Section 2.5 of this report and in Section B of the Areawide Waste Treatment Management Plan. Figure 3–3 indicates the areas considered in the natural resource planning alternatives.

Great South Bay. Over 50 percent of the present total nitrogen loading to Great South Bay is from groundwater—sixteen percent from groundwater underflow, and 40 percent from stream base flow. (See Table 2–7 in Section 2.5.) Since nearly 100 percent of stream base flow is derived from groundwater, both sources can be considered together. Groundwater underflow to Great South Bay is approximately 78 cubic feet per second (cfs). This compares to the average stream base flow of 260 cfs.* Nitrogen concentrations in groundwater underflow and stream base flow show similar concentrations. In western Great South Bay (west of the Connetquot River), groundwater nitrogen concentrations average about five milligrams nitrogen per liter. The resulting nitrogen loadings to western Great South Bay are 720 pounds per day from groundwater and 1800 pounds per day from stream base flow.

In eastern Great South Bay (east of the Connetquot River) nitrogen loading is 330 pounds per day from groundwater underflow and 830 pounds per day from stream base flow. The lower loadings are primarily due to lower nitrogen concentrations of 1.4 milligrams nitrogen per liter for streams and one milligram nitrogen per liter for groundwater. Although the nitrogen loadings to eastern Great South Bay are smaller than the loadings to the western Great South Bay, the long residence time (the average length of time for which a parcel of water remains in the bay) of eastern Great South Bay makes it the more critical half of the system. Current nitrogen loading from stream base flow and groundwater underflow in eastern Great South Bay

*Includes groundwater inflow to streams below gauging stations.

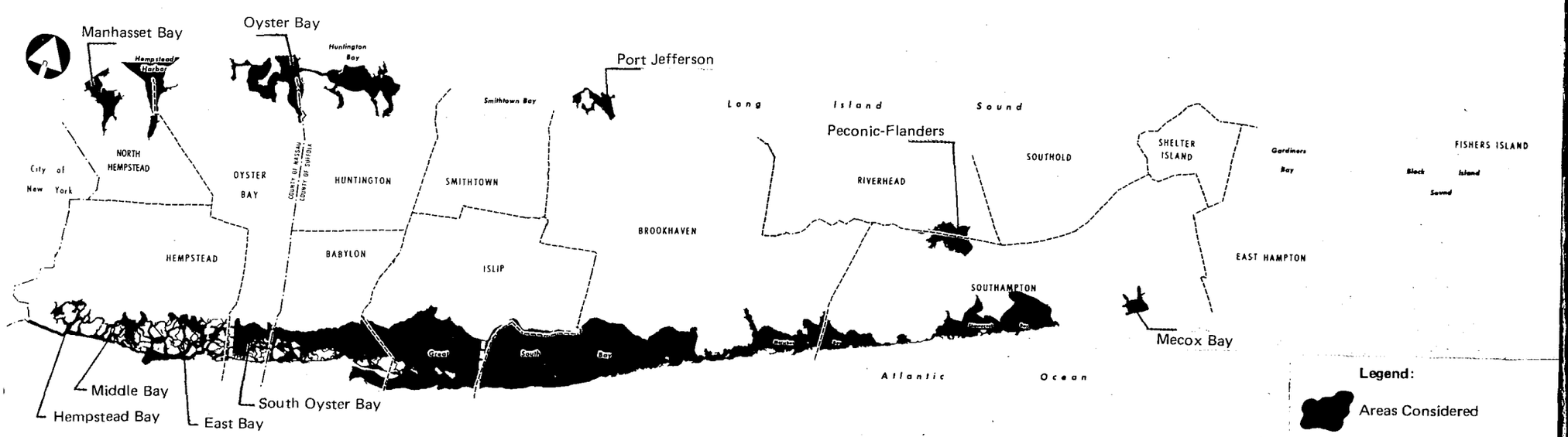


FIGURE 3–3 *Areas of the Nassau-Suffolk 208 Study Area Considered for Natural Resource Planning Alternatives*

produces average receiving water nitrogen concentrations over one milligram nitrogen per liter.

Additional increases in groundwater nitrogen discharging to eastern Great South Bay must be avoided if serious degradation to the bay is to be prevented. If groundwater nitrogen concentrations increase to two milligrams nitrogen per liter or more, nitrogen concentrations in eastern Great South Bay will exceed two milligrams nitrogen per liter.

In western Great South Bay, the residence time is lower and the flushing considerably better than in eastern Great South Bay, except in some canals, where the low flushing rate is a very real problem. Although the loadings are greater, receiving water nitrogen concentrations are currently near acceptable levels. Sewering programs with ocean outfall, currently planned for southwestern Suffolk County, should result in lower groundwater nitrogen concentrations within ten to twenty years.

The two remaining major non-point sources are direct rainfall and stormwater runoff. There are no options available for controlling nitrogen loading from direct rainfall. However, storm runoff into eastern Great South Bay should be controlled. Point sources account for only two percent of the total nitrogen loading to Great South Bay. The major point source, the Patchogue treatment plant, discharges to eastern Great South Bay. This discharge should be removed, or receive denitrification.

Western South Shore Bays. Point source discharges are the major internal source (76 percent) of nitrogen to the western South Shore bays of Nassau County. The point sources are concentrated in Hempstead Bay; an additional source is located at the Jones Beach Sewage Treatment Plant outfall east of Jones Inlet. Flows to the Freeport Sewage Treatment Plant will be diverted to the Cedar Creek plant in 1979. Receiving water nitrogen concentrations are excessive in Hempstead Bay and Middle Bay, and near acceptable levels in East Bay and South Oyster Bay.

The Bay Park Sewage Treatment Plant contributes about 85 percent of the total point source nitrogen loading to the Nassau County South Shore bays. If this outfall were moved to an offshore location, there would be a reduction of the total nitrogen loading (to the western South Shore bays) by 66 percent and the total coliform loading by eleven percent.

Moriches Bay. Moriches Bay has experienced high nutrient and coliform loadings, particularly in the form of wastewater from duck farms in the vicinity of its tributary streams. Point sources account for fourteen percent of the total nitrogen loadings. There are no estimates of the amount of nitrogen trapped in duck waste sludges deposited during past years. However, they are not considered to be significant nitrogen sources at present. Groundwater underflow and streams contribute significant inputs of nitrogen to the system. In order to attain surface water quality goals of 0.4 milligrams nitrogen per liter and 5.0 milligrams per liter dissolved oxygen, these sources must be reduced. Point sources, although only fourteen percent of the total loads, cause localized problems in the poorly flushed streams on which they are located. Any pollutant loads to the Narrows area will affect both Moriches Bay and eastern Great South Bay. Large areas of Moriches Bay are presently closed to shellfishing because of elevated coliform concentrations.

Nitrogen and coliform loads do not occur to the same extent in all the sources. It will be necessary to reduce pollutant contributions from a number of sources in order to attain the required water quality objectives.

Mecox Bay. The inlet from this bay to the Atlantic Ocean is closed approximately half the time. The one duck farm in the area no longer discharges its wastes to the bay.

Shinnecock Bay. Flushing rates, surrounding land use and the absence of point sources have allowed maintenance of high water quality in Shinnecock Bay. For this reason, wastewater management should ensure non-degradation of this resource.

Manhasset Bay. Seventy percent of the nitrogen loading from sources within the bay is discharged from point sources. High nitrogen concentrations in Long Island Sound water are an even larger influence. A waste management plan to maintain recommended nitrogen levels in Manhasset Bay must, therefore, consider control of sources within the bay and possibilities for control of sources outside of the bay (Long Island Sound) and beyond the boundaries of the Nassau-Suffolk study area.

The high nitrogen concentration in Long Island Sound impacts water quality in Manhasset Bay (and Hempstead Harbor). The recommended nitrogen loading to Manhasset Bay assumes future reduction in the concentration of nitrogen in the Sound. This assumption is valid only if New York City ceases its nitrogen discharges to the upper East River. If Long Island Sound water quality does not improve, the attainment of water quality standards in Manhasset Bay (and Hempstead Harbor) cannot be assured even with nitrogen removal or mid-bay discharge. It is therefore very important that the New York State DEC or EPA plan and implement waste controls required to improve water quality in western Long Island Sound.

Hempstead Harbor. Hempstead Harbor, like Manhasset Bay, is subject to high nitrogen loadings from Long Island Sound. Approximately seventy percent of the nitrogen loading from sources within the harbor is from point sources. These point source nitrogen loadings are concentrated in Glen Cove Creek, which receives approximately 1600 pounds per day from the Glen Cove Municipal Treatment Plant and an average of 400 pounds per day from the Powers Chemco plant. (Powers is preparing to treat their wastewater for nitrogen removal.) Although not normally regarded as a point source, the semi-wild duck population on Roslyn Park Pond constitutes one. (The pond discharge frequently requires chlorination because of high bacteria levels.) To avoid localized water quality degradation, the recommended total nitrogen loading to the harbor has been established at 417 pounds per day. At the south end of Hempstead Harbor, the Roslyn Sewage Treatment Plant discharges an average nitrogen loading equal to the total recommended for the entire harbor.

Oyster Bay. Stormwater runoff and stream base flow are currently responsible for contravention of coliform bacteria standards and elevated nitrogen loadings.

Current nitrogen loadings from the Oyster Bay Treatment Plant are well below the maximum recommended loading.

Huntington Bay. Within this embayment, 75 percent of the point source loadings discharged to Northport Harbor and Huntington Harbor originate from sewage treatment plants. Loadings to both harbors exceed the recommended loadings. Therefore, reduction of nitrogen concentrations is required. Stormwater runoff contributes 98 percent of the coliform loading to the bay and requires control.

Port Jefferson Harbor. The Port Jefferson Sewage Treatment Plant is the major nitrogen point source to the harbor. Current loadings are within the recommended maximum of 500 pounds per day. Future loadings greater than 500 pounds per day will result in unacceptable concentrations if the outfall remains in its present location.

Stormwater runoff and stream base flow are currently responsible for violations of shellfish standards in Conscience Bay and Setauket Harbor/ Little Bay; they also contribute to violations in southern Port Jefferson Harbor.

Flanders Bay. Flanders Bay and the Peconic Estuary receive point source nitrogen loadings from duck farms located on tributaries, including the Peconic River, and from the Riverhead Sewage Treatment Plant. Over 50 percent of the present loading is from duck farms. The approximate loading to Flanders Bay from Meetinghouse Creek and the Crescent Duck Farm was 600 pounds per day during the 208 sampling period. The recommended discharge is 464 pounds per day. Thus nitrogen removal would be indicated for the Crescent Duck Farm. However, significant treatment system improvements were made subsequent to the 208 sampling period. These have resulted in no surface discharge from this farm for most of the period beginning February 1977. A re-evaluation of the impact of this discharge point should therefore be made.

The Peconic Estuary receives most of its nitrogen loading from the Riverhead Treatment Plant and the Peconic River. The nitrogen loading of the Peconic River is variable because of the variation of river discharge. From four observations between July 1976 and April 1977, the total nitrogen loading to the Peconic Estuary from the river ranged from 133 pounds per day to 414 pounds per day. In addition to the Peconic River discharge, the Riverhead Treatment Plant discharges an average of 148 pounds per day of total nitrogen.

The maximum allowable nitrogen loading to the estuary is 182 pounds per day. To meet this allowable discharge, the two duck farms on the Peconic River must either institute effluent nitrogen removal, or go to zero discharge. This will reduce the nitrogen loadings of the Peconic River by 40 to 50 percent. No additional nitrogen loading should be allowed from the Brookhaven or Grumman treatment plants. Even with these controls on discharges to the river, the maximum allowable nitrogen loading to the Peconic Estuary may still be exceeded periodically.

3.3 Point Source and Residual Controls

The previous parts of Section Three have described the objectives of the Program and have developed a series of waste management options for different geographic areas. These are general in nature and are meant to provide decisionmakers with an overview of existing problems, their probable causes, and general courses of action for addressing the problems.

This section discusses in more detail structural alternatives to wastewater management. It presents information on various treatment approaches that may be used in the bi-county area, evaluates new technological concepts, and discusses alternative programs for residuals (solid waste, sludges, hazardous wastes) management.

The term "cost-effectiveness" is used throughout this report. It is defined in traditional engineering terminology as those measures that are economically feasible in terms of tangible benefits that accrue from monies spent. Cost-effectiveness, as defined in USEPA "208" Guidelines, refers to the solution, chosen as a result of the systematic comparison of alternatives, that minimizes total costs to society over time, while meeting specified goals and objectives. The total costs should include resource, social, environmental and dollar costs. Effectiveness refers to meeting the 1983 goals of the ACT (PL 92–500), while providing for the highest practical degree of technical reliability in the pollution control alternative that is chosen. This national goal states, in Section 101–a–(2), that wherever attainable, an interim goal of water quality which provides for the protection and propagation of fish, shellfish and wildlife and provides for recreation in and on the water be achieved by July 1, 1983.

3.3.1 Point Source Controls

3.3.1.1 Introduction: Traditional Collection and Treatment Approach Alternatives. This section describes the alternative treatment approaches that have been developed in the 208 Program for Nassau and Suffolk Counties. Because of differences in the degree of development in the two counties, and the inherently fixed nature of the existing Nassau system, treatment emphasis differs not only by the hydrogeologic zone but also by administrative area. In Nassau, the major options concern treatment plant locations and effluent disposal; in Suffolk, the major options concern an identification of those areas that should be sewered as well as the siting of treatment facilities and effluent discharges.

In addition, Nassau and Suffolk are discussed separately because their municipal wastewater treatment needs differ. Nassau County is highly developed; according to the 208 population estimates, the county population is approximately 96 percent of saturation or zoned capacity, and is projected to reach 98 percent by the year 1995. Suffolk's population, on the other hand,

is currently at 52 percent of saturation and is expected to increase to 71 percent by 1995. Nassau County has 23 existing domestic wastewater treatment facilities, and major new construction is not anticipated except where expansion and upgrading of existing facilities is necessary. Suffolk County has 105 small domestic treatment facilities in operation, and one major facility (30 MGD) under construction. Nassau's domestic treatment facilities are generally large scale, treating up to 60 million gallons per day (MGD), but a typical Suffolk County domestic wastewater treatment plant treats less than one MGD, with the largest treating only approximately two MGD.

Surface water quality considerations also dictate different approaches in the Bi-county Region. Marine water quality in Nassau County and western Suffolk is influenced by the effects of New York City discharge. In eastern Suffolk, agricultural uses impact river and bay quality. A final reason for separate consideration of the two counties concerns their degree of urbanization: Nassau and western Suffolk Counties are highly urbanized, while eastern Suffolk is essentially rural and agricultural in nature.

In order to assist in the establishment of potential future sewer service areas and to estimate future domestic wastewater loads for traditional sewering alternatives, an attempt was made to correlate population density with nitrate-nitrogen (NO_3–N) concentrations in the Upper Glacial aquifer. Although the results were not statistically conclusive, they indicated that population density was an important factor that had to be considered in establishing sewer service areas. Several population density criteria were applied in those geographic areas that recharge to the Magothy aquifer to develop alternative geographic limits for potential sewer service areas.

A second reason for establishing areas to be sewered concerns high groundwater tables or low soil permeability, both of which would result in pervasive septic tank/cesspool failures and consequent health hazard. Concern for the protection of surface water quality was a final consideration in delineating potential future sewer service areas.

These criteria—protection of the Magothy, potential for on-lot systems failure and protection of surface waters—were combined to develop the various sewering alternatives. In Suffolk County, these alternatives ranged from the maintenance of the status quo, or no additional sewering, to sewering at a population density of one dwelling unit per acre. The greater part of the Suffolk area is currently unsewered and potential future sewer service areas could be extensive. For this reason, a wide range of alternatives had to be examined in order to delineate these areas, and to develop flow and cost estimates. Potential future service areas were developed for each of the following assumptions:

a. No new sewering; utilize existing service areas only (1975 population).
b. Include land with two dwelling units (D.U.) per acre in high groundwater table areas; five D.U. per acre in Magothy recharge areas (1995 population)
c. Include land with two D.U. per acre in high groundwater table areas; five D.U. per acre everywhere else (1995 population)
d. Include land with two D.U./acre in high groundwater table areas; two D.U./acre in Magothy recharge areas (1995 population)
e. Include land with two D.U. per acre in high groundwater table areas; two D.U. per acre in Magothy recharge areas (1975 population)
f. Include land with two D.U. per acre in high groundwater table areas; two D.U. per acre everywhere else (1995 population)
g. Include land with a density of one D.U. per acre everywhere (1995 population).

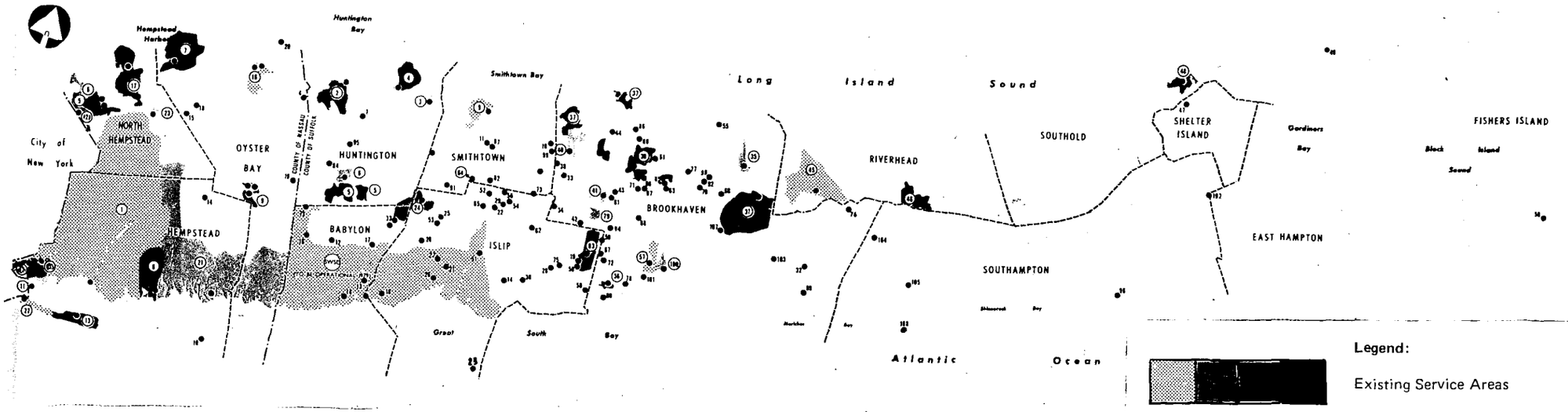
Figures 3–4 through 3–10 indicate the approximate geographic extent of the areas that would be sewered for each alternative. The areas do not include separate commercial/industrial areas because of scale, but they would be included in sewering approaches. Flows from these land uses are included in subsequent estimates.

Two dwelling units per acre was selected as the sewering criterion in areas of high groundwater or low soil permeability because, at lower densities, individual homeowners will normally have sufficient acreage to permit the installation, expansion or construction of new leaching facilities on other parts of the lot. At densities of two or more dwelling units per acre, those options are not as readily available and sewer systems may be the only viable solution.

Five dwelling units per acre was selected as representative of high density land use because, at this density and at higher levels, there is a clear threat to groundwater contamination from individual on-lot systems.

Although protecting groundwater quality provides a major justification for establishing an allowable population density, the geographic limits of the Magothy aquifer recharge area are not precisely defined. It should be recognized that deep flow also occurs to the north of the northern limit of the Magothy in both Nassau and Suffolk. This flow occurs in the deeper portion of the Upper Glacial deposits, which are the hydrologic equivalent of the Magothy in this area. Since this part of the aquifer is also used for water supply, it may be necessary to consider sewering here even in the minimum sewering alternatives. Therefore, criteria for sewering were applied on an Island-wide basis for some of the alternatives. Definition of those areas contributing subsurface flow to the bays was also uncertain, and provided further reason to examine sewering in all areas for some alternatives.

In considering sewering alternatives it should be noted that even the most comprehensive sewering plan will not address all water quality problems. Sewering does not reduce the nitrogen input from fertilizer, which appears to be a major source of elevated nitrate concentrations in groundwater. In addition, sewering an area can lead to land use changes that may actually increase contaminant loading, by encouraging more intense development. This results from more lawn fertilizing, greater volumes of stormwater



NOTE: FOR IDENTIFYING NUMBERS, REFER TO APPENDIX A, ELEMENT H.

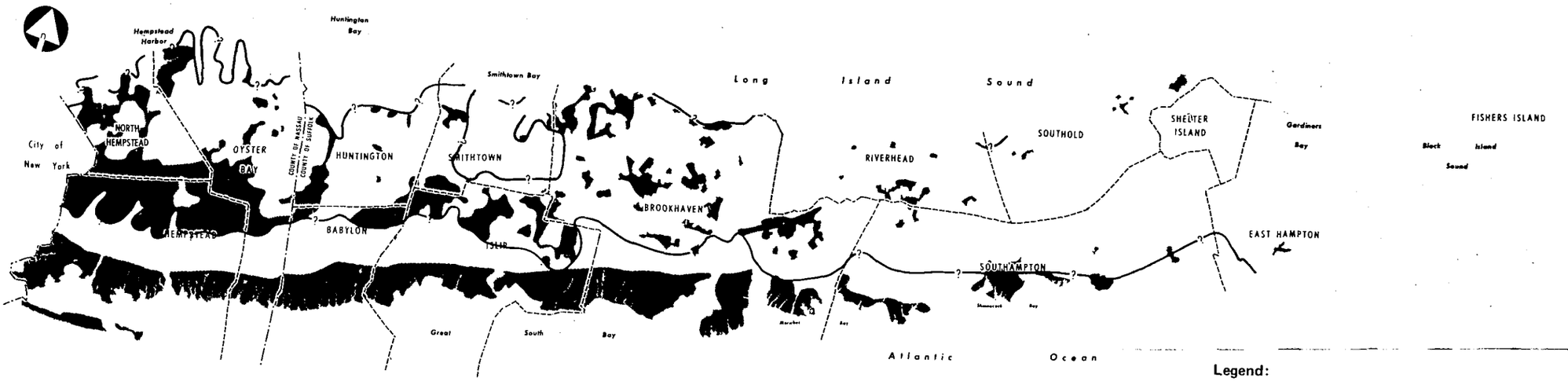
Legend:

Existing Service Areas

● Existing Domestic Wastewater Treatment Plant

FIGURE 3–4 *1975 Existing Service Areas*

Source: Section H of the Areawide Waste Treatment Management Plan.



(potential service areas on the Forks are based on population densities only)

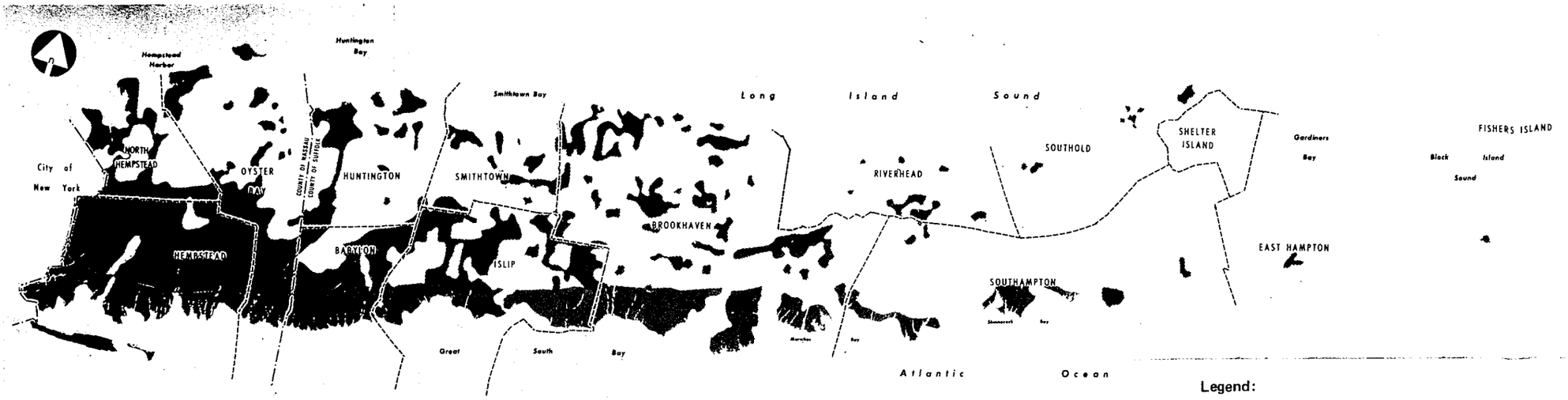
Legend:

2 D.U./Acre in High Groundwater Table Area

5 D.U./Acre in Deep Flow Recharge Area

FIGURE 3–5 *1995 Potential Service Areas*
2 D.U./Acre in High Groundwater Areas
5 D.U./Acre in Deep Flow Recharge Area

Source: Section H of the Areawide Waste Treatment Management Plan.



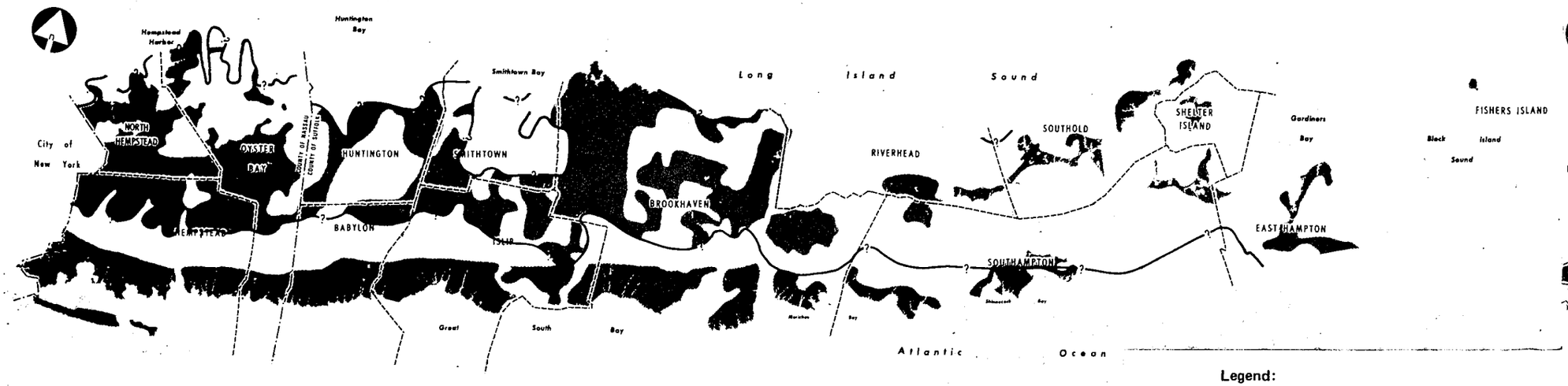
Legend:

2 D.U./Acre in High Groundwater Table Area

5 D.U./Acre Everywhere Else

FIGURE 3–6 *1995 Potential Service Areas*
2 D.U./Acre in High Groundwater Areas
5 D.U./Acre Everywhere Else

Source: Section H of the Areawide Waste Treatment Management Plan.



Legend:

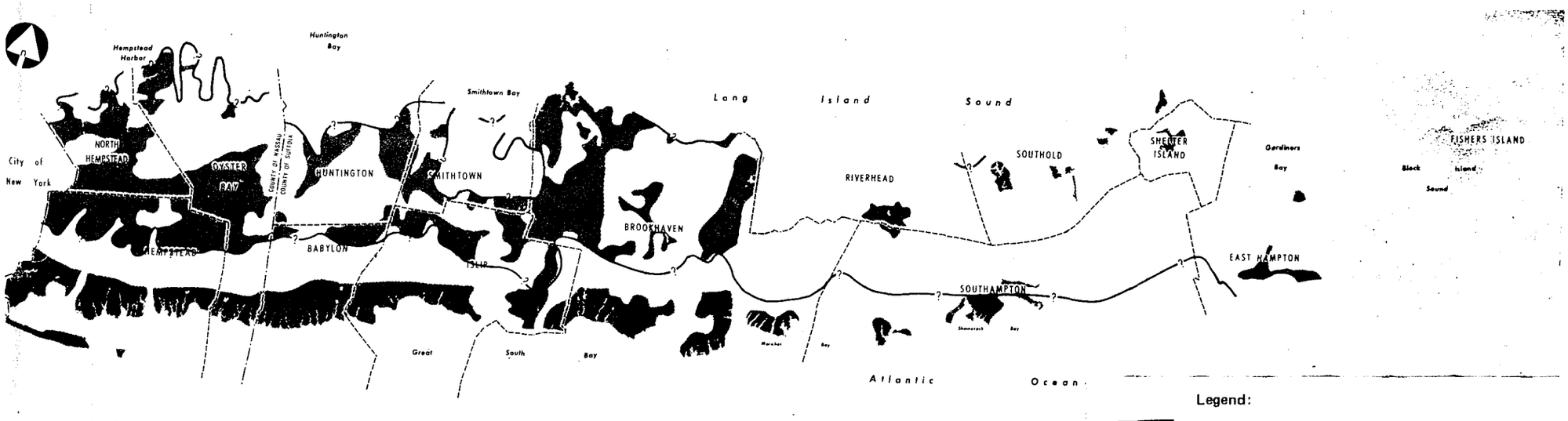
2 D.U./Acre in High Groundwater Table Area

2 D.U./Acre in Deep Flow Recharge Area

FIGURE 3–7 *1995 Potential Service Areas*
2 D.U./Acre in High Groundwater Areas
2 D.U./Acre in Deep Flow Recharge Area

Source: Section H of the Areawide Waste Treatment Management Plan.

(potential service areas on the Forks are based on population densities only)



(potential service areas on the Forks are based on population densities only)

FIGURE 3–8 *Potential Service Areas—Based on 1975 Population*
2 D.U./Acre in High Groundwater Areas
2 D.U./Acre in Deep Flow Recharge Area

Legend:

- 2 D.U./Acre in High Groundwater Table Area
- 2 D.U./Acre in Deep Flow Recharge Area

Source: Section H of the Areawide Waste Treatment Management Plan.

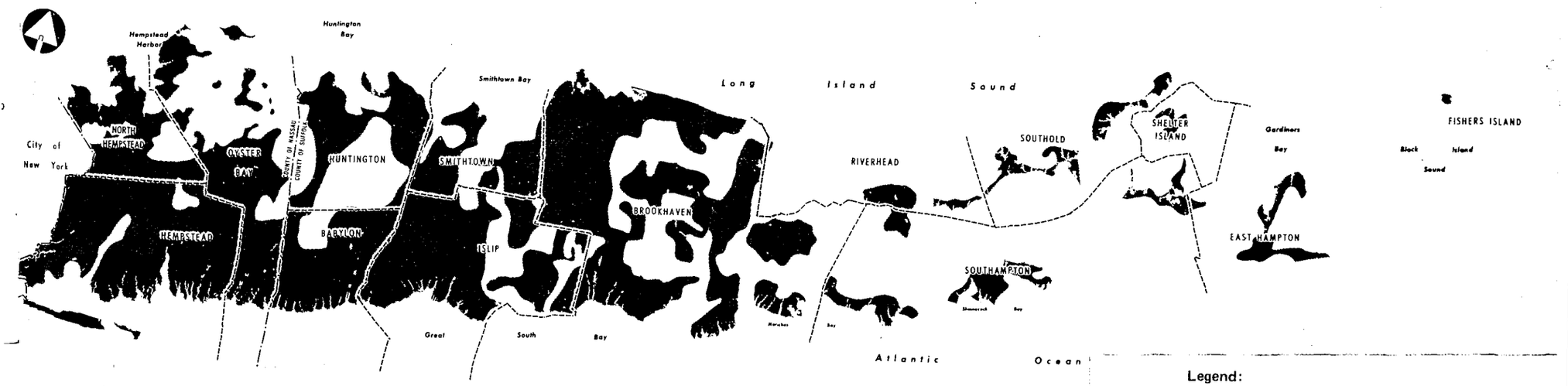


FIGURE 3–9 *1995 Potential Service Areas*
2 D.U./Acre in High Groundwater Areas
2 D.U./Acre Everywhere Else

Legend:

- 2 D.U./Acre in High Groundwater Table Area
- 2 D.U./Acre Everywhere Else

Source: Section H of the Areawide Waste Treatment Management Plan.

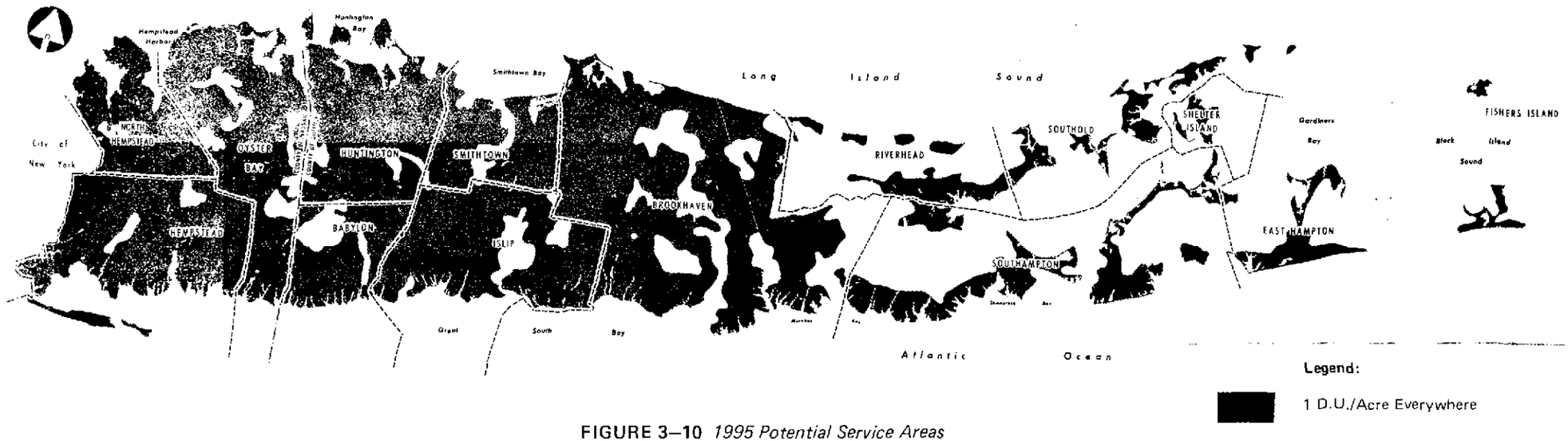


FIGURE 3–10 *1995 Potential Service Areas*
1 D.U./Acre Everywhere

Source: Section H of the Areawide Waste Treatment Management Plan.

runoff from roads, and increased commercial activity with attendant spills and accidental discharges.

The NSRPB projected 1995 population estimates were used to delineate future service areas. In order to study sewerage needs under no-growth policy, alternative (e) was mapped using the same density criteria but substituting the 1975 population for the 1995 population. Figures 3–4 to 3–10 illustrate potential future service areas for those alternatives identified above, including alternative (e) which utilized 1975 population figures.

3.3.1.2 Discussion of Various Sewering Alternatives. Each of the seven sewering alternatives listed in the previous section was developed to test the sensitivity of the study area (particularly Suffolk County) to various degrees of sewering. The first alternative (a) assumes that no new sewering will occur beyond the present sewer service areas (assuming Nassau County District III and Suffolk County Southwest Sewer District are complete). It implies that other technologies or non-structural measures will be employed and will be sufficient to handle the wastewaters of the area. It reflects a no-action alternative in terms of the traditional sewering approach.

As a first approach, it is assumed that sewering is not the most cost effective method for protecting public health and ground and surface water quality. Either water quality will be allowed to degrade and puhlic health threatened, or alternatives will be found to protect public health and water quality that do not require sewers. The major potential problem areas in the first approach will be south of Sunrise Highway, where groundwater elevations are high and on-lot systems fail, and in the Magothy recharge area, where nitrates, organic chemicals and other contaminants from on-lot systems discharge to the Magothy aquifer.

The second sewering alternative (b) attempts to alleviate the major problems cited in the no sewering approach. It provides for sewers in the areas of high groundwater since it assumes that other options are not viable for that area; the alternative would provide sewers in areas of high groundwater when population densities are equal to or greater than two dwelling units per acre. In areas of lower density, septic tanks with additional leaching fields are recommended.

This second approach also assumes that sewers are necessary in the Magothy recharge area to protect the water supply from contamination from on-lot home systems. It reflects a policy that is quite different from past practice in that it assumes sewering at high densities equal to or greater than five dwelling units per acre. Past practice in Suffolk County has required the provision of sewers whenever an area is developed at a density equal to or greater than one dwelling unit per 40,000 square feet. The county currently does not require sewering at lot sizes of 20,000 square feet or more, providing public water supply is available. It is important to note that none of the sewering alternatives assumes that sewers will solve all public health, and surface and groundwater quality problems. Rather, they attack the problems

of domestic sewage and industrial wastewater disposal by traditional means and assume that other pollutant sources (*e.g.,* fertilized areas, stormwater runoff) will also be controlled.

Because the specific Magothy recharge area is difficult to define with accuracy, alternative (c) has been included. It would sewer at densities equal to or greater than two D.U.s per acre in areas of high groundwater and is similar to (b). However, everywhere else, it would sewer at densities of five D.U.s per acre or greater. This approach is included to ensure that the total water supply is protected from wastewater generated by high density areas.

Alternatives (b) and (c) rely on sewering to protect the ground and surface waters and public health only from human and industrial waste. Both the (b) and (c) must be combined with waste management programs for fertilizers, stormwater runoff, landfills and other pollutant sources. Sewering alone cannot be used as a management tool to control all pollutant sources.

Alternatives (d) and (f) are similar to each other and differ from (b) and (c) only in that more protection is given to the Magothy recharge area by sewering at population densities of two D.U.s per acre or greater. In (d) and (f) areas of high groundwater table are sewered at two D.U.s per acre. In (d), areas in the Magothy recharge area are sewered at two D.U.s per acre or more. In (f), all areas of two D.U.s per acre or more are sewered because of the uncertainty of the recharge area boundary lines.

In adopting alternatives (d) or (f), it must be emphasized again that other major sources of pollution must be attacked concurrently as was described in the alternatives (b) and (c).

Alternative (e) has been developed for comparative purposes. It utilizes 1975 population distributions, not 1995 data, and assumes sewering wherever population densities are equal to or greater than two D.U.s per acre. It is similar to alternative (f), except 1975 population is used. Alternative (e) expresses the sewering consequences of a no-growth policy. In other words, if land use and population were controlled to the point where no growth was allowed, a sewering scenario similar to alternative (e) would result. The results of (e) can be visually and statistically compared to the other options, allowing decisionmakers to opt for future growth or no-growth policies..

Alternative (g) is the final traditional sewering approach that has been studied. It assumes that sewers would be provided in all areas where population densities are equal to or greater than one D.U. per acre. Thus, it might be considered the opposite of alternative (a) in that the first alternative assumed all sewering would cease at the present service area boundaries, while (g) assumes sewering will occur wherever subdivision development might occur. Later on in this section, flow estimates are presented for the various alternatives that indicate numerically the relative degree of sewering for each of the alternatives. Cost estimates are also presented.

The study areas used for the development of traditional sewering alternatives represent existing sewer service areas, 201 areas and disposal districts identified in earlier studies. The use of these areas, which are based on surface drainage, does not imply a conflict with the hydrogeologic approach to the selection of wastewater management options.

3.3.1.3 Development of Traditional Sewering Alternatives. In the detailed development of the structural sewering approaches, Nassau County was subdivided into four study areas approximately coinciding with existing or proposed disposal district boundaries as designated by the Nassau County Department of Public Works (NCDPW). In general, Suffolk County was subdivided into the five western towns and five eastern towns. The five western towns are considerably more urbanized and are similar to Nassau County in respect to land use and water quality problems. The five eastern towns are more rural and have extensive agricultural land use and lower population densities. The five western towns were subdivided into seven study areas, which approximate the boundaries of seven 201 planning areas as designated by the Suffolk County Department of Environmental Control (SCDEC). With the exception of those areas in or adjacent to the hamlet of Riverhead and the Village of Greenport, and on Fishers Island, the five eastern towns cannot be conveniently subdivided into proposed 201 study areas and were therefore divided into study areas coinciding with the SCDEC proposed disposal districts as identified by the 1966 Suffolk County Comprehensive Sewerage Disposal Plan (Disposal Districts No. 11 through No. 17). The seven study areas for the five western towns are the Southwest Sewer District (SWSD), West Central excluding the SWSD, Huntington-Northport, Kings Park, South Central, Port Jefferson and Yaphank.

Nassau County treatment alternatives consist of combining a variety of feasible components, including sewage flow diversions and/or the expanssion of particular treatment facilities. Since there are 23 existing domestic facilities in Nassau County, the number of possible permutations is too great to permit examination of all possible diversions between facilities. Instead, only viable options, as determined on the basis of an initial screening, were selected for examination.

In Suffolk County, sewering and treatment alternatives were more numerous than Nassau because many more options were available. Various potential future service areas were delineated utilizing different population density criteria; regional, sub-regional and small plant approaches were analyzed. A regional facility was defined as one treatment plant serving an entire study area such as the SWSD or the Huntington-Northport study area. A sub-regional approach was defined as two to six wastewater treatment facilities serving a study area, and the small plant approach was defined as a proliferation of treatment facilities of approximately one MGD in size, serving localized growth within a study area.

Table 3–4 summarizes the flow projection figures for each of the study areas of the five western towns in Suffolk County. The flows are presented for each of the various sewering criteria and include both domestic and industrial flows for the different scale systems (regional to small plants). Table 3–5 presents similar information for the five eastern towns.

Table 3–4

SEWAGE FLOW BY STUDY AREA FOR VARIOUS SEWERING CRITERIA, FIVE WESTERN TOWNS (MGD) [1]

Study Area	Alternative	Approach	Sewering Criteria					
			2 DU/A high GW [2] 5 DU/A Magothy [3] 1995	2 DU/A high DW 5 DU/A everywhere else 1995	2 DU/A high GW 2 DU/A Magothy 1975	2 DU/A high GW 2 DU/A Magothy 1995	2 DU/A everywhere 1995	1 DU/A everywhere 1995
SWSD								
	I-1	Regional	19.5	28.0	17.0	19.5	30.0	30.0
	I-2	Regional	33.5	52.5	31.5	36.5	54.0	61.0
West Central								
	II-2	Sub-Regional	6.00	7.50	10.5	13.3	17.0	21.0
	II-3	Sub-Regional	11.0	24.0	20.0	24.5	41.0	42.5
	II-4	Small Plants	11.0	24.0	20.0	24.5	41.0	42.5
Huntington-Northport								
	III-2	Regional	0.25	10.5	1.50	2.25	13.0	20.0
	III-3	Regional	0.25	10.5	1.50	2.25	13.0	20.0
	III-4	Sub-Regional	0.25	10.5	1.50	2.25	13.0	20.0
	III-5	Small Plants	0.25	10.5	1.50	2.25	13.0	20.0
Kings Park								
	IV-2	Regional	2.50	7.00	4.00	6.00	14.0	16.0
	IV-3	Sub-Regional	2.50	7.00	4.00	6.00	14.0	16.0
	IV-4	Small Plants	2.50	7.00	4.00	6.00	14.0	16.0
South Central								
	V-2	Regional	19.0	21.5	18.0	25.5	31.0	32.0
	V-3	Sub-Regional	19.0	21.5	18.0	25.5	31.0	32.0
	V-4	Sub-Regional	19.0	21.5	18.5	26.0	32.0	33.0
	V-5	Small Plants	19.0	21.5	18.5	26.0	32.0	33.0
Port Jefferson								
	VI-2	Regional	5.00	4.75	5.00	8.50	8.50	9.00
	VI-3	Regional	5.00	4.75	5.00	8.50	8.50	9.00
	VI-4	Sub-Regional	5.00	4.75	5.00	8.50	8.50	9.00
	VI-5	Sub-Regional	5.00	4.75	5.00	8.50	8.50	9.00
	VI-6	Small Plants	5.00	4.75	5.00	8.50	8.50	9.00
Yaphank								
	VII-2	Sub-Regional	20.5	23.0	15.0	31.0	37.5	38.5
	VII-3	Sub-Regional	20.5	23.0	15.0	31.0	37.5	38.5
	VII-4	Small Plants	20.5	23.0	15.0	31.0	37.5	38.5

(1) Refer to Section H of the Areawide Waste Treatment Management Plan. Numbers include industrial waste flow allocations. Where more than one regional or sub-regional option is listed, different configurations of regional or sub-regional systems were studied. These are discussed in detail in other study reports.

(2) Two dwelling units per acre in high groundwater table areas.

(3) Five dwelling units per acre in the Magothy recharge areas.

Table 3–5

SEWAGE FLOW BY STUDY AREA FOR VARIOUS SEWERING CRITERIA, FIVE EASTERN TOWNS (MGD) (1)

Study Area	Approach	Sewering Criteria					
		2 DU/A high GW (2) 5 DU/A Magothy (3) 1995	2 DU/A high GW 5 DU/A everywhere else 1995	2 DU/A high GW 2 DU/A Magothy 1975	2 DU/A high GW 2 DU/A Magothy 1995	2 DU/A everywhere 1995	1 DU/A everywhere 1995
D.D. No. 11							
	Regional	6.00	5.50	2.50	7.50	8.00	9.75
	Sub-Regional	6.00	5.50	2.50	7.50	8.00	9.75
	Small Plants	6.00	5.50	2.50	7.50	8.00	9.75
D.D. Nos. 12, 15, 16							
(Sag Harbor)		0.00	0.00	–	0.75	0.75	0.75
(Amagansett)		0.35	0.35	–	1.50	1.50	1.50
(Hampton Bay)		1.60	1.65	–	2.00	2.00	2.00
(East Quogue)		1.70	1.70	–	1.75	1.75	1.75
D.D. No. 13							
(Greenport)		1.00	1.00	–	2.00	2.00	2.00
(Mattituck)		0.30	0.30	–	1.50	1.50	1.50
D.D. No. 14							
(Shelter Island)		0.33	0.33	–	1.00	1.00	1.00
D.D. No. 17							
(Fishers Island)		0.00	0.00	–	0.25	0.25	0.25

(1) A more detailed definition of the alternatives for Suffolk County can be found in Section H of the Areawide Waste Treatment Management Plan, Appendix D–Suffolk County Point Source Alternatives.

(2) Two dwelling units per acre in high groundwater table areas.

(3) Five dwelling units per acre in the Magothy recharge area.

Capital, operating and maintenance costs were calculated for the various point source sewering alternatives. Present worth—that is, the current value of all costs incurred over the planning period as the result of the selection of a specific option—was determined for all sewering alternatives to facilitate comparison between them. Present worth includes the total capital cost, plus all of the annual operation and maintenance costs discounted back to the present time. For the various sewering alternative components in Nassau County, a least-cost optimization model was utilized to identify the combination of components that would result in the lowest total cost to Nassau County. A series of possible diversions and/or upgradings was screened based upon engineering feasibility and environmental impacts. In Nassau County, the fourteen existing domestic treatment plants (with one proposed new plant at Bayville) were examined for expansion and/or upgrading to accept additional service area or to be phased out with diversion to a regional facility. To permit selection of the most promising combination, a cost was developed for each component and computer techniques were utilized. (See Section H of the Areawide Waste Treatment Management Plan.)

The optimization results for the north shore plants of Nassau County are dependent upon treatment requirements. If the plants are to continue to discharge at the shorelines or bulkheads, it appears most economical to maintain the individual plants as they presently exist. If, however, the modeling runs indicate that AWT or mid-bay discharges are required to meet bay water quality standards, the cost-effective solution for meeting waste load allocations for the North Shore Nassau County plants appears to be to divert many North Shore facilities to the South Shore Cedar Creek plant to achieve economies of scale. It appears most cost-effective to divert the Great Neck Sewer District, Village of Great Neck, Port Washington Sewer District, Roslyn and Oyster Bay Treatment Plant flows to the Cedar Creek treatment facility, leaving Belgrave and Glen Cove as the major remaining facilities on the North Shore. Belgrave discharges to Little Neck Bay, and was therefore not studied

in detail. In addition, the New York Institute of Technology (NYIT) and C.W. Post treatment plants may be phased out and their flows diverted to the Cedar Creek Sewage Treatment Plant; if not, nitrogen removal should be provided. These concepts must be studied at the 201 level where greater cost estimating accuracy is possible.

The goals of the FWPCA will not be met in every instance in the Nassau-Suffolk study area. Some of the reasons for not attaining water quality goals, particularly those relating to shellfishing, include overriding surface water boundary conditions in western Long Island Sound caused by both treated and untreated sewage discharges, and combined sewer overflows, emanating from New York City; and the impact of internal sources of stormwater runoff to the bays.

Improved groundwater quality may be unattainable in the near-term due to the costs that would have to be incurred in controlling non-point sources of pollution. The actual cost implications of these actions, as well as the effectiveness of the proposed solutions and the probable benefits from attaining the water quality goals as stated in the Act, will require study and evaluation at a much greater level of detail, such as that which is associated with a 201 type of program.

The lowest cost option would maintain existing service area limits. This would involve utilizing on-lot diposal systems, such as septic tanks and cesspools, and could possibly lead to significant groundwater quality contamination in areas of higher population density. Table 3–6 summarizes the impact on costs of the different sewering criteria for Suffolk County. Costs are presented for the various regional, sub-regional and small-plants approaches by study area. The combination of a particular approach (*e.g.*, regional system) with a specific sewering criterion (*e.g.*, one D.U. per acre everywhere) constitutes an alternative. The variability in costs for different sewering criteria depends upon population density patterns in an area, how much of the area is part of the Magothy recharge system, or how much of the area has high groundwater table elevations.

3.3.1.4 Other Structural Alternatives Studied. In addition to the conventional structural sewering alternatives, a variety of newer technologies were examined in the 208 Program. An attempt was made to determine the large scale applicability of a variety of alternatives to the conventional sewering approach. Much of the new technology developed over the past several years is encouraging. However, when evaluating new technology, other factors, such as aesthetics, legal implications, reliability of operation, and implementation feasibility, must also be considered. Once these factors have been examined, recommendations can then be made as to those technologies most applicable to specific Nassau-Suffolk problems.

The approach taken in the evaluation of new technology in the Nassau-Suffolk 208 Program was to first analyze ground and surface water quality problems and their probable causes in the Region. Utilizing a literature review, a variety of new concepts were then described and discussed for applicability to the Nassau-Suffolk area.

The following technologies and concepts, which are described in greater detail in Section H of the Areawide Waste Treatment Management Plan, were initially considered:

- Marsh-Pond System for Treatment of Wastes
- Spray Irrigation with Cropping for Treatment of Wastes
- Black/Grey Water Separation
- Modified On-lot Systems (Aerobic Treatment)
- Septic Tanks with De-nitrification Units
- Waterless Composting Toilets
- Vacuum Collection Systems
- Pressure Collection Systems
- De-nitrification of Water Supply
- Dual Water Systems
- Flow Reduction Measures

New technologies that did not address regional water quality problems were then eliminated from further consideration. For the concepts that did address regional problems, typical capital and operation and maintenance costs were developed. The costs were compared to the costs of the traditional sewering and treatment approach. General conclusions were then reached and recommendations were made on those processes most applicable to Nassau-Suffolk that warrant further evaluation on a 201 level.

After analyzing the above listing of technologies, the following were selected for more detailed cost evaluations: marsh-pond, spray irrigation with cropping, black/grey water separation, subsurface denitrification of septic tank effluent, denitrification at a water supply well (ion exchange/reverse osmosis*), dual water systems (with denitrification of potable water supply), and flow reduction measures. These technologies were compared with the traditional sewering and treatment approach on the basis of costs for a representative development in Suffolk County. The traditional approach utilized a gravity collection network with secondary treatment and biological nitrification and denitrification.

A number of conclusions were reached as part of the analysis:

1. Modified on-lot treatment systems do not address the water quality problems of the Nassau-Suffolk area since they do not remove nitrate or ammonia. The waterless composting toilet concept probably cannot be implemented although it does address the nitrate problem, but the toilet has possible safety and health problems, and a sludge disposal problem. Furthermore, it is extremely expensive to install in existing homes, and therefore, its economic advantages are severely limited.
2. Vacuum and pressure collection systems should be evaluated at a 201 level of study. Their main attribute is capital cost savings but energy costs may eliminate their use in the future.

*Biological denitrification is another alternative but it was not studied in detail.

Table 3–6

SEWERAGE COST BY STUDY AREA FOR VARIOUS SEWERING CRITERIA
(TOTAL PRESENT WORTH IN MILLIONS OF DOLLARS) (1) (2) (3) (4) (5)

Study Area	Approach (6)	Sewering Criteria					
		2 DU/A high GW (7) 5 DU/A Magothy (8) 1995	2 DU/A high GW 5 DU/A everywhere else 1995	2 DU/A high GW 2 DU/A Magothy 1975	2 DU/A high GW 2 DU/A Magothy 1995	2 DU/A everywhere 1995	1 DU/A everywhere 1995
SWSD							
	Regional	358	444	329	358	463	463
	Regional	412	515	379	414	524	564
West Central							
	Sub-Regional	68.0	77.7	95.1	109	127	194
	Sub-Regional	10.4	167	150	169	230	235
	Small Plants	169	270	242	274	373	381
Huntington-Northport							
	Regional	638	59.6	18.5	23.6	67.7	87.7
	Regional	577	54.4	16.9	21.6	61.8	80.0
	Sub-Regional	530	49.9	15.5	19.8	56.7	73.4
	Small Plants	530	49.9	15.5	19.8	56.7	73.4
Kings Park							
	Regional	21.0	38.9	27.8	35.3	58.9	63.8
	Sub-Regional	27.2	50.4	36.0	45.8	76.4	82.8
	Small Plants	38.8	71.9	51.4	65.4	10.9	11.8
South Central							
	Regional	110	119	107	132	148	151
	Sub-Regional	122	132	118	146	164	167
	Sub-Regional	151	161	145	178	202	206
	Small Plants	191	204	184	226	256	261
Port Jefferson							
	Regional	33.8	32.8	33.8	46.5	46.5	48.1
	Regional	45.0	43.7	45.6	61.9	61.9	64.1
	Sub-Regional	36.3	35.2	36.3	49.9	49.9	51.6
	Small Plants	46.0	44.6	46.0	63.3	63.3	65.5
Yaphank							
	Sub-Regional	193	207	160	348	278	282
	Sub-Regional	186	199	154	238	267	271
	Small Plants	228	244	189	292	327	332
Disposal District No. 11							
	Regional	21.7	21.4	13.3	25.8	26.8	30.2
	Sub-Regional	25.2	24.8	15.4	29.8	31.0	34.9
	Small Plants	25.5	24.8	15.4	29.8	31.0	34.9
Disposal District Nos. 12, 15, 16							
	Sag Harbor	0.00	0.00	–	17.1	17.1	17.1
	Amagansett	11.3	11.3	–	27.1	27.1	27.1
	Hampton Bays	17.1	17.1	–	19.6	19.6	19.6
	East Quoque	24.2	24.2	–	24.6	24.6	24.6
Disposal District No. 13							
	Greenport	16.0	16.0	–	24.2	24.2	24.2
	Mattituck	7.01	7.01	–	18.4	18.4	18.4

Table 3–6 . . . Continued

Study Area	Approach (6)	Sewering Criteria					
		2 DU/A high GW (7) 5 DU/A Magothy (8) 1995	2 DU/A high GW 5 DU/A everywhere else 1995	2 DU/A high GW 2 DU/A Magothy 1975	2 DU/A high GW 2 DU/A Magothy 1995	2 DU/A everywhere 1995	1 DU/A everywhere 1995
Disposal District No. 14							
	Shelter Island	7.25	7.25	–	14.1	14.1	14.1
Disposal District No. 17							
	Fishers Island	0.00	0.00	–	6.20	6.20	6.20

(1) Costs do not include recharge, mid-bay or ocean outfalls, or lateral portions of the collection systems.

(2) Present worth at 6 3/8% interest amortized over 20 years, CRF (Capital Recovery Factor) = .08986.

(3) Costs are based on mid-1977 cost data, ENR (Engineering News Record) = 2580; they account for the staging of construction through the 20 year planning period (1975–1995).

(4) All costs in this table reflect secondary treatment.

(5) Cost obtained from Suffolk County Department of Environmental Control.

(6) Where more than one regional or sub-regional option is listed, different configurations of regional or sub-regional systems were studied; they are discussed in detail in Section H of the Areawide Waste Treatment Management Plan, Appendix F—Cost Memoranda.

(7) Two dwelling units per acre in high groundwater table areas.

(8) Five dwelling units per acre in the Magothy recharge area.

3. The marsh-pond and septic tank denitrification systems should be tested in the field under normal operating conditions and without experimentally controlled operation. Both are promising new technologies. (Refer to Section 1.4.3.2.)
4. Spray irrigation and other forms of land application may be viable; the concept should be evaluated in local studies.
5. Black/grey water separation systems may have limited application and should be evaluated in the field under normal operating conditions.
6. Water conservation and flow reduction measures should be generally recommended for implementation. Although the Nassau-Suffolk Region does not have a potable water shortage, water conservation measures are beneficial because they might slightly reduce flows to treatment plants or to on-lot systems. Furthermore, the potential savings in energy from reduced pumpage may be significant.
7. Intentional degradation, which allows for exceeding groundwater discharge and/or drinking water standards, is unacceptable under current State and Federal statutes. Limited or controlled degradation that does not violate standards but leads to water quality that is poorer than baseline conditions is unavoidable in much of the planning region. In other areas, groundwater quality in selected aquifer zones has already violated drinking water standards. Where such aquifers are necessary to meet water supply requirements, treatment of water at the wellhead should be considered as a viable management procedure.
8. Another management option in areas described under seven above is the tapping of unaffected aquifers for specialized uses. For example, the Lloyd aquifer in Nassau County could be developed to supply drinking water needs to limited coastal areas. Dual piping systems can also be employed to isolate drinking water from water used for other purposes.
9. Blending of good quality groundwater with water that has already been degraded is a viable technique for continuing to meet drinking water standards in problem areas. This may extend the life of an affected aquifer while still maintaining water of acceptable quality for consumption.

3.3.1.5 Animal Feedlot Operations. On Long Island, this category of point sources is represented, for the most part, by duck farms. Commercial duck farm operations are generally located close to marine waters and presently contribute bacterial and chemical pollution to surface waters. Commercial duck farms are required to obtain operating permits and to reduce and finally eliminate duck waste pollution. (Refer to Section I of the Plan.)

The following management options are available:

1. Prohibit the location of animal feeding operations where they may pollute surface waters or groundwater.
2. Expand monitoring and surveillance procedures to foster uninterrupted compliance with permit conditions.
3. Provide effective legal remedies for rapid abatement of illegal pollutant discharges.

3.3.2 Residuals Management. In the context of this study, residual wastes are considered to include solid wastes (refuse), hazardous wastes and domestic sludges. Hazardous wastes in the bi-county area generally include concentrated industrial pretreatment or treatment sludges. They may also include other miscellaneous liquid products and small amounts of toxic, solid materials. They do not include radioactive wastes. Disposal of residual wastes represents a potential impact on water quality, primarily as the result

of surface and/or groundwater contamination at the disposal site.

General concepts and specific alternatives are discussed for each of the three types of residual wastes. For solid wastes, concepts necessary to formulate a comprehensive management approach are discussed, including considerations for management and control strategies.

For hazardous wastes, a model hazardous waste treatment disposal facility is recommended and conceptually designed for each county. A discussion of the various processes in the flow scheme and treatment costs are also covered.

For sludges, specific alternative disposal techniques as well as alternative management approaches such as regional, sub-regional and local systems are described for both counties. Capital and annual operation and maintenance costs are developed from generalized cost functions. The purpose of evaluating these alternatives is to identify those disposal techniques and sludge management approaches that should be investigated further. Solution of the sludge disposal problem has become urgent because of the planned discontinuance of ocean dumping. Sludge management studies have been and are being conducted on regional and local levels, in response to this discontinuance.

3.3.2.1 Solid Waste Management Concepts. A review of the present situation in the Nassau-Suffolk Region indicates that present disposal systems (landfills and incineration) in general, do not provide adequate safeguards to prevent environmental degradation as they attempt to handle the approximately 3,000,000 tons per year of solid wastes generated. Also, existing county solid waste management plans do not address controlled landfills and do not present any alternatives to the processes of conventional incineration and landfilling.

Recently, the trend in the Nassau-Suffolk area has been towards the development of regional resource recovery facilities, but each has been an individual effort for a specific geographic area rather than part of a comprehensive county or Nassau-Suffolk area approach. A desirable solid waste management concept is that of resource recovery (such as pyrolysis or co-incineration) with residuals disposal in small, controlled landfills after 1985. The current system of incineration and landfilling, with the addition of those resource recovery facilities currently proposed or under construction, will be expanded to fill the solid waste management requirements through 1985.

Efficient, economical and environmentally sound solid waste management for the Nassau-Suffolk area is the goal; the following sections present generalized concepts, constraints and considerations recommended to aid in achieving that goal.

a. *Landfilling.* Landfilling is the only final method of disposal available. Any other process (incineration, co-incineration, composting or resource recovery) generates secondary residuals that require disposal in a landfill.

Landfilling of solid wastes (processed or unprocessed), even under the best conditions and most stringent constraints, will result in the production of leachates and gases—by-products which can degrade the environment. Historically, these by-products have not been controlled, and there are many cases on Long Island of pollution caused by uncontrolled landfills. Because of geology (predominantly porous materials) and dependence upon groundwater, the Nassau-Suffolk area is particularly susceptible and sensitive to this type of degradation.

Having established the need for landfills, what remains is the establishment of the recommended operating constraints. The intent is the creation of small, easily controlled landfills. Size is a very important constraint. If landfills are kept small, corrective measures can easily be implemented if problems arise. Recommended constraints, which should be followed to the maximum possible extent, are as follows:

- Locate no landfills in the Magothy recharge area or in other areas that contribute to deep groundwater flow, or in areas of high water table.
- Establish a maximum size of 25 to 30 acres.
- Accept processed (shredded, baled, incinerated, etc.) wastes only. This will extend the useful life of the landfills.
- Provide a double lining with adequate and proper materials to ensure isolation of any leachate from the surrounding ground or surface water environment.
- Accept no hazardous materials (except in chemical landfills).
- Establish complete leachate collection and treatment systems.
- Establish gas collection and treatment or venting systems.
- Employ impermeable covers, drainage channels or topographic drainage controls to minimize the amount of leachate that is generated.
- Consider locating new landfills down-gradient of existing landfills if the existing landfills are improperly designed and operated and are generating a pollutant plume in the groundwater.
- Provide an impermeable cover upon completion (*e.g.,* PVC asphaltic membrane, or other impervious non-reactive material, followed by two to four feet of cover material) to isolate the complete landfill from rainfall percolation and the atmospheric environment.
- Establish extensive and continuous monitoring systems (surface water, groundwater and gas).

The above constraints provide the optimum land disposal method known at this time and offer the maximum protection to the environment.

In order to limit the size and required number of controlled landfills, some types of intermediate processes are required.

b. *Intermediate Processes.* An intermediate process serves two functions: first, it reduces the volume and changes the characteristics of the

materials requiring disposal; and second, it usually produces a usable by-product either in the form of energy (*e.g.,* steam or fuel) or recoverable materials (*e.g.,* ferrous metals, non-ferrous metals, glass and compost). For ease of comparison, a very brief description of each process follows.

- Incineration—controlled combustion of solid waste. Achieves significant volume and weight reductions. By-products are gases, quench waters and generally inert residue. Resource recovery is not practiced in conventional incineration (exception ferrous metals).
- Co-incineration and pyrolysis—controlled combustion of solid waste and usually dewatered wastewater treatment plant sludges. Achieves significant volume and weight reduction. By-products are gases, quench waters and a generally inert residue. Usually resource recovery is achieved by passing the off gases through a waste heat boiler to generate steam.
- Composting—the aerobic, biological decomposition of solid waste. Achieves volume reduction. Resource recovery is also possible if the materials are applied to plants in accordance with normal cultivation practices, thus permitting the utilization of nutrients. The compost can be used as a soil conditioner.
- Resource Recovery—processes are divided into two classifications: materials and energy, but a mixture of both is usually present in any one system. Materials recovered are used to replace a portion of the materials normally required in the production of iron, aluminum, glass, etc. Energy in the form of fuels for later use or steam for immediate use is generated by these processes. In general, all processes achieve some form of volume reduction.

c. *Recommended Concepts.* It is recommended that, for the short term through 1985, the following tasks be completed:

- Perform detailed evaluations of existing resource recovery facilities and update as new facilities are constructed and started up, especially those currently proposed for the Nassau-Suffolk area. It is felt that, for the long term, resource recovery should receive primary emphasis in solid waste planning.
- Through the regulatory controls contained in 6 NYCRR Part 360, supervise, monitor and initiate the corrective measures required to insure the proper disposal of solid wastes.
- Require all new landfills to be designed for operation under the suggested constraints.
- Formulate a comprehensive solid waste management plan for implementation as soon as possible.

At this time, the two processes showing the most promise for implementation in the future are co-incineration and pyrolysis. Both processes, which may include resource and materials recovery, can be used for the simultaneous processing of solid wastes and wastewater treatment plant sludges, and both generate a form of energy: co-incineration by passing the gases through a waste heat boiler to generate steam; and pyrolysis by passing the fuel rich gases through an afterburner and then through a waste heat boiler to generate steam. In pyrolysis, the fuel rich gases can either be condensed to form a fuel oil or cleaned to provide a fuel gas.

Two other processes (waterwall incineration and refuse derived fuel) are technically viable, and by 1985 it would be expected that they would have undergone sufficient refinement/upgrading to warrant further consideration. Composting, although workable, is not a viable alternative for mixed solid wastes; it should only be considered for sludges and leaves or other agricultural wastes.

Taking into consideration the rapidly advancing technology and the scale of facilities either on line or under construction, it is almost certain that a number of proven systems will be available by 1985. The system recommended for the post-1985 comprehensive plan consists of a complete materials and energy recovery system(s), with disposal of remaining materials in a controlled landfill.

3.3.2.2 Hazardous Waste Treatment Systems. Hazardous waste disposal is only one part of hazardous waste management. Management of hazardous wastes means awareness and control over the wastes from the time of their generation through their transportation, temporary storage, treatment and disposal. In the past, comprehensive hazardous waste management has not been practiced in the Nassau-Suffolk area. Therefore, a brief description of components that make up a good hazardous waste management system is presented below. (Refer to Section K of the Areawide Waste Treatment Management Plan.)

1. Regulation and Enforcement—at both State and local levels, are necessary if a proper and effective hazardous waste management system is to be formulated and enacted in order to provide adequate protection for the environment.
2. Survey and Inventory—of all firms in the Nassau-Suffolk area (with appropriate Standard Industrial Classification System Codes) is required to identify all generators. In the bi-county area, the existing NYS Department of Environmental Conservation survey and a Nassau County Department of Health survey should establish this data base.
3. Standard and Effective Identification and Labeling System—is essential so that all personnel involved may readily identify the hazardous waste and initiate proper handling and/or treatment procedures.
4. Waste Transportation Control System—is required for continuous monitoring of the waste flow from generator through disposal. This usually consists of some manifest or "trip ticket" system to ensure accountability.

5. Control at the Source
   a. Waste Reduction—through process changes and/or changes in raw materials, is desirable. Restriction of hazardous chemicals utilized in operations, substitution of less hazardous materials, better quality control and material recovery are all alternatives that may reduce the quantity of hazardous wastes generated.
   b. Waste Separation and Concentration—hazardous waste separation early in process stream flows before contamination of other, non-hazardous process stream flow occurs, isolation of similar wastes into separate disposal containers, and concentration by dewatering or some other process will reduce quantities of hazardous wastes that require treatment and disposal.
   c. Waste Exchange—investigate the possibility of reuse by another firm (*e.g.,* one firm's wastes may be another firm's raw materials or process chemical).
   d. Energy or Material Recovery—extraction of materials from hazardous waste streams may be cheaper than to produce them from virgin materials. Combustion to recover energy or heat value for other purposes may result in savings.
6. Treatment and Disposal
   a. Treatment—for those hazardous wastes not suitable to energy/material recovery systems, some form of thermal, biological, physical or chemical treatment should be applied to detoxify and neutralize the wastes to the maximum extent possible.
   b. Encapsulation/Chemical Waste Landfill—for those hazardous wastes not amenable to recovery, treatment or destruction, volume reduction followed by encapsulation or disposal in a chemical waste landfill is recommended.
7. Emergency Hazardous Waste Management Procedures—required in case of spills so that the best means of correcting the situation and protecting the environment will be utilized.
8. Monitoring of Hazardous Waste Treatment Facilities and Chemical Waste Landfills—to insure proper operation.
9. Hazardous Waste Disposal Site Shut-Down Procedures—to insure that disposal sites are properly closed and maintained after closure.
10. Buffer Zones—in addition to sufficient land for all processes to insulate sites from the public.

Description of Recommended Hazardous Waste Treatment System. Public health and environmental considerations suggest that Long Island disposal of hazardous wastes is the least acceptable of several alternatives. The need to protect the deep flow aquifers, in order to maintain a potable water supply, and the shallow flow system, to prevent degradation of productive marine waters, provides a strong argument for out of area disposal.

Export of hazardous wastes to out of area landfills or processing facilities would meet the local objectives of this Waste Treatment Management Plan. The relatively low volume and somewhat diverse nature of the wastes requiring treatment would probably make this option more cost-effective than local treatment. However, should Federal regulations or legal action preclude such export, consideration should be given to the establishment of a single bi-county facility or individual county facilities. The treatment process, described next, would be the same whether for one or two facilities.

A hazardous waste management system for the Nassau-Suffolk area should include a comprehensive regulatory and monitoring program that directs all hazardous wastes generated in the bi-county area to one or two county owned and operated, centrally located treatment facilities, one in Nassau and one in Suffolk. Alternatively, a single facility might be implemented to serve both counties. Disposal of treatment residuals is by transporting and placing them in properly located, constructed, operated, monitored and controlled chemical landfill, one for each treatment facility. This type of comprehensive, controlled system is required to ensure environmentally safe treatment and disposal of hazardous wastes in the area.

Treatment Processes. The treatment system for hazardous wastes should include physical-chemical treatment, sludge dewatering, incineration, effluent polishing and disposal of treatment residues in a chemical landfill. Facilities proposed for each county differ in that batch treatment of cyanide and chromic wastes is provided in Nassau as opposed to the continuous treatment of these wastes in Suffolk. (Batch treatment may also be employed in Suffolk County after a more definitive analysis is made of the types and quantities of wastes to be treated.) Concentrated metal finishing wastes are of a sufficient volume in Suffolk to require equalization for continuous flow-thru processing.

Estimated costs for each county's facilities are presented in Table 3–7. (See Plan Section K.) The treatment plant is designed to accommodate all hazardous wastes generated within the county that were identified during the 208 Study. It is recommended that once the inventories of hazardous wastes are completed, the design flows be adjusted if necessary. A detailed study is required to establish the design basis for the plant.

The ultimate disposal of residues from these plants is to be by chemical landfill. Residue quantities would be small. An estimate of dewatered sludge (30 percent solids), which would be incinerated, would be 1.1 cubic yards per day. The landfill would be protectively lined, with provisions for leachate collection and treatment, and installation of monitoring wells. Special attention is to be given to the location of the landfill because of possible groundwater contamination. The proposed landfill should be located in accordance with the previously discussed criteria.

The effluent from the hazardous waste treatment plants would be discharged through existing or proposed ocean outfalls, as an additional safety measure.

Table 3–7

COSTS FOR HAZARDOUS WASTE DISPOSAL PLANTS [1]

Alternative	Design Flow [2] (GPD)	Capital Cost	Annual O & M Cost	Total Annual Cost [3]
Bi-county Plant	325,000	$ 6,931,000	$ 458,000	$ 1,050,000
County Plants				
Nassau	65,000	$ 4,363,000	$ 247,700	$ 616,000
Suffolk	260,000	4,513,000	357,600	736,000
Total	**325,000**	**$ 8,876,000**	**$ 605,300**	**$ 1,352,000**

[1] Order-of-magnitude cost estimate; based on mid-1977 costs (ENR = 2580)

[2] Less trucked-in sludge volume

[3] Capital cost amortized over 20 year planning period at 6 3/8%

3.3.2.3 Sludge Management Alternatives. Alternative sludge disposal techniques for the Nassau-Suffolk area were identified, developed and evaluated. Various management systems and approaches were formulated and capital and operation and maintenance costs were generated. (See Plan Section K.) Seven sludge handling and reduction techniques were examined and include composting, landfilling, land application, incineration, co-incineration (with solid waste), pyrolysis and thermal drying. The alternative management approaches compared regional, subregional and small treatment plants.

In Nassau County, the regional approach was defined as a single sludge processing facility to handle the approximately 90 MG per year of sludge generated in the county. In Suffolk County, a regional approach was defined to include a central processing facility for each particular study area. Total sludge generated from treatment systems in Suffolk is about eighteen MG per year. The study areas are the same as those defined for point source alternatives.

A preliminary screening of the disposal techniques and management approaches was conducted for each area. In Nassau, it was not deemed feasible to combine incinerators, pyrolysis, or thermal drying units with all the domestic treatment facilities, and a regional or sub-regional approach was examined for these processes. In Suffolk, it was considered unnecessary to haul all sludge to a single wastewater treatment plant for subsequent landfilling, provided there are suitable landfill sites available closer to the sludge source. Landfilling, as a sludge disposal option, was examined on a plant-by-plant basis.

Sludges generated from the implementation of non-point source structural abatement alternatives are negligible in quantity compared to domestic wastewater treatment plant sludges. The non-point source sludges can be dewatered by vacuum filter and transported to the nearest regional or sub-regional sludge processing facility. Sludges currently generated from the periodic scouring and dredging of recharge basins are landfilled. This sludge could be placed in a sanitary landfill directly, or treated at a sludge processing facility. The disposal of contaminated dredge spoil from bays and estuaries was not studied as part of the 208 Program.

In general, the degree of confidence that can be placed in the sludge processing costs is somewhat low (± 50 percent) when compared with actual detailed cost estimates. Documentation in the literature on sludge processing costs is not nearly as extensive as documentation found in conventional wastewater treatment processing. In particular, newer technologies, such as composting, land application, co-incineration, thermal drying and pyrolysis have little available cost information. Costs for the newer technologies were obtained, wherever possible, from documents describing actual operating installations.

Nassau County. In Nassau County, all seven of the alternative disposal techniques were evaluated, some being applicable on a regional and sub-regional basis, and others on a local basis.

For purposes of economic analysis, locations for regional sludge processing facilities were considered to be Bay Park, Cedar Creek or adjacent to a solid waste processing facility, *e.g.,* the Town of Hempstead plant. Potential sub-regional locations included Port Washington and Glen Cove.

For incineration, thermal drying and pyrolysis, dewatering was assumed to achieve a cake solid content of approximately 35 to 40 percent, which is sufficient for autogenous combustion. For composting, land application, landfilling and co-incineration, liquid sludges were assumed to be dewatered by vacuum filters to approximately twenty percent solids, which is sufficient for handling as a semi-solid material rather than a liquid.

Transportation costs within the county were calculated assuming the trucking of dewatered material. For the two largest treatment facilities in Nassau County that currently do not dewater (Cedar Creek and Bay Park), costs for pipeline transportation were utilized because of potentially significant savings over trucking. In addition, there is an existing pipeline between Cedar Creek and Bay Park. Additionally, for the land application alternative, sludge was assumed to be barged to available farm land in Suffolk County for application. The actual acreage required for applying all the sludge generated in Nassau County would not be sufficient within county boundaries.

Apart from economic considerations, processes such as pyrolysis, thermal drying, co-incineration, land application and composting lack a significant operating record. While these processes seem promising in many instances, they have also been prone to failures in full-scale operation. Furthermore,the economic feasibility of such processes as thermal drying or composting for the purpose of recovering a saleable by-product such as soil conditioner is a function of the market for this material. If both counties were to undertake full-scale composting operations or thermal drying operations for soil conditioning, there might not be a readily available local market for all the material that would be generated. Further, should New York City utilize the recommended ISC plan of composting sludge, a great deal of

difficulty could be experienced in finding a market for all the compost that would be generated.

Other considerations besides economics affect the feasibility of implementing the various technologies. For example, in land application, concerns include the possibility of applying excess nutrients, heavy metals or organic chemicals that may be found in the sludge. The intent of applying the sludge to the land is to stimulate plant growth by adding various nutrients. Additional nutrients however could be leached out of the sludge and into the groundwater. This same concern applies in the case of heavy metals since wastewater sludges could leach toxic metals such as cadmium, lead and mercury to the groundwater. Further, cadmium is readily taken up into plants and subsequently concentrated. If these plants are utilized for human consumption they may be toxic. Potential bacteriological contamination is a further concern since pathogens may be conveyed from the sludge to the land and then onto plants or into the groundwater.

Theoretically, complete enforcement and implementation of county and local pretreatment guidelines would prohibit large concentrations of metals from reaching domestic wastewater treatment facilities and subsequently being concentrated in the sludge. Due to the number of metal finishing industries in the county, however, it is difficult to ensure that metals will not reach these domestic facilities. The extreme care required to protect the environment from these potentially hazardous materials reinforces the case for a regional approach to hazardous wastes handling.

Table 3–8 summarizes the costs for various sludge alternatives. Costs ranged from a low of $6.28 million per year for landfilling to a high of $16.0 million per year for land application (exclusive of land costs). High transportation costs ($12.4 million) are incurred in barging Nassau County's sludges to Suffolk County farmland near Riverhead. Nassau County could have difficulty in finding 17,600 acres of suitable land (agricultural or park land) for spreading sludge. While landfilling is the least expensive process, (at an assumed cost of $15 per ton), it is contingent upon the availibility of suitable landfill capacity.

Ranking very close to landfilling, in terms of costs, were composting and co-incineration at $6.7 million to $7.2 million, depending upon management level (regional, sub-regional or small plant). The ten to fifteen percent difference in cost between landfilling and composting (or co-incineration) is well within the accuracy of the cost estimates. Composting appears to be slightly more costly on a regional basis due to the transportation costs and minimal economies of scale. Co-incineration at about $7.0 million per year appears quite promising economically, even at low refuse to sludge ratios (2.67:1).

Incineration, pyrolysis and heat drying represent a third group of costs ranging from about $9.5 million (incineration) to $12.2 million (heat drying). Incineration appears to be slightly less costly on a regional basis, with economies of scale off-setting increased transportation costs. While incineration is

Table 3–8
ESTIMATED ANNUAL COSTS FOR DOMESTIC AND NON-POINT SOURCE SLUDGE DISPOSAL ALTERNATIVES FOR NASSAU COUNTY
(Dollars Per Year)

Management Approach	Transportation Cost[1]	Total Annual Cost[2] [3]
Incineration		
Regional	$ 760,000	$ 9,550,000
Sub-Regional	503,000	9,820,000
Composting [4]		
Regional	$ 760,000	$ 7,070,000
Sub-Regional	503,000	6,740,000
Small Plants	–	6,860,000
Landfilling[5]		
Small Plants	$ 867,000	$ 6,280,000
Pyrolysis		
Regional	$ 760,000	$10,500,000
Sub-Regional	503,000	10,400,000
Heat Drying[4]		
Regional	$ 760,000	$10,400,000
Sub-Regional	503,000	12,200,000
Co-Incineration[6]		
Regional	$ 760,000	$ 6,700,000
Sub-Regional	503,000	7,190,000
Land Application[7]		
Sub-Regional	$12,400,000	$16,000,000

(1) Includes both amortized capital and operation and maintenance costs to transport sludge from existing generation point to central processing facility.

(2) Amortized over 20 years at 6 3/8% interest, CRF = .08986. Total annual costs also include ultimate residue disposal (landfill). Does not include cost of land.

(3) Cost of energy generation or sale is not included in the calculations.

(4) No credit taken for sale of final product.

(5) Assumes utilization of Town of North Hempstead L-4 landfill for North Shore sludges and Oceanside landfill for South Shore.

(6) Assume refuse and sludge are co-incinerated at a refuse:sludge ratio of 2.67. Sludge is dewatered to 20% solids. Costs are allocated to sludge on an "as incinerated" wet ton basis. (See Section K of the Areawide Waste Treatment Management Plan.)

(7) Assumes sludge is barged from Glen Cove and Bay Park to farmland in Suffolk County and applied as a liquid at a dosage of 4 tons per acre per year.

the least expensive of the thermal processes (excluding co-incineration previously discussed), it remains about 50 percent higher than landfilling.

Pyrolysis is approximately ten percent more expensive than conventional incineration. No cost savings were realized in a regional approach as opposed to a sub-regional approach (within one percent). While heat drying to produce a saleable product was comparable to pyrolysis on a regional basis, sub-regional costs were about twenty percent higher. With a sale value of something greater than twenty percent of the cost of processing, heat drying could become less costly than incineration or pyrolysis. This again is a function of marketability.

Land application is feasible only in Suffolk County, since there is little land available for this purpose in Nassau County. While land application ranked the highest in cost, a large portion of the total cost (about 75 percent) is accounted for by transportation costs.

All of these processes can be utilized without significant negative impact on the environment. Composting, heat drying and land application would require guidelines on allowable application rates to avoid potential groundwater contamination by excess nutrients, metals or organic chemicals. Incineration, co-incineration and pyrolysis require suitable emission control devices to protect ambient air quality. Quench water from these processes must also be properly treated prior to release to surface or groundwater.

It is recommended that the cost-effectiveness of some combination of landfilling, incineration, co-incineration and composting be evaluated in further detail in the Nassau County Sludge Management Study. Potential impacts on the environment must be evaluated in detail.

Suffolk County. Table 3—9 summarizes Suffolk County costs for incineration, composting, landfilling, pyrolysis, heat drying, co-incineration and land application. Each table provides costs by study area (or disposal district) for various regional, sub-regional and/or small plant options. Each table facilitates a comparison of costs for different management approaches (regional *versus* sub-regional) for each Study Area (or Disposal District).

In reviewing the previous table, it can be seen that costs change from area to area for the same sludge treatment process. This is a reflection of the quantities of sludge to be handled and economies of scale. In general, as more sludge is handled, the unit costs per ton for handling and disposal decrease. This is also true within a single geographic area as regional, sub-regional and small-plant systems are analyzed. Again, economies of scale affect the final cost estimates.

In costing the landfilling option in Suffolk County, a disposal cost of $15 per ton was assumed and includes liners as well as environmental monitoring and leachate treatment. Sludges from various sources would be hauled to the nearest landfill. The co-incineration alternative assumes that solid wastes are diverted to a particular co-incineration facility.

A second case is costed for each of the co-incineration facilities representing a minimum recommendable ratio of refuse to sludge of 2.67. For example, for the Huntington-Northport co-incineration facility, all of Huntington's refuse (956 tons per day) would represent a refuse to sludge ratio of approximately sixteen to one, whereas the minimum necessary ratio would be 2.67 to one, or 160 tons per day of refuse to 60 wet tons per day of sludge.

For many of the areas, there is an economical preference for land application, landfilling and composting as opposed to pyrolysis, incineration and heat drying. Co-incineration appears competitive, depending upon the refuse to sludge ratio. (Co-incineration becomes less economically feasible at lower solid waste to sludge ratios). However, cost is not the only consideration. Environmental impacts must also be evaluated.

For the Huntington-Northport Study Area, composting and land application are economically preferable at a predicted annual cost of $250,000 to $300,000 per year. Co-incineration, incineration and heat drying comprise another level of costs at about $600,000 to $700,000 per year. Pyrolysis represents the highest cost at as much as $1,500,000 on a regional basis and would seem economically prohibitive. In the land application options, specific land disposal sites were not identified. For cost estimating purposes, it was assumed that dewatered sludge would be hauled by truck to farmland in the eastern portions of the county for final disposal.

In the Southwest Sewer District, methods of sludge disposal have already been investigated. Because of the lack of sufficient space in the immediate area, and because energy recovery was a major objective, incineration was the method selected. The sludge incinerators have been constructed alongside the other treatment facilities on the sewer district treatment plant site.

For the West Central Study Area (exclusive of SWSD), only land application and composting are economically preferable, with landfilling being significantly higher than both, by a factor of almost two, and incineration, heat drying, pyrolysis being substantially higher yet. If sewage is diverted to the SWSD, it would entail expansion of the incineration facilities.

The Port Jefferson Study Area shows land application, landfilling and composting relatively cost-effective, with incineration and heat drying not far behind, and pyrolysis being significantly more expensive than all others. For the South Central Study Area, composting and land application appear to be the most economically feasible, with landfilling almost twice as much in cost, and heat drying and incineration and pyrolysis most costly. Co-incineration does not appear economically competitive with composting and land application.

In Yaphank, the situation is very similar to South Central, except that landfilling is somewhat more economically competitive. Riverhead shows land application as economically attractive due to the location of Riverhead relative to the farmland where sludge may be applied. Composting also appears economical, especially since there may be more of a market for the compost material in the agricultural areas of eastern Suffolk County.

For the small plants of Southold, Shelter Island, Southampton, East Hampton, and Fishers Island, composting generally appears slightly higher than landfilling, with land application being slightly lower than landfilling. Co-incineration, heat drying, incineration and pyrolysis were not examined for the small plants of eastern Suffolk County.

The cost estimates for land application do not include land costs. Therefore, in order for this approach to be economically viable, land must be available on a low-cost rental or purchase basis. Actual land costs are very site-specific and so could not be analyzed herein. However, in more detailed studies, land costs must be identified and included in the analysis.

In summary, it appears that in Suffolk County, landfilling, land applica-

Table 3–9

ESTIMATED ANNUAL COSTS FOR DOMESTIC & NON-POINT SOURCE SLUDGE DISPOSAL ALTERNATIVES FOR SUFFOLK COUNTY: SUMMARY BY PROCESS

Total Annual Cost (Thousands of Dollars)[1]

Study Area / Management Approach	Incineration	Composting	Landfill	Pyrolysis	Heat Drying	Co-incineration [2]	Land Application
Huntington-Northport							
Regional	603	229	394	983	640	619	280
Regional	601	229	388	980	640	619	280
Sub-Regional	758	316	422	1,590	722	–	280
Small Plants	–	316	422	–	–	–	280
SWSD							
Regional [3]	1,320	464	885	1,420	1,370	1,220	521
West Central							
Sub-Regional	2,260	871	1,540	3,610	2,590	–	713
Sub-Regional	1,830	694	1,350	4,040	2,230	–	606
Small Plants	–	3,280	2,540	–	–	–	713
Kings Park							
Regional	650	247	419	1,030	677	743	268
Sub-Regional	868	343	503	1,740	940	–	305
Small Plants	–	1,060	831	–	–	–	325
Port Jefferson							
Regional	520	196	350	935	584	–	207
Regional	466	176	283	830	457	–	173
Sub-Regional	583	258	310	–	518	–	173
Sub-Regional	674	276	356	–	637	–	194
Small Plants	–	584	474	–	–	–	194
South Central							
Regional	1,300	475	942	1,430	1,380	1,210	481
Sub-Regional	1,660	622	1,060	–	1,750	–	521
Sub-Regional	2,050	1,010	1,210	–	2,090	–	574
Small Plants	–	2,580	1,860	–	–	–	632
Yaphank							
Sub-Regional	1,930	824	1,380	3,300	2,220	1,790	615
Sub-Regional	2,330	988	1,380	–	2,320	–	561
Small Plants	–	2,830	2,000	–	–	–	615
Riverhead							
Regional	431	172	256	921	459	–	138
Sub-Regional	566	253	286	–	509	–	138
Small Plants	–	253	286	–	–	–	138

Table 3--9 . . . Continued

Study Area Management Approach	Total Annual Cost (Thousands of Dollars) (1)						
	Incineration	Composting	Landfill	Pyrolysis	Heat Drying	Co-incineration (2)	Land Application
Southold							
Small Plants	–	217	172	–	–	–	109
Shelter Island							
Small Plants	–	75	53	–	–	–	46
Southampton-East Hampton							
Small Plants	–	402	297	–	–	–	127
Fishers Island							
Small Plants	–	24	24	–	–	–	30

(1) Amortized over 20 years at 6 3/8% interest, CRF = .08986.
(2) Costs represent average of two different refuse to sludge ratios shown in Section K of the Plan.
(3) Incineration has already been selected because of limited available space and energy recovery requirements.

tion and composting are economically preferable to pyrolysis, heat drying and incineration. Co-incineration becomes more economically attractive for the five western towns (due to refuse generation in concentrated areas). In the eastern areas of Suffolk, land application and composting of sludges should be given serious consideration by virtue of proximity to agricultural land, and the probable lack of high concentrations of heavy metals in the domestic treatment plant sludges.

All of these processes can be made environmentally safe with proper precautions, and their impacts are evaluated in Section Four of this Summary Plan. Those most economically attractive should be examined in greater detail at the 201 level for application to specific areas.

3.4 Non-Point Source Controls

The 208 Program has identified a number of non-point source problems that contribute to ground and surface water pollution in the Region. For each class of non-point sources, the program identified a series of implementable, cost-effective responses that can be utilized to reduce the non-point problem. These non-point controls should be implemented on a priority basis and must, wherever possible, supplement and strengthen existing programs, regulations and structural alternatives.

3.4.1 Identification of Applicable Non-Point Controls. (Refer to Section J of the Areawide Waste Treatment Management Plan.)

3.4.1.1 Stormwater Runoff Control. Stormwater runoff from impervious surfaces is generally controlled through the use of infiltration basins or allowed to flow through drainage systems or overland to surface waters. Stormwater runoff often contains plant nutrients (*e.g.*, nitrates), heavy metals, organic compounds and bacteria. Pollutants contributed by runoff constitute significant hazards in many parts of the area, and are particularly deleterious to the Great South Bay system. The program has formulated the following control strategies that can aid in minimizing problems attributable to this pollution source:

- Require the immediate recharge or on-site detention of stormwater, where feasible, in order to reduce the volume of runoff.
- Promote the use of storage areas—either specially constructed detention basins, multi-purpose paved areas, natural ponds or other existing or altered landforms—to reduce sediment transport and coliform contamination from runoff.
- Promote or require the imposition of controls to reduce pollution generated by domestic animals.
- Limit, regulate and, where necessary and practicable, prohibit new shoreline development in order to protect the quality of adjacent surface waters.
- Provide adequate buffer zones surrounding tidal and freshwater wetlands.
- Establish and require compliance with Best Management Practices for land clearance and construction in order to minimize erosion and construction-related pollutant discharges.
- Promote or require the institution of municipal street cleaning programs to help minimize the pollution effects of stormwater runoff. Require strict control over the disposal of collected materials in sanitary landfills.

3.4.1.2 Domestic On-Site Disposal Systems. Domestic on-site disposal systems are in widespread use throughout portions of the Nassau-Suffolk area and contribute significant amounts of nitrogen to the area's groundwater. In addition to the usual structural responses, that is, municipal collection and treatment, the Program has identified the following control strategies that can aid in minimizing this pollution source:

- Withhold permits for individual systems in any area where it has been determined that on-site disposal is causing significant deterioration of groundwater or surface waters.
- Promote further investigation into the feasibility of utilizing innovative on-site treatment—disposal techniques including, but not limited to, pressure/vacuum systems, alternate leaching fields and in-ground denitrification systems.
- Prohibit or restrict the use of various classes of products that may contribute to the chemical pollution of the groundwater. Such products include various detergents, dry cleaners and septic system cleaners or reconditioners.
- Establish minimum lot sizes in specific areas subject to hydrologic constraints or, if such areas are already developed, provide for and require hook-up to a collection and treatment system.
- Promote the establishment of municipal or neighborhood programs for the routine preventive maintenance of on-site systems.
- Provide for a monitoring program in areas where pervasive violations of the nitrogen standard or the presence of heavy metals or organic chemicals is considered likely.
- Plan for conversion to alternative disposal techniques in those areas where monitoring indicates unacceptable pollutant concentrations.

3.4.1.3 Subsurface Leakage from Domestic Collection Systems. Sewer systems develop leaks as a result of improper construction, materials failure or aging. These leaks may permit domestic and industrial-commerical waste to be carried to the groundwater. The program has identified the following strategies that can aid in minimizing the pollution problems associated with exfiltration and clogging:

- Continue to apply stringent performance standards for construction materials and practices, accompanied by agency surveillance during construction.
- Require the establishment of regularly scheduled maintenance and cleaning programs.

3.4.1.4 Product Storage Tanks, Pipelines, Accidental Discharges. Leakage of materials from product storage tanks and accidental discharges may introduce hydrocarbons, organic solvents and toxic industrial liquids into surface and groundwaters. The program has identified the following control strategies which can aid in minimizing the pollution source:

- Require construction standards that will minimize the probability of leakage or, in the event of accident, will minimize the entry of pollutants into ground and surface waters.
- Establish siting and location standards that will prohibit the storage of certain materials in areas where leakage and spills will constitute a significant pollution hazard.
- Establish a monitoring program that will enable a management agency to evaluate the performance of storage facilities in relation to baseline ground or surface water quality.
- Require that owners or operators of storage and transmission facilities develop an emergency shut down, containment and clean-up procedure as a permit condition.
- Promote or, where feasible, require changes in clean-up techniques to minimize the flushing or disposition of hazardous spilled materials to groundwater or surface waters.
- Establish and maintain an emergency notification system with a trained emergency response team capable of responding to spill emergencies.
- Provide for criminal and/or civil liability in cases of ground or surface water pollution caused by violation of permit or operating conditions and assume that compliance with these conditions will not affect such liability.
- Require that accurate product records be maintained and made available to regulatory agencies.
- Require that buried tanks be constructed or protected in such a way as to positively prevent the escape of contents due to tank corrosion, both internal and external. Techniques to be considered include, but are not limited to, the use of non-corrosive materials, cathodic protection, coatings and double-walled tanks.
- Prohibit the establishment of waste piles (stock piles) containing potential pollutants within the flood plain of the 100-year flood.
- Prohibit above and below ground storage of potential pollutants in primary recharge or watershed areas except where reasonable safeguards are provided in order to prevent the escape or movement of such pollutants into ground or surface waters.

3.4.1.5 Discharge and Storage of Industrial Wastes. Industrial wastes discharged to municipal treatment facilities and ground/surface waters may contain a variety of toxic organic and inorganic compounds that constitute a public health hazard. The program identified the following control strategies that can aid in minimizing this pollution source:

- Require adequate pretreatment levels as a condition of discharge.
- Prohibit disposal of waste materials on the land surface, or to groundwater, unless permitted or exempted. (Specific classes of materials may be exempted.)
- Prohibit the discharge of specific classes of industrial waste to

groundwater in any prime recharge or watershed area.

- Expand permit conditions relating to an enumeration of chemical constituents and allowable limits to ensure maximum protection of the groundwater resource.
- Promote and, if necessary, require that specified classes of industrial wastes be subject to a materials recovery process prior to discharge.

3.4.1.6 Landfills. The use of the land for the ultimate disposal of solid wastes, sludges and toxic chemicals constitutes a significant threat to groundwater quality and the public health. The program has identified the following control strategies that can aid in minimizing this pollution source:

- Prohibit all landfill operations that rely on natural attenuation as a means of leachate control.
- Prohibit the location of new landfill operations in primary recharge or watershed management areas.
- Require that landfill operators adhere to a cover schedule and maintain a minimally exposed face. Where appropriate, require a cover of relatively impervious material.
- Classify all landfill sites according to the materials that may be placed in them, with toxic wastes assigned to specific disposal sites that are strictly controlled and monitored.
- Promote the use of volume reduction techniques, and resource recovery and reuse, wherever economically feasible.
- Require permits for all landfill operations, regardless of size.
- Require the provision of an underdrain system and an impermeable barrier where the landfill is located in a permeable soil and where it can reasonably be expected that the quantity and quality of the leachate will have a significant adverse effect on ground or surface waters. Provide for treatment and disposal of collected leachate.
- Establish, maintain or supplement groundwater monitoring and surveillance at each landfill site, both open and closed.
- Require surface liners, proper grading and revegetation of completed landfills to minimize infiltration and ensure compatability with the surrounding area.

3.4.1.7 Recharge of Sewage Treatment Effluent. Sewage treatment plant effluent discharged to the ground does not constitute a major threat to the area's groundwater; however, there may be significant local impacts when discharges are concentrated at a few sites. Most of the plants that discharge to the ground are generally treated to the secondary level; some are denitrified. The program has identified the following control strategies that can aid in minimizing this pollution source:

- Establish and/or enforce strict control of treatment plant operating procedures.
- Provide for public take-over in instances where private owners and operators consistently fail to meet permit conditions.
- Require the use of advanced wastewater treatment techniques in primary recharge areas, or prohibit sewage treatment plant discharges to ground in prime recharge or watershed management areas.
- Establish demonstration projects to test alternative treatment and disposal techniques including, but not limited to, the land application of treated effluent, spray irrigation and marsh-pond basins.
- Establish, maintain or supplement monitoring programs to determine baseline water quality and to ensure early detection of any degradation caused by discharges from sewage treatment plants.

3.4.1.8 Construction-Related Erosion. Sediment is the end product of the erosion that occurs when the protective vegetal cover of the land is removed and rain and wind forces can work freely on the exposed soil. Although erosion is not as serious a problem on Long Island as it is elsewhere in New York State, there are areas where the deposition of sediments can severely damage aquatic or wetland ecosystems. In 1974 the Soil Conservation Service reported that erosion from construction sites accounted for approximately half of all erosion losses in Suffolk County. The program has identified the following control strategies that can aid in minimizing pollution from this source:

- Prepare or support the preparation of a handbook for local officials and developers. The handbook would describe Best Management Practices for the control of construction-related erosion.
- Establish or strengthen sub-division ordinance requirements for the reduction of erosion during and after site development.
- Supplement building permit requirements by including provision for submission of a site clearance, interim grading and restoration plan designed to minimize runoff and erosion.

3.4.1.9 Water Well Construction and Abandonment. Improper construction and practices may permit surface pollutants to enter the groundwater aquifer system and may contribute to the movement of contaminated water between groundwater aquifers. Existing controls over this non-point source of groundwater contamination are not particularly stringent. Drillers are licensed and permits are required before wells can be drilled, except for agricultural wells. In addition, Nassau and Suffolk County Health Departments maintain records on public supply wells, but generally do not sample and inspect the numerous agricultural wells. The 208 Program has identified the following control strategies that can minimize this pollution source:

- Extend the NYSDEC regulations governing well construction and abandonment to cover wells presently not subject to regulation.
- Require the registration of all persons and/or firms engaged in well drilling activities with the appropriate county management

agency. Require all drillers to obtain a license and post surety or cash bonds before engaging in activites related to well drilling. The license should provide for revocation wherever regulations are violated.

- Establish a program of well inspection. Inspection priority should be accorded to the classes of wells considered most likely to contribute to groundwater contamination.
- Require a permit for the abandonment, sealing or demolition of any public or private well having a capacity greater than 45 gpm and of any observation well or other well installed for the purposes of scientific investigation.

3.4.1.10 Highway Deicing Materials. The storage and application of highway deicing materials contribute to chloride and sodium contamination of fresh surface and groundwaters. Leachate from inadequately protected salt piles and salt-laden runoff from impermeable road surfaces seeps directly into the ground or is diverted to a storm recharge basin. In some places along the shores of Long Island, street runoff is diverted to storm drains that empty into surface waters. The Program has identified the following control strategies that can minimize pollution from this source:

- Require that salt piles be stored in permanent buildings.
- Require the substitution of inert abrasives, such as sand or cinders, for chemical salts wherever possible.
- Modify application procedures and equipment to allow preferential spreading on high hazard road segments.

3.4.1.11 Well Disposal of Heated Cooling Water to Groundwater (Diffusion Wells). Diffusion wells may cause contamination of groundwater through the introduction of heated water and of chemical additives used in the cooling process or for the maintenance of cooling equipment. The Program has identified the following control strategies that can aid in minimizing pollution from this source:

- Restrict the use of chemical additives in cooling processes or in the maintenance of cooling equipment.
- Require that no cooling waters discharged to the ground differ significantly from ambient water except in respect to temperature.
- Provide adequate surveillance to ensure compliance with diffusion well permit conditions.

3.4.1.12 Control of Domestic Animal Wastes. Data provided by the Soil Conservation Service indicates that the animal population of the Region is sufficiently diverse and numerous to add to the BOD, COD, bacterial, nitrogen and phosphorus content of ground and surface waters. Regulations controlling the disposal of waste from domestic animals are generally designed to prevent public health nuisances and do not protect ground or surface water quality. The Program has identified the following control strategies that can aid in minimizing pollution from this source:

- Promote dog sterilization programs in order to limit the growth of the canine population.
- Require that pet owners assume responsibility for the clean-up and disposal of animal wastes.
- Provide for the repeal of dog curbing ordinances, and promote the adoption of clean-up ordinances.
- Require that persons having ownership or control of numbers of domestic animals obtain a permit specifying the Best Management Practices to be followed, including an approved plan for the disposal of wastes.
- Prohibit the continued sale and/or distribution of White Pekin ducks for pets.

3.4.1.13 Groundwater Development. Optimization of groundwater withdrawal practices is required to assure the long term quality of Nassau-Suffolk groundwaters. Although salt water intrusion does not appear to be a significant areawide problem, there have been instances of local contamination due to saltwater intrusion or upconing in pumping wells. The Program has identified the following control strategies that can aid in minimizing pollution from this source:

- Control pumping patterns, especially of high yield wells, to minimize the interaquifer movements of contaminants.
- Control pumping patterns to minimize local saltwater contamination of supply wells.
- Establish pumping patterns that will minimize the migration of existing contaminants within any aquifer and/or abate existing contamination.
- Formalize interdistrict allocation of public water, where required.
- Encourage use of public lands for groundwater development.
- Amend the New York State law to remove the clause exempting agricultural irrigation wells from operating permit requirements.
- Employ land use controls to limit development in those areas where water supply is restricted.
- Require wellhead treatment of public water supplies in areas where water quality contravenes drinking water standards.

3.4.1.14 Agricultural Chemicals. Large quantities of pesticides and fertilizers are used on Long Island, not only in eastern Suffolk agricultural areas, but also in western Suffolk and in Nassau, where they are applied to lawns, golf courses and nursery stock. Contamination hazards from pesticides are generally controlled by natural physical-chemical biological processes in the soil. Recent developments in pesticide chemistry, however, may yield classes of chemicals that are more persistent and/or toxic. The potential hazard from these chemicals, therefore, cannot be overlooked. Intensive application of fertilizer in domestic, recreational, agricultural and commercial use results in the leaching of a large part of the nitrogen content to groundwater. The Program has identified the following control strategies that can aid in mini-

mizing pollution from these sources:

Pesticides

- Limit or prohibit the distribution and/or use of specific chemicals that are suspected carcinogens.
- Promote the substitution of less persistent or less toxic chemicals for those currently in use.
- Institute measures to control the disposal of used pesticide containers.
- Continue and supplement the licensing of commercial operators.

Fertilizers

- Enlist the active participation of the United States Department of Agriculture, local Soil and Water Conservation Districts, and the Cooperative Extension Service, to conduct information and education programs designed to promote the cost-effective use of fertilizers and erosion/runoff control.
- Limit or prohibit the distribution or sale of those chemical fertilizer formulations that have effective organic substitutes.
- Institute fertilizer use controls in areas with significant hydrologic constraints, *e.g.,* the deep flow Zones I and III. Initial emphasis should be on non-food crops, lawns, golf courses, etc.
- Promote the use of low-maintenance lawns and natural plant materials in order to reduce the need for extensive watering and fertilizing.

3.4.2 Application to Stormwater Control

3.4.2.1 Stormwater Runoff to Bays. A number of factors are considered in formulating and applying control methods to non-point sources. Structural methods (*e.g.,* retention/settling basins) can be used where stormwater is conveyed to the receiving water by a stream or large storm sewer. If the greater portion of flow reaches the water at many diffuse locations, Best Management Practices (usually including street cleaning) are appropriate, if cost-effective. (See Section L of the Areawide Waste Treatment Management Plan.)

Non-point source control in the bi-county area was evaluated on the basis of two factors. The first factor was the presence or absence of a long term problem with bacterial contamination in the receiving water. Closed shellfish areas were used as the indicators for this type of pollution. (It should be noted that, in all but one of the bays studied, the contribution of bacteria from non-point sources far exceeded that from point sources.) The second factor was the relative magnitude of non-point pollution contributed by streamflow as compared with that contributed by diffuse flow. In analyzing this factor, the bays and bay complexes were divided into subdrainage areas, which were then evaluated separately. Also considered was the scale at which the evaluation should be conducted. One approach considers only those streams that have drainage areas of 100 acres or more; another approach considers all streams.

Structural and Best Management Practice techniques for non-point source control were grouped into the following approaches:

Approach I: Bay divided into reaches and controls applied where a problem is indicated (for example, closed shellfish areas). Structural alternatives applied to streams with drainage basins greater than 100 acres where the proportion of stream runoff to areal runoff is relatively high. Best Management Practices applied to suspect overland flow areas and areas downstream of structural facilities.

Approach II: Reliance on Best Management Practices only, throughout the basin.

Approach III: Application of structural alternatives to all streams with drainage basins greater than 100 acres, regardless of the relative proportion of stream and areal flow. In addition, application of Best Management Practice to all other drainage areas.

Approach IV: No action. To be applied to drainage areas contributing to those bay segments where no problem exists or is expected.

The above approaches were applied to the following bays and bay complexes of significance: Great South Bay complex, Manhasset Bay, Hempstead Harbor, Oyster Bay/Cold Spring Harbor complex, Huntington Bay complex, Port Jefferson Harbor and Peconic Estuary.

For each bay, approaches were developed with associated total annual cost, annual pollutant loads and sludge production.

There are a number of natural ponds in the study area that are located on streams near their discharge points. If the settling capability of the ponds is utilized, then only disinfection may be required. This concept should be evaluated in detail when stormwater structural approaches are being considered. The degree of sedimentation taking place in the natural pond should be estimated by comparing influent and effluent water quality. If sedimentation is effective and if effluent water quality is sufficiently good (*i.e.,* low values of suspended solids or turbidity), only disinfection need be applied.

For a comparison of the costs of structural approaches with Best Management Practices, street sweeping was selected as a representative of the latter approach. It is the most commonly applied Best Management Practice; it has been implemented in the past; its costs have been estimated; and it is being studied extensively in other 208 investigations. Other Best Management Practices could also be included but comparable cost-estimating data and operational experience are lacking. In actual applications, a combination of Best Management Practices would probably be applied to an area to achieve maximum effectiveness.

Great South Bay Complex. As illustrated in Figure 2–3, the Great South Bay Complex basin is made up of parts of basins NI, N2, S1, S2 and S3a. The basin is characterized by its extensive tributary system, the discrete location of its streams, a relatively large percentage of impervious surface area (in N1 and N2), and a gradual basin slope with minimum bank runoff.

The percentage of the total drainage area from which runoff reaches

the bays via streams varies for each subdrainage basin.

Sub-Drainage Basin	% Stream Drainage Area
N1	38.9
N2	54.1
S1	60.2
S2	58.5
S3a	53.4

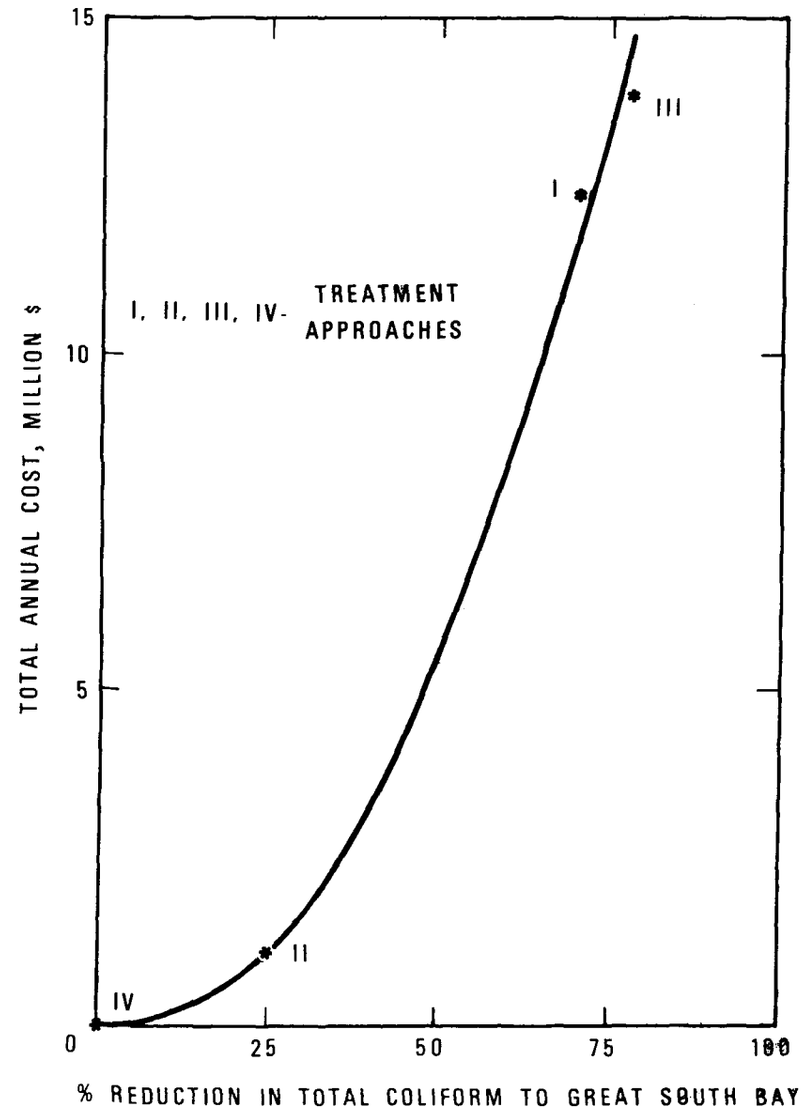
The above drainage area data take on importance when coupled with data indicating areas closed to shellfishing. Figure 2–8 identifies areas of the Great South Bay complex that were closed to shellfishing as of August 1977. Inspection of Figure 2–8 shows that essentially the entire area of the Great South Bay complex below drainage areas N1 and N2 is closed to shellfishing, as are parts of the Bay below S1 and S2, and a small area of the Bay below S3a.

Approach I attempts to identify areas where structural/non-structural methods are more appropriate, based upon the pollution reduction potential of a particular drainage basin and a history of shellfish bed closings. This approach resulted in the following:

1. Best Management Practices were considered for use in N1, because structural methods offer a relatively low pollution reduction potential and because N1 is entirely closed to shellfishing.
2. Since shellfishing closings occur in a large part of the bay below N2, S1 and S2, and since relatively high pollution reduction potential by structural methods exists, structural methods were considered.
3. Although S3a has a high pollution reduction potential, the need for structural abatement facilities is unwarranted because the shellfish closings occur in small isolated areas. For S3a, therefore, Best Management Practices were considered.

In the sub-drainage basins where structural methods were considered (N2, S1 and S2), land availability was checked to determine whether a storage/sedimentation reservoir could fit the available space. If space was not available, then a swirl regulator-concentrator treatment was selected. The total annual cost estimates (amortized capital and operation and maintenance) as well as an estimate of the recent reduction in coliform bacteria (effectiveness) are graphically illustrated in Figure 3–11. The sludge generated from the non-point source structural abatement facilities would be a small quantity in comparison to projected municipal sludges.

Approach II involves the application of Best Management Practices throughout the entire drainage basin of the Great South Bay complex. It represents the minimum treatment level that can be provided from both a cost and treatment efficiency standpoint. The cost for implementing a street sweeping program was estimated at about $97 per curb mile per year. The estimated total annual costs and effectiveness are illustrated in Figure 3–11.



Source: Section L of the Areawide Waste Treatment Management Plan.

FIGURE 3–11 *Cost-Effectiveness of Various Treatment Approaches for the Great South Bay*

Approach III involves the installation of structural abatement facilities on all streams draining areas greater than 100 acres, and implementing Best Management Practices in those areas of the basin not drained by these streams. The only exception to this is that Best Management Practices were considered for applications to the Mill River, the Connetquot River and the Carmans River, since they are too large to control structurally. Approach III represents the highest degree of treatment that can be provided. The estimated total annual costs and effectiveness are illustrated in Figure 3–11.

Approach IV is the no-action alternative. Based on the history of shellfish closings alone, it would appear that some kind of action is warranted and that the no action alternative is not viable.

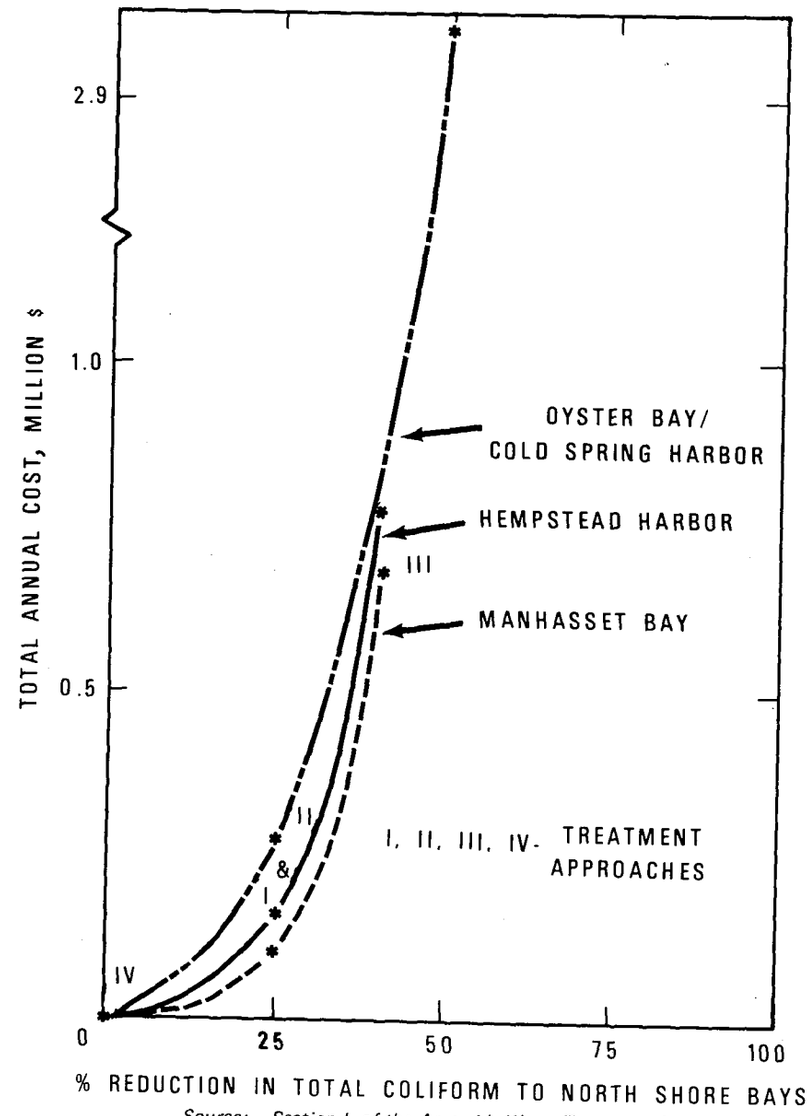
As illustrated in Figure 3–11, the estimated total annual costs differ significantly between Approaches I and III on the one hand, and Approach II on the other. The cost of implementing a street sweeping program (Approach II) throughout the Great South Bay area is about one to two orders-of-magnitude less than the costs of the other approaches. The estimated treatment efficiency, however, of Approach II is less than it is for Approaches I and III. The total coliform reduction of Approach III is 76 percent, while the reduction by Approach II is 25 percent.*

From Figure 3–11 it would appear that, of the four approaches, the most cost-effective solution is Approach II, which yields the greatest estimated efficiency per unit dollar of cost.

North Shore Bays. In general, the basins contributing flow to the North Shore bays are characterized by a minor tributary system, steep basin slope and significant bank runoff. The exception to this is Oyster Bay/Cold Spring Harbor. The drainage area of the streams in that basin accounts for approximately 44 percent of the total drainage area.

As illustrated in Figure 3–12, total annual costs and treatment efficiencies are the same for Approaches I and II for Manhasset Bay, Hempstead Harbor and Oyster Bay. This is because Best Management Practices were used in Approach I after it was decided that structural methods would not appreciably reduce overall non-point source pollution into the bays because of the small drainage area attributable to streams. In the case of Port Jefferson Harbor, Approaches I, II and III are identical because there are no streams where structural control measures would apply. In the case of Huntington Bay, Approaches I and II are identical and III is slightly different. Both of these bays are shown in Table 3–10. Coliform reductions achieved by Approaches I and III differ significantly for the bays illustrated in Figure 3–12. For example, Approach III at Oyster Bay/Cold Spring Harbor results

*Future studies will be required to determine the efficiency of non-structural means of non-point source control. In addition, future modeling studies will be required to correlate the effects of Best Management Practices on receiving water quality.



Source: Section L of the Areawide Waste Treatment Management Plan.

FIGURE 3–12 *Cost-Effectiveness of Various Treatment Approaches for North Shore Bays*

in a coliform reduction of 51 percent (*versus* 25 percent for Approaches I and II). This pattern is generally the same in the other two bays.

Table 3–10 indicates that a structural solution would not achieve much improvement in coliform levels in the Huntington Bay/Northport Bay complex. Port Jefferson Harbor options are limited to Best Management Practices.

Considering Table 3–10 and Figure 3–12, the apparent maximum effectiveness per unit cost of the four approaches for each bay is Approach II. Approach II, therefore, appears to be the most cost-effective alternative for all the North Shore bays, assuming that a 25 percent reduction in BOD_5, suspended solids, nutrients and total coliform bacteria can be achieved by Best Management Practices, and that bay water quality standards can be met.

Table 3–10

ESTIMATED TOTAL ANNUAL COST AND EFFECTIVENESS OF APPROACHES TO CONTROL STORMWATER RUNOFF INTO HUNTINGTON/NORTHPORT BAY AND PORT JEFFERSON HARBOR

Bay/Approach	Estimated Total Annual Cost, $	Estimated % Reduction of Total Coliform Load
Huntington/Northport Bay		
I	151,000	25
II	151,000	25
III	213,000	25
IV	– 0 –	0
Port Jefferson Harbor		
I	98,000	25
II	98,000	25
III	98,000	25
IV	– 0 –	0

Source: Section L of the Areawide Waste Treatment Management Plan.

The dynamic water quality model was used to measure the response to various inputs of stormwater and pollutants to Manhasset Bay and Hempstead Harbor. On the basis of sampling programs and model runs, it is reasonably certain that coliform levels in the outer portions of these bays are dominated by conditions in Long Island Sound, and the inner portions by stormwater runoff from the tributary drainage basin. Coliform levels in these embayments, which are over 70 MPN per 100 milliliters preceding a storm event, can increase to above 2000 MPN per 100 milliliters in response to a "design" storm. The overriding influence of present Long Island Sound water quality will prevent the reduction of coliform levels to below shellfishing standards during storm events, even with a 25 percent reduction of coliform bacteria in runoff. However, Best Management Practices in the control of runoff may insure the suitability of these waters for bathing, following moderate to heavy rainfall.

Peconic Estuary. Flanders Bay-Peconic Estuary is characterized by a major tributary (Peconic River) and a number of much smaller streams. Most of the runoff can be considered bank runoff, with a small portion contributed by the streams. The drainage areas of the streams account for approximately 34.9 percent of the total drainage area of Peconic Estuary. A tabulation of drainage areas of the streams flowing into the Peconic Estuary and the percentage of total drainage area attributable to streams for each subdrainage basin are given as follows:

Sub-Drainage Basin	% Stream Drainage Area
S11b	70
S12a	Negligible
S15a	Negligible
S13b	Negligible

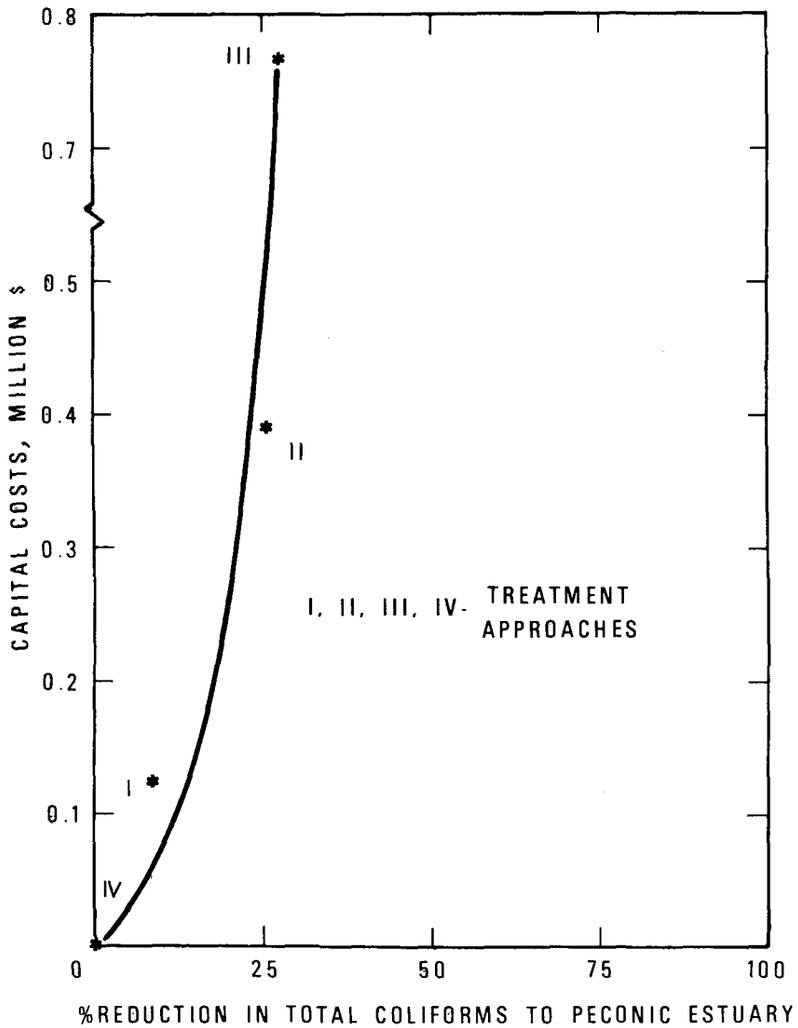
The above drainage area data were compared with the data on areas closed to shellfishing (see Figure 2–8), and the following treatment approaches were developed as part of Approach I:

1. Since Flanders Bay is partially closed to shellfishing, there is a need to reduce the non-point source pollutant loads entering from S11b. It was decided to consider implementation of Best Management Practices in this basin since structural methods are not feasible for large streams such as the Peconic River. Since the southern portion of Flanders Bay has not been closed to shellfishing, the no-action alternative was considered for Mill Creek and Hubbard Creek.
2. For sub-drainage basins S12a, S15a and S13b, no-action was considered acceptable because the bays adjacent to these basins are not closed to shellfishing.

The estimated total annual costs and effectiveness for Approach I are illustrated in Figure 3–13.

Approach II involves the application of Best Management Practices throughout the basin. In the case of Peconic Estuary, this level of treatment seems unnecessary since certain sub-drainage basins (S12a, S15a and S13b) do not appear to contribute to the problem of shellfish closings.

Approach III involves the application of structural abatement facilities on all major streams in S11b and the implementation of Best Management Practices in those areas of the bay not drained by the streams. The exception is that non-point source pollution from the Peconic River is controlled by non-structural measures. Approach III represents the highest degree of treatment that can be provided.



Source: Section L of the Areawide Waste Treatment Management Plan.

FIGURE 3–13 *Cost-Effectiveness of Various Treatment Approaches for Peconic Estuary*

Approach IV is the no-action alternative. It is reasonable to assume that non-point source pollution from sub-drainage basins S12a, S15a and S13b, need not be reduced since the bay areas adjacent to these basins have not been closed to shellfishing.

Estimated total annual costs and effectiveness are illustrated in Figure 3–13. Figure 3–13 suggests that Approach I or II would provide the most cost-effective solution. However, if water quality is improved and the duck farms that discharge to Meetinghouse Creek attain zero discharge, then Approach IV (no action) may be acceptable for the Peconic Estuary.

One of the major questions concerning stormwater control is the effectiveness of street sweeping/vacuuming as a Best Management Practice. There is no experimental or operational data available to describe its effectiveness in the Nassau-Suffolk area. Therefore, in order to evaluate the efficiency of street sweeping, demonstration programs should be established on the basis of topographic and runoff differences. One should be implemented on the North Shore and one on the South Shore. Sampling of stormwater runoff should be conducted in areas where street sweeping/vacuuming is intensively employed and the results compared with samples from areas where minimal amounts or no street cleaning is provided.

Recharge Basin Analysis. There are between 2000–3000 recharge basins on Long Island, recharging approximately 80 MGD of stormwater runoff to the Long Island aquifers. Street surface contamination consists of hydrocarbons (gasoline, oils, grease), organic chemicals (pesticides), heavy metals (lead, copper, zinc) and fecal matter (bacteria and viruses).

At the present time, there are no systems in use to treat the recharge prior to its entering the ground, although use of a marsh-pond approach as well as mechanical systems appears to be feasible. Therefore, unless the contaminants are removed by the natural vegetation and soils, they may eventually reach the groundwater.

The 208 has determined that surface runoff is a source of pollutants and that some form of treatment may have to be implemented. It is suggested that a concept requiring little maintenance, such as the marsh-pond concept, be investigated on a pilot basis to treat stormwater prior to recharge. The marsh-pond concept was selected for the following reasons:

- Runoff comes in contact with the soil and vegetation roots for a maximum amount of time.
- The vegetation removes heavy metals and organics by bio-assimilation.
- Both of the lined sections of such a system act as settling ponds, effectively removing any silt particles that would otherwise plug up the recharge basin.
- The vegetation will act as a nitrogen sink and if cropped will reduce the nitrates reaching the groundwater aquifers. Cropping would also be necessary to avoid accumulation and recycling.

Some disadvantages of this concept are:

- There will not be enough room for a marsh pond installation in all cases.
- The plants will have to be cropped about once per year and disposed of as potential hazardous wastes.
- Water levels in the marsh may have to be maintained during dry periods to prevent the plants from dying off.
- Variable climatological factors may impair the effectiveness of plant and other biological life in removing pollutants.

The estimated cost of such a system depends heavily on the size of each basin and the acreage requirement of the lined sections. For an average-sized recharge basin of 1.5 acres, the capital cost would be approximately $50,000 to $100,000, with an operation and maintenance cost of about $300 to $500 per year.

Summary. The recharge of untreated urban runoff poses a threat to the groundwater quality on Long Island. Many studies have shown that urban runoff may contain organic chemicals, heavy metals, bacteria and viruses, and may reach the subsurface water through recharge basins. (See Plan Section L.)

A review of possible alternatives leads to the recommendation that a marsh-pond pilot treatment plant be constructed in an existing recharge basin in order to test its ability to remove the pollutants in runoff. After a one year trial period, the operating data should be reviewed and a decision made on whether to implement the concept on a large-scale basis or to abandon it altogether.

If the pilot study proves successful, then a plan of phased construction to fit recharge basins in the Magothy recharge area with marsh-ponds can be prepared.

If it proves to be infeasible to treat at the recharge basins, it may be necessary to begin phasing them out in key groundwater areas. If this policy is implemented, substantial quantities of recharge water will be lost. The impact of this loss on groundwater levels and water supply must be carefully analyzed by existing digital and analog mathematical models before such a policy is adopted.

3.5 Planning Options

3.5.0 Introduction. There are a number of ways of achieving any specific wastewater management objective. Common end objectives can be reached generally through point source controls, non-point controls and/or some mix of the two.

In an attempt to keep the array of alternatives and/or complementary ways of achieving a management objective to a reasonable number, the planning process contained herein was designed to subject all alternatives to continuing evaluation, based on technical and economic feasibility, probable environmental effects and legal-statutory requirements. Where an alternative, or set of alternatives was found to violate any of these requirements, it was either modified or eliminated. It is possible to establish a number of area specific water supply alternatives as tradeoffs or second best solutions to wastewater management problems. However, one of the basic constraints, regarding the selection of the more viable wastewater management alternatives, is maintaining the self-sufficiency of the Region's drinking water supply by maintaining the high quality of the reserves. The nature and role of these trade-offs are discussed in Section Six.

This section describes the most viable alternatives as they relate to specific hydrogeologic zones and adjacent marine surface water elements. These alternatives are broken down into two categories: (1) areawide alternatives, or those alternatives that are generally applicable across all Nassau-Suffolk groundwater zones and surface water elements and, (2) area specific alternatives, or those alternatives that are applicable only to designated Nassau-Suffolk groundwater zones and surface water elements. An example of an areawide alternative is the restriction of the use of fertilizer throughout the bi-county area, whereas an example of an area specific alternative is the prohibition of landfills in selected groundwater zones.

The areawide and area specific alternatives follow. The preferred alternatives, or combinations of alternatives, and the reasons for their selection, are described in Section Six.

3.5.1 Areawide Alternatives

3.5.1.1 Provide for Routine Maintenance of On-Site Septic Tank and Leaching Pool Systems. Provisions should be made for routine pumping and maintenance to extend the service life of the leaching facility and ensure its continued efficacy.

3.5.1.2 Prohibit the Use of Certain Chemical Cleaners in On-Lot Systems. The use of organic solvents and other chemical agents that are used in an attempt to clean or extend the life of an on-lot waste disposal system, but that impair or alter groundwater quality, should be prohibited or controlled.

3.5.1.3 Expand Regulations and Enforcement Regarding the Disposal of Industrial Wastes. Where industrial wastes are discharged to municipal sewer systems, strict enforcement of sewer use ordinances should be insured. Where industrial wastes are discharged to the ground, present regulations should be expanded to include greater coverage of specific contaminants and prescribed allowable discharge levels. This applies primarily to organic chemicals.

3.5.1.4 Regulate the Storage and Transportation of Chemical Products. Permits and other controls should be required for the storage and transportation of chemical products that would pose an environmental threat to either the groundwater or surface water. The regulations should include prescribed practices relating to safeguards, inspection and emergency contingency plans. In addition to industrial chemicals, these products include chemical wastes and sludges, deicing salts and petroleum products.

Particular emphasis should be placed on regulating gasoline storage

facilities at automobile service stations and, to a lesser degree, home heating oil storage tanks. The 208 Study has recognized these two types of facilities as major potential pollutant sources but has not been able to define the precise magnitude of the problem.

3.5.1.5 Restrict the Use of Fertilizers. Since fertilizers constitute one of the largest sources of nitrogen applied to the land surface, they are also a significant potential source of ground and surface water impairment. Pending further necessary study to better define their impact on water quality, public education should, and regulation may, be employed to limit or possibly eliminate the use of all or specific types of fertilizers. Included in the Best Management Practices, some of which may also pertain to agriculture, are modification of application rates, discontinuance of reliance on fast-acting inorganic fertilizers, and promotion of low-maintenance lawns, which would require both less fertilizer and less consumptive use of water.

3.5.1.6 Control Stormwater Runoff. To the extent feasible, surface runoff should be intercepted and disposed of as close as possible to the source. Best Management Practices and/or structural systems should be employed to minimize the volume of runoff and the transport of sediments, nutrients, metals, organic chemicals and microorganisms to surface waters. Recharge basins may need to be modified, where feasible, to improve the removal of nutrients, metals and organic chemicals in stormwater runoff that contribute to groundwater contamination. Inasmuch as most of the techniques for both practical and cost-effective treatment of runoff are still relatively untested, the establishment and operation of several pilot projects is recommended prior to consideration for full scale implementation. Street vacuuming and the use of natural or man-made detention systems with marsh-pond application and/or disinfection are recommended for further investigation and testing.

3.5.1.7 Reduce Animal Wastes. Best Management Practices should be employed to minimize the deposition of animal wastes, primarily from dogs and semi-wild ducks, directly into the surface waters or on impermeable areas draining into surface waters. Among these management practices are the reduction of animal populations, regulation of the acquisition and abandonment of certain domestic animals, and proper animal waste disposal by owners.

3.5.1.8 Minimize Pollution from Site Preparation and Development. Regulations should be established requiring the use of Best Management Practices during site clearance, building construction and site restoration in order to control the erosion from development activities and the subsequent transport of sediment to surface waters.

3.5.1.9 Reduce Reliance on Landfills. Regional and/or subregional resource recovery facilities should be constructed as rapidly as feasible in order to minimize the current reliance on landfills for the disposal of domestic and other non-hazardous wastes. In addition, these resource recovery facilities should also provide for the adequate treatment of wastewaters originating at such facilities. The first resource recovery facility on Long Island is presently being constructed in the Town of Hempstead. Until such facilities become available, all new landfills should be interim in nature and should be provided with dual liner systems to prevent leachate contamination of ground and surface waters. Leachate should be collected and treated. This recommendation is consistent with present New York State Department of Environmental Conservation policy. The location of new landfills should conform to recommendations presented as part of the area-specific alternatives. Abandoned and/or completed landfills should also be upgraded when feasible by providing an impervious cover to prevent water infiltration and the continued production of leachate, especially in deep-flow recharge areas.

3.5.1.10 Provide for the Treatment of Hazardous Wastes. Provisions must be made for the safe disposal of hazardous wastes. Because of the types of industries in the Nassau-Suffolk Region and the wastewater treatment processes they employ, two kinds of hazardous wastes are generated: small volumes of strong, toxic industrial wastes, and industrial waste treatment sludges.

In view of the environmental sensitivity of the study area, continued disposal of these types of hazardous wastes outside of the area should be encouraged. However, if this disposal option is not available in the future, treatment facilities and landfills for hazardous wastes and residuals will have to be provided in the bi-county area.

3.5.1.11 Provide Alternatives to Ocean Disposal of Municipal Treatment Plant Sludge. The major municipal treatment plant sludge processing and disposal approaches that appear viable in the Nassau-Suffolk Region include composting, landfilling, land application, incineration, co-incineration with solid waste, pyrolysis and thermal drying. (These approaches also apply to the sludge from scavenger waste treatment plants.) It has been found that any of the conventional approaches can be implemented in parts of the Nassau-Suffolk area without significant environmental degradation if normal safeguards are taken. Final sludge disposal options should be selected after 201-level detail studies have been conducted, since the final decision should be based upon cost-effectiveness, and the 208 Study has not developed sufficiently detailed cost analyses. The 208 has determined that the conventional approaches are regionally acceptable.

Land-based sludge disposal options (land application, composting) must be accompanied by monitoring or other control programs to insure against contamination from heavy metals, organic chemicals and other pollutants. This is particularly important in hydrogeologic Zones I, II and III. Land-based disposal options will require strict enforcement of industrial pretreatment requirements to minimize the amount of toxic materials in municipal treatment plant sludges.

3.5.1.12 Require Nitrogen Removal for Treatment Plants Recharging Effluent. All waste treatment facilities that discharge to either recharge basins or to streams, should be required to provide nitrogen removal. The level

of nitrogen removal required should be in conformance with all applicable groundwater and surface water standards.

3.5.1.13 Minimize Population Density. Minimize population density by encouraging large lot development (one dwelling unit/one or more acres), where possible, to protect the groundwater from future pollutant loadings.

3.5.1.14 Promote Water Conservation. Water conservation is a matter of particular importance on Long Island, where the sole source of the potable water supply is the groundwater. Conservation of water use will help to preserve this water supply, and to maintain aquifer water levels. An additional benefit will be a reduction in energy consumption, also a matter of general concern. It should be noted, however, that insofar as areawide waste treatment management is concerned, water conservation will have limited benefit.

3.5.2 Area Specific Alternatives. The selection of area specific alternatives, whether structural or non-structural or both will influence the character and extent of future collection and treatment service areas.

In order to facilitate the selection of the most appropriate waste management options and the subsequent determination of the areas that should be served by community collection systems and those that should be served by on-site disposal systems, a series of alternatives is offered for each hydrogeologic zone and surface water element. In the case of the hydrogeologic zones, these range from total reliance on non-structural non-point source controls with no additional sewering to comprehensive sewering at densities of one or more units per acre, in combination with the immediate imposition of selected non-structural controls. In the case of the surface water elements, these range from total reliance on non-structural non-point source controls to the upgrading of treatment plants or the relocation of outfalls done in combination with the imposition of selected non-structural controls. A more complete discussion of these alternatives may be found in 3.3 and 3.4 of this section of the Summary Plan, and in Sections B and H of the Areawide Waste Treatment Management Plan.

An outline of the suggested procedure for relating hydrogeologic zone and surface water element alternatives with 201 study area plans is presented in Section Six.

In most cases several alternatives are listed. The rationale for the consideration of these, rather than some of the alternatives presented in 3.3 and Plan Section H, is discussed below.

Based upon an analysis of population densities and Upper Glacial aquifer nitrate-nitrogen (NO_3–N) concentrations in selected unsewered areas with twenty to 30 year old development and vertical groundwater flows, it was concluded that waste loadings generated by development at densities of ten to eleven persons per acre would result in an average NO_3–N concentration of ten milligrams per liter in the shallow groundwater. (An average of ten milligrams per liter implies that approximately 50 percent of the samples will exceed this concentration.) Further statistical analysis of these data indicated that an average level of six milligrams per liter NO_3–N would probably yield concentrations below ten milligrams per liter in 90 percent of the samples. It was calculated that in order to utilize on-site disposal systems, residential density should not exceed five to six persons per acre.

However, since the analyses relating population density to NO_3–N in the groundwater are not conclusive, it was decided that a viable range of alternatives should be offered and that additional study to better define the criteria for delineating service areas be included in a "201" study. In addition to the concern for protecting groundwater quality, consideration was given to factors such as the presence of a high water table or low soil permeability affecting the reliability of individual on-site disposal systems.

The selection of the range of sewering alternatives relating to population density is based upon the analysis of the probabilities of exceeding ten milligrams per liter as indicated from historical data and presented in Table 3–11. (See Section H of the Areawide Waste Treatment Management Plan and Section 4.5.2 of the Summary Plan.)

Table 3–11

POPULATION DENSITY AND OBSERVED NITROGEN CONCENTRATION IN SHALLOW WELLS

Percentage of Individual Well Observations Exceeding 10 mg/l NO_3–N	Predicted Average Concentrations of all Shallow Wells Less Than 100 ft. in a Given Area	Predicted Average Population Density Persons/ Gross Acre
50	10.3	10.9
40	8.7	8.6
30	7.9	7.4
20	7.1	6.3
10	6.0	4.7

Sources: Porter, K.S., et al., 1978, "Nitrogen: Sources and Potential Impact", Cornell University/Cooperative Extension Service. (Draft);
Appendix B, Section H of the Areawide Wastewater Management Plan.

The initial selection of sewering options of one, two and five dwelling units per acre, as discussed earlier in Section Three, was based upon previously recorded and projected residential densities, on which the cost estimates for sewering and waste treatment alternatives were also based. The initial selection of the one and two dwelling units per acre as maximum and intermediate sewering options is still consistent with the statistical data presented above. However, were one to assume a density of five dwelling units per acre and an average household size of four persons, in the area from which the data was obtained, the resulting population density of twenty persons per acre could be expected to produce an average NO_3–N groundwater concen-

tration of approximately twenty milligrams per liter. This would result in a concentration exceeding ten milligrams per liter NO_3-N in about 90 percent of the observations at shallow wells.

Since the violation probability of 90 percent at five dwelling units per acre is extremely high, the minimum sewering option was modified to reflect a lower and more reasonable density at which sewering would be recommended. The options for plan selection are as follows:

1. Minimum Sewering Option. Sewer at six or more persons per gross acre in areas of high water table and low soil permeability in order to provide the necessary space for adequate on-lot disposal systems. Such systems might require relatively extensive tile fields and would therefore require more than the normal amount of space.

   Sewer at nine or more persons per gross acre everywhere else, since it has been shown that, at these densities, groundwater contamination will probably exceed ten milligrams per liter, if sewering is not initiated.
2. Intermediate Sewering Option. Sewer at six or more persons per gross acre everywhere. Based upon the studies conducted during this program and others, this density appears to be the critical point about which both groundwater quality and cost revolve.
3. Maximum Sewering Option. Sewer at three or more persons per gross acre, since this will probably insure that groundwater NO_3-N levels will not exceed ten milligrams per liter, if non-point controls are also implemented. Unsewered areas will then have more than adequate lot sizes to accommodate any on-site sewage disposal system. However, it should be noted, that this maximum sewering option does not necessarily preclude the sewering of any area, if there is a complete failure of on-site systems or if the groundwater is threatened by contamination from on-site systems.

Regardless of the initial sewering alternative selected, it should be accompanied by a groundwater monitoring program in the less densely populated areas to determine the need, if any, for the creation of a new community sewer system or the expansion of the service area of an existing system.

The intensity and scope of the monitoring effort would depend in part on the sewering alternative selected for any given area. For instance, a comprehensive sewering alternative at four or more persons (one dwelling unit) per acre would probably preclude the necessity for an extensive monitoring system. A system perhaps only slightly broader than the one presently in place might be needed. This would allow for limited monitoring of inorganic chemicals, and in the future, organic chemicals. At the other extreme, total reliance on non-structural controls or even sewering at nine or more persons (three dwelling units) per acre would require an extensive monitoring system of many wells, sampled on a regular basis and with data being continually evaluated. This system is described in more detail in Section Six.

Monitoring of the concentrations of nitrogen, metals and organic chemicals, can be used to identify water quality trends in recently developed areas. The presence of average concentrations of six milligrams per liter NO_3-N in the samples from shallow monitoring wells can be used to signal the presence of existing problems in established areas.

A finding of increasing trends in contaminant concentrations or of a critical level of NO_3-N should initiate the necessary response to protect the public health and the long term quality and usefulness of the groundwater aquifer. In recently developed areas, such a response would comprise the stringent control of relevant non-point sources of contamination, followed by the extension of public water supply in order to minimize dependence on untreated water from private wells where applicable. If there is no indication of improvement in water quality, after continued monitoring, and if the degradation can be reasonably assumed to originate from on-lot sewage disposal systems, controls should be implemented.

In developed areas, especially those undergoing 201 study in the near future, time may not allow for a decision to be based upon trends, nor a determination of the effectiveness of Best Management Practices; therefore, the decision to reduce the nitrogen loading may need to rely primarily on structural controls.

3.5.2.1 Hydrogeologic Zone Alternatives. Wastewater management alternatives consisting of structural, non-structural and non-point source control options are given for each of the hydrogeologic Zones I through VIII. In addition, areawide alternatives having particular importance to a zone have been outlined.

Sewering, in the context used below, is defined as communal collection of wastewater and centralized treatment. Methods of treatment must be evaluated (traditional secondary/tertiary, marsh-pond, spray irrigation, and other innovative methods). This is not intended to preclude the future use of effective on-site treatment systems, as these are approved, in areas indicated for sewering.

Many of the pollutants that impact groundwater and surface waters can be expected to persist regardless of the sewering options that are selected. For this reason, non-point source controls must be regarded as an essential part of a comprehensive wastewater treatment management plan.

Zone I: Deep Flow System (Magothy Recharge Area). This zone is an area of recharge to the deep groundwater reservoirs in Nassau and western Suffolk Counties, and constitutes the major source of public water supply.

a. Wastewater Management Alternatives

   Alternative A—Total Reliance on Non-Structural Controls

   i. Permit no additional sewering.

   ii. Determine the acceptability of a given residential lot size and

of commercial and industrial activities on the basis of their impact on groundwater quality.

iii. Strictly control, and possibly upgrade, on-site systems.

iv. Strictly regulate site development and management practices, such as grading and maintenance of vegetation to control runoff.

Alternative B—Minimum Sewering Option

i. Provide sewering for areas with six or more persons (two or more dwelling units) per gross acre in areas of high water table and/or low soil permeability.

ii. Provide sewering for all other areas with nine or more persons (three or more dwelling units) per gross acre.

Alternative C—Intermediate Sewering Option

Provide sewering for all areas with six or more persons (two or more dwelling units) per gross acre.

Alternative D—Maximum Sewering Option

Provide sewering for all areas with three or more persons (one or more dwelling units) per gross acre.

b. Highest Priority Areawide Alternatives

i. Minimize population density by encouraging large lot development (one dwelling unit/one or more acres), where possible, to protect the groundwater from future pollutant loading.

ii. Prohibit the establishment of new landfills, and the expansion of existing ones. Upgrade existing landfills, where possible, to minimize further groundwater contamination.

iii. Restrict the use of inorganic, fast-acting fertilizers. Promote the use of low-maintenance lawns.

iv. Require nitrogen removal for treatment plants recharging effluent.

v. Strengthen and enforce regulations pertaining to industrial waste disposal, product storage and transportation of residuals.

vi. Prohibit the use of certain chemical cleaners in on-lot systems.

Zone II: Impaired Water Quality Area

a. Wastewater Management Alternatives. This zone lies mostly within Nassau County Sewage Disposal District No. 3 (Cedar Creek Facilities Planning Area), and is already scheduled to be sewered. Portions of the water supply have been seriously impaired by organic chemical contamination. For these reasons a single sewering alternative and two water supply alternatives are presented.

i. Convey wastewater to the Cedar Creek Sewage Treatment Plant for subsequent ocean disposal.

ii. Require wellhead treatment (physical/chemical treatment, blending) of public supply water if local water quality does not conform to drinking water standards.

iii. If local water quality does not conform to drinking water standards, or if further pumpage is considered inadvisable, water should be imported.

b. Highest Priority Areawide Alternatives

i. Prohibit the establishment of new landfills, and the expansion of existing ones. Upgrade existing landfills, where possible, to minimize further groundwater contamination.

ii. Restrict the use of inorganic, fast-acting fertilizers. Promote the use of low-maintenance lawns.

iii. Strengthen and enforce regulations pertaining to industrial waste disposal, product storage and transportation of residuals.

Zone III: Highest Grade Reservoir. Groundwater in this zone is generally of excellent quality. The groundwater resource in this zone offers a large potential for further development of public water supplies, provided that measures are taken to ensure the protection of groundwater quality.

a. Wastewater Management Alternatives

Alternative A—Total Reliance on Non-Structural Controls

i. Permit no additional sewering.

ii. Determine the acceptability of a given residential lot size and of commercial and industrial activities on the basis of their impact on groundwater quality.

iii. Strictly control, and possibly upgrade, on-site systems.

iv. Strictly regulate site development and management practices, such as grading and maintenance of vegetation, to control runoff.

Alternative B—Land Use Controls

i. Land use controls should be employed to assure the least intensive use of land wherever possible. Development of this zone for residential, commercial, industrial or agricultural use should be discouraged. However, where residential development cannot be avoided, large lot development should be required. Large land holdings should be maintained and public holdings should be increased to the extent possible.

ii. Institute a water table aquifer monitoring program to provide early warning of incipient degradation of the excellent water quality, and to permit timely action to protect the groundwater.

Alternative C—Maximum Sewering Option

Provide sewering for all areas with three or more persons (one or more dwelling units) per gross acre.

b. Highest Priority Areawide Alternatives

i. Require nitrogen removal for treatment plants recharging effluent.

ii. Provide for the routine maintenance of on-site disposal

systems.

iii. Restrict the use of inorganic, fast-acting fertilizers. Promote the use of low-maintenance lawns.

iv. Prohibit the construction of new landfills or the expansion of existing landfills. Presently operating landfills should be upgraded, insofar as possible, in order to minimize groundwater contamination.

v. Control stormwater runoff to minimize transport of nutrients, metals and organic chemicals to groundwaters.

vi. Strengthen and enforce regulations pertaining to industrial waste disposal, product storage and transportation of residuals.

vii. Prohibit the use of certain chemical cleaners in on-lot systems.

Zone IV: North Fork and Eastern South Fork

a. Wastewater Management Alternatives. This zone is characterized by unique groundwater conditions, especially with respect to local water quality problems such as high nitrate levels in farm areas and saltwater upconing where pumpage is concentrated. One water supply and four sewering alternatives are presented.

Alternative A—Importation of Future Water Supplies

Agricultural usage would be allowed to continue or expand. Groundwater quality controls should be employed only in areas of present residential use. Public water may be imported from Zone III if groundwater contamination becomes pervasive. Even presently adequate water supplies may be replaced with imported and/or renovated water. Wastewater controls will be minimal.

i. Only areas where on-lot disposal systems are subject to failure, or where the surface waters are threatened would be sewered. (This can be equated essentially to the minimum sewering option.)

ii. No new public water supply wells will be installed and existing public water supply wells will be abandoned as concentrations of nitrates or other contaminants exceed drinking water standards.

Alternative B—Total Reliance on Non-Structural Controls

i. Permit no additional sewering.

ii. Determine the acceptability of a given residential lot size and of commercial and industrial activities on the basis of their impact on groundwater quality.

iii. Strictly control, and possibly upgrade, on-site systems.

iv. Strictly regulate site development and management practices, such as grading and maintenance of vegetation to control runoff.

Alternative C—Minimum Sewering Option

i. Provide sewering for areas with six or more persons (two or more dwelling units) per gross acre in areas of high water table and/or low soil permeability.

ii. Provide sewering for all other areas with nine or more persons (three or more dwelling units) per gross acre.

Alternative D—Intermediate Sewering Option

Provide sewering for all areas with six or more persons (two or more dwelling units) per gross acre.

Alternative E—Maximum Sewering Option

Provide sewering for all areas with three or more persons (one or more dwelling units) per gross acre.

b. Highest Priority Areawide Alternatives

i. Reduce excessive use of irrigation water and require the permitting, regulation and monitoring of irrigation wells.

ii. Optimize the timing of agricultural fertilizer applications.

iii. Control the establishment of new landfills, and the expansion of existing ones. Upgrade existing landfills, where possible, to minimize further groundwater contamination. In cases of extreme hardship, new landfills may be permitted if extraordinary measures are taken to protect surface and groundwater. However, the relocation of landfills out of the zone should be encouraged.

iv. Optimize pumping patterns to minimize saltwater intrusion in public water supply wells.

v. Minimize population density by encouraging large lot development (one dwelling unit/one or more acres), where possible to protect the groundwater from future pollutant loadings.

vi. Prohibit the use of certain chemical cleaners in on-lot systems.

Zone V—Western South Fork

a. Wastewater Management Alternatives. The groundwater regime and quality problems resemble those of Zone IV, but agriculture is of less importance; therefore, the same alternatives as listed in Zone IV apply.

b. Highest Priority Areawide Alternatives

i. Minimize population density by encouraging large lot development (one dwelling unit/one or more acres), where possible, to protect the groundwater from future pollutant loading.

ii. Control the establishment of new landfills, and the expansion of existing ones. Upgrade existing landfills, where possible, to minimize further groundwater contamination. In cases of extreme hardship, new landfills may be permitted if extraordinary measures are taken to protect surface and groundwater. However, the relocation of landfills out of the zone should be encouraged.

iii. Reduce excessive use of irrigation water to minimize salt water intrusion.

iv. Optimize pumping patterns to minimize saltwater upconing.
v. Restrict the use of inorganic, fast-acting fertilizers. Promote the use of low-maintenance lawns.

Zone VI—Surface Water Impact Area. This zone is characterized by a shallow flow system, which directly impacts the water quality in eastern Great South Bay and Moriches Bay. In order to protect the important natural resources of the bays, it is necessary to maintain groundwater and stream nitrogen concentrations at, or below, two milligrams per liter. Alternatives developed for this zone stress the protection of the marine surface water quality.

a. Wastewater Management Alternatives

Alternative A—Total Reliance on Non-Structural Controls

i. Permit no additional sewering.
ii. Determine the acceptability of a given residential lot size and of commercial and industrial activities on the basis of their impact on groundwater quality.
iii. Strictly control, and possibly upgrade, on-site systems.
iv. Strictly regulate site development and management practices, such as grading and maintenance of vegetation, to control runoff.

Alternative B—Sewering Option

Provide sewering for all areas with three or more persons (one or more dwelling units) per gross acre.

Alternative C—New Ocean Inlet

If this alternative should prove feasible, it will relax the constraints in the above alternatives and permit the selection of additional options as described for Zone VII. Study the feasibility of constructing a new inlet(s) through the barrier island to control and reduce the nitrogen levels in eastern Great South Bay through improved dilution and dispersion.

b. Highest Priority Areawide Alternatives

i. Minimize population density by encouraging large lot development (one dwelling unit/two or more gross acres), where possible, to protect the groundwater from future pollutant loadings.
ii. Control stormwater runoff to minimize the transport of sediments, nutrients, metals, organic chemicals and bacteria to ground or surface waters.
iii. Control animal populations and animal waste disposal.
iv. New landfills should be permitted under current New York State policy, provided the site is landward of the primary coastal zone* and the depth to groundwater is sufficient to ensure an adequate unsaturated zone below the bottom of the landfill.
v. Restrict the use or inorganic, fast-acting fertilizers. Promote the use of low-maintenance lawns.
vi. Require nitrogen removal for treatment plants recharging effluent.
vii. Prohibit any new development along streams and shorelines. Create buffer zones where possible along all water bodies and protect all remaining marine wetlands.
viii. Prohibit the use of certain chemical cleaners in on-lot systems.
ix. Provide for routine maintenance of on-site disposal systems.

Zone VII—South Shore Shallow Flow System. Hydrogeologically, this zone, which contains parts of Nassau and western Suffolk Counties, is similar to Zone VI. Most of the area, however, is currently sewered or is scheduled for sewering within the near future. The alternatives offered for this zone relate primarily to the protection of surface waters. Whereas the adjacent surface waters are not generally as sensitive to nutrient loading as is eastern Great South Bay, the eastern portion of Zone VII does, however, contribute to the nitrogen loading of eastern Great South Bay.

a. Wastewater Management Alternatives

Alternative A—Minimum Sewering Option

i. Provide sewering for areas with six or more persons (two or more dwelling units) per gross acre in areas of high water table and/or low soil permeability.
ii. Provide sewering for all other areas with nine or more persons (three or more dwelling units) per gross acre.

Alternative B—Intermediate Sewering Option

Sewer as in Alternative A and also in areas where potable water is currently obtained from the Glacial aquifer, and densities reach six or more persons (two or more dwelling units) per gross acre.

Alternative C—Maximum Sewering Option

Implement all presently proposed sewer plans, and expand sewering to cover all areas with three or more persons (one or more dwelling units) per gross acre.

b. Highest Priority Areawide Alternatives

i. Control stormwater runoff to minimize the transport of sediments, nutrients, metals, organic chemicals and bacteria to ground or surface waters.
ii. Control animal populations and animal waste disposal.
iii. New landfills should be permitted under current New York State policy, provided the site is landward of the primary coastal zone* and the depth to groundwater is sufficient to ensure an adequate unsaturated zone below the bottom of the landfill.

*The primary coastal zone extends landward for 1000 feet or to the ten foot elevation whichever includes the greater distance from the shoreline or from any stream flowing into marine waters.

Zone VIII—North Shore Shallow Flow System. Although Zones VII and VIII differ hydrogeologically, both are areas that are likely to contribute recharge only to the shallow groundwater system. This flow discharges primarily to streams and marine surface waters, and hence will have a greater effect on these surface systems than on the deep flow drinking water supply. Since Zones VII and VIII are similar with respect to groundwater and surface water constraints, the same alternatives (both areawide and wastewater management) apply to both. The Glen Cove area presents a special problem in that portions of the water supply have been seriously impaired by organic chemical contamination. Water supply options listed for Zone II are applicable to the Glen Cove sector of Zone VIII.

3.5.2.2 Surface Water Alternatives

A. Western Long Island Sound. Western Long Island Sound waters contain high levels of solids, nitrogen and coliform bacteria. Since most of the suspended solids, nitrogen and coliform bacteria levels in western Long Island Sound can be traced to discharges within New York City, Sound conditions are largely beyond the control of the Nassau-Suffolk 208 Program. Long Island Sound conditions are a dominant influence on Manhasset Bay and Hempstead Harbor. Thus, it is the responsibility of the USEPA and the NYSDEC to require the implementation of waste controls necessary to improve water quality to meet the standards specified for this surface water element. These controls may include nitrogen removal for existing sewage treatment plants and the retention and treatment of combined sewer overflows. Pretreatment for metals and/or organic chemicals may be required if it can be shown that toxic contaminants originating in New York City impact Nassau-Suffolk surface waters.

B. Manhasset Bay. Although the contaminant concentrations in western Long Island Sound dominate the water quality within Manhasset Bay, existing point and non-point sources in this embayment currently produce localized high nitrogen and coliform levels. The following options are available for control of these local conditions.

a. Point Source Control Alternatives:

Alternative i Upgrade the Port Washington, Great Neck Sewer District and the Great Neck Village Sewage Treatment Plants to include nitrogen removal, with outfalls remaining at their present locations.

Alternative ii Retain secondary treatment and move present sewage treatment plant outfalls to a mid-bay location.

Alternative iii Divert sewage influent out of the area to the Cedar Creek treatment facility.

Alternative iv Divert sewage flows from Great Neck Sewer District and the Village of Great Neck to the Port Washington treatment facility.

Alternative v Delay upgrading, relocations or diversions until western Long Island Sound improvements are committed. Make no local improvements if minimum sewering is selected for the unsewered portions of the surrounding area.

b. Highest Priority Non-point Source Control Measure:

i. Control stormwater runoff to minimize the transport of sediments, nutrients, metals, organic chemicals and bacteria to surface waters.

ii. Strictly enforce existing ordinances prohibiting the discharge of untreated wastes from boats.

C. Hempstead Harbor. The characteristics of this embayment are similar to those of Manhasset Bay. However, the influence of western Long Island Sound is less dominant. The following control options should be considered for Hempstead Harbor.

a. Point Source Control Alternatives:

Alternative i Implement nitrogen removal for both the Glen Cove and Roslyn Sewage Treatment Plants.

Alternative ii Retain secondary treatment and relocate outfalls to mid-harbor sites for both the Glen Cove and Roslyn Sewage Treatment Plants.

Alternative iii Divert the Roslyn influent to Glen Cove, Port Washington or Cedar Creek.

Alternative iv Delay upgrading, relocations or diversions until western Long Island Sound improvements are committed. Make no local improvements if minimum sewering is selected for the unsewered portions of the surrounding service area.

b. Industrial Point Source Control Alternatives:

Monitor and abate all industrial discharges to Glen Cove Creek.

c. Highest Priority Non-point Source Control Measures:

i. Control stormwater runoff to minimize the transport of sediments, nutrients, metals, organic chemicals and bacteria to surface waters.

ii. Encourage the relocation of solid waste handling operations and landfills, which are now sited within the coastal zone, to sites outside it.

D. Oyster Bay. Oyster Bay has relatively good water quality and is surrounded by a large number of wetland areas. Except for the densely developed, unsewered Bayville area, which is affected by on-site treatment system failures, the choices for this surface water body relate to the level of commitment to the maintenance of a pristine Oyster Bay environment. Non-point source controls are especially important for the protection of the local shellfishing industry.

a. Point Source Control Alternatives:

Alternative i Retain the present method of treatment and outfall for the Oyster Bay Sewage Treatment Plant. If a plant

is constructed at Bayville, locate the outfall in Long Island Sound.

Alternative ii Divert the Oyster Bay influent (and Bayville, if sewered) out of the area to the Cedar Creek treatment facility in order to retain the relatively pristine quality of the embayment.

Alternative iii Implement nitrogen removal at the Oyster Bay treatment facility.

Alternative iv Divert the Oyster Bay influent (and Bayville, if sewered) to the Glen Cove treatment facility.

b. Highest Priority Non-point Source Control Measures:

i. Control stormwater runoff to minimize the transport of sediments, nutrients, metals, organic chemicals and bacteria to surface waters.

ii. Prohibit, or severely restrict, all further development in shoreline areas. Establish adequate buffer zones around wetlands. Assign priority to public acquisitions, based on the protection of groundwater quality and natural resources.

iii. Strictly implement existing ordinances prohibiting the discharge of untreated wastes from boats.

E. Huntington Bay. Water quality data shows that the four harbor areas in Huntington Bay exhibit high nitrogen levels and depressed dissolved oxygen levels. Thus, whether or not minimum sewering options are selected, the discharges into those bays require more extensive treatment.

a. Point Source Control Alternatives:

Alternative i Institute nitrogen removal for both the Huntington and Northport Sewage Treatment Plants.

Alternative ii Relocate Huntington and Northport outfalls to mid-bay and allow secondary treatment to be continued.

Alternative iii Institute tertiary treatment and recharge.

Alternative iv Divert all sewage flows to the Huntington treatment facility, or to an alternative regional site.

Alternative v Serve areas outside existing sewered areas by small treatment plants with effluent recharge.

b. Highest Priority Non-point Source Control Measures:

i. Control stormwater runoff to minimize the transport of sediments, nutrients, metals, organic chemicals and bacteria to surface waters.

ii. Strictly implement existing ordinances prohibiting the discharge of untreated wastes from boats.

iii. Control animal populations and animal waste disposal.

F. Port Jefferson Harbor. Modeling studies of Port Jefferson Harbor show that sewage treatment plant loads will affect bay water quality only if flows increase significantly.

a. Point Source Control Alternatives:

Alternative i Utilize secondary treatment and present discharge location, provided that there is no significant increase in flow.

Alternative ii Institute nitrogen removal for the Port Jefferson sewage treatment plant.

Alternative iii Relocate the outfall to mid-harbor and allow for secondary treatment.

b. Highest Priority Non-point Source Control Measures:

i. Control stormwater runoff to minimize the transport of sediments, nutrients, metals, organic chemicals and bacteria to surface waters.

ii. Strictly implement existing ordinances prohibiting the discharge of untreated wastes from boats.

G. Flanders Bay—Peconic Estuary. The Peconic Estuary, into which the Riverhead Sewage Treatment Plant now empties, shows high chlorophyll counts and frequently low dissolved oxygen levels. A similar condition exists in the numerous creeks that flow into Flanders and Peconic Bays. Thus, discharges into the Peconic Estuary can only be allowed if nitrogen removal is instituted and if flows do not increase significantly.

a. Point Source Control Alternatives:

Alternative i If minimum sewering options are selected for the Riverhead service area, institute nitrogen removal for the Riverhead Sewage Treatment Plant.

Alternative ii If minimum sewering options are selected for the Riverhead service area, then utilize secondary treatment with relocation of the outfall to a mid-bay location.

Alternative iii If one D.U./acre or two D.U./acre sewering options are selected for the Riverhead service area, institute nitrogen removal for the Riverhead Sewage Treatment Plant and relocate the outfall to an open bay location.

Alternative iv If one D.U./acre or two D.U./acre sewering options are selected for the Riverhead service area, relocate the treatment plant outfall to Long Island Sound or Flanders Bay.

Alternative v Institute tertiary treatment and recharge.

b. Highest Priority Non-point Source Control Measures:

i. Control stormwater runoff to minimize the transport of sediments, nutrients, metals, organic chemicals and bacteria to surface waters.

ii. Prohibit, or severely restrict, all further development in shoreline areas. Establish adequate buffer zones around wetlands. Assign priority to public acquisition, based on the protection of groundwater quality and natural resources.

iii. Initiate a study to determine the impact of duck sludges as a source of nutrients and bacteria, and the feasibility of their removal.

c. Special Monitoring Requirements:
Provide for further monitoring, specifically for dissolved oxygen nutrients and chlorophyll a to better define and select one of the point source control alternatives.

H. Mecox Bay. The only outlet for Mecox Bay is an ephemeral channel connecting to the Atlantic Ocean. This inlet provides limited flushing and drainage of the bay approximately 50 percent of the time. In order to protect the important natural resources of the bay, it is necessary to maintain groundwater and stream nitrogen concentrations at, or below, two milligrams per liter.

a. Point Source Control Alternatives:
Alternative i Prohibit new point source discharges to the bay.
Alternative ii Provide nitrogen removal or complete effluent recycling for duck farm discharges located in the drainage area.

b. New Inlet Alternatives:
Study the feasibility of stabilizing the inlet from the Atlantic Ocean to provide adequate flushing and dispersion.

c. Highest Priority Non-point Source Control Measures:
i. Prohibit, or severely restrict, all further development in shoreline areas. Establish adequate buffer zones around wetlands. Assign priority to public acquisition, based on the protection of groundwater quality and natural resources.
ii. Provide for routine maintenance of on-site disposal systems.
iii. Restrict the use of inorganic, fast-acting fertilizers. Promote the use of low-maintenance lawns.
iv. Initiate a study to determine the impact of duck sludges as a source of nutrients and bacteria and the feasibility of their removal.

I. Shinnecock Bay. Shinnecock Bay is a shallow bar-built estuary, whose water quality is regulated by tidal flushing through the ocean inlet. The inlet is in a mode of unstable deposition, and it is imperative to keep it open in order to maintain the present water quality conditions.

a. Point Source Control Alternatives:
Alternative i Prohibit new point source discharges to the bay.
Alternative ii Maintain the ocean inlet to provide adequate flushing and dispersion.

b. Highest Priority Non-point Source Control Measures:
i. Prohibit, or severely restrict, all further development in shoreline areas. Establish adequate buffer zones around wetlands. Assign priority to public acquisition, based on the protection of groundwater quality and natural resources.
ii. Provide for the routine maintenance of on-site disposal systems.
iii. Control stormwater runoff to minimize the transport of sediments, nutrients, metals, organic chemicals and bacteria to surface waters.

J. Moriches Bay. Moriches Bay is a shallow bar-built estuary, whose water quality is regulated by tidal flushing through the ocean inlet. The inlet is currently subject to an unstable scouring trend, and flushing is increasing. However, it is still desirable to maintain groundwater and stream nitrogen concentrations at, or below, two milligrams per liter in order to protect the bay's important natural resources.

a. Point Source Control Alternatives:
Alternative i Prohibit new point source discharges to the bay.
Alternative ii Provide nitrogen or complete effluent removal from duck farms located in the drainage area.

b. Highest Priority Non-point Source Control Measures:
i. Control animal populations and animal waste disposal.
ii. Control stormwater runoff to minimize the transport of sediments, nutrients, metals, organic chemicals and bacteria to surface waters.
iii. Initiate a study to determine the impact of duck sludges as a source of nutrients and bacteria and the feasibility of their removal.

K. Great South Bay. Great South Bay is a large and complex system. Control strategies for specific pollutant loads need to be formulated on a case by case basis using the available data analyses and modeling tools. In general, western Great South Bay is well flushed and eastern Great South Bay is poorly flushed. Strict controls are required for the eastern portions of the bay. In order to protect the important natural resources of the bay, it is necessary to maintain groundwater and stream nitrogen concentrations at, or below, two milligrams per liter.

a. Point Source Control Alternatives:
Alternative i Prohibit new point source discharges into eastern Great South Bay and divert to an ocean outfall.
Alternative ii Prohibit new point source discharges into eastern Great South Bay and recharge tertiary treated effluent.
Alternative iii Provide nitrogen removal for the Patchogue Sewage Treatment Plant.

b. New Inlet Alternative:
Study the feasibility of constructing a new inlet through the barrier island to control and reduce the nitrogen levels in eastern Great South Bay.

c. Highest Priority Non-point Source Control Measures:
i. Control stormwater runoff to minimize the transport of sedi-

ments, nutrients, metals, organic chemicals and bacteria to surface waters.

ii. Control animal populations and animal waste disposal.

iii. Restrict the use of inorganic, fast-acting fertilizers. Promote the use of low-maintenance lawns.

iv. Require nitrogen removal for treatment plants recharging effluent.

v. Prohibit any new development along streams and shorelines. Create buffer zones where possible along all water bodies and protect all remaining marine wetlands.

vi. Strictly implement existing ordinances prohibiting the discharge of untreated wastes from boats.

L. Western South Shore Bays. Western South Shore bays are relatively well flushed but are sensitive to high pollutant loads. The dominant nitrogen and coliform loads requiring control are contributed by the Bay Park Treatment Plant discharge.

a. Point Source Control Alternatives:

Alternative i Locate the Bay Park Sewage Treatment Plant outfall offshore.

Alternative ii Divert the Long Beach Sewage Treatment Plant effluent to the proposed Bay Park ocean outfall.

Alternative iii Institute further study to determine which of the following steps should be selected, if water quality standards are violated in Bannister Creek: divert the Lawrence treatment facility effluent to Reynolds Channel; divert the influent to the Bay Park plant; provide nitrogen removal.

b. Highest Priority Non-point Source Control Measures:

i. Control stormwater runoff to minimize the transport of sediments, nutrients, metals, organic chemicals and bacteria to surface waters.

ii. Control animal populations and animal waste disposal.

iii. Strictly implement existing ordinances prohibiting the discharge of untreated wastes from boats.

M. Nearshore Atlantic Ocean. It is the responsibility of the USEPA and NYSDEC to implement the necessary wastewater controls to prevent the discharge of contaminants and floatable material into the New York Bight. Such contaminants and floatables have periodically impaired the use of regional ocean bathing beaches. These regulations should apply to the control and treatment of raw or inadequately treated sewage discharges, industrial discharges and combined sewer overflows from sites located in New York City and New Jersey.

N. Fresh Water Bodies. Non-point pollution is the major source of contamination of streams and lakes. Generally, the water quality problems are caused by excessive nutrient and bacteria loadings. However, the greatest problem is not the effects of these contaminants on the streams themselves, but the contribution they make to the pollution of some of the bays.

a. Point Source Control Alternatives:

Require nitrogen removal for all treatment plants which discharge to streams.

b. Highest Priority Non-point Source Control Measures:

i. Control stormwater runoff to minimize the transport of sediments, nutrients, metals, organic chemicals and bacteria to surface waters.

ii. Control animal populations and animal waste disposal.

iii. Prohibit any new development along streams and shorelines. Create buffer zones where possible along all water bodies, and protect all remaining marine wetlands.

iv. Provide for routine maintenance of on-site disposal systems.

3.5.3 Selection of Alternatives for the Areawide Waste Treatment Management Plan. Section Three has marshalled all the significant options available for the management of point and non-point sources, and has identified those which are most pertinent to the hydrogeologic zones and surface water segments of Nassau and Suffolk Counties. The economics have been discussed, wherever useful information is available.

It has been seen that marine surface water quality is closely associated with the quality of groundwater in adjacent areas. Furthermore, the enhancement of both groundwater and surface water quality demands the employment of many of the same point and non-point source controls, both structural and non-structural.

The environmental impacts of all the pertinent options are examined in the following section, Section Four.

On the basis of the information summarized in Section Three and Four (and available, in full, in the reports generated in the course of the 208 Study Program), the final selection of alternatives of the Areawide Waste Treatment Management Plan is made and discussed in Section 5.