NONPOINT SOURCE MANAGEMENT HANDBOOK

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Long Island Regional Planning Board
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INTRODUCTION

The 208 Implementation Program

The Long Island Comprehensive Waste Treatment Management Plan, prepared pursuant to Section 208, of the Federal Water Pollution Control Act Amendment of 1972 (PL92-500), was completed by the Long Island Regional Planning Board (LIRPB) in July, 1978. The Plan identified nonpoint sources of pollution as a major cause of both groundwater and surface water contamination. This Handbook, which has been prepared as part of the U.S.E.P.A. 208 Plan Implementation Program, focuses on existing problems and needed controls for nonpoint sources of contamination. Various nonpoint source impacts on ground and surface waters and relevant legislation are discussed. A series of state, municipal and non-government actions are recommended for the control or mitigation of undesirable impacts. The Handbook has been designed to meet the needs of several diverse groups including laymen, site planners, engineers and architects; professional staff of Municipal Planning, Highway, Environmental, Engineering, Parks and Recreation, and Public Works Departments and elected officials.

Geographic Description of Long Island

Nassau and Suffolk Counties comprise 750,000 acres or 1,172 miles, approximately one-sixth of the entire New York Metropolitan Region (See Map).

Although the pace has slowed in recent years, the bicounty area has been one of the fastest growing areas in the United States since World War II. The 1980 Census of Population counted 2,605,813 persons in Nassau and Suffolk Counties. According to Land Use 1981 (LIRPB-December 1982), about 9.5% of the lands in Nassau and 32.2% of the lands in Suffolk remain vacant and available for development. In addition to the vacant land, there is considerable acreage, particularly in the agricultural category (exclusive of those parcels in the Suffolk County Farmland Preservation Program), and land currently used for sand mining operations that is likely to become available for development.

Long Island is totally dependent on underground aquifers for all of its drinking water. The LIRPB’s Waste Treatment Management Plan identified eight hydrogeologic zones comprising both deep recharge and shallow discharge zones in Nassau and Suffolk Counties. Knowledgeable management of these areas is essential to maintain groundwater quality and quantity.

Surface waters are also an important resource for Long Island residents and tourists alike. There are more than 1,000 linear miles of stream, river, ocean, bay and Long Island Sound frontage. The Long Island Sound, the bays and the Atlantic Ocean offer excellent opportunities for recreation and marine-related activities. Both the Long Island tourism and fishing industries rely heavily on the perception and reality of clean beaches and waters.

Purpose of the Handbook

The purpose of the Handbook is to identify cause-effect relationships and to provide the best available guidance for use by public officials, developers and Long Island residents concerned with the protection of ground and surface waters. The major objectives, which underlie the recommendations, are maximization of the recharge of high quality groundwater to the aquifers, minimization of pollutant loadings from all land uses and reduction of the amount of consumptive use of groundwater, particularly in shoreline areas or other areas where quantities are limited.
Nonpoint sources, unlike point sources—which are generally controlled by a clearly identifiable agency—require control through action by several agencies and individuals. The control of runoff-borne contaminants requires the parallel, coordinated efforts of legislators and administrators at all levels of government and of knowledgeable citizens.

In order to obtain the best possible information for the handbook, numerous sources were consulted among them, State, County and local officials and other professionals with specific expertise relative to the subject. The Handbook provides the user with a compilation of materials developed from this knowledge and summarized in a single volume. After chapters were completed in draft form, both the 208 Technical Advisory Committee (TAC) and the Citizens Advisory Committee (CAC) reviewed and commented on them. Their thoughtful criticism, and that of other reviewers is reflected in the final document.

There are ten chapters in the Handbook, eight identify and discuss specific non-point sources: Land Use; Well Location, Construction, Use and Abandonment; On-Site Systems; Stormwater Runoff; Fertilizers; Animal Wastes; Highway Deicing and Boat Pollution. The Site Plan Review Process Chapter provides recommendations for minimizing groundwater or surface water impacts through an effective site plan review process. Each of these chapters is divided into three main sections: Key Problems, Existing Management, and Recommendations. The Ordinances chapter includes both existing and proposed ordinances for the control of nonpoint source pollutants.

The reference section provides the user with sources for all the topics in the handbook. The references are presented by chapter to facilitate the location of the sources. A glossary is also provided in this section. Words included in the glossary were chosen based upon the importance of their meaning in relation to the understanding of the subject. Most of these words appear in italics in the chapter; however, some do not. In addition, some words which appear in italics were found to be self-explanatory and therefore were not included in the glossary.

How to Use the Handbook

The 208 Nonpoint Source Management Handbook is presented in a loose-leaf form, with tabs to facilitate the location of specific chapters. The format permits easy removal and reinsertion of needed chapters and additional sections, as available, and any relevant information or notes.

The Handbook—
- Discusses the cumulative impacts of nonpoint source pollutants, thus giving readers a perspective on the problem.
- Recommends various nonpoint source controls for each nonpoint source pollutant.
- Offers guidelines for siting, layout and density of development for single properties and subdivisions.
- Shows how plan implementation strategies can be developed by integrating the information contained in several chapters.
- Facilitates the preparation of Environmental Assessments and Impact Statements.
- Furnishes technical justification for the adoption of needed nonpoint source controls.
- Provides model ordinances.
A detailed explanation of the subject matter of each chapter is provided below.

1. Land Use—discusses existing land uses on Long Island, their relationship to the Hydrogeologic Zones, and existing controls. Makes recommendations for necessary controls relative to the location and siting of various land uses in particular areas and zones.

2. Stormwater—discusses stormwater processes and constituents, drainage system design and operation, impacts on ground and surface waters and existing management and legislation. Makes recommendations for appropriate stormwater controls and development guidelines.

3. On-Site—discusses current siting practices, system functions and maintenance and existing regulations. Makes recommendations for needed legislation, administration, siting, guidelines and proper maintenance.

4. Highway Deicing—discusses existing highway deicing and salt storage practices and existing management. Makes recommendations for the control of salt application and salt storage.

5. Fertilizer—discusses current fertilizer practices (residential, agricultural) and the effects on groundwater. Makes zoning and site development recommendations for decreasing fertilizer use and the utilization of alternative groundcovers.


7. Well Location, Construction, Use and Abandonment—discusses all of these aspects. Makes general recommendations regarding the permit and review program and techniques for the proper siting, construction and use of wells and appropriate well abandonment procedures.

8. Boat Pollution—discusses boating practices, maintenance, disposal of sanitary wastes and the associated effects on surface waters. Makes recommendations for the control of houseboats, boating practices and proper use of marine sanitation devices.

9. Site Plan Review—discusses the existing site plan review process and its relationship to controlling some of the nonpoint sources discussed in the other chapters. Makes recommendations for streamlining the process while ensuring that the appropriate nonpoint source controls are implemented.

10. Ordinances—The last chapter includes a compilation of existing and proposed ordinances. These ordinances are used to illustrate alternative ways of meeting the water resource protection needs of a particular municipality. The existing ordinances are currently being used on Long Island or in various other states. These ordinances, in the judgment of the LICPB constitute the best available models for the control of the impact of a particular nonpoint source. Some of these ordinances may be used in their present form, while others may need to be tailored to the specific needs of the municipality.

The Handbook will be distributed on Long Island and to other parts of the country where similar conditions may exist. Ultimately use of the Handbook should help to create a better understanding of existing problems and to improve the environment, particularly ground and surface waters.
ACKNOWLEDGEMENTS

This Handbook has been the product of a collective endeavor in the best sense of that term. Interdisciplinary skills, involving a wide array of talents and expertise from all levels of government were required. Extensive reviews, including editing and the addition of essential information, have assisted in the creation of a comprehensive document.

This volume could not have been properly completed without the participation and support of many people whose contributions are too numerous to list here. The names of the major contributors are listed in the credits. The Long Island Regional Planning Board wishes to take this opportunity to express its sincere thanks to them and to the other unnamed individuals who have helped to make this Handbook a reality.

However, the Board would be remiss if it did not express a special appreciation to our professional colleagues in the New York regional office of the Environmental Protection Administration whose support, guidance, encouragement and professional input were so important to us over the past decade in facilitating the conduct of our Long Island Comprehensive Waste Treatment planning; our National Urban Runoff Program; and now this effort on implementation. I also must commend Dr. Edith Tanenbaum and Carole Swick of my staff for their dedicated, diligent application to this complex study.

Lee E. Koppelman
Chapter One

INTRODUCTION

Land use and related activities are a source of contamination to ground and surface waters; however, many existing land use plans and zoning ordinances fail to reflect current water quality concerns.

Some understanding of the groundwater system and the impacts of past land use activities upon this system is essential to the development of comprehensive plans and implementing measures needed to minimize future impacts upon groundwater. A generalized illustration of the groundwater system is presented in Figure 1.

There are three major aquifers or water-bearing units on Long Island:

- The Upper Glacial is a shallow aquifer
- The Magothy (upper and lower) and the Lloyd are deep aquifers

They are composed of unconsolidated sands and gravels. The Upper Glacial and the Magothy are the primary sources of potable water. The Lloyd aquifer, which underlies the Magothy, is not generally used for water supply except in a few locations.

Approximately fifty percent of the annual precipitation recharges the Long Island aquifers. Rainfall entering the Upper Glacial aquifer moves as groundwater flow as shown in Figure 1. Prior to recharging the aquifer, the infiltration water may be contaminated by inorganic and organic pollutants discharged into the air, on the land, or into the unsaturated zone above the water table. The impacts of these discharges will vary according to location.

In 1978, the Long Island Regional Planning Board published the Long Island Comprehensive Waste Treatment Management Plan (208 WTMP). The plan introduced the concept of hydrogeologic zones based upon differences in underlying groundwater flow patterns and water quality. See Figure 2. The zones are land areas that recharge either deep aquifers or shallow aquifers and/or are discharge zones. The plan identified eight hydrogeologic zones, which are described briefly in the following paragraphs.*

* Since the completion of the 208 WTMP, a USGS study of the groundwater on the South Fork identified additional deep recharge zones in Zones IV and V which are shown in Figure 2.
FIGURE 2  Hydrogeologic Zones
• Zones I, II, III are the major deep aquifer recharge zones. Zone I, located in Nassau County and western Suffolk, contributes water to the middle and lower portions of the Magothy Aquifer. The Glacial aquifer and portions of the Magothy have been contaminated by nitrates from fertilizers and on-site systems and organics resulting from industrial and other discharges. Initially, the nitrate contamination resulted from farming and then, later, from urbanization.

• Zone II, located in eastern Nassau County and a portion of western Suffolk County, is bordered on three sides by Zone I. Groundwater in this zone is generally contaminated and the contamination is spreading beyond the zone boundary.

• Zone III, located in central Suffolk and a small portion of eastern Suffolk County, includes a major portion of the Long Island Pine Barrens. Most of the area within the zone is undeveloped and contains groundwater of excellent quality in the Upper Glacial and Magothy aquifers. Some contamination occurs in the Glacial aquifer in the western portion of the zone, primarily due to the impacts of development, including the discharge of sewage from package treatment plants and on-site systems. It appears likely that there are several small plumes of contamination that originated in old landfills or as a result of spills and other activities.

• Zone IV encompasses the North Fork, Shelter Island, and the eastern portion of the South Fork; Zone V, the remainder of the South Fork. The groundwater underlying the deep recharge areas on the South Fork (See Figure 3) is generally of excellent quality.

• The rest of Zone IV and V, as well as Zones VI, VII, and VIII are characterized by shallow flow systems that discharge to streams and marine waters. Zone IV on the North Fork has been contaminated as a result of agricultural activities. A few areas of Zone V have also been impacted by agricultural activities.

• Zone VI, located on the south shore of Suffolk County, discharges streamflow and underflow to Moriches Bay and eastern Great South Bay. A large portion of these waters are poorly flushed and contaminated in some areas.

• Zone VII is also located on the south shore and discharges to Nassau and western Suffolk south shore bays, where greater tidal exchange facilitates the dilution and dispersion of contaminants.

• Zone VIII is located on the north shore of Nassau and Suffolk Counties. Groundwater flows toward the harbors, bays, or to the Sound.

In spite of extensive development within Nassau and Suffolk counties in the past fifteen years, vacant, agricultural, recreational and open space land uses still account for approximately fifty percent of the total acreage in the bi-county area. Vacant land and some of the recreational and open space lands serve to protect the groundwater quality.

Land use activities can have significant impacts upon groundwater quantity and quality. The variation in the impacts of land use activities on groundwater is dependent upon the location of the activities, the pollutant loading resulting from the activities, the amount of recharge from precipitation, and the characteristics of the aquifer system.

In the past, land use plans and zoning ordinances, which specify the location and distribution of land uses, often reflected little consideration of the need for groundwater protection. The plans called for the location of industry and similarly incompatible land uses in deep aquifer recharge areas. Other environmental factors were not always considered; non-compatible uses were also placed on wetlands, areas with high water tables and within the 100 year flood plain, along stream corridors and on steep slopes. In recent years, some towns have used upzoning, open space acquisitions, and site plan and subdivision review to reduce environmental impacts and to protect groundwater. Several towns are currently in the process of revising their comprehensive plans to protect water quality and satisfy other related environmental concerns.

The land uses on Long Island can be divided into a number of categories. Table 1 represents the Land Use classification used by the Long Island Regional Planning Board. Various activities associated with the different land uses are presented.
**TABLE 1**

Land Use Classifications — 1981

<table>
<thead>
<tr>
<th>Residential</th>
<th>Commercial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Res. Residential</td>
<td>Hotels-Motels</td>
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<tr>
<td>Single Family</td>
<td>Commercial establishments in which</td>
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<tr>
<td>Two-Family</td>
<td>short term lodging is the major</td>
</tr>
<tr>
<td>Multi-Family</td>
<td>business activity —</td>
</tr>
<tr>
<td>Farm Houses</td>
<td>Hotels</td>
</tr>
<tr>
<td>Estates</td>
<td>Motels</td>
</tr>
<tr>
<td>Rooming &amp; Boarding</td>
<td>Cabins</td>
</tr>
<tr>
<td>Houses</td>
<td></td>
</tr>
<tr>
<td>Seasonal Houses</td>
<td>Establishments whose main purpose is</td>
</tr>
<tr>
<td>Trailers</td>
<td>the sale or rendering of a personal</td>
</tr>
<tr>
<td></td>
<td>service on a retail level and not</td>
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<td></td>
<td>listed under “offices.”</td>
</tr>
<tr>
<td>Low Density</td>
<td>Retail &amp; Services</td>
</tr>
<tr>
<td>- 1 Dwelling Unit or</td>
<td>Service Stations</td>
</tr>
<tr>
<td>less/acre</td>
<td>Dealers</td>
</tr>
<tr>
<td>Medium Density</td>
<td>Repair, painting and washing</td>
</tr>
<tr>
<td>- 2-4 D.U./acre</td>
<td>Tire sales</td>
</tr>
<tr>
<td>Intermediate Density</td>
<td>Seat cover installation</td>
</tr>
<tr>
<td>- 5-10 D.U./acre</td>
<td>Boat yards and marinas (private)</td>
</tr>
<tr>
<td>High Density</td>
<td>Sales and services</td>
</tr>
<tr>
<td>- 11 or more D.U./acre</td>
<td>Fishery services</td>
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<td></td>
<td>Boat Storage</td>
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<td>Commercial-Marine</td>
<td>Recreational</td>
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<td>Commercial</td>
<td>Amusement parks</td>
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<tr>
<td>Transportation,</td>
<td>Beaches and Pools (profit oriented)</td>
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<tr>
<td>Communications,</td>
<td>Billiards</td>
</tr>
<tr>
<td>Utilities</td>
<td>Bowling</td>
</tr>
<tr>
<td>(including expressways,</td>
<td>Dance (school, hall, studio, etc.)</td>
</tr>
<tr>
<td>major highways and</td>
<td>Day camps and nursery schools</td>
</tr>
<tr>
<td>parking areas)</td>
<td>Miniature golf and driving ranges</td>
</tr>
<tr>
<td></td>
<td>Theaters — indoor and drive-in</td>
</tr>
<tr>
<td></td>
<td>Sports arenas, skating rinks</td>
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<tr>
<td></td>
<td>Race tracks</td>
</tr>
<tr>
<td>Industrial</td>
<td>Offices</td>
</tr>
<tr>
<td>Recreation &amp; Open</td>
<td>Banks, credit agencies and loan</td>
</tr>
<tr>
<td>Space (including</td>
<td>companies</td>
</tr>
<tr>
<td>parkways)</td>
<td>Investment and securities</td>
</tr>
<tr>
<td></td>
<td>Advertising, blueprinting and mailing</td>
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<tr>
<td></td>
<td>services</td>
</tr>
<tr>
<td>Agricultural</td>
<td>Doctors, dentists &amp; legal services</td>
</tr>
<tr>
<td>Vacant (including</td>
<td>Medical labs and animal hospitals</td>
</tr>
<tr>
<td>unused land around</td>
<td>Employment and travel agencies</td>
</tr>
<tr>
<td>large residences)</td>
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<td>Water</td>
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<table>
<thead>
<tr>
<th>Industrial</th>
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<tr>
<td>Manufacturing</td>
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</tr>
<tr>
<td>Non-Manufacturing</td>
<td>Quasi-Public</td>
</tr>
<tr>
<td>Mining</td>
<td>Beaches and pools</td>
</tr>
<tr>
<td></td>
<td>Golf courses, conservation and wildlife areas, arboretas</td>
</tr>
<tr>
<td></td>
<td>Cemeteries</td>
</tr>
<tr>
<td></td>
<td>Marinas and boat ramps</td>
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<tr>
<td></td>
<td>Parks</td>
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<td></td>
<td>Playgrounds</td>
</tr>
<tr>
<td></td>
<td>Beach clubs, golf clubs, gun clubs</td>
</tr>
<tr>
<td></td>
<td>Cemeteries, scout camps and all non-profit recreation</td>
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<tr>
<td>Transportation-Utilities-</td>
<td>Agriculture</td>
</tr>
<tr>
<td>Communications</td>
<td>Vacant</td>
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<tr>
<td>Utilities</td>
<td>Tidal land</td>
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<tr>
<td></td>
<td>Land not in use</td>
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<tr>
<td></td>
<td>Land containing abandoned buildings</td>
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<td></td>
<td>Urban renewal-approved areas</td>
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<tr>
<td></td>
<td>Recharge basins, drainage areas</td>
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<tr>
<td></td>
<td>Lakes and inland fresh water</td>
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<tr>
<td></td>
<td>South Shore only:</td>
</tr>
<tr>
<td></td>
<td>Channels and bays (excludes Peconic Bay)</td>
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<td></td>
<td>Wetlands-conservation water areas</td>
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<tr>
<td></td>
<td>Inland</td>
</tr>
<tr>
<td>Transportation</td>
<td>Tidal</td>
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<tr>
<td>Railroads</td>
<td></td>
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<tr>
<td>Airports</td>
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KEY PROBLEMS

Land use activities vary in the amount of pollutant loadings to groundwater and surface waters, and in the consumptive use of groundwater. In Nassau and western Suffolk, sewage treatment plants discharge large volumes of groundwater to marine waters causing a long term reduction in available groundwater. As a result, significant reductions in streamflow, stream length and wetland acreage have occurred.

Residential

All of the hydrogeologic zones contain residential land uses. The highest density residential uses are located in Nassau County (portions of Zone I, II and VII). In Suffolk County, 2-4 units per acre density constitutes the major residential land use category in the western and central portion of the county (Portions of Zones I and most of Zone VII.) (See Land Use 1981 - Quantification and Analysis of Land Use for Nassau and Suffolk Counties, Long Island Regional Planning Board, December 1982). Residential uses generally become less intensive from west to east in Suffolk County.

The pollutant loadings attributable to residential land use activities vary according to residential density and the degree of sewage treatment. Residential densities at or greater than 2-4 dwelling unit/acre have a significant impact on water quality. In areas where septic systems are utilized, nitrate-nitrogen, other inorganic chemicals, toxic and non-toxic metals, organic chemicals, bacteria and viruses are discharged. (See the chapter on On-site Systems.) Sewering also impacts groundwater quality. When sewage treatment plants discharge to groundwater, partial treatment or plant malfunctioning may contribute undesirable nitrate and other pollutant loadings.

A large portion of the developed residential acreage is in turf or other plantings that require the use of fertilizers, pesticides and herbicides that release nitrogen and organic chemicals. Lawns are a major source of nitrates. A one acre residential development with an extensive lawn area and a septic system may contribute nitrate contamination equal to that contributed by a 2 unit/acre residential development with less extensive lawns and septic systems. Lawn irrigation may also impact aquifers through the over-pumping of the water supply. Other problems may result from the discharge of crankcase oil, paint, paint thinners, solvents and degreasers, from possible spills from oil trucks and gasoline and fuel oil tank leakages.

Commercial

Commercial uses occur in all zones, but they are most prevalent in Zones I and II. In Nassau County the most extensive commercial activity is located in the vicinity of Garden City, Hempstead Village and Roosevelt Field. In Suffolk, major commercial activity is located along Route 110, from the Northern State Parkway to the Southern State Parkway. There are also numerous commercial strips located along the major highways in both Counties. (See Figure 4).

Due to the diversity of activities associated with commercial land uses, there is a wide range of pollutants and pollutant loadings that can impact ground and surface waters. In unserved areas, large office buildings, hotels, motels, restaurants, theatres, laundromats, dry cleaning operations, and many other commercial uses discharge nitrates and organic chemicals into septic systems. Automotive service, repair, painting, and washing operations may contribute gasoline, oil, paint and paint thinners to groundwater. Medical laboratories and animal hospitals may release radioactive wastes and viruses. Racetracks and equestrian centers may be a source of nitrogen due to the accumulation of animal wastes. (See the chapter on Animal Wastes.)

Surface water impacts of commercial uses are generally associated with automotive service and repair stations located adjacent to surface waters. Contamination from marine-related activities occurs on a seasonal basis, with the discharge of gasoline, oil, and human wastes into marine waters. (See the chapter on Boat Pollution).
Industrial

Industrial discharges constitute the most serious threat to groundwater quality. Industrial parks or development areas generally situated in the deep aquifer recharge zones I and II along major transportation arteries, within the central corridor of Long Island. (See Figure 5.) The use of central corridor sites offers great locational advantages for industry, but poses a significant threat to groundwater quality, especially in areas where the underlying aquifers are relatively free of contamination and are extremely susceptible to serious long term degradation. Zones I and II have already experienced contamination from extensive industrial development.

Since industrial development is also located along stream corridors, freshwater and estuarine streams may be impacted.

Industrial land use activities comprise the manufacture, assembly, storage and distribution of goods. Manufacturing activities impact ground and surface waters through intentional and unintentional discharges of process water and wastewater, and through improper handling and storage of materials and wastes. Industrial processes can contribute significant contaminant loadings of organics and some heavy metals to ground and surface waters wherever inadequate or malfunctioning treatment systems are utilized (see the following discussion related to state controls).

The impacts of non-manufacturing activities are generally less significant. However, improper storage and handling practices may lead to significant toxic and hazardous accidental spills (oil bulk stations, etc.) (See Figure 6). Junkyards also discharge a number of contaminants: metals, gasoline, oils, etc. Sand mining operations may use large quantities of water for the cleaning of sands causing overpumpage of aquifers and the intrusion of salt water into freshwater aquifers in coastal areas. Sand mining is now permitted to depths only four feet above the water table, thus assuring no more than a minimal layer of unsaturated soil between the land surface and groundwater.

Although there are strict standards for the types of treatment systems required for industrial operation, the illegal disposal of organic (or inorganic) pollutants cannot be completely controlled.
Institutional

The institutional land use category comprises a variety of public and quasi-public uses that are distributed throughout the two counties. Associated land use activities are often intensive and are likely to generate or involve disposal of contaminants. Large hospitals and schools located in unsewered deep aquifer recharge areas are a major concern. Hospitals discharge human wastes, organic chemicals, radiological constituents and viruses. High schools and colleges discharge large amounts of sewage and may illegally discharge contaminants from chemistry laboratories and auto mechanics shops into on-site systems.

Recreation and Open Space

This designation includes both public and quasi-public land uses. Of the two counties, Suffolk contains the larger percentage of open space, mainly undeveloped and low intensity use areas. Nassau County’s more limited open space is more intensively developed to accommodate the need for active recreation opportunities. Passive activities, which may include hiking, use of scenic overlooks, etc., generally do not affect water quality. Intensive active recreation facilities may generate high BOD and nitrate loadings discharged into ground and surface waters. Golf course maintenance is a major concern, since extensive use of fertilizers may cause nitrogen contamination and irrigation practices may cause over-pumpage of aquifers. (See Figure 7.) The impacts resulting from the use of beaches and other recreational areas tend to occur on a seasonal basis.

Agricultural

Long Island agricultural land uses include

- potato farms
- vegetable and berry farms
- orchards
- vineyards
- horse, poultry and duck farms
- sod farms
- nurseries
- greenhouses

Currently, most agricultural activities are located on the North Fork and sections of the South Fork. Portions of Nassau and Suffolk have experienced contamination from fertilizers and pesticides. Excessive pumpage from irrigation has resulted in the accelerated movement of pesticide, fertilizer and salt contaminated groundwater resulting in well closure. (See the Well and Fertilizer Chapters).
Transportation-Utilities-Communication

This category comprises

- roads
- transportation facilities
- landfills
- incinerators
- sewage treatment plants
- oil distribution centers
- energy production and supply
- communication services

Drainage from the extensive paved surfaces required for roadways is a source of runoff borne contaminants such as gasoline and oil from automobiles and chlorides used for highway deicing. (See the Highway Deicing Chapter.) Landfills generate leachate containing inorganic and organic contaminants. Incinerators dispose of water used to dissipate heat from fuel gases and gas residue. The contaminants contained in the quench water are similar to those contained in landfill leachate. Sewage treatment plants discharge effluent containing organic and inorganic chemicals. The anticipated use of coal rather than oil to fuel the UlCO plant in Port Jefferson will result in the production of coal ash, bottom ash and fly ash to be landfilled or disposed of in some alternative manner.

Vacant Lands

The vacant lands are basically undeveloped, forested lands some of which may have been disturbed as a result of earlier use, (i.e. loss of natural vegetation, etc.). These lands, scattered throughout Nassau and Suffolk Counties, play a positive role in the maintenance of water quality. Vacant lands allow maximum recharge of relatively uncontaminated stormwater to ground and surface waters.

For a summary of the impacts on groundwater related to the various land use activities, see Table 2.

In the deep recharge zones, the impacts of the land use activities described above may have a very long term effect. Waterborne contaminants reaching the Upper Glacial aquifer near the groundwater divide can take as much as 50 to 100 years just to move to the base of the deeper Magathy aquifer and an additional 400 years to move to the north shore or 800 to move to the south shore. In contrast, under natural conditions, water reaching the Upper Glacial aquifer in one of the discharge zones can be expected to move to the shoreline within the period of one or two generations.

Failure to protect groundwater from the point and non-point contamination associated with land uses and related activities described above, reduces the total quantity of potable water available at reasonable cost. As a result, water must be obtained at greater depth or transported longer distances; or alternatively, contaminated water must be treated at the wellhead.
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R = Residential  
C = Commercial  
I = Industrial  
IN = Institutional  
O = Open Space Recreation  
A = Agriculture  
T = Transportation, Communication, Utilities  
W = Roadways  
All = All Land Uses  

(1) fluoride, sulfates  
(2) boron, copper, iron, manganese, sodium, zinc  
(3) foaming agents, vinyl chloride, polychlorinated biphenyls (PCBs), chloroform  
(4) benzene, toluene, trichloroethylene, tetrachloroethylene  
(5) arsenic, barium, cadmium, chromium, lead, mercury, selenium, silver  

EXISTING MANAGEMENT

Legislation, Regulation and Administration

Authority for the control of land use and related activities is shared by various levels of government and jurisdictions. New York State has delegated a portion of its police power responsibility relating to land use, planning, zoning, and subdivision design to the counties, towns and villages/cities through enabling legislation; but has retained control and, in some cases, direct administration of other related police power functions. The following discussion covers the major federal, state, and local laws affecting land use.

Federal

Federal laws affect land uses, both directly and indirectly. Many of these laws serve as catalysts, encouraging states and/or counties to develop their own laws pursuant to the federal legislation.

In 1972, the National Pollutant Discharge Elimination System (NPDES) was developed under the Federal Water Pollution Control Act to establish standards for treatment and to improve receiving water quality through the establishment of a permit program for point sources. The State Pollutant Discharge Elimination System (SPDES) is the EPA approved, New York State substitute for the federal program—see State Controls below.

The National Environmental Policy Act (NEPA) requires an environmental review for all federal projects and activities prior to their approval. The Quality Review Act (SEQRA) is a comparable law affecting governmental activities of New York State and its municipalities—see State Controls.

The Intergovernmental Cooperation Act of 1968 (Title IV) established the A-95 Area-wide Clearinghouse Review process, which has required the distribution of grant applications for federal funding to interested parties, and has made it possible for reviewing agencies to assess and comment on the compatibility of proposed projects with land use plans and with the social, economic and environmental objectives reflected in these plans. While the A-95 review has been terminated by Executive Order 12372, effective October 1, 1983, the Long Island Regional Planning Board will continue to review grant applications for the region in cooperation with the N.Y.S. Clearinghouse.

The Safe Drinking Water Act of 1974 (42USC 300lf) enabled the U.S. Environmental Protection Agency (EPA) to designate Long Island’s groundwater as a sole source aquifer. This designation precludes federal funding of any project likely to degrade groundwater.

The National Flood Insurance Program adopted pursuant to the National Flood Insurance Act (1968) encourages localities to develop land use controls for areas within the 100-year flood zone as identified by the Federal Emergency Management Agency.

The Internal Revenue Code of 1983 has an indirect influence on development patterns by encouraging donations of lands to the public. This legislation authorizes individuals or corporations to receive a tax deduction for the contribution, sale or bargain sale (below fair market value) of land to a legitimate non-profit organization. Section 1.501-C3 includes the provisions for land trusts to be managed by non-profit organizations (for example, Nature Conservancy). These lands must be managed in the public interest and the non-profit organization must not be subject to political influences. No legislation, just proof of status as a non-profit organization, is needed for the establishment of a land trust. To date, this law contains some incentives for individuals or corporations to donate lands for conservation purposes.

State

New York State enabling legislation authorizes local municipalities to develop and review comprehensive plans and zoning ordinances. Planning and zoning enabling legislation permits local municipalities to control a wide range of activities relating to public health, safety and welfare including the siting and density of residential, commercial and industrial structures. The planning enabling legislation requires that the plan cover the entire area of the municipality, but offers considerable latitude with respect to plan content. A comprehensive plan normally includes the following:

- a statement of community goals and objectives
- policies necessary to the achievement of the goals and objectives
- land use, transportation, housing and other components required to meet the goals and objectives
The plan creates a framework for rational zoning, subdivision and building ordinances along with budgetary and other administrative decisions required for plan implementation.

Article 16-Zoning and Planning, Section 263 of Town Law requires that zoning be based upon a comprehensive plan to insure the orderly growth of the community and protect property values. Recent court decisions indicate a pattern of support for zoning decisions based on a comprehensive plan.

Section 281 of NYS Town Law authorizes the town boards to modify zoning to permit and encourage flexibility in the design of developments. The number of dwelling units permitted in the area may at no time exceed the number of dwelling units that would have been permitted in a conventional subdivision. The dwellings may be detached, semi-detached, attached or multi-story structures, as approved by the planning and town boards. The plat may show lands available for parks, recreation or open space. The planning board may set requirements for the management of these open space areas.

Article 247 of the General Municipal Law of the State of New York allows local governments to purchase or accept donations of easements or development rights in land to preserve open space and agricultural lands. The use of conservation easements can provide permanent protection of lands that are of scenic or ecological value. Easements may cover fresh or tidal wetlands, steep slopes, cliffs, marine, estuaries or fresh surface waters, old fields, grasslands, forests or other natural areas.

The State Pollutant Discharge Elimination System (SPDES) (N.Y.S. Law ECL-Article 17, Title 8) requires permits for all industrial, commercial, municipal and residential land uses producing discharges of more than 1,000 gallons per day (see the On-Site Systems Chapter for further discussion of this law). Discharges from commercial and industrial operations are required to meet SPDES sanitary-industrial standards in order to obtain a permit. (For specific discharge regulations, see On-Site Chapter.) Although many of the older treatment systems have been upgraded under the SPDES system, a number of the older facilities apparently still discharge untreated or partially treated wastes to ground or surface water. At the present time there is no complete list of the types and quantities of constituents discharged from various types of commercial and industrial establishments.

Changes in industrial operations, often as a result of change in tenancy, may also result in discharges that are not covered or cannot qualify for a permit. There is no satisfactory system for tracking new tenants and changes in the discharge.

The State Environmental Quality Review Act (SEQRA) requires the review of actions that may have a significant impact on the environment, including ground and surface waters. A list of actions has been developed to facilitate the identification of those that require review and those that do not. Type I actions are actions that can be expected to have a significant impact on the environment and require the submission of an Environmental Assessment Form (EAF). Type II actions may require an Environmental Impact Statement. Type III actions are actions that may be expected to have little, if any, impact on the environment; therefore, no further review is required. Unlisted actions may have a significant impact on the environment and require review. All county and local agencies must abide by this law.

Local governments may identify Critical Environmental Areas (Section 617.4 SEQRA). Upon designation, all new development within a critical area is a Type I action, subject to the SEQRA procedure. The criteria for the designation of Critical Areas according to Section 617.4 are quoted as follows:

- a benefit or threat to the public health or public safety
- a natural setting (e.g., fish and wildlife habitat, forest and vegetation, open space and aesthetics)
- social, cultural, historical, archaeological, recreational, or educational purposes
- an inherent ecological, geological, or hydrological sensitivity to change which could be adversely affected by any change

New York State has several laws dealing with the protection of environmentally sensitive areas. The protection of tidal and freshwater wetlands plays an integral part in maintaining ground and surface water quality. The Tidal Wetlands Act (ECL 25-100) and the Freshwater Wetlands Act (Article 24 and Title 23 of Article 71, ECL) authorize the state to regulate activities and grant permits in addition to local permits for the use of wetlands and adjacent areas.

In August of 1980, the New York State Legislature passed the Wild, Scenic and Recreational Rivers Act (ECL, Section 15-2703) to preserve rivers characterized by outstanding natural, scenic, historic,
ecological and recreational features. The N.Y.S. Department of Environmental Conservation (NYSDEC) is the administering agency. Specific criteria for the identification of wild, scenic and recreational river systems are provided. The Commissioner or agency develops and enforces regulations for the management and control of land uses in designated areas. Predesignation studies are in various stages of completion for Suffolk County’s four major rivers: the Carmans, Connetquot, Nissequogue, and Pecos. Following designation and approval of the plans by NYSDEC administrative and implementation responsibilities will be shared by state and local governments.

Several state enabling laws which promote the dedication of lands through contributions and the development of non-profit corporations have an indirect effect upon land use distribution. There are two state laws that authorize the dedication of land through charitable contributions or trusts. Within the Estates, Powers and Trusts Law, Articles 7 and 8 entitled Trusts, and Charitable Trusts, respectively, provide the parameters by which these trusts may be upheld in court. Under Article 8: property may be disposed of to any incorporated village or city of the state to be held in trust for educational purposes, dissemination of knowledge or relief of distress, or for parks, gardens or ornamental grounds, or the exercise of health and recreation.

Land may also be disposed of to the commissioners of common schools of any town or to the trustees of any school district. Article 7 states that a trust may be created for any lawful purpose and the article continues by stating the parameters by which the trust may be created.

The Not-for-Profit Corporation Law, Article 2, authorizes the creation of non-profit corporations. Article 5 which discusses corporate finance states that these corporations may not purchase real property and that they may not sell, mortgage or lease its real property unless authorized by a 2/3 vote of the entire board provided that there are 21 or more directors, the vote of the majority of the entire board will be sufficient.

Nassau and Suffolk Counties

In 1970, the Nassau-Suffolk Regional Planning Board* completed the preparation of a Comprehensive Development Plan for Nassau and Suffolk Counties. The Plan sets forth policies and programs for the accommodation of growth with minimal degradation of the natural environment (air, water, soils). The 208 WTMP was completed in 1978 and has been adopted as one component of the Comprehensive Plan. As new studies or information permit the development of detailed policies and programs for specific geographic or functional areas, the additional policies and programs are incorporated into the Plan. The Plan has already been revised for the coastal zone and some other areas of Suffolk County. The Pine Barrens Planning Council is assisting the LRIPB in the preparation of a Comprehensive Plan for the Pine Barrens Study Area within Zone III.

Nassau County

Nassau County laws and regulations affect land use or related activities in various ways, such as requiring developers to furnish all utilities leading to and contained within a development (Ord. 157, 1953), prohibiting on-site systems in sewer systems in unincorporated areas (Public Health ordinance), and authorizing the County to construct, lease, own, operate and maintain sewer facilities (Charter, Art. XII).

The Nassau County Planning Commission reviews all proposed subdivisions located in the unincorporated areas in Nassau County. Pursuant to the Nassau County Planning Commission’s Rules and Regulations, the Commission has the authority to require that three percent of the acreage within a subdivision be dedicated as parkland. Cash may be accepted in lieu of a dedication and used to purchase lands adjacent to existing parkland or for the rehabilitation or expansion of existing parks. This is generally done when the area to be dedicated comprises less than ten acres.

The Planning Commission also acts as the lead agency for the review of County projects pursuant to the State Environmental Quality Review Act.

Nassau County Municipalities

The cities, towns and villages can control the type of development that is permitted within their jurisdiction through utilization of zoning, site plan review, and the SEQRA review process. The Towns of Hempstead and North Hempstead are almost entirely developed. Most of the remaining vacant lands in the town have limited suitability for development (tidal or freshwater wetlands, steep slopes, and lands with other environmental constraints). The Town of Oyster Bay and the villages within the Town still contain large undeveloped parcels located within Hydrogeologic Zone 1.

*Changed to LRIPB in 1978
Suffolk County

Suffolk County affects land use and related activities through the Planning Commission’s review of selected zoning and subdivision proposals pursuant to Article XIII, Sections 1323 and 1333 of the Suffolk County Charter, Department of Health Services administration and enforcement of the Sanitary Code and departmental regulations, and participation in the administration of the State Pollutant Discharge Elimination System; and the Council on Environmental Quality (CEQ) functions pursuant to Article I of the Suffolk County Charter. The CEQ also develops proposals for the dedication of specific lands or structures as part of the Suffolk County Nature Preserve and Historic Trust.

The Suffolk County Department of Real Estate carries out the County’s program for the acquisition of environmentally sensitive lands. The County currently owns 17,770 acres of open space lands. Additional lands were recommended for acquisition as part of the 1970 Bi-County Comprehensive Plan and as a part of the Open-Space Policy Report to the Suffolk County Legislature, May 1980. In the latter, County Executive Peter Cohalan identified additional farmlands, river corridor and greenbelt lands and aquifer recharge areas for acquisition and protection. The County has recently acquired a number of parcels through tax default. Some of these parcels are located in freshwater and tidal wetlands, flood plains, prime aquifer recharge areas, watershed management areas, and wildlife areas. The County expects to dedicate much of this land as County parkland to be designated as forever wild subject to Article I of the Suffolk County Charter. This designation virtually insures that these areas will remain as open space.

In January 1982, the Suffolk County Planning Commission’s staff completed a paper entitled Management of Perpetual Conservation Easements. The paper may be used as a guide for municipalities in the development of management criteria for conservation easements. Although areas have been designated as open space or forever wild, they are nonetheless subject to a variety of impacts. Proper management can reduce the potential for adverse impacts. The paper is on file at the offices of the Suffolk County Planning Commission.

Suffolk County Municipalities

Six Towns within Suffolk County: Brookhaven, Southampton, East Hampton, Smithtown, Riverhead and Southold are in the process of revising their comprehensive plans. The revised plans are expected to reflect water quality as well as other environmental concerns.

Some towns have already enacted large lot zoning for the protection of environmentally sensitive areas. The Town of Brookhaven has reclassified 13,000 acres of residentially-zoned land within Zone III from a category requiring one half to one acre zoning to a category requiring two acre minimum lot size. The Town’s 1976 Comprehensive Plan recommended inclusion of 36,000 acres within the two acre minimum lot size category. The legality of the reclassification, which had been challenged in the state and federal courts, has been upheld.

The Town of Southampton has recently upzoned 25,630 acres from the two acre category to a five acre minimum lot size for residential and industrially zoned properties. Additional acres are being proposed for upzoning.

On May 20, 1983, the Town of Southold amended the zoning code to upzone approximately 12,000 acres of agricultural and residential zoned lands. The minimum lot size was increased from one acre to two acres. Existing filed subdivisions, wetlands, and parcels in the County Farmland Program were excluded.

The Town of East Hampton has revised a portion of its zoning ordinance by reclassifying 105 acres of land in Napeague from a one acre to a two acre category. The action was initiated in order to preserve fragile dune areas. The Town is considering upzoning critical shallow aquifer recharge areas.

Two towns, East Hampton and Islip, now require mandatory clustering for new residential development in order to protect their environmental resources and groundwater. The Towns of Brookhaven and Southampton are currently in the process of drafting mandatory cluster ordinances. As part of their subdivision regulations, several of the towns require the dedication of land for open space to meet their needs for active and passive recreation and/or the preservation of environmentally sensitive areas.

Various municipalities within Suffolk County have a variety of ordinances that have been adopted pursuant to State laws for the protection of environmentally sensitive areas. The majority of the municipalities have Environmental Quality Review ordinances. The municipalities generally use the State’s list of Type I actions. At the present time, the Town of Brookhaven is revising its SEQAR review process for Type I actions and establishing standards for industrial development. (see Recommendations).
Introduction

The following land use recommendations have been developed primarily for the protection of groundwater quality and quantity and surface water quality. They reflect the constraints imposed by the characteristics of the water resources and other local conditions.

There are a number of land use control options available to the municipalities to insure improved groundwater and surface water protection. The revision of comprehensive plans, and the subsequent revision of zoning and other local ordinances to make them compatible with the plans can minimize future environmental impacts in partially developed or undeveloped areas.

Local environmental ordinances, county and state laws are important implementation tools. In some cases new legislation is needed, in others the extension or improved utilization of existing laws may suffice.

The local municipalities could also utilize the NYS Environmental Conservation Law, (SEQRA) Section 617.4 to designate specific geographic areas as critical areas in accordance with the law.

Coordination of the groundwater protection policies, monitoring and, law enforcement of the various levels of government can minimize impacts while reducing the costs of groundwater protection.

Legislation, Regulations and Administration

State

- New York State should enact enabling legislation authorizing municipalities, individually or in concert, to establish Special Groundwater and Special Surface Water Protection Districts.
- New York State should amend the preamble to the Town and Village Zoning Enabling Acts (Article 16-Zoning and Planning, Section 261 of Town Law and Article 6-A-Building Zones, Section 175 of Village Law) to add language explicitly identifying the protection of groundwater and surface water quality as a proper purpose of zoning.

State, Counties and the Long Island Regional Planning Board

- The State, the Counties and the LIRPB should provide technical assistance to the municipalities for the revision of their comprehensive plans.
- The NYSDEC, LIRPB and the County Health Departments should assist in securing designation of Special Protection Districts (see Municipalities). Once the Districts have been designated, the State and Counties should revise any legislation, regulations or administrative actions as required to meet special district management needs.
Counties

- The County Health Departments should establish a listing of non-polluting industries to aid the municipalities in determining which industries may be acceptable in non-sewered critical aquifer recharge areas or other sensitive areas. The list can serve as a guide to the towns in their planning, zoning, site plan and building permit review process.

- The Counties should develop, enact and enforce appropriate controls to minimize pollutant loadings resulting from any land use activities in the following areas:
  - areas recommended for Special Groundwater and Special Surface Water Protection Areas
  - other shallow or deep recharge areas containing high quality groundwater
  - areas where nitrate concentrations are approaching six mg/l, or organic concentrations are increasing and where additional development at the present zoning densities and/or types may be expected to cause ambient groundwater concentrations or the potable water supply to exceed groundwater quality standards.

Municipalities

REVISE COMPREHENSIVE PLANS

The municipalities should evaluate and as necessary revise comprehensive plans to incorporate the objectives and, wherever feasible, carry out recommendations contained in the 1978-208 Waste Treatment Management Plan and the more detailed, updated guidance presented below.

The municipalities should design and adopt plan revisions that will protect undeveloped deep recharge and critical shallow recharge areas where high quality groundwater exists.

- Limit new development, particularly industrial uses, in the deep recharge and critical shallow recharge areas.
- New industries with a wet discharge should be located in sewered areas. Wet industries should not be allowed in unsewered areas; if they are allowed in unsewered areas, they should be required to have pretreatment and collection and treatment equal to those industries located in sewered areas.
- Concentrate high density or commercial/industrial land uses in existing high density or commercial/industrial areas or in areas located downgradient and within existing contaminant plumes.
- Aggregate uses that would require similar sewage treatment at densities where sewage treatment will be economically feasible in those portions of the deep recharge areas where development is unavoidable.
- Decrease permitted residential densities ranging from two to ten units per acre to one unit or less per acre or open space in the following areas:
  - relatively undeveloped portions of the recharge areas
  - areas where current or increased groundwater usage may result in salt water intrusion, reduction of stream flow or wetland acreage.
- Limit the removal of natural vegetation and the creation of lawn areas.
- See Table 3 for a summary of the land use recommendations for the deep aquifer recharge areas and the critical shallow recharge areas.
- See Figure 8 for selected environmental information required for Comprehensive Plan revision for a selected area and Figure 9 for maps of existing land use, and the recommended land use plan revision.
<table>
<thead>
<tr>
<th>Land Use</th>
<th>Groundwater Protection (1,2,3)</th>
<th>Surface Water Protection (1,4)</th>
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<tr>
<td></td>
<td>Developed Areas</td>
<td>Partially Developed Areas</td>
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<tr>
<td></td>
<td>Sewered</td>
<td>Unsewered</td>
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<tr>
<td><strong>RESIDENTIAL:</strong></td>
<td></td>
<td></td>
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<tr>
<td>Low Density (1 d.u./acre or less)</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Medium Density (2.4 d.u./acre)</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>High Density (more than 4 d.u./acre)</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td><strong>COMMERCIAL:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Intensity (8) - Bakeries, Deli's, Warehouses, etc.</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Medium Intensity - Service establishments, offices, theatres, restaurants, medical labs</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>High Intensity - Hotels/ motels, automotive, laundromats, dry cleaning operations, racetracks</td>
<td>Yes</td>
<td>No</td>
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<tr>
<td><strong>INDUSTRIAL:</strong> (7)</td>
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<td></td>
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<td>Industrial Processes</td>
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<td>a) Toxic and Hazardous Wastes</td>
<td>No</td>
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<tr>
<td>b) Non-Toxic and Non-Hazardous Wastes</td>
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<td>Yes</td>
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<tr>
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<tr>
<td>Junkyards</td>
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</tr>
</tbody>
</table>

**LEGEND:**
- The land pattern has been set, a small percentage of the area remains to be developed consistent with existing land uses.
- Over 50% of the land is available for development.
- Allow the described land use development.
- Do not allow the described land use development.

**GENERAL DEVELOPMENT GUIDELINES:**
Allow development consistent with the existing land pattern.

Permit development in accordance with New York State Environmental Conservation Laws and Regulations, County Health Code, local municipality requirements and zoning and site development performance standards (structural or non-structural) to prevent or minimize environmental impacts.

WHERE DEVELOPMENT IS PERMITTED, THE FOLLOWING ITEMS MAY APPLY:
1. Minimize nitrate loadings to groundwater and surface waters by requiring natural vegetative controls to limit lawn areas, thereby decreasing fertilizer use. (See the Site Plan Review Chapter for recommended controls).
2. In areas where use of on-site systems is permitted, nitrogen removal systems should be utilized.
3. Require or enforce existing controls to prevent any direct discharge of wastes or products to groundwater.
4. Improve enforcement of existing controls to prevent any direct discharge of stormwater, commercial or residential wastes or products to surface waters.
5. Require development to be connected to existing sewage treatment plants (Nassau or Suffolk Counties) or package treatment plants (Suffolk County only).
6. Low Intensity Commercial (300 gpd) is equivalent to Suffolk County Department of Health Services standards, 1-2 d.u./acre residential designation (as per regulations by Hydrogeologic Zone in the Suffolk County Health Code - Article VI - Realty Subdivisions and Developments).
7. Require site development and operational controls, monitoring and enforcement for industrial uses in special protection districts.
FIGURE 8  A Sample Of Environmental Mapping Information Used For Comprehensive Plan Revisions
FIGURE 9  Land Use Plan Revised To Minimize Land Use Impacts Upon Groundwater
Consider the establishment of Special Groundwater Protection Areas.

A Special Groundwater Protection Area would comprise a relatively undeveloped portion of a deep recharge area, or of a shallow recharge area underlain by salt water, that requires comprehensive management to maintain existing water quality and quantity. Comprehensive management as envisioned here requires coordinated efforts by the various town, county and state agencies in the exercise of their respective responsibilities. NYSDEC Region I, in cooperation with the LIRPB, has undertaken a preliminary identification of candidate areas for the Special Groundwater Protection Areas, based upon the evidence of one or more of the following:

- a relatively undeveloped groundwater recharge area where groundwater withdrawal is occurring or is expected to occur.
- an area underlain by a high quality aquifer that may be contaminated if the land is developed according to existing zoning.
- an area where the presence of extensive groundwater contamination limits or can be expected to limit the amount of potable water that can be made available at a reasonable cost.

(See Figures 10-13 for the proposed boundaries. The proposed boundary maps are available from the LIRPB and the NYSDEC Region I offices.)

- Each municipality should review the proposed boundaries within its jurisdiction and recommend modifications as necessary to insure needed aquifer protection.
- Once the boundaries are established, the municipalities should undertake the planning, legislative and administrative actions necessary to insure prudent groundwater management.
- The municipalities should incorporate the district designations and policies related thereto in local decisions affecting land use, taxation, and capital programs.

The municipalities should protect fresh and marine surface waters through the selection of minimal impact land uses for undeveloped or partially developed shoreline areas.

Consider the establishment of Special Surface Water Management Areas.

- Special Surface Water Protection Areas would comprise watershed areas requiring management to maintain selected high quality surface waters. The designation by the local municipalities of Special Surface Water Protection Districts immediately adjacent to surface waters could provide the rationale for the imposition of needed controls for areas subject to future development. Performance standards and development guidelines could be used to protect important aquatic or marine resources from future increases in pollutant loadings affecting the aquatic or marine species associated with these waters. Such areas should include but not be limited to the following: important, relatively undeveloped, watershed lands located within the primary coastal zone or lands that drain to marine water as identified in the Long Island Nationwide Urban Runoff Program. (See Figure 14 for a sample proposed Surface Water Protection Area). (See the Site Plan Review Chapter for further discussion).
FIGURE 10 Special Groundwater Protection Areas - Nassau County
FIGURE 11  Special Groundwater Protection Areas - Western Suffolk County
FIGURE 12 Special Groundwater Protection Areas—Central Suffolk County
8 - SOUTH FORK DEEP RECHARGE AREA
Towns of Southampton, East Hampton

9 - HITHER HILLS
Town of East Hampton

FIGURE 13  Special Groundwater Protection Areas—Eastern Suffolk County
FIGURE 14  Special Surface Water Protection Area
REVISE ZONING ORDINANCES

The municipalities should revise local zoning ordinances to reflect changes in the comprehensive plan.

- Modify use designations and zoning boundaries to insure consistency with revised comprehensive plans.
- Encourage the establishment of special overlay districts encompassing deep aquifer recharge areas and Special Groundwater or Surface Water Protection Areas. Overlay district provisions should preclude intensive uses except where such uses can meet performance standards designed to minimize groundwater, surface water or other environmental impacts.
- Require SEQRA Type I assessment for any down-zoning of residential use or any change from residential to commercial, industrial or institutional use.
- Enact mandatory clustering and site plan review provisions as a part of zoning/subdivision regulations with appropriate applicability and criteria standards to effectuate preservation of groundwater resources. Mandatory clustering should be applied in areas where groundwater recharge, maintenance of the natural terrain and the protection of other environmental resources is required. Undeveloped lands should become the property of the municipality or a homeowners association. If land is deeded to a homeowners association, the conveyance should include a reverter clause providing that in the event of the abandonment or dissolution of the association, ownership would revert to the municipality.
- Revise zoning ordinances by establishing stringent performance standards* such as those being used by the Town of Brookhaven covering the development and operation of industrial activities in the 208 Deep Aquifer Recharge Areas and the Special Groundwater Protection Districts.

All proposed actions within are to be considered as having a potentially significant effect on the environment which will require notification and coordinated review, with possible preparation of an Environmental Impact Statement, pursuant to the State Environmental Quality Review Act, N.Y. ECL § 84101 et. seq. (SEQRA) and the Rules and Regulations issued thereunder of NYCRR, Part 617. Actions as used in this paragraph shall have the meaning set forth in Part 617.2(b).

All changes in tenants or occupants and new tenancy or occupancy and/or existing tenant or occupant industrial process changes will also require notification and coordinated review and possible preparation of an Environmental Impact Statement pursuant to SEQRA and Part 617; provided, however, that this paragraph shall not apply to changes in tenants or occupants and space that is used or occupied exclusively for offices.

Landscaped areas are to be covered using grass, shrub or tree species that have low nitrogen requirements and that are disease and insect resistant. Native plant species are to be used where appropriate.

All industries are to provide access to appropriate government inspectors during normal working hours.

*The performance standards were developed by the Town of Brookhaven in cooperation with the Suffolk County Department of Health Services.
No industrial discharges into the ground shall be permitted, whether by floor drains or otherwise. No permit for a State Pollutant Discharge Elimination System (SPDES) shall be issued except for non-contact cooling water and sanitary sewage disposal systems maintained on the user’s property. The sanitary SPDES permit application shall include full plumbing and piping diagrams, showing all subsurface facilities and all internal piping fixtures and connections to the sanitary system. No additions to the approved system shall be added without further review and approval by the Suffolk County Department of Health Services (SCDHS) or the relevant successor agency, if any. No toxic or hazardous materials, as defined in the Suffolk County Sanitary Code, Article 11, Section 1203, Items n and o, shall be issued under Article 12, Section 1206 and 1207 of the Suffolk County Sanitary Code, but facilities that comply with Section 1208 shall be permitted. The building area of each lot shall not exceed thirty-five percent of such lot’s area without a sewage treatment plant for the lot or unless the building on such lot is connected to a sewage treatment district facility; provided, however, that no such connection or sewage treatment plant shall be required if the discharge of sanitary sewage does not exceed 600 gallons per day per acre of lot area or unless the property shall subsequently become subject to mandatory requirements for sewage system connection by reason of its inclusion in a sewage district. Each industrial tenant or occupant may be responsible for installation of monitoring wells, both up-gradient and down-gradient in the groundwater flow. The wells will be installed in conformance with the requirements of the SCDHS. The number and location of the monitoring wells shall be as reasonably directed by the SCDHS. The tenant or occupant will be responsible for all costs of these services, as well as costs for groundwater monitoring and evaluation as required by the SCDHS. Well specifications are to be as follows:
- minimum of 4 inch well casing
- screen to be 10 feet below groundwater level to 5 feet above groundwater level for a total of 15 feet.
- wells shall be cased, vandalproof, and accessible to SCDHS.
Any violation of the above provisions shall cause the violator to be responsible for any and all legal fees and expenses incurred by the County of Suffolk and the Town of

ADDITIONAL ORDINANCES FOR FURTHER PLAN IMPLEMENTATION

Require Site Clearance Permits

- The local municipalities should enact and enforce site plan review regulations as a part of their zoning ordinances and site clearance requirements as a part of their subdivision regulations.
Regulation should require site clearance permits and the preservation of natural vegetation to minimize extensive clearing and future lawn areas, or to prevent the development of golf courses in critical recharge areas and within the buffer zones mentioned below (See the Fertilizer Use and Site Plan Review Chapters).
Require the Dedication of Conservation Easements

- The municipalities should require the dedication of conservation easements as a part of their zoning ordinances for site plan review and as a part of their subdivision regulations, for new development in critical recharge areas or within any of the special protection districts. The taxes for the dedicated areas should be based on the open space value rather than the development value.

  Conservation easements should include buffer zones (preservation areas) extending for a minimum distance of 50 feet from river, stream, lake, or pond banks in undeveloped or partially developed lands adjacent to surface waters and land required to protect additional resource areas (wetlands, woodlands, wildlife habitats).

ADDITIONAL PLAN IMPLEMENTATION RECOMMENDATIONS

Review and modify Type I and Type II SEQRA Lists

- The municipalities should review and revise their Type I and Type II action lists to insure consideration of potential environmental impacts affecting deep aquifer or important shallow aquifer recharge areas, priority surface water watershed areas and other critical environmental areas.

Acquire Lands for Preservation

- The municipalities should establish priorities for public acquisition and acquire properties located within the Special Groundwater and Surface Water Protection Areas that are necessary for the protection of these areas. (Please see the glossary for a select listing of land preservation tools).
Chapter Two

INTRODUCTION

Description

Stormwater runoff is that part of the total precipitation that flows over the land surface. Under natural conditions, during and following a rainfall, stormwater flows (within the watershed area) to lower elevations where it is either recharged to groundwater or it drains to streams, rivers, bays, and other surface waters. The amount of runoff from an undeveloped watershed area depends upon

- storm characteristics
- type and amount of vegetative cover
- soils and soil permeability
- slope characteristics
- type and capacity of natural drainage systems

Storms are characterized by their

- duration (period of rainfall)
- total precipitation
- intensity
- frequency
- number of antecedent dry days.

The number of antecedent dry days is one of the most important variables determining the amount of runoff and the concentration of contaminants in stormwater (see Design of Stormwater Drainage Systems).

A portion of stormwater runoff evaporates during overland flow and from surface waters.

Recharge water (infiltration water) is that portion of stormwater that infiltrates the soils and moves downward to recharge the aquifers. A portion of the infiltration water is taken up by soil plants and lost to the atmosphere by evapotranspiration.
Due to the gradual percolation of much of the rainfall into the soil in relatively undisturbed watersheds, both the volume of runoff and the rate of overland flow are reduced, thus maximizing aquifer replenishment in some areas and minimizing erosion. In developed watersheds the amount of runoff also depends upon

- amount of impervious surface area
- existing stormwater control measures
- other factors

The presence of impervious surfaces and of stormwater drainage systems that conduct runoff from the site may increase the volume; accelerate the flow; and, in some cases, contribute to the erosion of soils and streambanks.

In upland urban areas where stormwater drainage systems are installed, stormwater flows to recharge basins or to other drainage structures where recharge occurs. In coastal areas stormwater is often discharged directly into surface water bodies; in other cases the overflow of drainage structures is directed into surface waters.

Stormwater as runoff or as infiltration water is the vehicle by which pollutants move across land and through the soils to groundwater or to surface waters.

Contaminants accumulate or are disposed of on natural and urban land surfaces. Sources of contaminants include:

- animal wastes
- highway deicing materials
- decay products of vegetation and animal matter
- fertilizers
- pesticides
- air-borne contaminants deposited by gravity, wind or rainfall
- general urban refuse
- by-products of industry and urban development
- improper storage and disposal of toxic and hazardous materials.

The contaminants associated with and carried in stormwater runoff include the following major categories:

- Metals
- Organic Chemicals
  - Base Neutral Compounds
  - Acid Compounds
  - Volatiles
  - Pesticides
- Inorganic Chemicals
  - Phosphates
  - Nitrates
  - Chlorides
- Bacteria & Viruses
- Oxygen Demanding Substances

Raindrops dislodge soil particles and contaminants from land surfaces. This material is carried in solution or suspension and travels with the runoff. Suspended particles are deposited en route if the velocity of stormwater decreases. Contaminants carried in solution in stormwater enter the soil through the larger pores at the soil surface and move downward and horizontally through the pore network. Water diffuses into the smaller pores by capillarity or soil moisture tension. The rate of movement through the soils and surficial materials depends upon the size, shape, continuity and arrangement of the pore network system. Long Island soils are moderately coarse, quite porous, and therefore highly permeable. The most soluble constituents such as nitrates and chlorides and many organic chemicals continue to move downward through the aquifer system or to the bays. Soils with a high clay, fine sand, or silt content or with the presence of interspersed clay lenses retard the rate of movement of water and some contaminants through the soil. A portion of the constituents may be used by plants and soil bacteria. The above is a generalized description of a very complex system.

Types of Stormwater Systems on Long Island

There are two major types of stormwater systems on Long Island: nonstructural and structural.

NONSTRUCTURAL

Nonstructural systems attempt to deal with stormwater problems at their source. A variety of techniques are used to minimize stormwater runoff and erosion, maximize recharge and to maintain natural stormwater receiving areas. These include the use of

- ecological and land use planning
- conservation easements
- zoning ordinances (establishment of the amount of site development and coverage)
- maintenance of natural vegetation
- the use of swales, depressions and other grading and planting techniques (see Recommendations)

STRUCTURAL

Structural controls utilize built systems such as

- stormwater sewerage systems
- recharge basins
- sedimentation basins
- dry wells
- other systems

The typical closed stormwater drainage system on Long Island consists of drop inlets, catch basins and manholes connected to pipes of increasing size (See Figures 1-5).
0 TO 9'-0" NO REINFORCEMENT EXCEPT CLOSE TO SLAB. FOR DEPTHS GREATER THAN 9'-0" PROVIDE REINFORCEMENT.

GALV. BAR STEPS

1' x 1' OPENING GRAVEL FILLED (TYP.)

**FIGURE 1** Typical Catch Basin Section

MINIMUM COVER OF 24" OVER PIPE. INVERTS MAY BE AT SAME ELEVATIONS. OUTLETS SHOULD HAVE A DROP OF 4" BELOW INLETS.

**FIGURE 2** Typical Manhole Section

*Source: Town of Huntington - Road and Drainage Details*
FIGURE 3  Leaching Pool

FIGURE 4  Road Drainage Plan - Town of East Hampton
FIGURE 5  Stormwater Drainage System Being Installed
They are usually installed under roadways and parking lots to provide positive drainage. In many cases in the urban areas, stormwater is discharged into recharge basins (See Figures 6-8) which are used in Nassau and in many Suffolk towns to collect and recharge stormwater from the development within the watershed area (drainage basin) including subdivisions, roads, major highways, and some parking lots. Recharge basins are usually designed to provide a storage capacity of five or more inches of rainfall from the catchment area adjusted by the coefficient of runoff. Stormwater may also be discharged into:

- detention ponds (See Figure 9)
- biofiltration ponds (See Figures 10-12)
- energy dissipator—sedimentation basin systems (see Figure 13)
- leaching pools (See Figure 3).
FIGURE 8  Plan of a Typical Recharge Basin

Source: Town of East Hampton - Road and Drainage Details

FIGURE 9  Detention Pond
FIGURE 10  Biofiltration Pond

FIGURE 11  Biofiltration Pond - Plan
FIGURE 12 Biofiltration Pond - Section A-A

FIGURE 13 Sedimentation Basin
The overflow from these systems may be discharged into a stream or other surface waters.

Most of the runoff into recharge basins comes from impervious surfaces. Occasionally pervious surfaces are a source of runoff when the infiltration rate and water holding capacity are exceeded due to periods of high intensity rainfall.

A system of leaching pools and pipes (in-line systems) or a system of swales (drainage channels) and shallow depressions may be used to recharge some or most of the stormwater. This technique is most applicable in low density or rural areas. (See Figures 14 & 15). The in-line system may also be suitable in areas where the depth to the high water table allows sufficient room for the installation of structures. Ponds and wetlands, kettle holes and other natural land depressions and swales are also used for the disposal of stormwater runoff and in some cases, groundwater recharge.

Design of Stormwater Drainage Systems

Proper management of stormwater requires informed judgement in order to interpret data and evaluate empirical runoff projections. Knowledge of the quantitative and qualitative characteristics of rainfall and the watershed or drainage basin is needed to permit the prediction of rates of runoff. Since there is considerable variation in the frequency, intensity and duration of rainfall, the designer must rely upon data derived from observations over long periods of time. Rain gages have been used for almost a century to measure the intensity, duration and amounts of rainfall from specific storms. Historical records can be used to identify future probabilities (see Field Measurements).

STORM CHARACTERISTICS

Several general conclusions can be drawn in respect to the storms on Long Island:

- Intense storms usually cover small areas and are of short duration; storms of lower intensity tend to cover larger areas and are of longer duration
- Storms of high intensity and/or high total rainfall tend to have relatively lower frequencies of occurrence
- Storms characterized by periods of high intensity often cause flooding and damage due to erosion and sedimentation

FIGURE 14 Area Where In-Line Storage System Was Installed - Bayville, New York
DESIGN OF CLOSED STORMWATER DRAINAGE SYSTEMS

The Rational Method

The most important consideration in designing stormwater control measures is to provide sufficient capacity to accommodate the peak rate of runoff. It is also necessary to determine the total amount of runoff for a given time period to insure adequate capacity for the storage of runoff. All too often in some locations, stormwater drainage and storage systems are underdesigned due to high costs. The Rational Method is generally used as a first step for computing stormwater runoff for the design of closed stormwater drainage systems when the contributing area is less than 200 acres. This method of calculation is based upon selecting a design storm event that is characterized by its duration, average intensity and frequency of occurrence. This technique provides the average peak rate of runoff from a storm, but it does not provide a description of the actual storm. The formula for the Rational Method is \( Q = CIR \) where

- \( Q \) equals the amount of discharge (peak runoff rate) in cubic feet per second (cfs)
- \( C \) equals the runoff coefficient(s) of the drainage area
- \( I \) equals the intensity of rainfall in inches per hour
- \( A \) equals the area of the watershed (acres)

FIGURE 15 In-Line Storage System
RUNOFF COEFFICIENTS

Runoff coefficients refer to the percentage or ratio of runoff to the total amount of rainfall that will reach a stormwater drainage or storage system. A watershed that is completely forested and is located on gentle slopes will have minimum runoff even following a storm of relatively high intensity and duration due to the high retention capacity and low runoff coefficients associated with natural groundcover. A watershed that is primarily developed with extensive impervious surface areas has limited storage capacity and high runoff coefficients. The amount of runoff is a function of the amount of rainfall, the amount of evaporation and plant evapotranspiration (seasonally variable), the soil permeability, slope and possibly the texture of the surface area (see Table 1). Runoff from impervious surfaces usually varies from 80 to over 90 percent, therefore the runoff coefficient as a ratio is 0.80 or 0.90 accordingly. The runoff ratios from pervious surfaces usually vary from 0.10 (natural vegetation) to 0.60 (compacted bare soils) or higher. The runoff ratio for a lawn or golf course is approximately 0.20-0.35. The coefficients used to calculate runoff from pervious surfaces may be low in some cases, particularly during a storm that occurs when the ground is frozen. If snow is present, runoff is further increased due to snow melt.

<table>
<thead>
<tr>
<th>TABLE 1</th>
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Runoff Coefficients

\[
\text{Value of } C = \frac{\text{runoff}}{\text{rainfall}}
\]

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<tr>
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<td>1.00</td>
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<tr>
<td>0.25</td>
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</table>

Earth Surfaces with Light Vegetation

| Sand    | 0.10 | 0.40 |
| Loam    | 0.10 | 0.45 |
| Gravel  | 0.15 | 0.50 |
| Clay    | 0.20 | 0.60 |

Source: Adapted from Seelye, E.E., *Data Book for Civil Engineers—Design*, Volume One. 1953.

INTENSITY OF RAINFALL

The intensity of rainfall is defined as the rate of rainfall in inches per hour for a given time period. This rate varies during the storm period. One method of determining intensity is to use a compilation of rainfall probability curves displayed in a Rainfall Intensity-Frequency Graph (see Figure 16). The curves indicate a one hour rainfall in inches to be expected to recur on an average of 1, 2, 5, 10, 25, 50 or 100 years.

It is also necessary to determine an accurate time of concentration or the point at which runoff from all parts of the watershed contributes to the runoff volume. An empirical method of determining the intensity of rainfall in relation to the time of concentration is

\[
l = \frac{x}{t + y}
\]

where:

- \( l \) equals rainfall intensity in inches per hour
- \( t \) equals time of concentration in minutes (15 or 20 minutes)
- \( x \) & \( y \) equal constants that vary with geographic location and frequency of storms.

The intensity of runoff \( l \) that is commonly used for Long Island is determined by using the following formula:

\[
l = \frac{120}{t + 20}
\]

where:

- \( t \) equals the time of concentration in minutes
- \( x \) and \( y \) have been substituted with constants used for Long Island.
FIGURE 16  Rainfall Intensity Curve Graph

Source: Seelye, E.E., Data Book for Civil Engineers - Design, Volume One. 1953.
The establishment of maximum time of concentration requires the computation of both overland and channel flow times for many of the remote parts of the watershed. Additional formulas are required to determine the time of channel flow including the Mannings and Chezy-Kutler formulas. All of the formulas depend upon the arbitrary assignment of values to represent the hydraulic conditions of the channels.

**FORMULA FOR CHANNEL RUNOFF**

Runoff in cubic feet per second for channels can be calculated by using \( Q = av \) where:

- \( a \) = areas of the waterway in square feet
- \( v \) = velocity in feet per second.

The specific design of closed drainage systems involving the selection, sizing and location of piping, drop inlets, catch basins, manholes and discharge basins is beyond the scope of this chapter. This material can be obtained from a number of engineering texts that deal with the subject. However, some material for the design of recharge basins and leaching pools is provided in the following paragraphs since this information is not available in standard texts.

**DESIGN OF LEACHING POOLS FOR THE STORAGE AND SLOWER DISCHARGE OF STORMWATER**

A formula used for seepage or leaching pools is \( SC = ARC \), where:

- \( SC \) equals storage in cubic feet capacity
- \( A \) equals the tributary drainage area in square feet
- \( R \) equals rainfall in feet (.33 feet (4 inches))
- \( C \) equals the coefficient of runoff of the drainage area

**Field Measurements of Rainfall, Runoff and Contaminant Concentrations**

A hyetograph can be used to portray the rainfall in inches as a function of time (See Figure 17). A typical hyetograph for an urban area illustrates the volume of stormwater or stream discharge measured in cubic feet per second, according to the hours into a given storm event and the time of peak discharge (see Figure 17). Flow measurements can be taken for storm sewer discharges or for stream flow. The watershed or contributing area that drains to that point must be known. The runoff rate corresponds directly to the flow rate measured at that designated point. (See Figure 18 for a hydrograph illustrating discharge from a relatively undeveloped area).

A pollutograph may be used to indicate the concentrations of contaminants in stormwater during the entire period of the storm. See Figure 19 for a pollutograph that displays concentrations of various constituents (i.e., bacteria, lead, chromium) versus time.
The peak flow into the recharge basin occurred four hours after the beginning of the storm. The flow then dropped abruptly returning to normal within a few hours. A similar situation would have occurred if the stormwater had been discharged into a stream. The stream flow would have increased significantly but would have returned to normal within a short time.


Unlike the hydrograph depicted in Figure 17, the hydrograph for the undeveloped watershed revealed a more gradual increase in flow with the peak volume occurring after eight and one-half hours. The flow did not return to base flow condition until at least 48 hours had passed.

Source: Dale Simmons, Hydrologist, USGS, 1984
The pollutograph for a winter storm indicates that chloride and chromium concentrations were highest at the beginning of the initial rainfall and reached secondary peaks towards the end of the storm. Lead and total nitrogen concentrations were the highest towards the end of the storm.

The pollutograph showing counts of bacteria in stormwater indicates that fecal streptococci and total coliform bacteria were the highest during the peak period of runoff. Fecal coliform counts were the highest following the peak runoff period at the end of the storm.

**FIGURE 19** Pollutographs for the Storm of February 20, 1981

*Source: The Long Island Segment of the Nationwide Urban Runoff Program - Long Island Regional Planning Board - 1983.*
Introduction

In the past, stormwater runoff systems were designed to get the stormwater off the site and into stormwater drainage systems or onto roadways as fast as possible, sometimes at the expense of the neighbors or downstream communities. Although a large portion of the inland runoff was directed towards recharge basins, most of the stormwater and associated contaminants from areas adjacent to coastal waters were discharged untreated through drainage system outfalls and from roadways into surface waters.

As Long Island became more urbanized, the types and amounts of pollutants generated by land use activities increased and the extent of natural stormwater recharge areas decreased. Natural vegetation was replaced with impervious and modified pervious surface areas. Individual sites were developed without provision of land area for the recharge of stormwater and erosion control measures. Over time, this resulted in increased volumes and rates of runoff. (See Figures 20, 21) Accelerated erosion and sedimentation were associated with the higher rates of runoff. An increase in runoff (and sedimentation) created the need for more extensive drainage systems to prevent the accumulation of water in streets and highways and in flood-prone areas. Since stormwater runoff is a transport vehicle for contaminants deposited on impermeable or relatively impermeable surfaces, it is often an important contributor to surface water degradation. (See the Land Use Chapter). To compound the problem, many coastal and inland wetlands were filled and developed, further reducing the storage area for stormwater, sediments and contaminants associated with the sediments. These conditions resulted in the following major effects:

- increased local expenditures for the installation and maintenance of stormwater drainage systems and the maintenance of roadways
- increased outlays for channel maintenance
- increased flooding of roads and of lowland areas resulting in hazardous driving conditions, dangerous flash floods and property damage
- loss of viable wetland oceages due to sedimentation
- increased concentrations of contaminants in groundwater
- the closing of a large portion of the area's shellfish grounds due to high coliform concentrations introduced by stormwater (See Health Related Problems)
- changes in the values of aquatic and estuarine water quality parameters with possible adverse effects on aquatic and marine species.
FIGURE 20 Stormwater Runoff Under Natural Conditions

FIGURE 21 Increases in Stormwater Runoff Due To Increases in Impermeable Surfaces

Health Related Problems

Although stormwater runoff may contain high concentrations of one or more contaminants, treatment is rarely provided before discharge into Long Island surface waters. In a few areas a marsh pond or biofiltration pond is used to trap some of the pollutants for a period of time, thus allowing for reduction of indicator coliform bacteria and the partial uptake of some heavy metals and inorganic nutrients by plants.

A high coliform bacterial count in runoff is equated with the possibility that pathogens may also be present. While confined to storm drainage systems, runoff containing pathogenic organisms generally posed little direct threat to public health since stormwater is not ingested. When stormwater enters surface waters it can become a problem. The number of bacteria or viruses that can cause infection vary widely. Although thousands of viable bacteria may be needed to cause infection in humans, it is assumed that a single virus particle is an infective dose. Even though an infection occurs, it may not lead to disease, since the onset of disease is also dependent upon the age, general health and degree of immunity of the host.

There were at least eight clam associated gastroenteritis outbreaks in Broome County between August 26, 1982 and September 2, 1982. The county health department identified 223 cases of illness in these outbreaks and they administered over 450 doses of gamma globulin to persons who consumed clams. Clams in these outbreaks may have come from Prince Edward Island, Canada, North Carolina, Long Island or Rhode Island. Rhode Island clams were served at most of the events, either exclusively or along with clams reported to be from the other listed sources. The State Health Department continues to receive isolated reports of clam associated illness, either gastroenteritis or hepatitis A. The approximate summer totals for reported clam associated illness stands at 400 gastroenteritis and 50 hepatitis A cases.

Reported by: Broome County Health Department - K. Gaffney, M.D., A. Carey, P. Orr.

Occasionally, stormwater carrying microorganisms may enter a drinking water source due to flooding in the area of a well. (For a discussion of this subject, see the Well chapter).

For health related impacts of nitrate levels in stormwater and sources of nitrates to groundwater see the Fertilizer and On-Site Systems Chapters. The Highway Design chapter identifies health problems related to increased sodium levels in drinking water.

Stormwater Impacts Upon Groundwater and Surface Waters

The investigations conducted by the Long Island Regional Planning Board as a part of the Nationwide Urban Runoff Program (NURP-1983) have contributed to a better understanding of the impacts of stormwater runoff upon groundwater and surface water quality on Long Island. The study has lent further credence to several findings and assumptions of the 1978 Long Island 208 Waste Treatment Management Plan.

IMPACTS UPON GROUNDWATER

Contaminants deposited on and adjacent to roads and highways are carried by stormwater to recharge basins and possibly to groundwater beneath the recharge basins. Samples of the stormwater entering several recharge basins and groundwater beneath the basins were analyzed for a number of constituents. (See the NURP report for a detailed discussion of the sites and monitoring). Stormwater runoff contaminant concentrations were generally low for most of the constituents analyzed.
In most cases they fell within the permissible range for potable water; however, there were two notable exceptions where drinking water standards were exceeded:

- Median lead concentrations in stormwater runoff samples collected at the recharge basin draining a major highway consistently exceeded the drinking water standards.
- Dissolved chloride concentrations in stormwater and groundwater were found to be periodically high.

Organics discharged into recharge basins were not found to be a significant problem. However, in four cases, priority pollutants were found in excess of New York State guidelines in one sample of runoff at the Plainview site, and in groundwater samples taken below the basins at the Plainview and Huntington recharge basin sites. (The New York State Department of Health guidelines recommend a limit of 50 µg/l or less for an individual organic constituent in drinking water and 100 µg/l or less for total organic constituents and 5 µg/l or less for the known carcinogens vinyl chloride and benzene.)

Samples of stormwater runoff collected at the influents to five recharge basins during the course of the Nationwide Urban Runoff Program indicated that the most commonly occurring organic compounds were:

- benzene
- bis (ethyl hexyl) phthalate
- chloroform
- methyl chloride
- toluene
- 1,1,1-trichloroethane

Of these, only methylene chloride was consistently found in concentrations greater than 8 micrograms per liter (µg/l). Organic pesticides were also found along with chlorinated hydrocarbons and polychlorinated biphenyl compounds (PCB). The findings of the 208 WTRP showed that there were nine instances where the concentration of organic compounds exceeded 10 µg/l in groundwater under five recharge basins studied.

In those instances where there was a large influx of heavy metals into a recharge basin, there was considerable attenuation before the stormwater runoff reached the water table. In addition to lead, zinc, copper, and cadmium, were found in local stormwater runoff. It is thought that the infiltration of stormwater runoff through the soil results in the attenuation of heavy metals. However, there was little or no removal of chloride or nitrogen as the stormwater moves through the unsaturated zone beneath the recharge basin.

The chemical constituents found in stormwater runoff did not vary in response to seasonal changes except in the case of chlorides, which increased by two orders of magnitude during the winter months as a result of highway deicing activities. It was determined that the control of chemical constituents in stormwater runoff requires year-round mitigation measures (see the Highway Deicing Chapter).

The type of land use in the drainage area and the length of time that a recharge basin has been in use affect the concentration of pollutants in the basin soil. The limit of the soils' capacity to adsorb and retain various constituents is not fully documented.

IMPACTS UPON ESTUARINE WATERS

Stormwater runoff and stream base flow are important sources of pollutant loadings to the Long Island streams, ponds and bays. Two categories of runoff to estuarine waters have been observed: upland runoff that enters the freshwater portions of the streams and is conveyed thereby to the bays, and overland runoff that enters the bays, or the tidal portions of the streams) usually by direct overland flow or storm drainage systems. Impervious surfaces constitute the major source of stormwater runoff to streams and bays, but some runoff from pervious surfaces also occurs.

Stormwater runoff has been associated with high concentrations of bacteria in estuarine waters and the closing of shellfishing areas due to high indicator bacteria counts. Another portion of the NURP study involved monitoring bacterial counts following storms in fresh water streams and ponds, at discharge points to estuarine waters and in the bays during and following storm events. It was calculated that stormwater runoff accounted for at least 93% of the total and fecal coliform discharge.

Sedimentation rather than bacteriological die-off appears to be the mechanism for the attenuation of bacteria in stormwater runoff from ponds before discharge into marine water.

Ratios of fecal coliform bacteria to fecal streptococci (FC/FS) are calculated because the ratio can serve as an indicator of the source of the bacteriological contaminants. It appears that the relatively low ratios that were reported can be attributed to the presence of wastes from animal populations, including waterfowl, and domestic animals. The ratios were low enough to indicate animals rather than humans as the primary source.
Although dogs and birds are common throughout the study area, the data are not sufficient to permit identification of any individual source or combination of sources. Nitrogen (and phosphorus) from fertilizers, general animal wastes, and duck farms enter fresh and marine waters by stormwater runoff, stream flow and groundwater flow. Elevated nitrogen levels can result in phytoplankton bloom and rooted aquatic growth (e.g., eelgrass), since nitrogen is a limiting growth factor in estuarine waters.

IMPACTS UPON FRESH SURFACE WATERS

Biological monitoring has been used to measure the impact of stormwater upon aquatic communities. Increased pollution in urban ponds and streams has resulted in marked changes in the type and number of species present. High concentrations of phosphorus from fertilizers applied to landscaped areas and phosphorus from other sources in the immediate watershed area can result in algal blooms and other eutrophic conditions. (A slug of pollutants can totally decimate aquatic life).

The depletion of oxygen as measured by high BOD₅ values in receiving waters is one of the most important impacts on fresh water systems. When high BOD₅ loadings are discharged to surface waters, the resultant depressed oxygen levels eliminate those species that cannot survive at low oxygen levels. Aquatic life changes over time as high oxygen demanding species are replaced by those that can tolerate lower dissolved oxygen (D.O.) levels. This is especially an important problem in lakes and ponds. A pond that once had species indicative of good water quality such as mayflies, stoneflies and caddisflies may now have large numbers of worms such as Tubifex tubifex and Limnodrilus udekamnianus. Other types of worms may be present that have special types of blood or breathing mechanisms that allow them to adapt to waters with low D.O. levels.

Grease and oil products are sometimes disposed of on the land, into storm sewers or directly into surface waters. If sufficient concentrations of these products are found in the water column or accumulate on aquatic plants, they can harm or kill aquatic biota.

High concentrations of salts from highway deicing practices may also impact aquatic vegetation and aquatic ecosystems.
EXISTING MANAGEMENT

Legislation, Regulation and Administration

Federal

The Federal Water Pollution Control Act Amendments (FWPCA) of 1972 authorized the United States Environmental Protection Agency (USEPA) to create a comprehensive program designed to restore and maintain the chemical, physical and biological integrity of the nation’s waters. As a part of this program, USEPA provided funds to selected agencies to undertake water quality planning. The USEPA mandated the consideration of nonpoint sources of water pollution in the development of areawide and local water quality management planning. The Long Island 208 WTMP identified stormwater runoff as a significant determinant of water quality.

Various 208 studies including the 208 WTMP, documented the need for the control of nonpoint sources, including stormwater runoff, to obtain needed improvements in water quality.

The Clean Water Act (P.L. 95-817) amended the Water Pollution Control Act to provide funding for a national stormwater runoff problem assessment and a report of the findings to the Congress in 1983. USEPA established the Nationwide Urban Runoff Program comprising both federal and local components to address the following questions:

- Where and under what conditions is urban runoff likely to cause water quality problems?
- What types of problems can be anticipated?
- What solutions are available and at what cost?

The Long Island Regional Planning Board was among the state and areawide agencies selected to investigate and plan for the mitigation of local runoff related stormwater problems. See Key Problems for the Discussion of the Long Island NURP Study.

State, Counties and Municipalities

Stormwater runoff management on Long Island generally consists of local laws and ordinances, standards and guidelines for stormwater collection systems that are predominantly structural in nature. These standards and guidelines are based on the premise that watershed characteristics and various types of development will produce specific quantities of runoff. Collection systems are based on design standards and engineering practices that include the use of empirical formulas (such as the Rational Method), the construction and use of recharge basins according to a specified storage capacity (number of inches of rainfall), the use of leaching systems, catch basins, dry wells or other structures deemed appropriate. Roadway design standards are provided by the New York State Department of Transportation, the County Department of Public Works and Town Highway Departments.

The use of these standard structural practices has generally been successful. However, they have not always proved to be the best in respect to long term environmental impacts, nor the most cost beneficial in terms of maintenance costs.
A comprehensive approach to stormwater runoff management, in which performance standards and site development techniques are used to protect the natural resources of the site and the downstream watershed area, is becoming more widely accepted. Drainage designs are increasingly based upon individual site characteristics and goals of watershed management. This type of approach implements certain stormwater control objectives, such as preserving the integrity of natural drainage patterns in order to prevent flooding and damage to stream channels or other surface waters. It also requires adherence to standards that will insure the attainment of these objectives. The requirement that stormwater runoff from a site when developed not exceed that generated under natural or undisturbed conditions is one example of such a standard. In this instance developers are not held to a specified type of drainage facility, but are given the flexibility to choose the stormwater runoff system or alternative approach best suited to the needs of each development, subject to the requirements of a performance standard. The type of drainage system that should be installed will be determined by system effectiveness given the variations of:

- slope
- lot size
- cover type
- soils
- type of development under consideration

Until recently, the focus of stormwater management was on flood prevention and the recharge of groundwater. Recharge basins have been required for suitable areas for over thirty years in Nassau County.

Prior to 1960 it was the practice of most municipalities in Suffolk to discharge stormwater runoff into streams rather than recharge basins. Flooding at culverts was the result. The protection of fresh surface waters, the prevention of soil erosion and sedimentation, and the retention of natural drainageways and vegetation were generally a secondary concern. Acknowledging the destructive capabilities of stormwater runoff, the state, counties and most of the municipalities in Nassau and Suffolk Counties now employ various types of stormwater control measures to protect against flooding, erosion, sedimentation, and loss of vegetation. The following discussion examines the existing stormwater runoff controls that are used on Long Island.

N.Y.S. TIDAL AND FRESHWATER WETLANDS ACTS

See the Land Use Chapter, Existing Management — Wetland Discussion.

NEW YORK STATE DEPARTMENT OF TRANSPORTATION

The New York State Department of Transportation has outlined design procedures for New York State roadway stormwater collection systems. The type of system used depends upon site geology, location of groundwater, watershed hydrology, (including the size of the entire drainage/recharge area, the amount of water moving in and out of the drainage area), soils and other characteristics. Due to the scale of state roadways, recharge basins are usually constructed; however, leaching basins are used for smaller projects. Diffusion wells are used in areas with poor soil permeabilities and, in many cases, siltation chambers are used for discharge into streams or other surface waters.

Stormwater controls for State building sites are designed on a case-by-case basis, according to best management practices. For instance, oil and grease interceptors are provided at many sites as part of parking lot drainage systems.
 Counties

SUBDIVISION REVIEW

In Nassau County, the Planning Department is required to review subdivision plans in detail for the effect on the drainage of the area. In Suffolk County, the Planning Department reviews the proposed subdivision if it fronts, has access to or is directly related to a state or county roadway, right-of-way or property. The Nassau County Planning Commission (NCPC) may approve or disapprove a plan based on whether or not the subdivision may be expected to create any hazards to property or existing structures. The Suffolk County Planning Commission’s (SCPC) recommendations are advisory. If considered to be in its best interest, any municipal government may override the SCPC decision by a majority plus one vote and the reasons for such action must be part of the public record.

SITE PLAN REVIEW

In both counties, if a single proposed development fronts, has access to or is directly related to a county roadway, right-of-way or property, no building permit will be issued without approval by the respective county Department of Public Works. Again, in Suffolk County, a local municipality may override the county decision.

Nassau County

Design standards for Nassau County roadways are based on the best drainage management practices of the Nassau County Department of Public Works (NCDPW). The Department guidelines require the use of the Rational Method of stormwater control design. If a recharge basin is required and it contains a natural outflow to pond or to a storm drainage system, the storage capacity of the recharge basin must be sufficient to contain the runoff (adjusted by the coefficient of runoff) from a 5 inch rainfall on the entire tributary area. If there is no outlet to the recharge basin must be sufficient to contain the runoff from an 8 inch rainfall.

The stormwater drainage plan for every subdivision located within a Nassau County city, town or village must be approved by the Department of Public Works. The review of the drainage plan for each subdivision is conducted on a case-by-case basis following the best management practices for stormwater runoff control as administered by the NCDPW. This approach has provided a uniform review of subdivisions on a County-wide basis.

Suffolk County

The Suffolk County Department of Public Works (SCDPW) uses the Soil Conservation Service (SCS) method— which considers site specific, physical considerations such as soil types, topography, and land use, in determining the difference between rainfall and the amount of runoff for the design of stormwater runoff controls for county highways. This method provides percolation rates that can be used to predict the effects of development based on the volume of runoff actually produced. In most cases positive drainage systems to a recharge basin are installed. The recharge basins have storage capacity sufficient to contain runoff that accompanies a ten year storm event for the area. As part of departmental policy, the SCDPW does not allow direct discharge of stormwater runoff into surface waters. Where necessary, sedimentation chambers are installed to remove sediments and detain stormwater. A diffusion well was utilized in one project when the soils had poor permeability. Natural swales are used for stormwater drainage where possible and re-planting of any area disturbed by site development is required for all highway projects.

Drainage system plans are reviewed to assure that no stormwater runoff directly enters surface waters or adversely affects Federal, State, or county properties including parklands, highways and the shoreline.

Nassau and Suffolk Municipalities

HOUSING OR BUILDING STANDARDS

Towns throughout Nassau and Suffolk either have similar regulations regarding stormwater runoff as it relates to housing or other building specifications or they rely on the use of best management practices to provide proper drainage for individual site developments.

North Hempstead’s Administration and Enforcement Ordinance §2: Article II—Plumbing and Drainage, stipulates that:

...in no case will water from any rain leader be allowed to flow upon the sidewalk or adjoining property. In addition, no pipe or drain of any description, such as a stormwater drain, may be allowed to be connected to a sanitary sewer system.
The Town of Smithtown has established a Building Permit Review Board to examine and review all individual building permit applications. The creation of such a board was intended, among other things, to protect against the failure to consider surface water drainage as part of each site plan. Town regulations further state that no certificate of occupancy may be issued if the proposed development is to be built within the bounds of a pond, marsh or other areas of surface waters that cannot be drained.

The Towns of Riverhead, North Hempstead and Islip provide Housing Standards Ordinances. Islip's ordinance (§27) requires roofs and paved areas to be adequately drained so as to prevent any accumulation of water. Riverhead and North Hempstead also require that surface and subsurface waters be appropriately drained in order to prevent stagnant ponds and protect building structures. In Babylon, the installation of storm drainage gutters, leaders, and drains on all new residential one and two-family construction is to be conducted according to the table entitled, Maximum Permissible Loads for Storm Drainage, Piping, and Gutters — Table 531 of the New York State Building Code as stipulated in the Babylon Town Code §7 — Buildings and Structural Appurtenances.

OTHER REGULATIONS AND ORDINANCES

There are a few additional legal controls that certain local municipalities in the bi-county area utilize to reduce the negative impacts of stormwater runoff. Most towns and villages have enacted Marina Laws or Tidal Wetlands and Watercourse Ordinances that require a permit to dredge, construct docks, or install bulkheads or other structures. Such proposed operations may not substantially change the course of any channel or natural movement (or flow) of any waters unless special permission is granted.

Most municipalities have amended their tidal wetland and watercourse regulations to include protection of freshwater wetlands as well. Babylon added a comprehensive Freshwater Wetlands Protection Law (Sub Part Z) requiring a permit to conduct certain activities, including the discharge of stormwater and sediments on any freshwater wetland or adjacent areas. The effective date of the law is dependent upon the final acceptance of the New York State Freshwater Wetlands maps by the NYSDEC. Other towns have adopted similar wetland ordinances in accordance with the procedures and concepts set forth in Article 24 of the New York State Environmental Conservation Law.

Many towns throughout Nassau and Suffolk have ordinances pertaining to the excavation of topsoil, sand and other earthen materials. These ordinances attempt to insure that proposed operations will not interfere with drainage, including the interception and diversion of runoff from natural and man-made drainage channels resulting from filling or otherwise preventing adequate or proper drainage. Any overloading of existing drainage systems, thus creating flooding conditions or causing accelerated erosion is also prohibited.

In addition, a number of towns within Nassau and Suffolk have tree ordinances or vegetation protection ordinances that protect against the indiscriminate destruction of trees and their natural environments. Such regulations have recognized the role of trees in soil stabilization and the prevention of erosion.

SITE PLAN REVIEW

In both Nassau and Suffolk counties, the review of individual site plans is required in accordance with the zoning regulations of the various municipalities. (In an attempt to provide an easier interpretation of the requirements for both subdivisions and individual site developments, towns such as Huntington, Islip and Babylon have integrated them within the same body of regulations.) Other towns have included the review of individual site plans within their zoning regulations. Table 2 describes each town's requirements for the review of individual site plans and their associated drainage systems.

Suffolk Municipalities

TOWNS

Explicit details for the control of stormwater runoff are described within the subdivision regulations of each municipality. The most typical approach is the use of design criteria for various structural drainage collection systems, including recharge basins, leaching pools, seepage basins, dry wells and others. In most municipalities, the Rational Method is used to predict the runoff rate for a drainage area to determine the appropriate runoff collection system design. Where recharge basins are required, the storage capacity must contain the runoff resulting from five to eight inches of rainfall per storm event depending on each town's regulations.