D R A F T

ENVIRONMENTAL IMPACT STATEMENT

WASTEWATER COLLECTION AND TREATMENT FACILITIES

NEW SHOREHAM, RHODE ISLAND

United States Environmental Protection Agency

Region I

JOHN F. KENNEDY FEDERAL BUILDING · GOVERNMENT CENTER - BOSTON, MASSACHUSETTS 02203

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NEW SHOREHAM, RHODE ISLAND

Prepared By
U.S. Environmental Protection Agency
New England Region I
John F. Kennedy Federal Building
Boston, Massachusetts 02203

Approved by

Regional Administrator   Date 3/21/75

This Environmental Impact Statement (EIS) has been prepared pursuant to P.L. 91-190, the National Environmental Policy Act (NEPA) of 1969, and Executive Order 11514,"Protection and Enhancement of Environmental Quality" dated March 5, 1970. Both NEPA and Executive Order 11514 require that all Federal Agencies prepare such statements in connection with their proposals for major Federal actions significantly affecting the quality of the human environment.

This EIS has been prepared in accordance with the regulations and guidance set forth in the President's Council on Environmental Quality (CEQ) Guidelines dated August 1, 1973, and the U.S. Environmental Protection Agency's (EPA) Interim Regulation, CFR 40-Part 6, dated January 17, 1973; both concerning the preparation of Environmental Impact Statements.

Under the statutory authority of P.L. 92-500, the Federal Water Pollution Control Act Amendments of 1972, the EPA is charged with administering Federal financial assistance for the construction of publicly-owned wastewater treatment facilities and their appurtenances. In addition, the EPA will issue permits to municipal governments to allow the discharge of treated wastewater effluent into navigable waters in such a manner as to protect the health and welfare of the public and the environment.
P.L. 92-500 further establishes a national goal of eliminating the discharge of pollutants by 1985, and wherever attainable, an interim water quality goal by July 1, 1983, which provides for the protection and propagation of fish, shellfish, and wildlife, and provides for recreation in and on the water.

For the purposes of the Environmental Impact Statement, EPA, Region I, Boston, Massachusetts is the "Responsible Federal Agency" as required by the National Environmental Policy Act.

To insure that the public is kept fully informed regarding this action, and that it participates to the fullest extent possible in the Agency's decision-making process, this Draft EIS is being circulated for a 45-day review as required by the CEQ, August 1, 1973 Guidelines. In addition, a public hearing is scheduled to be held in the near future.

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1. Type of Action

(x) Administrative (x) Draft Environmental Impact Statement

( ) Legislative ( ) Final Environmental Impact Statement

2. Background of Project

In August 1973 the Town of New Shoreham (Block Island), Rhode Island applied to Region I for financial assistance under Title II of the Federal Water Pollution Control Act, as amended (PL 92-500). The community requested a grant for construction and reimbursement for planning and design of a wastewater treatment facility, including sewering and construction of pumping stations.

After preparing the environmental impact appraisal as part of the review of the proposed project, EPA determined that the project would not significantly affect the environment and issued a negative declaration on May 6, 1974.

Before final approval of the project, Block Island residents brought three key issues to the attention of the Regional Administrator:

1. Possible accelerated growth induced by the project,

2. Possible adverse effects of the outfall pipe on adjacent beaches, and

3. Possible adverse effects from locating the wastewater treatment plant within a designated national historical district.

After carefully considering the potential impacts of the proposed action in light of these locally controversial issues, the Regional Administrator reversed his initial decision and issued a notice of intent to prepare an environmental impact statement on September 19, 1974.

3. Preferred Actions

After completing the environmental study and draft impact statement to find an environmentally sound, cost effective solution for Block Island's wastewater treatment problem, EPA has selected two preferred alternative actions. Both systems include a municipal collection system and an extended aeration system at the Spring Street location.

Several recommendations are made to improve the treatment plant as it is presently designed including extension of the outfall, noise attenuation, effluent filtration and sludge aeration.

The difference between alternatives is the extent of the area to be served. One plan extends the collection system only to the developed Old Harbor section of New Shoreham. The second plan extends the collection farther to include the New Harbor area.

EPA prefers sewering only the Old Harbor area. This would encourage the improvement and rehabilitation of the Old Harbor area and reduce the development pressures around the New Harbor area. Increased development around New Harbor would cause encroachment on wetland areas. This preferred plan is in general conformance with the objectives of the Block Island Master Plan, which include maintaining the rural character of the Island.

Also in support of EPA's preferred alternative is the fact that the developed Old Harbor area does not have sufficient land available to support subsurface disposal systems. On the other hand, New Harbor has enough land and suitable soil for existing development to rely on subsurface disposal systems.

4. Summary of Impacts

The major direct impacts of EPA's preferred alternative are related to construction and operation of the wastewater treatment facility and include the aesthetic impact of locating the plant at the Spring Street site, the temporary disruption of various parts of Old Harbor by noise and other construction related activities, the protection of Old Harbor's subsurface drinking water supply, elimination of odor problems from malfunctioning septic systems, and enhancement of water quality along the recreation beaches on Block Island.

The major indirect impact of EPA's preferred alternative is the inducement to rehabilitate and redevelop the Old Harbor area as a result of eliminating the existing wastewater treatment problems and potential health hazard.

5. Other Alternatives Considered

Three other major alternatives are discussed in detail in the draft environmental impact statement, including the alternative of taking no action.

The no action alternative was determined to be unfeasible because the failing subsurface disposal systems in Old Harbor are a potential health hazard and produce unpleasant odors.

The project proposed in June 1973 by the Firm of Fenton Keyes Associates was considered undesirable because it extended the sewer service area beyond the Old and New Harbor areas, especially in Phase II. In addition, Fenton Keyes' proposed action did not appear to be consistent with the goals of the Master Plan adopted by Block Island.

The alternative of rehabilitating the septic systems in the densely populated area around Old Harbor was considered impractical because there is not enough suitable land to support these systems.

Sub-alternatives discussed include various outfall locations, treatment plant sites, types of treatment and possibilities of flow reduction devices.

6. Distribution

Copies of the draft following Federal and State agencies.

FEDERAL

Council on Environmental Quality

United States Department of the Interior

- Bureau of Sports Fisheries and Wildlife
- Bureau of Outdoor Recreation
- Bureau of Land Management
- Geological Survey

United States Department of Agriculture

- Soil Conservation Service

United States Department of the Army

- Corps of Engineers

United States Department of Commerce

National Oceanographic and Atmospheric Administration

Department of Housing and Urban Development

Department of Health, Education, and Welfare

Senator John O. Pastore

Senator Claiborne Pell

Representative Fernand J. St. Germain

Representative Edward P. Beard

State of Rhode Island

Department of Natural Resources

Department of Water Resources

Department of Health

Historical Preservation Commission

REPORT

1.0 INTRODUCTION

1.1 Background

The Town of New Shoreham (Block Island) is located in the county of Washington, Rhode Island, approximately 10 miles offshore from the south coast of the mainland of Rhode Island and approximately 14 miles east of Montauk Point, Long Island. The land area is approximately 11 square miles (see Map 1). The Island is a year-round residence to 500 people and a summer residence to an additional 1,200 people. During the average day of the summer tourist season, the Island is a refuge to approximately 1,000 overnight guests and an equal number of day visitors.

In the past few years, there has been an increase in summer visitors and in construction of summer residences. This growth coupled with forced abandonment of raw ocean discharges and the lack of a municipal treatment system has caused Islanders to resort to subsurface disposal systems.

Because of improper construction due, in part, to insufficient land area, these systems are not functioning properly. The concentration of a number of failing systems in the commercial area of New Shoreham has resulted in a situation which is aesthetically displeasing to residents and visitors. In addition, failing subsurface disposal systems are a potential health hazard.

Because of the seriousness of the situation, the people of New Shoreham enlisted the services of the engineering consulting firm of Fenton G. Keyes Associates to study the problem. In February, 1972, the firm submitted a report to the Town entitled: Preliminary Engineering Survey and Report on the Control of Water Pollution for the Town of New Shoreham, Rhode Island, February 1972.

On June 6, 1972, the Town Council filed a notice of intent to apply for Federal aid for a municipal collection and treatment system and on April 2, 1973, contracted with Fenton G. Keyes Associates to design, supervise construction, and start operation of the wastewater treatment system recommended in their report.

On August 17, 1973, the Environmental Protection Agency (EPA) received an application for Federal aid from the Town of New Shoreham. The application, based on engineering estimates, was for a total project cost of $1.8 million.

Based on the application and the proposed design by Fenton Keyes, EPA prepared an Environmental Impact Appraisal in accordance with the National Environmental Policy Act (NEPA). The project appraisal was for the construction of a secondary wastewater treatment plant, interceptor sewers, two pumping stations, associated force mains, and an outfall sewer off the breakwater near Old Harbor. The treatment facility proposed consisted of an extended aeration-type treatment with a design capacity of 0.28 million gallons per day (mgd). This system was to serve both the Old and New Harbor areas, including marinas, and was to be adequate for the design year of 1997. The locations of the proposed treatment plant and service area are shown in Map 2.

Reviewing the proposal, EPA made the preliminary determination that the funding of this project was not a major action significantly affecting the environment and circulated a negative declaration on May 6, 1974. Hearing no significant comment or controversy in response to the negative declaration, EPA, in accordance with Title II, Section 201 (g)(1) of the Federal Water Pollution Control Act of 1972, made a grant offer to the Town of New Shoreham on May 21, 1974. The offer was accepted on June 7, 1974.

Final plans and specifications were approved June 14, 1974 and the job was opened to bid. On August 14, 1974, the low bid was confirmed at $4.4 million, approximately $2.6 million higher than the engineering estimates made a year earlier.

The higher cost of the treatment system sparked a new citizen awareness, causing considerable controversy about the project. Issues raised were:

(1) possible accelerated growth due to a municipal collection and treatment system;

(2) possible effects of the outfall on adjacent beaches;

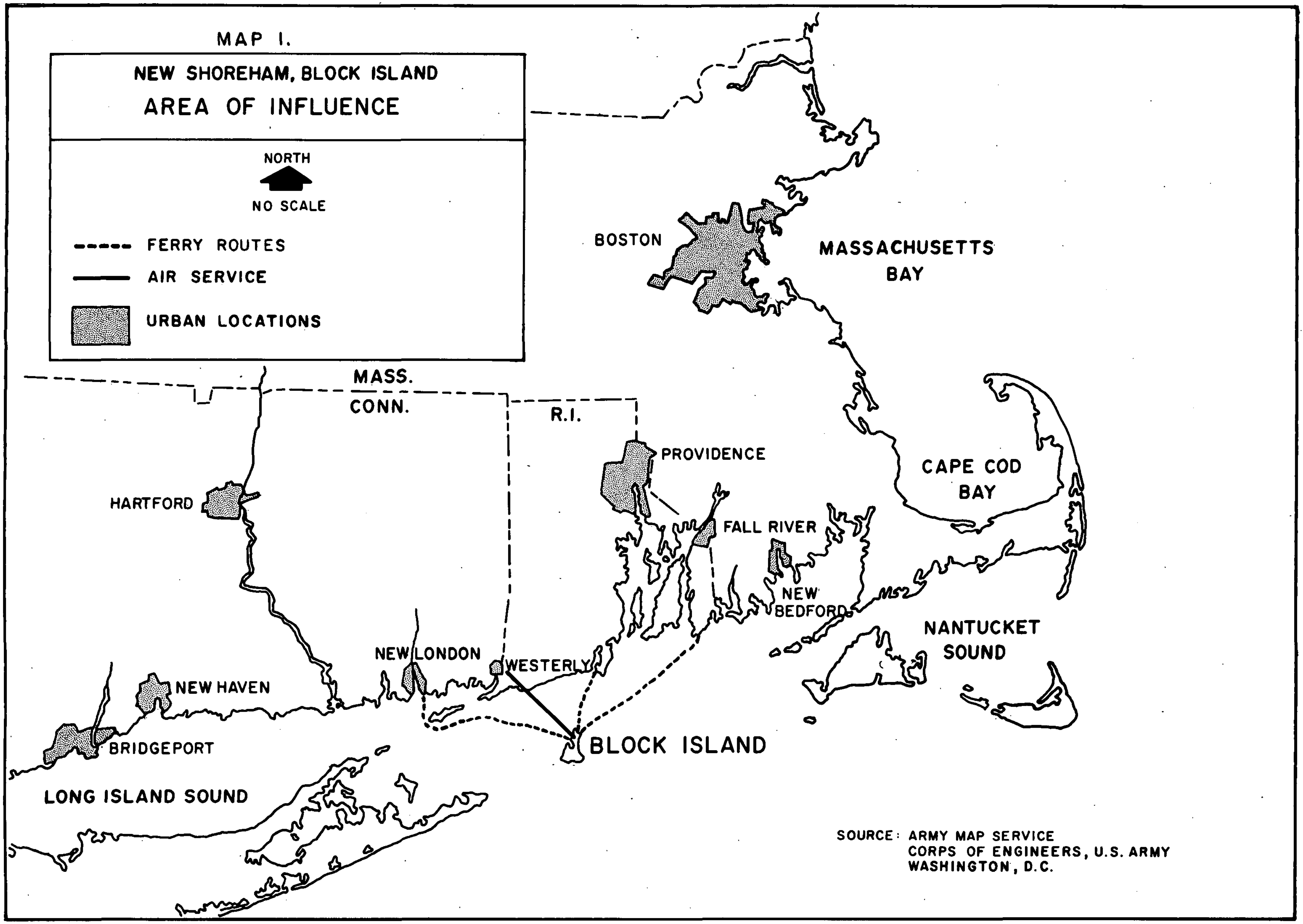
(3) possible infringement of plant site on historical landmarks.

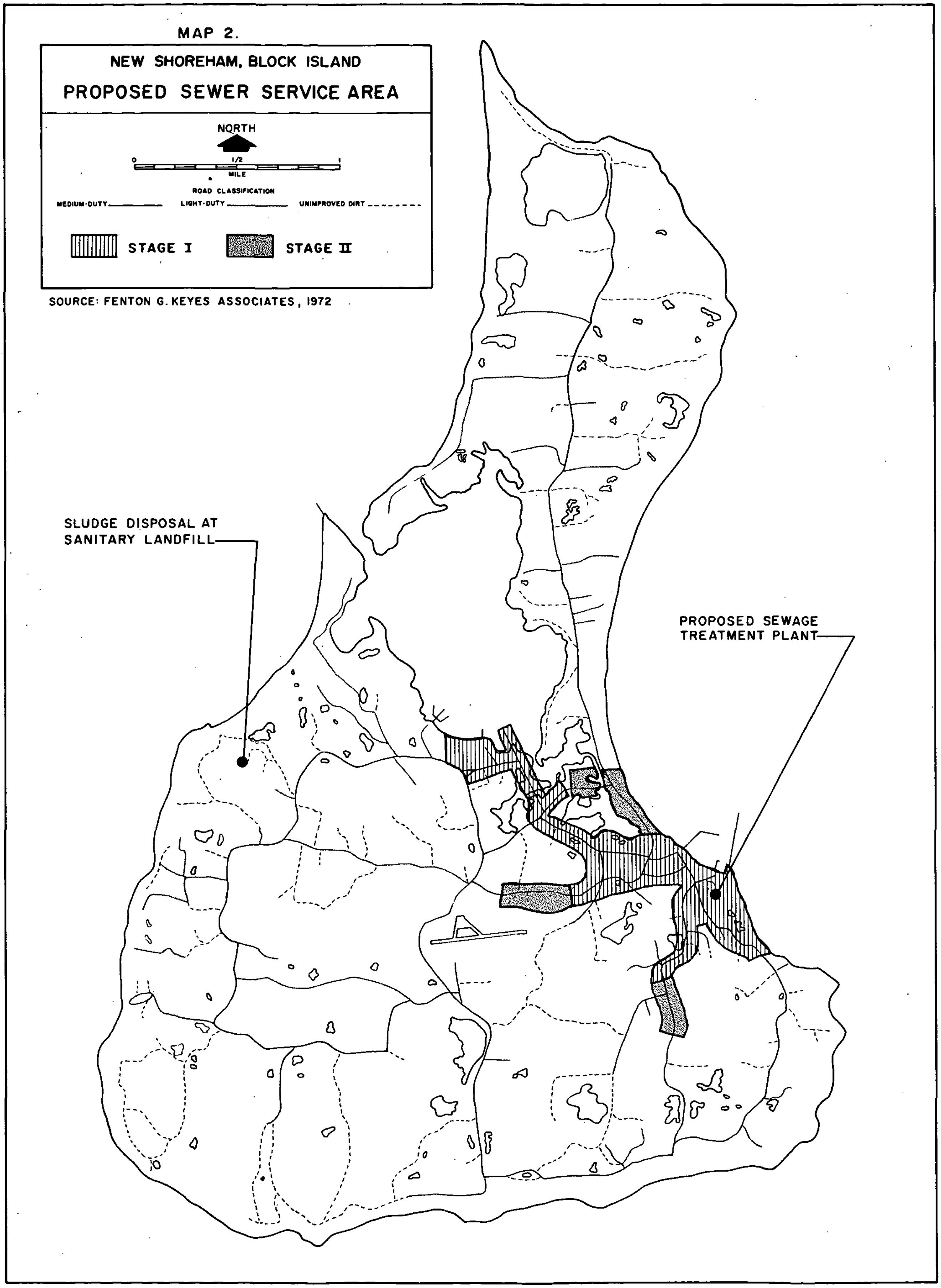
Finally, on September 17, 1974, a meeting was held in the EPA Regional Office so that proponents and opponents of the project could air their views to the Agency. The next day, based on the issues brought to the attention of EPA at this meeting, a decision was made to reverse the initial determination and to proceed with an environmental impact statement in accordance with the National Environmental Policy Act (Section 102(2)(c).

1.2 Other Proposed Actions

The proposed wastewater collection and treatment system is an independent action; that is, it was not proposed because of another project. It is not anticipated that the sewage system will be the cause of another Federal project, other than possible Stage II extension of the proposed sewer.

However, pending EPA approval of the project, the Farmers Home Administration (FmHA) is prepared to grant additional Federal aid for the project. On April 23, 1973, a loan for $1,015,000 was approved and later on October 21, 1974, funds were obligated for an additional loan of $85,000 and a grant for $220,000. The FmHA as stipulated the preparation of the


MAP I.
NEW SHOREHAM, BLOCK ISLAND
AREA OF INFLUENCE
NORTH
NO SCALE
FERRY ROUTES
AIR SERVICE
URBAN LOCATIONS
BOSTON
MASSACHUSETTS BAY
MASS.
CONN.
R.I.
PROVIDENCE
CAPE COD BAY
HARTFORD
FALL RIVER
NEW BEDFORD
NANTUCKET SOUND
NEW LONDON
WESTERLY
NEW HAVEN
BRIDGEPORT
BLOCK ISLAND
LONG ISLAND SOUND
SOURCE: ARMY MAP SERVICE
CORPS OF ENGINEERS, U.S. ARMY
WASHINGTON, D.C.


MAP 2.
NEW SHOREHAM, BLOCK ISLAND
PROPOSED SEWER SERVICE AREA
NORTH
0
1/2
1
MILE
ROAD CLASSIFICATION
MEDIUM-DUTY
LIGHT-DUTY
UNIMPROVED DIRT
STAGE I
STAGE II
SOURCE: FENTON G. KEYES ASSOCIATES, 1972
SLUDGE DISPOSAL AT SANITARY LANDFILL
PROPOSED SEWAGE TREATMENT PLANT

environmental impact statement and subsequent decisions by EPA are a condition of final approval of the grant.

The State of Rhode Island has also made a grant offer of $140,000 as a matching fund to the EPA grant.

2.0 EXISTING ENVIRONMENT

The history and existing environment of Block Island are described to provide a background against which the impacts of alternative actions can be evaluated.

2.1 Historical Background

Originally, Block Island was called by its Indian inhabitants, "Monisses," the "Isle of the Little God." Adrien Block, in 1614, was the first white man to land on the Island, but it was not until 1661 that the first white settlement consisting of sixteen families arrived on the Island. In 1672, it was incorporated as "New Shoreham, otherwise Block Island."*

During the next 100 years, the vulnerable island was repeatedly beseiged by pirates. When the War of Independence broke out, there were nearly eight hundred whites, fifty Indians, and forty negroes living on the Island and the prosperous little community was considered quite a temptation to the British fleet.

After the War and through much of the 19th century, the Islanders supported themselves by fishing and piloting vessels through the hazardous waters between the Island and the mainland. In 1870, the first of two breakwaters was begun with Federal funds. It was the construction of the harbors that signaled the growth of the Island as a vacation resort. In 1879, New Shoreham's official name was changed to Block Island, yet delighted visitors called it "The Bermuda of the North." By the turn of the century, steamers arrived daily from New York, Boston, Providence, Newport, New London and Montauk. Fashionable hotels and plush golf courses covered the Island.

The First World War, however, abruptly ended this prosperous era. The Depression and subsequent Second World War further curtailed the Island's tourist trade and many hotels closed. Fortunately, the Island was still self-supporting through this period by fishing and farming. In the postwar decades, Block Island was rediscovered as a family resort. Private yachting and flying grew more and more popular and a new generation of tourists once again visited the Island. What they found was a lovely, windswept place, with old fashioned inns and simple cottages. Many bought abandoned farmlands overrun by shrubs and bayberry, but dotted with ponds. They fixed up the old homes bit by bit, doing most of the work themselves.

Today, "New Shoreham, otherwise Block Island," is governed directly by a five member Town Council. In 1970, its people defeated a bill to establish legalized gambling on the Island. It is interesting that opposition to this bill was so intense that even the possibility of secession from the State was explored as an alternative to the Island becoming "The Las Vegas of the East." It is now the concensus of those who visit or reside on the Island that preservation of the existing rural character and pristine environment is of utmost importance and they are determined

* Land Use Analysis, New Shoreham, Rhode Island

to achieve a sensible balance between conservation and development before it is too late.

Map 3 displays general points of interest on the Island.

2.2 Physical Inventory

Climate. Block Island's climate is typically maritime, but can be affected by extreme conditions. For example, temperatures ranging from 10° to 95° have been recorded. Summers are usually dry with maximum temperatures averaging 74° during July and August. The Island is too small to build up cumulonimbus clouds, therefore local thunderstorms do not occur. Fog occurs on one out of four days in early summer when the ocean temperatures are relatively cold.

Winters are distinguished for their comparative mildness with temperature maxima averaging 4° to 10° above freezing and minima averaging 25° in February. The surface winds are usually from the east, when snow begins it soon changes to rain or melts rapidly if it does pile up.

The ocean has a dampening effect on hot winds in the summer and an accelerating effect on cold winds from the mainland in the winter. Sea winds can reach 40 mph under certain conditions in the winter with the average for that season about 20 mph. Year round averages are also relatively high at 17 mph. In the early fall, the Island is affected by most of the tropical storms moving up the coast.

During these storms and other periods of high wind, flooding occurs along the shores of the Island. The extent of this flooding, the hurricane high water line is indicated in Map 4.

The efficiency of a wastewater treatment facility is directly related to the ambient temperatures.

With relatively mild conditions prevailing throughout the year, it is not expected that the operation of such a facility would be inhibited. However, with the high winds experienced on the Island precautions must be taken to reduce the possibility of flooding of structures built on the shoreline or in the sea itself.

Topography. Block Island consists of two irregular, hilly areas connected by a sandy lowland. It may be divided into three topographic units which are illustrated on Map 4.

The first unit is a lowland covering about 3 square miles which extends along the north and west sides of the northern half of the Island and encloses Great Salt Pond on the east and west. A manmade breach of the lowland on the pond's west shore forms a channel into a protected harbor. The highest altitude in the lowland is 40 feet above mean sea level (msl) and relief is slight except in areas of sand dunes. Brackish ponds and marshes are numerous.

The second unit is the plain, about 3/4 of a square mile in area, in the extreme northeastern part of Block Island. Its altitude increases northeastward to about 100 feet msl at the eastern sea cliffs, the altitude of the highest point being 141 feet. About a dozen ponds, each covering roughly an acre, occupy local depressions.

The third unit is the southern section of Block Island with an area of about 5 square miles. Its altitude increases from Great Salt Pond, reaching about 140 feet above msl at the southern sea cliffs. The western portion of this section is very irregular; local relief often exceeds 50 feet and the highest point has an altitude of 211 feet above msl. Much of the eastern portion of the southern section of the Island is nearly flat; local relief is a few tens of feet. Its highest point has an altitude of about 170 feet above msl. Of the approximately 50 ponds in the area, about 12 are larger than an acre. Many ponds and swamps in the higher parts of Block Island go dry during the summer and most of the streams on the Island are intermittent.

The Island is principally covered by low to medium height shrubs such as bayberry, rusugo rose, sumac and chokeberry. Presumably, early settlers had used all available forests for fuel and lumber.

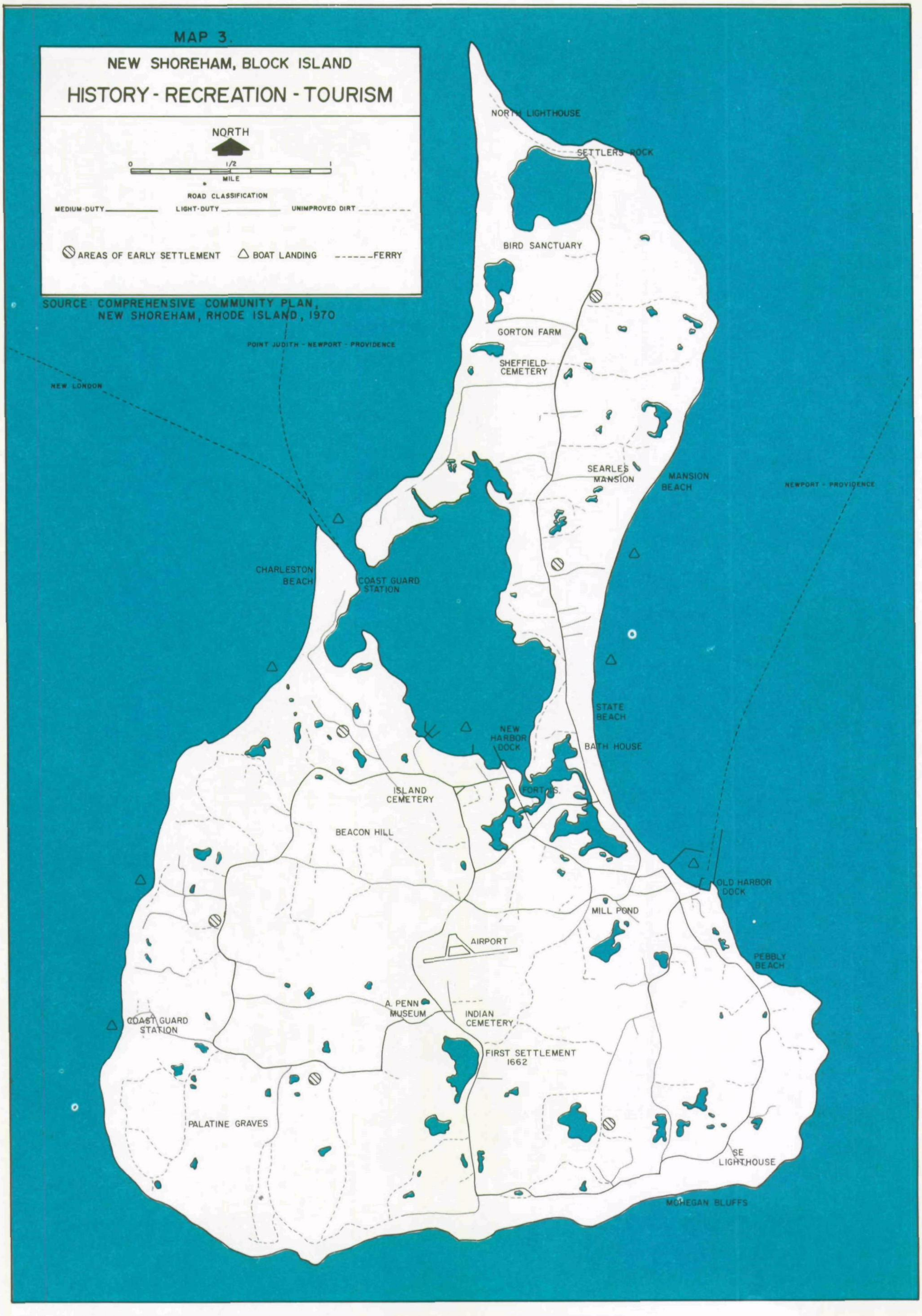
The area of development proposed to be sewered encompasses the eastern halves of the first and third topographical units discussed above.

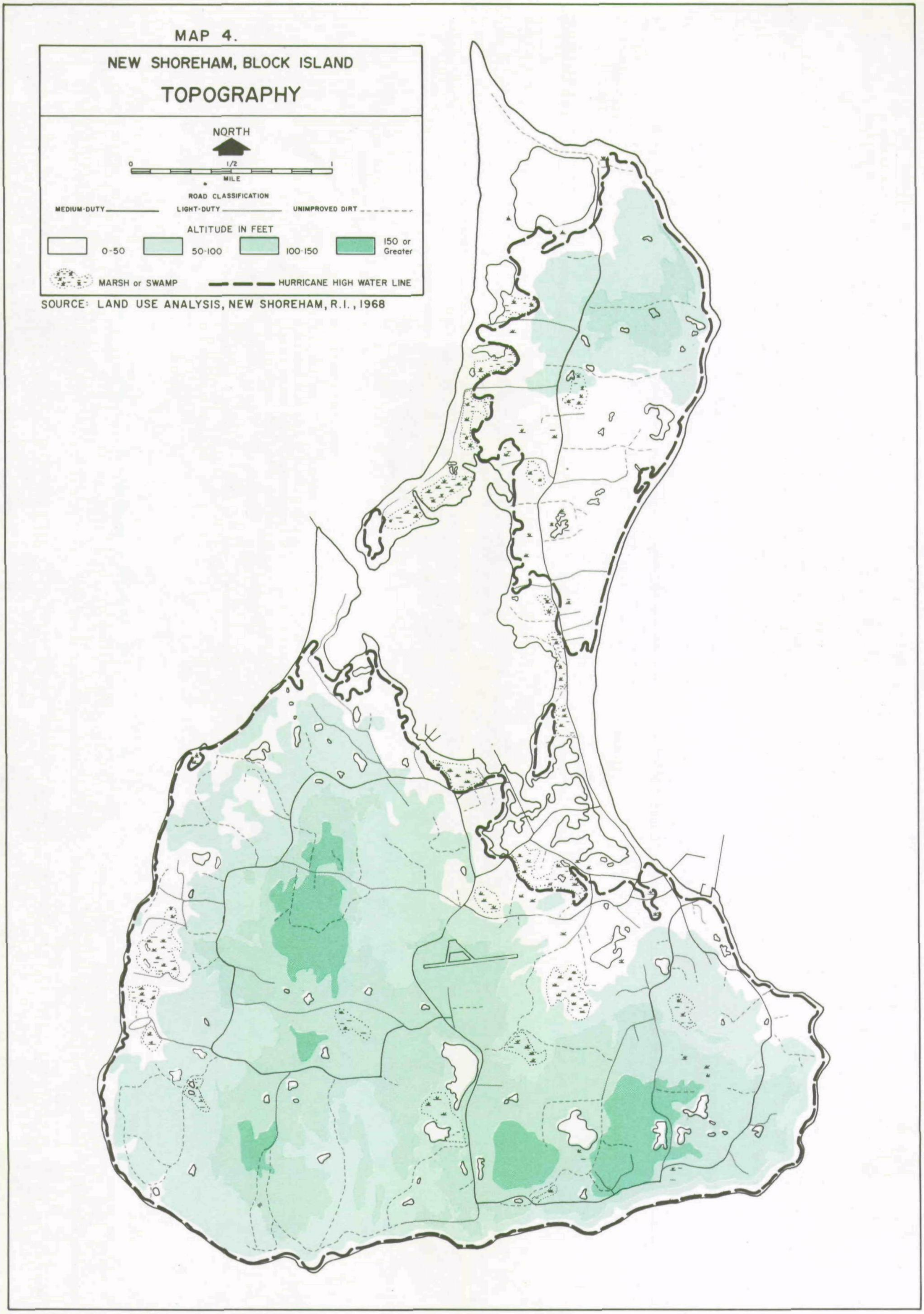
Geology. Block Island was affected by two or more periods of Pleistocene glaciation. However, most of the superficial glacial deposits were left by the most recent glaciation. Most of the glacial deposits on Block Island are part of the terminal moraine, consisting of till and sorted drift, that extends northeastward from the Bonkonkoma moraine of Long Island to Nantucket.

Till generally has low porosity and permeability because all sizes of rock debris were dumped together by the melting ice so that the smaller particles fill the pore spaces between the larger rocks. Till particles range in size from clay to boulders.

Although sorted drift has the same size range of rock particles as till, the drift has been sorted and layered by glacial meltwater streams so that individual layers generally have a narrow range of particle size.

Since the Pleistocene glaciation, wave erosion of the Cretaceous and glacial deposits around the perimeter of the Island has formed sea cliffs along large parts of the shoreline. Pebbles and coarser materials have accumulated at the base of these cliffs while sand and finer particles have been transported away by ocean currents. Some of the sand has been redeposited as beaches on the lee side of the Island, along the western shore of the northern part of the Island, and around Great Salt Pond.


MAP 3.
NEW SHOREHAM, BLOCK ISLAND
HISTORY - RECREATION - TOURISM
NORTH
0
1/2
1
MILE
ROAD CLASSIFICATION
MEDIUM-DUTY
LIGHT-DUTY
UNIMPROVED DIRT
AREAS OF EARLY SETTLEMENT
BOAT LANDING
FERRY
SOURCE: COMPREHENSIVE COMMUNITY PLAN,
NEW SHOREHAM, RHODE ISLAND, 1970
POINT JUDITH - NEWPORT - PROVIDENCE
NEW LONDON
NEWPORT - PROVIDENCE
NORTH LIGHTHOUSE
SETTLERS ROCK
BIRD SANCTUARY
GORTON FARM
SHEFFIELD CEMETERY
SEARLES MANSION
MANSION BEACH
CHARLESTON BEACH
COAST GUARD STATION
STATE BEACH
NEW HARBOR DOCK
BATH HOUSE
FORTS.
ISLAND CEMETERY
BEACON HILL
OLD HARBOR DOCK
MILL POND
AIRPORT
PEBBLY BEACH
A. PENN MUSEUM
INDIAN CEMETERY
COAST GUARD STATION
FIRST SETTLEMENT 1662
PALATINE GRAVES
SE LIGHTHOUSE
MOHEGAN BLUFFS



MAP 4.
NEW SHOREHAM, BLOCK ISLAND
TOPOGRAPHY
NORTH
0
1/2
1
MILE
ROAD CLASSIFICATION
MEDIUM-DUTY
LIGHT-DUTY
UNIMPROVED DIRT
ALTITUDE IN FEET
0-50
50-100
100-150
150 or Greater
MARSH or SWAMP
HURRICANE HIGH WATER LINE
SOURCE: LAND USE ANALYSIS, NEW SHOREHAM, R.I., 1968

Till, sorted drift, and beach deposits are the materials which would be encountered throughout the trench depths required for sewer construction. Severe excavation techniques such as blasting are not expected to be necessary.

The major portion of the Island is overlaid by two types of fairly permeable soils, as shown on Map 5.

1. Narragansett Fine Sandy Loam, well drained non-stony soil, which covers the northern and southeastern parts of the Island, is formed on sorted drift and compact till. This soil usually averages about 2 feet in thickness and occupies gently rolling to rolling areas. The natural drainage is good, but due to a relatively compact substratum, the downward movement of water is retarded to some extent and the soil has a fairly high water holding capacity.

2. Gloucester Stoney Fine Sandy Loam, well drained stony soil, which covers the southwestern part of the Island, is formed on sorted drift and relatively permeable loose sandy till. This soil averages about 2 feet in thickness and has developed in areas having steeply rolling relief. Natural drainage is good to excessive.

A third type of soil, Whitman Silty Clay Loam, is poorly drained and occurs only in a few small bodies which occupy small depressions or pot holes and are practically stone free. Natural drainage is poor and water stands on the surface in wet seasons.

The Muck and Peat Areas are composed of deposits of organic matter in varying degrees of decomposition. None of these areas are drained and water stands on the surface of the ground most of the year.

The Coastal Sand Areas, including beach and dune sand, have value only for recreational purposes.

Evaluation of the above soils would indicate that only the two well drained types, Narragansett Fine Sandy and Gloucester Stoney Fine Sandy Loams, are satisfactory for onsite septic tank disposal fields year round. The Gloucester type in the steep phase is not satisfactory due to its erosive characteristics, and a considerable area in the southwestern section of the Island has slopes greater than 12 percent. However, this is only a general analysis and individual onsite investigations are necessary prior to approval of septic system locations.

An important factor of the geology of Block Island is the lack of the proper type gravel and stone for septic tank leaching field construction. Good "bank run gravel" for fill purposes and 1/2-1 1/2 inch washed, crushed stone for leaching field construction are not readily available.

Ground water. The source of all fresh water on Block Island is precipitation. Since the water vapor for this precipitation is derived by evaporation from the ocean, the precipitation falling on Block Island contains more salt than that falling on most mainland areas. Part of the Island's precipitation runs off into the sea, part returns to the atmosphere by evaporation and the remainder seeps into the ground. Map 6 displays general areas of ground water availability on Block Island.

Ground water on Block Island occurs principally within three types of layers: The upper perched water bodies, the lower perched water zone and the main zone of saturation, in order of increasing depth below land surface.

The upper perched water bodies are not considered a dependable source of supply. Many of the upper perched ponds and wells tapping the perched water go dry during the summer. Only domestic water supply systems utilize the upper perched water with yields averaging about 5 to 10 gallons per minute (gpm).

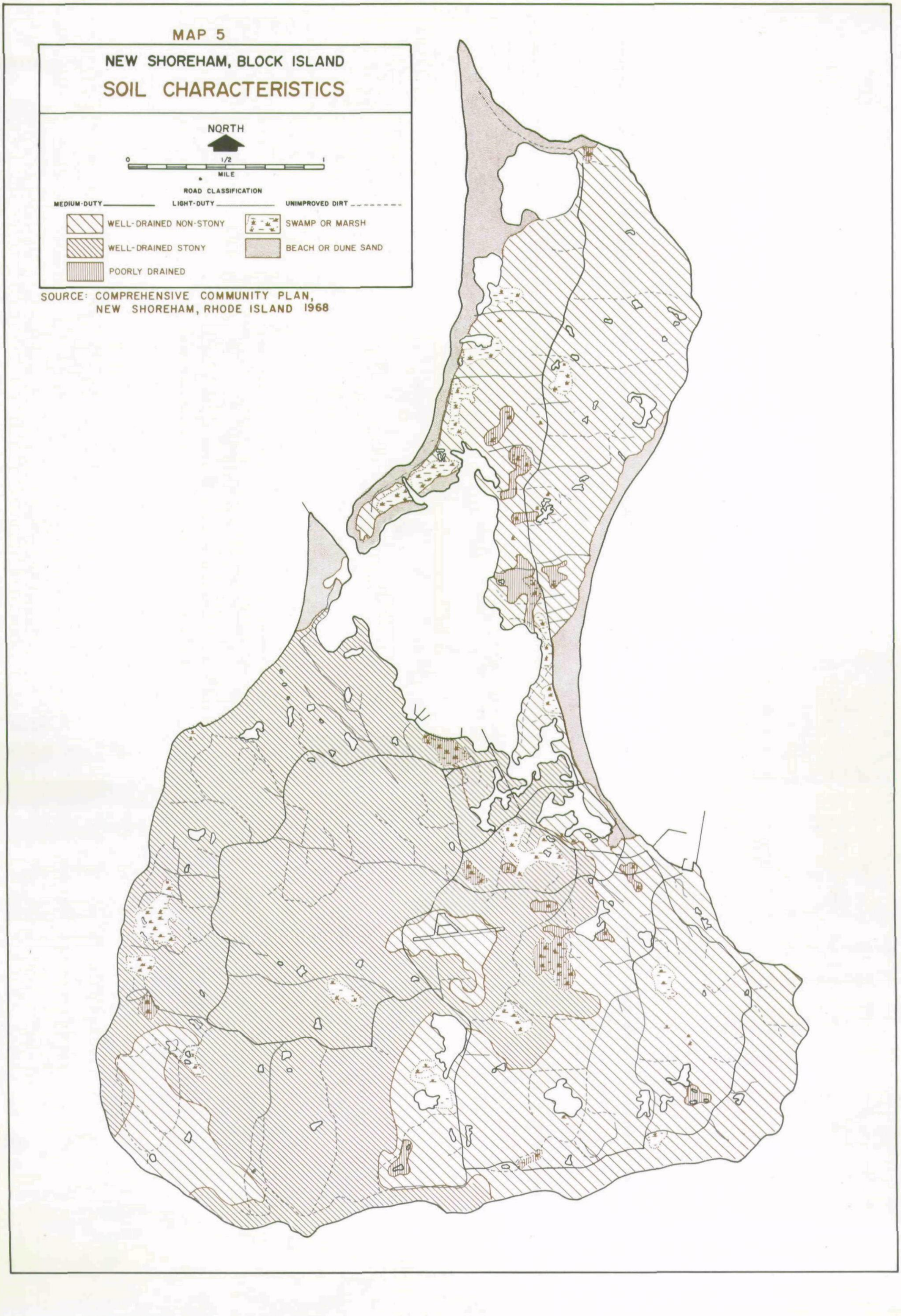
The lower perched water zone is supported by aquicludes of clay or compact till and underlies considerable areas of the northern and southern sections of Block Island. Maximum well yields from the lower perched zone may be as much as 80 gpm.

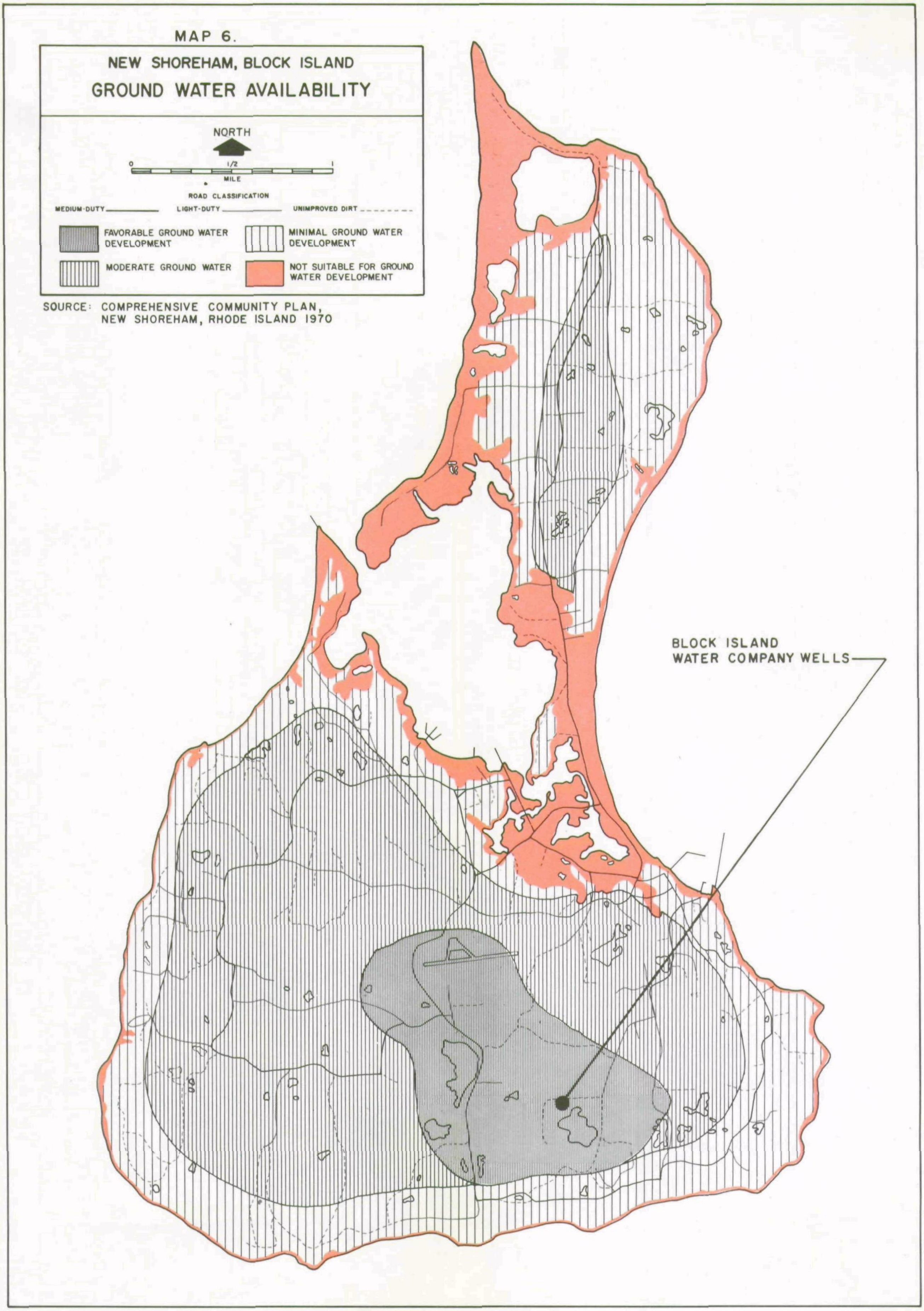
The main zone of saturation is continuous beneath all of Block Island. The upper part of the main zone of saturation consists of fresh ground water, the lower part is saline. The water table of the main zone of saturation is only 1 or 2 feet above sea level in the lowland and shore areas of Block Island. The mid-southern section of the water table ranges from 3 to 18 feet above sea level.

The most important source of fresh ground water on Block Island is the lower perched water zone in the southern section of the Island. For several decades, it has been a reliable source of water for public supply. Recharge to this perched water body is roughly estimated to be 720 million gallons per year. The yield obtainable by normal development methods is estimated to be on the order of 1 million gallons per day (mgd). Most discharges from the lower perched water zone are natural, only about 15 million gallons per year are discharged from wells on the Block Island Water Company.

The yield of fresh ground water from the main zone of saturation depends primarily upon the height of the water table above sea level. For each foot the water table stands above sea level, a maximum of about 2 gpm can be pumped without saltwater encroachment. Thus, the best potential area for development in the main zone of saturation is the southern section of the Island where the water table is highest.

Fresh and Sands Ponds in the southern section of Block Island, when used together, would be a potential source of water supply. Sands Pond


MAP 5
NEW SHOREHAM, BLOCK ISLAND
SOIL CHARACTERISTICS
NORTH
0
1/2
1
MILE
ROAD CLASSIFICATION
MEDIUM-DUTY
LIGHT-DUTY
UNIMPROVED DIRT
WELL-DRAINED NON-STONY
SWAMP OR MARSH
WELL-DRAINED STONY
BEACH OR DUNE SAND
POORLY DRAINED
SOURCE: COMPREHENSIVE COMMUNITY PLAN,
NEW SHOREHAM, RHODE ISLAND 1968


MAP 6.
NEW SHOREHAM, BLOCK ISLAND
GROUND WATER AVAILABILITY
NORTH
0
1/2
1
MILE
ROAD CLASSIFICATION
MEDIUM-DUTY
LIGHT-DUTY
UNIMPROVED DIRT
FAVORABLE GROUND WATER DEVELOPMENT
MINIMAL GROUND WATER DEVELOPMENT
MODERATE GROUND WATER
NOT SUITABLE FOR GROUND WATER DEVELOPMENT
SOURCE: COMPREHENSIVE COMMUNITY PLAN, NEW SHOREHAM, RHODE ISLAND 1970
BLOCK ISLAND WATER COMPANY WELLS

is used seasonally by the Block Island Water Company. Both ponds are a part of the lower perched water zone and have a surface area of about 0.05 square mile, direct recharge averages about 25,000 gpd.

Overland runoff and ground water discharge into the ponds also contribute some recharge. Each pond is reported to average about 10 feet in depth. About 10 million gallons of water is stored for each foot of their depth. It is assumed that at least 5 feet of the 10 foot pond depth is perennially available. Thus, about 150,000 gpd can be withdrawn safely from the ponds. Treatment, in accordance with State requirements for adequate sanitary protection, would be necessary.

Water Quality. The State of Rhode Island, Dept. of Health has classified the relative quality of all the waters of the State by means of a letter designation. The present and proposed classification for most of the waters around Block Island is S(A), the highest marine water quality designation. Two exceptions are closures around the docking areas in Great Salt Bay and Old Harbor (shown on Map 7). Both closures were given the second highest marine water classification S(B). The uses and standards of quality of waters under each of these classifications are defined by the State and shown on Table 1.

Although the existing classifications indicate a relatively clean water environment, apparently there are localized conditions where the quality of water is in violation of the standards set forth under each classification. Little data is available on existing water quality levels for Block Island except for a survey done in 1973 by the Rhode Island Department of Health on Great Salt Bay (see Appendix A). However, officials from the State Dept. of Health, Division of Food Protection and Sanitation have attested to the severity of existing localized conditions.

The cause of local violations of water quality standards is directly attributable to untreated or partially treated discharges of domestic wastewater. No public sewers exist within the town. Waste disposal throughout the town is handled entirely on an individual basis by means of septic tanks, cesspools or by direct outfalls to ponds, harbors or the ocean. In the Engineering Report developed by Fenton G. Keyes Associates, the sources of pollution were identified as wastes from pleasure crafts, overflowing and inadequately drained septic systems and direct outfalls. A generalized indication of the location of these discharges is shown on Map 7. Their existence has created a potential health hazard on the Island.

Specifically, in the New Harbor area (north of Beach Avenue), there are several structures whose combined septic effluent is collected in a pit on the shore and subsequently seeps into the harbor. In addition to many single direct discharges, there is one discharge whose effluent flows very close to a spring-fed water supply pumping station. Also, there are several low-lying leaching fields whose operation is limited by high water table conditions.

TABLE 1 - Rhode Island Water Quality Standards for Sea Water

CLASS SA: Suitable for all sea water uses including shellfish harvesting for direct human consumption (approved shellfish areas), bathing, and other water contact sports.

Standards of Quality

Item	Water Quality Criteria
1. Dissolved oxygen	Not less than 6.0 mg/1 at any time.
2. Sludge deposits--solid refuse floating solids oil grease scum	None allowable
3. Color and turbidity	None in such concentrations that will impair any usages specifically assigned to this Class.
4. Coliform bacteria per 100 ml	Not to exceed a median MPN of 70 and not more than 10% of the samples shall ordinarily exceed an MPN of 230 for a 5-tube decimal dilution or 330 for a 3-tube decimal dilution
5. Odor	None allowable
6. pH	6.8 - 8.5
7. Allowable temperature increase	None except where the increase will not exceed the recommended limits for the most sensitive water use.
8. Chemical constituents	None in concentrations or combinations which would be harmful to human, animal, or aquatic life or which would make the waters unsafe or unsuitable for fish or shellfish or their propagation, impair the palatability of same, or impair the waters for any other uses.
9. Radioactivity	

TABLE 1 - Rhode Island Water Quality Standards for Sea Water (Continued)

CLASS SB: Suitable for bathing, other recreational purposes, industrial cooling and shellfish harvesting for human consumption after depuration (restricted shellfish area); excellent fish and wildlife habitat; good aesthetic value.

Standards of Quality

Item	Water Quality Criteria
1. Dissolved oxygen	Not less than 5.0 mg/l at any time
2. Sludge deposits solid refuse floating solids oils grease scum	Not allowable
3. Color and turbidity	None in such concentrations that would impair any usages specifically assigned to this class.
4. Coliform bacteria per 100 ml	Not to exceed a median value of 700 and not more than 2,300 in more than 10% of the samples
5. Taste and odor	None in such concentrations that would impair any usages specifically assigned to this class and none that would cause taste and odor in edible fish or shellfish
6. pH	6.8 - 8.5
7. Allowable temperature increase	None except where the increase will not exceed the recommended limits on the most sensitive water use assigned to this class
8. Chemical constituents	None in concentrations or combinations which would be harmful to human, animal or aquatic life or which would make the waters unsafe or unsuitable for fish or shellfish or their propagation, or impair the water for any other usage assigned to this class.
9. Radioactivity	

The Old Harbor Village is heavily developed with characteristically small lots and large structures. This condition results in septic systems with relatively small leaching fields (or none at all). These small fields, which serve many of the hotels and commercial establishments, appear sufficient for winter operation but are undersized for the great demands put upon them by the large influx of summer population.

In both Harbor areas, pleasure craft dispose of their sanitary wastes overboard, and until January 1975 there were no Federal or State regulations controlling such disposal. (New Federal regulations aimed at correcting this problem are described in Appendix B). In any event, no disposal facilities such as pumpout stations are presently provided at marinas to relieve the pleasure craft of these wastes. In addition, no public toilet facilities are available on the Island to boaters, thus increasing discharges from pleasure crafts.

Noise Levels. Ambient noise level measurements were conducted by EPA in the proposed study area and more specifically in the area adjacent to the proposed treatment plant site. A summary of those results are given in Table 2.

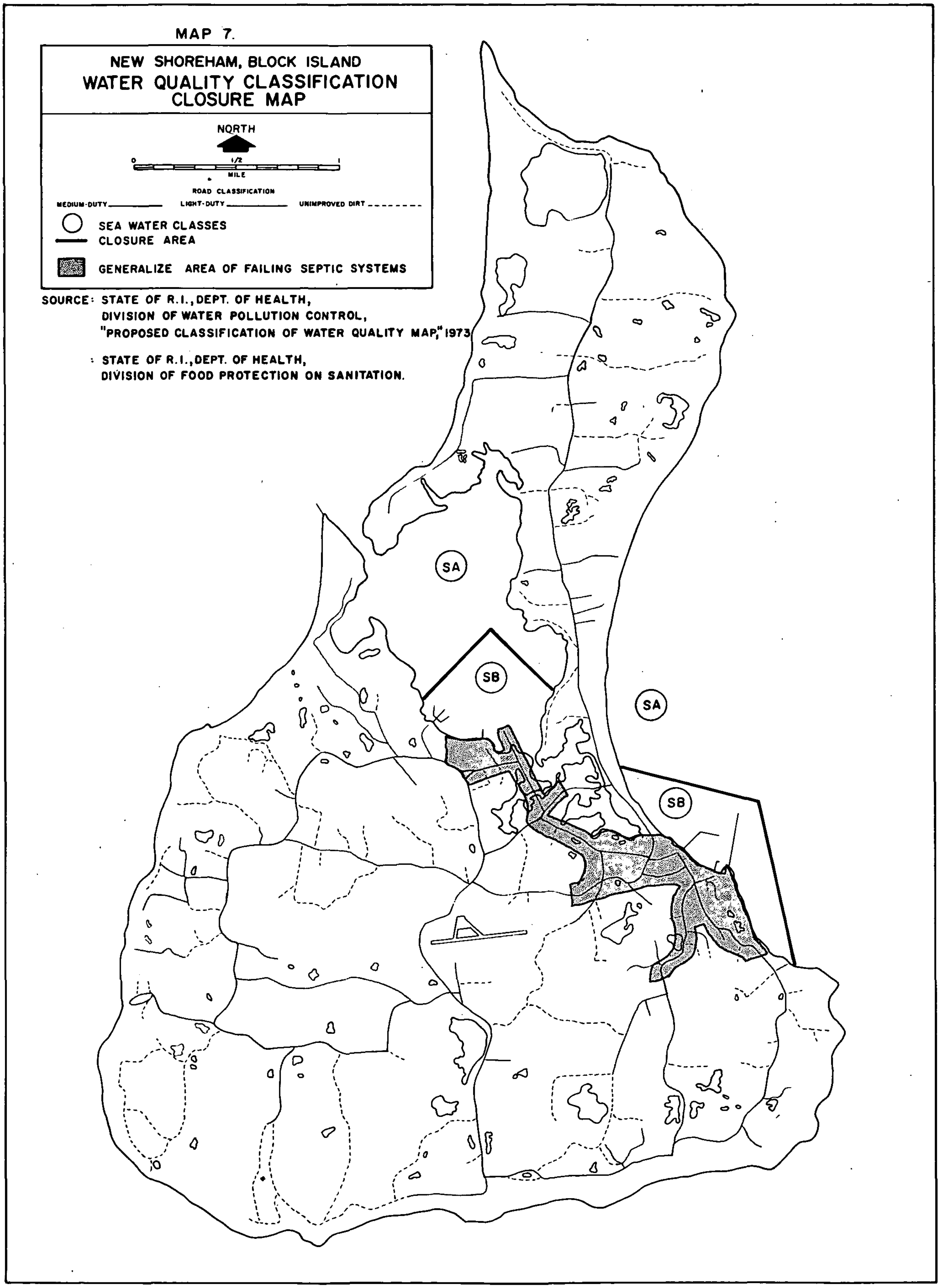
TABLE 2 Noise Levels on Block Island - January 1975

Location	Time of Day	L90	Leq
Location on High St. (approx. 100 ft. from plant)	10:15 to 10:30	29 dBA	34 dBA
	12:12 to 12:27	27	34
	14:50 to 15:05	26	47*
Ballard's Hotel (approx. 250 ft. from plant)	11:12 to 11:27	35	39
	14:11 to 14:26	33	38
Residence on Road "M" (approx 500 ft. from plant)	10:48 to 11:03	34	50**
	13:20 to 13:35	38	51**
Residence on Spring St. (approx. 300 ft. from plant)	16:04 to 16:19	25	44

* aircraft overflights dominate Leq value
** high Leq due to vehicle traffic on Road "M"

Source: EPA Measurements

These levels are indicative of a very quiet noise climate in the vicinity of the proposed treatment plant. On the basis of the above data, a crude estimate of the daytime equivalent sound level (Leq) is 40 decibels (dBA) and it can be estimated that nighttime Leq would be about 27 dBA. These values can be combined to obtain an estimated day-night average sound level (Ldn) of 39 dBA.


MAP 7.
NEW SHOREHAM, BLOCK ISLAND
WATER QUALITY CLASSIFICATION
CLOSURE MAP
NORTH
0
1/2
1
MILE
ROAD CLASSIFICATION
MEDIUM-DUTY
LIGHT-DUTY
UNIMPROVED DIRT
SEA WATER CLASSES
CLOSURE AREA
GENERALIZE AREA OF FAILING SEPTIC SYSTEMS
SOURCE: STATE OF R.I., DEPT. OF HEALTH,
DIVISION OF WATER POLLUTION CONTROL,
"PROPOSED CLASSIFICATION OF WATER QUALITY MAP," 1973
: STATE OF R.I., DEPT. OF HEALTH,
DIVISION OF FOOD PROTECTION ON SANITATION.
SA
SB
SA
SB

This estimate is probably only valid during the winter season and it can be expected that the noise levels will increase somewhat during the summer months due to the seasonal increase in population.

Air Quality. No major sources of air pollution presently exist on the Island. From 1969 through 1972, the State of Rhode Island Department of Health maintained an air quality monitoring station at the New Shoreham Airport on Block Island (approximately 1 mile west of the proposed wastewater treatment plant). Data obtained from this station are shown in Table 3. It can be seen from Table 4 that none of the air quality data measured during this period even approached violations of National Ambient Air Quality Standards or Rhode Island Ambient Air Standards; and therefore, the State discontinued the operation of the site.

TABLE 3 1970 Air Sampling Data
Block Island Airport*

	Pollutants		
	Particulates	Sulfur-Dioxide	Nitrogen-Dioxide
Number of Readings	13	12	12
Maximum 24-hours	66.7	15.7	86.5
Minimum 24-hours	19.2	7.9	5.6
Arithmetic Mean	36.8	8.7	12.4
Geometric Mean	34.2	-	-
Standard Deviation	1.45	1.23	2.20

*latest complete data available

Source: State of Rhode Island Department of Health

Fish and Wildlife. The predominant fish species found in the waters adjacent to Block Island are: yellow tail flounder, ocean pout, little skate, winter flounder and spiny dog fish. Commercial fishing on the Island is limited to the offseason as the primary occupation of fishermen on the Island is shellfishing. Lobster harvesting is minimal but clams and scallops are harvested in great quantities. Great Salt Pond, which is protected from the ocean currents, contains at least five species of shellfish commercially available to local fishermen. A marine biologist from the Rhode Island State Department of Natural Resources indicated that about 80% of the shellfish (hard and soft clams, mussels and bay scallops) are located in beds outside of the closure (shown on Map 6) in the open classification of this natural saltwater pond.*

* Memo from Edward Wong, Natural Resource Officer, Surveillance and Analysis Division, EPA.

TABLE 4 - Comparison of National Primary and Secondary Standards and Rhode Island Air Quality Standards

Pollutant	National Primary Standard	National Secondary Standard	State of R.I. 1973 Goal	State of R.I. 1975 Goal
Particulates	75 ug/M^3 (annual geometric mean)	60 ug/M^3 (annual geometric mean)	60 ug/M^3* (annual geometric mean)	50 ug/M^3* (annual geometric mean)
	260 ug/M^3 (24-hr maximum)	150 ug/M^3 (24-hr maximum)	168 ug/M^3* (24-hr maximum)	130 ug/M^3* (24-hr maximum)
Sulfur Dioxide	80 ug/M^3 (annual arithmetic mean)	60 ug/M^3 (annual arithmetic mean)	72 ug/M^3* (annual geometric mean)	57 ug/M^3* (annual geometric mean)
		1300 ug/M^3 (3-hr maximum)	858 ug/M^3* (1-hr maximum)	687 ug/M^3* (1-hr maximum)
	365 ug/M^3 (24-hr maximum)	260 ug/M^3 (24-hr maximum)	358 ug/M^3* (24-hr maximum)	286 ug/M^3* (24-hr maximum)
Nitrogen Dioxide	100 ug/M^3 (annual arithmetic mean)	100 ug/M^3 (annual arithmetic mean)	NONE	NONE
Carbon Monoxide	10 mg/M^3 (8-hr max. average)	10 mg/M3 (8-hr max. average)	9.2 mg/M^3* (8-hr max. average	NONE
	40 mg/M^3 (1-hr max. average)	40 mg/M^3 (1-hr max. average)		
Total Oxidants	160 ug/M^3 (1-hr max. average)	160 ug/M^3 (1-hr max. average)	118 ug/M^3* (1-hr max. average)	NONE
Hydrocarbons	160 ug/M^3 (3-hr max. average)	160 ug/M^3 (3-hr max. average)	118 ug/M^3* (3-hr max. average)	NONE

*Standard conditions for measurements are established at 25°C, 1 atm pressure.
Source: State of Rhode Island, Department of Health

The hard clams and ocean quahogs are distributed around the Island with concentrations of surf clams growing in beds close to shore. The quahogs and hard clams are in waters about one to two miles off-shore predominantly on the western side of the Island. There are clams on the eastern side; however, the density and yield is commercially less attractive and because of wire cables extending out of Old Harbor, there are restrictions on the dredging operations in that area. The fishing fleet is made up of between four and six dredge boats operating simultaneously, although not consistently, on a day-to-day basis.

The waters around Block Island have become increasingly valuable during the past three years due to an increase in the production of the ocean quahog and surf clams whose sources are traceable to this area. In the listing of the Rhode Island Landings, Summary of 1971, dredge boats harvested 1,650,000 pounds of clam meats, having a landed value of about $286,000. This is a conservative figure because the largest operator reported a landed value on ocean quahogs to his firm alone for 1973 in the order of $306,000. All of these clams were collected from areas west of Block Island and parts of Rhode Island Sound. Most of the extensive harvesting is on the western side of the Island. After processing by the food industry, the retail value of the shellfish is several times the landed value.

Wildlife on Block Island includes birds and small mammals. The Island serves as a migratory resting place for several varieties of birds, many of which can be seen in the Wildlife Refugee at Sandy Point. None of these birds are on the United States List of Endangered Fauna. One mammal species of significance is the Block Island Meadow Vole. This small rodent is found in areas of beach grass and uncut fields on about 600 acres of the Island. The vole has been decreasing in numbers due to alteration or elimination of its habitat caused by the construction of buildings and roads on Block Island.* However, it is not likely that this small creature will be included on the United States List of Threatened Species which is currently being prepared by the U.S. Fish and Wildlife Service.

Another species which uses the Island as a temporary home during migratory travels is the seal. Although neither State nor Federal Fish and Wildlife agencies have recorded the seals' presence, many of the Islanders have seen them. The seals are of special concern because their resting area is on the eastern side of the Island, in the vicinity of the proposed treatment plant outfall sewer.

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* Clough, C.G., and Fulk, G., Current Status of the Block Island Meadow Vole, Rhode Island, 1971.

Environmentally Sensitive Areas. Map 8 is an identification of environmentally sensitive areas on Block Island. A fundamental definition of an environmentally sensitive area is any area which is intolerant to major changes by man. It is, therefore, implicit that exploitation of such regions could result in irreparable and irretrievable damage. Specific land types which fall under this category are; fresh and salt water ponds, marshes and wetlands, coastal zones, areas with impermeable soils, areas which have a slope greater than 15%, areas with high ground water tables which generally includes any area on Block Island which is below the 10 ft. elevation, areas favorable for ground water supply, and dunes and bluffs.

2.3 Utilities and Other Community Facilities

Water. A small water supply system, owned by the Block Island Water Company serves about 250 winter and 2000 summer customers in the Old Harbor and surrounding areas (see Map 9). The water supply for this system includes two wells with a reported capacity of 185 gpm and Sands Pond, which is used about nine months of the year.

The remainder of the Island is serviced by private wells, springs and in some cases, man-made impoundments. Recent proposals, however, recommend the enlargement of this system to service the majority of the southeastern portion of the Island, including the proposed sewer service area. Such a system would require a capacity of 650 gpm or 0.6 mgp by 2022.*

Sewers. At present, there is no sanitary sewer system on the Island. As was discussed earlier, all wastewater is treated on an individual basis by means of either septic tanks, cesspools or direct discharges. No public toilet facilities exist except for rest rooms available in private establishments, and facilities to collect wastewater from pleasure crafts are not available at marinas.

Septage which must be pumped from septic tanks, from time to time, is disposed of at the recently relocated town landfill site.

Gas. Gas is provided by a private bottled gas company.

Electricity. Electricity is generated on the Island by the Island Light and Power Company. Supply by overhead line is generally available.

Telephone. A radar link between Pt. Judith and the Island provides telephone connection to the mainland.

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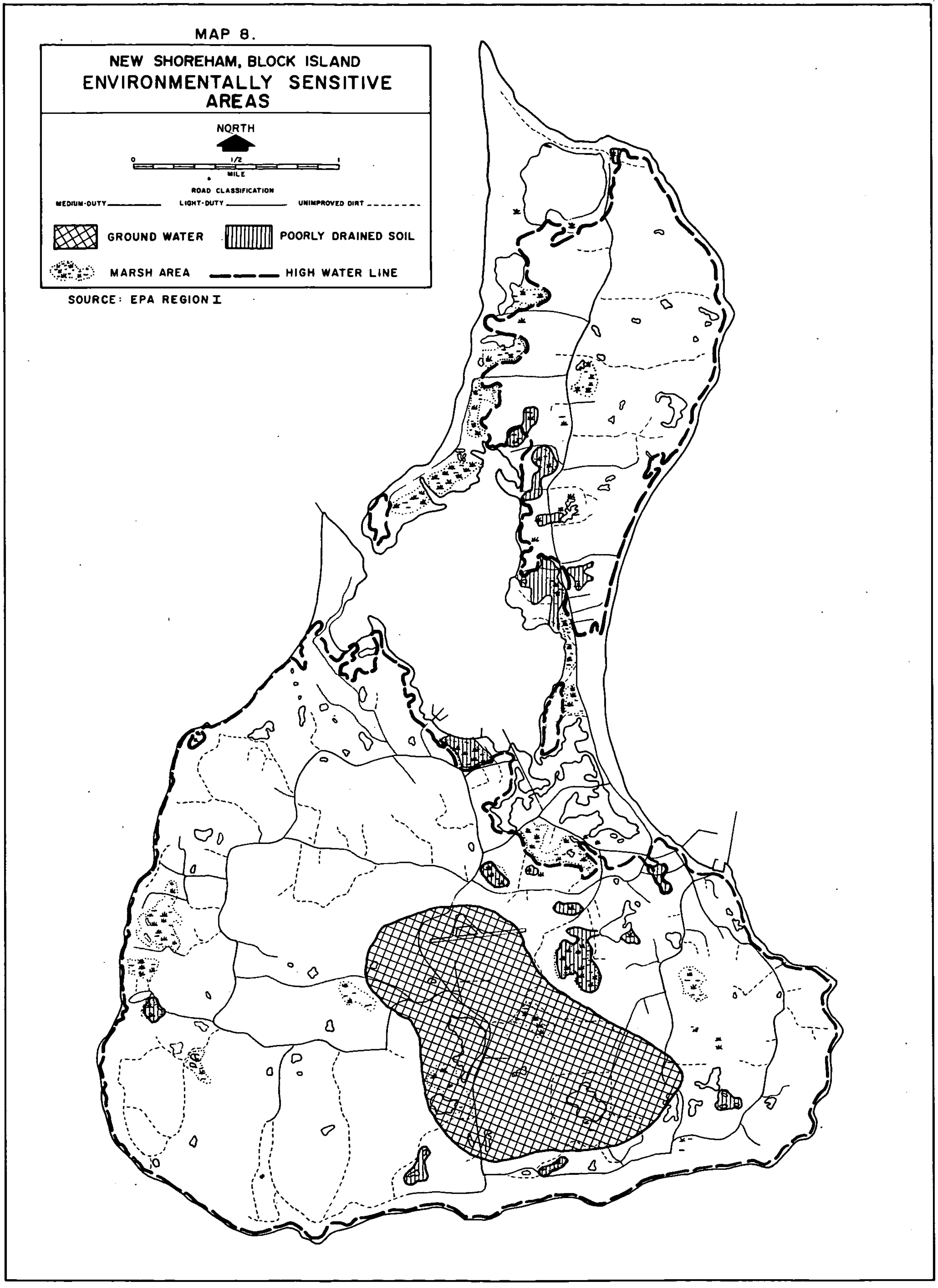
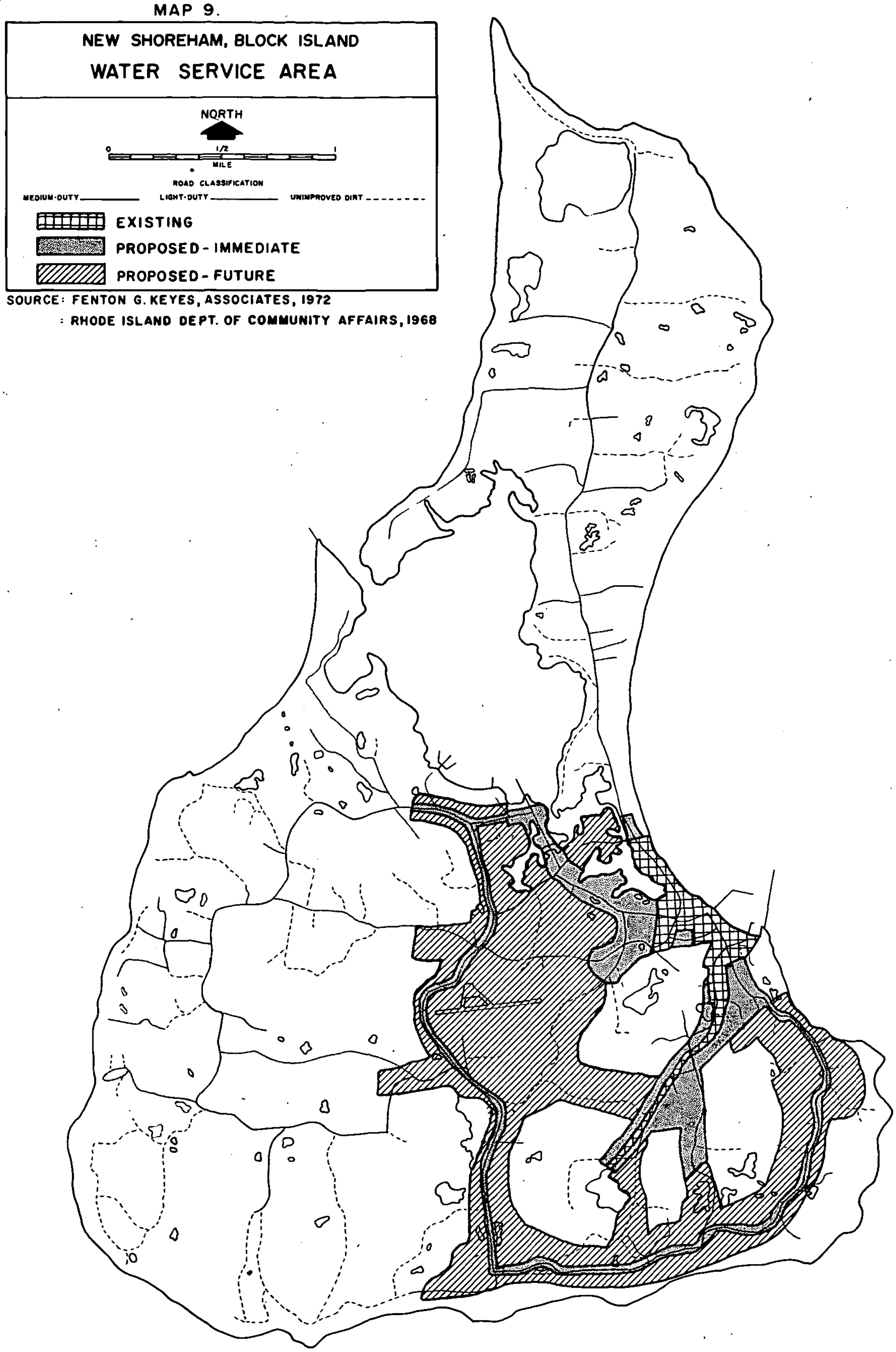
* Fenton G. Keyes Associates, Preliminary Engineering Survey and Report on Water Supply and Distribution for the Town of New Shoreham, Rhode Island, May 1972.


MAP 8.
NEW SHOREHAM, BLOCK ISLAND
ENVIRONMENTALLY SENSITIVE AREAS
NORTH
0
1/2
1
MILE
ROAD CLASSIFICATION
MEDIUM-DUTY
LIGHT-DUTY
UNIMPROVED DIRT
GROUND WATER
POORLY DRAINED SOIL
MARSH AREA
HIGH WATER LINE
SOURCE: EPA REGION I

MAP 9.



SOURCE: FENTON G. KEYES, ASSOCIATES, 1972
: RHODE ISLAND DEPT. OF COMMUNITY AFFAIRS, 1968

Refuse Disposal. In 1974, the town began operation of a new 23 acre sanitary landfill. This new facility is located off West Side Road near Swede Hill (see Map 10). The site has been approved by the State for septage disposal and during the summer several truckloads are brought to the site each week. This site appears to be adequate to serve the town's solid waste disposal needs, including septage disposal, for the foreseeable future.*

Other Facilities. The locations of other important public facilities are shown on Map 10.

2.4 Growth and Land Use Analysis

Population and Socio-economic Trends. The Island's population and economic activity reached its peak shortly after the turn of the century. The Island supported a prosperous summer trade with flourishing summer hotels, a fishing industry, and 1,400 year-round residents until the 1920's.

Subsequently, the 1938 hurricane destroyed the fishing fleet and, given the distance from land markets, the fishing industry never recovered. The summer hotel trade began declining here, as elsewhere with the increased use of the auto in vacations. As shown in Table 5, the residential population steadily declined to 486 by 1960, and has remained stable since at between 450 to 500 year-round residents.

TABLE 5 - Population

Year	Population
1915	1,414
1930	1,029
1960	486
1970	501
2000	500

Source: U.S. Census of Population 1960 & 1970, Rhode Island; Land Use Analysis, Rhode Island Dept. of Community Affairs, 1968.

The population increases by approximately 1,200 summer residents, 1,000 overnight visitors to the hotels, and 1,000 day visitors on the average day during the 100 day summer season. Estimates of peak holiday weekends have run as high as 3,000 visitors.

* EPA estimates of site capacity.

With few employment opportunities, the proportion of the population in the productive age brackets has declined sharply. The youth have been leaving the Island to seek educational, employment, and cultural opportuntities. Those who have come to live there have been mainly older retirees.

Since the first half of the century, the Island's resident labor force has dwindled to approximately 180 persons. The majority are in professional, managerial, craft and service occupations including construction and maintenance, as shown in Table 6. Indicative of the highly seasonal economy, 85 percent of the retail sales are made between May and October. The 1969 median family income of $8,289 was substantially below the Rhode Island median of $9,733.

TABLE 6 - Labor Force*

Occupation	Labor Force 1960	Labor Force 1970
Professional & Managerial	53	37
Craftsmen	33	44
Laborers	32	11
Operatives & Service Workers	23	34
Clerical	12	11
Sales	8	--
Not reported & Others	15	15
Total Employed	176	152
Unemployed	19	28
Total Labor Force	204	180

*Source: U.S. Census of Population, 1960, 1970.

Table 7 summarizes housing trends between 1960 and 1970.

Based on data from both the 1960 and 1970 census, it is estimated that about forty-eight percent of the housing units (365) were constructed prior to 1939. From 1940 to 1960, only 74 new housing units were constructed on the Island, but between 1960 and 1970, there was a net increase of 314 new dwelling units. Of these, 301 were built by summer residents as seasonal homes, an average of 30 units per year. From 1970 to 1974, 125 building permits have been issued for new dwelling units. There has been very little multiple unit construction on the Island since 1960. Thus, following several decades of overall decline, there is an upswing in the construction of new summer homes, but not as yet in restoration of the former hotel capacity and businesses serving the tourists.

The number of hotel and other overnight tourist accomodations has, in fact, declined in the past decade, despite some rental cottage construction. For example, three hotels totaling over 400 rooms closed. The existing over night capacity of approximately 1500-1800 persons is not considered adequate to sustain the Island's tourist economy.*

*Estimates by the Block Island Chamber of Commerce. See: The Land Use Analysis.

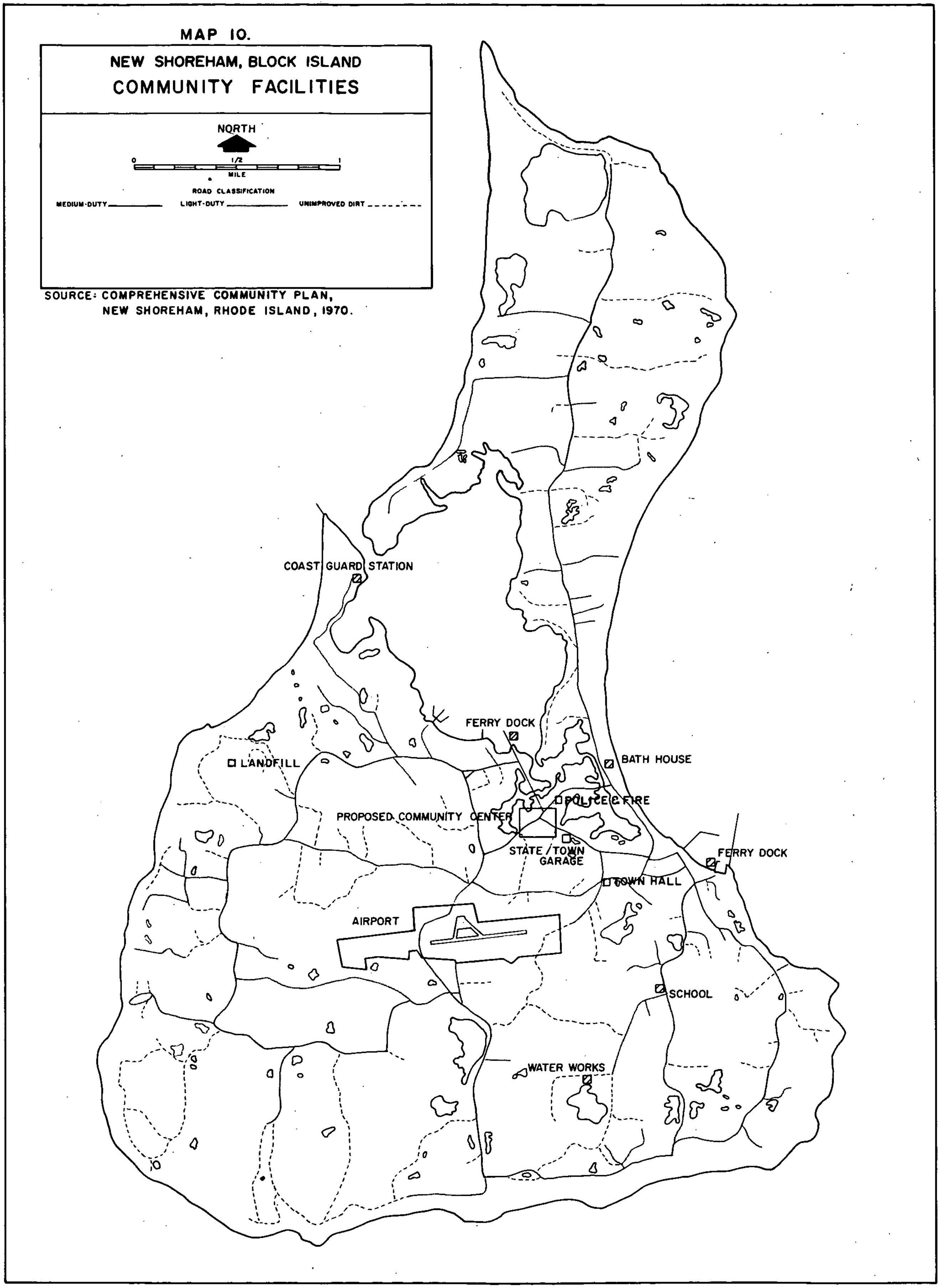

MAP 10.
NEW SHOREHAM, BLOCK ISLAND
COMMUNITY FACILITIES
NORTH
0
1/2
1
MILE
ROAD CLASSIFICATION
MEDIUM-DUTY
LIGHT-DUTY
UNIMPROVED DIRT
SOURCE: COMPREHENSIVE COMMUNITY PLAN, NEW SHOREHAM, RHODE ISLAND, 1970.
COAST GUARD STATION
FERRY DOCK
BATH HOUSE
LANDFILL
POLICE & FIRE
PROPOSED COMMUNITY CENTER
STATE / TOWN GARAGE
FERRY DOCK
TOWN HALL
AIRPORT
SCHOOL
WATER WORKS

TABLE 7 - Housing Characteristics

Occupancy	Number of Units 1960	1967*	1970
Year-round	195	173	208
Owner-occupied	149	-	153
Renter-occupied	46	-	55
Seasonal (or vacant)	243	486	544
Total - all units	438	659	752

*Year-round and seasonal single family homes, single family seasonal units in cluster colonies, and 7 housing units in mixed use structures, but not seasonal rooms.

Source: U.S. Census of Housing, 1960 and 1970, and 1967 Inventory of Housing in Land Use Analysis, Rhode Island Department of Community Affairs, 1968.

Existing Land Use. Development is concentrated in Old Harbor, as shown on Map 11. Old hotels, inns, rooming houses, restaurants and shops cluster along the harborfront. Homes and a few scattered inns line the five streets radiating into the countryside, especially to the south and to the southwest toward the airport.

Over the last twenty-five years, much smaller scale development has been taking place in New Harbor, 1.5 miles to the northwest on Great Salt Pond: a ferryslip three marinas and two hotels and restaurants. Along Ocean Avenue, leading to New Harbor, are the Island's power plant, State highway garage and fire-police building, as well as wetlands and open land.

Within a couple of blocks of the old harborfront, the houses become spaced farther and farther apart, with stonewalls enclosing bayberry heath and abandoned pastureland. The remainder of the Island is largely open heath, pasture, numerous ponds and inland and coastal wetlands. The scene conveys a sense of openness, dotted with an occasional white building. The openness is illustrated in Map 11 and Column 1 of Table 8, which summarizes existing land uses statistically. Of the Island's nearly 7,000 acres, over 5,000 are in heath and open pasture (including some fields and scrub forest) and another 1,000 acres are in water and wetlands.

The newer homes are beginning, still almost imperceptibly, to close in upon this sense of openness. This is becoming evident in the vicinity of Old Harbor, especially on the uplands overlooking the Harbor.

State and Local Land Use Plans. Public and privately sponsored plans for the Island all emphasize the need to preserve the Island's unique natural environment and charm in the face of development pressures. At the same time, they recognize the need to strengthen the economy. These plans do not explicitly forecast population and economic activity, nor do they present any optimum levels for designing future public facilities.

The Land Use Analysis (LUA) prepared for Block Island in 1968 by the Rhode Island Department of Community Affairs, assumes 500 year-round residents to be the minimum to sustain basic economic life, and projects this minimum as the population through the year 2000.

The New Shoreham Comprehensive Community Plan (CCP) attempts to outline community objectives; to plan for community facilities, recreation, conservation and land use; and to recommend implementation action. The CCP was prepared in consultation with the Town Council and Planning Board by the Rhode Island Department of Community Affairs, and was adopted by the Town Council in April, 1972.

A major stated goal of the CCP is "...to insure that development will occur in an orderly fashion and will be in keeping with the present character of the community...." To protect the Island's ecology and character, the CCP states the following goals as the Town's official policy:

1. Development shall be avoided on land subject to periodic flooding.

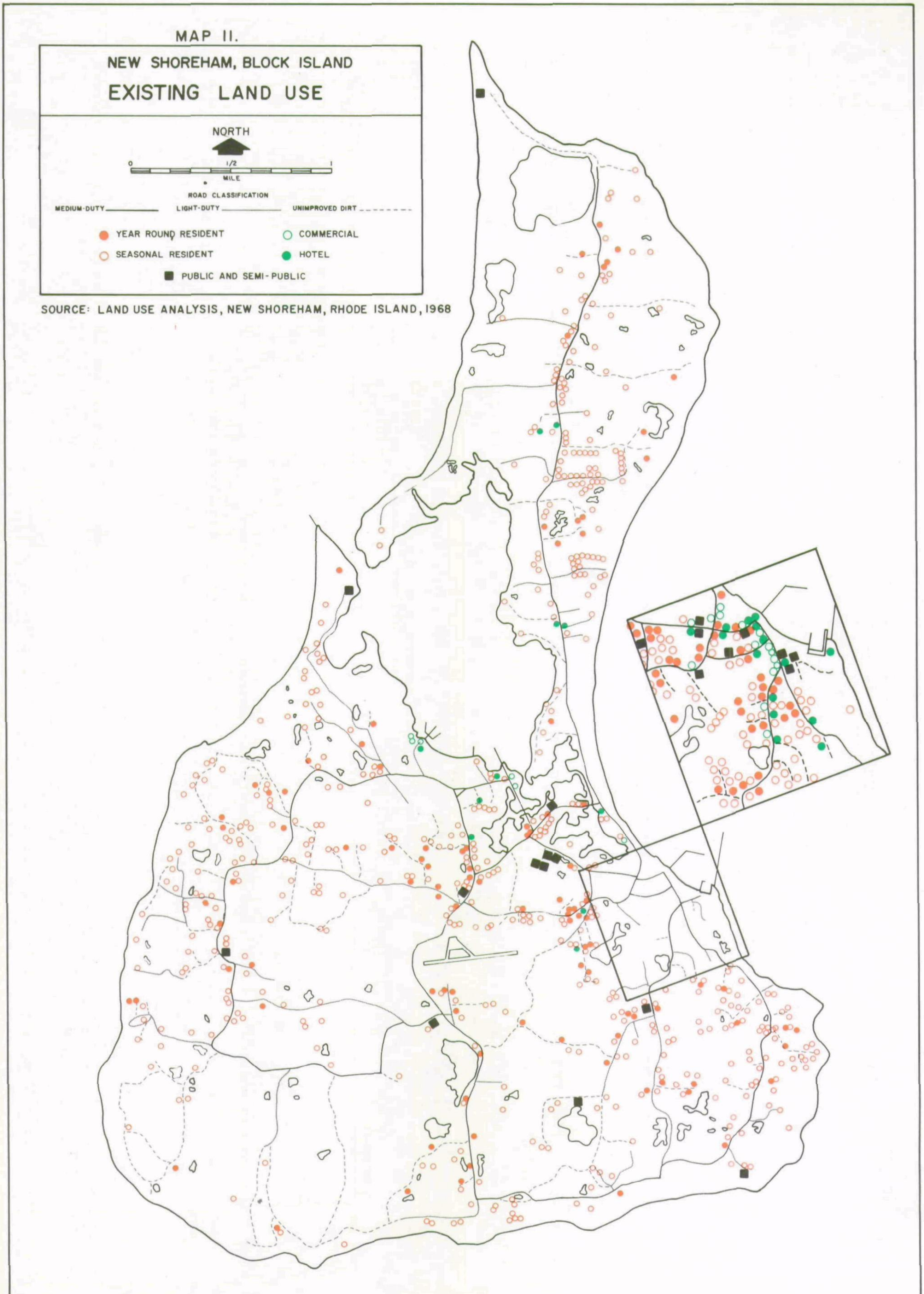
2. Development utilizing septic tanks shall be confined to lands having good subsurface drainage.

3. Lands which are difficult and expensive to develop because of steep slopes, poor soil or other factors shall be utilized as recreational open space.

4. Waterfront development shall follow the natural undulations of shoreline and shall avoid long, straight lines or abrupt curves and angles.

5. Natural areas of special value shall be acquired and preserved by some public or quasi-public agency whenever possible.

6. Freedom from air and water pollution is the right of the citizens of the community. Any substance added to the air or water to a degree which damages property, vegetation, natural resources or commerce shall be considered a pollutant and shall not be permitted.


MAP II.
NEW SHOREHAM, BLOCK ISLAND
EXISTING LAND USE
NORTH
0
1/2
1
MILE
ROAD CLASSIFICATION
MEDIUM-DUTY
LIGHT-DUTY
UNIMPROVED DIRT
YEAR ROUND RESIDENT
SEASONAL RESIDENT
COMMERCIAL
HOTEL
PUBLIC AND SEMI-PUBLIC
SOURCE: LAND USE ANALYSIS, NEW SHOREHAM, RHODE ISLAND, 1968

7. Local flora and fauna are important to the natural environment and are a part of our heritage. The town shall support and encourage programs to protect wildlife and to maintain and supplement vegetation.

8. The appearance of the town is recognized to be of high importance to the town's economy, its future development, and to the pride and pleasure of its residents. Improved community appearance shall be encouraged whenever possible. The town government shall cooperate with individuals and groups which engage in constructive activities on behalf of community appearance. A community's heritage should be reflected in its appearance; therefore, the policy of New Shoreham shall be to preserve the rural New England character. This goal involves preservation of buildings of architectural importance, consideration of the design relationship between new and existing structures, preservation of stone walls, maintenance of open space and so forth.

Recognizing the recent trends in construction of new homes throughout the Island, the plan emphasizes that many types of development would diminish the Island's "unspoiled, rural character," a strongly held value of the year-round residents and a major attraction to tourists and seasonal residents. "Therefore, (the CCP states) the major planning concern in New Shoreham is to prevent indiscriminate, undesirable development."

At the same time, the CCP provides for additional development to strengthen the hotel/tourist business base, lengthening the season and attracting more visitors. Statements in the CCP about the development potential of the Old and New Harbor areas and the contiguous, presently sparsely settled areas assume moderate growth. Also, proposals for a sewer and water system, new town hall and civic center presume moderate development.

Map 12 outlines future land uses proposed in the Comprehensive Community Plan (CCP). These proposed uses take into account both environmental and socioeconomic objectives, present land use patterns, soils, flood areas, elevations, ground water, public utilities, development trends and community goals. A detailed description of the proposed uses is indicated in Appendix C. Table 8, Column 2 gives acreage distributions of these proposed uses.

The draft report, State Land Use Policies and Plan, sets forth the State, environmental, social and economic goals; development and conservation policies; and recommendations for State-local implementation. These are similar to those which the CCP outlined somewhat more specifically for the Island. The State Plan also outlines essentially similar future land uses in its generalized sketch of proposed State land uses in 1990. These broad designations are summarized in Table 8, Column 3.

TABLE 8 - Existing & Proposed Land Uses

Land Uses*	ACREAGE Existing (1970)	DISTRIBUTION Proposed (1990) (CCP)	State Plan	Existing Zoning
	(Col.1)	(Col.2)	(Col.3)	(Col.4)
Mixed - commercial, industrial, high density residential	157	170		500
Commercial-industrial	34			
High density residential	4			
Urban public	43			
Airport	57			
Spoil areas	19			
Medium Density Residential - 1 acre lots	108	500	1,100 "mixed" & low density"	700
Medium residential	54			
Light residential	54			
Low Density Residential - 2 acre lots	5,207	3,400	3,400 "woodland & openland"	5,300
Scattered residential	157			
Heath	3,169			
Pasture/abandoned field	1,577			
Forest	239			
Tilled	65			
Developed Recreation	11	30		
Open Space Recreation (Should also include some of heath/pasture W SE)	370	1,000	400	
Conservation				
Water & wet level marshes	1,090	1,800	1,800	400
ISLAND TOTAL	6,943	6,900	6,800	6,900

*Land Use categories combined to form a composite of existing and proposed land use plans and zoning. Major categories follow the New Shoreham Comprehensive Plan (CCP), subcategories follow William P. MacConnell, Univ. of Mass., mapping of 1970 land uses for the Southeastern New England Study, New England River Basins Commission. Subcategories are grouped into future land use categories in CCP.

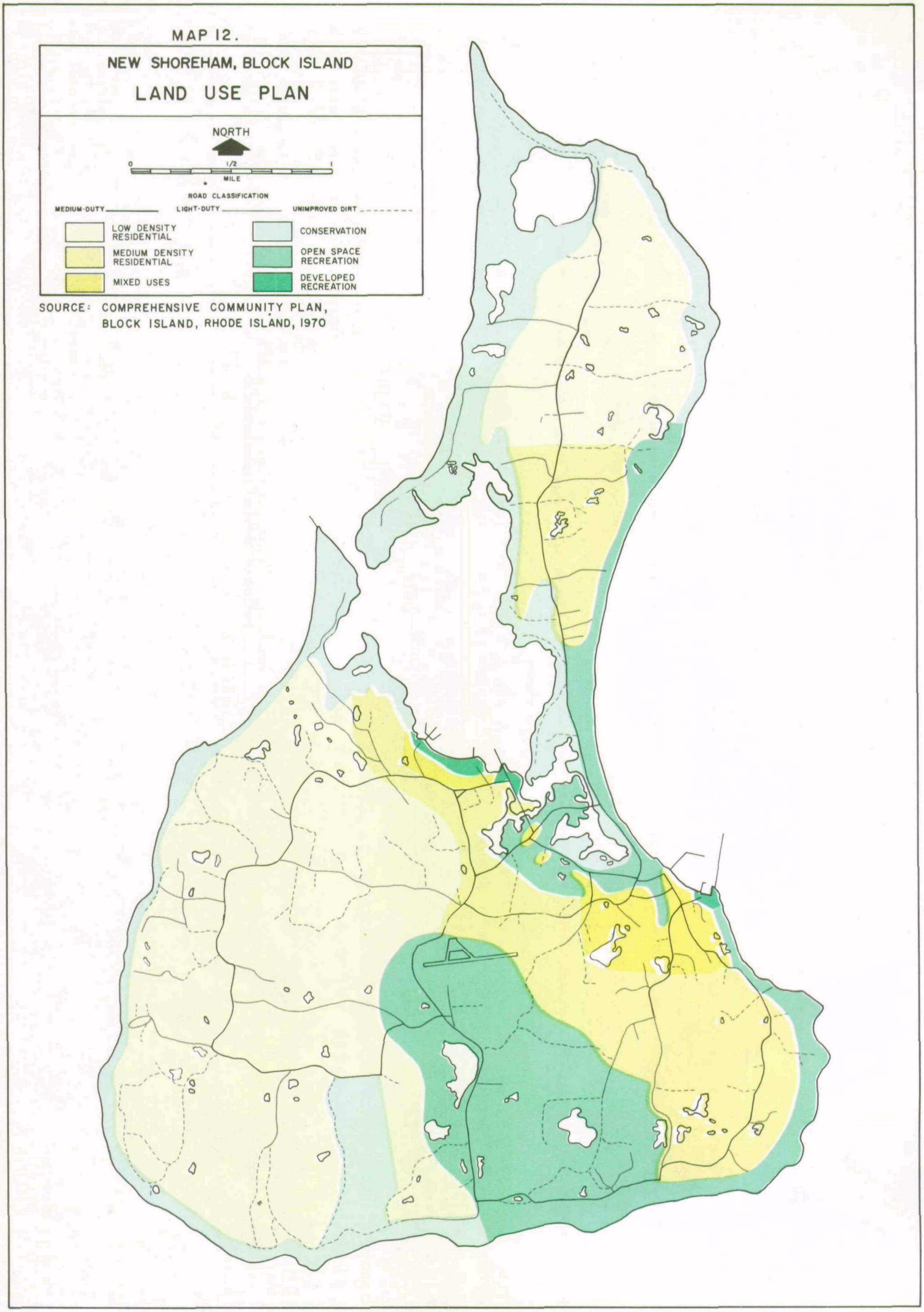
Sources:

Col. 1: Compiled from Prof. William P. MacConnell, Univ. of Mass., Dept. of Forestry and Wildlife Management., "Land Use and Vegetative Cover Mapping for New England River Basins Commission, Southeastern New England Study". Based on 1970 aerial photographs overlaid on U.S. Geological Survey topographic quadrant of Block Island Quadrangle Categories consolidated by EPA.

Col. 2: Acreage distributions estimated by EPA from Future Land Use Map, New Shoreham Comprehensive Community Plan Rhode Island Dept. of Community Affairs, 1970.

Col. 3: Summary of the Report on the State Land Use Policies and Plan, Rhode Island Statewide Planning Program, Providence, R.I., April 1973.

Col. 4: Acres estimated by EPA from Zoning, Chapter 33 of the Revised Ordinances of the Town of New Shoreham, enacted June 5, 1967 through November 5, 1973.


MAP 12.
NEW SHOREHAM, BLOCK ISLAND
LAND USE PLAN
NORTH
0
1/2
1
MILE
ROAD CLASSIFICATION
MEDIUM-DUTY
LIGHT-DUTY
UNIMPROVED DIRT
LOW DENSITY RESIDENTIAL
MEDIUM DENSITY RESIDENTIAL
MIXED USES
CONSERVATION
OPEN SPACE RECREATION
DEVELOPED RECREATION
SOURCE: COMPREHENSIVE COMMUNITY PLAN, BLOCK ISLAND, RHODE ISLAND, 1970

A major goal of the State Land Use Plan is to control urban sprawl. Policies outlined in the Plan with specific regard to utilities include:

1. Policy #5: Locate public water and sewer facilities so as to shape development in accordance with the State Land Use Plan.

2. Policy #10: In developments which are of an intensity to support public water and sewer facilities, coordinate development with provision of facilities so as to assure availability of these facilities at the time the area is developed.

3. Policy #12: Minimize extensions of water and sewer systems, consistent with goals to reduce existing pollution, in order to discourage urban sprawl.

As a major private effort, the University of Rhode Island, School of Design Study, evaluated the environmental constraints and demand for development and prepared a study entitled the Block Island Report. This report has taken the position that development pressures are fast upon the Island and attempts to outline environmental constraints and a proposed zoning, design control, and action program to guide this development. Again no estimates are made of the future population, but the detailed suitability map provides a guide to the location, density and types of development, which can serve as a planning tool. The most suitable development patterns are summarized in a proposed zoning map (shown on Map 13).

Existing Zoning. New Shoreham's zoning ordinance and map, first enacted on June 5, 1967 and subsequently amended as recently as November 5, 1973, essentially projects existing land use and would permit extension of business and residential development along and around the axis connecting Old and New Harbor. The zoning classifications shown in Map 14 are as follows:

1. Business -- commercial establishments and residences, with special exceptions for hotels and inns.

2. Residence C -- single-family dwellings on 1/2 acre lots with exceptions for two-family dwellings, hotels, motels, boatels, on 1 acre lots.

3. Residence B -- single-family dwelling units on 1 acre lots, with exceptions for marinas, hotels, motels, boatels on 3 acre lots.

4. Residence A -- single-family dwelling units on 2 acre lots, with exceptions for hotels on 10 acre lots.

5. <u>Beach</u> — bathing, recreation or picnic areas, wildlife refugees, with exceptions for beach clubs, bath houses and marinas.

Table 8, Column 4 presents an estimated acreage distribution of the zoning classifications.

The ordinance also includes the following provisions:

1. Development in residential clusters is permitted by the Planning Board in Residential Zones A, B, & C, provided they blend in with the general land use pattern established by the Zoning Ordinance and stay within the overall maximum density set for the Residential Zone in which the development would lie. The Planning Board must review and approve a development plan for each cluster.

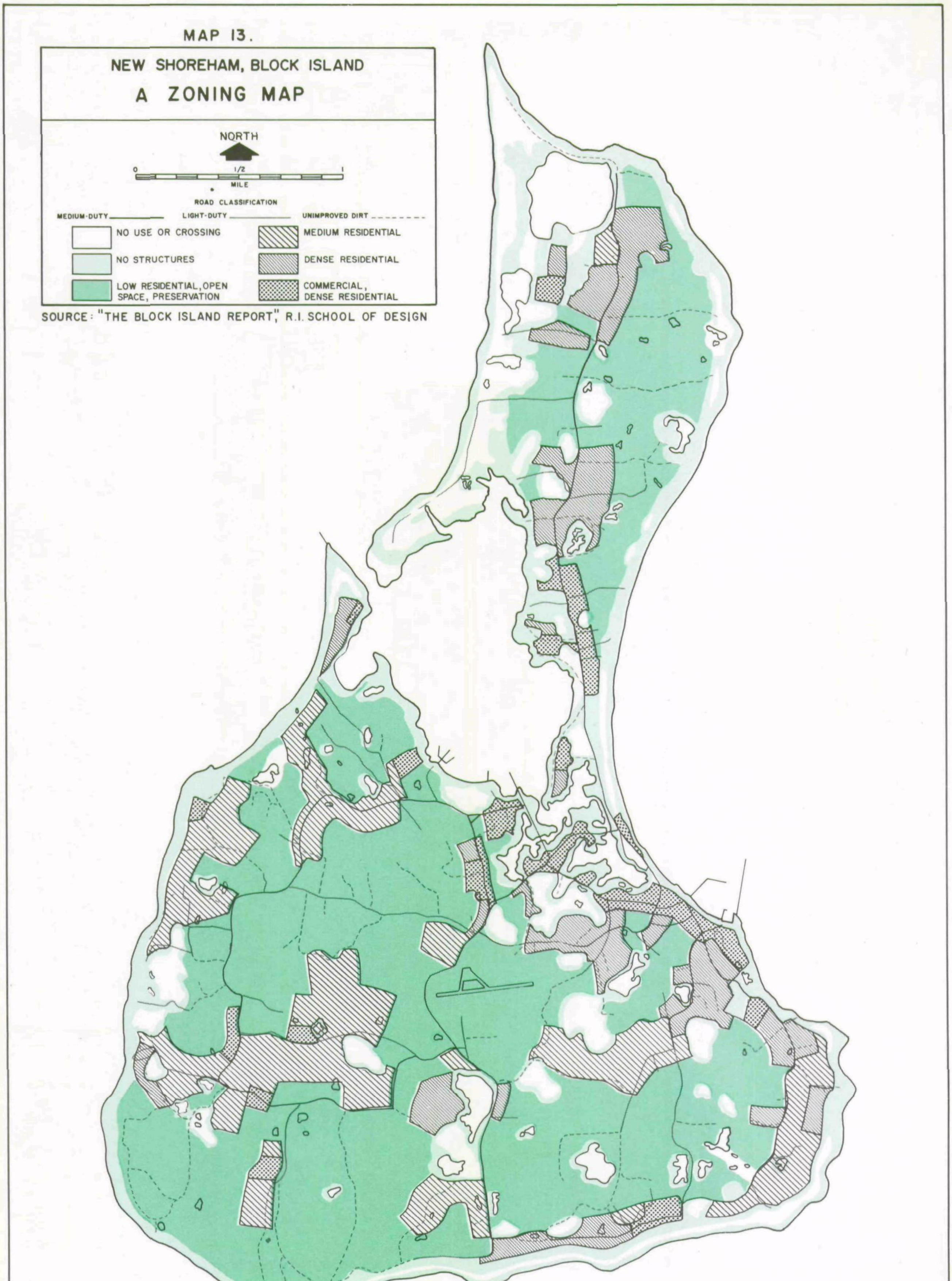
2. Subsurface sewage disposal facilities shall be located not less than 100 feet from the edge of any pond or stream. In addition, the subdivision code does not permit any subdivision in areas subject to periodic flooding; further, existing stream channels and fresh water wetlands shall be preserved.

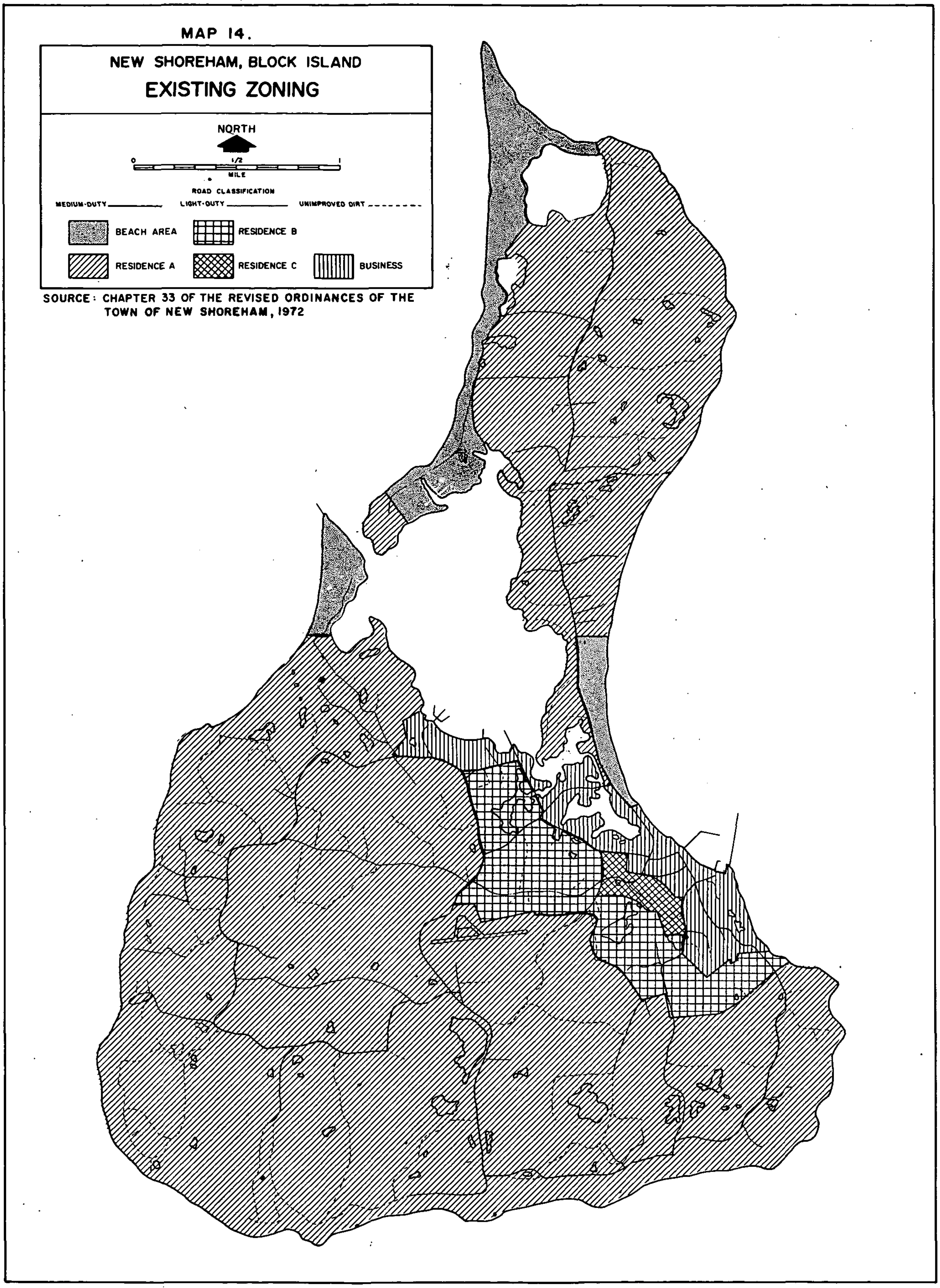
<u>Analysis of Existing Plans, Policies and Zoning</u>. No estimates of future population or economic activity have been developed that systematically take into account the Island's developmental limits necessary to preserve environmental quality and community character. The Land Use Analysis presents a maximum estimate of 2,500 additional dwellings if the 3,960 acres of undeveloped land deemed suitable for development were fully developed under the existing zoning.* But, the Analysis hastens to emphasize that such maximum growth would drastically alter the attractiveness of the Island as a resort.

The CCP cites the marked upturn in construction of new summer homes as a warning to plan wisely to protect the Island's future environment and charm. In balancing environmental and socioeconomic objectives, the CCP and, by implication, the State Plan and Town zoning do not evaluate how much development and what kinds of development the Island can take before development infringes on the environmental and amenity values that residents and visitors alike seek to preserve. Nor did the Islanders debate these issues when they adopted adopted the CCP at town meetings--the basic issues of future growth, land development and their impact on the Island's environmental goals and community amentities. The unanswered question, then, becomes, "What social and economic values would the Island have to give up and be willing to give up in order to retain the high quality environment, and in particular, the rustic open character of the Island as a whole, now present even in much of the Old Harbor area?"

<u>Growth Assumptions</u>. Three major alternate assumptions, about the Island's future growth are summarized below. The three growth levels are quantified in Table 9.

*These figures were based on the zoning map in effect in 1968. Since that time, amendments have been made to the map which would result in a lesser number of dwelling units at maximum development.


MAP 13.
NEW SHOREHAM, BLOCK ISLAND
A ZONING MAP
NORTH
0
1/2
1
MILE
ROAD CLASSIFICATION
MEDIUM-DUTY
LIGHT-DUTY
UNIMPROVED DIRT
NO USE OR CROSSING
NO STRUCTURES
LOW RESIDENTIAL, OPEN SPACE, PRESERVATION
MEDIUM RESIDENTIAL
DENSE RESIDENTIAL
COMMERCIAL, DENSE RESIDENTIAL
SOURCE: "THE BLOCK ISLAND REPORT," R.I. SCHOOL OF DESIGN



MAP 14.

SOURCE: CHAPTER 33 OF THE REVISED ORDINANCES OF THE TOWN OF NEW SHOREHAM, 1972

1. Present level - Restore existing tourist accommodations to full capacity, less than 15 percent increase in summer visitors.

2. Moderate growth - 15 to 25 percent in summer residents and visitors.

3. Substantial growth - Nearly doubling of summer residents and visitors.

The Moderate Growth assumption would appear to support goals of the CCP. It would support major rehabilitation of the old hotels and inns and allow a modest increase in visitor accommodations and residences. At the same time, with effective planning and zoning, the valued character of the Island would be maintained.

Fenton Keyes Associates design capacity (6,662 equivalent persons) is in the order of magnitude of the Substantial Growth (doubling) assumption.

TABLE 9 - Growth Assumptions

Population Characteristics	Present - Little Additional growth		Moderate growth		Substantial growth***	
	Island	Study Area	Island	Study Area	Island	Study Area
Basic year-round residents	500	400	500	450	600	550
Summer residents	1,200	500**	1,500	900**	2,500	1,500
Hotel visitors/ average summer day	1,500*	1,400	2,000	1,900**	3,000	3,000
Day visitors/average summer day	1,000	1,000	1,200	1,200	2,000	2,000
TOTAL/Average Summer day	4,200	3,300	5,200	4,450	8,100	7,050

* Estimated capacity, assuming rehabilitation of existing hotels and inns.
** Forty-five percent of summer residents are within Study Area.
*** Assume approximate doubling of summer residences, hotel visitors, and day visitors.

Source: Estimates by EPA based on discussion with town and state officials.

3.0 ALTERNATIVES

The following section deals with the description and evaluation of possible alternatives that Block Island could pursue in its attempts to improve existing wastewater treatment techniques. To effectively evaluate possible avenues of action; and to do so in a manner that will result in the most cost effective, environmentally sound alternative: the analysis concentrates on what are considered the four most practical alternatives. They are:

Alternative A. Construction of the project proposed by Fenton Keyes Associates, which includes a treatment facility and collection system to serve the Old and New Harbor sections of the Island (Stage I) with provisions to serve the area south of Old Harbor in the future (Stage II).

Alternative B. Construction of the project (Stage I) without provisions for sewering the area south of Old Harbor in the future.

Alternative C. No sewer construction, but a comprehensive program for the rehabilitation of individual septic systems.

Alternative D. Construction of a treatment facility and collection system for the Old Harbor area only, with rehabilitation of individual septic systems in the New Harbor area.

Also evaluated is the alternative of NO ACTION. Although the least practical, it is presented to facilitate the reader's understanding of the consequences of doing nothing.

Discussed below are common sub-alternatives which affect all or some of the major alternatives to be addressed. An individual analysis of each major alternative and its environmental impact is presented in Chapter 4.

3.1 Alternative Treatment Plant Locations

For Alternatives A, B, and D above, a suitable site for a treatment plant is required. In the proposed project (Alternative A), a site was selected near Old Harbor on Spring St. Alternative sites were evaluated one near the Island's Power Plant and another further south on Spring St. Neither site displayed significant advantages over the proposed location and were not recommended. It should be assumed throughout this Impact Statement that any reference to a treatment facility location refers to the Spring St. site.

3.2 Multiple Facility Alternatives

For Alternatives A, B and D under discussion, the use of more than one treatment plant was studied. No multiple facility arrangement was found to be practicable. The major deterring factor was the requirement by the Rhode Island State Department of Health, Division of Water Supply and Pollution Control that there be only one discharge into the waters of Block Island. Thus, any benefits of a two plant system would be negated by the additional cost of pumping to one outfall location. Other factors such as operating two facilities and utilizing two areas for treatment plants also made the multiple facilities alternative unattractive.

3.3 Treatment Process Alternatives

A variety of treatment processes were evaluated by EPA in addition to the process recommended in the proposed project (Alternative A). In the analysis which follows, two points must be noted; first, the analysis was based on a .30 mgd facility (Alternatives B and D would not require a facility that large), and secondly, the cost shown for each treatment type reflect average costs for New England and are not specifically representative of costs on Block Island.

Certain treatment processes were eliminated immediately as a preliminary analysis of the Block Island situation indicates that they are not feasible. For instance, the conventional activated sludge process and several of its modifications such as step aeration and tapered aeration have been determined not feasible for a plant of this small size. The trickling filter process was not considered because of inadequate treatment and possible nuisance problems. Primary treatment alone was not considered due to the fact that secondary treatment is required by law.*

The following treatment systems were considered feasible for a project such as Block Island and are evaluated in more detail:

1. Extended Aeration
    a. Aeration tanks (proposed project)
    b. Oxidation ditch
2. Modified activated sludge (contact stabilization)
3. Aerated lagoons
4. Stabilization
5. Physical-chemical

*Federal Water Pollution Control Act, Public Law 92-500.

6. Land disposal

A cost breakdown for each of the above systems is displayed in Table 10.

Although the tabulation of basic average annual costs indicates that certain alternatives appear more cost-effective than others, evaluation of special considerations will tend to show that the alternatives are really more equal than might appear.

Extended Aeration. The alternative chosen by Fenton Keyes Associates, that of the extended aeration process with aeration tanks has the highest initial construction cost and average operating costs. It is, however, the system which is in greatest use for the size project proposed and is probably the best overall method for treating the large flow variation between winter and summer. A minimum of operational manpower and skill are required to produce a good effluent and will result in the production of a relatively small volume of stabilized sludge which can be easily disposed of.

The use of oxidation ditches as a method of extended aeration treatment is a very similar process to the above system and appears to be far less costly to construct. However, the basic oxidation ditch system is not able to handle the extreme variations in flow of the Block Island system and would have to be modified by construction of an additional small ditch to accommodate winter flows only. This may increase the initial construction cost to an amount near the amount estimated for an aeration tank system. The oxidation ditch system would require only slightly more land area. However, this would be sufficient to preclude use of the presently proposed site. If a new site were found for this system, it may not be centrally located and would result in adding to the cost of the collection system and outfall sewer. The oxidation ditch is generally more susceptible to adverse weather conditions which could cause operational problems.

Modified Activated Sludge. The modified activated sludge process known as a contact stabilization is slightly less costly to construct than the proposed system; however, it has the major disadvantage in being a costly and more complex system to operate. The major reason for the increased operating cost is the larger volumes of sludge produced and the necessity to condition the sludge prior to disposal.

Aerated Lagoon. The basic aerated lagoon system is moderately costly to construct and operate; however, it requires substantially more land than the proposed system and a new site would be required. This again would probably result in an increased cost for the collection system and outfall sewer. It has been found that these systems generally develop problems with formation of algae which could cause odor problems and necessitate additional treatment to correct.

TABLE 10 - Average Costs for 300,000 Gal/day Treatment Facilities
Southern New England

Type Treatment System	Construction Costs*	Ave. Annual Bond Payment**	Annual Operating Costs	Total Ave. Annual Costs
Extended Aeration:				
a) Aeration tanks	$ 750,000	$ 65,400	$ 22,500	$ 87,900
b) Oxidation ditch	525,000	45,700	13,000	58,700
Modified Act. Sludge (Contact Stabilization)	640,000	55,700	35,000	90,700
Aerated Lagoons	635,000	55,400	22,500	77,900
Stabilization Ponds	585,000	51,000	8,500	59,500
Physical-chemical	450,000	39,200	40,000	79,200
Land Disposal	---	---	---	---

*Based on a 20-year bond issue @ 6% with .08718 - Capital Recovery Factor
**ENR 2100

Source: See Appendix D

Stabilization Pond. Stabilization ponds have a decided advantage in construction costs and are quite simple to operate. However, the extremely large amount of land necessary for this process could increase the initial cost well above that of other alternatives, unless most of the land were available to the town at little or no cost. The cost of the collection system would be increased appreciably as there is no centrally located sites of sufficient land area for this system. In addition, the cost to construct an outfall from this system would be prohibitive as there are no adequate sites in close proximity to any shore area. Effluent would, therefore, have to be discharged through intermittent sand filter beds in a form of land disposal. The possible environmental effects of this method of treatment would probably preclude this alternative. Land disposal is discussed in detail in a later paragraph.

Physical-Chemical Treatment. The physical-chemical system has the advantage of being the least costly to construct, requiring the smallest area, being least susceptible to toxic wastes (such as boat wastes), being able to handle flow fluctuation very well and being able to be completely enclosed. However, this system is the most costly to operate and requires skilled operation. Physical-chemical treatment is generally used where a high degree of treatment and the removal of phosphorus is necessary.

Although the use of the physical-chemical treatment alternative appears to have several technological advantages as well as an economic advantage over the proposed alternative, a note of caution must be made. At present, there is no definitive cost data for municipal physical-chemical treatment plants as there are few, if any, which have been in operation for any length of time. The capital and operating costs for physical-chemical treatment presented in Table 10 are based upon estimates from pilot plant and demonstration studies upon manufacturers costs of equipment and upon experience with costs of these processes in other industries. How the actual capital cost will be affected by bidding of general contractors is relatively unknown. Competition may be limited. In some areas, such as Block Island, it is doubtful that contractors bidding on the work will be familiar with this type of construction and the resulting bids are likely to be higher than anticipated.

The annual operating costs presently being estimated for physical-chemical treatment are even less reliable than the capital cost estimates. There is little or no data on full-scale operations of physical-chemical plants for wastewater treatment. The costs of the chemicals and media used in the processes may increase rapidly due to increasing demand. Associated with this increasing demand are uncertainties concerning the long-term availability of these chemicals and media. For a small user, such as Block Island, the availability and cost of such supplies could become critical in the future as witnessed by recent experiences with shortages of chlorine. The long-term maintenance requirements of physical-chemical wastewater treatment facilities are unknown at this time and can only be estimated from experience in other industries.

Land Disposal. Land application of the treated effluent and sludge, at first glance, seemed attractive due to the abundant presence of soils with characteristics favorable to land disposal of treated wastewater and the high costs associated with a submerged ocean outfall. In addition, there appeared to be sufficient depth to groundwater beneath the acceptable soils even during the wet season.

The U.S. Department of Agriculture, Soil Conservation Service advised EPA that the sites tentatively proposed as land application areas are generally well suited for the intended uses. One possible conflict noted was the proximity of one area to the municipal water supply wells at Sands Pond. (See Appendix K)

By combining the yearly base flow and the seasonal high wastewater flow a determination of the amount of land necessary was made. The application period was assumed to be limited to six months per year due to climate. Using the adjusted flows, it was determined that approximately 30 acres were required for spray irrigation and approximately 5 acres were needed for rapid infiltration.

Analysis of the areas with the best physical characteristics revealed that without exception there are competing interests for the sites. The soil type and topographical characteristics most suitable for land application of wastes also are the best suited for water supply development, construction purposes and agriculture. It is not possible, within one to one-and-a-half miles of the municipal center, to locate an adequately sized parcel of land a sufficient distance from a public or private water supply well.

Summary of Treatment Methods. Chart A, which follows, summarizes the relative merits of each of the treatment processes discussed above.

While some of these methods may appear more attractive than others, in the final analysis several of them could be successfully employed to treat Block Island's wastewater. Fenton Keyes Associates chose the extended aeration process because of its cost effectiveness and its reliability for small treatment plants. For the purposes of this report, extended aeration has been assumed to be the method of treatment to be employed for Alternatives A, B and D. The following process modifications are recommended to be made to the plant as presently designed:

CHART A - Comparative Summary of Treatment Methods

Alternative	Technical	Environmental	Economic
1. Extended Aeration A. Aeration Tanks	a. Biological system which may be upset by watercraft wastes. b. Has ability to operate under variations in flow. c. Requires minimum of skilled operators. d. Minimum amount of sludge to be handled.	a. Will meet secondary effluent requirements. b. Minimal land requirements. c. Minimum amounts of odors and noise.	a. Annual cost - $87,900
B. Oxidation Ditches	a. Same as above except efficiency may be more susceptible to variations in weather.	a. Same as above except greater requirement for land.	a. Annual cost - $58,700
2. Modified Activated Sludge	a. Same as for Extended Aeration, Aeration Tanks, except will require greater operational controls and will produce more sludge to be handled.	a. Same as for Extended Aeration Tanks.	a. Annual cost - $90,700
3. Aerated Lagoons	a. Biological system which may be affected by watercraft wastes. b. Less amenable to variations in flow than Extended Aeration. c. Sludge handling difficult. d. Susceptible to adverse weather conditions. e. Minimum of skilled operators required.	a. Will meet secondary effluent requirements but generally requires additional treatment for algae formation. b. Considerably more land required than for Extended Aeration.	a. Annual cost - $77,900
4. Stabilization Ponds	a. Although a biological system, less susceptible to toxic wastes from watercraft. b. Amenable to flow variations. c. Little or no sludge produced. d. Least amount of operational controls required.	a. Generally will not meet secondary effluent requirements. b. Minimal noises but requires controls of odors. c. Large amounts of land necessary.	a. Annual cost - $59,500
5. Physical-Chemical	a. Not a biological system. Not susceptible to toxic wastes from watercraft. b. Best system to deal with variations in flows. c. Produces great amounts of sludge. d. Requires greatest amount of highly skilled operators. e. Requires greatest amount of importation of chemicals.	a. Will meet better than secondary effluent requirements. b. Minimum amount of land required.	a. Annual cost $79,200
6. Land Disposal.	a. Not susceptible to toxic wastes from watercraft. b. Amenable to flow variations. c. No sludge produced. d. Requires great amount of operational controls. e. Limited by weather conditions. f. Requires constant monitoring of groundwater supplies.	a. Essentially produces no discharge. b. Largest land requirements. c. Aesthetics a major problem. d. Possible contamination of groundwater supplies.	

1. Provide a method for filtering the final effluent for use during start up and peak periods in the summer to ensure removal of excess solids.

2. Provide a method of supplying air to the sludge storage tanks to insure complete aerobic stabilization of sludge, thus preventing odor problems.

3. Provide a method for controlling odors at the treatment plant such as introduction of an odor reducing chemical.

3.4 Outfall Location Alternatives

The outfall location chosen for the proposed project is off Pebbly Beach. A detailed evaluation of that outfall site is presented under Alternative A. Alternative locations were investigated but none were considered better than the proposed site. Because of the State requirement prohibiting a discharge into Class SA waters, the only possible alternative sites are in the closures around Old Harbor and Great Salt Pond (refer to Map 7). A discharge in the Great Salt Pond closure is unacceptable due to the pond's characteristic lack of sufficient flushing action. A discharge into the Old Harbor closure, other than at the proposed site, would be closer to Crescent Beach, the Island's only public beach and prime tourist attraction. This also was unacceptable. Thus, in each case, the location of the ocean outfall required for Alternatives A, B and D is at the proposed site off Pebbly Beach.

3.5 Sludge Disposal Alternatives

For Alternatives A, B and D, the recommended sludge disposal technique is by landfill at the Town landfill site. The ability of that site to handle these residual wastes is discussed under Alternative A. Alternative and more costly techniques, such as incineration and dewatering or digestion, were not considered practicable based upon the small amount of sludge produced by the recommended extended aeration treatment process.

The disposal of septic tank pumpouts (septage), is also by application to the land at the Town landfill site. Because the present site is more than adequate, alternative techniques or sites were not investigated.

3.6 Flow Reducing Alternatives

New technology has made available flow reducing equipment which when installed in single or multiple unit homes, can reduce wastewater flows by 15-20 percent. The types and costs of the various equipment on the market are found in Appendix E). On the average, an initial investment of $500 and an annual cost of $50 would be required to achieve a 15% reduction per single home.

The use of this equipment is not recommended for homes or establishments that will tie into a sewer system since it would have little impact on a treatment plant operation. For homes that will remain on subsurface systems, especially in the developed Old and New Harbor areas, installation of this equipment could have significant benefits. Research has been done which indicates that installation of these or similar systems will increase the efficiency of septic systems and consequently mitigate against their failure.

For Alternatives C or D which would require homes in the Old and New Harbor areas of the town to remain on septic systems, installation of the above equipment is recommended to reduce system failures. As neither Federal or State authorities can require use of such equipment, it would be the responsibility of the community to regulate and control its installation and operation.

4.0 IMPACT OF ALTERNATIVE ACTIONS

This Chapter presents a detailed description of the four major alternatives outlined in Chapter 3, along with a discussion of the primary and secondary environmental impacts of these alternatives and of the NO ACTION Alternative.

Alternative Wastewater Flows

Wastewater flows are based on existing and future projected populations for the area to be served. The three levels of population growth discussed in Chapter 2 reflect the total Island and, therefore, must be modified to reflect just the proposed sewered area. The general area under consideration for a wastewater treatment system is shown on Map 2, and more specifically, on Map 15 as the area encompassing Stages I and II. Table 11 presents service area design populations and wastewater flow for the three alternatives requiring a sewerage system. The figures for Alternative A were taken directly from the engineering report for the proposed project. Figures for Alternatives B and D were estimated from detailed data from the engineering report. The wastewater flows were based on the total amount of equivalent persons contributing to the system. The number of equivalent persons at 100 gallons per capita per day (gpcd) were calculated combining the estimated number of persons in single family dwellings at (100 gpcd) with persons in multiple dwellings at 45 gpcd, and the number of persons coming to the Island on boats at 25 gpcd*.

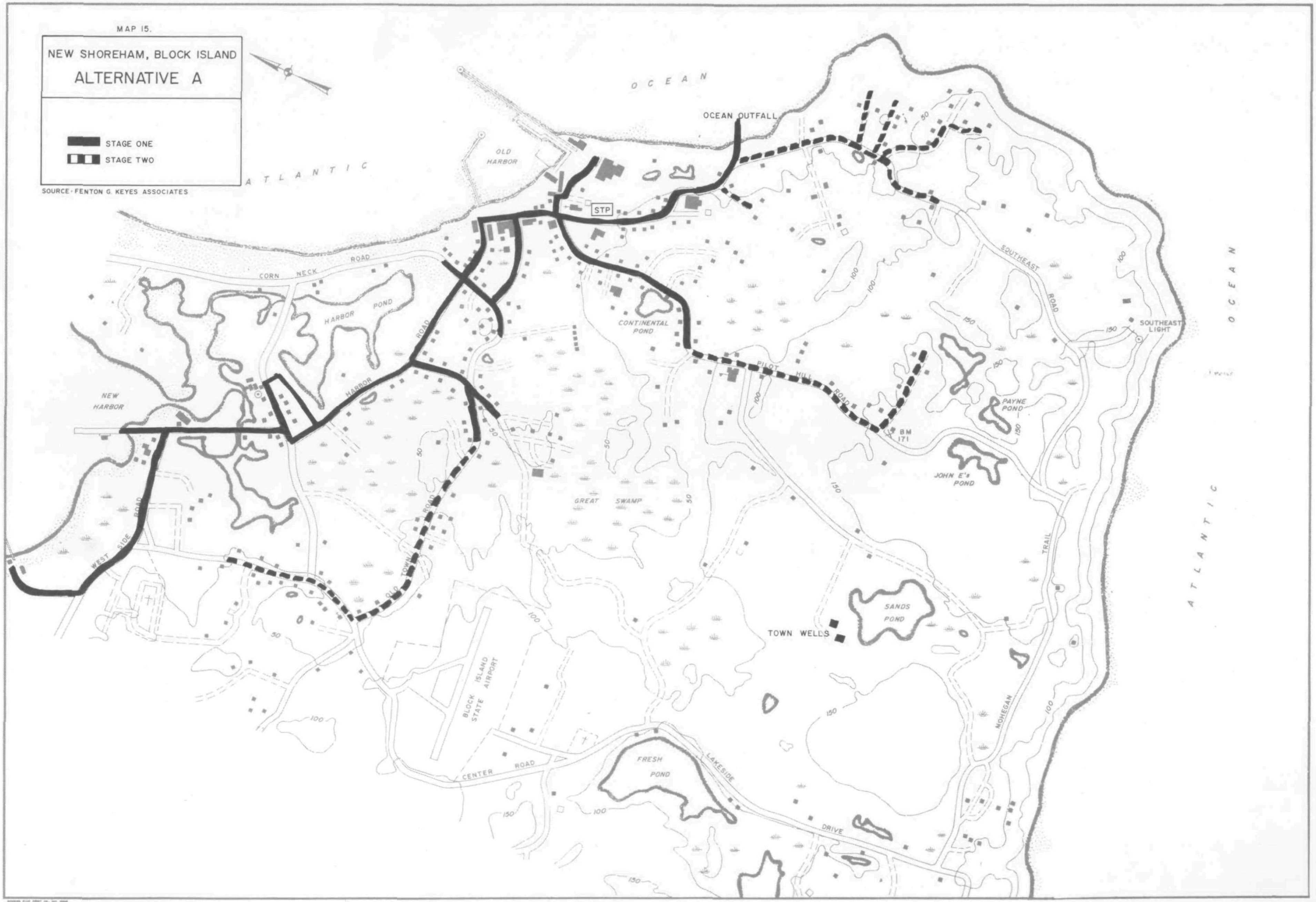
TABLE 11 - Comparative Equivalent Service Area Population and Wastewater Flows

Alternative	DESIGN YEAR			
	1973		1998	
	Summer	Winter	Summer	Winter
Population*				
A	2032	383	3000	538
B	1447	159	2415	258
D	901	90	1271	150
Wastewater Flow**				
A	203,200	38,300	300,000	53,800
B	144,700	15,900	241,500	25,800
D	90,100	9,000	127,100	15,000

* Equivalent persons
** Gallons per day

Source: Fenton G. Keyes and Associates and estimated by EPA based on data from Fenton G. Keyes Associates.

* The estimate of 25 gpcd for boaters is based on the assumption that each person visiting the Island by boat will spend a majority of time on land. Therefore, the estimate represents 22.5 gpcd on land and 2.5 gpcd of 8,000 gal/day, from the boat holding tanks, and implementation of Federal regulations concerning holding tanks will have minimal impact on the capacity of the sewerage system.



MAP 15.
NEW SHOREHAM, BLOCK ISLAND
ALTERNATIVE A
STAGE ONE
STAGE TWO
SOURCE - FENTON G. KEYES ASSOCIATES
ATLANTIC
OCEAN
OCEAN OUTFALL
OLD HARBOR
STP
CORN NECK ROAD
HARBOR POND
HARBOR ROAD
NEW HARBOR
WEST SIDE ROAD
OLD TOWN ROAD
CONTINENTAL POND
PILOT HILL ROAD
GREAT SWAMP
SOUTHEAST ROAD
SOUTHEAST LIGHT
PAYNE POND
BM 171
JOHN E's POND
SANDS POND
TOWN WELLS
MOHEGAN TRAIL
BLOCK ISLAND STATE AIRPORT
CENTER ROAD
FRESH POND
LAKESIDE DRIVE

Actual population projections for the proposed project in terms of single and multiple units and boats are presented in Table 12.

TABLE 12 - Actual Numbers of Units and Persons to be Served for Alternative A

Description of Units	Summer Units	Summer Persons	Winter Units	Winter Persons
1972				
Single	162	567	114	400
Multiple	345	690		
Boats	800	3,200		
Totals		4,457		400
1997				
Single	350	1,225	143	500
Multiple	700	1,400		
Boats	900	3,600		
Totals		6,225		500
2022				
Single	392	1,372	172	600
Multiple	845	1,690		
Boats	900	3,600		
Totals		6,662		600

Source: Fenton G. Keyes Associates

A street by street breakdown of estimated present and future units prepared by Fenton Keyes Associates is included in Appendix F.*

Estimation of units for Alternatives B and D are not shown but can be assumed to be in general conformance to the above but at reduced scales.

Wastewater flows for Alternative C were not computed but estimations of future septic system construction were based on present growth rates.

4.1 NO ACTION Alternative

Description. The alternative of NO ACTION implies a continuation of existing conditions and practices of wastewater disposal on Block Island.

Primary Impacts. As was presented previously, existing water quality conditions within the Old Harbor and New Harbor areas of the Island are tenuous.

*The design figures in Appendix F are not directly comparable to Table 12; however, the resulting average flows are the same.

Direct discharges and failing septic systems would continue, and associated public health, aesthetic and environmental problems would persist. Pumping and haulage of septage from overflowing septic systems would go on with the regularity of the past. For many of the commercial establishments, it is necessary to pump as often as once a week during the busy tourist season. Fortunately, the disposal site for the final dumping of the septage is adequate to handle such loads, (a further discussion of the septage disposal area is included under Alternative A), but there are negative aesthetic affects associated with the transportation of these wastes.

Since the major water supply is or will be taken from ground water aquifers in the southern section of the Island, discharges from the Old and New Harbor areas will not affect that supply. However, seepage from direct outfalls and failing septic systems into Great Salt Bay, Old Harbor and Crescent Beach could eventually affect the quality of fishing, shellfishing and water contact recreation in those areas. The discharge of watercraft wastes would also continue to contribute a great pollution load to Great Salt Bay and the Harbor areas, at least until Federal regulations go into effect.

The State Department of Health has indicated that many warnings have been issued to establishments on Block Island which are in violation of the State sanitary code. However, sources from that Department say that they have been hesitant to close establishments because the Town has exhibited, in good faith, their intentions to improve conditions with proposals to build waste water collection and treatment facilities. However, if no affirmative action is taken, the State will have no course but to condemn these establishments which continually violate sanitary regulations.

Secondary Impacts. Under the Alternative of NO ACTION, it is obvious that growth rates will not increase (see present level trends in Chapter 2). Yet, it is likely that there will be a significant change in present land use. Inasmuch as growth within the established Island cores (Old Harbor and New Harbor) cannot be assimilated because of inadequate land available for subsurface disposal systems, it is conceivable the resultant effect will be the eventual disintegration of the social, environmental, and economic viability of those town centers. Further, future developments, if any, will spread outward from these cores and possibly infringe upon the openness of the southerly and northerly sections of the Island.

4.2 Alternative A - Fenton Keyes Proposed Project

Description. The alternative described and evaluated in this section is the proposed project submitted by Block Island to the EPA for funding. This project consists of pumping stations, interceptor sewers, lateral sewers and a wastewater treatment plant. The total project is designed to be constructed in two stages. The first and second stages are shown on Map 15. The dashed lines (----) indicate the extent of Stage 2. The design of the treatment system was based on the projected waste flows displayed at the beginning of this chapter, the design capacity is 0.3 MGD for expected flow through the year 1998.

The treatment plant is to be located on the high land south of Old Harbor, east of Spring Street (refer to Map 15). The method of treatment is the extended aeration modification of the conventional activated sludge process. Properly operated, this system will remove at least 85% of the suspended solids and 90% of the BOD contained in the incoming wastes. The units in the treatment plant consist of grit removal, comminution, six aeration tanks, two secondary sedimentation tanks, and dual chlorine contact chambers.

Power to operate the system will be generated at the plant site. This self-sustaining feature was recommended by the engineers as a result of a cost evaluation of alternative power supplies. Dual 1200 cubic inch diesel generator pairs are proposed to supply every-day and emergency power. The multiplicity of units in the treatment plant mitigates against total equipment failure. Should such failure occur, however, the storage capacity of the plant is sufficient to remove virtually all of the settleable and floating solids.

The effluent from a plant of this type is essentially colorless and low in suspended solids and turbidity. The suspended solids (10 to 15 percent remaining) are light and flocculent, will not form sludge banks, and are relatively stable.

The effluent is to be discharged into the ocean off Pebbly Beach via an outfall sewer (refer to Map 15). Due to the severe weather conditions that are experienced in the area, it will be necessary to completely enclose the submerged portion of the outfall in a concrete case.

Although the extended aeration process normally does not produce a sludge by-product, at times an excess will buildup in the system. When this situation occurs, excess sludge can be pumped from the system to a waste sludge holding tank for ultimate disposal at the town landfill located in the southwestern part of the Island. It is estimated that once every 30 days in the summer and once every 60 days in the winter, the sludge must be hauled from the treatment site to the landfill for final disposal.

Provisions to accept watercraft holding tank wastes at each marina are included in the design.

Social Impact. The most significant social impact of this alternative is that it will clean up the pollution problems in Old and New Harbors and the resulting health and asthetic effects.

At present, the land on which the treatment plant will be constructed is zoned for business. However, this site is located within the Old Harbor area which was designated by the Rhode Island Historical Preservation Commission as an historic district and was placed on the National Historic Register in May 1974. The Commission indicated that it was unfortunate that the site was to be located in an historical district, but further indicated that in the future the whole Island may be designated as an historical area. In that event, the relative effect of a treatment plant site in that area would be minimal. (See Appendix 6).

Of greater concern to the Commission was the close proximity of the treatment facility to the Ocean View Hotel ruins, "The Shamrock Inn," which is being restored, and the nearby church. Although the actual site will be in a depression thus affording some natural cover, a sufficient buffer zone does not exist between the three structures and the facility. Fences and shrubbery will be required to screen the facility from the structures. The Commission indicated it will assist in the design of fences and landscaping that will effectively reduce any negative aesthetic impacts.

The route of the outfall sewer from the point it departs from the roadway and continues through the beach area and eventually to the ocean, will have aesthetic and psychological effects. The concrete encased outfall will rise above mean sea level and will be in effect a groin or pier extending from the shore out approximately 200 feet. From a visual sense, the groin will undoubtedly change the natural setting of the area. From a psychological sense, just the presence of a wastewater outfall may impart a negative attitude or atmosphere to the area. Health aspects of this outfall are discussed in the environmental section.

It can be seen from Map 15 that the sewer routes are in most cases along existing roadways. It is not anticipated that these routes will be affected negatively by the interceptor. However, the impact or short term effects during construction of the sewers, as well as the treatment plant and outfall sewer, depend on the time of year the construction takes place. As was established earlier in this report, the Island's major asset is its attractiveness as a recreational area. If construction occurs during the tourist season, the associated disruptions will have an unfavorable effect on the Island's tourist trade. For this reason, the condition that there be no construction activities during the tourist season was included in the design of the proposed system.

Technical. From a technical standpoint, there is no indication of problems in construction of either the sewer system or the treatment facility. The site of the treatment facility is high enough above sea level to be protected against floods and the soil characteristics are amenable to construction of such a unit. Construction of that portion of the outfall that is in the water, will be difficult, as is reflected in estimated costs; however, no overwhelming constraints are foreseen.

Because many of the soils in the total project area are erosive and the topography is steep and undulating, the Soil Conservation Service indicated that a plan for control of erosion is required. Such a plan should include provisions to reduce erosion from excavation areas, stock piled soil material, construction sites and final revegetation after construction. Practices that will probably be needed in the control plan include: temporary and permanent seeding of critical areas, sediment basins, diversion interceptor dikes, mulching, drainage log or bailed hay erosion checks, and tree planting in heavy use areas. In addition, revegetation plans should include only those plants that are tolerant and adapted to "salt spray" such as, Japanese Black Pine, Russian Olive, Tatarian Honeysuckle, and Scotch Broom. The Soil Conservation Service is willing to assist in the development of such a control plan.

Operation and maintenance of the proposed treatment facilities could present some problems. Specifically, the drastic changes in flow due to seasonal changes in population may upset the biological action in the treatment plant. This will necessitate additional monitoring and operational activities during the periods when flows change, at the beginning and end of the tourist season and possibly on weekends.

Another problem may be the inclusion of salts and chemicals in the system from the boat dumping facilities.

The magnitude of saline and chemically treated wastes emanating from watercraft, that will affect a biological treatment plant has been determined by various research programs. A report developed by Ludzork & Noran in the October, 1965 issue of the Journal of the Water Pollution Control Federation indicated total concentrations of chlorides at the treatment plant up to 8000 parts per million (ppm), assuming a reasonably constant concentration, will not inhibit biological action. For the treatment system described in this alternative, 2.5 gpcd for each of the 3600 boaters contributing, results in a chloride concentration of 645 ppm at the treatment plant. It is not probable that levels of this nature will impair treatment efficiency, but during periods of seasonal changes in flow, the shock loads of high salinity wastewater may cause temporary disruptions in treatment efficiency.

Additional chemical ingredients which are found in watercraft wastes, and can be harmful to the treatment system are zinc and formaldehyde. A research report prepared by FMC Corporation, San Jose, California for EPA (1974) indicated zinc concentrations above 20 mg/l or formaldehyde concentrations greater than 120 mg/l cause adverse effects in biological systems. Based on the projected rate of 2.5 gpcd times 3600 persons and the reported concentrations for zinc (4500 mg/l) and formaldehyde (4500 mg/l) in watercraft wastes, the resultant concentrations at the treatment plant will be: 135 mg/l zinc and 135 mg/l formaldehyde. Considering the reliability of these estimates to be within 50%, it is probable that zinc concentrations, and to a lesser extent, formaldehyde concentrations will upset the biological treatment efficiency of the extended aeration facility.

The problem of salts and chemicals in the treatment system is directly related to EPA, Coast Guard and State regulations concerning watercraft wastes. The present EPA standard of no discharge by 1981 will require holding facilities on boats and pumpout facilities at marinas in the future. Under these requirements, pretreatment of chemically laded boat wastes will be required for this alternative and Alternatives B and D, which also utilize a biological treatment facility. It is possible that Federal or State authorities will prohibit the use of these toxic chemicals in which case pretreatment would not be necessary. However, such action does not appear likely at this time. It is also possible that the no discharge standard may be totally abandoned in favor of flow through devices, in which case no facilities would be required at the marinas. (See Appendix B).

An example of the type of treatment systems necessary at each marina under the present law is included in Appendix G. The exact type of system to suit the situation on Block Island should be investigated and determined by the design engineer. The disposal technique of the residual toxic wastes from the pretreatment processes should also be investigated by the engineer. Because of their expected toxicity, special landfilling procedures may be required.

The materials to be used in the construction and operation of the proposed project include concrete, fill material, piping and machinery, which for the most part will have to be shipped from the mainland since little or no supplies are available on the Island. Neither the consumption nor the transportation of these materials is considered to have a significant environmental impact.

As stated previously, power will be generated at the treatment plant. Thus, there will be no consumption of the Island's municipal energy supply.

Although this type of treatment system, extended aeration, is known for its reliability and simplicity of operation, under non-seasonal conditions, the operational difficulties that will be experienced because of seasonal flows will require skilled technicians. Finding personnel capable of operating this facility may require relocating them from the mainland as the present work force on the Island is limited. This in itself may be a problem.

Environmental Impact. Discharging over 300,000 gallons of treated wastes in four feet of water only some 200 feet from shore presents environmental questions that must be addressed in detail. For this purpose a mathematical model, verified by on-site investigations was used by EPA to simulate the conditions that can be expected if a discharge occurs.

The complete analysis is included in Appendix H, however, a summary of the conclusions are as follows:

1. Drogue studies indicated it is highly improbable that the wastewater effluent will encroach upon the nearest bathing area, Ballard's Beach, and at no time will it reach Crescent Beach.

2. Dispersion models predicted the proposed outfall design would meet water quality standards most of the time, but that with an improved diffuser design, water quality standards could be met all of the time.

The above conclusions were based on secondary treatment wastewaters with an effluent coliform count of 1000/100 ml. and the required water quality standard (SB) of 700/100 ml. It was considered that the treatment plant should at least chlorinate the wastewater at all times.

Another important question concerning the outfall is its accessibility to swimmers, strollers, or curious youngsters. Because the depth of water at the end of the outfall is only four feet, it is conceivable that anyone could walk out to that point. Furthermore, the concrete encasement for the outfall, which will be above water, will afford an even more direct route to the discharge point. For this reason, it is recommended that the outfall be extended to a depth which would preclude easy accessibility (the 10 feet depth would require extending the outfall some 500 feet), or, some arrangements to limit accessibility to the discharge point such as fences or warning signs be employed.

EPA and the State will assist in the design of the improved diffuser, and the extension of the outfall or the confinement of the discharge point.

As indicated in the project description, the sludge will be disposed of no more than 20 times per year at the Town's landfill site shown on Map 10. The United States Department of Agriculture Soil Conservation Service was consulted and commented that the disposal site has well drained, deep, coarse textured soils and a water table between 30 and 40 feet deep. Thus, the site is suitable for the proposed use. Both the State Department of Health and the local Conservation Commission have approved the site for sludge disposal.

Since the majority of septic tanks now requiring frequent pumping would be replaced by sewers, the septage load, under this alternative, coming to the landfill would be greatly reduced.

The present treatment plant design does not contain provisions for odor control and odors emanating from the treatment plant will be present. With proper operating practices, these can be minimized; however, we recommend that odor control provisions be made. Haulage of the sludge may present some odor problems as the trucks must pass relatively near the populated Old Harbor area. However, by collecting the sludge at times such as early in the morning, when it will least affect the neighboring populace, the potential problem can be minimized.

A preliminary inspection of the drawings of the treatment plant indicate that the noise emitted from the plant may be considerably higher than the measured ambient levels (indicated in Chapter 2), such that a significant noise impact may be generated by the plant. The main source of emitted noise can be identified as:

1. Radiator and radiator fan noise, 75 dBA at 50 ft. These radiators are located on the outside of the proposed plant and evidently will not be located behind acoustic barriers.

2. Exhaust noise, 75 dBA at 50 ft. The engine exhausts vent directly to the exterior of the building. This assumes the use of a standard exhaust muffler.

3. Engine noise, 70 dBA at 50 ft. while the engines are located inside the building in an acoustically treated engine room, there is a 10 ft. by 5 ft. opening from the room to the outside for engine inlet air and it is reasonable to expect about 70 dBA at 50 feet emitted through this opening.

All three sources are related to the two diesel generators (approximately 150 KW capacity each) and the dBA levels have been estimated based on the data given for truck diesel engines in EPA-550/9-74-018, BACKGROUND DOCUMENT FOR PROPOSED MEDIUM AND HEAVY TRUCK NOISE REGULATIONS, OCT. 1974.

All three sources are visible from the boundary line of proposed site and all three sources are located on the inland side of the proposed building and, therefore, visible to the adjacent receptors. All three sources together give a single equivalent source of:

75 + 75 + 70 = 78.6 dBA at 50 ft.

Assuming 6 dB per doubling of the distance gives 72.6 dBA at 100 ft., 66.6 dBA at 200 ft., 60.6 dBA at 400 ft., and 54.6 dBA at 800 ft. Furthermore, the emitted noise over a continuous 24-hour period will result in **Ldn values** of 79 dBA at 100 ft., 73 dBA at 200 ft., 67 dBA at 400 ft., 61 dBA at 800 ft., and 55 dBA at 1600 ft. These LDN values should be compared to the Ldn of 39 dBA estimated for the existing winter level. During the winter period the plant will be audible at distances up to about 1.2 miles with no additional attenuation.

In view of the possible noise impact indicated above, EPA would require that measures be taken to include noise attenuation features sufficient to reduce the Ldn at all receptors to a maximum of 55 dBA. (An Ldn of 55 dBA is identified in the EPA document, "Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare With an Adequate Margin of Safety" as adequate to protect against outdoor activity interference and annoyance). As the noise impact would be the same for Alternatives B and D, this requirement would apply to those alternatives as well.

In view of the low ambient levels, an Ldn of 45 dBA should be set as a design goal to be achieved if economically feasible.

The following are possible solutions to the problem:

1. Use acoustically insulated louvers.
2. Construct an acoustical baffle between generators and louver opening.
3. Construct acoustical barrier wall around radiator fan area.
4. Construct earth berm barrier between plant and receptors.
5. Use improved exhaust silencer.
6. Relocate generators to less sensitive area, if available.

The preceeding are standard noise-control procedures. The effects of such procedures on engine efficiency and plant working conditions must be taken into account by the design engineer. The Region I Noise Program will provide technical assistance to engineers to the extent possible.

The only effect of the treatment plant on the ambient air quality other than the odors from the sewage itself will be emissions of the diesel generators. Operation of the two diesel engines, one at a time, will be continuous, burning approximately 57,000 gallons of diesel fuel per year. Using emissions factors in the EPA publication, "Compilation of Air Pollutant Emission Factors", Second Edition, AP-42, p.3.1.5-2 (emission factors for heavy-duty, diesel-powered vehicles), the following annual emissions are predicted from the diesel engines:

Particulates	741 #/year
SOx (as SO_2)	1540 #/year
(Based on ave. sulfur content of 0.2%)	
CO	12820 #/year
HC	2120 #/year
NOx (as NO_2)	21200 #/year
Aldehydes (as RCHO)	171 #/year
Organic Acids	171 #/year

No background CO levels are estimated due to the absence of CO monitoring on Block Island. However, as stated in the section on air quality, no major sources of air pollution (including CO) exist on Block Island.

Due to the relatively low background levels of SO and particulates and the relatively insignificant amounts of air pollutants estimated for this facility, the emissions from the diesel engine will not cause a violation of any applicable ambient air standards.

To determine the effect of the treatment system on the Island's wildlife, various authorities were consulted. According to the Department of the Interior, U.S. Fish and Wildlife Service, neither the wildlife refuge area in Sandy Point nor the "Block Island Vole" will be disturbed by the proposed system. In addition, Dr. Howard Winn, a marine mammalia expert from the University of Rhode Island who has been studying the seals indicated it was unlikely that the effluent from the proposed treatment plant would adversely affect the reported seals.

The environmentally sensitive areas indicated in Map 8 were evaluated with respect to the physical system proposed by this alternative. There do not appear to be any major conflicts.

Economic Impact. The costs associated with Alternative A are shown on Table 13. The costs for Stage I are based on bid prices of August 1974. All other costs are based on best estimates.

TABLE 13 - Annual Costs of Alternative A

	Construction Cost*	Average Annual Bond Payment	Annual Operating Cost	Total Average Annual Cost
Phase I	$ 4,383,000	382,000	27,000	409,000
Phase II**	500,000	44,000	0	44,000
Individual House Connections	150,000	13,000	0	13,000
TOTAL	$ 5,033,000	439,000	27,000	466,000

* A detailed cost breakdown is included in Appendix I.
** When constructed.

Source: Construction Bids - August 1974 and Estimates by EPA

The Town's share of the construction cost will be borne by a minor increase in the total tax rate and by betterment assessments on the properties within the service area. The operating costs will be covered by service charges based on extent of user facilities.

In addition to the annual costs of this alternative there are other ramifications to the economic base of the Island. It is a fact that many of the Town's commercial establishments are suffering economically from a lack of sanitary systems. For instance, some establishments are limited in the number of people they can serve, and in some cases establishments have been closed. Since the Island's economy is based on the ability of its commercial industries to provide services to tourists, the improvements provided by this alternative will significantly benefit the economy of the established Town center.

Political and Legal/Institutional Impact. Many of the legal and institutional arrangements required to maintain and regulate a sewer system have already been established by the Town in anticipation of the construction of this system, including the Block Island Sewer Commission and subsequent sewer cost assessments. Some strengthening of these arrangements may be necessary to better reflect the needs and desires of the townspeople since the preparation of this impact statement would indicate that the dialogue between local regulatory authorities and the general public is less than complete.

In addition, the arrangements recommended by the designing engineer concerning subsurface disposal systems for areas outside the sewer system are excellent and should be implemented.*

*Preliminary Engineering Survey and Report on Control of Water Pollution for the Town of New Shoreham, R.I., Fenton G. Keyes Associates, Providence, R.I., Feb. 1972, pp.20-26.

Secondary Impacts. Based on the development pressures on the Island's coastline serving the Northeast's recreation demand centers, construction of sewer lines and waste treatment capacity could be expected to stimulate and accelerate growth on Block Island.

The design capacity of the proposed project is based on the assumption that both single and multiple housing units will double in the study area by 1997. (See Table 12).

The significance of this fact is dependent to a great extent on two factors: (1) How much development could occur without the sewer systems, and (2) How that new development is distributed within the study area.

Based on existing zoning allowances and recent demand for building permits, doubling of the single housing units will likely occur within the study area whether or not the area is sewered. Sewering this area could cause an acceleration of single family development (See Table 14). However, there has been almost no recent demand for building permits for multiple units, probably due primarily to the lack of adequate sewage disposal. Thus, without the new sewers, it is probable that few multiple unit structures would be built.

It is possible that as a result of sewering this area the emphasis will be placed on multiple unit development. A portion of this multiple development will probably include hotels and possibly condominiums along with commercial establishments. These will generally be located in either New or Old Harbor. As Old Harbor is presently the most densely developed area on the Island, additional development would likely have the effect of enlarging the core of the Old Harbor area, possible causing more intensive land use without substantial change to its character. If, on the other hand, the greater portion of the multiple unit and commercial development occurs in New Harbor, there will be a noticeable change in the character of New Harbor, simply because present development in this area is minimal.

TABLE 14 - Comparison of Development Trends in Proposed Sewer Service Area

	NEW UNITS			UNITS/YEAR		
	Total	Single	Multiple	Total	Single	Multiple
Estimated						
1960-1970	175	125	50	17	13	5
Projected for Design						
1972-1997	543	188	350	22	8	14
1997-2022	187	42	145	10	2	7

Source: 1) Estimates from U.S. Census and U.S.G.S. maps.
2) Fenton G. Keyes Associates.
3) This estimate includes 36 units in Ballards.

In either case, there will be an eventual demand for an extension of other public utilities and services such as water supply, electricity and solid waste disposal.*

A large portion of the area proposed to be sewered by Phase II is wetlands, and cannot be developed using subsurface disposal methods. If sewers were made available there is a strong possibility that development would encroach upon these areas. Intensive commercial resort development would be especially likely in the extensive undeveloped areas in the vicinity of New Harbor, accessible to Great Salt Pond, marinas and a ferry-slip. New summer home developments would likely occur both in the vicinity of New Harbor and in the heights to the south of Old Harbor. There is even a possibility that, with the extension sewers and other utility services, a pattern of new condominiums, motels and summer home developments in presently undeveloped areas could take place at the expense of revitalization of the old hotels, homes, and businesses of Old Harbor.

A substantial impact on the character of the residential areas outside of Old and New Harbors would result from the sewers only if there were sufficient demand for development to cause either zoning changes to smaller lot sizes with in the sewered area or zoning variances to the same end. Such development is theoretically limited by the design capacity of the sewer system, but once the system reaches capacity, demand for additional development could result in pressure for expansion of the system and the costly expansion of treatment facilities. Then the cycle could begin again, resulting in denser development of outlying areas.

Substantial changes in character of these types would be in direct contrast to one of the Town's prime goals: maintaining its rural New England character.

In further consideration of the character of the Island, present zoning does not restrict building heights in the business zone or hotel heights in other zones where they are allowed by special permit. Since residential density for individual buildings will no longer be limited by on-lot sewage disposal capabilities, it is possible that there will be some building to heights greater than those now present on the Island. Such development could create a substantial visual impact anywhere within the sewer service area, unless the zoning bylaw is changed to include a height restriction on these types of development.

It must be recognized that although the design capacity is based on certain development assumptions, once the capacity is provided development may proceed in many different ways and at differing rates, unless the town

*In 1972, Fenton G. Keyes Associates prepared a "Preliminary Engineering Survey & Report On Water Supply & Distribution for the Town of New Shoreham."

makes a conscious effort to control such development through zoning or other planning techniques.*

On other northeast resort islands, the demand for recreation facilities and summer homes has resulted in intensive development and proliferation of resort complexes, condominiums, motels, shopping centers and well-equipped modern summer residences. With sewers and other improvements, such development would be made possible in the vicinity of proposed sewer lines on Block Island.

It is not probable that an extreme growth situation will occur on Block Island either directly or simultaneously as a result of the proposed project. But such growth will occur little by little if the sewer system is permitted to expand with complementary changes in the zoning densities either by variance and special permit or bylaw amendment. Based on the experience of these other places and depending on the strength of development demand to force zoning changes and further expansion of sewer and treatment capacity, an extreme growth situation could result in the following impacts:

1. Impose resort complexes and residences on wetland and shoreland ecosystems and on flood hazard areas. Especially adverse would be encroachment upon the salt water marshes of the Great Salt Pond embayments as well as fresh water marshes abutting the Ocean Avenue and Beach Avenue sewer lines; also, the south shoreline of Great Salt Pond accessible to the West Side Road sewer line and extensive areas in the south central sector tentatively proposed for "conservation" or "open space recreation" in the CCP and for "low residential, open space preservation", "no structures", or wetlands in the Block Island Report prepared by the University of Rhode Island.

2. Facilitate condominium and medium density residential development in the extensive open moors, dotted with small lakes, to the southwest of New Harbor. Intrude upon open space character, marsh and upland vegetation and general sense of openness of the Great Salt Pond area and view of Great Salt Pond and Block Island Sound.

3. Stimulate medium density residential development (1 acre lots) on the extensive "low density residential" and "conservation" areas southeast and south of Old Harbor proposed in the CCP. These areas embrace perched fresh water marshes, ponds, water supply recharge areas, and the picturesque pasture-bayberry moor vistas of Old Harbor and the ocean from the upland plateau. Proposed for "low density residential" (2 acre lots) and some

*One such mechanism which could be used to check unwanted growth attributable to sewer construction is through the National Pollutant Discharge Elimination System permit. Effluent quantity limitations at different points in the design life of the treatment facility, over development of the sewered area could be controlled.

"open space recreation" in the CCP and "low density, open space preservation" in the URI report (zoning in conflict with both).

4. Facilitate resort and beach house development northward along Corn Neck Road toward North Neck, through the potential for sewer connections. Thus closing in upon the beaches, salt water marshes and open vistas of the ocean, Great Salt Pond and North Neck Highlands. Much of this area presents flood hazards and lies below the hurricane highwater line.

5. A higher level of development, public services, commercial activity, tax assessments and overall publicity about the Island would encourage land sales and greater numbers of people to build summer homes on the Island even in areas beyond the influence of the sewers and treatment plant, thus impairing surface and ground water and further encroaching upon the open countryside of the Island hinterland.

6. Greater numbers, densities, and range of activities on the Island would have an overall adverse impact on the high quality environment:

   - on water quality through runoff from additional paved and impervious surfaces, through some erosion and sedimentation of fragile ponds and wetlands associated with construction and continuing earth disturbance, and through additional solid waste-septage disposal and septic system operation - all associated with a higher level of development;

   - on noise levels through additional vehicles, lawnmowers, and human activities;

   - on air quality through additional motor vehicles and powered boats;

   - on visual appeal of sweeping vistas of sea, sand, and sky; of rolling moors, pastures, ponds, and vegetation.

   - on fragile ecosystems; salt and fresh water marsh associations, dunes associations, and upland plant and animal associations.

7. Greater numbers, densities, range of activities, and standardized outside architectural styles could overwhelm or clash with the character of the Island countryside, with the relative open scale of the Old Harbor community itself, with the indigenous architecture, and with historic preservation.

   On the other hand, a sewer system would help to maintain the historic hotels, shops, and houses of Old Harbor as a community cluster.

8. Greater numbers of residents and visitors and diversity of outside interests could weaken the cohesiveness and close personal relationships of a small tightly-knit Island community. Yet, at the same time, some additional residents economic activities, and services would sustain, enrich, and round out the social fabric of the community.

9. Additional numbers, economic activity, and services would provide a base for a sustained year-round economy and raise the monetary level-of-living. At the same time, this could lend to greater dependence on values associated with a cash economy as opposed to a way-of-life that features a quality environment, indigenous community charm, and opportunities for solitude.

A section by section analysis of the town under extreme conditions of induced growth is included in Appendix J.

4.3 Alternative B Proposed Project minus Stage II

Description. It is apparent from an examination of the Septic System Failure, Map 7 and the Soil Characteristics, Map 5 that septic systems are, at present, working properly in the Stage II area (refer to Map 15), and by all indications could continue to work with a reasonable degree of reliability for the future. Therefore, Alternative B includes a wastewater system similar to the proposed project which would include Stage I sewers but not future Stage II sewers. The treatment facility design under Alternative A includes an additional capacity of 58,500 gallons per day for Stage II. That capacity would not be required under this Alternative. No other changes from the system described in Alternative A are suggested.

Primary Impacts. Because of the similarity between Alternative B and Alternative A, the primary Social, Technical, Political and Legal/ Institutional Impacts will be the same. The environmental impacts differ only in that the expected discharge under this alternative will be less than under Alternative A by 58,500 gpd at design conditions. This amount, however, is not significant enough to consider a redesign of the outfall system or the treatment process itself. This decrease in capacity should be handled by a simple restriction on the NPDES permit.

Table 15 lists the estimated costs for Alternative B and reveals a slight savings over Alternative A. The economic advantages, however, may be deceiving. While Alternative B would not require an expenditure of $500,000 for Stage II sewer construction, growth within the Stage II area will require construction of new septic systems. Based on moderate growth projections, individual expenditures for septic system construction in the Stage II area could total up to $225,000 in the next 25 years. Further, while the sewer system costs are partially funded by State and Federal grants, the cost for the construction of individual septic systems must be entirely borne by the individual.

Secondary Impacts. Secondary impacts of this alternative would be similar to those of the proposed project (Alternative A), except that there would be no real pressure for smaller zoning lot sizes or for multiple unit structures in the Stage II area. This would eliminate the potential adverse effects of such development on the open space and ground water availability areas to the south of Old Harbor. Elimination of Stage II could result in directing development to sewered areas in New Harbor. Such development might eventually encroach on environmentally sensitive areas adjacent to Great Salt Pond.

TABLE 15 - Estimate Costs for Alternative B

	COSTS			
Item	Capital	Average Annual	Operation & Maintenance	Total Annual
Treatment Plant & Sewer System	$ 4,083,000	355,000	25,000	380,000
House Connection	100,000	9,000	0	9,000
Future Stage II Septic System Construction	225,000	20,000	500	20,500
TOTAL	$ 4,408,000	384,000	25,500	409,500

Source: See Detailed Cost Breakdown in Appendix I.

4.4 Alternative C - Rehabilitation of Individual Subsurface Disposal Systems

Description. This alternative for dealing with the water pollution problems of Block Island is based on the continued utilization of individual subsurface disposal systems. Subsurface disposal or septic tanks have been demonstrated to be an effective, reliable, economic and environmentally satisfactory method for the disposal of wastewater for individual homes at low development densities and with appropriate soil conditions. Subsurface disposal systems have served all of the commercial and residential dwellings on Block Island with many dwellings using the subsurface systems originally constructed with the building. However, in the more densely developed commercial areas of Old Harbor and New Harbor subsurface systems have failed because of either poor construction, inadequate soil conditions or insufficient area for drainage fields. As was stated previously, the proper backfill (Bank Run Gravel) and trench material (1/2 to 1 1/2 crushed stone) are not readily available on the Island and were probably not used in many cases.

As was discussed under Alternative B, septic systems in the Stage II area are working properly and by all indications will continue to work adequately for the future. Existing systems which have failed would be reconstructed in accordance with the State of Rhode Island's standards for construction and maintenance of individual sewage disposal systems included in Appendix M. A major assumption of this alternative is that all subsurface systems in the areas, defined by Stage I of Alternatives A & B, would need to be rebuilt within the next five years. The life of a reconstructed system is assumed to be twenty years with annual inspections and pumpout of the septic tank solids as necessary perhaps once every three years. In situations where sufficient land is not available to construct systems to meet State regulations, such land would have to be acquired. Future developments would also require more stringent construction practices. Septage from septic tanks would be trucked and disposed of at the existing landfill site.

The Federal requirements for disposal of watercraft wastes as discussed in Appendix B may necessitate holding tank pumpout facilities at each marina similar to those provided in Alternatives A and B. Under this alternative, wastes pumped out of the boats will have to be trucked to the Town landfill site for disposal along with the septage wastes. Although there is ample room at the landfill site to accept these wastes, recent research has indicated that the highly toxic chemicals added to holding tank wastes as a conditioner could eventually seep into ground water supplies. Consequently, costly pretreatment to eliminate such chemicals will be required prior to disposal in a sanitary landfill.

In order for Alternative C to be considered viable, State regulations on subsurface disposal must be rigidly enforced in the future to minimize the possibility of additional water pollution problems resulting from failing systems. It should be recognized that design and construction of subsurface disposal systems is not an exact science, but that careful design and construction coupled with favorable soil conditions minimize possible septic tank failure. Seasonal use of these systems further enhances the prospects for their successful use. An additional mitigating factor would be the utilization of in-house flow reducing equipment discussed in Chapter 3 for the critical New Harbor and Old Harbor areas.

Under this alternative, development would be constrained to present levels and would be limited, prohibited, or uneconomical in the low lying areas, generally below elevation of 10 feet. Environmentally sensitive areas below elevation 10 feet were presented on Map 15.

Social Impacts. A primary social impact will be general disruption of services from construction activity during rehabilitation of the septic systems. Construction impacts can be minimized, however, by scheduling such activities during nontourism months. Additional social impacts may result from public health and aesthetic problems of systems which may fail in the future.

The aesthetic impacts of odors associated with transport and land disposal of septage and watercraft wastes are expected to be minimal.

Technical. The continued use of individual subsurface disposal systems provides a number of technical advantages in that such systems are simple, relatively inexpensive, reliable and effective if designed, constructed, operated and maintained properly. However, this alternative poses significant problems particularly with regard to existing buildings which have failing systems. The failure of these systems may generally be attributed to high ground water conditions, inadequately sized or constructed leaching fields, or inappropriate soil conditions. In the more densely developed areas of the Island, lot sizes and geographical locations may physically preclude the construction of satisfactory subsurface disposal systems. In those cases, reconstruction of the systems may only provide an adequate functioning system for several months or less and pumping of the septic tank on a regular daily or weekly basis may be necessary. The only possible solution for these failing systems is to convey the wastes to adjoining properties or other locations where satisfactory systems could be built.

Use of properly constructed subsurface disposal systems will require the continuation of pumping, hauling and landfilling septage, but on a less frequent basis than at present.

Environmental Impacts. An advantage of subsurface disposal is that it serves to recharge the ground water and thereby serves to sustain the fresh water supply. The longterm effects on water quality of continued discharge to the ground water are uncertain. However, experience with subsurface disposal systems at the densities proposed on the Island indicate that the effects would be minimal. In areas served by the community water system these impacts would be further reduced (See Appendix N).

The possibility of continuing failure of subsurface disposal systems always exists. Odors and public health problems which might arise from sewage seepage would pose a significant environmental problem.

The magnitude of septage to be disposed of will probably be less under this alternative than under present conditions. The possibility of odors and ground water contaminants at the disposal site are considered to be minimal.

Economic Impacts. The costs of continued use of subsurface disposal systems are based on reconstruction of the existing systems and construction of new systems in accordance with State of Rhode Island regulations. Reconstruction of existing systems within the proposed sewered area and new construction of systems to accomodate new development through 1998 is estimated at $2,000,000.

As previously noted, several of the existing systems cannot be adequately reconstructed because of physical site limitations. The cost of conveying this wastewater to adjoining properties where adequate subsurface disposal systems could be constructed is not included.

Total Capital and Annual Costs for Alternative C, including costs for handling watercraft wastes are shown in Table 16.

TABLE 16 - Estimated Costs of Alternative C

	COSTS			
Item	Capital	Average Annual	Operation & Maintenance	Total Annual
Rehabilitation on future construction of Septic Systems in Phase I areas	$1,801,000	157,000	4,500	101,500
Future construction of Septic Systems in Phase II areas	225,000	19,000	500	19,500
TOTAL	$2,026,000	$176,000	5,000	121,000

Source: See Detailed Cost Breakdown in Appendix I.

The continued use of subsurface disposal systems would require that the costs of necessary system reconstruction and annual maintenance be financed by private owners. Where additional land area is required for the construction of existing systems, private land owners would have to acquire or make arrangements for the use of adjoining land. Because of the high cost of septic system construction on Block Island, the total costs to be borne by an individual property owner in the proposed sewer service area would generally be higher under Alternative C than the total assessments to be made on his property over the design life of the sewer system. On the other hand, the cost of this alternative to property owners outside the proposed service area would be zero as compared with the sewer assessment in the general tax rate under Alternatives A, B and D.

Political and Legal/Institutional Impacts. The continued use of subsurface disposal systems on Block Island poses special legal and institutional considerations.

In order for individual systems to be considered a realistic possibility for dealing with current and future wastewater management, existing laws and regulations must be rigidly enforced including the use of stone for leaching fields. While this may increase the costs of system construction, these actions are necessary to reasonably ensure system reliability. Also, the minimum distance to ground water from the leaching field should probably be maintained at 4 feet for all new development on the Island.

All percolation tests and leaching field construction should be observed and inspected by regulatory agency personnel, preferably by a well qualified engineer.

In some instances, these requirements may place the Town and State regulatory agencies in a politically difficult enforcement role, particularly relative to existing systems. However, the adequacy of rehabilitated subsurface disposal systems rests heavily on the achievement of this regulatory capability.

Secondary Impacts. Similar to the secondary impacts of the NO ACTION Alternative, this alternative could perpetuate the deterioriation of the Old Harbor town center. Extremely high costs for the construction or reconstruction of septic systems in that area could channel development to other areas, instead of channeling investment in the restoration and clustering development of the Old Harbor core.

Growth resulting from this alternative would be at or near "present levels" such that the magnitude of the influx of people and associated development would not infringe upon the environmental amenities of the Island. However, the existing development patterns could be affected with a possible adverse change in the Island's unique character and its ability to attract tourists.

A solution would be the adoption and strict enforcement of a refined zoning plan, with emphasis on environmental suitability, land capability and community goals. This solution is always subject to development pressures, but such pressures should be less intense than those likely to result from construction of a sewer system.

4.5 Alternative D - Sewer System for Old Harbor

Description. Under Alternative D, only the immediate Old Harbor area would be served by a sewer system and treatment facility. Map 16 indicates the extent of this system. In New Harbor, or the portion of Stage I not served by this system, inadequate subsurface disposal systems would be ameliorated through rehabiliation as was discussed in Alternative C. For the area south of Old Harbor, Stage II, existing individual septic systems can generally continue to be used without rehabilitation.

The justification for consideration of this alternative is premised on the general availability of amenable soils and sufficient land in New Harbor to facilitate subsurface disposal techniques. Septic System Failures Map 7 indicates many systems, at present, are failing in the New Harbor area, rehabilitation of these systems and coupled with the utilization of in-house flow reducing apparatus, would make individual subsurface systems an acceptable disposal technique for that area.

The treatment facility for the Old Harbor sewer system under this alternative would be reduced in capacity to approximately 130,000 gallons per day. This would require a major redesign of the plant and sewer system possibly involving changes in the treatment process or sewer routes. For purposes of discussion of this alternative, it is generally assumed that these things will not change. Watercraft wastes from marinas in the New Harbor area would have to be hauled to the Town landfill site. Pretreatment may be required as discussed in the Technical section of Alternative A.

Social Impacts. The major social impact of this alternative is that it will provide a municipal service to clean up the pollution problems in Old Harbor. However, the remainder of the Island and particularly the New Harbor area will not have the advantage of municipal responsibility for sewage collection and treatment. Those areas outside of Old Harbor will have to rely upon the effectiveness of code enforcement to insure that there will be no repetition of current problems. While the chance of failure of proper septic systems is minimal, such failure could result in adverse public health and aesthetic conditions.

Technical. In order to reduce the capacity of the proposed treatment plant to 130,000 gal/day, a major redesign would be required by the engineer. Although the extended aeration treatment process would be viable under this alternative, during the redesign process some other treatment method might be found to be more suitable or more cost effective. In addition, during the design process, sewer pipes may have to be re-sized and possibly relocated. This whole process would take a few months, thus further delaying solution to Old Harbor's problems.

Reconstruction of subsurface disposal systems in the New Harbor area could begin immediately. Septic tanks will still have to be pumped out although on a less frequent basis than at present. Septage from these pumpings and boat wastes from the New Harbor marinas will have to be trucked to the landfill.

Reduction of the plant capacity would not necessarily preclude expansion of the plant and system to service New Harbor at some future time.

Environmental Impacts. The discharge from the treatment facility in this alternative will be significantly reduced from that expected in Alternative A. The resultant effect on the receiving water will consequently be reduced. However, the reduction in flow is not so great that the outfall sewer dimensions should be decreased or that the recommendations made for the outfall sewer in Alternative A be disregarded.

Again, the possibility of septic system failure in the New Harbor area remains. However, proper code enforcement action should prevent multiple failures, thus preventing serious environmental problems in that area.

Economic Impacts. The costs associated with Alternative D are considerably reduced from those estimated for Alternatives A and B, as shown in Table 16. Again, however, expenditures for reconstruction of individual septic systems are not fundable by either State or Federal grants and must be borne by the landowner. Therefore, the costs shown on Table 17 represents overall reduction in costs to the Island and cannot be interpreted to indicate a concomitant reduction to the costs of each individual.

Further, the costs to New Harbor properties will likely be slightly greater under this alternative than under Alternatives A and B because of the general tax increase necessary to build the municipal facilities.

Political and Legal/Institutional Impact. The reduction in the size and extent of the wastewater system in this alternative will reduce, somewhat, the necessary administrative arrangements that would be required for a larger system. However, the demand for regulatory and enforcement controls to oversee construction or rehabilitation of septic systems will be nearly as significant as those discussed under Alternative C.

Secondary Impact. The secondary impacts of this alternative will be a concentration of growth in the Old Harbor area. Overall growth and particularly development of multiple unit structures will be much less than predicted for the proposed system without the stimulus of an extensive sewer system. Therefore, the New Harbor and Stage II areas will essentially continue to develop at a rate equal to or less than past trends. Thus, the potential for associated adverse environmental effects to the wetlands and shoreline adjacent to Great Salt Pond and the open space and scenic vistas to the south of Old and New Harbors will be practically eliminated.

It is also clear that without a sewer system, expansion of the economic base of the New Harbor area may be restricted. That is, large structures such as condominiums or hotels may be prevented from building there due to

MAP 16.


NEW SHOREHAM, BLOCK ISLAND
ALTERNATIVE D
SEWER SYSTEM
AREA REQUIRING SEPTIC SYSTEM REHABILITATION
SOURCE: FENTON G. KEYES ASSOCIATES
OCEAN
ATLANTIC
OCEAN OUTFALL
OLD HARBOR
STP
CORN NECK ROAD
HARBOR POND
HARBOR ROAD
NEW HARBOR
CONTINENTAL POND
PILOT HILL ROAD
SOUTHEAST ROAD
SOUTHEAST LIGHT
PAYNE POND
BM 171
JOHN E's POND
GREAT SWAMP
WEST SIDE ROAD
OLD TOWN ROAD
TRAIL
SANDS POND
BLOCK ISLAND STATE AIRPORT
MOHEGAN
CENTER ROAD
FRESH POND
LAKESIDE DRIVE
ATLANTIC
OCEAN

the extremely high costs to construct large septic systems. Similarly, the large land requirements for these systems would prohibit dense development.

On the other hand, the economic base in Old Harbor would benefit, both in terms of rehabilitation of old properties which have been closed or have reduced operations due to failing septic systems and from the potential for new economic development.

Such development, if not too extensive, would be in keeping with the development goals of the Island.

TABLE 17 - Estimated Costs of Alternative D

	COSTS			
Item	Capital	Average Annual	Operation & Maintenance	Total Annual
Treatment Plant & sewer system	$2,820,000	225,000	20,000	245,000
House Connections	75,000	6,000	0	6,000
Present & future Septic System construction, Stage I	700,000	61,000	2,500	63,500
Future Septic System Construction, Stage II	225,000	20,000	500	20,500
TOTAL	$3,820,000	312,000	23,000	335,000

Source: See Detailed Cost Breakdown in Appendix I.

5.0 PREFERRED ALTERNATIVES

Of the five alternatives evaluated in the previous Chapter, it is the opinion of EPA that the following two represent the most environmentally acceptable solutions to the existing wastewater disposal problems on Block Island:

1. Alternative D - Construction of a sewer system and treatment facility for Old Harbor only.

2. Alternative B - Construction of the proposed project without including Stage II.

The rationale for rejecting the remaining alternatives is summarized below:

1. NO ACTION Alternative - Due to the potential health hazard that is present and the reliance of the Island's economy on tourism, it would not be in Block Island's best interest to allow the existing situation to continue.

2. Alternative A (Proposed Project) The basic assumptions of this alternative are not invalid; however, it does not appear that sewer service will be required in the Stage II area in the forseeable future. Primary impacts can be minimized with implementation of the recommendations noted in the appropriate sections. Yet, possible adverse secondary impacts, particularly encroachment on wetlands, make this alternative undesirable.

3. Alternative C (Rehabilitation of Septic Systems) Rehabilitation of septic systems in New Harbor and continuation of present septic systems in the Stage II area are viable solution; however, due to the lack of available space in the densely populated Old Harbor area, rehabilitation of existing systems appears impractical. In addition, the secondary impacts of this alternative are unattractive.

Of the two environmentally acceptable alternatives, the primary impacts are essentiallly equal since both require a treatment facility and a sewer system. (Alternative B provides sewer services to a greater area, while Alternative D relies more on rehabilitation of septic systems but is less costly.) The major differences lie in the secondary impacts of each.

As Alternative D will provide sewers for Old Harbor only, it will confine the pressures for major development to that area. This will result in the least amount of secondary growth on the Island as a whole, thus enabling the Town to keep development in general conformance with the objectives of its Master Plan, i.e., to maintain the Island's rural character.

Alternative B will provide relief in the Old Harbor area and also provide sewer services in the New Harbor area. Multiple unit development could result in a transformation of the open character of New Harbor.

The question of development in New Harbor, however, is not really a decision to be made by EPA, but a decision for the Town. In EPA's opinion, Alternative D, has the least adverse environmental impact. On the other hand, the people of Block Island may feel that their Town's existence is predicated on the stimulus for development that will be provided by sewers in New Harbor. And if this is the case, Alternative B is acceptable with the recommendations made in Chapter 4.

Chart B displays, for purposes of comparison, the primary and secondary impacts of Alternatives B & D.

CHART B - Comparison of Preferred Alternatives

	Alternative B	Alternative D
Primary Impacts		
Social	1. Treatment facility location in historical area. 2. Outfall sewer aesthetically unpleasing. May change natural setting of area. 3. Short-term disruptions during construction will not affect tourist season. 4. Construction of system will enhance the Island's recreational assets.	1. Treatment facility location in historical area. 2. Outfall sewer aesthetically unpleasing. May change natural setting of area. 3. Short-term disruptions during construction will not affect tourist season. 4. Construction of system will allow improvement to Island's recreational ability. 5. Adverse public health and aesthetic impacts may result from septic systems which may fail in the future.
Technical	1. Construction will be difficult but not overwhelming. 2. Minimizing erosion during construction and revegetation measures will be necessary and difficult tasks.(See Alternative A) 3. Operating and maintaining the facility at required levels of efficiency during periods when flows drastically change will be difficult. Operation under stable conditions will be no problem. 4. Pretreatment of chemically laden watercraft wastes will be required. (See Alternative A)	1. Construction will be difficult but not overwhelming. 2. Minimizing erosion during construction and revegetation measures will be necessary and difficult tasks. (See Alternative A) 3. Operating and maintaining the facility at required levels of efficiency during periods when flows drastically change will be difficult. Operation under stable conditions will be no problem. 4. Pretreatment of watercraft wastes will be required along with transportation of these wastes to the landfill. 5. Proper leaching field material must be shipped in from the mainland. 6. Construction and reconstruction of septic systems must comply with new State Regulation (R23-1-SD) amended 30 August, 1974. (Refer to Appendix K)
Environmental	1. Short-term effects due to construction although present will be minimal. 2. Effluent will have little effect on receiving waters with implementation of recommendations noted. (See Alternative A) 3. Wildlife and environmentally sensitive areas will be affected minimally. 4. Treatment system will have negligible affect on air quality. 5. Noise impacts of treatment system can be minimized by employing recommendations made. (See Alternative A) 6. Land disposal of sludge not a problem. 7. Treatment system will collect wastes being discharged directly or indirectly into Island's water bodies. Such action will eliminate health hazard potential and improve Island's overall water related abilities, i.e., water contact sports, fishing and shellfishing. 8. Odors from septage during haulage to the disposal site will be minimal.	1. Short-term effects due to construction although present will be minimal 2. Effluent will have little effect on receiving waters with implementation of recommendations noted. (See Alternative A) 3. Wildlife and environmentally sensitive areas will be affected minimally. 4. Treatment system will have negligible affect on air quality. 5. Noise impacts of treatment system can be minimized by employing recommendations made. (See Alternative A) 6. Land disposal of sludge not a problem. 7. Treatment system and rehabilitated septic systems will collect wastes being discharged directly or indirectly into Island's water bodies. Such action will eliminate health hazard potential and improve Island's overall water related abilities, i.e., water contact sports, fishing and shellfishing. 8. Long term adverse effects on ground water from septic systems in New Harbor are not expected. 9. Use of inhouse flow reduction apparatus should be employed to reduce the potential for failing septic systems. 10. Odors from septage and treatment plant sludge haulage to the disposal site will be present but minimal.

CHART B - Comparison of Preferred Alternatives, Cont'd.

Primary Impacts	Alternative B	Alternative D
Economic	1. Estimated total cost $4,408,000; estimated annual cost $409,500. 2. Construction of system will improve ability of Town's commercial industries to provide services to tourists. 3. Funds for this alternative will be raised by a general increase in the tax rate and betterment charges to those to be served by the system.	1. Total capital cost $2,820,000; total annual cost $335,000, including costs for reconstruction and new construction of all systems in New Harbor area and new construction in the Stage II area. 2. Individual costs for inhouse wastewater flow reducing equipment: initial = $500 per home; annual O&M = $50 per home. 3. Construction of system will improve ability of Town's commercial industries to provide services to tourists. 4. Funds for the sewer system portion of this alternative will be raised by a general increase in the tax rate with betterment charges to those to be served by the system. 5. The investment necessary to implement the New Harbor portion of this alternative must be financed by private owners.
Political		1. Strong enforcement of laws concerning design, construction and maintenance of septic systems is mandatory.
Legal/Institutional	1. Present legal and institutional arrangements to maintain and regulate a treatment system should be strengthened. 2. Strict enforcement of revised zoning plan, and sewer connection will be necessary to control growth and development. 3. NPDES permit limitations should be imposed. 4. Regulatory authority over septic system construction outside of sewered area should be implemented.	1. Strengthened regulatory action required to make this alternative work 2. Sewer connections and NPDES permit limitations are still necessary to control development.

Secondary Impact	Alternative B	Alternative D
Social	1. Growth rates induced by this system will be moderate to substantial. 2. Construction of multiple unit development will be much greater than in recent years. 3. Greater densities will require increased public services. 4. Future development could endanger Island's overall attractiveness. 5. Increased activity could provide a stable year-round economy, raising the level of living on the Island. 6. Growth would most likely take place in several Old and New Harbor areas, strengthening established city cores.	1. Growth rates will remain nearer present levels. 2. Most multiple unit and commercial development will be directed to Old Harbor area.
Environmental	1. Uncontrolled growth could lead to densities of people which could adversely affect: water quality, air quality, noise levels, and aesthetics. 2. Without Phase II, the possibility of encroachment of the environmentally sensitive areas to the south of the Island would be reduced. However, for adverse impacts on Great Salt Pond would be decreased.	1. Adverse affects to Great Salt Pond and southern sections of the Island due to increased development density will be averted.
Economic	1. Additional commercial activity could supplement existing economic base in Old and New Harbor areas.	1. The economy of Old Harbor will be boosted but at expense of Hew Harbor.
Political	1. New or expanded public facilities associated would be required to serve the additional development, possibly including public water supply and police and fire protection.	
Legal/Institutional	1. Addition regulatory functions including zoning revisions may be required to control development and serve a larger population	1. Zoning revisions although desirable, will not be as critical to control development.

6.0 PROBABLE ADVERSE IMPACTS WHICH CANNOT BE AVOIDED

In this Chapter, the impacts which cannot be avoided for the two preferred alternatives are discussed.

6.1 Primary Impacts

Alternative B. Unavoidable impacts will probably be greatest for this alternative since it involves the most construction activities. Erosion will be minimized through following an erosion control plan (described in Chapter 4) to be developed with assistance from the Department of Agriculture, Soil Conservation Service. A revegetation plan, also developed in coordination with the SCS, will aid in restoring construction areas as closely as possible to original conditions.

Noises and odors emanating from the treatment plant are unavoidable but will be minimized as much as possible. Visual impacts of the above-ground facilities, such as the treatment plant and pumping stations, can be minimized with proper design and screening. The Rhode Island Historical Society will assist in the design of fences and shrubbery around these facilities. The visual impact of the concrete outfall, however, cannot be reduced.

Alternative D. Unavoidable primary impacts for this alternative will be similar to , but in many cases, less extensive than those stated for Alternative B, above.

Disruption of traffic and noise during construction will be confined to the smaller Old Harbor area. Impacts due to the treatment plant will be similar to those for Alternative B, particularly the impact of the sewer outfall.

Another possibly unavoidable consequence of confining the sewer system to Old Harbor is that boat wastes will have to be hauled by truck to the landfill site, if the present Federal law is put into effect.

6.2 Secondary Impacts

Alternative B. Moderate growth rates, coupled with significant multi-unit development, particularly in the New Harbor area, can be expected with the implementation of this alternative. Commensurate with this growth will be unavoidable adverse impacts on water quality, air quality, and public services through encroachment into environmentally sensitive areas, increased use of recreational facilities, greater number of cars, and, in general, increased activities on the Island. However, with revised zoning and strict enforcement of such regulations, the above affects can be minimized. In addition, through the National Pollutant Discharge Elimination System, Waste Discharge Permits, effluent quantity limitations can be included for different points in the design life of the facility. This is a mechanism that may be available to insure that the capacity of the treatment facility is not reached in the early stages of its design life, and therefore, can control growth in the service area.

Alternative D. The area to be sewered for this alternative is considerably smaller than for the preceeding alternative, consequently development pressures will be less intense. However, enforcement of zoning and sewer connection ordinances, in addition to limitations in the NPDES permits may still be necessary to keep growth under control.

7.0 LOCAL SHORT-TERM VERSUS LONG-TERM PRODUCTIVITY

This Chapter will consider the tradeoffs between the immediate local benefits of each of the preferred alternatives and their effects on future options available to the Island. For example, both of the preferred alternatives have the short-term benefit of abating existing pollutional sources. However, each alternative will have different affects on the long-term productivity or future courses of action the Island can take.

Alternative B can commit the Island to a pattern or course of action that may be acceptable now but not acceptable and unchangeable in the future. For instance, permanent municipal structures can limit road changes, development patterns, or other community goals that may require change in the future. In addition, growth rates can be stimulated which will result in population and development densities beyond optimum capacities for the Island, and once the development is there, it will stay whether the population does or not.

The future of the Island is not to be determined by a sewer system alone. The availability of other public services such as water supplies and fire protection also play a significant role in a town's future development. However, an initial step is necessary before any action can be taken and construction of a sewer system and treatment facility can provide that step.

Alternative D, by its smaller physical nature, is less limiting on the future options of the Island. It will serve an area which is already developed and is likely to be upgraded because of the sewer system. At the same time, however, sewering Old Harbor will not be the major cause of new development in presently sparsely developed portions of the Island. If additional public facilities, such as an expanded sewer system are required in the future, that option will still be available, although at an increased cost.

8.0 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Under each of the two alternatives considered in this statement, the materials and energy used in construction will be an irretrievable commitment of resources. Where the alternatives require land that cannot be used for purposes other than intended, such commitment of land is considered irretrievable, at least for the design life of the structure on it. Loss in property values due to the nature of the project, such as the treatment plant and visable outfall sewer, are also likely to be irretrievable and irreversible for the life of the structures.

Necessary changes in the natural topography and unavoidable loss of vegetation through construction are considered irretrievable. Further, to the extent that both alternatives, in differing degrees, will induce growth resulting in a loss of open space, such a loss is irreversible.

On one hand, the State and Federal funds committed to this project will be an irreversible and irretrievable commitment of financial resources in that such funds will be unavailable for other projects or needs. On the other hand, such a substantial investment is not irretrievable since it will be manifested in an improvement in the quality of life on Block Island.

APPENDICES

APPENDIX A - EXISTING WATER QUALITY

BLOCK ISLAND SURVEY

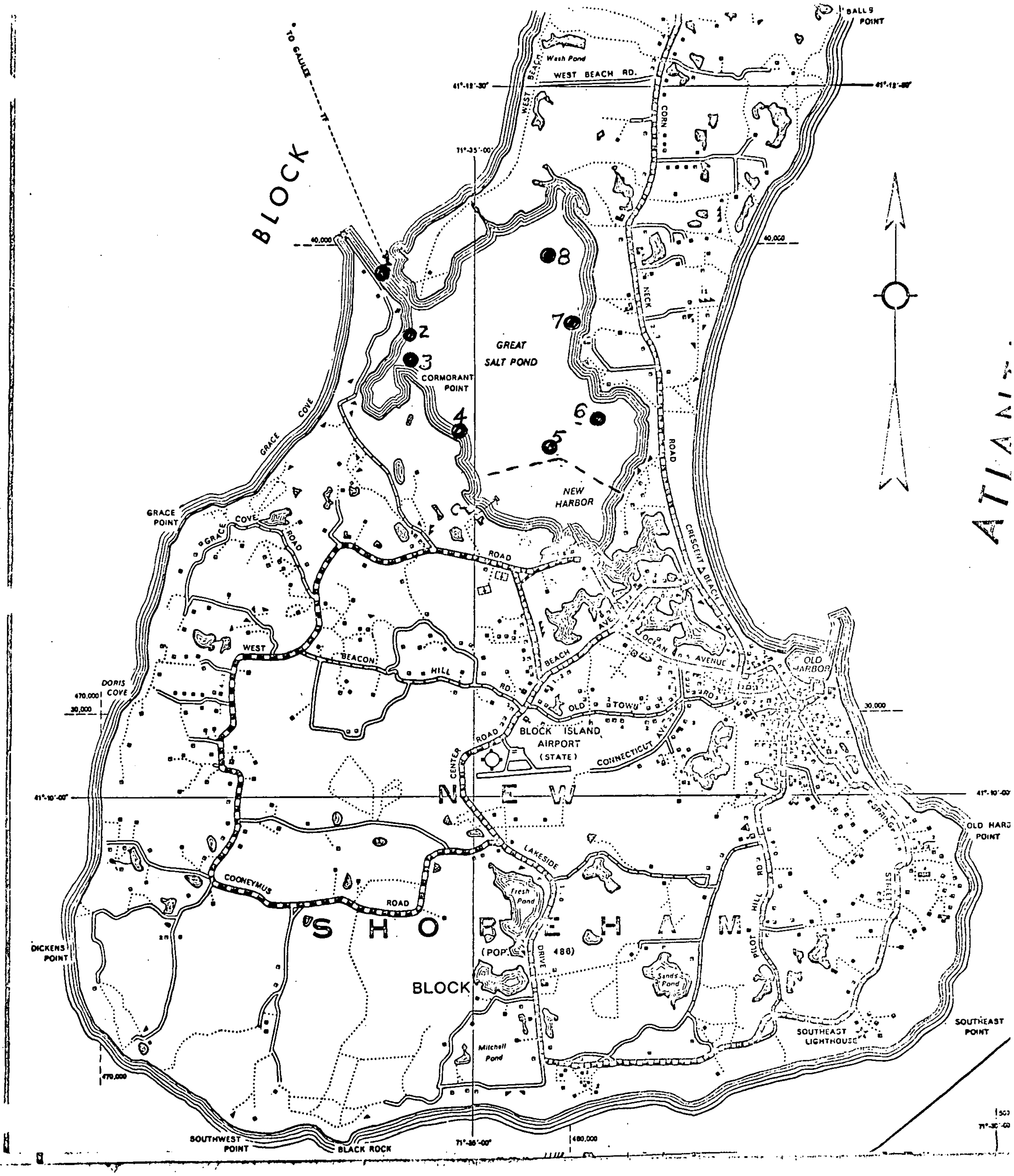
August 26, 1971

A. Water Quality High Tide 12:05 pm (EDT)

Station*	Coliform MPN/100 ml Total	Fecal
1	3-	3-
2	4	4
3	230	11
4	93	21
5	9	4
6	3-	3-
7	4	4
8	3-	3-

*See chart

Source: Rhode Island Department of Health, Division of Water Supply and Pollution Control.


BLOCK
TO GALILEE
BALLS POINT
Wash Pond
WEST BEACH RD.
WEST BEACH
CORN
NECK
ROAD
GREAT SALT POND
CORMORANT POINT
NEW HARBOR
GRACE COVE
GRACE POINT
GRACE COVE ROAD
ROAD
WEST
BEACON
HILL
RD.
BEACH AVE
OCEAN AVENUE
CRESCENT BEACH
OLD HARBOR
OLD TOWN RD
DORIS COVE
BLOCK ISLAND AIRPORT (STATE)
CENTER ROAD
CONNECTICUT AVE
NEW
SHOREHAM
(POP 486)
LAKESIDE DRIVE
Fresh Pond
COONEYMUS ROAD
DICKENS POINT
BLOCK
Sands Pond
Mitchell Pond
PILOT HILL RD
SPRING STREET
OLD HARBOR POINT
SOUTHEAST POINT
SOUTHEAST LIGHTHOUSE
SOUTHWEST POINT
BLACK ROCK
ATLANTIC
1
2
3
4
5
6
7
8

APPENDIX B - REGULATIONS GOVERNING WASTE DISCHARGES FROM WATERCRAFT

The State of Rhode Island has no existing law regarding the discharge of sanitary waste from watercraft. Vessel pollution control will be covered, however, under Section 312 of the Federal Water Pollution Control Act Amendment of 1972. Under the Act, EPA is authorized to promulgate effluent standards for marine sanitation devices, and the Coast Guard is authorized to promulgate criteria on the design, construction and certification. Furthermore, the Federal law will preempt any State laws regarding the design, manufacture, installation or use of any marine sanitation devices. Such preemption will not take place, however, until the effective date which is 2 years and 5 years from the date of final promulgations for the new and existing vessels, respectively. Section 312 also provides two waivers for the States to apply for no discharge zones, one based on water quality protection and the other based on the availability of pump-out facilities, but no guidelines have yet promulgated for the application of no discharge zones.

The Coast Guard promulgated its design criteria and certification procedures on January 30, 1975 and EPA has promulgated its standards on June 23, 1972. Therefore, Section 312 of the Act will come into effect on January 30, 1977 for new vessels and on January 30, 1980 for existing vessels. In brief, the EPA standards requires zero discharge after the effective date. However, as an incentive for existing boaters to install marine sanitation devices before the effective date, the following provisions are included: (1) any existing vessel, equipped with a Coast Guard certified flow-through device that will reduce fecal coliform bacteria to no more than 1000/100 ml, with no floating solid and is installed with 3 years after the time of promulgation, the vessel shall be deemed in compliance. (2) If the above device is installed after 3 years from the time of promulgation but before the effective date, the vessel shall be deemed in compliance for only 3 more years following the effective date. In addition, the Coast Guard promulation further allows one year incentive period (ending January 30, 1976) for new vessels to install certified flow through devices and still be deemed in compliance.

<u>Reference</u>:

1. Section 312, Public Law 92-500, Federal Water Pollution Control Act Amendment of 1972.

2. Federal Register, Volume 37, Number 122. Title 40 - Protection of Environment, Chapter 1, Part 140.

APPENDIX C - COMPREHENSIVE COMMUNITY PLAN PROPOSED LAND USE CATEGORIES

Mixed Uses. Commercial and intensive residential development. Suitable areas are Old Harbor, the center of the present hotels and commercial establishments, and New Harbor, the location of the three marinas on Great Salt Pond. Ferries from the mainland serve both areas. The Comprehensive Community Plan notes that further development could take place on vacant land in the Old Harbor area, and that the vacant land along West Road in New Harbor is suitable for the same kind of mixed commercial and residential development that characterizes Old Harbor.

Medium Density Residential. Tourist cottages, boarding houses, summer homes and year-round residence, averaging one dwelling unit per acre. These areas border the two mixed use areas, contiguous to proposed sewer and water systems, and the Comprehensive Community Plan envisions tying into these proposed systems in the future.

Low Density Residential. Year-round and summer homes, averaging one dwelling unit per 2-acres. These are the areas now rural in character embracing much of the remainder of the Island beyond the development centers. Here, according to the Comprehensive Community Plan, low density will conserve ground water supplies and the open space character. The soils are generally well-drained and suitable for properly installed and operated septic systems.

Developed Recreation. Areas designated for facilities to support intensive recreation such as marinas, restaurants, and movie theatres. Mixed use areas are suitable for such development, but in addition, such development could occur in the shoreline areas at the piers at Old and New Harbor, with buildings on stilts to avoid the flood water (potential conflict with conservation objectives).

Open Space Recreation. Areas maintained in open space free of intensive recreation facilities and homes to maintain the Island's scenic qualities and ecological balance. Areas include the erodable and highly scenic southwestern cliffs, the ground water recharge zone in the south portion and the low-lying beach land separating Great Salt Pond from the ocean.

Conservation. Relatively undisturbed shoreline ecology to be preserved in its natural state. These areas include the salt marshes around Great Salt Pond, fish spawning grounds; western coastline north of Great Salt Pond, lying below the hurricane high water line and including a bird sanctuary; narrow strips along the northwestern and southwestern shores, where the cliffs are subject to erosions, not suitable for development yet highly scenic; and also Rodman Hollow in the southwest, an unusual land form linking the southwest sector to the ocean.

APPENDIX D - BASIS OF COSTS ALTERNATIVE TREATMENT SYSTEMS

The cost data for this report was compiled in the following manner:

a) Construction Costs - EPA, Region I prepared graphs of construction costs vs. design capacity for various treatment plants located in Southern New England (Conn., Mass., and R.I.) in the Summer of 1973. The costs for these graphs were taken from the low bid quotes for the recent construction of Municipal Wastewater Treatment in those states. A least mean regression computer analysis was made which resulted in equations for a log/log plot in the form:

$$\log_{10} (\text{cost}) = a \log_{10} (Q) + b$$

a = slope of line of best fit
b = y intercept
Q = design average flow

For this Report, these costs have been updated to present conditions based on an ENR Construction Cost Index of 2100. These costs represent the complete treatment facilities including preliminary treatment, if any; effluent disposal and sludge handling. As they are a composite of many diverse projects, they should be used as a guide with consideration for any special conditions which may affect the individual project.

b) Operation & Maintenance Costs - The records of the Operation and Maintenance Section of EPA, Region I were analyzed to compute average yearly costs of operations and maintenance of wastewater treatment facilities. These are based on actual reported costs by a large number of municipalities throughout New England over the last several years. It should be noted that these costs generally represent treatment of a more or less constant flow throughout the year. Projects, such as Block Island, which will treat a greatly varying seasonal flow must be analyzed with this fact in mind.

c) Exception - The capital and operating costs for physical-chemical treatment alternative are based upon pilot-plant and demonstration studies, upon manufacturers costs of equipment and upon experience with the cost of those processes in other industries. There are no functioning physical-chemical treatment facilities in New England (or in the U.S.) at present. Therefore, there is no actual capital and operating cost data to be presented.

d) Land Costs - The cost of land has been estimated as $10,000/ acre based on correspondence with local officials in New Shoreham.

e) Summary - The use of the above cost data is intended to show the relative costs of alternative treatment systems and the costs presented are not meant to imply the actual cost to construct any of the systems on Block Island. The cost data reflects capital and operating cost for a treatment facility with a design average flow of 300,000 gal/day, unless indicated otherwise.

TABLE A - Average Costs for 300,000 Gallon Per Day Treatment Facilities

Southern New England

Type Treatment System	Construction Cost	Avg. Annual Bond Payment*	Annual Operating Cost	Total Avg. Annual Cost
Extended Aeration:				
a) Aeration Tanks	$ 750,000	$ 65,400	$ 22,500	$ 87,900
b) Oxidation Ditch	525,000	45,700	13,000	58,700
Modified Act. Sludge (Contact Stabilization)	640,000	55,700	35,000	90,700
Aerated Lagoons	635,000	55,400	22,500	77,900
Stabilization Ponds	585,000	51,000	8,500	59,500
Physical-Chemical	450,000	39,200	40,000	79,200
Package Treatment Plants (60,000 MGD)	100,000	8,700	6,000	14,700

* Assuming 20-year bond issue @ 6%.
.08718 - Capital Recovery Factor

TABLE B - Land Area Required for Various Treatment Alternatives

Type Treatment System	Land Area (Acres)	Cost of Land *
Extended Aeration:		
a) Aeration Tanks	2.0	20,000
b) Oxidation Ditch	3.0	30,000
Modified Activated Sludge (Contact Stabilization)	2.0	20,000
Aerated Lagoons	6.0	60,000
Stabilization Ponds	30.0**	300,000
Physical-Chemical	0.25	2,500

* Assuming $10,000/acre.
**Including land for intermittent sand filters.

EVALUATION OF ALTERNATIVE TREATMENT SYSTEMS

References:

1. Preliminary Engineering Survey & Report for the Town of New Shoreham - Fenton G. Keyes Associates, Feburary, 1972.
2. Environmental Impact Appraisal - EPA, Region, May, 1974.
3. "Wastewater Treatment for Small Communities" - George Tchobanoglous, University of California, September 28, 1973.
4. Construction Cost Curves, EPA,Region I, January, 1974.
5. Personal communications.

APPENDIX E - FLOW REDUCTION EQUIPMENT

The following In-house flow reduction equipment has been tested by EPA and are available or will shortly be available on the open market. The information shown below was adopted from the EPA publication, "Demonstration of Waste Flow Reduction from Households", EPA-670/2-74-071, Sept., 1974.

Description of Units Tested

Wash Water Recycle System = Laundry and bath water are collected in a suitably sized vented storage tank, provided with an overflow pipe, side bottom outlet, and a low-level control system for supplemental feed water. The stored wash water is either continuously or intermittently (when the pressurization pump operated) disinfected prior to filtration. The treated water is pressurized by a 1/3 HP shallow well jet pump mounted on either a 45 or 115 liter pressure tank, controlled by a pressure switch over the range of 105 to 210 cm HG. When the pump is activated, wash water is pulled through a cartridge or diatomite filter and pressurized. The treated water is then carried through copper tube lines to the flush toilet and lawn sprinkler.

Shallow Trap Toilet = One of the approaches involved the use of a water saving toilet designed to use approximately one-third less water than ordinary toilets. The specific model selected for testing was the American Standard Water Saving Elongated Cadet. It is similar in appearance and cost to the standard model except for a noticeably smaller tank. Less water is required for flushing due to the special design of the bowl (shallower trap).

Dual Flush Toilet Devices = The second approach utilized devices which converted a conventional water closet to dual cycle operation, i.e., a short flush for liquids and a normal flush for solids. Two different devices were examined during the program.

1) Econo-Flush = This toilet device consists of two interconnected plastic tanks open at the bottom which are positioned inside the toilet tank, and a handle/lever assembly incorporating a unique valve arrangement. The Econo-flush operates in the following manner:

(a) Light flush - this is activated by pushing the handle up. The handle assembly, through a unique linkage arrangement, simultaneously opens the toilet flush valve and closes a plastic valve which seals both plastic tanks from the atmosphere. The contents of both tanks (approximately one gallon) are thereby trapped by the vacuum created and a reduced flush results.

(b) Normal flush - this is activated by pushing the handle down in the usual manner. The plastic valve now opens in conjunction with the toilet flush valve, breaks the vacuum seal and thereby allows a full flush to occur.

A label is included for posting on or near the toilet in order to remind the household occupant of the new flushing procedure.

2) Sink-Bob = This dual flush device consists of a polystyrene float and lead sinker connected to the float stem by a split brass ring. As with the Econo-flush device, most standard toilet models will accomodate the Sink-Bob. The Sink-Bob attaches to both rod and flapper-type seals at a point just above the flush valve. The device operates in the following manner:

(a) Light flush - the Toilet handle is tripped in the normal manner, opening the flush valve and allowing the water in the closet tank to drain into the bowl. When the level inside the tank has decreased by approximately 50%, the Sink-Bob attains sufficient negative buoyancy to prematurely seat the flush valve.

(b) Normal flush - for full flush, the handle must be held down during the entire flushing operation to prevent premature closing of the flush valve.

Flow Limiting Shower Heads = Shower heads with built-in flow limiting orifices are available which can reduce water consumption rates from the typical 19 to 38 liter per minute (lpm) (5 to 10 gpm) to 9.5 or 13.3 lpm (2.5 to 3.5 gpm). The actual amount of water saved will depend primarily on the system water pressure and the personal habits of the bather. Two different Speakman flow limiting shower heads were selected for testing. The first of these, "Auto-flo" flow is equipped with a 13.3 lpm integral limiting orifice. This shower head has a fully-adjustable spray, integral ball joint and a 5 cm face. The second shower head is equipped with a 9.5 lpm integral "Auto-flo" limiting orifice. It is also of the adjustable spray, ball joint type but has a much narrower shape. Both shower heads have standard 1.27 cm (1/2") I.P.S. female inlets which are compatible with standard shower arms.

The following Tables summarize waste flow reduction from households:

TABLE A - Water Savings Summary

Unit Tested	Water Savings lpcd[a]	% Reduction of water usage	% Reduction in total water usage	Benefit to Homeowner	Adverse Effects
Wash water recylce system	44.0 (11.6)[b]	--	26.0	The recylce system minimize the surge in outflow to the septic system. It reduced total waste flow & allowed the septic tank and soil absorption system to operate more effectively. Little maintenance required.	Temporary stains in toilet bowls. Tie-up of essential metals needed for plant growth due to high phosphate detergents. Possible reduction in soil moisture content.
Shallow Trap water closet	14.8 (3.9)	25.6	6.9	Achieve good reduction in water use.	None
Dual Flush Devices:					
<u>Sink-Bob</u>	20.5 (5.4)	28.6	8.6	Achieve good reduction in water use.	None
<u>Econo-Flush</u>	12.4 (3.3)	16.6	3.3	Achieve adequate reduction in water use.	None
Flow limiting shower head	2.7 (.7)	7.1	1.0	Significant savings in hot water. The flow limiting shower heads have good reduction for high frequency users.	None

a - lpcd = liters per capita-day.
b - gallons per capita-day.

TABLE B - Cost Summary - Bathroon Water Saving Devices

Water saving device	Material Cost-$	Labor Cost-$	Installed Cost-$	Operating Cost-$	Expected Life, yrs.	Total[a] Annual Cost-$/yr.
Shallow-trap flush toilet	60	15	75	0	20	3.75
Dual flush devices						
Sink-Bob	4	0[b]	4	0	10	0.40
Econo-Flush	14	0[b]	14	0	10	1.40
Saveit	6	0[b]	6	0	10	0.60
Flow limiting shower heads						
13.3 lpm	6	0[b]	6	0	15	0.40
9.5 lpm	8	0[b]	8	0	15	0.53

a - The Total Annual Cost was based on amortization of the installed cost over the expected life of the device.

b - Assume homeowner installs unit himself.

TABLE C - Cost Summary - Wash Water Recycle Systems

	Prototype Recycle Systems[1] Diatomite filter	Prototype Recycle Systems[1] Cartridge filter	Projection for mass produced recycle system (Diatomite filter)
A. Initial cost			
Storage sys.	$175	$175	$70
Filter sys.	135	60	100
Pressurization sys.	115	115	85
Disinfectant feeder	20	20	20
Valves, pipe, fittings	95	80	75
Total Mat'l Cost	540	450	350
Labor Cost	100	90	50
Total Installed Cost	$640	$540	$400
B. Annual operating cost			
Filter media	$3.50	$38.80	$3.50
Electric power	12.00	1.20	7.00
Disinfectant	5.50	5.50	5.50
	$21.00	$45.50	$16.00
C. Total annual cost[2]			
Expected life years	15	15	15
Total cost per yr	$63.50	$81.50	$43.00

1 - Fram filter selected for cost analysis.

2 - The Total Annual Costs were determined by amortizing the initial costs over the expected life and adding the respective operating costs.

TABLE D - Cost Comparison

Flow reduction device		Cost per unit vol. of flow reduction $/1000 liters	Typical[c] water rates $/1000 liters	Typical[d] sewer rates $/1000 liters	Septic tank system - poor soil $/1000 liters	Net Savings $/year
Shallow trap water closet		0.15	0.16 - 0.42	0 - 0.13	---	$.25 to 9.80
Dual flush devices	Sinkbob	0.02	0.16 - 0.42	0 - 0.13	---	$4.10 to 15.60
	Econoflush	0.07	0.16 - 0.42	0 - 0.13	---	$1.72 to 9.20
	Saveit	0.04	0.16 - 0.42	0 - 0.13	---	$2.40 to 10.20
Flow limiting shower heads	13.3 lpm	0.08	0.16 - 0.42	0 - 0.13	---	$1.10 to 5.32
	9.5 lpm	0.22	0.16 - 0.42	0 - 0.13	---	$.52 to 3.53
Wash water recycle system	Prototype	0.57	0.16 - 0.42	0 - 0.13	0.40	$-45.70 to -2.30[a] $-1.30 to 27.60[b]
	Mass-produced	0.39	0.16 - 0.42	0 - 0.13	0.40	$-25.20 to 18.20[a] $19.20 to 48.10[b]

a - Net savings per year based on water and sewer rates.
b - Net savings per year based on water rate and septic system cost.
c - Domestic water rates throughout the State of Connecticut.
d - Typical sewerage use rates in the Connecticut area.

APPENDIX F - DESIGN FLOWS

(see following pages)

FENTON G. KEYES ASSOCIATES

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ARCHITECT — ENGINEERS
Providence, R. I. 02903 Waltham, Mass. 02154

Page ....

Subject: BLOCK ISLAND S.T.P.
Computation: DESIGN FLOWS
Computed by: JRM Checked by: .... Date: 10/17/72

DESIGN FLOW

4/4

I. PRESENT - 1973

Summer (3000-968 = 2032 equivalent persons)
Average flow = 300,000-96,800 = 203,200 gpd = 0.31 cfs

Peak flow = 203,200 x 4.34 = 881,900 gpd = 1.36 cfs
Minimum flow = 203,200 x 0.23 = 46,700 gpd = 0.07 cfs

Winter (333 persons + 5,000 gpd = 383 equiv. persons)
Average flow = 333 x 100 + 5000 = 38,300 gpd = 0.06 cfs.

Peak flow = 38,300 x 5.0 = 191 500 gpd = 0.30 cfs.
Minimum flow = 38,300 x 0.2 = 7,660 gpd = 0.01 cfs

II. FUTURE - 1993

Summer (3000 equivalent persons)
Average flow = 3,000 x 100 = 300,000 gpd = 0.46 cfs

Peak flow = 300,000 x 4.0 = 1,200,000 gpd = 1.86 cfs
Minimum flow = 300,000 x 0.24 = 72,000 gpd = 0.11 cfs

Winter (468 persons + 7,000 gpd = 538 equiv. persons)
Average flow = 538 x 100 = 53,800 gpd = 0.08 cfs

Peak flow = 53,800 x 5.0 = 269,000 gpd = 0.42 cfs
Minimum flow = 53,800 x 0.2 = 10,760 gpd = 0.02 cfs

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Page ....

Subject Block Island [illegible]
Computation Winter Population & Flows
Computed by JRM **Checked by** .... **Date** 10/17/72

WINTER POPULATIONS & FLOWS

I. 1973 — 312 − 146 = 166 homes total
Assume 2/3 of the homes are year-round and house 3.0 persons/unit.
2/3 × 166 = 111 homes × 3.0 = 333 persons

Also assume a commercial and business contribution of 5,000 gpd.

Total Flow = 333 × 100 + 5,000 = 38,300 gpd which represents 383 equivalent persons.

II. 1998 — 312 homes in the sewer service area.
Assume that the ratio of year-round to total homes reduces to 1/2 by this time.
1/2 × 312 = 156 × 3.0 = 468 persons.

Also assume a commercial and business contribution of $\frac{468}{333} \times 5,000$ = 7,000 gpd.

Total Flow = 468 × 100 + 7,000 = 53,800 gpd. which represents 538 equivalent persons.

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Page 1

Subject Block Island [illegible]
Computation 25-Year Design Flow
Computed by JAM Checked by Date 10/12/72

Location		Exist. Homes	Future Homes	Total	No. Persons	Average Flow	Equiv. Persons
West Side Rd.		8	3	11	39	3,850	39
"I"	Champlin's Marina - 200 boats				800	20,000	200
	Block Island Marina - 100 boats				400	10.000	100
	Narragansett Hotel				100	5,000	50
	Future Business					18.000	
[illegible] Ave.		1	1	2	7	700	7
"II"	New Harbor Dock - 100 boats				400	10,000	100
	New London Ferry - @10 gpd/per.				800	8,000	80
Beach Ave.		8	5	13	45	4,550	45
	Town [illegible]				40	2,000	20
"III"	Barrington				16	800	8
	Future Multiple				100	5,000	50
Ocean Ave.	(to Old Town Rd.)	25	10	35	122	12,750	122
	Beachcomber				22	1,250	18
"IV"	Star Cottage				12	600	6
	Driftwood				18	900	9
	Block Island Inn				50	2,500	25
	Historical Society				40	2,000	20
Corn Neck Rd. & Old Town Rd.		3	4	7	25	2,450	25
"V"	Guest House				15	750	7
	Sheet Total				3,064	111,100	931

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Subject: Block Island S.T.P.
Computation: 25-Year Design Flow
Computed by: JRM Checked by: Date: 10/12/72

Location	Exist. Homes	Future Homes	Total	No. Persons	Average Flow	Equiv. Persons
Dodge Street	8	–	8	28	2,800	28
Guest House				15	750	8
Guest House				20	1,000	10
Gables				50	2,500	25
Wayside				30	1,500	15
Blue Dory				30	1,500	15
Surf Hotel				80	4,000	40
VI						
Water Street	4	–	4	14	1,400	14
National Hotel				150	7,500	75
Guest House				30	1,500	15
New Shoreham House				35	1,750	17
Royal Hotel				70	3,500	35
Guest House				15	750	8
Drug Store - guests				30	1,500	15
VII						
Center Road						
Future	14	3	17	59	5,950	59
Future Holiday Haven				35	1,750	17
VIII						
Old Town Rd.						
Future	1	3	4	14	1,400	14
Future Old Town Inn				20	1,000	10
Present	40	15	55	192	19,250	192
Neptune House				50	2,500	25
Hi View				80	4,000	40
Mill Pond Cottages (future)			5	18	1,750	18
IX						
Sheet Total				1,065	69,550	695

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Page 3

Subject: Block Island S.T.P.
Computation: 25-Year Design Flow
Computed by: JRM Checked by: Date: 2/13/72

Location	Exist Homes	Future Homes	Total	No. Persons	Average Flow	Equiv Persons
CHAPEL STREET	9	5	14	49	4,900	49
X Business Area (Future)					5,000	
HIGH STREET – OLD HARBOR AREA						
	1	—	1	4	350	4
XI Outer Harbor – 50 boats				200	5,000	50
Inner Harbor – 100 boats				400	10,000	100
Providence Ferry				600	6,000	60
Point Judith Ferry				600	6,000	60
Ballard's Hotel				100	5,000	50
SOUTHEAST ROAD						
XII Future 15		26	41	143	14,350	142
XIII INTERCEPTOR "A"	11	—	11	39	3,850	39
SPRING STREET	10	—	10	35	3,500	35
XIV Spring House Hotel				175	8,750	87
1661 House				50	2,500	25
The Manisses				50	2,500	25
SHEET TOTAL				2,446	77,700	72.

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Page 4

Subject: Block Island S.T.P.
Computation: 25-Year Design Flow
Computed by: JRK Checked by: Date: 10/12/72

Location	Exist. Homes	Future Homes	Total	No. Persons	Average Flow	Equiv. Persons
Pilot Hill Rd.						
Future	8	--	8	28	2,800	28
XV						
Payne Road	6	—	6	21	2,100	21
XVI						
High Street	49	11	60	210	21,000	210
Atlantic Hotel				75	3,750	38
Eureka Guest House				100	5,000	50
XVII Belvue Guest House				30	1,500	15
Perry Cottage				50	2,500	25
Mitchell Cottage				30	1,500	15
Dodge Cottage				30	1,500	15
			Sheet Total	574	41,650	417

10/1/72

Grand Total:

Sheet	No. Persons	Average Flow	Equiv. Persons
1	3064	111,100	931
2	1065	69,550	695
3	2445	77,700	727
4	574	41,650	417
Total =	7,148 per.	300,000 gpd	2,770 P.

Breakdown:

		Actual	Equivt.
Private boats	=	3300 per.	550
Ferry pass.	=	2000	200
312 homes	=	1092	1092
Hotels	=	1956	928
		7148	2770

1998 - Average Flow = 300,000 GPD
Peak Flow (x 4.0) = 1,200,000 GPD.

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Page ....

Subject: Block Island STP
Computation: Design Flows
Computed by: [illegible] Checked by: Date: 10/16/72

DEDUCTIONS FOR PRESENT - 1972 FLOWS

1. Homes = 9+1+5+10+4+17+4+15+5+5+41+8+4+18 = 146 homes
   146 x 350 = 51,100 gpd = 511 persons

2. Multiple = Beach Ave. = 100 persons
   National = 95
   Holiday Haven = 35
   Old Town Inn = 20
   Manisses = 50
   280 persons x 50 = 14,000 gpd
   140 equiv. persons

3. Private Boats = B.I. Marina = 40 boats
   Others = 20
   60 x 100 = 6,000 gpd
   60 equivalent persons

4. Ferry Passengers = New London = 105 persons
   Providence = 100
   Pt. Judith = 65
   270 x 10 = 2,700 gpd
   27 equiv. persons

5. Future Business = West Side Rd. = 18,000 gpd
   Chapel St. 5,000
   23,000 gpd

TOTAL	51,100	TOTAL	511
FLOW	14,000	POPULATION	140
REDUCTION =	6,000	REDUCTION =	60
	2,700		27
	23,000		738 equiv. persons
	96,800 gpd		

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Page

Subject: BLOCK ISLAND S.T.P.
Computation: DESIGN LOADINGS
Computed by: JRM Checked by: Date: 10/18/72

B.O.D. LOADING — BASIS = 0.20 #/cap./day

1973: Summer = 2032 x 0.2 = 406 #/day
Winter = 383 x 0.2 = 77 #/day

1998: Summer = 3000 x 0.2 = 600 #/day
Winter = 538 x 0.2 = 108 #/day

SUSPENDED SOLIDS LOADING — BASIS = 0.25 #/cap/day

1973: Summer = 2032 x 0.25 = 508 #/day
Winter = 383 x 0.25 = 96 #/day

1998: Summer = 3000 x 0.25 = 750 #/day
Winter = 538 x 0.25 = 135 #/day

APPENDIX G - FMC WASTE TREATMENT SYSTEM*. AN EXAMPLE OF A PHYSICAL/CHEMICAL TREATMENT SYSTEM FOR MARINAS.

The FMC Waste Treatment System employs a physical/chemical process to treat sanitary sewage and other wastes. Chemicals are added to condition the sewage, which is then filtered to remove suspended solids. The system operates automatically on demand, with instantaneous on-off treatment capability. Influent sewage flow may be constant or variable, with no loss in degree of treatment.

During the process, chemicals are added automatically in proportion to the influent sewage flow rate. The type and function of each chemical is as follows:

1. Bactericidal Agent. A bactericidal agent, chlorine, is used to destroy bacteria and inactivate viruses present in sewage so that the effluent water and solid filter cake are free of live pathogenic organisms.

2. Activated Carbon. Powdered activated carbon is used to adsorb certain soluble organic compounds in sewage that could not be removed by filtration. Once adsorbed, they are readily removed by filtering out the spent carbon particles.

3. Flocculating Agent. A flocculating agent, aluminum sulfate, is used to destabilize the colloidal particles of sewage. The result is the coagulation of many small colloidal particles into large flocs, which are removed by filtration.

4. Filter Aid. A filter aid, diatomaceous earth, is used to assist the filtration process. Diatomaceous earth is a finely divided, insoluble, rigid material that will not compact or channel when forming a mat during filtration. This maintains the filtration rate by preventing fine gelatinous solids from blinding the filter surface.

The basic process, shown schematically in Figure 10, involves four operations: (1) comminution, (2) disinfection, (3) flocculation, and (4) vacuum filtration.

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* "Development of On-Shore Treatment System for Sewage from Watercraft Waste Retention System", EPA-670/2-74-056, July, 1974.

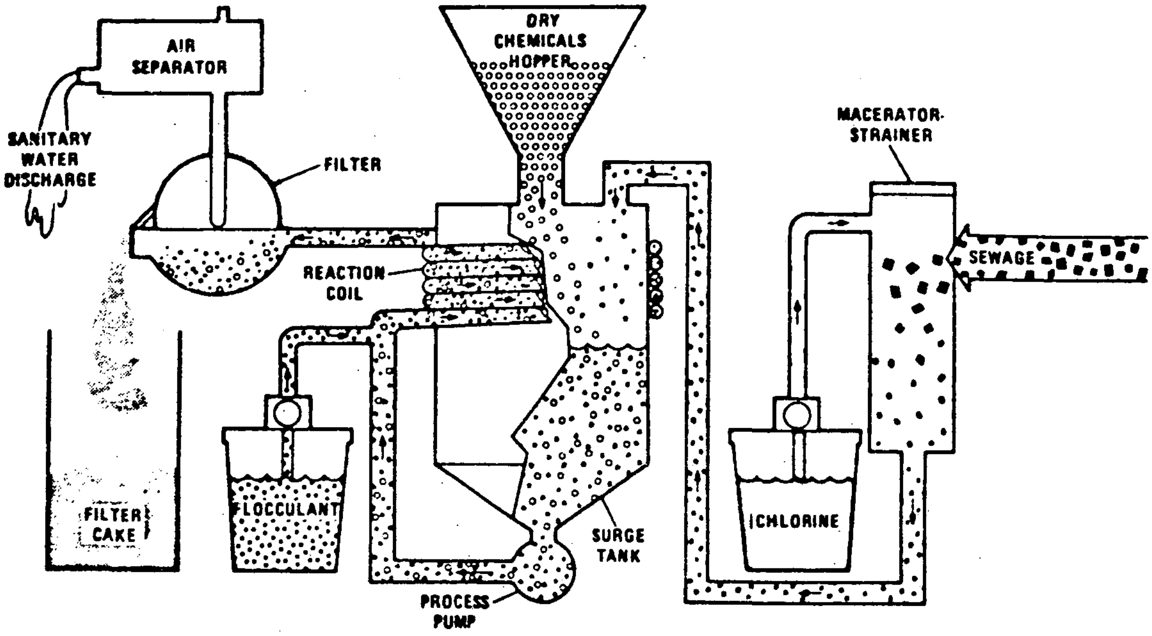

Figure 10. Schematic drawing of FMC waste treatment system

Influent wastes are coarsely screened and comminuted to reduce solid particle size. A bactericidal agent (aqueous chlorine) is added automatically with a metering pump. This treated mixture flows to an agitated surge tank designed to handle anticipated load fluctuations. A dry chemical mixture of activated carbon and filter aid is added automatically to the surge tank by a vibrating feed mechanism supplied from a hopper above the tank. At a set level, sewage in the surge tank is moved by a low-volume pump into a reactor coil wound around the surge tank. Before entering the coil, chemical flocculant is added automatically to the sewage/chemical mixture by a metering pump. The coagulated sewage mixture then flows to a rotary vacuum filter, which separates solids from the liquid. Sewage solids, filter aid, and carbon retained on the drum filter fabric are removed with a "wire doctor blade." The clear effluent passes through an air separator tank before being discharged. The solid filter cake is accumulated and disposed as sanitary landfill.

Complete automatic operation is accomplished with a magnetic flow meter, electrical timers, relays, and liquid-level sensors. Fail-safe intelligence systems prevent the unit from operating if any component fails. An alarm system sounds a warning of low chemical level and, if not replenished, the system automatically shuts off.

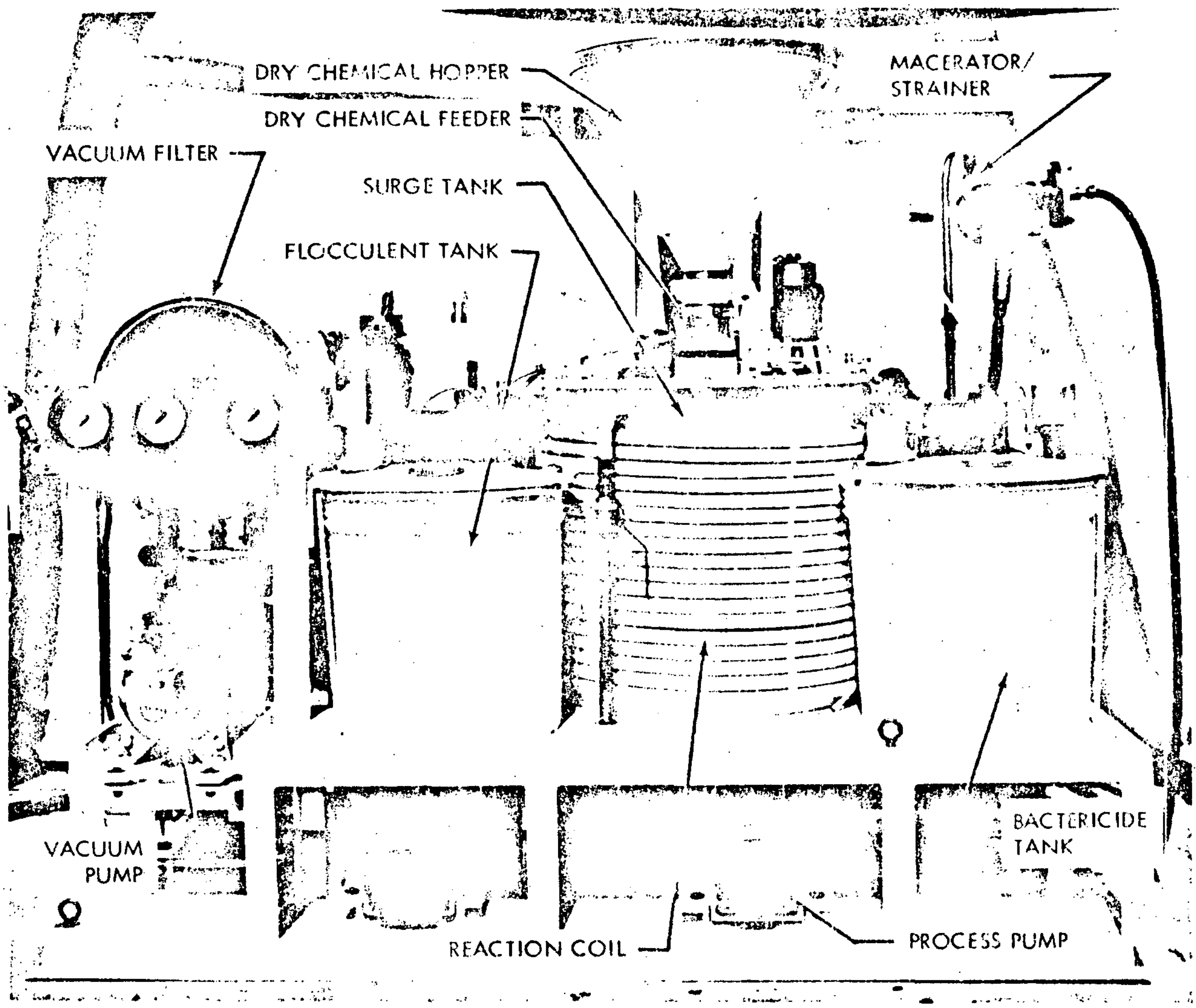

Figure 11. Photograph identifying major components of the FMC waste treatment system, model 50-2000

Figure 11 is a photograph of the FMC Waste Treatment System Model 50-2000, with major components identified. An aluminum frame houses copper-nickel plumbing and shielded electric motors. Overall dimensions are 239 cm long, 122 cm high, and 203 cm wide, with a total empty weight of 1135 kg (2500 pounds). Maximum electrical demand is 12 kva, using three-phase 220- or 440-volt current. The design flow capacity for processing domestic sewage is 15 kl/day (4000 gal/day) at an average flow rate of 9.5 l/min (2.5 gal/min).

Operating costs for wastes having approximately 2000 mg/l ss and BOD_5 were #602/KI ($23.5/1000 gal). Auxiliary treatment cost for zinc removal and postchlorination was $1.5/KI ($5.7/1000 gal.).

Capital costs for unit not given.

APPENDIX H - OCEAN CURRENT STUDIES - PEBBLY BEACH OUTFALL LOCATION AND BLOCK ISLAND OUTFALL ANALYSIS

(see following pages)

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

SUBJECT: Proposed Ocean Outfall, New Shoreham, Rhode Island DATE: January 7, 1975

FROM: 1AS

TO: Wallace E. Stickney, Chief
Environmental Impact Statment Office

Enclosed is our final report prepared for the ocean current studies conducted near Pebbly Beach, New Shoreham, Rhode Island, during October 22 - 24, 1974. Most of the report presents the conditions which existed and occurred during the study. The discussion portion presents our interpretation of the data collected.

This report is presented as part of our support effort to the environmental impact statement being prepared for the proposed wastewater treatment system at New Shoreham and, at the discretion of the editor, may be used in its entirety or without the discussion portion included.

Myron O. Knudson
Myron O. Knudson, Chief
Surveillance Branch

Attachment

JAN 10 1975

EPA Form 1320-6 (Rev. 6-72)

OCEAN CURRENT STUDIES
PEBBLY BEACH OUTFALL LOCATION
NEW SHOREHAM (BLOCK ISLAND), RHODE ISLAND
OCTOBER, 1974

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LIST OF TABLES

List of Appended Figures

Ocean Current Studies
Pebbly Beach Outfall Location
New Shoreham (Block Island), Rhode Island
October, 1974

OCEAN CURRENT STUDIES
PEBBLY BEACH OUTFALL LOCATION
NEW SHOREHAM (BLOCK ISLAND), RHODE ISLAND

INTRODUCTION

During October 21 - 25, the Environmental Protection Agency, Region I's Surveillance & Analysis Division engaged in near shore current studies off the east shore of Block Island (see Figure 1). The studies were precipitated as part of a data collection program prior to preparing an environmental impact statement for a proposed municipal wastewater treatment plant at New Shoreham, Rhode Island.

The Environmental Protection Agency mathematically modeled the drift and dispersion of the sewage plume from a proposed sewer outfall at Pebbly Beach, New Shoreham, Rhode Island. The preliminary model used available modeling techniques.

Two data sources were immediately available with which to compare current velocity assumptions used in developing the model. These were a report prepared for Fenton Keyes Associates and Department of Commerce Tidal Current Charts for Block Island Sound. The Fenton Keyes current study had used drogues deposited 60 meters (200 feet) east of the end of the Old Harbor breakwater. This point is some 1070 meters (3500 feet) north of the currently proposed outfall which will be submerged in 1.3 meters (4.3 feet) of water[1] approximately 70 meters (230 feet) from Pebbly Beach.

[1] at mean low tide

The currents shown in the Department of Commerce Tidal Current Charts are based upon data collected approximately 1600 meters (one mile) offshore and did not necessarily represent local current patterns. The charts showed that offshore from the proposed outfall the near shore current patterns are southeast on ebb tide, but on flood tide the current splits. North of the Old Harbor breakwater the current drift is northwest while at Southeast Point the drift is southwest. The proposed outfall lay in the nebulous area where the current splits.

The Environmental Protection Agency needed to collect local current data which would demonstrate the reasonableness of the assumptions used in developing the model. In addition, currents at locations more distant from shore needed examination in case the proposed outfall terminus is unsuitable.

STUDY DESIGN

Since the mathematical model used critical time-displacement vector assumptions, the Environmental Protection Agency conducted shallow water drogue and surface float studies to determine the tide and wind induced current patterns in the vicinity of the proposed outfall. The drogue details are shown in Figure 2. The floats were constructed of 15.2 cm X 15.2 cm X 1.3 cm (6" X 6" X 1/2") squares of plywood and painted orange.

The field crew deposited drogues approximately 75 meters (250 feet), 150 meters (500 feet), and 230 meters (750 feet) from shore. Because of concerns about a current split, two stations were selected which were 750 meters (250 feet) perpendicular to the proposed outfall pipe extended. See Figure 3 for the displacement pattern. Because of the shallow depth at the outfall location, the validity of the drogue data from this location might be doubtful. Therefore, the crew used floats at the 75 meters and 150 meters locations to plot surface currents.

On bluffs overlooking the outfall location, the field crew operated two transits for triangulating the drogue and float drift positions. Critical observations were made at two minute intervals for the first ten minutes on floats. If the drogues were moving laterally along the shoreline, sightings were recorded at fifteen minute intervals. If the drogues were moving out from shore, they were withdrawn. In the event that the drogues and/or floats reach shore, the contact time and locations were noted and that test series terminated.

The Environmental Protection Agency felt that flood tide and north to east winds would create the critical transport currents. Three days were allotted to tracking current patterns. Because of time constraints for completing the study, October 22 - 26 was the only time envelope which was favorable (i.e. when light would be available) for tracking the drogues. This time frame allowed for sightings through the entire flood tide and a major portion of ebb tide. If inclement weather had prevented conducting the study on one or two days, tides and light still would have been favorable for observing most of the flood tide.

In conversations with personnel at the National Oceanic and Atmospheric Administration's weather station at the Block Island State Airport, it was learned that winds during the late spring and summer are usually from the south - southwest quadrant. As fall progresses, the winds shift toward the northwest and in December and January are prevailent from the north - northeast. The wind then begins its counter-clockwise movement toward becoming a south - southwesterly wind in the late spring.

STUDY OBSERVATIONS

Monday, October 21

Weather: Overcast Winds: North

Tides: low - 0545 hours[1] high - 1230 hours

On Monday, October 21, the winds were from the north and arriving on the island at 1100 hours the crew had its first encounter with the type of surf north or east winds create. A steady line of white capped waves were rolling in on Crescent Beach. The waves were 1.2 to 1.8 meters (4 to 6 feet) in height and began breaking approximately 240 meters (800 feet) from the shoreline. In the Pebbly Beach area, the vicinity of the proposed outfall, ground swells were rolling in at approximately the same height and crashing into the rocks. The waves in this area were breaking 60 to 150 meters (200 to 500 feet) from shore.

On Monday, the crew established stations for setting up transit. One station was located at the northeast end of Spring Street, overlooking Pebbly Beach; the other was located 134 meters (438 feet) northeast of the first point on the edge of the bluff overlooking Pebbly Beach. On the next day the crew had to abandon this point because of sun reflections in the early morning. It was replaced with a new transit point at the

[1]All times in this report are Eastern Daylight Time.

edge of Spring Street 117 meters (383 feet) southeast of the first transit point.

Tuesday, October, 22

Weather: Clear Winds: West—southwest 10-14 knots[1]

Tides: low - 0635 hours high - 1328 hours

In the vicinity of the outfall rocks 0.3 to 0.6 meters (1 to 2 feet) in diameter littered the beach, and boulders 1 to 2 meters (4 to 6 feet) in diameter are visible in the water or lying slightly submerged up to 60 meters (200 feet) from shore. The winds were blowing directly offshore, and the seas were lapping gently against the shoreline. Wave heights were less than 0.5 meters (1 1/2 feet) high.

At approximately 0800 hours the first drogue was installed at Station 4 and shortly thereafter at Stations 2 and 3. Surface floats were installed at Station 1. It was not long until the crew determined that the north transit location was unsuitable. At approximately 1000 hours, the transit was moved to the southerly location on Spring Street. Later, when drogues were released at Station 1, their paths were erratic seeming to indicate that the drogues would get hung up on rocks and bounce among them. The velocities of the drogues installed at Station 1 are suspect. Drogues installed at Stations 2, 3, and 4 moved southeasterly on a flood tide. This same general drift continued throughout the day and into ebb tide. (See Figures 4 - 8.)

Surface currents rapidly moved floats placed at Station 1 from shore in an east - northeast direction. (See Figures 6 and 8.)

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[1]Hourly wind readings are available in Table 1.

TABLE

WIND DIRECTIONS[1] AND VELOCITIES[2]

OCEAN CURRENT STUDIES
PEBBLY BEACH OUTFALL LOCATION
NEW SHOREHAM (BLOCK ISLAND), RHODE ISLAND

DATE	10/22/74		10/23/74		10/24/74	
Time (Hours) (EDT)	Direction	Knots	Direction	Knots	Direction	Knots
0600	270	10	280	10	350	07
0700	300	11	260	11	360	13[3]
0800	240	10	280	11	350	14[3]
0900	260	11	310	10	340	14[3]
1000	240	12	300	12	020	10[3]
1100	240	13	330	15	010	10[3]
1200	220	13	300	15	040	06
1300	220	12	310	15	070	06
1400	220	13	290	16	070	06
1500	210	14	290	15	160	08
1600	240	14	250	14	170	09
1700	230	12	230	11	170	07
1800	230	14	320	12	180	07

NOTE: Wind directions and velocities were supplied by the National Oceanic and Aeronautic Administration's Weather Station at the Block Island State Airport.

[1]Direction indicates the azimuth from which the wind blows. The azimuth is read clockwise with zero and 360° denoting north.

[2]Five knot correction factor has been added to reported readings.

[3]Station was manned; no correction factor applied.

Surface velocities were 0.97 knots at 1145 hours and 0.31 knots at 1440 hours. Other floats were not recorded because the slight wave action coupled with the narrow field-of-view of the transits prevented observers from locating and tracking the floats. Using binoculars, the floats were observed moving out from shore.

The drogues, although all moved southeastward, gradually shifted to a more easterly direction as high tide approached and on into ebb tide. Drogues released from 0800 - 0900 hours travelled from 0.05 to 0.09 knots with those farther from shore having greater velocities. During the next two hours, the velocities in the vicinity of 230 meter stations remained relatively constant. However, when the drogues were northeast of the near point (see Figure 1), velocities increased to more than 0.12 knots. Throughout the tidal cycle little velocity change was noted in the cove area, but the velocities of the offshore drogues and those which passed the near point increased markedly at the approach of high tide and into ebb tide. The farther the drogue was from shore the more rapid its movement. One and one-half hours after high tide, velocities greater than 0.30 knots were recorded.

Wednesday, October 23

Weather: Clear   Wind: West - northwest   10-19 knots

Tides: low - 0736 hours   high - 1427 hours

Wednesday the sea and weather conditions were similar to those on Tuesday. The wind, however, had shifted northward. This shift had an apparent effect upon the current patterns in the cove area. The drogue drift was more to the south with a gentle sweep eastward as they approached the near and far points of land. (See Figures 9 - 16.) As had occurred on the previous day, the drift moved more eastward near the time of high tide and into ebb tide. The drogues on this day tended to run aground among submerged rocks lying off the points.

Because the drift continued to be in one direction with no indication of a current split northward, Stations 2 and 3 were abandoned as drogue release points. A Station 5 lying midway between Stations 1 and 4 was established.

Drogue velocities were similar to those encountered on 10/22/74. Those placed at Station 4 moved more rapidly than those deposited at Station 5. Velocities of the Station 5 drogues sometimes doubled as the drogues passed the near point. Velocities in the cove area (Station 5 drogue) ranged from 0.06 to 0.16 knots with most being 0.07 to 0.08 knots. Off the near point, these drogue velocities ranged from 0.07 to 0.18 knots but generally held about 0.11 knots. At Station 4 drogue velocities ranged from 0.08 to 0.24 knots with most being near 0.12 knots.

Floats placed at Staion 1 moved parallel to the shoreline at velocities ranging from 0.20 to 0.27 knots. All were washed onto the north shore of the near point,

Thursday, October 24

Weather: Overcast changing to broken clouds

Wind: North - northwest changing to east 6-14 knots with gusts to 25 knots

Tide: low - 0855 hours high - 1520 hours

Thursday morning the weather was blustery, similar to that encountered upon the crew's arrival on the island, North winds existed from 0600 to 1100 hours. White capped swells 1.5 to 2.5 meters (5 to 8 feet) high were rumbling into shore from the northeast. The waves were rolling, cresting, and breaking nearly 150 meters (500 feet) from shore. Those thundering against the Old Harbor breakwater would toss water high above and at times over the breakwater. The waters within Old Harbor were more violent than the boat crew had encountered at the outfall location on Tuesday and Wednesday. Throughout the day seas continued to run from the east-northeast quadrant, but their intensity diminished in the late morning to rythmic ground swells 1.2 to 1.8 meters (4 to 6 feet) high. By early afternoon the surf line had moved to within 60 meters (200 feet) offshore. Residents on the island disclosed that during stronger wind conditions or storms at sea the surf line could extend more than 300 meters (1000 feet) out from shore.

Because of the turbulent conditions, the boat crew could not approach Station 1 so they released no drogues there. In addition, a Station 6 was established to determine current velocity and direction farther from shore. Station 6 lay on a line with Stations 1, 4, and 5 approximately 300 meters (1000 feet) from shore.

From 0830 - 1000 hours the drogues moved as on the other days--southeastward. From 0830 - 0915 the current drift was approximately 0.20 knots. During the next hour, the drogue velocities decreased rapidly and at 1030 hours current reversal was detected. During this same period winds had shifted from north-northwest to north-northeast. Continued drogue releases showed that the offshore current movement was southward, but a clockwise eddy was being generated. Drogues released at Station 6 moved south but gradually turned westward as they approached the near point. Once entering the cove area the drogues moved northward parallel to the shoreline. Drogues placed at Station 5 moved northwest and started to parallel the shoreline. At 1400 hours, winds were shifting rapidly from east - northeast to south - southeast, and currents were moving onshore (southwest) but the velocity decreased rapidly near shore. Drogues placed at Station 6 moved approximately 140 meters (450 feet) in twenty-one minutes while the drogue near Station 5 moved about 35 meters (120 feet) in nineteen minutes. From 1430 hours to 1520 hours (high tide), the drogue movements were relatively stagnant, and then the drogues began moving off to the southeast at 0.03 knots although the winds had shifted to south -southeast at 8 knots. (See Figure 21.)

Groups of floats were placed at Station 5. Floats deposited at 0900 hours were on shore within nine minutes. Those dropped at 1020 hours were at Station 1 in six minutes and on shore two minutes later. Others placed at 1200 hours were on shore in nine minutes.

At 1500 hours floats were tossed from shore in the vicinity of Station 1. The floats that landed just beyond the surf line drifted southeastward. Those which landed within the surf line were on Pebbly Beach within one minute.

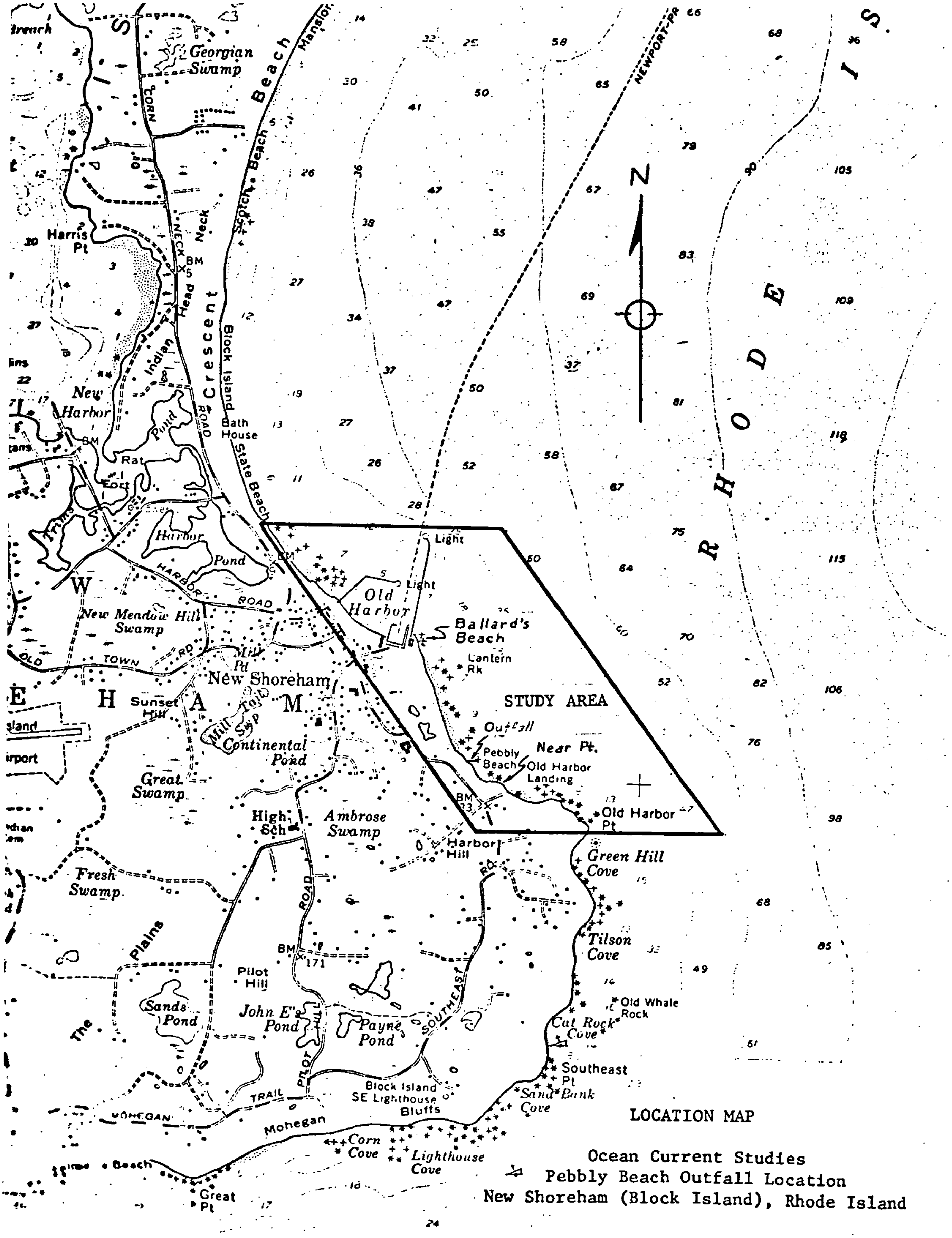
DISCUSSION

Pebbly Beach is aptly named. Rocks and boulders litter the proposed outfall area. Drogues released at Station 1 appear to ground or get hung up on rocks. Their paths were erratic and drogue velocities in this area were not reliable indicators of current movements.

The near shore ocean currents in the vicinity of Pebbly Beach appear to be wind influenced. The predominent drift on both flood and ebb tides was southeast. A north - northeast wind can induce clockwise currents near Old Harbor Landing and Pebbly Beach. While the wind effect seems to have counteracted the southeast movement during flood tide, it did not overcome the southeast flow during ebb tide. On Thursday, October 24, 1974, the wind had shifted to south - southeast but had not been from that quadrant long enough to determine the effect of a sustained southeast wind.

The surf is of major concern. While the wind direction is critical for surf development, the surf produced the most rapid on shore movement. On Thursday the crews recorded on shore float velocities of 1 to 2 knots in the surf. Residents said that Thursday's surf was not unusual with the northeast wind. Since the surf line remained at, or beyond, the proposed outfall location, one can expect that anything discharged at that location under such conditions would be on the beach in 1 to 2 minutes. Residents' comments that the surf line can occur more than 300 meters from shore means that an extended outfall will be at times subject to the same phenomenon. However, since winds are reportedly from the south and west during the late spring, summer, and early fall months, sewage wash may be an infrequent problem during the months of high recreation use.

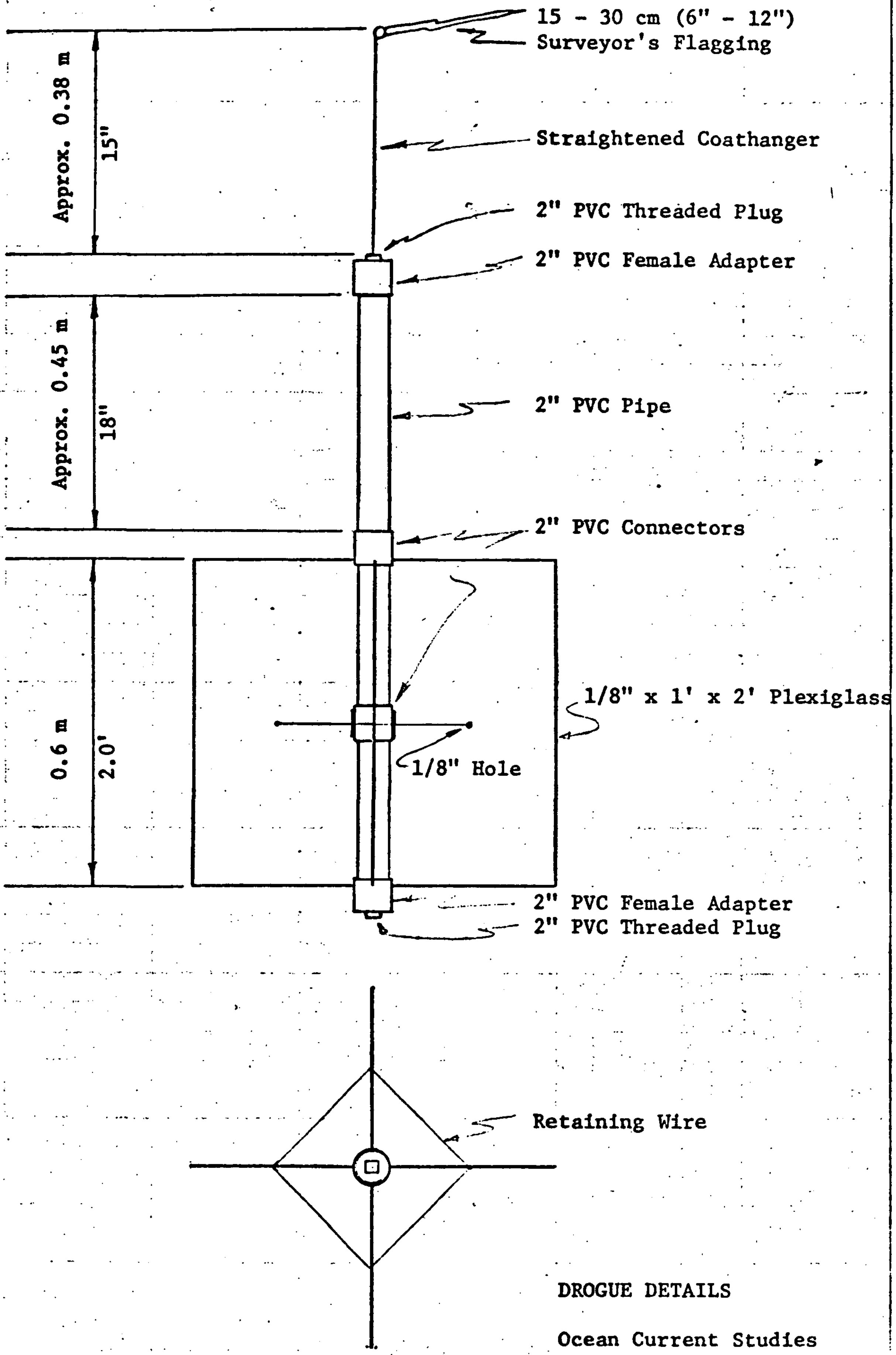
The nearest recognized bathing area is Ballard's Beach, located on the south side of the Old Harbor breakwater (see Figure 1). This beach is approximately 550 meters (1800 feet) north - northeast of the proposed outfall. At no time did a float or drogue get within 300 meters (1000 feet) of Ballard's Beach.



LOCATION MAP

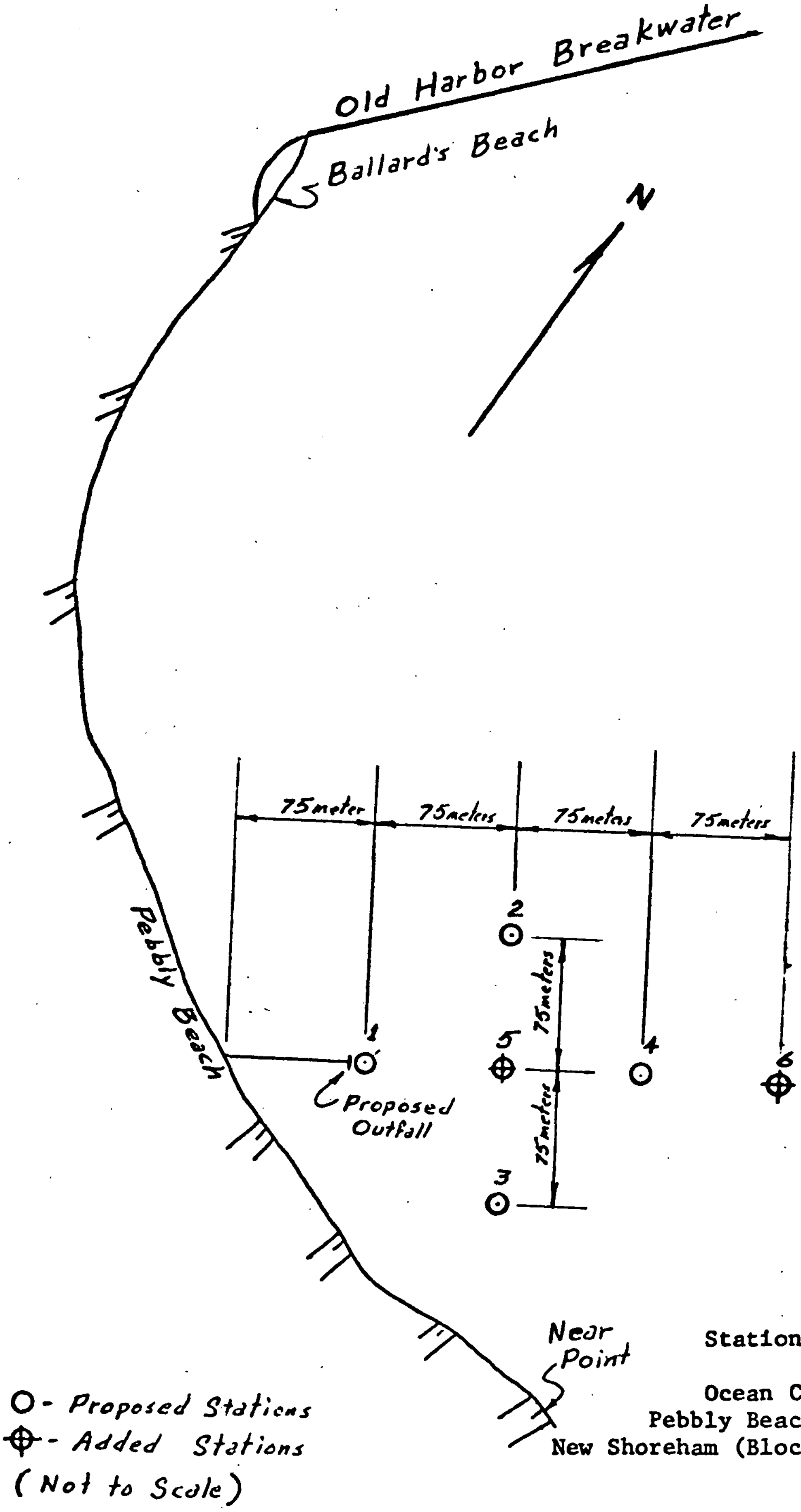
Ocean Current Studies
Pebbly Beach Outfall Location
New Shoreham (Block Island), Rhode Island

Figure 1



DROGUE DETAILS

Ocean Current Studies
Pebbly Beach Outfall Location
New Shoreham (Block Island),
Rhode Island



Station Displacement

Ocean Current Studies
Pebbly Beach Outfall Location
New Shoreham (Block Island), Rhode Island

FIGURE 3

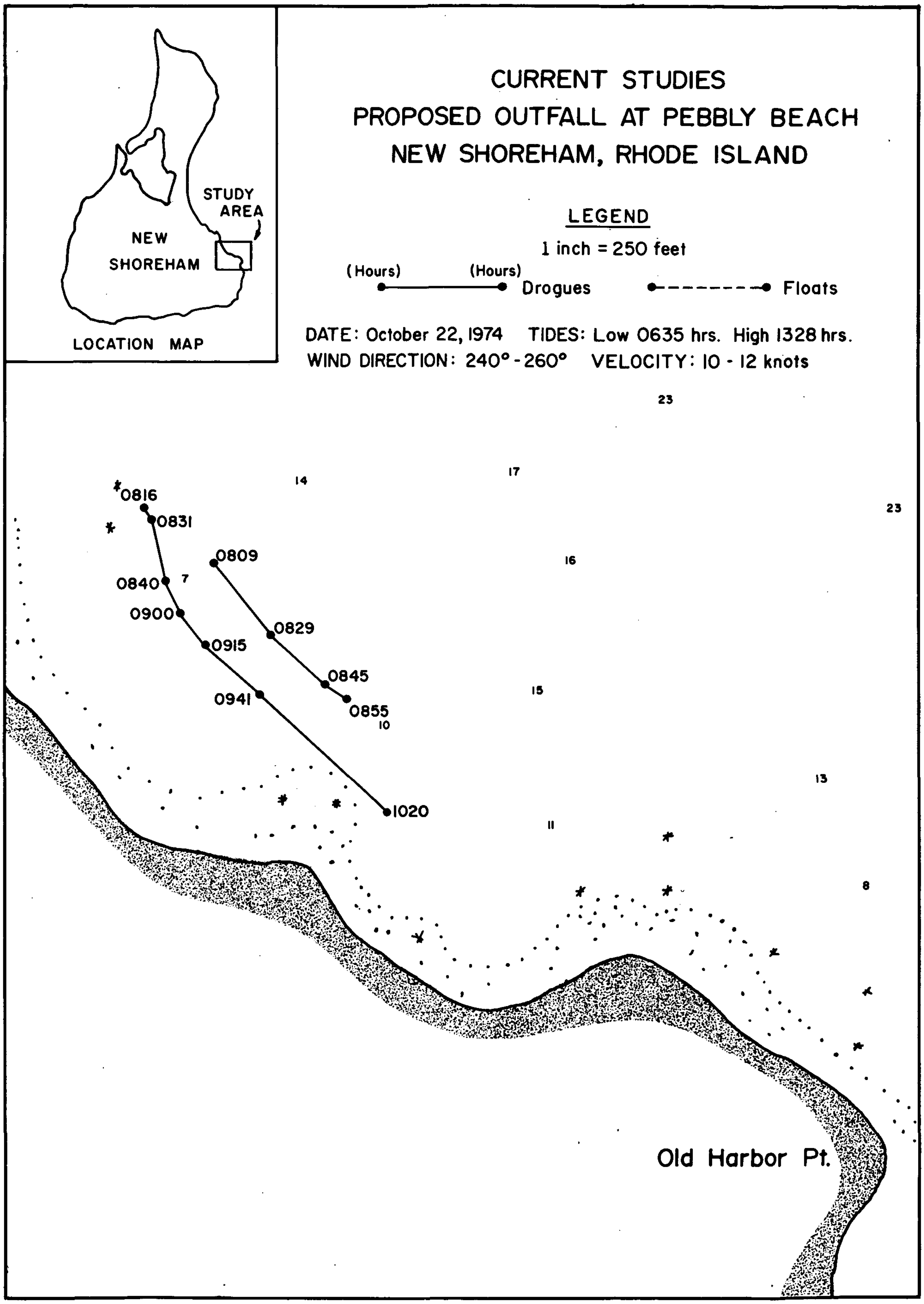

CURRENT STUDIES
PROPOSED OUTFALL AT PEBBLY BEACH
NEW SHOREHAM, RHODE ISLAND
LEGEND
1 inch = 250 feet
(Hours) (Hours) Drogues
Floats
DATE: October 22, 1974 TIDES: Low 0635 hrs. High 1328 hrs.
WIND DIRECTION: 240° - 260° VELOCITY: 10 - 12 knots
STUDY AREA
NEW SHOREHAM
LOCATION MAP
0816
0831
0840
0900
0915
0941
1020
0809
0829
0845
0855
Old Harbor Pt.

FIGURE 4

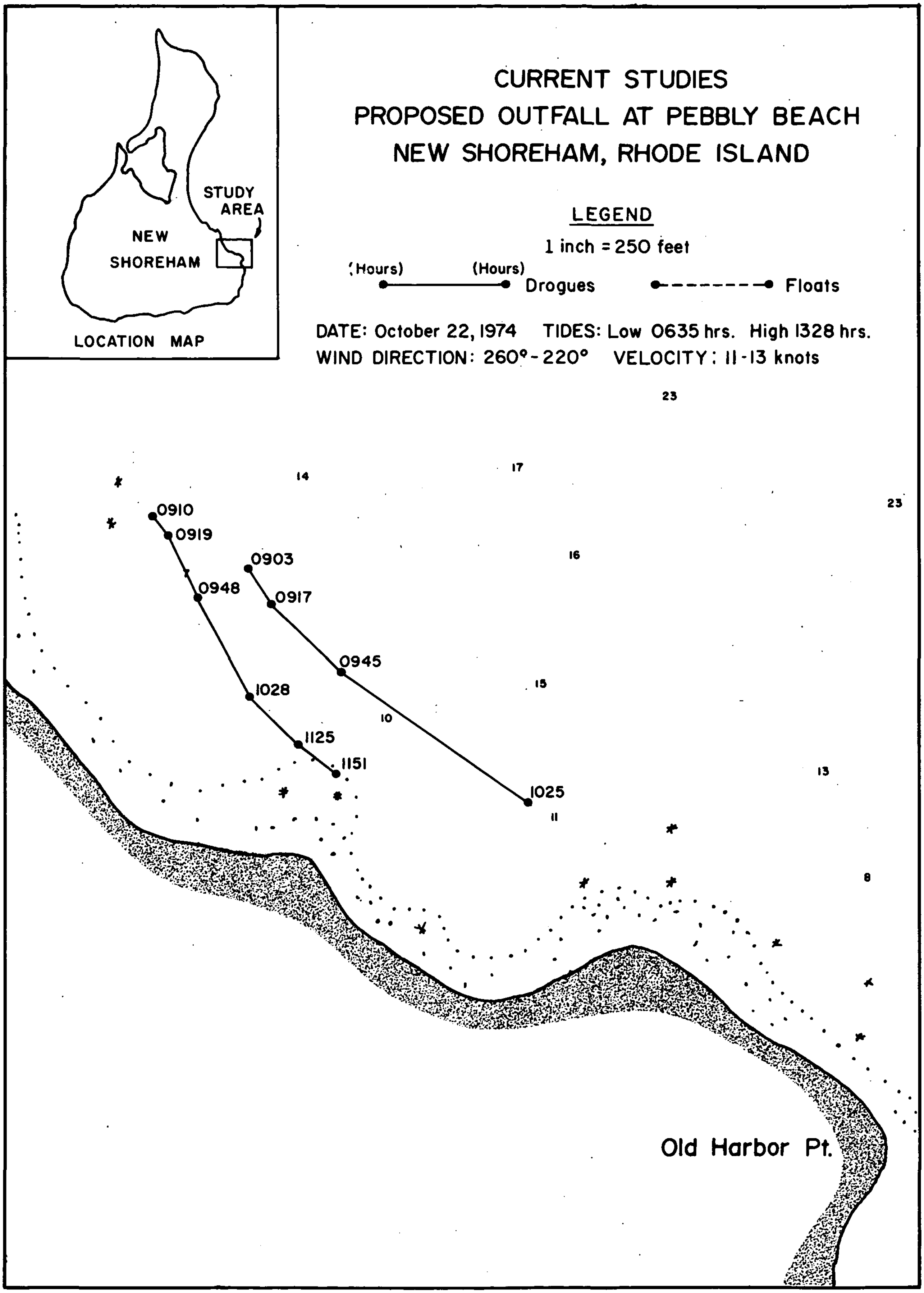

CURRENT STUDIES
PROPOSED OUTFALL AT PEBBLY BEACH
NEW SHOREHAM, RHODE ISLAND
LEGEND
1 inch = 250 feet
(Hours) (Hours) Drogues
Floats
DATE: October 22, 1974 TIDES: Low 0635 hrs. High 1328 hrs.
WIND DIRECTION: 260°-220° VELOCITY: 11-13 knots
STUDY AREA
NEW SHOREHAM
LOCATION MAP
0910
0919
0948
1028
1125
1151
0903
0917
0945
1025
Old Harbor Pt.

FIGURE 5

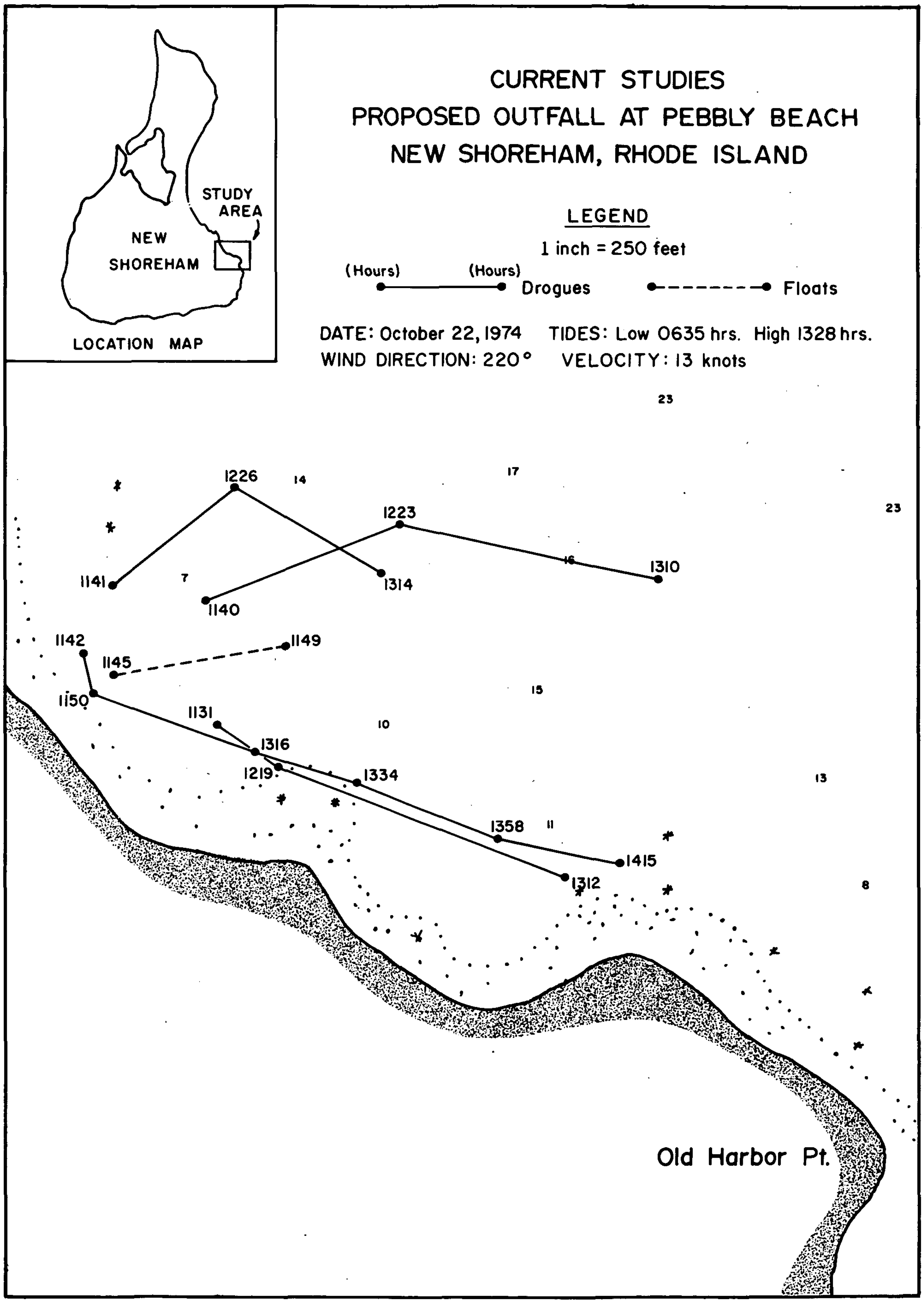

CURRENT STUDIES
PROPOSED OUTFALL AT PEBBLY BEACH
NEW SHOREHAM, RHODE ISLAND
LEGEND
1 inch = 250 feet
(Hours)
(Hours)
Drogues
Floats
DATE: October 22, 1974
TIDES: Low 0635 hrs. High 1328 hrs.
WIND DIRECTION: 220°
VELOCITY: 13 knots
STUDY AREA
NEW SHOREHAM
LOCATION MAP
1226
1141
1314
1223
1140
1310
1142
1145
1149
1150
1131
1316
1219
1334
1358
1415
1312
Old Harbor Pt.

FIGURE 6

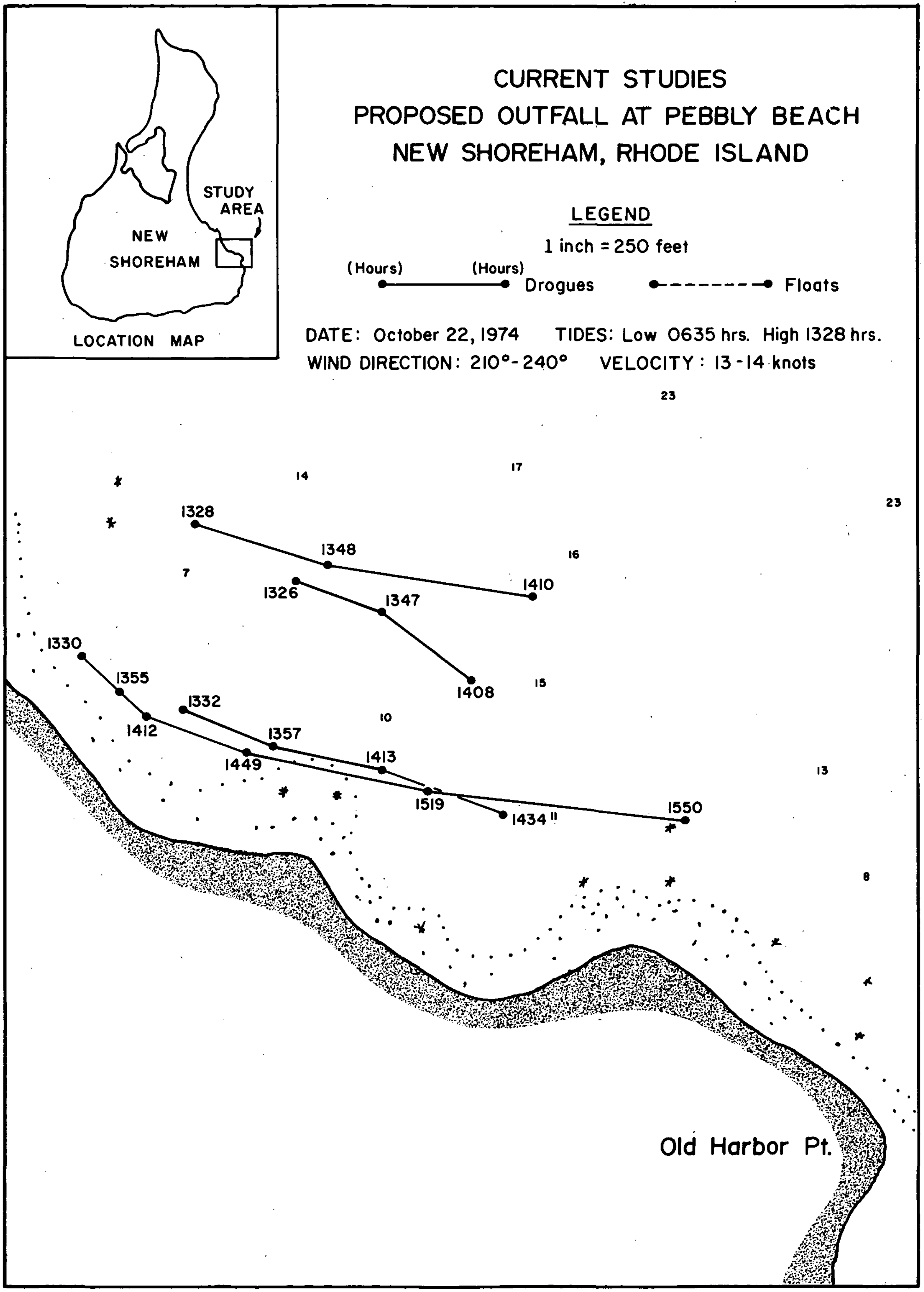

CURRENT STUDIES
PROPOSED OUTFALL AT PEBBLY BEACH
NEW SHOREHAM, RHODE ISLAND
LEGEND
1 inch = 250 feet
(Hours) (Hours) Drogues
Floats
DATE: October 22, 1974 TIDES: Low 0635 hrs. High 1328 hrs.
WIND DIRECTION: 210°-240° VELOCITY: 13-14 knots
STUDY AREA
NEW SHOREHAM
LOCATION MAP
1328
1348
1410
1326
1347
1408
1330
1355
1412
1332
1357
1413
1449
1519
1434
1550
Old Harbor Pt.

FIGURE 7

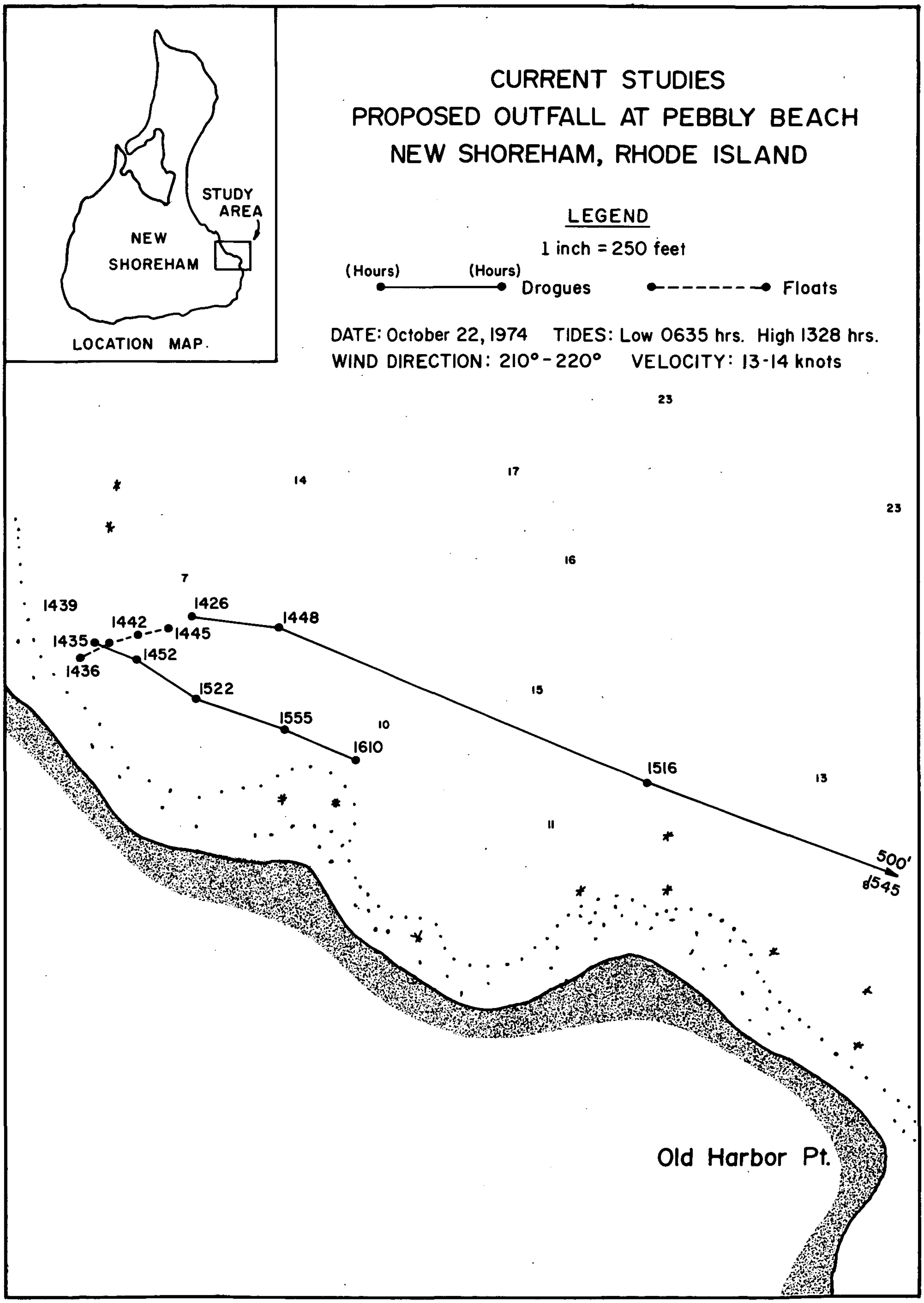

CURRENT STUDIES
PROPOSED OUTFALL AT PEBBLY BEACH
NEW SHOREHAM, RHODE ISLAND
LEGEND
1 inch = 250 feet
(Hours) (Hours) Drogues
Floats
DATE: October 22, 1974 TIDES: Low 0635 hrs. High 1328 hrs.
WIND DIRECTION: 210° - 220° VELOCITY: 13-14 knots
STUDY AREA
NEW SHOREHAM
LOCATION MAP.
23
14
17
23
16
7
1439
1426
1448
1442
1445
1435
1452
1436
1522
15
1555
10
1610
1516
13
11
500'
1545
Old Harbor Pt.

FIGURE 8

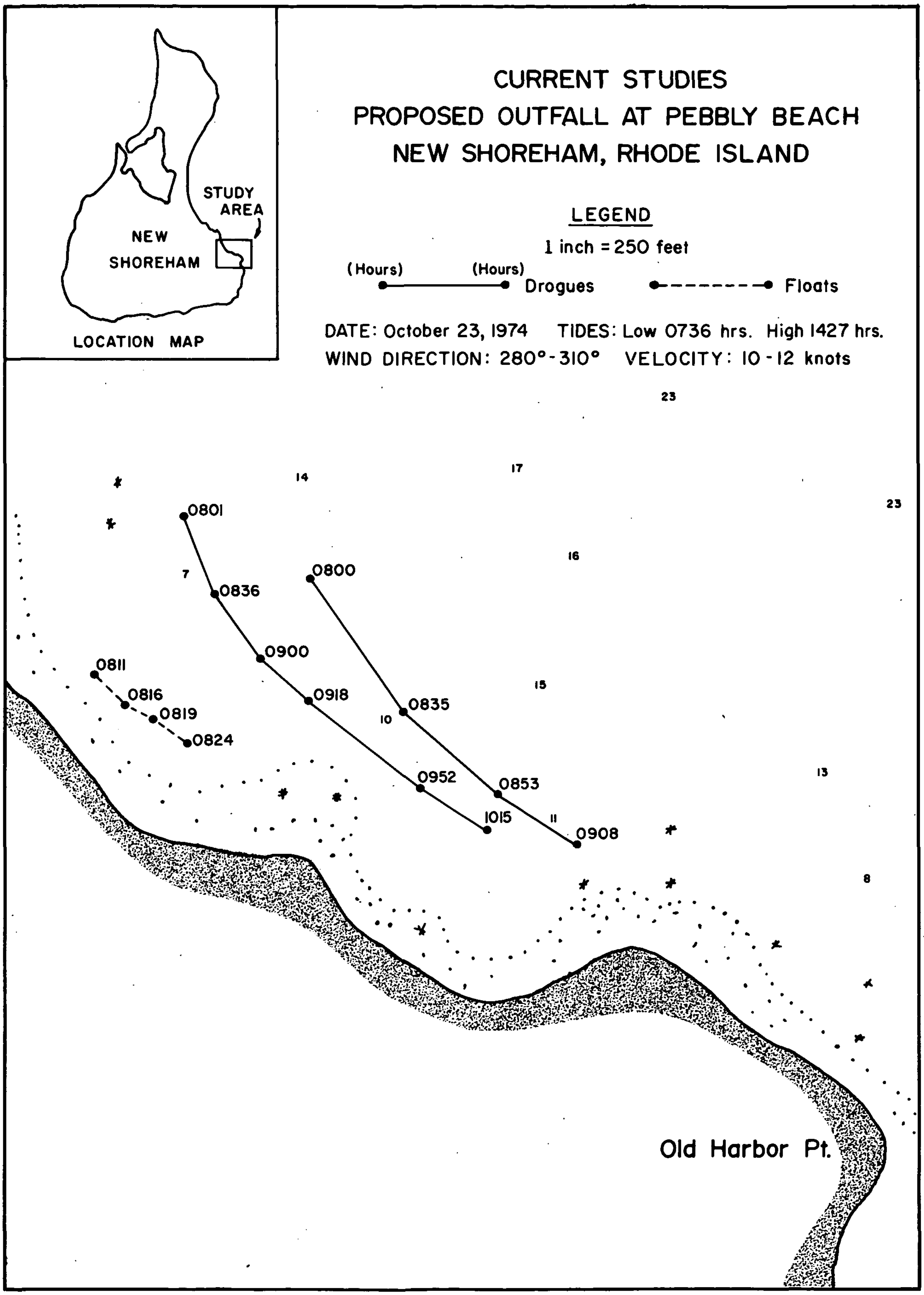

CURRENT STUDIES
PROPOSED OUTFALL AT PEBBLY BEACH
NEW SHOREHAM, RHODE ISLAND
LEGEND
1 inch = 250 feet
(Hours)
(Hours)
Drogues
Floats
DATE: October 23, 1974 TIDES: Low 0736 hrs. High 1427 hrs.
WIND DIRECTION: 280°-310° VELOCITY: 10-12 knots
STUDY AREA
NEW SHOREHAM
LOCATION MAP
0801
0836
0900
0918
0952
1015
0800
0835
0853
0908
0811
0816
0819
0824
Old Harbor Pt.

FIGURE 9

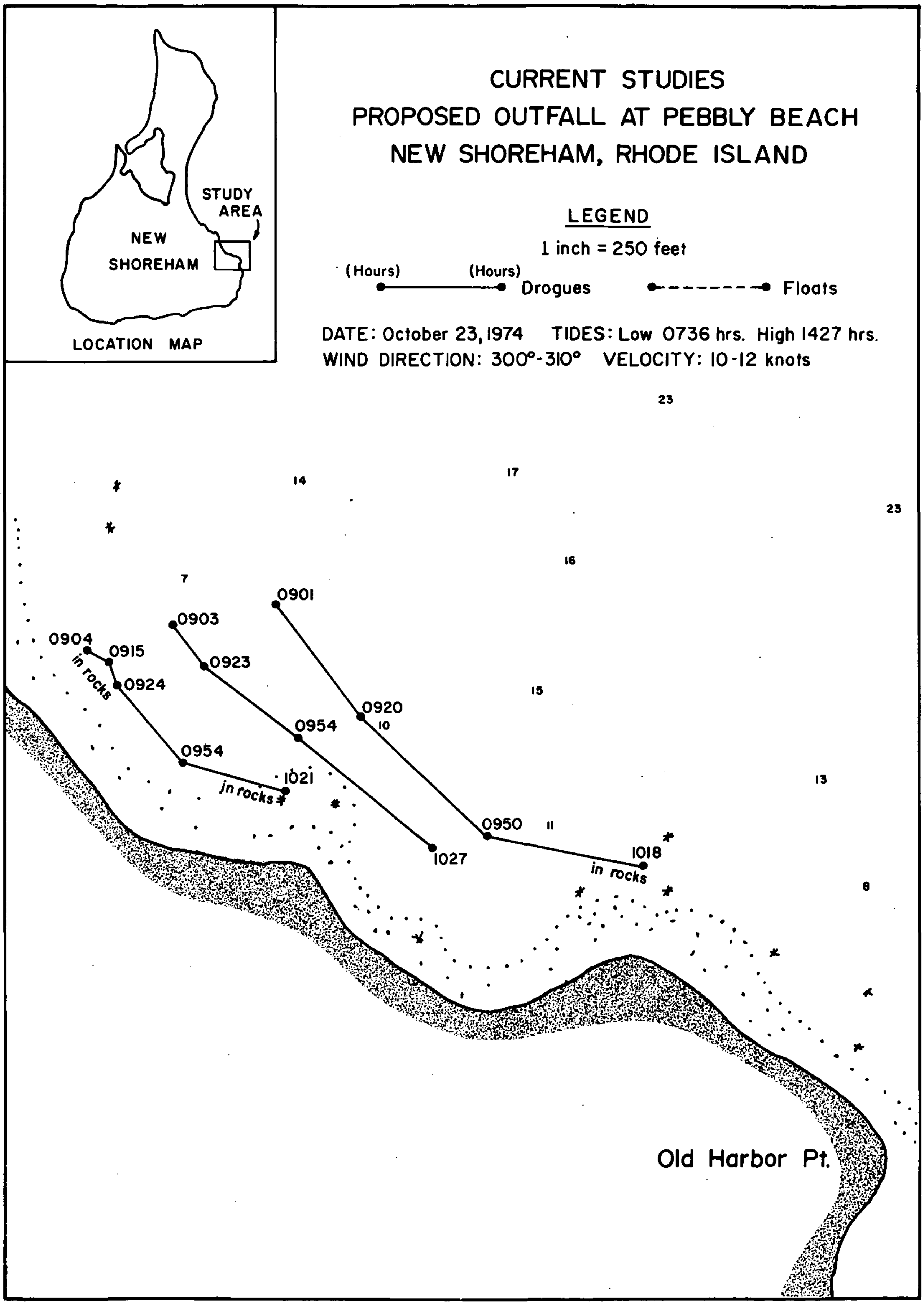

CURRENT STUDIES
PROPOSED OUTFALL AT PEBBLY BEACH
NEW SHOREHAM, RHODE ISLAND
LEGEND
1 inch = 250 feet
(Hours) (Hours) Drogues
Floats
DATE: October 23, 1974 TIDES: Low 0736 hrs. High 1427 hrs.
WIND DIRECTION: 300°-310° VELOCITY: 10-12 knots
STUDY AREA
NEW SHOREHAM
LOCATION MAP
0901
0903
0904
0915
0923
0924
0920
0954
0954
1021
in rocks
in rocks
0950
1027
1018
in rocks
Old Harbor Pt.

FIGURE 10

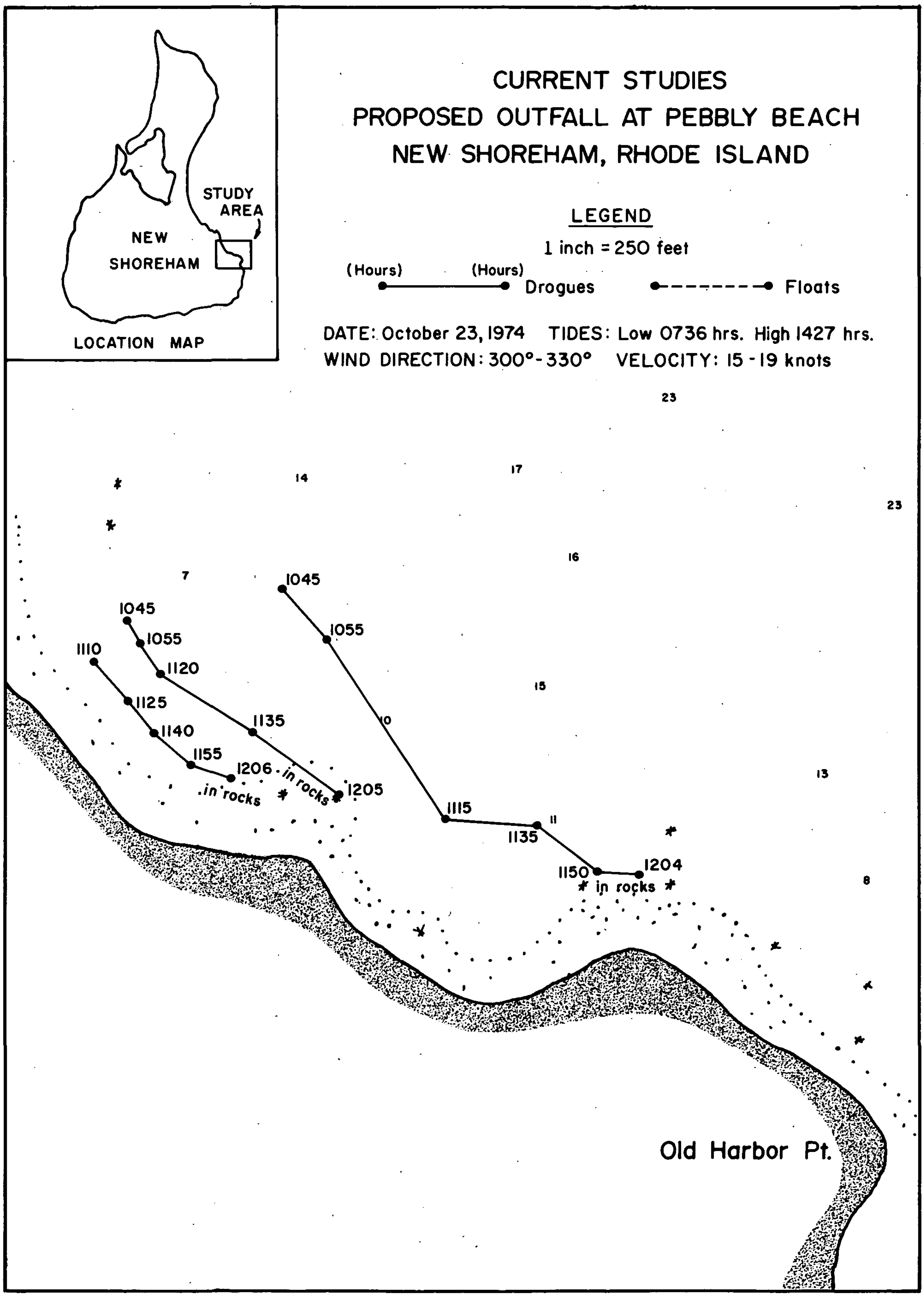

CURRENT STUDIES
PROPOSED OUTFALL AT PEBBLY BEACH
NEW SHOREHAM, RHODE ISLAND
LEGEND
1 inch = 250 feet
(Hours) (Hours) Drogues
Floats
DATE: October 23, 1974 TIDES: Low 0736 hrs. High 1427 hrs.
WIND DIRECTION: 300°-330° VELOCITY: 15-19 knots
STUDY AREA
NEW SHOREHAM
LOCATION MAP
1045
1055
1120
1135
1205
in rocks
1110
1125
1140
1155
1206
in rocks
1045
1055
1115
1135
1150
1204
in rocks
Old Harbor Pt.
23
17
14
23
16
7
15
10
13
11
8

FIGURE 11

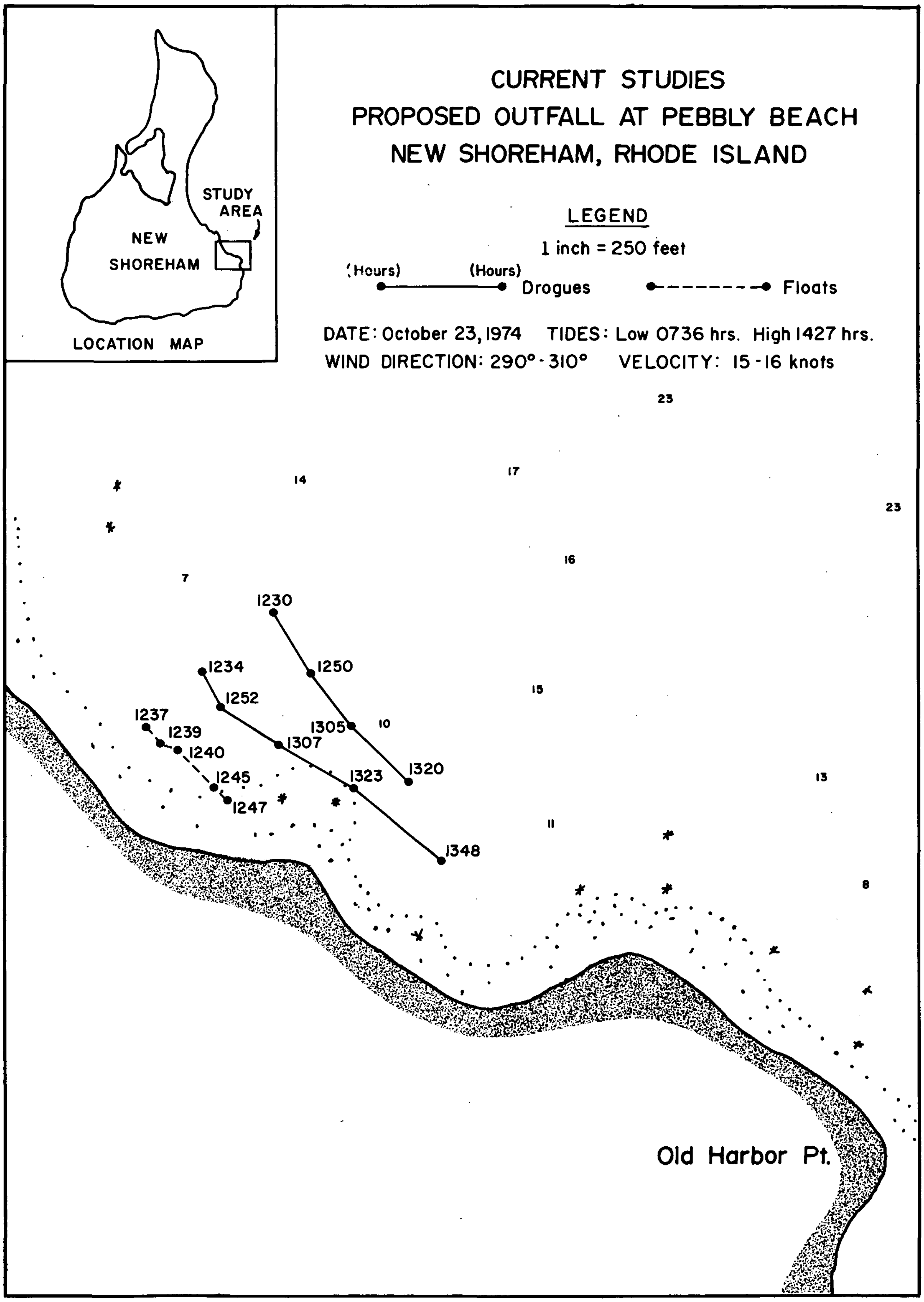

CURRENT STUDIES
PROPOSED OUTFALL AT PEBBLY BEACH
NEW SHOREHAM, RHODE ISLAND
LEGEND
1 inch = 250 feet
(Hours) (Hours) Drogues
Floats
DATE: October 23, 1974 TIDES: Low 0736 hrs. High 1427 hrs.
WIND DIRECTION: 290° - 310° VELOCITY: 15 - 16 knots
STUDY AREA
NEW SHOREHAM
LOCATION MAP
1230
1250
1305
1320
1234
1252
1307
1323
1348
1237
1239
1240
1245
1247
Old Harbor Pt.
23
14
17
23
16
7
15
10
13
11
8

FIGURE 12

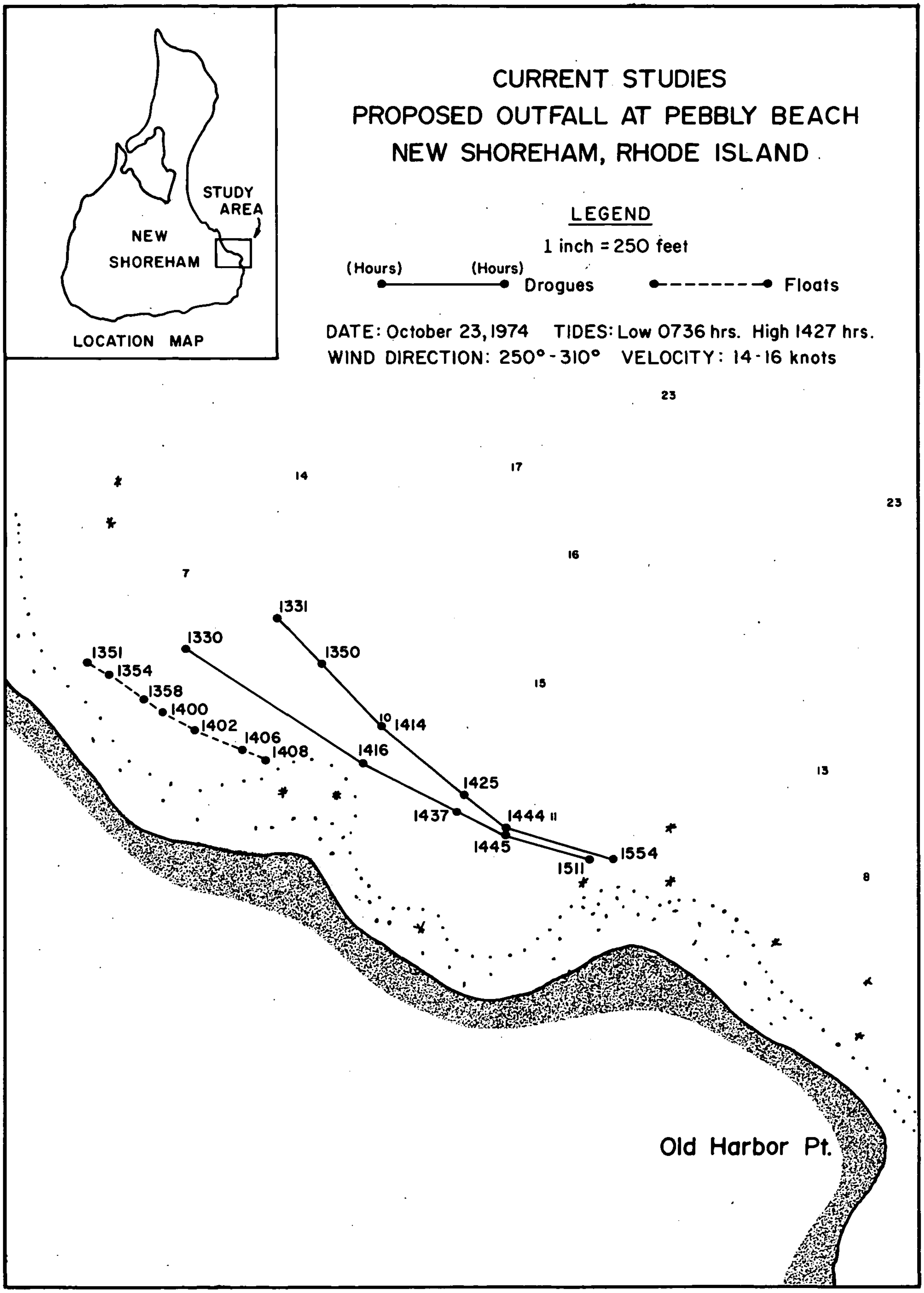

STUDY AREA
NEW SHOREHAM
LOCATION MAP
CURRENT STUDIES
PROPOSED OUTFALL AT PEBBLY BEACH
NEW SHOREHAM, RHODE ISLAND
LEGEND
1 inch = 250 feet
(Hours) (Hours) Drogues
Floats
DATE: October 23, 1974 TIDES: Low 0736 hrs. High 1427 hrs.
WIND DIRECTION: 250° - 310° VELOCITY: 14 - 16 knots
23
14
17
23
16
7
1331
1330
1350
1351
1354
1358
1400
1402
1406
1408
15
10 1414
1416
1425
13
1437
1444 11
1445
1554
1511
8
Old Harbor Pt.

FIGURE 13

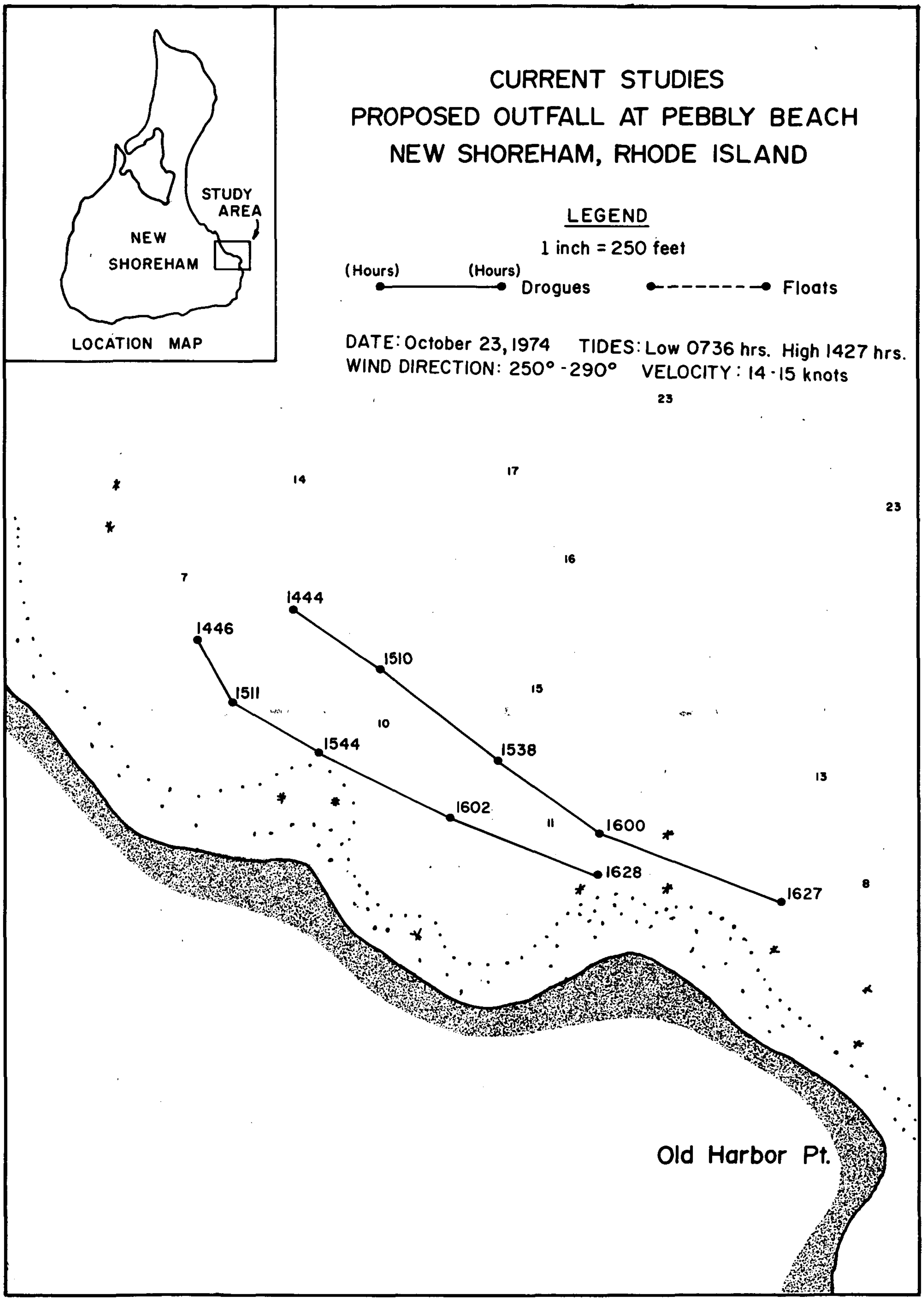
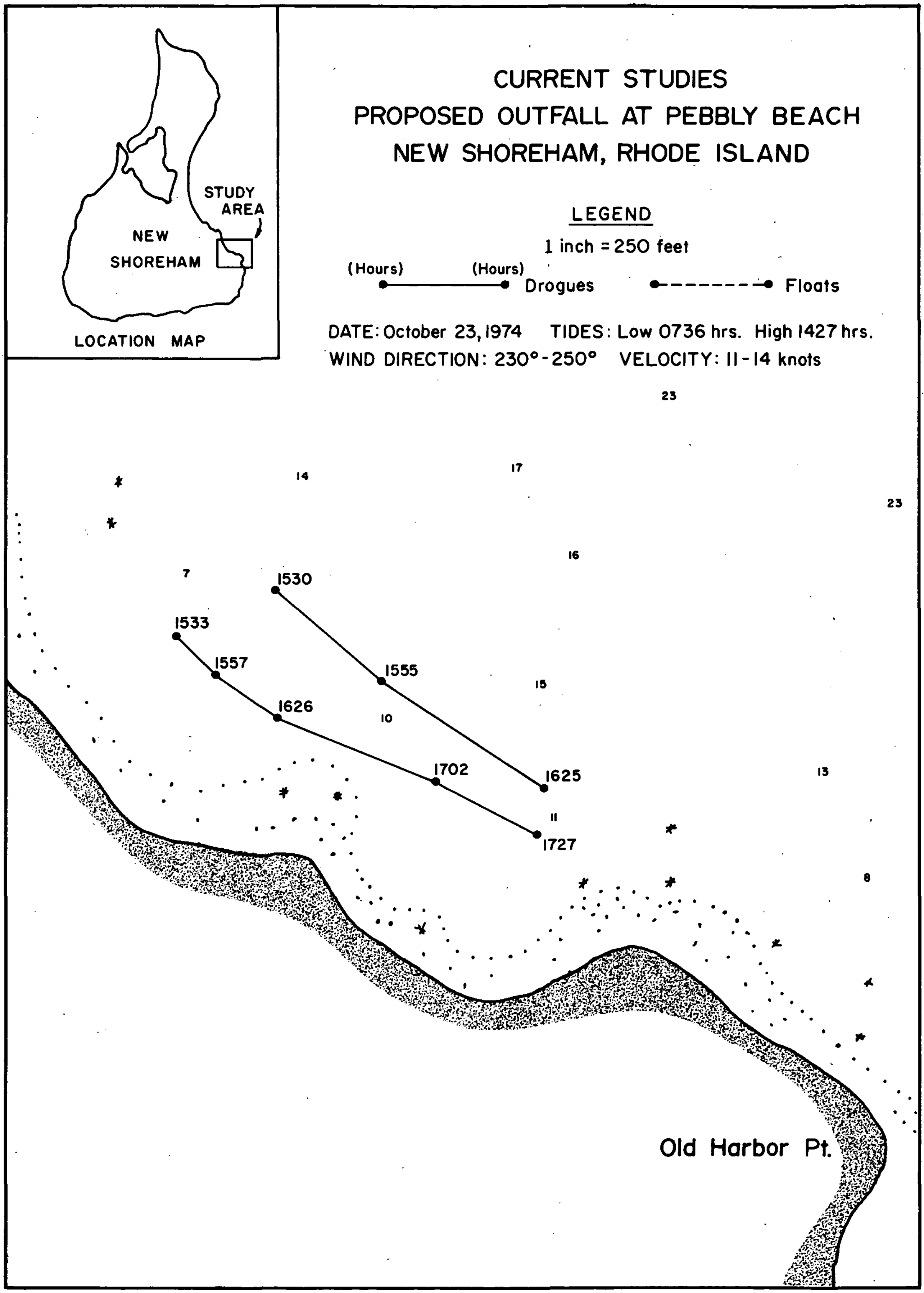
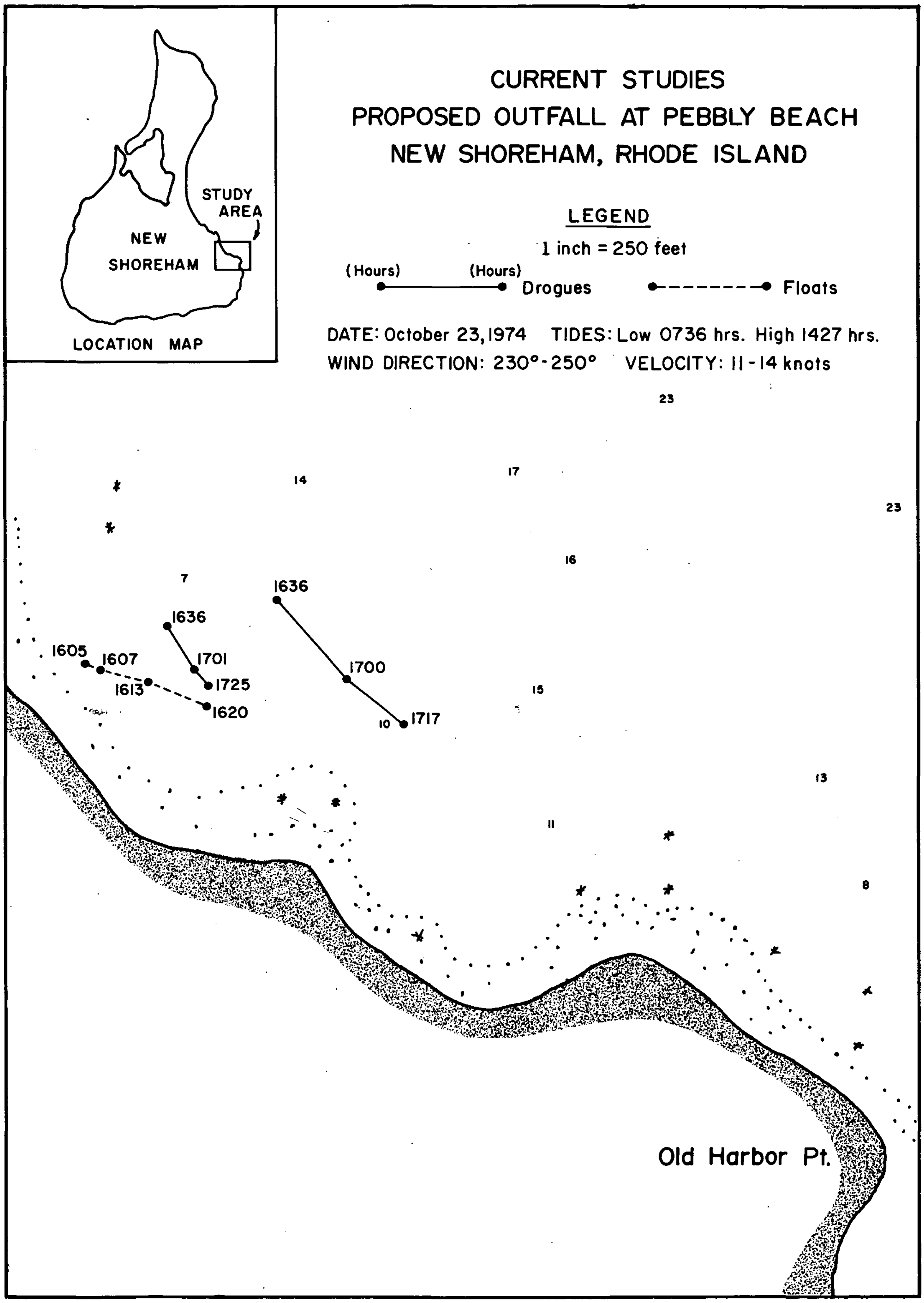

CURRENT STUDIES
PROPOSED OUTFALL AT PEBBLY BEACH
NEW SHOREHAM, RHODE ISLAND
LEGEND
1 inch = 250 feet
(Hours)
(Hours)
Drogues
Floats
DATE: October 23, 1974
TIDES: Low 0736 hrs. High 1427 hrs.
WIND DIRECTION: 250° - 290°
VELOCITY: 14 - 15 knots
STUDY AREA
NEW SHOREHAM
LOCATION MAP
1444
1510
1538
1600
1627
1446
1511
1544
1602
1628
Old Harbor Pt.

FIGURE 14



CURRENT STUDIES
PROPOSED OUTFALL AT PEBBLY BEACH
NEW SHOREHAM, RHODE ISLAND
LEGEND
1 inch = 250 feet
(Hours) (Hours) Drogues
Floats
DATE: October 23, 1974 TIDES: Low 0736 hrs. High 1427 hrs.
WIND DIRECTION: 230°-250° VELOCITY: 11-14 knots
STUDY AREA
NEW SHOREHAM
LOCATION MAP
1530
1555
1625
1533
1557
1626
1702
1727
23
14
17
23
16
7
15
10
13
11
8
Old Harbor Pt.

FIGURE 15



CURRENT STUDIES
PROPOSED OUTFALL AT PEBBLY BEACH
NEW SHOREHAM, RHODE ISLAND
LEGEND
1 inch = 250 feet
(Hours)
(Hours)
Drogues
Floats
DATE: October 23, 1974 TIDES: Low 0736 hrs. High 1427 hrs.
WIND DIRECTION: 230°-250° VELOCITY: 11-14 knots
STUDY AREA
NEW SHOREHAM
LOCATION MAP
1636
1700
1717
1636
1701
1725
1605
1607
1613
1620
23
14
17
23
16
7
15
10
13
11
8
Old Harbor Pt.

FIGURE 16

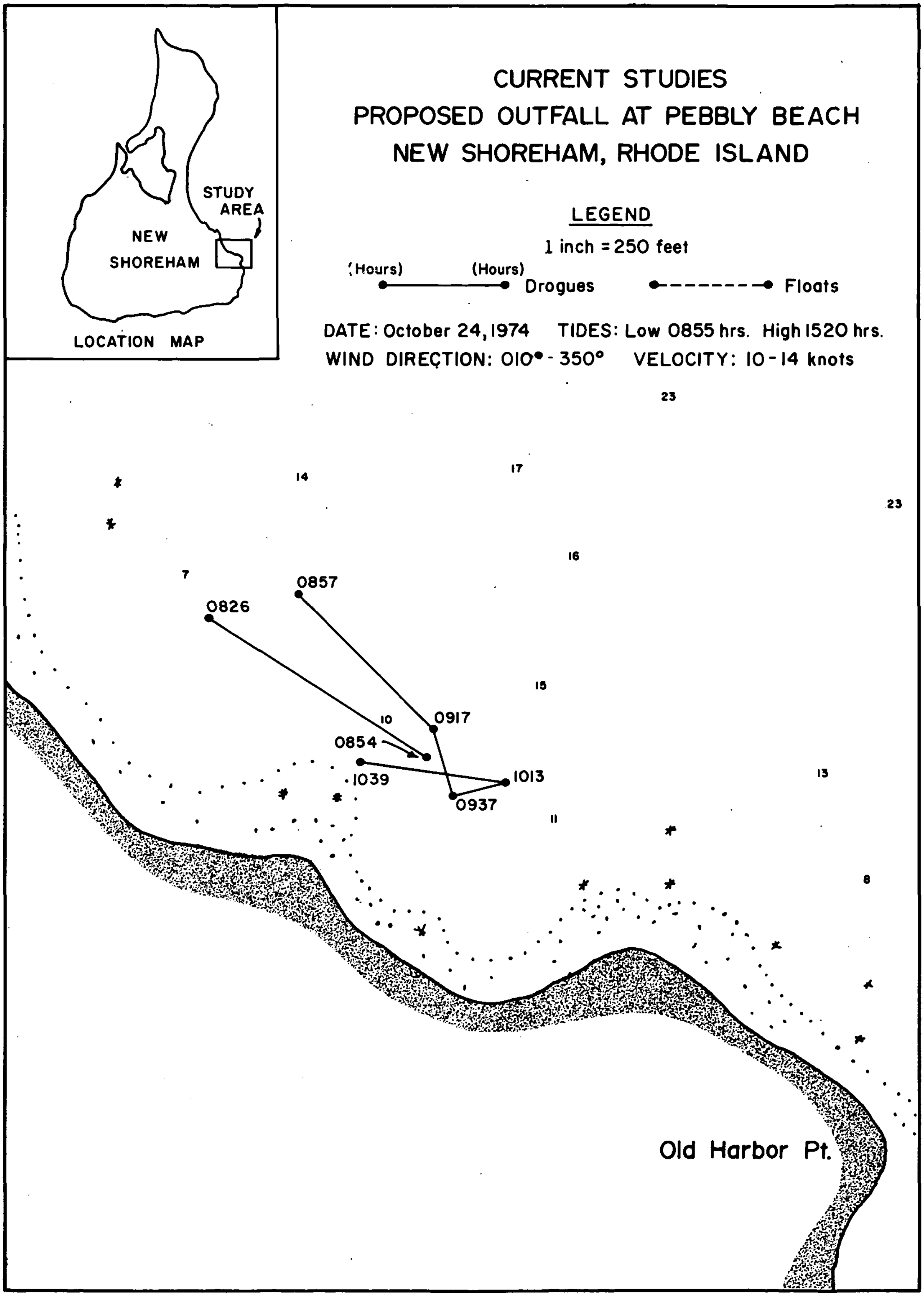

CURRENT STUDIES
PROPOSED OUTFALL AT PEBBLY BEACH
NEW SHOREHAM, RHODE ISLAND
LEGEND
1 inch = 250 feet
(Hours) (Hours)
Drogues
Floats
DATE: October 24, 1974 TIDES: Low 0855 hrs. High 1520 hrs.
WIND DIRECTION: 010° - 350° VELOCITY: 10 - 14 knots
STUDY AREA
NEW SHOREHAM
LOCATION MAP
0826
0857
0917
0854
1039
1013
0937
Old Harbor Pt.

FIGURE 17

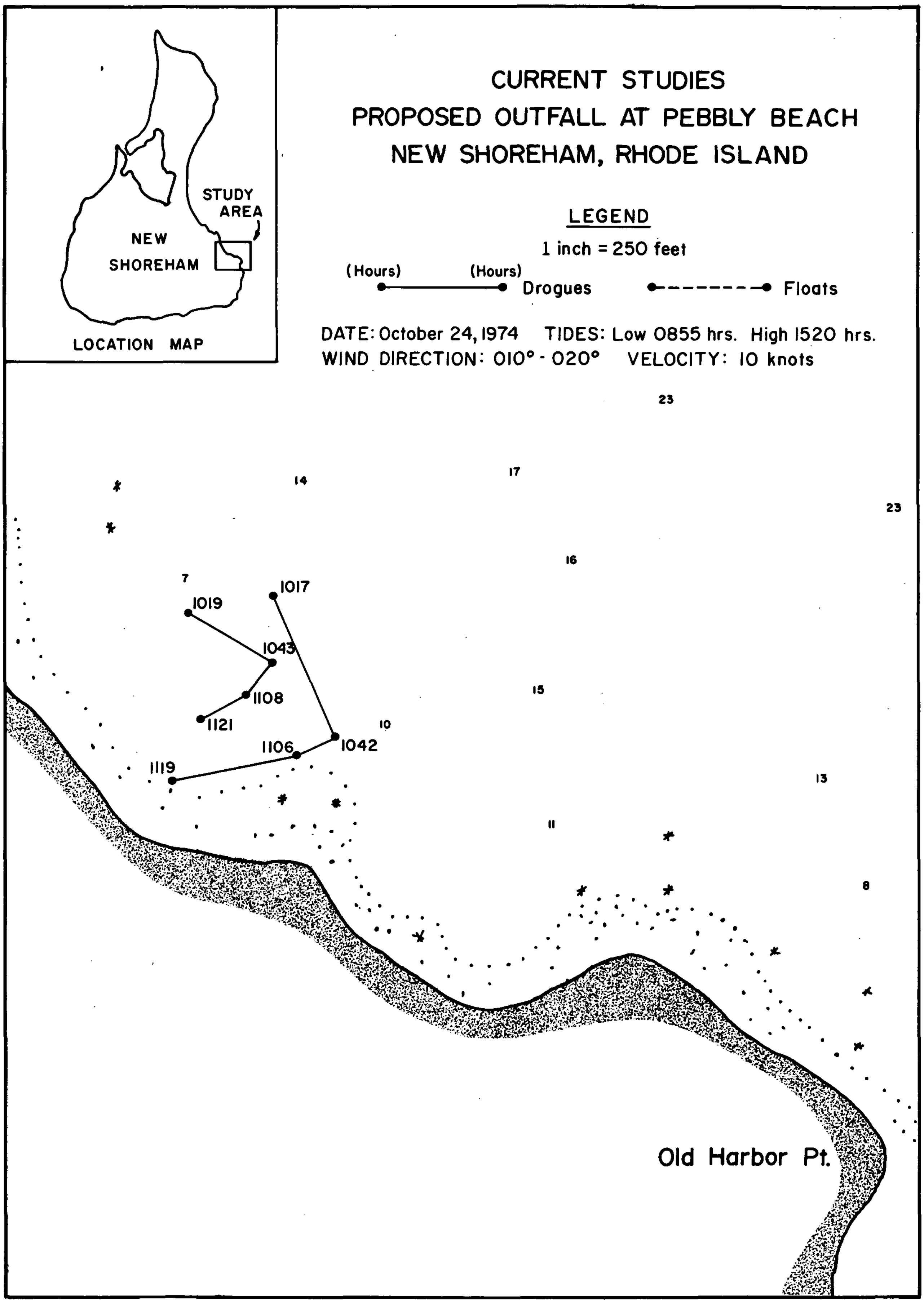
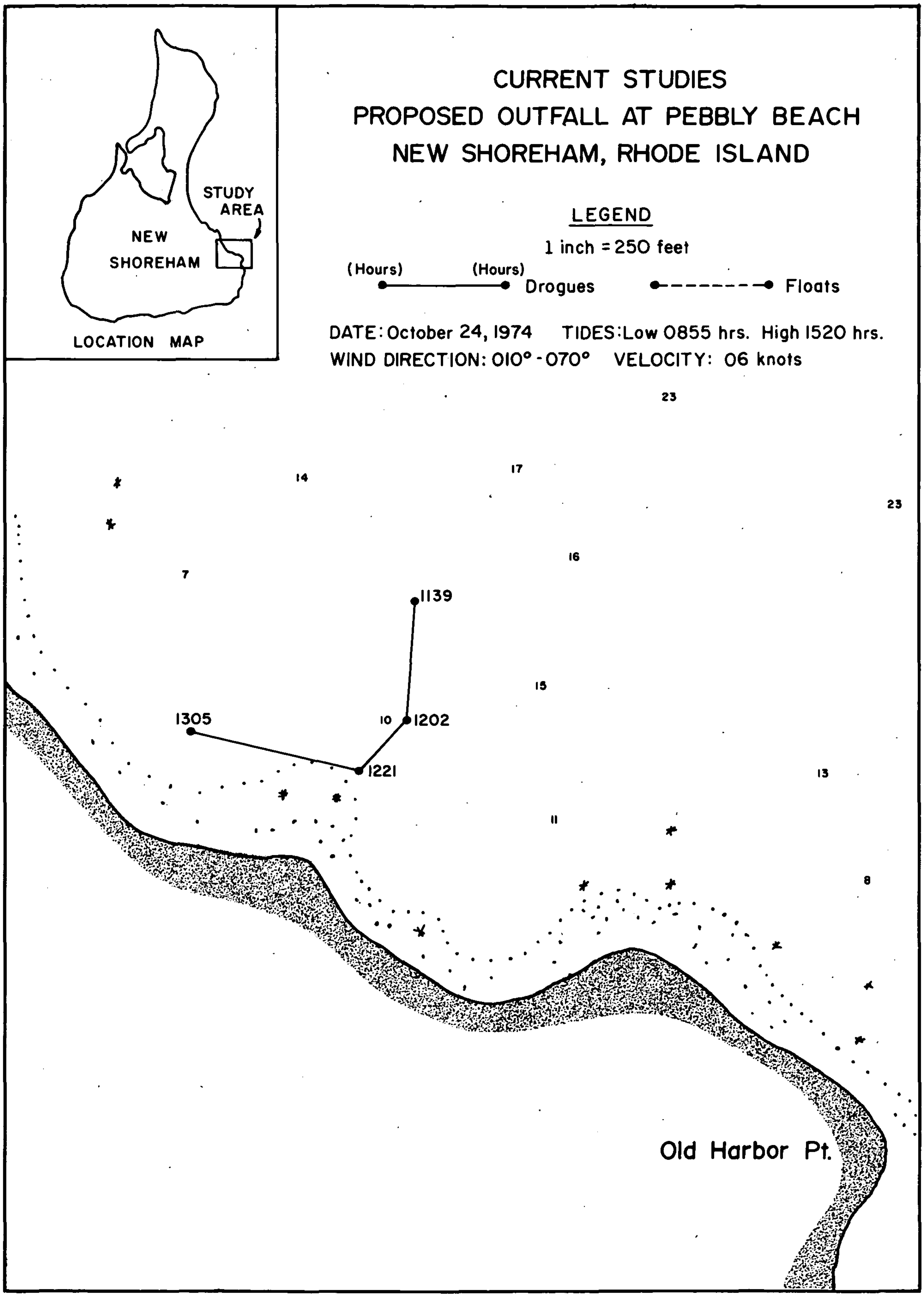

CURRENT STUDIES
PROPOSED OUTFALL AT PEBBLY BEACH
NEW SHOREHAM, RHODE ISLAND
LEGEND
1 inch = 250 feet
(Hours) (Hours)
Drogues
Floats
DATE: October 24, 1974 TIDES: Low 0855 hrs. High 1520 hrs.
WIND DIRECTION: 010° - 020° VELOCITY: 10 knots
STUDY AREA
NEW SHOREHAM
LOCATION MAP
1019
1017
1043
1108
1121
1106
1042
1119
Old Harbor Pt.

FIGURE 18



CURRENT STUDIES
PROPOSED OUTFALL AT PEBBLY BEACH
NEW SHOREHAM, RHODE ISLAND
LEGEND
1 inch = 250 feet
(Hours)
(Hours)
Drogues
Floats
DATE: October 24, 1974
TIDES: Low 0855 hrs. High 1520 hrs.
WIND DIRECTION: 010° - 070°
VELOCITY: 06 knots
STUDY AREA
NEW SHOREHAM
LOCATION MAP
1139
1202
1221
1305
Old Harbor Pt.
23
14
17
23
16
7
15
10
13
11
8

FIGURE 19

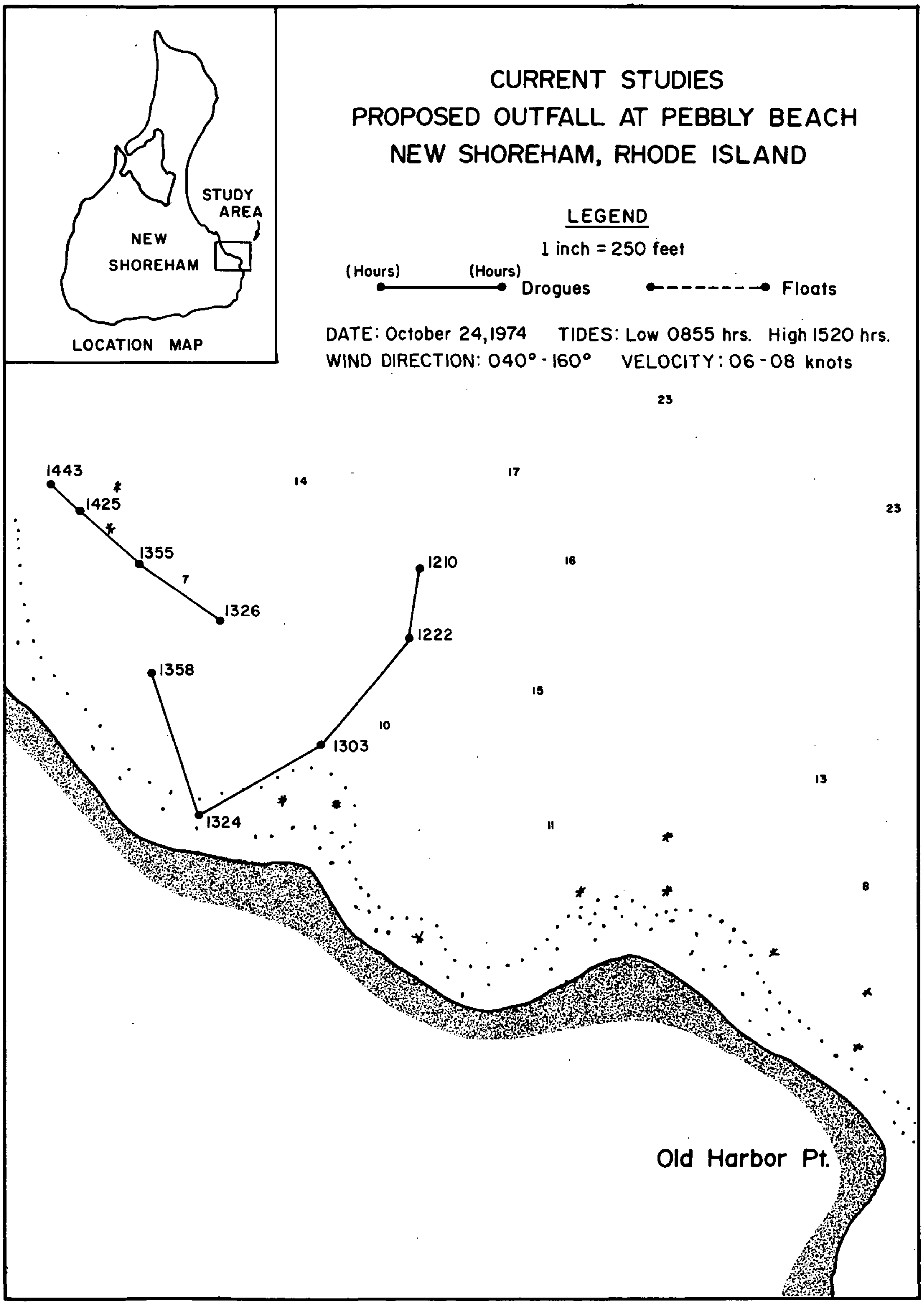

CURRENT STUDIES
PROPOSED OUTFALL AT PEBBLY BEACH
NEW SHOREHAM, RHODE ISLAND
LEGEND
1 inch = 250 feet
(Hours) (Hours) Drogues
Floats
DATE: October 24, 1974 TIDES: Low 0855 hrs. High 1520 hrs.
WIND DIRECTION: 040° - 160° VELOCITY: 06 - 08 knots
STUDY AREA
NEW SHOREHAM
LOCATION MAP
1443
1425
1355
1326
1210
1222
1358
1303
1324
Old Harbor Pt.

FIGURE 20

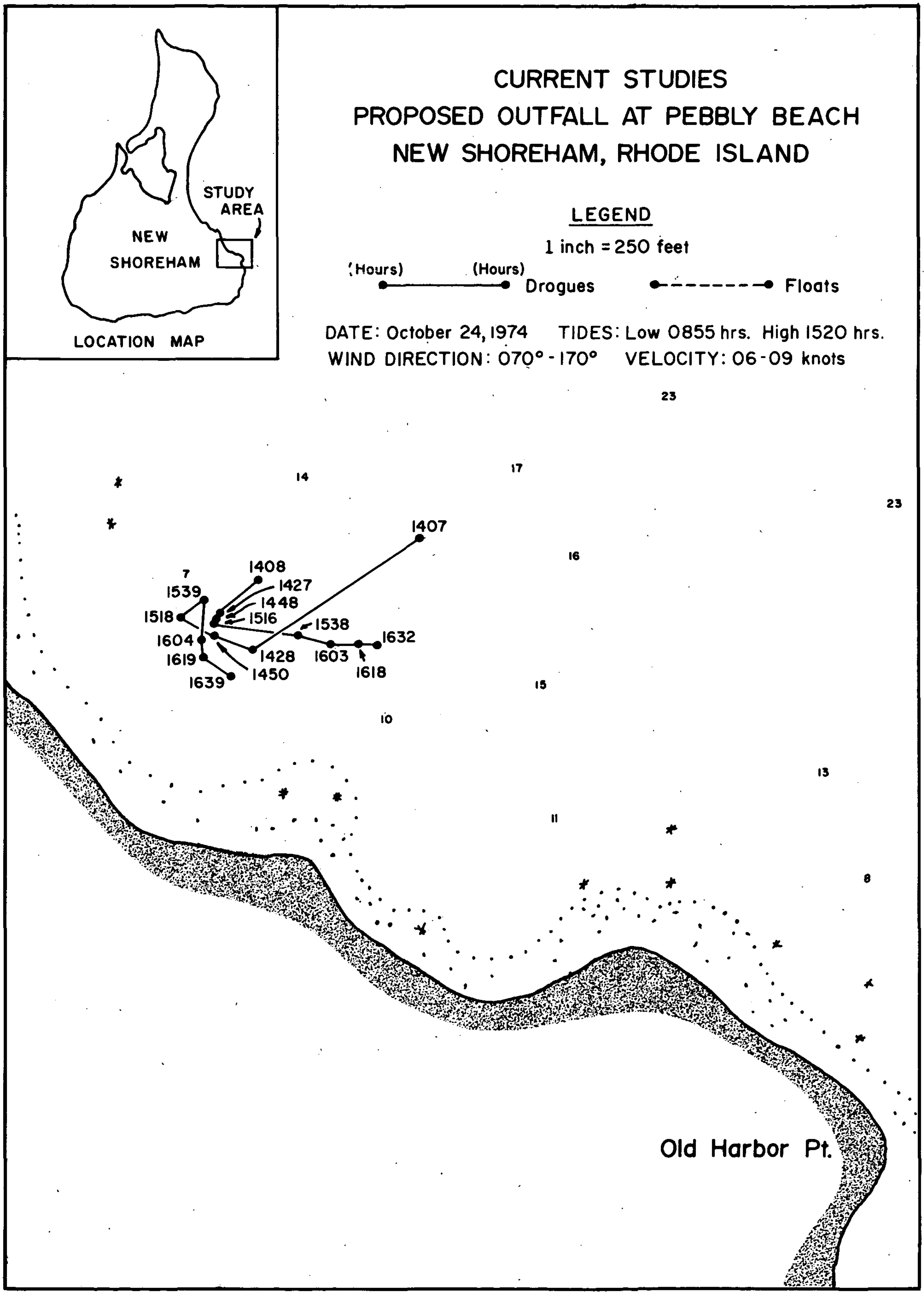

CURRENT STUDIES
PROPOSED OUTFALL AT PEBBLY BEACH
NEW SHOREHAM, RHODE ISLAND
LEGEND
1 inch = 250 feet
(Hours) (Hours) Drogues
Floats
DATE: October 24, 1974 TIDES: Low 0855 hrs. High 1520 hrs.
WIND DIRECTION: 070° - 170° VELOCITY: 06 - 09 knots
STUDY AREA
NEW SHOREHAM
LOCATION MAP
1407
1408
1427
1448
1516
1539
1518
1604
1619
1639
1428
1450
1538
1603
1618
1632
Old Harbor Pt.

FIGURE 21

INTRODUCTION:

We have conducted analyses of two aspects of dilution of wastewater from the proposed New Shoreham Wastewater treatment facility. These are dilution due to diffuser design and depth of water over the diffuser; and dilution due to dispersion of surface plume of wastewater under two conditions; constrained by a seawall parallel to the path of flow and unconstrained in the horizontal plane.

RESULTS:

We found that it would be desirable to relocate the outfall in deeper water to increase dilution. Certain specific modifications of the diffuser design would also increase dilution.

The following sections detail the analyses of the diffuser problem and allow for the investigation of a large number of design options by means of generalized tables and charts.

BLOCK ISLAND OUTFALL ANALYSIS

A. Diffuser analysis

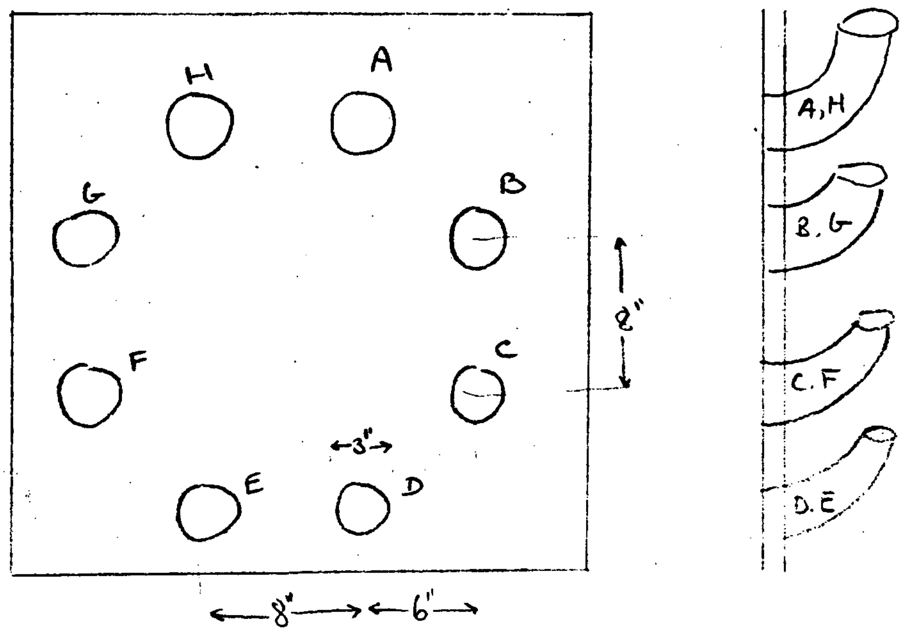
The dilution of sewage effluent by means of a diffuser system is a function of jet velocity, jet diameter, discharge angle, sewage density, and water depth. Work by Fan & Brooks (1), as presented by Norman Brooks at Manhattan College, May, 1973, analyzes sewage dispersion by use of the densimetric Froude Number, and the depth/diameter ratio of the diffuser, for peak flows of 0.3 MGD (0.45 cfs) each port of the 8 port present - design would have a Froude Number of 2.3 and would, if acting independently,

Froude number, $\mathbb{F} = \dfrac{U}{\sqrt{\frac{\Delta\rho}{\rho} g D}}$

U = velocity of jet
$\frac{\Delta\rho}{\rho}$ = ratio of difference of densities to ambient density
g = acceleration due to gravity
D = diameter of port

(1) Van, Loh-Nien and Brooks, N.H., "Numerical Solutions of Turbulent Bouyant Jet Problems" W. M. Keck Laboratory of Hydraulics and Water Resources Report No. KH-R-18, California Institute of Technology, Pasadena, January, 1969, 54 pp.

produce dilution ratios somewhere between 6 and 9. However, the close proximity of the eight individual ports, as shown below, make the likelihood of plume interaction very high, although impossible to determine (because of the very low velocity, and very shallow, changing depth).



Interaction of G & F and B & C to a high degree is certain because low jet velocities mean there will be very little horizontal movement before density differences cause vertical rise. Interaction between jets E & H and A & D are also very likely, although the resulting loss of dilution would probably not be as great as in the case of G & H and B & C. There is also a likelihood of plume interaction between adjacent ports in the horizontal plane, such that ports F & E, E & D, H & A, G & H, A & B, and C & D would not be likely to have sufficient spacing to allow unrestrained dilution.

Besides the problem of actual plume interaction, there could be a problem of restraint of dilution water flow. Plume analysis theory requires sufficient access to the plume by clean dilution water. With this scheme, as the individual plumes expand, the availability of clean dilution water could be severely limited, thereby decreasing dilution.

Additionally, dilution expected during periods of considerably lower flow (lower than 0.45 cfs), would be drastically lower still, because of decreased velocity and therefore a lower Froude Number, so that the sewage field would not be likely to act as a jet, but as a weakly buoyant flow, with little mixing likelihood. As a result of the above analytical difficulties, no dilution of the sewage could be ascribed to the present design.

Several other possible diffuser arrangements were analyzed for their possible environmental effects. Three designs were analyzed for six one-inch diameter ports at plant flows of 0.45 cfs, 0.225 cfs, and 0.112 cfs, along with three designs for six two-inch ports at the same flows. In each case, ports were assumed to be spaced such that they would not interact (spacings of several feet, discharging horizontally). Froude Numbers of: 9.3, 4.6, and 2.3 resulted from the two-inch ports at the specified flows, while the one-inch ports at these flows resulted in Froude Numbers of: 54.7, 27.8, and 13.9, respectively.

The following chart shows the dilutions that could be expected from a given depth and Froude Number.

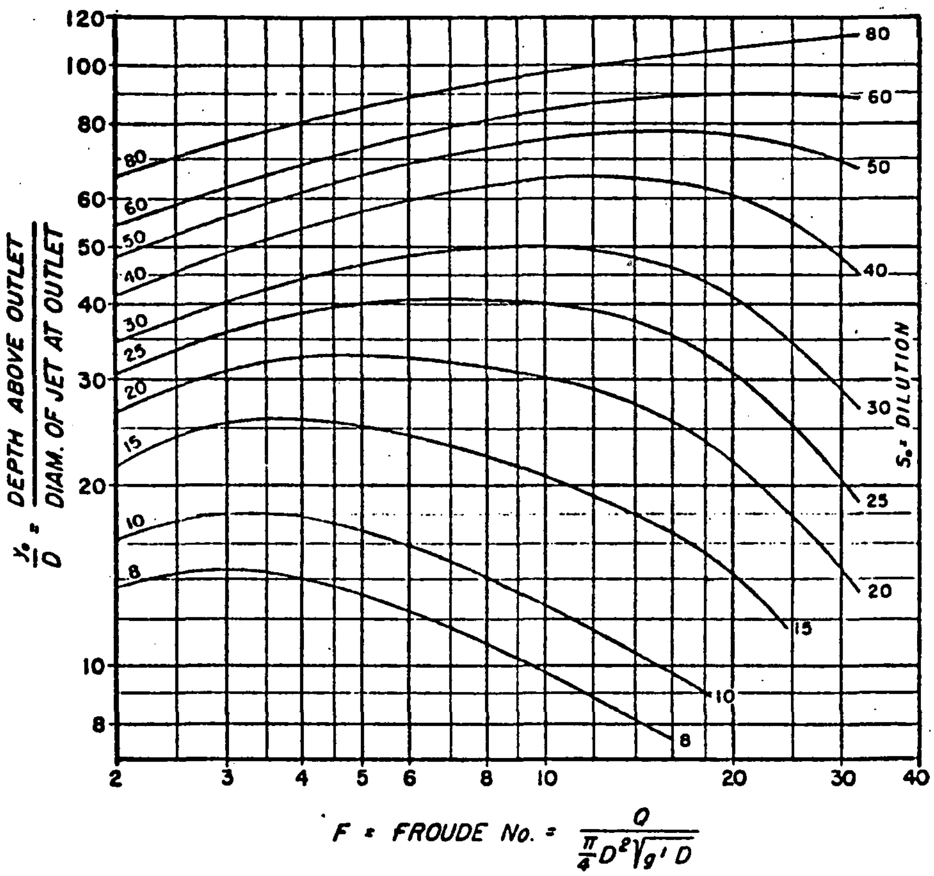


FIG. 7.—DILUTION AS A FUNCTION OF y_0/D AND F FOR HORIZONTAL DISCHARGE

DIFFUSERS FOR DISPOSAL OF SEWAGE IN SEA WATER

By A.M. Rawn, F.R. Bowerman, and Norman H. Brooks
Journal of the Sanitary Engineering Division,
ASCE, March 1960

BLOCK ISLAND OUTFALL ANALYSIS

B. Surface Plume Analysis

Once the bouyant jet from the diffuser reaches the surface, the sewage field is carried in local ocean currents, and undergoes further reductions in concentration of pollutants by far field dispersion and by decay of non-conservative substances such as coliforms and biochemical oxygen demand, (BOD). The following equation is used to describe the changes in concentration due to lateral dispersion, advection and decay:

$$-\epsilon \frac{\partial^2 c}{\partial y^2} + u \frac{\partial c}{\partial x} + kc = 0 \qquad (2)$$

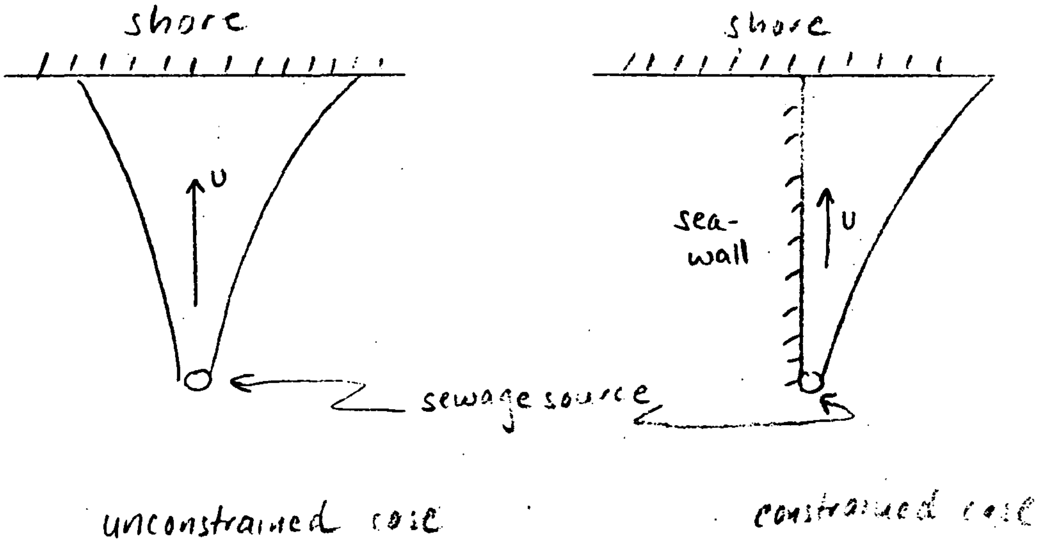
ϵ = diffusion coefficient
c = Concentration
u = Velocity in "x" direction
k = decay rate
x, y = spatial coordinate system

The equation was solved numerically by the Systems Analysis Branch, EPA, Region I, (3) for two cases, herein referred to as the unconstrained case and the constrained case. The unconstrained case is open to dispersion in

(2) Brooks, N.H. "Waste Water Disposal in the Marine Environment" Pearson, U. California, Berkely, 1959, Pergamon

(3) Internal Memos, October - November, 1974, Systems Analysis Branch, EPA, Region

both directions perpendicular to the center-line velocity. The constrained case has a berm or seawall along one side, preventing dispersion in that direction. Figure 1 below illustrates the two cases studied.



$\vec{u}$ = current velocity

FIGURE 1

The plume analysis computed lateral dispersion perpendicular to the center-line of the sewage plume. The plume need not be heading toward shore to be valid, although this would seem to pose the most environmentally important case, as other paths require additional lengths of travel, and result in higher dilutions. Figures 2 through 10 summarize the computer runs of the plume model. All sewage concentrations refer to the ratio C/Co or the fraction of the original surface concentration remaining.

Figure 2 shows a schematic drawing of the system being analyzed, with the peak concentration declining as the plume spreads, i.e. as the plume width increases. Figure 2 shows only half of the plume for the symmetric unconstrained case, and shows the whole plume for the constrained case because there is no dispersion through the seawall.

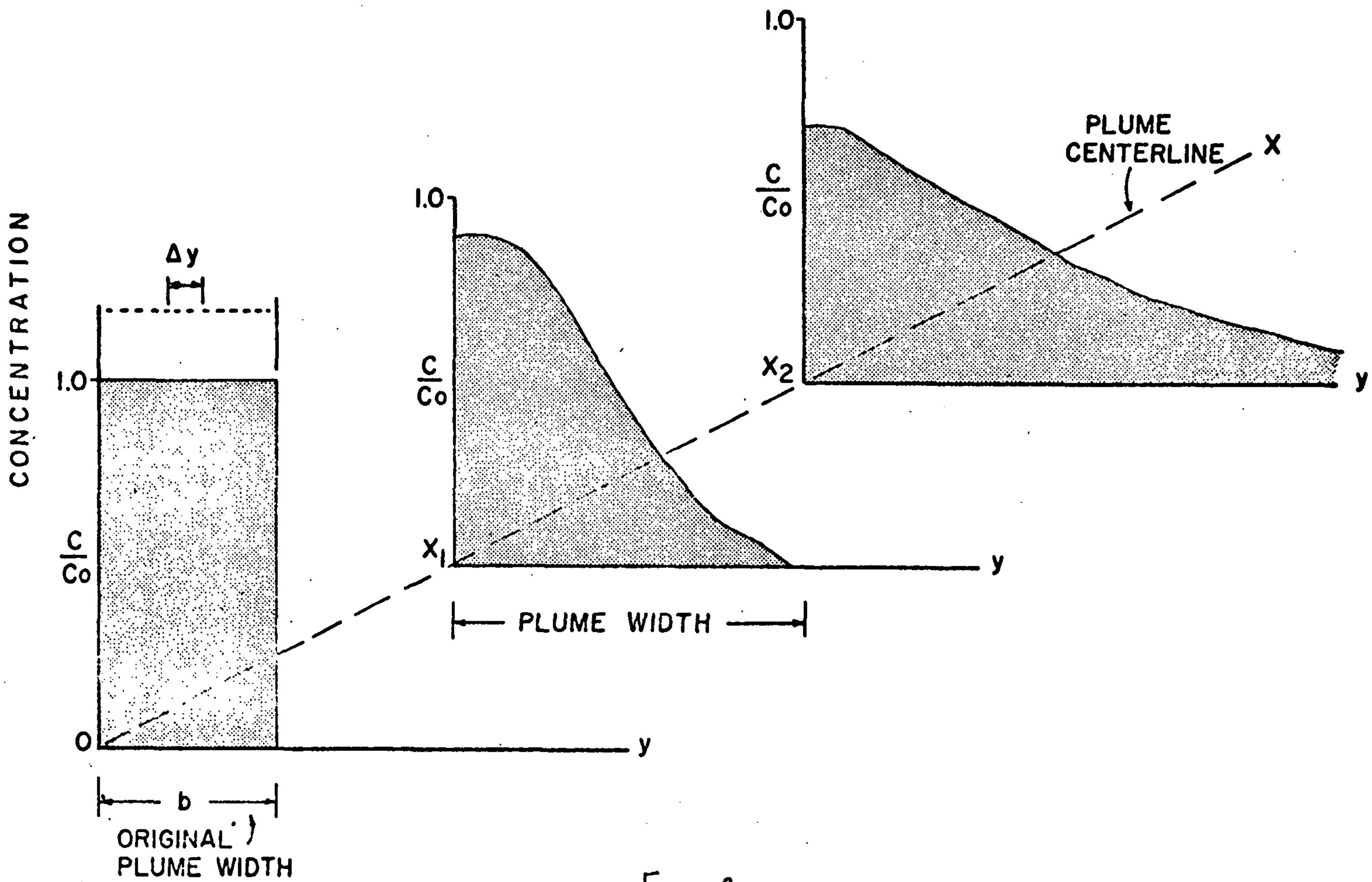
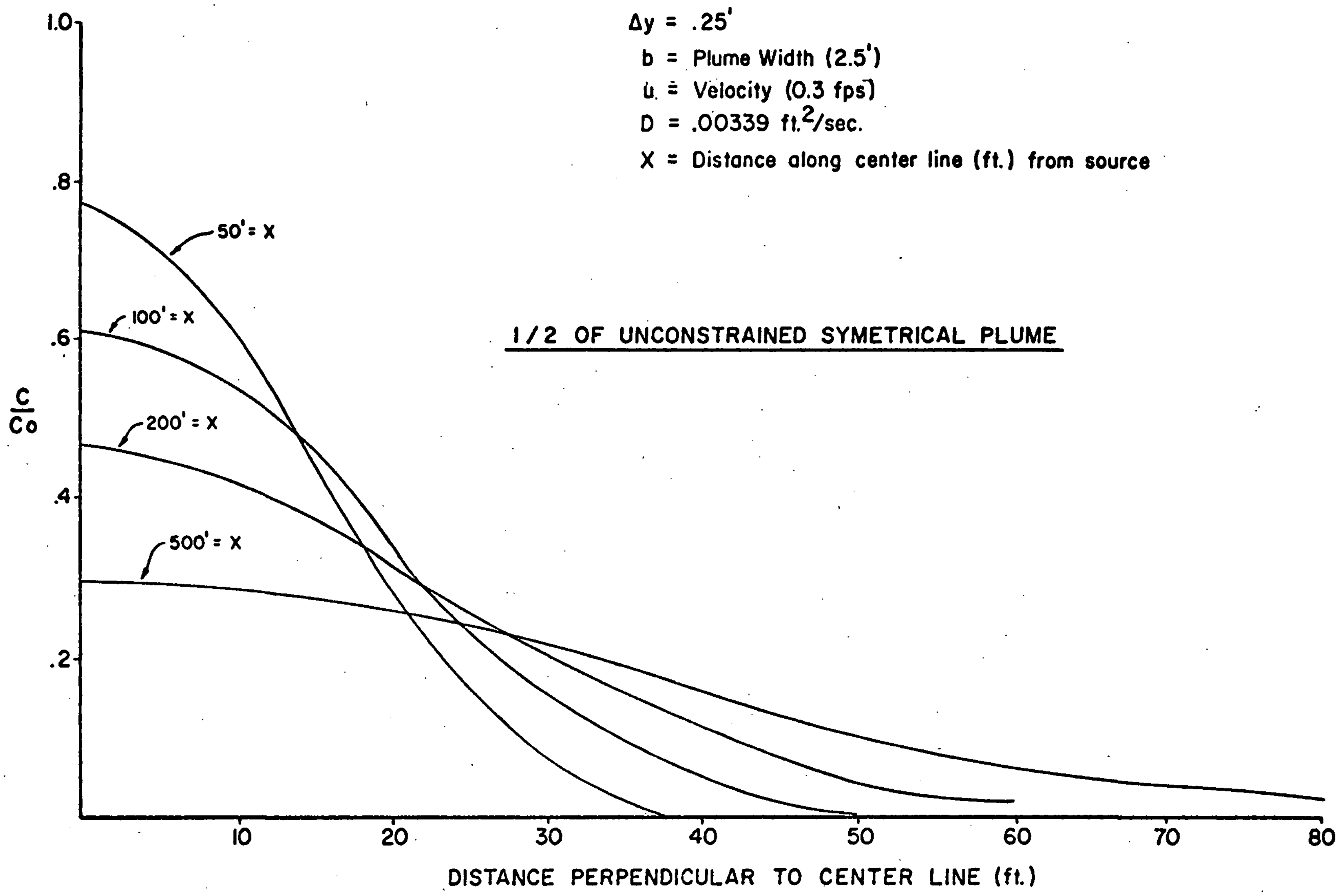

CONCENTRATION
Δy
1.0
C/Co
0
y
b
ORIGINAL PLUME WIDTH
1.0
C/Co
X1
y
PLUME WIDTH
1.0
C/Co
X2
y
PLUME CENTERLINE
X

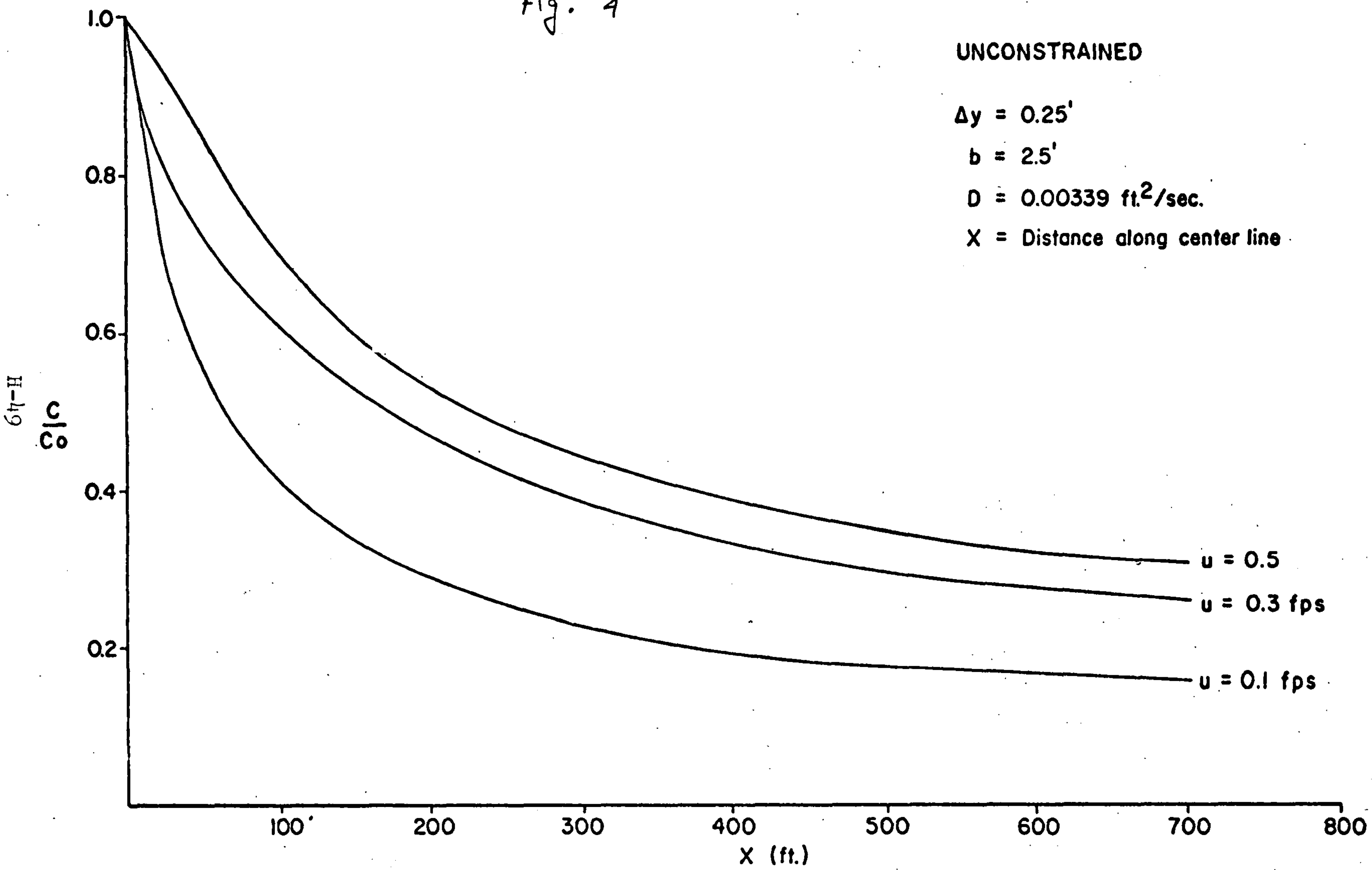
Fig. 2



Δy = .25'
b = Plume Width (2.5')
u = Velocity (0.3 fps)
D = .00339 ft.2/sec.
X = Distance along center line (ft.) from source
1/2 OF UNCONSTRAINED SYMETRICAL PLUME
50' = X
100' = X
200' = X
500' = X
C/Co
1.0
.8
.6
.4
.2
10
20
30
40
50
60
70
80
DISTANCE PERPENDICULAR TO CENTER LINE (ft.)

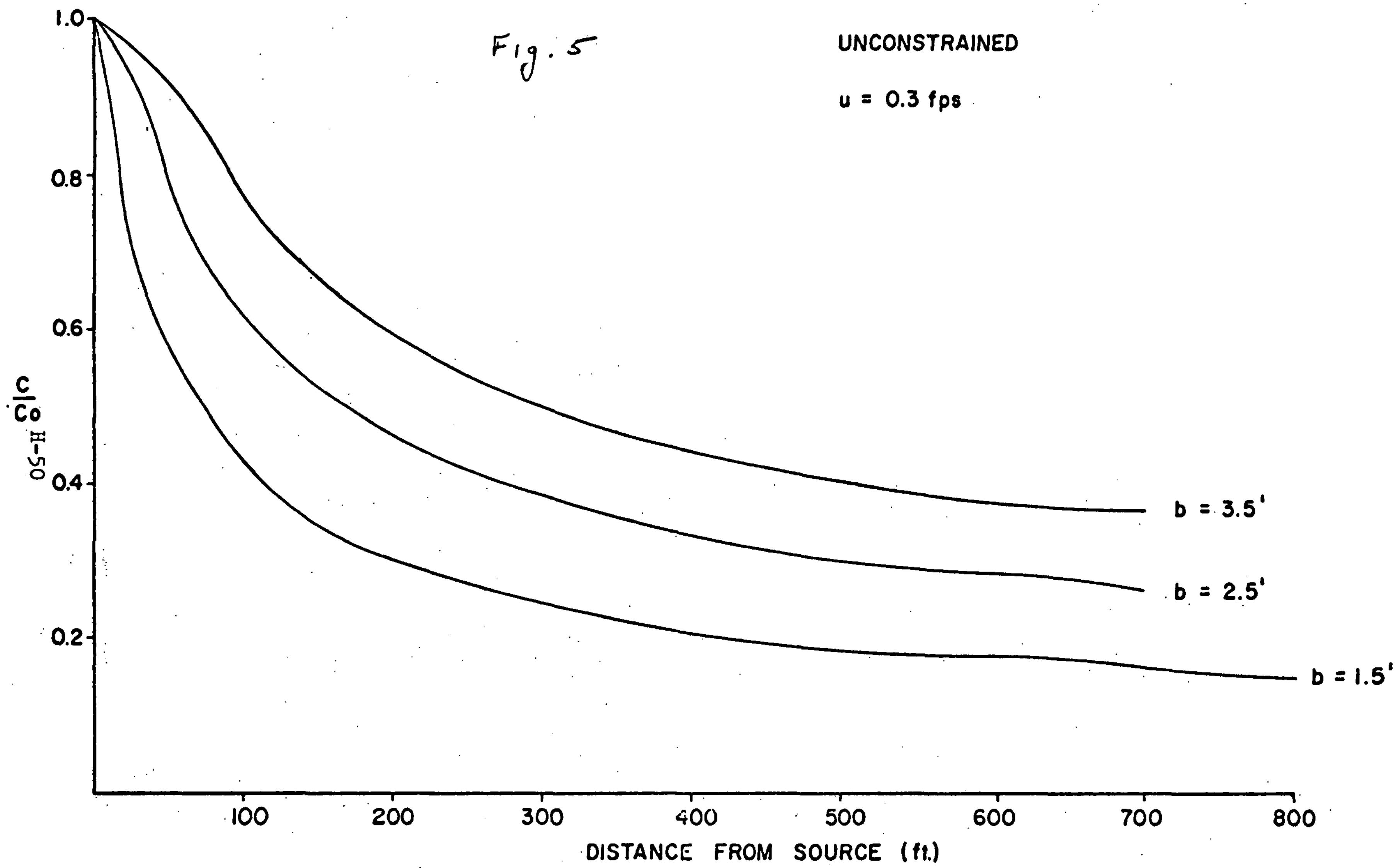
Fig. 3

Fig. 4

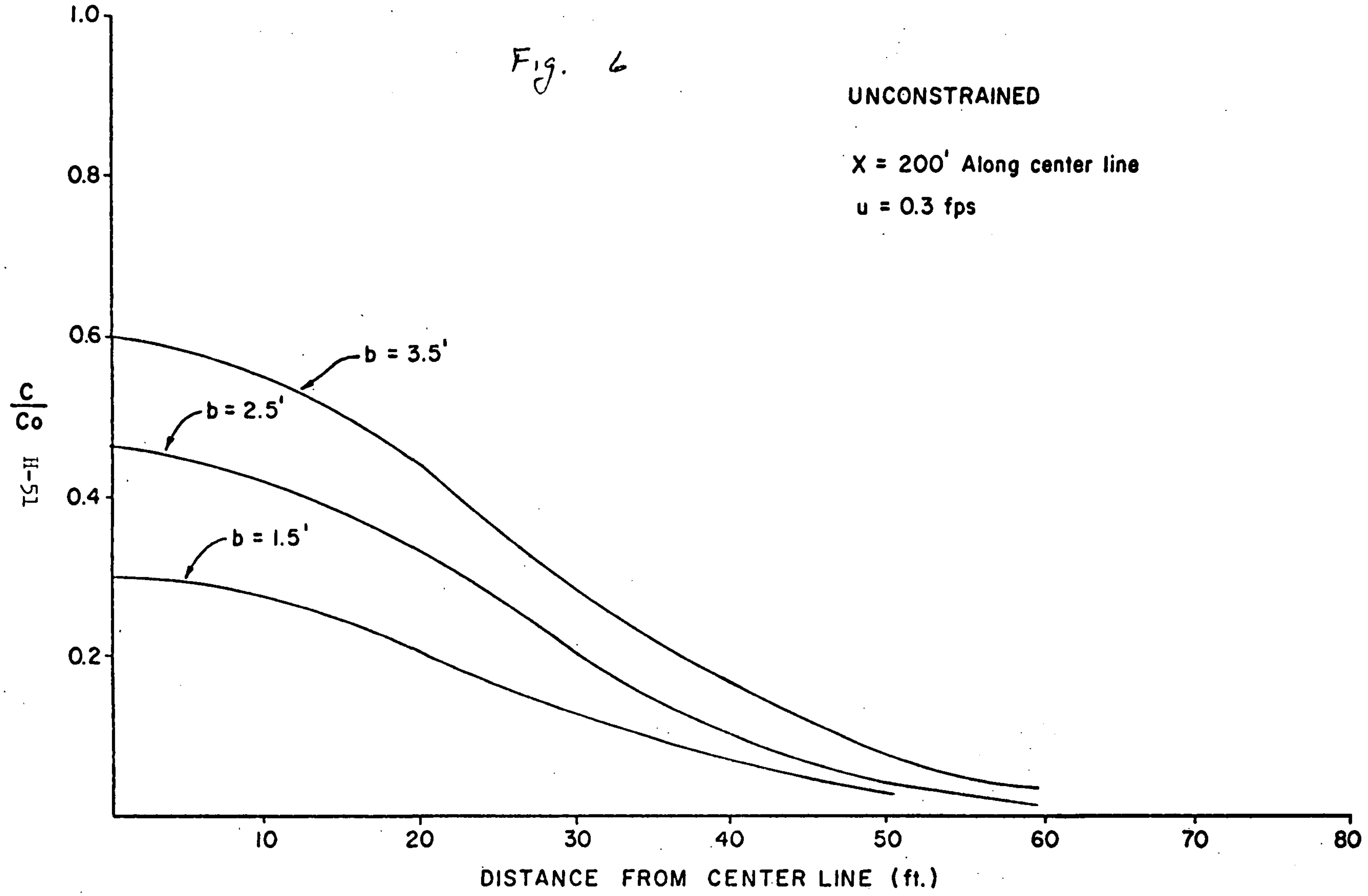


CENTER LINE CONCENTRATIONS

H-49

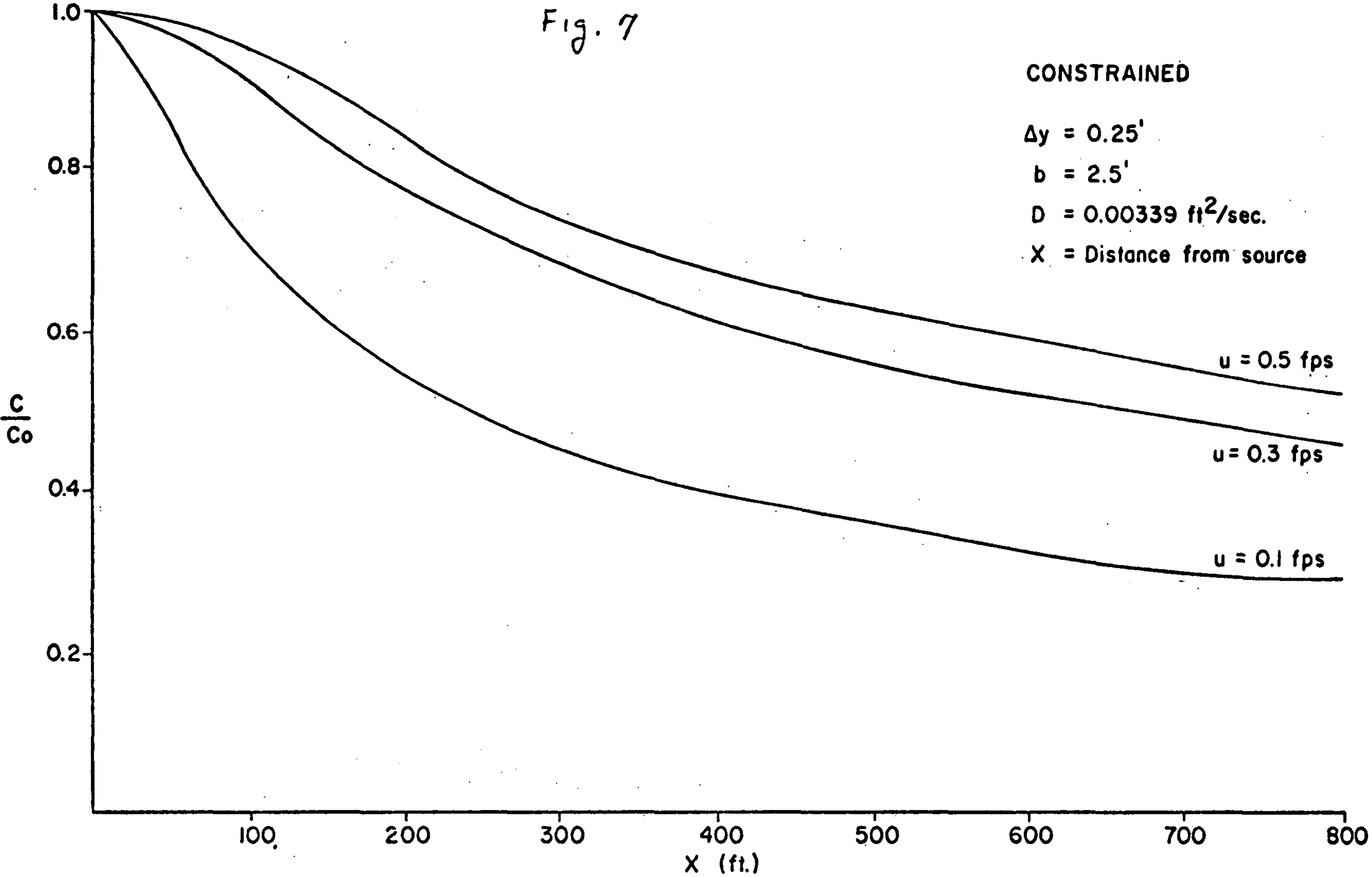


EFFECT OF SOURCE WIDTH ON CENTER LINE CONCENTRATION

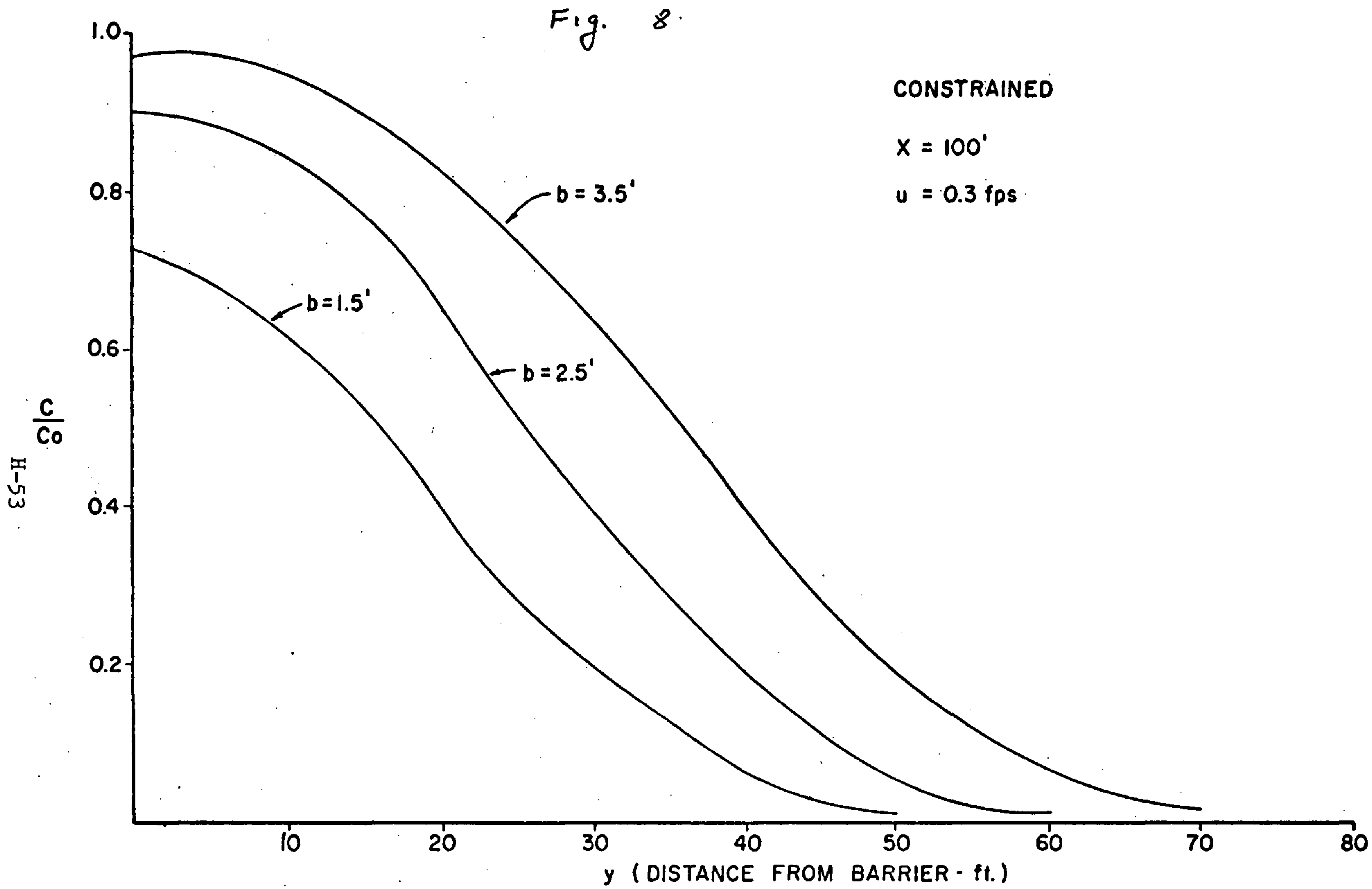


EFFECT OF SOURCE WIDTH ON CONCENTRATION PROFILE PERPENDICULAR TO CENTER LINE

Fig. 7

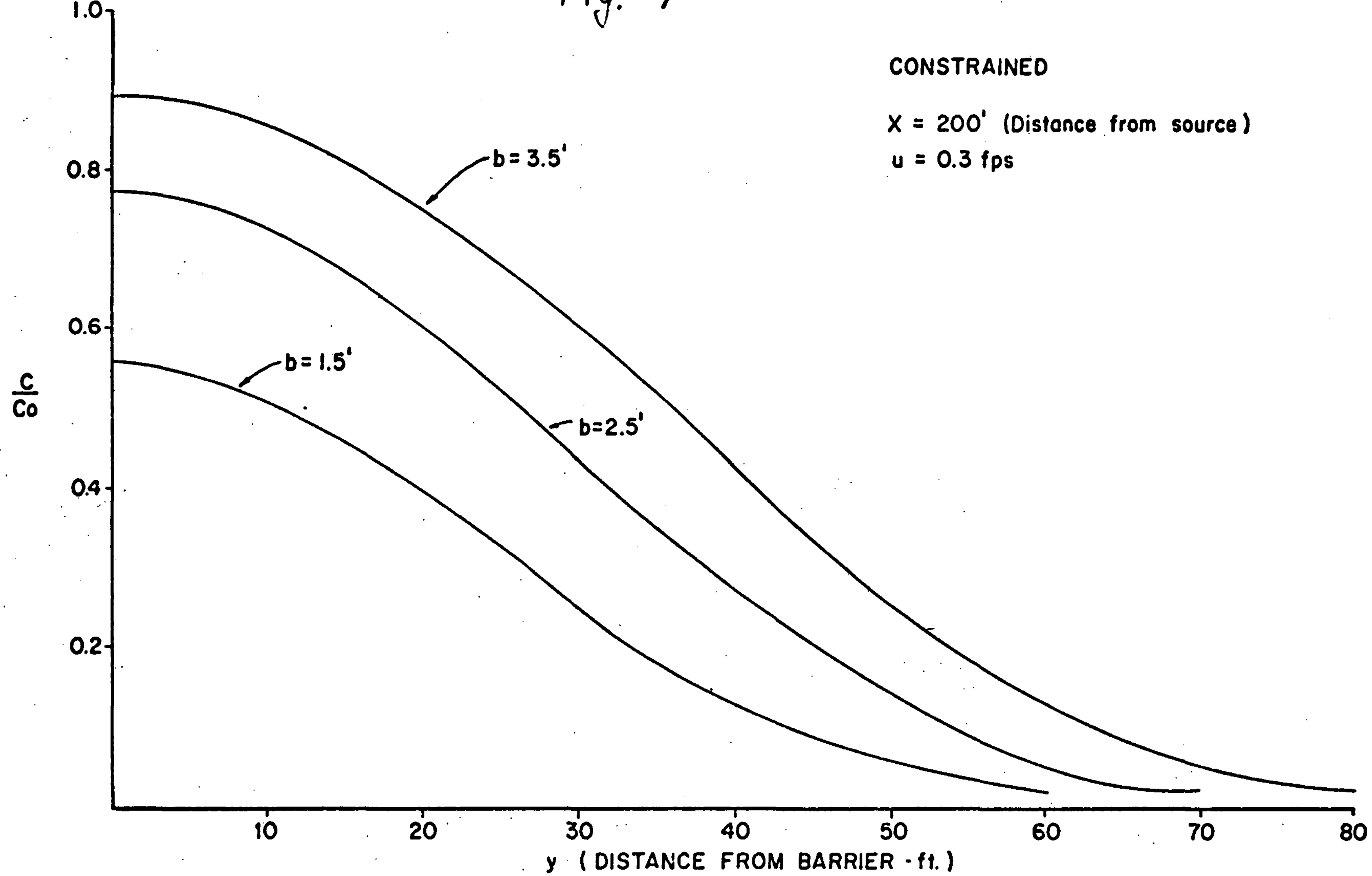


LINE OF HIGHEST CONCENTRATION (ALONG SEAWALL)

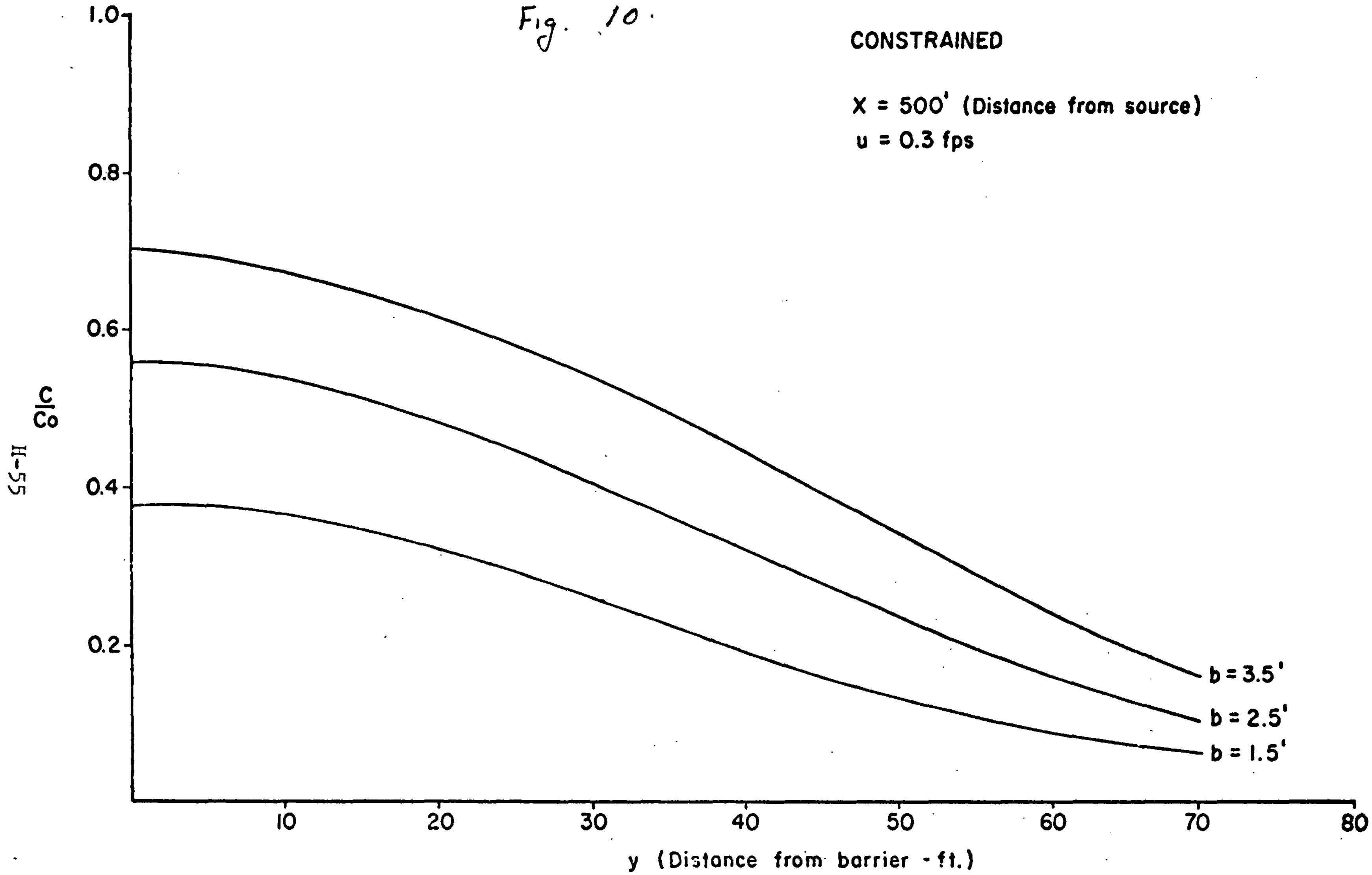


EFFECT OF SOURCE WIDTH ON CONCENTRATIONS PERPENDICULAR TO CENTER LINE

Fig. 9



EFFECT OF SOURCE WIDTH ON CONCENTRATION PERPENDICULAR TO CENTER LINE



EFFECT OF SOURCE WIDTH ON CONCENTRATION PERPENDICULAR TO CENTER LINE

Figure 3 shows the concentrations perpendicular to the plume center-line at various distances from the sewage source, for the unconstrained case. These curves show the peak decreasing, and the plume width increasing with distance from the source.

Figure 4 shows the effect of various current velocities on the dispersion of the sewage. It can be seen that higher velocities result in lower dilution of the sewage.

The reasons for this become apparent when the solution of the differential equation (2) is examined in finite difference form for the case where there is no decay:

$$C(i+1,j) = \frac{(\Delta x/b)}{(\Delta y/b)^2}\left(\frac{\epsilon}{ub}\right)\left[C(i,j-1) - 2C(i,j) + C(i,j+1)\right] + C(i,j)$$

Where:

$C(i,j)$ = Concentration at i, j

$C(i+1,j)$ = Concentration at i + 1, j

i, j = Are grid coordinates in the x and y directions respectively

ϵ = Diffusion Coeficients

u = Velocity in the x direction

b = Original source width

Δx = Grid spacing in x direction

Δy = Grid spacing in y direction

The whole first term on the right side shows the change in concentration from one grid point to the next in the x direction. This is seen to become smaller with increasing velocity u.

Figure 5 shows the effect of source width on plume centerline concentrations for a constant velocity, and the unconstrained case. This is important because various diffuser alternatives would result in different dilutions and different surface boil sizes.

Figure 6 shows the effect of source width on plume profile concentrations at a distance of 200 feet from the source.

Figures 7, 8, 9, and 10 show similar analyses for the case of a constrained plume.

Using the above generalized curves, almost any expected current strength or outfall location can be evaluated.

C. Special Surf Conditions

If an outfall is subject to surf conditions, the results of any diffuser and surface plume analysis must be evaluated in a different light. Breaking surf usually occurs when sea depths become shallow. A diffuser system that is located inside the surf line is subject to widely varying hydrodynamic forces, most of which are adverse. Swell action causes significant depth changes when compared to total depth, and local velocities near the diffusers could interfere with jet dispersion. The surface plume, when caught in a surf would experience high velocity which would be guaranteed to be shoreward in direction, and dilution would be significantly reduced. The curves for plume dilution as found in Section B would be invalid. The following is quoted from Brooks (2) pp. 262:

"The prediction of the coliform count in the surf zone presents an added difficulty because of the littoral drift, upwelling of bottom water, and the less rapid flushing in the shallow region very close to shore. Because of these effects the shore count of a given magnitude may be as much as two or three times as frequent as predicted by the above analysis. The experience of the Los Angeles County District indicates that the frequency of counts greater than 10 per ml is greater at the shore than it is offshore."

Therefore, a diffuser located in only 3 to 4 feet of water, at only two hundred feet offshore, and known to be within the surf line in some current conditions, would not be likely to produce significant sewage dilution with a high degree of confidence. Any site for an outfall which falls within the surf line should be considered a poor site.

D. Diffuser/Plume Analysis Applied to Survey Results

The EPA study of October, 1974, utilized floats and drogues in the vicinity of the proposed outfall, 225 offshore of Pebbly Beach. The study was designed to test the reasonableness of computations and assumptions made in the plume analysis. Current studies were conducted on three days. Two days during the study found almost no surf, with one day showing a predominantly south west wind (9 - 13 knots) and the other day with a north west wind (9 - 18 knots). The third day showed heavy surf

200 to 400 feet offshore in the morning with a North to North-East wind (6 - 14 knots gusting to 25 knots). The wind dropped to 5 - 8 knots from a southerly direction in the afternoon.

Drogues and floats were released periodically starting one hour after low tide, and their velocities and paths were recorded. On the second day, with a southwest wind, all drogues moved in a southeasterly direction with a velocity range of .07 fps to .4 fps with a large grouping at about .15 to .20 fps. These are within the range of velocities used to develop the curves in Section B.

The third day's work encountered winds roughly parallel to shore to almost directly on shore, NNE to SE. Heavy surf prevailed about 200 feet to 400 feet off the beach. Floats released in the surf line came up on the shore, and had an approximate velocity of 6 fps. The analysis of Sections A and B would not be valid for this condition. However, drogues released beyond the surf exhibited a definite shoreward motion soon after flood tide began, with velocities ranging from .1 fps to .6 fps. The curves derived from the analysis in Section B are valid for this situation up to the point the plume enters the surf line. The diffuser analysis of Section A applies for locations beyond the surf.

E. Example Dispersion Analysis

1. An outfall is located 225 feet offshore, with wind from the Northwest 9-13 knots.

The effluent coliform count is 2300/100ml.

The present outfall design, with seawall depth = 3.5 feet at low water produces a source width of 2.5 feet.

Dilution due to diffuser is unknown (=1).

The path of plume is 565 feet towards Old Harbor Point.

The average current velocity is 0.13 fps in that direction.

The centerline dilution is 5.8 to 1 (from Figure 4).

The centerline concentration at Old Harbor Point is 2300/5.8 = 396/100 ml

2. Same conditions as Example 1, except a diffuser with 3" ports and a Froude Number of 4.67 is used.

The dilution due to the diffuser is 7:1 (Table 1).

The dilution due to the surface plume is 5.8:1 (Figure 4).

The total dilution at Old Harbor Point is 7 x 5.8 = 40.6:1

The coliform concentration at Old Harbor Point is 2300/40.6 = 56/100ml

3. Northeast wind 6-14 knots.

Present outfall location and design.

The surf line is at 225 feet and the outfall dilution due to the diffuser is 1:1.

The dilution due to dispersion in the surface plume (velocity = 6 fps) is 1.33:1 (likely to be lower).

The coliform concentration on Pebbly Beach is 2300/1.33 = 1725/100 ml.

4. Outfall 600' offshore, northeast wind surf at 400' offshore.

The diffuser is composed of 2" ports.

The plume source width is 2.5 feet.

The depth is about 10'.

The current velocity is 0.2 fps to surf line.

The densimetric Froude Number is 13.9.

The dilution due to diffuser is found to be 30:1 (Table 1).

The dilution due to a 200 foot plume traveling to the surf line is

The total dilution is 2.5 x 30.1:1 = 75:1 at the surf line.

The coliform concentration at surf line = 2300/75 = 30./100 ml.

Any combination of possible situations can be analyzed in this manner, and the above 4 examples only illustrate possible situations.

APPENDIX I - COST BASIS FOR ALTERNATIVE ACTIONS

Alternative A: Collection and Treatment.

Cost basis: The costs for the treatment plant and sewer system are taken from the bid prices of the selected contractor.

Costs for Phase II sewers which were not included in original bid are based on Block Island estimated costs per foot of sewer installed.

House connections costs were estimated by EPA, Region I, at $500/unit.

Total Costs:

	Capital	Ave. Annual	O & M	Total Annual
Treatment Plant	$ 2,214,000	--	--	--
Sewer System	1,505,000	--	--	--
Tech. Services	338,000	--	--	--
Legal	16,000	--	--	--
Administrative	16,000	--	--	--
Contingency	184,000	--	--	--
Inspection	100,000	--	--	--
Site	10,000	--	--	--
Subtotal	$ 4,383,000	$ 382,000	$ 27,000	$ 409,000
Phase II sewers	500,000	44,000	--	44,000
House Connections	150,000	13,000	--	13,000
Total	$ 5,033,000	$ 439,000	$ 27,000	$ 466,000

Alternative B: Collection and Treatment minus Phase II sewers.

Cost basis: Future sewer constructions costs for Phase II eliminated. Existing septic systems in Phase II areas adequate. Future septic tank construction estimated at $225,000.

Design of treatment facility reduced by amount of flow estimated for Phase II or approximately 60,000 gpd.

Reduction in cost of treatment facility interpolated from EPA, Region I cost curves. Therefore, a 240,000 gpd treatment facility would cost $2,000,000 (this does not include any redesign costs).

Total Costs:

	Capital	Ave. Annual	O & M	Total Annual
Treatment Plant	$ 2,000,000	--	--	--
Sewer System	1,505,000	--	--	--
Tech. Services	300,000	--	--	--
Legal	14,000	--	--	--
Administrative	14,000	--	--	--
Contingency	140,000	--	--	--
Inspection	100,000	--	--	--
Site	10,000	--	--	--
Subtotal	$ 4,083,000		$ 25,000	
Future Phase II septic system construction	225,000	--	--	--
House Connections	100,000	--	1,000	--
Total	$ 4,408,000	$ 384,000	$ 26,000	$ 410,000

Alternative C: Rehabilitation of Individual Subsurface Disposal Systems.

Cost basis*:

Construction or reconstruction of single home septic system	=	$ 4,000.
Construction or reconstruction of multiple unit S.S. with average daily flow less than 2,000 gallons	=	10,000.
Construction or reconstruction of multiple unit S.S. with average daily flow between 2,000-5,000 gallons	=	25,000.
Construction or reconstruction of multiple unit S.S. with average daily flow over 5,000 gallons	=	50,000.

Annual Cost Basis:

Assumed each septic tank must be pumped once every three years @ = $60/pumping

Therefore, 207 units (Phase I only) at a design life of 20 years will require

1,400 pumpings @ $60/per = $84,000 ÷ 20 years
= 4,200 or $4,500/yr.

Estimated units from Fenton G. Keyes Associates projections Appendix F, less Phase II.

Total Costs:

	Capital	Ave. Annual	O & M	Total Annual
Construction of Septic Systems in Phase I areas	$ 1,801,000	$ 157,000	$ 4,500	$ 161,500
New Construction of septic systems in Phase II areas	225,000	19,000	500	19,500
	$ 2,026,000	$ 176,000	$ 5,000	$ 181,000

*SOURCE: Tony Lafasio, Rhode Island Department of Health

Alternative D: Collection and treatment of Old Harbor only. Rehabilitation of individual septic systems for remainder of Phase I area.

Cost basis: Sewer construction of Phase II eliminated.

Sewer construction for "Old Harbor Only" taken from bid costs - $1,505,000 - 405,000 = $1,100,000.

Treatment plant design average flow reduced by 50,000 gpd (Phase II) and 114,400 gpd (New Harbor area). Reduction in cost of treatment facility interpolated from EPA curves. Therefore,

300,000 - (60,000 + 114,000)
= 126,000 gpd or $1,300,000

Reconstruction or new construction of septic systems in New Harbor estimated at $700,000. Future construction of septic systems in Phase II areas estimated at $225,500.

Total Costs

	Capital	Ave. Annual	O & M	Total Annual
Treatment Plant	$ 1,300,000	--	--	--
Sewer System	1,100,000	--	--	--
Tech. Services	240,000	--	--	--
Legal	10,000	--	--	--
Administrative	10,000	--	--	--
Contingency	100,000	--	--	--
Inspection	50,000	--	--	--
Site	10,000	--	--	--
Subtotal	$ 2,820,000		$ 20,000	
House Connections	75,000	--	--	--
Individual Septic systems in Phase I	700,000	--	2,500	--
Future septic systems in Phase II	225,000	--	--	--
Total	$ 3,820,000	$ 312,000	$ 22,500	$ 335,000

APPENDIX J - IMPACT OF SEWERS ON SPECIFIC SECTORS OF THE ISLAND

Following is an analysis of the growth and environmental impact of Phase I and Phase II sewer lines, or the potential for connecting to these sewer lines, in the various sectors of the Island. Refer to Maps, Alternative A superimposed on environmental sensitive areas and cultural features.

New Harbor

A sewer to the New Harbor marinas would extend from Old Harbor for 1.5 miles along Ocean Ave and West Side Road, plus a Beach Ave loop, through extensive vacant land, highly attractive for development, yet largely environmental-critical marshland, shoreland, and scenic uplands. This line, and the potential for connections, would, based on all experience elsewhere, open up for resort and summer house development the mid portion of the Island, adversely altering the environment of Great Salt Pond, its shoreline, marshes, and moor-pasture uplands rising to the south.

Specifically, the West Side Road sewer to Champlins marina could encourage condominium and resort development along West Side Road and, in addition, the opportunities for connections to this sewer could spur condominiums and medium density residential subdivisions to the west along West Side Road and Center Road and to the south toward Beach Hill Road. This would press upon salt water marshes, fresh water marshes, ponds and shorelands and bring strong pressures for intensive resort development within the storm inundation areas adjacent to Great Salt Pond and the extensive lowlands below the hurricane high waterline. If such developments were to occur and suffer flood and hurricane damage, pressures could, in turn, mount for flood protection projects, which would be costly and damaging to the wetland ecosystems and scenery. These development pressures could defeat CCP proposals to preserve as a conservation area Cormorant Point and Cove Northwest to Champlins marina and the Charlestown Beach Peninsula. Southwest to West End Road, it would crowd open bayberry heath, up land pasture, vegetative cover, and scenic vistas of the Great Salt Pond.

Northern Section

With a basic sewer system in Old Harbor, the potential for extension northward along Corn Neck Road would stimulate beach condominiums and houses between the road and the southeast embayments of Great Salt Pond (especially Harbor Pond). Unless this development were carefully confined to the higher ground (as proposed in Bradford), it would encroach upon the salt marshes. Some of the area is subject to storm inundation and lies within the hurricane high water line. Dense development would diminish views of Old Harbor, the ocean, Great Salt Pond and the North Neck uplands.

Old Harbor

Development associated with the basic sewer system might bring pressures to fill in a portion of the marshy area at the foot of High St. - near the commercial center. More intense development would fill in the "vacant" open spaces and vegetation and might stimulate construction that would diminish the area's essential openness and charm. Construction of new architectural styles might clash with the older styles and historic character. Development of the open spaces surrounding the Old Harbor care would further diminish this appeal.

On the other hand, construction of a sewer system would permit concentrations of people and buildings and encourage restoration and additions to strengthen a compact town center, without the density limits set by individual subsurface disposal systems. But proliferation of the system into the hinterland, particularly to New Harbor, might actually turn additional investment and development away from restoration of Old Harbor.

Southeast Sewer Extensions - Phase I and II

Pressures for summer home development have already been demonstrated in the construction of approximately 60 new homes in this section since 1957.

The Pilot Hill Road sewer extension southward and upward from the school would support growth in the lower perched ground water zone, on which much of the Island's population depends for water supply. The area embraces Sands Pond and a number of other ponds. Lacking outlets and small in size, these ponds have little capacity for self-cleansing: they are extremely sensitive to pollutants from construction activity and from runoff from build up areas. The area embraces approximately 20 percent of the Island's taller, heavier coastal shrub cover and approximately 20 percent of its agricultural land.

The entire area is recommended for "low residential, open space preservation" in Bradford. That portion west of Pilot Road embraces a proposed park for extensive recreation - water supply - conservation uses, and that portion east of Pilot Road for "low density residential" in CCP.

The Southeast Road extension, together with lateral interceptors, would cumulatively crowd the breathtaking open vistas of, moor, farmland, stone-walled pastures and ocean. There would be a lesser impact on water supply. The area west of the road, as Bradford suggests, is generally best suited to "low residential, open space preservation", but the area east of the road may accommodate, if desired, a ring of "medium" to "dense residential" development.

The Conn. Ave. extension could encourage connections of development impinging upon Great Swamp. On the other hand, the high ground immediately to the east of the Connecticut Ave. terminus appears suitable for development and offers vistas of Old Harbor. It is proposed for "commercial" and "dense residential" in Bradford, and for "medium" and "low" residential in CCP. Dense development here would enclose some of Old Harbor's open, vegetative backdrop. This closing in upon open space would become more pronounced as development were extended as a belt along the hillsides to the south of Old Harbor.

South-Southwest

The Old Town Road-Center Road extension would also traverse upland moor and wooded areas southwesterly from Old Harbor. Large sections would traverse a strip deemed suitable for "dense residential" in Bradford and for "medium density residential" in CCP. But, this extension could also induce development of intermingled wetlands to the south of Old Town Road. In addition, the associated development would diminish the backdrop to Old Harbor of some of the Island's taller coastal shrub and moors. Sedimentation and other pollutants associated with the increased land runoff from construction and denser settlement would wash into the fragile wetlands and ponds, which have little flushing action.

APPENDIX K

UNITED STATES DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

222 Quaker Lane, West Warwick, Rhode Island 02893

November 12, 1974

Mr. Mark Possidento
Sanitary Engineer
US Environmental Protection Agency
Region I
J. F. Kennedy Building
Boston, Mass. 02203

Re: New Shoreham, Rhode Island
Impact Statement

Dear Mr. Possidento:

As requested, our Agency has completed a review of the "Preliminary Engineering Survey and Report on Control of Water Pollution for the Town of New Shoreham". This review has been separated into two sections: The first being of erosion and sediment control during construction and the second section dealing with an evaluation of the soils of the land disposal and sludge disposal sites.

SECTION #7 - GEOLOGY:

The majority of the soils on New Shoreham are underlain either by stratified sands and gravels or coarse textured glacial till. This fact is going to make it important that provisions are made to control erosion and sediments of this erosive soil material during excavation and construction. There is also growing concern that these permeable soils may lead to contamination of ground waters because effluent may pass through them to rapidly to be adequately filtered if ground waters are relatively close to the surface.

SECTION #11 - DESIGN OF SEWAGE SYSTEM:

Because many of the soils found on the Island are erosive and the topography of the "Area of Study Concentration" is steep and undulating, it is our opinion that a plan for the control of erosion and sediment needs to be included in the design of the sewage system. Such a plan should include provisions to reduce erosion from excavation areas, stock-piled soil material, construction sites and final revegetation after construction.

Probable practices that may be required in an erosion and sediment control plan include: temporary and permanent seeding of critical areas, sediment basins, diversions, interceptor dikes, mulching, drainage, log or baled hay erosion checks, heavy use area protection and tree planting.

Our Agency is willing to cooperate with the firm awarded the design contract for this project to develop an erosion and sediment control plan once this proposal has reached that stage.

SECTION #13 - SEWAGE TREATMENT PLANT SITE:

The last paragraph in this section discusses the "landscaping of the plant site in a pleasing fashion". We would like to caution that this landscape plan include only those plant materials that are tolerant and adapted to "salt spray" such as: Japanese Black Pine, Russian Olive, Tatarian Honeysuckle and Scotch Broom. We would recommend Dr. Robert Wakefield, Professor - Plant and Soil Science, College of Resource Development, University of Rhode Island, in regards to salt tolerant plant materials.

SECTION #15 - COST ESTIMATES:

Cost estimates should be developed to include necessary expenditures for erosion and sediment control measures.

The second part of this report deals with an evaluation of the soils of the land disposal and sludge disposal sites. To complete this part of the report we had our soil scientist update and re-map the soil survey of those sites that you had indicated on the topo map. The results of the soil survey is enclosed on the attached photo copies. The areas we were asked to investigate are shaded in "red".

The following is a list of the soils found on these properties and a brief description of them:

16A - - BRIDGEHAMPTON SILT LOAM: This is a deep silty soil on 0-3% slopes underlain by stratified sands and gravels. Depth to bedrock is generally greater than 10 feet and depth to seasonal high water table is greater than 4 feet. Surface drainage is slow to rapid depending on the slope and soil cover. Internal drainage and permeability are moderate in the upper sequim. The lower sequim may be water-logged in winter, early spring and after heavy rains because of the strongly contrasting textures in the lower solum and the substratum. The permeability range of this soil is between 0.6 and 2.0 inches per hour. The available water holding capacity of this soil is 0.18 to 0.30 inches per inches of soil.

16B - - BRIDGEHAMPTON SILT LOAM: This is the same soil as 16A except that the slopes will range from 3-8%.

27A - - HINCKLEY GRAVELLY SANDY LOAM: This is an excessively drained sandy soil underlain by stratified sands and gravels on 0-3% slopes. Depth to bedrock is generally greater than 10 feet and depth to seasonal high water table is greater than 4 feet. This soil has been developed from deep outwash deposits of sand and gravel. The permeability range of this soil will be something greater than 6.0 inches per hour and the available water holding capacity of this soil is between 0.06 and 0.14 inches per inch of soil.

27C - - HINCKLEY GRAVELLY SANDY LOAM: This is the same as 27A except that the slopes will range from 3-15%.

27D - - HINCKLEY GRAVELLY SANDY LOAM: This is the same soil as 27A except that the slopes will range from 15-25%.

28C - - HINCKLEY-ENFIELD COMPLEX: The soils in this unit occur in such an intricate and complex pattern that it is not practical to separate them with the scale used. This complex includes both well drained sandy and silty soils underlain by stratified sands and gravels on slopes ranging from 0-15%. The permeability range of this soil is between 0.60 and 6.0 inches per hour. The available water holding capacity of this soil is between 0.06 and 0.30 inches per inch of soil.

50A - - ENFIELD SILT LOAM: This is a well drained silty soil on 0-3% slopes underlain by stratified sands and gravels. These soils are on terraces and outwash plains formed by glacial melt waters. Depth to bedrock is generally greater than 10 feet and depth to seasonal high water table is greater than 4 feet. The upper 2 feet of this soil has a permeability range from 0.60 to 2.0 inches per hour. The permeability range in the substratum will be greater than 6.0 inches per hour. The available water holding capacity in the upper 2 feet will be between 0.16 and 0.30 inches per inch, below 2 feet it will be between 0.01 and 0.08 inches per inch.

51B - - WINDSOR LOAMY SAND: This is an excessively drained sandy soil on 3-8% slopes underlain by sands. Depth to bedrock is generally greater than 10 feet and depth to seasonal high water table is greater than 4 feet. The permeability of this soil will be something greater than 6.0 inches per hour. The available water holding capacity of this soil is between 0.01 and 0.12 inches per inch of soil.

53 - - RAYNHAM SILT LOAM: This is a poorly drained silty soil on slopes of 0-3% underlain by stratified sands and gravels. Depth to bedrock is generally greater than 10 feet and depth to seasonal high water table is commonly between 0.5 and 1.5 feet of the surface. Internal drainage is slow because of the high water table that occurs in the winter and spring. The permeability of this soil will range from 0.60 to 2.0 when the water table is down and the available water holding capacity of this soil is between 0.17 and 0.30 inches per inch of soil. The high water table condition of this soil restricts its uses.

54 - - BELGRADE SILT LOAM: This is a moderately well drained deep silty soil on 0-3% slopes underlain with stratified sands and gravels. Depth to bedrock in this soil is generally greater than 10 feet and the water table is usually within 2 feet of the surface from late fall to early spring. During the summer and early fall the water table recedes to below 4 feet. The permeability range of this soil is between 0.60 and 2.0 inches per hour when not being restricted by the high water table. The available water holding capacity of this soil ranges between 0.17 and 0.24 inches per inch of soil.

61 - - TISBURY SILT LOAM: This is a moderately well drained soil on 0-3% slopes underlain with stratified sands and gravels. Depth to bedrock in this soil is generally greater than 10 feet and the water table is usually within 2 feet of the surface from late fall to early spring. During the summer and early fall the water table recedes to below 4 feet. The permeability range of this soil in the upper two feet is between 0.60 and 2.0 inches per hour; when not restricted by high water tables, the substratum in this soil will have a permeability rate greater than 6 inches per hour. The available water holding capacity of this soil ranges between 0.01 and 0.30 inches per inch of soil.

68B - - BROADBROOK SILT LOAM: This is a well drained soil on 3-8% slopes underlain by glacial till. In Rhode Island these soils have an impervious fragipan at a depth of 30 inches or more. Depth to bedrock in this soil is generally greater than 10 feet and depth to seasonal high water table is greater than 4 feet. The permeability range in the upper 3 feet of this soil will be between 0.60 to 2.0 inches per hour; below this depth the fragipan will restrict to permeability to less than 0.20 inches per hour. The available water holding capacity of the upper 3 feet of this soil is between 0.15 to 0.30 inches per inch; below 3 feet the range will be between 0.08 to 0.16 inches per inch.

117B - - AGAWAM FINE SANDY LOAM: This is a deep well drained soil on 3-8% slopes underlain by coarse textured outwash materials. Depth to bedrock in this soil is generally greater than 10 feet and depth to seasonal high water table is generally greater than 4 feet. The permeability range in this soil will be between 2.0 to greater than 6.0 inches per hour. The available water holding capacity of this soil in the upper 2 feet will range from 0.11 to 0.25 inches per inch, below 2 feet the range will be from 0.01 to 0.09 inches per inch.

The above brief descriptions of the soils found on the lands tentatively proposed as possible land disposal sites (irrigation of liquid effluent) and sludge disposal sites leads to the conclusion that the sites picked are generally well suited for the intended uses. The exception to this general statement would be Raynham, Belgrade and Tisbury Silt Loam which have a high seasonal water table condition that may restrict their use during periods of the year.

Both the existing sludge disposal site and the proposed sludge disposal site are suited for land fill and disposal areas because they are well drained, deep coarse textured soils that we estimate from topographic maps that the water table will be between 30 to 40 feet deep.

Another important consideration is that the Towns' wells are located on the property indicated just north of Sands Pond as a possible land disposal area. Detailed investigation would be recommended to determine that the ground water supply would not become contaminated.

In this review we have attempted to point out some items we feel need further consideration in the areas in which our Agency has expertise. It is hoped that our suggestions and recommendations will be useful in strengthening this already fine "Preliminary Engineering Survey and Report". If we can be of further assistance please contact our office.

Sincerely,

Thomas E. Jewett, Actg

Austin L. Patrick, Jr.
State Conservationist

Attachments

APPENDIX L

STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS

HISTORICAL PRESERVATION COMMISSION
John Brown House
52 Power Street
Providence, R.I. 02906
(401) 277-2678

September 16, 1974

Mr. John McGlennon, Regional Administrator
Environmental Protection Agency
John F. Kennedy Federal Bldg.
Boston, Mass. 02203

Dear Mr. McGlennon:

At the request of your office, we have reviewed the plans for the proposed sewage treatment facility at Block Island. We understand that considerable discussion of alternative sites has already taken place.

The fact that the location chosen falls within the National Register Historic District is unfortunate. However, preliminary survey by our Commission indicates that several other districts could be identified as eligible for the Register, and possibly the whole island could be considered as a district, as has been done at Nantucket. This means that any location could possibly affect historic sites, and therefore an attempt to minimize impact should be the goal.

In its presently planned location, we are concerned with the sewage facility's proximity to the Shamrock Inn, recently purchased and slated for restoration. We feel it is essential that improvements be made in the design of the fence surrounding the aerating tanks, and provision made for plantings which could provide a more effective screen between the facility, the hotel, and the nearby church.

We feel that the construction of the sewage treatment facility at Block Island is in the best interests of historic preservation there. We would be happy to advise on the design of a suitable fence and landscape planning which could effectively accomplish the screening which we propose. We certainly want to review final plans for improvements in this area, but see no reason why this could not be done as construction progresses.

Sincerely,

Richard Alan Dow
Executive Director

RAD/dn

cc Mr. Herbert S. Whitman

APPENDIX M - STATE OF RHODE ISLAND MINIMUM STANDARDS RELATING TO LOCATION, DESIGN, CONSTRUCTION, AND MAINTENANCE OF INDIVIDUAL SEWAGE DISPOSAL SYSTEMS

(see following pages)

R23-1-SD

RULES AND REGULATIONS ESTABLISHING MINIMUM STANDARDS RELATING TO LOCATION, DESIGN, CONSTRUCTION AND MAINTENANCE OF INDIVIDUAL SEWAGE DISPOSAL SYSTEMS

AS AMENDED JULY 1973

STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS

DEPARTMENT OF HEALTH

AUTHORITY: Chapter 23-1-17 and 23-1-18 (6) of the General Laws of 1956, as amended

NEW AMENDMENTS EFFECTIVE 30 AUGUST 1974

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DEPARTMENT OF HEALTH

RULES AND REGULATIONS ESTABLISHING MINIMUM STANDARDS RELATING TO LOCATION, DESIGN, CONSTRUCTION, AND MAINTENANCE OF INDIVIDUAL SEWAGE DISPOSAL SYSTEMS

PART A. DEFINITION OF TERMS

R23-1-SD 1.00 Definitions

As used in these rules and regulations, the following terms shall, where the context permits, be construed as follows:

SD 1.01 Alteration - Alteration shall be held to mean any change in size or type of system or installation of a replacement system.

SD 1.02 Building Sewer - The building sewer shall be held to mean the pipe which begins three feet outside the building wall and extends to a public sewer, septic tank, or other place of sewage disposal.

SD 1.03 Cesspool - The term cesspool shall be held to mean a covered pit with open-jointed sidewall lining and an earth bottom into which raw sewage is discharged.

SD 1.04 Director - The term director shall mean the director of health of the state of Rhode Island or his duly authorized agent.

SD 1.05 Disposal Bed - A disposal bed for sewage shall be held to mean a shallow excavation in the ground, backfilled with stone in which open-jointed or perforated distribution lines are laid and over which a cover of earth is placed.

SD 1.06 Disposal Trench - A disposal trench shall be held to mean a shallow ditch with vertical sides, filled with stone, in which a single distribution line is laid and over which a cover of earth is placed.

SD 1.07 Distribution Box - A distribution box shall be held to mean a water-tight structure which receives septic tank effluent and distributes it in substantially equal portions to two or more pipe lines leading to some type of seepage system.

SD 1.08 Distribution Line - A distribution line shall be held to mean an open-jointed or perforated pipe used to disperse septic tank effluent.

SD 1.09 Dosing Tank - A dosing tank shall be held to mean a watertight structure placed between a settling or septic tank and a distribution box and equipped with one or more siphons or pumps designed to discharge sewage intermittently into a seepage system.

SD 1.10 Impervious - For the purposes of these regulations, any soil with a percolation rate in excess of 40 minutes per inch, or any ledge or shale are considered impervious and unsuitable for individual sewage disposal systems.

SD 1.11 Individual Sewage Disposal System - An individual sewage disposal system shall be held to mean one installed to provide sanitary sewage disposal by leaching into the ground where no public sewer system is available or accessible.

SD 1.12 Invert - The invert shall be held to mean the lowest portion of the interior of a pipe or fitting placed horizontally.

SD 1.13 Leaching Area - The leaching area, when applied to a disposal trench or disposal bed shall be held to mean the bottom area of the trench or bed; when applied to a seepage pit, the combined bottom area and sidewall area below the inlet pipe; when applied to a cesspool, the sidewall area below the inlet pipe, only.

SD 1.14 Maximum Ground Water Table Elevation - The maximum ground water table elevation shall be held to mean that observed when the ground water is at its highest level during the year or the highest level observed in past years when such inforamtion is available.

SD 1.15 Owner - Owner shall be held to mean any person who alone, or jointly, or severally with others (a) has a legal title to any premises, or (b) has control of any premises as agent, executor, executrix, administrator, administratrix, trustee, lessee, or guardian of the estate of a holder of a legal title. Each such person is bound to comply with the provisions of these rules and regulations.

SD 1.16 Person - The term person shall include any individual, group of individuals, firm, corporation, association, partnership or private entity, including a district, county, city, town, or other governmental unit or agent thereof, and in the case of a corporation, any individual having active and general supervision of the properties of such corporation.

SD 1.17 Privy - A privy shall be held to mean a structure used for a toilet lacking the flushing aid of water. It consists of a shelter built above a pit or vault in the ground into which the waste matter falls.

SD 1.18 Repair - Repair shall be held to mean replacement of septic tank, distribution box, leach field, or pipes connecting same with no change in type of material, location, or area of system.

SD 1.19 Sanitary Sewage - Sanitary sewage shall be held to mean any human or animal excremental liquid or substance, any putrescible animal or vegetable matter, garbage and filth, including the discharge of water closets, laundry tubs, washing machines, sinks, dishwashers, and the contents of septic tanks, cesspools, or privies.

SD 1.20 Seepage Pit - A seepage pit shall be held to mean a covered pit with open jointed sidewalls and bottom, from which septic tank effluent is leached into the soil.

SD 1.21 Septic Tank - A septic tank shall be held to mean a water-tight receptacle which receives the discharge of sewage from a building sewer, and is designed and constructed to permit the deposition of settled solids, the digestion of the matter deposited, and the discharge of the liquid portion into a leaching system.

SD 1.22 Siphon - A siphon shall be held to mean a hydraulic device designed to discharge the contents of a dosing tank rapidly when a predetermined level is reached.

SD 1.23 Slope or Grade - Slope or grade shall be held to mean the rate of fall or drop of a pipe line or of the ground surface in reference to a horizontal plane. It is commonly expressed as fall or drop in inches per 100 feet, inches per foot, or feet per 100 feet.

SD 1.24 Subdividing - Subdividing for the purposes of these regulations shall be held to mean the division of a lot, tract or parcel of land into three (3) or more lots, sites or other division of land for the purpose, whether immediate or future, of building development.

SD 1.25 Subsurface Drains - A subsurface drain shall be held to mean a deep trench intended to lower the water table of an area where an individual sewage disposal system is to be located. It shall consist of not less than 6 inches of washed stone ½ inch to 2 inches in diameter, over which is laid a perforated or open jointed pipe. The stone shall extend above the pipe to within 2 feet of the ground surface, and then be covered with at least a 2 inch layer of washed pea stone or a 2 inch layer of straw or hay, or by a layer of untreated building paper. The size of the pipe used shall be at least 4 inches in diameter when less than 3 lots are being drained; otherwise the pipe must be at least 8 inches in diameter.

SD1.26 Test Pit - A test pit shall be held to mean an open pit dug to permit an examination of the soil profile, and a determination of the elevation of the ground water table.

SD 1.27 Watercourse - The term watercourse shall be held to mean any tidewater, or any river, stream, brook, pond, lake, swamp, or any other standing or flowing body of water.

SD 1.28 Well - A well shall be held to mean an opening into the ground or bedrock located safely in respect to sources of pollution, encased, covered and equipped in a sanitary manner, and yielding supply of potable water safe for human consumption sufficient to meet the needs of the property on which it is located and ordinarily used as a drinking water supply.

PART B-1 APPLICATION AND CONDITIONS FOR APPROVAL

R23-1-SD 2.00 Disposal of Sewage

SD 2.01 Approval of an Individual Sewage Disposal System - No person shall install, construct, alter, or repair or cause to be installed, constructed, altered, or repaired any individual sewage disposal system, nor shall he begin construction of any improvement to his property from which sewage will have to be disposed of by means of an individual sewage disposal system until he has obtained the written approval of the director of the plans and specifications for such work. Repairs or alterations shall, insofar as possible, comply in every respect with the standards set forth in these regulations.

Note: A municipality may only grant a building permit according to the provisions of Chapter 23-27-6 of the General Laws of the State of Rhode Island as amended.

SD 2.02 Application for Approval of a New Sewage Disposal System -

(a) The application for approval of plans and specifications for a new sewage disposal system shall be made on forms provided by the director.

(b) It shall be accompanied by basic design data, and a plan, to scale, of the property or pertinent portion thereof showing the size and location of the sewage disposal system, also manholes, cleanout plugs, essential invert elevations, and a fixed bench mark that can be readily referenced and that will not be disturbed during construction.

(c) Other information to be provided includes: 1. present, and proposed finished grades. 2. the location of test pits. 3. the results of percolation tests. 4. a description of the type of soil. 5. the maximum elevation of the ground water table in the location of the proposed seepage system, and 6. size and location of building(s).

(d) The location of any drinking water line within 25 feet, and any well, watercourse or drain within 200 feet of the proposed disposal system must be shown.

(e) Approval granted an applicant shall expire two years from the date of its issuance if construction has not begun in that period. It may be renewed if the data provided in the application is unchanged. All required design criteria shall be included.

SEE ATTACHED AMENDMENTS

(f) The location of existing individual sewage disposal systems within 100 feet of any well to be installed on subject property must also be shown.

(g) *Nothing in the foregoing shall prevent the director from requiring any additional information he deems necessary to carry out his obligations for approving an application.*

SD 2.03 Repair and Alteration - Application must be made for repair or alteration of a system. Requirements for repair or alteration under these regulations may be waived at the discretion of the director.

SD 2.04 Use - The use of an individual sewage disposal system shall conform to the terms of the approval; its designed capacity must not be exceeded.

SD 2.05 Certification of Conformance - A newly constructed, altered or rebuilt individual sewage disposal system, shall not be covered with earth until the director shall have inspected it and certified in writing that it conforms with the terms of the approval granted under the provisions of these regulations. Said system shall be covered within 48 hours after inspection and approval. No dwellings, buildings, or additions thereto, to be served by such a system, shall be sold or occupied until the entire system is completed, including the covering of the system and the necessary grading to divert surface water from the area of the leaching field.

SD 2.06 Inspection - The director may inspect the installation of an individual sewage disposal system at any stage of its construction, and may require its modification if unanticipated conditions are disclosed which make it necessary. If changes from the approved plans and specifications are found necessary, revised plans must be submitted for review and approval.

SD 2.07 Discharge to a Watercourse - No person shall discharge or permit the entrance of sanitary sewage, treated or untreated, into any watercourse, nor shall he discharge or permit the entrance of such sewage into any open or covered drain tributary to such waters, without having obtained an order from the director approving the same.

SD 2.08 Discharge on or to the Surface of Ground - No person shall discharge or permit the overflow or spillage of any sanitary sewage on or to the surface of the ground, provided, however, this shall not interfere with the spreading of animal manure on the surface of the ground in an amount not in excess of that essential to meet agricultural requirements, and that will not cause water pollution.

SD 2.09 Dwelling or Building - Each dwelling or other building having plumbing fixtures, or on which sanitary sewage is produced, in a location where no public sanitary sewage system is available or accessible, shall be provided with an individual sewage disposal system of type and design approved by the director.

SD 2.10 Connection to a Public Sanitary Sewer - An individual sewage disposal system shall not be approved for use on any premises if a public sanitary sewer is accessible to such premises, and permission to enter it can be obtained from the authority having jurisdiction. When problems are encountered in the operation of an individual sewage disposal system and public sewage service is accessible and available to the property on which it is located and where permission to enter such a sewer can be obtained from the authority having jurisdiction over it, the director may require the owner or occupant of an existing building or buildings to be connected thereto within a period of time as specified by him.

SD 2.11 Maintenance - All building sewers and individual sewage disposal systems shall be maintained in good repair by the owner. The director may order the owner to clean or repair such sewers or systems within a reasonable time if he finds them to be in need of the same.

SD 2.12 Septic Tank Cleaners - No person shall engage in the removal or transportation of the contents of privies, cesspools, or septic tanks without first having obtained the approval of the director for the site, and the means of disposal of such contents that he proposes to use.

Such approval may be withdrawn by the director if he finds, that with use, the site or means of disposal has become insanitary or offensive.

Note: See Chapter 23-49 Rhode Island General Laws 1956 as amended
Entitled: Cesspool and Sanitary Tank Cleaners

SD 2.13 Prohibition in Certain Filled Areas - No sewage disposal system may be constructed in fill placed on a swamp, marsh, bog, or other area where water is at the surface in the wet season, or where fill is placed on an impervious formation.

SEE ATTACHED AMENDMENTS

Use of Acid in Septic Tanks

PART B-2 CONDITIONS FOR APPROVAL IN RELATION TO WELLS

SD 2.14 Construction in Areas Served by Private Wells - Before an approval can be granted to construct a building being served by a private well, sufficient additional area must be available for the replacement of the disposal field, in case of failure. This area must be on the property of the individual seeking approval and meet all the minimum distance requirements set forth in these regulations.

SD 2.15 Location of Wells - No person shall locate or cause to be located, any well within 100 feet of an individual sewage disposal leaching area. The director may grant an exception for the replacement of a well on property with an existing, owner occupied, private single family dwelling when no other water supply is available.

SD 2.16 Protection of Wells on Adjoining Property - An application for the installation of a sewage disposal system shall not be denied on the grounds that the system cannot meet the required minimum distance from a well if the well is on adjoining property and a public water supply is readily available to such property.

PART C. STANDARDS FOR CONSTRUCTION AND DESIGN

R23-1-SD 3.00 Standards of Flow and Minimum Distances

SD 3.01 Determination of Sewage Flow - A sewage disposal system must be designed to dispose of the estimated maximum days' flow from the building it serves. The maximum days' flow is estimated by multiplying flow (according to the following table) by the maximum design capacity of the building. Consideration will be given to sewage flow estimates derived from actual records of water consumption kept at comparable establishments.

MINIMUM DESIGN REQUIREMENTS FOR SEWAGE FLOW

TYPE OF ESTABLISHMENT	GALLONS PER PERSON PER DAY
Single Residence (2 persons per bedroom)	75
Multiple family dwelling units (2 persons per bedroom)	100
Rooming House	40
Hotel or boarding house	50
Nursing home	100
Rest home	75
School without cafeteria, gymnasium, or showers	10
School with cafeteria, but no gymnasium or showers	15
School with cafeteria, gymnasium, and showers	20
Boarding school or college	80
Motel	40
Motel - efficiency units	50
Public institution other than a hospital	100
Public picnic park-toilet wastes only	5
Public park with bathhouse, showers and flush toilets	15
Swimming pool or other bathing place	15
Camp (day) - toilets (add 3 gallons per capita per meal if any served)	15
Camp (overnight)	35
Restaurant (per table seat or counter seat)	70

TYPE OF ESTABLISHMENT	GALLONS PER PERSON PER DAY
Restaurant, toilet and kitchen wastes (per patron)	10
Restaurant, throughway service area (per table seat or counter seat)	350
Factory or industrial plant without cafeteria - (per person)	15
Factory or industrial plant with cafeteria - (per person)	20
Office Building	15
Drive-in-theater - (per stall)	5
Theater - (per person)	3
Auditorium or hall - (per person)	3
Gymnasium - (per spectator)	3
Gymnasium - (per participant)	15
Service station (minimum)	500
Cocktail lounge, bar (per seat)	20
Bowling alley - (per alley)	200
Hospital - (per bed)	200
Country club - (per person at maximum usage) (Exclusive of Food Service and Bar)	25
Fellowship Hall (per seat)	6
Barber shop (per chair)	100
Beauty Parlor (per booth)	200
Dental Office (minimum 3 persons per chair)	500
Mobile Home (exceeding 8 feet wide and 32 feet long) (using individual toilets)	75 (minimum 450)
Trailers (not exceeding 8 feet wide and 32 feet long) (and recreational vehicles using individual toilets)	200 (per day per space)
Central Service Building (Toilet-Shower-Lavatories) Serving recreational vehicles/trailers	140 (per day per space)
Dumping Station (for recreational vehicle/trailer park without individual water and sewer connections)	50 (per day per space)

SD 3.02 Separate Systems - Where separate treatment systems are to be installed, the following proportions should be used unless there is definite data available as to the exact distribution of flow. Toilet and bath facilities - 60% of total flow, kitchen wastes - 40% of total flow, laundry wastes - 40% of total flow.

SD 3.03 Type of System Required - Except as provided in Sections 11 and 12, an individual sewage disposal system shall consist of a septic tank followed by a subsurface seepage system or other sewage disposal method approved by the director.

SD 3.04 Surface Water Drainage - Provision shall be made to prevent the flow of surface water from the surrounding area onto the area of the seepage system.

SD 3.05 Location - The horizontal distances between the parts of an individual sewage disposal system and the items listed in the following table shall not be less than those shown.

MINIMUM DISTANCES

	Septic Tank (ft)	Disposal Trench or Disposal Bed (ft)	Seepage Pit or Cesspool (ft)	Building Sewer (ft)	Privy (ft)
1. Well or suction line (f)	50	100	(c)	50 (a)	50
2. Water supply line (pressure)	10 (b)	25 (b)	25 (b)	10 (b)	25 (b)
3. Property line	10	10	20	---	30
4. Dwelling	5	15 (d)	20	---	30
5. Surface drinking water supplies or tributaries including open and subsurface drains, thereto	50	100	150	50	50
6. Watercourses	25	50	50	---	25
7. Subsurface drains	25	25	25	---	25
8. Edge of any bank sloping to a level lower than the invert of the distribution line	10 (e)	25 (e)	25 (e)	---	10 (e)

(a) Distance may be reduced if extra heavy cast iron pipe or equal with tight joints is installed.

(b) Disposal facilities shall be installed as far away as possible from water supply lines. Where sewer lines must cross water supply lines, they should be constructed of durable, corrosion-resistant material with water-tight joints. Whenever possible, however, sewer lines should be laid below water supply lines at crossings.

(c) Installation of a seepage pit or cesspool is unacceptable if drinking water is obtained from wells within 200 feet.

(d) Distance may be reduced to 8 feet with no cellar.

(e) Where fill is required and where it is necessary to fill beyond the boundary of the subject property to meet the requirements of these regulations, no approval will be granted unless the adjoining property owner(s) have given a permanent legal release (easement, etc.) granting such right to the owner of the applicant property. A copy of such right of access and use shall be attached to the application.

(f) *See Section SD2.16*

SD 3.06 <u>Subsurface Drains</u> - The effectiveness of subsurface drains used to lower the water table to meet the limitations of these regulations must be demonstrated through one complete wet season, January 1, through April 30, before consideration can be given to an application for an individual sewage disposal permit.

SD 3.07 Subsurface Drain Discharges - Subsurface drains which discharge ground water to a watercourse shall meet the distance requirements in *Section SD 3.05* pertaining to watercourses.

REPEALED

R23-1-SD 4.00 BUILDING SEWERS

SD 4.01 Size - The building sewer shall be designed with a capacity, when running full, of not less than twice the peak rate of flow from the connected fixtures. In no case shall the building sewer be less than four inches in diameter.

SD 4.02 Material - The building sewer shall be constructed of cast iron, vitrified tile, concrete, asbestos cement, or other material acceptable to the director, provided, however, cast iron or equal shall be used where the building sewer may be subjected to heavy loads.

SD 4.03 Joints - All pipe joints for the building sewer shall be made water-tight and protected against damage by roots. Poured type joints shall be properly wiped on the inside to prevent obstruction of flow.

SD 4.04 Slope or Grade - The grade of the building sewer should be at least 1%, 1 foot fall per 100 feet, or 1/8 inch per foot.

SD 4.05 Alignment - The building sewer should be laid as nearly as possible in a straight line. Horizontal bends, where unavoidable, shall not be greated than 45 degrees. Any greater bend requires a manhole at the change in alignment.

SD 4.06 Manholes - A manhole with a removable cover of concrete, cast iron, or other durable material shall be provided at the junction of two or more pipes, at all sharp changes in direction or grade of pipes, and at intervals not greater than 300 feet.

SD 4.07 Ventilation - The building sewer shall be vented through the stack or main vent of the building it serves. No trap shall be installed in the building sewer.

SD 4.08 Grease Traps - A grease trap may be required at premises from which large quantities of grease can be expected to be discharged and where there is reasonable assurance that it will be cleaned frequently. A separate line shall be installed to serve the fixture from which the grease is discharged and the grease trap inserted in this line. The trap shall be so located and constructed that the temperature of the sewage will be reduced to promote congealing or separation of grease. It shall be located and constructed in a manner that will permit easy access for cleaning.

R23-1-SD 5.00 SEPTIC TANKS

SD 5.01 Capacity - For individual dwellings, the required capacity of a septic tank, below the flow line, shall be at least that shown in the following table:

Number of bedrooms	Capacity below flow line in gallons
2	750
3	900
4 (1)	1,000

(1) For each additional bedroom, add 250 gallons. For other than individual dwellings, the capacity of the septic tank for sewage flows up to 500 gallons per day shall be at least 750 gallons. For flows between 500 and 1,500 gallons per day, the capacity of the tank shall be equal to at least one and one-half of a days' flow. For flows greater than 1,500 gallons per day, the capacity of the tank shall equal 1,125 gallons plus 75% of the daily flow.

SD 5.02 Length - In rectangular tanks, the distance between the inlet and outlet should be at least equal to the liquid depth of the tank and at least one and one-half times the width.

SD 5.03 Diameter of Circular Tanks - Circular tanks shall have a diameter of at least 52 inches.

SD 5.04 Depth - The depth of the tank below the flow line should be not less than 4 feet or more than 8 feet.

SD 5.05 Multiple Compartments - Multiple compartment tanks, including two individual septic tanks placed in series, will be approved, provided the total capacity (below the flow line) is not less than 5,000 gallons and the capacity of the first compartment or tank is at least one-half of the capacity required.

SD 5.06 Construction - Septic tanks shall be water-tight. They shall be constructed of sound and durable materials not subject to excessive corrosion, decay, or frost damage, or to cracking or buckling due to settlement or soil pressures. Tanks and covers shall be constructed so as to withstand any load that may be expected to be placed upon them.

SD 5.07 Inlet and Outlet - The tops of inlet and outlet tees or the tops of the baffles shall extend a minimum of 6 inches above the flow line. Tops of the inlet and outlet tees or baffles shall be left open to provide ventilation. There shall be an air space of at least 3 inches between the tops of the tees or baffles and the top of the tank. The outlet tee or baffle should extend downward one-third of the depth below the flow line. The inlet tee or baffle should extend downward at least 1 foot below the flow line but not below the outlet tee or baffle. Multiple outlets shall be provided on tanks wider than 7 feet.

SD 5.08 Inlet and Outlet Elevations - The invert elevation of the outlet shall be at least 2 inches below the invert elevation of the inlet.

SD 5.09 Foundation - The septic tank shall be installed on a level base that will not settle.

SD 5.10 Materials - Septic tanks may be constructed of poured in place reinforced concrete, pre-cast reinforced concrete, coated steel, or other material approved by the director. Steel tanks designed in accordance with the provisions of these regulations shall meet Commercial Standard 177 of the U. S. Department of Commerce.

SD 5.11 Access Manholes - At least one manhole with a removable cover of concrete, iron, or other durable material shall be provided each septic tank compartment. Inlets and outlets shall be made accessible for cleaning by placing manholes or clean-out plugs over the tees or baffles. Manholes on tanks of under 2,000 gallons capacity should be brought up to within 12 inches of finished grade; and properly marked for location. Manholes on tanks of 2,000 gallons capacity or over shall be brought up to finished grade.

SD 5.12 Accessibility - Septic tanks shall be so located on the lot as to be accessible for servicing and cleaning. They should be placed between the building and the street wherever practicable, to facilitate connection to a public sanitary sewer when it becomes available.

SD 5.13 Backfill - Backfill shall be placed around the septic tank in such a manner as to avoid damage to it. All backfill placed around the septic tank shall be free of large stones, stumps, waste construction material and rubbish.

SD 5.14 Holding tanks - Holding tanks are not acceptable as a means of an Individual Sewage Disposal System for new installations.

SD 5.15 Pumping to Septic Tanks Prohibited - Sewage shall not be pumped into septic tanks unless approved by the director.

R23-1-SD 6.00 DOSING TANK

SD 6.01 General - A dosing tank equipped with a siphon or two pumps shall be provided where the total length of the distribution lines exceeds 500 feet. The dosing tank shall be provided with at least two alternating siphons or two pumps delivering to separate fields or beds, if the total length of the distribution lines exceeds 1,000 feet. When pumps are installed, the pump discharge lines shall be inter-connected and properly valved or gated so as to permit dosage to both fields or beds with one pump when the other is being repaired. The pumps installed must be capable of passing 2.5 inch diameter solids. System head curves must be submitted for each installation.

SD 6.02 Capacity - Dosing tanks shall discharge a volume of sewage which is between 60 and 75% of the interior capacity of the distribution lines of the disposal trenches to be dosed, and not more than the full capacity of the distribution lines in the case of a disposal bed.

SD 6.03 Construction - Dosing tanks shall be water-tight. They shall be constructed of sound, durable materials not subject to excessive corrosion or decay and be able to withstand any load which may be placed upon them.

SD 6.04 Foundation - Dosing tanks shall be constructed on a level base that will not settle.

SD 6.05 Ventilation - Dosing tanks and similar appurtenances shall be adequately ventilated.

SD 6.06 Inlet - The invert elevation of the inlet pipe to the dosing tank shall be located above the maximum water elevation in the dosing tank, and at least one foot above the maximum elevation of the ground water table.

SD 6.07 Access - Each dosing tank or compartment thereof shall be provided with an access located so as to facilitate repair or adjustment of the siphons or pumps.

R23-I-SD 7.00 DISTRIBUTION BOX

SD 7.01 General - A distribution box shall be installed between the septic tank and the seepage system.

SD 7.02 Inlet - The distribution box shall be provided with an inlet tee or a suitable baffle. The invert of the inlet pipe shall be not less than 2 inches above the invert of the outlet pipe.

SD 7.03 Outlet Elevations - The invert of all the outlet pipes shall be a minimum of 4 inches above the floor of the distribution box. All outlet inverts shall be at the same elevation.

SD 7.04 Distribution Pipes - All distribution pipes for minimum of 2 feet from the distribution box to the first section in the laterals shall be level and unperforated and shall be laid with tight joints. Any sections of such pipe laid with tight joints shall not be considered in determining the leaching area.

SD 7.05 Construction - The distribution box shall be constructed water-tight of concrete or other durable material; it shall be designed to accommodate the necessary distribution lines.

SD 7.06 Number o' Outlets - If there is no dosing tank, there shall be a separate outlet for each distribution line. Where a dosing tank or pump chamber is installed, there should be either a separate outlet for each distribution line, or a separate outlet of at least six (6) inches in diameter for every two distribution lines. In all cases following a dosing tank or pump chamber, the outlet shall be of sufficient size to accept the sewage flow at the rate sewage is delivered to the distribution box.

SD 7.07 Foundation - The distribution box shall be installed between the septic tank and seepage system on a solid and level base that will not settle.

R23-1-SD 8.00 SEWAGE SEEPAGE SYSTEMS - GENERAL

SD 8.01 Minimum Leaching Area - The minimum leaching area of a disposal system will be dictated by the number of bedrooms in the case of individual dwellings, or the maximum daily sewage flow for places other than individual dwellings, and the results of percolation tests performed in accordance with *Section SD 14.00.*

SD 8.02 Ground Water - The bottom of the seepage system shall be at least 3 feet above the maximum elevation of the ground water table.

SD 8.03 Impervious Material - The bottom of the seepage system shall be at least 5 feet above impervious formations. Excavating into impervious material is prohibited unless otherwise approved by the director.

SD 8.04 Excavation - The excavation for the seepage system may be made by mechanical means, however, if such means are used, care must be taken to assure that the soil at the bottom of the excavation is not compacted or smeared. The bottom of the excavation shall be level and scarified.

SD 8.05 Location - The minimum distance the sewage seepage system must be from items it might effect is found in *Section SD 3.05.*

SD 8.06 Minimum Leaching Area for an Individual Dwelling - The minimum leaching area required per bedroom shall be determined from the following table:

Percolation Rate (minutes per inch)	Disposal Trenches (leaching area, sq. ft. per bedroom) (1) (3)	Disposal Beds, Seepage Pits, Cesspools, (leaching area, sq. feet per bedroom (2) (3)
2	85	125
3	100	145
4	115	165
5	125	180
10	165	235
15	190	270
20	220	315
25	240	
30	250	
40	290	

(1) Soil with a percolation rate of over 40 minutes per inch is unsuitable for disposal of sewage by any means of sub-surface leaching.

(2) Soil with a percolation rate of over 20 minutes per inch is unsuitable for these means of subsurface leaching.

(3) To determine effective leaching area, see *Section SD 9.00, 10.00, and 11.00.*

SD 8.07 Minimum Leaching Area for Places Other Than Individual Dwellings - The minimum leaching area required shall be determined from the following table using the estimated daily sewage flow as determined by means given in *Section SD 3.01.*

Percolation Rate (minutes per inch)	Disposal Trenches (maximum rate of sewage application gallons per sq. ft. per day) (1) (3)	Disposal Beds, Seepage Pits, Cesspools (maximum rate of sewage application) - (gals. Per sq. ft. per day) (2) (3)
2	3.5	2.5
3	2.9	2.0
4	2.5	1.8
5	2.2	1.6
10	1.6	1.1
15	1.3	0.9
20	1.1	0.8
25	1.0	
30	0.9	
40	0.8	

(1) Soil with a percolation rate of over 40 minutes per inch is unsuitable for disposal of sewage by any means of subsurface leaching.

(2) Soil with a percolation rate of over 20 minutes per inch is unsuitable for these means of subsurface leaching.

(3) To determine effective leaching area, see Sections *SD 9.00, 10.00 and 11.00.*

SEE ATTACHED AMENDMENTS

R23-1-SD 9.00 SPECIFICATIONS FOR DISPOSAL TRENCHES AND DISPOSAL BEDS

SD 9.01 Effective Leaching Area - The effective leaching area shall be held to mean the total bottom area of the disposal trenches or the entire bottom area of the disposal bed. The leaching area required shall be determined in accordance with the provisions of *Section SD 8.00.* In no event shall the total effective leaching area be less than 170 square feet in the case of disposal trenches or 250 square feet in the case of disposal beds.

SD 9.02 Construction of Disposal Trenches and Beds - Disposal trenches and beds shall follow the construction details listed in the table below:

Minimum lines per field or bed	2
Maximum length per line	100 feet
Minimum diameter of distribution lines	4 inches
Grade of distribution lines (No gradient needed if dosed by siphon or pumps)	2 to 4 inches per 100 feet
Maximum width of disposal trench bottom	3 feet
Minimum distance between walls of adjacent trenches	5 feet
Minimum cover over distribution lines	12 inches
Maximum distance between distribution lines in disposal beds	6 feet
Maximum depth of invert of distribution pipe below finished grade	2.5 feet
Minimum distance between adjacent beds	10 feet
Length of bell and spigot clay pipe lines	2 feet
Openings at joints of bell and spigot clay pipe lines	0.5 inches
Distance between distribution lines and edge of bed shall not be less than	2 feet
Termination of distribution lines from end of trench	2 feet

SD 9.03 Distribution Lines - The distribution lines may consist of clay or tile,bell and spigot pipes, perforated asbestos cement pipe, or other suitable pipe approved by the director. The ends of all distribution lines shall be interconnected, unless otherwise approved by the director.

SD 9.04 Stone - The stone used in the leaching system to surround the distribution lines shall consist of washed stone ranging from not less than 1/2 inch to not more than 2 inches in size and free from iron, fines and dust. It shall cover the full width of the trench or bed and shall be placed to a depth not less than 6 inches below the bottom of the distribution lines in a disposal trench and not less than 12 inches below the bottom of the distribution lines in a disposal bed. The stone shall extend at least 2 inches above the top of the distribution pipes. The stone shall be covered with at least a 2 inch layer of washed pea stone or a 2 inch layer of straw or hay, or by a layer of untreated building paper.

SD 9.05 Construction in Fill - When a sewage leaching system can be approved in filled land, the leaching area, extending at least 10 feet on all sides, must be stripped of trees, brush, stumps, topsoil, and soil containing fines and the bottom of the excavation scarified and backfilled with a coarse grained soil containing little or no fines. The leaching system shall not be constructed when the original soil was stripped to, or into, the ground water table unless approved by the director. Distribution lines shall be supported by grade boards attached to stakes driven into undisturbed soil whenever required.

SD 9.06 Backfill - All backfill placed over a seepage system shall be free of large stones, frozen clumps of earth, rubbish, masonry, stumps or waste construction materials. Backfill shall be placed carefully in disposal trenches or beds so as to avoid displacement and damage to piping. Heavy machinery shall not be permitted to pass over the leaching area.

SD 9.07 Parking Area Location - The area of the seepage system shall not be paved or used for vehicular parking or vehicular traffic. Systems serving other than individual dwellings shall be adequately curbed or fenced so as to exclude all vehicular traffic. Parking areas adjacent to seepage systems shall be graded or curbed to divert runoff from the seepage area.

SD 9.08 Finished Grade - The surface area over the sub-surface disposal field shall be grassed.

R23-1-SD 10.00 SEEPAGE PITS

SD 10.01 Acceptability - A seepage pit may be constructed in lieu of a disposal field only where a special condition justifies its use. It must be preceded by a septic tank. A seepage pit shall not be used in an area where wells are within 200 feet.

SD 10.02 Leaching Area - The leaching area of a seepage pit shall be determined in accordance with provisions of Section *SD 8.00.* Only the bottom and sidewall area below the invert of the inlet shall be considered to be leaching area.

SD 10.03 Spacing - When more than one seepage pit is installed, a distance of at least 20 feet between sidewalls shall separate the pits.

SD 10.04 Access - The top of a seepage pit shall be provided with an access manhole with a removable cover of concrete, iron, or other durable material. The top of the manhole should be brought up to within 12 inches of the finished grade, and properly marked.

SD 10.05 Construction - The lining of a seepage pit shall be of stone, brick, or cement block, laid dry with open joints. The space between the excavation and the lining shall be backfilled with washed stone, 1/2 inch to 2 inches in size, for a distance of at least 6 inches from the lining. Washed stone 1/2 inch to 2 inches in size shall be placed on the bottom of the pit to a depth of 12 inches.

R23-1-SD 11.00 CESSPOOLS

SD 11.01 Acceptability - The installation of a cesspool will be approved only in those situations in which the soil has excellent seepage properties, the need is of short term, or the use is infrequent, or in other special situations which warrant their approval. Cesspools will not be approved in areas where water is obtained from wells within 200 feet.

SD 11.02 Leaching Area - The leaching area of a cesspool shall be determined in accordance with the provisions of *Section SD 8.00*. Only the sidewall area below the invert of the inlet shall be considered to be leaching area. The size shall be determined by the director.

SD 11.03 Construction - The lining of a cesspool shall be of stone, brick, or cement block laid with dry open joints. The space between the excavation and the lining shall be backfilled with stone 1/2 inch to 2 inches in size, for a distance of at least 6 inches from the lining.

SD 11.04 Access - The top of the cesspool shall be provided with an access manhole with a removable cover of concrete, iron, or other durable material. The top of the manhole should be brought up to within 12 inches of the finished grade, and properly marked.

R23-1-SD 12.00 PRIVIES, CHEMICAL TOILETS AND INCINERATOR TYPE

SD 12.01 Acceptability - The installation of a privy, chemical or incinerator type toilet will be approved only where a water-carriage system is not practicable.

SD 12.02 Location - The Location of a privy shall meet the requirements of *Section SD 3.05.*

SD 12.03 Construction - A privy shall have a self-closing seat cover, and a fly-tight vault and superstructures. A screened vent shall extend from the vault to the atmosphere.

SD 12.04 Maintenance - When a privy vault becomes filled to within two feet of the surface of the ground, it shall be cleaned and the contents disposed of in a sanitary manner, or it shall be covered with clean compacted earth to a depth not less than two feet.

PART D. SOIL STUDIES AND PERCOLATION TESTING

R23-1-SD 13.00 SUBSOIL EXPLORATION

SD 13.01 General - The suitability of the soil for disposal of sewage by leaching shall be determined through the consideration of the type of soil, the results of percolation tests, the maximum ground water table elevation, the occurrence of impervious formations, and any other relevant data. The director may require percolation tests and ground water table determinations on individual lots in subdivisions or parts thereof which have been reviewed and the soil found suitable for the installation of individual sewage disposal systems. In areas where available information makes such tests unnecessary the director may waive or modify the requirements for soil studies and percolation tests.

SD 13.02 Site Suitability - The installation of an individual sewage disposal system is prohibited in any area where the ground water table at its highest seasonal elevation is within [illegible] feet of the original ground surface, or where an impervious layer is within 6 feet of the original ground surface.

SEE ATTACHED AMENDMENTS

SD 13.03 Percolation Test - At least one percolation test, carried out in accordance with the procedure outlined in *Section SD 14.00* shall be made at the site of each disposal system. More than one test will be required if the soil structure is highly variable or if a large disposal area is required.

SD 13.04 Exploration holes - An adequate number of borings or excavations shall be made in the proposed leaching area to clearly establish the type of soil, and the location of impervious formations. The borings or excavations shall be carried to a depth of at least 5 feet below the elevation of the bottom of the proposed seepage system.

SD 13.05 Persons Qualified to Test

(a) Engineers and Surveyors - Percolation tests, ground water table elevation determinations, and the gathering and submission of other essential information in addition to the requirements of *Section SD 2.02* shall be carried out by a registered professional engineer or registered surveyor at the expense of the owner or developer.

(b) Sanitarians and Soil Scientists - Percolation tests and the determination of the depth to the ground water table may be carried out by a qualified professional sanitarian or soil scientist approved by the director. Such approval shall be made on the basis of satisfactory experience and education in the area of soil science and standards for the design and construction of individual sewage disposal systems. Such qualifications shall be presented in writing.

(c) 1. <u>Home Owner</u> - If the property owner is installing, constructing or altering an individual sewage disposal system to serve a building he occupies or will occupy as his intended permanent domicile, he or his representative may prepare the necessary holes and carry out the tests as prescribed in these regulations.

(c) 2. *Whenever in the opinion of the director the requirements* of these regulations protecting the public health and environment can be met, a home owner as defined in *Section SD 13.05* (C-1) may prepare the plans and layout of his proposed system. For this purpose any requirements of these regulations may be waived at the discretion of the director. The director reserves the right to require any data he deems necessary to fulfill his obligations under these regulations.

(d) The director may require that all soil examinations be performed in the presence of one of his agents.

SD 13.06 <u>Recording Results</u> - The complete record of percolation tests, ground water table determinations, type of soil, and the location of impervious formations in the area shall be recorded on forms provided by, or approved by, the director. Any person making and/or witnessing the determinations shall certify to the accuracy of the technical data recorded.

R23-1-SD 14.00 PERCOLATION TEST PROCEDURE

SD 14.01 (a) Dig two or more test holes within the area of the proposed seepage system, not less than 10 feet apart. One of the holes should be at the depth of the bottom elevation of the proposed seepage system, and the second hole should be at a depth of about 18 inches below the bottom elevation of the proposed seepage system. This is to evaluate the consistancy with depth of the seepage qualities of the soil. The size of the seepage system must be based on the highest percolation rate obtained. The holes shall be not less than 6 inches in diameter or 6 inches square, nor should they be greater than 8 inches in diameter or 8 inches square.

(b) Scarify the bottom and sides of the test holes and remove all loose material. Place about 2 inches of coarse sand or fine gravel in the holes to prevent bottom scouring.

(c) Fill the holes with clear water to a minimum depth of 12 inches above the coarse sand or fine gravel. Keep water in each hole for at least four hours and preferably overnight by refilling. If necessary to maintain water in each hole for this period, provide a reservoir of water and an automatic siphon to deliver it to the holes intermittently, or the percolation test holes should be soaked and maintained full for not less than four hours before the percolation test is made. In uncompacted sandy soils containing no clay or silt, the above saturation procedure is not necessary; the test can be made as soon as the water from one filling has seeped away.

(d) The percolation test should be made following the saturation process. When the saturation process is complete, the water depth should be adjusted to 6 inches over the coarse sand or fine gravel before the test is begun. The drop in water level should be measured from a fixed reference place, such as a board laid across the hole, over 30 minute intervals, refilling the holes to a depth of 6 inches as necessary.

(e) When three consecutive readings at 30 minute intervals read the same rate, the test may be considered complete. If no stability is reached between three 30 minute readings, not less than four hours of readings must be followed. The drop in water level which occurs during the final 30 minute period is used to calculate the percolation rate. This rate is expressed in minutes per inch.

(f) Soils in which the first 6 inches of water seeps away in less than 30 minutes, after the saturation period, the time interval between measurements should be reduced to 10 minutes and the test run over a period of one hour. The drop in water level which occurs during the final 10-minute period is used to calculate the percolation rate. This rate is expressed in minutes per inch.

SD 14.02 If an unanticipated cut is made, the results of any percolation test made prior to the cut is invalid. A new percolation test shall be made under the changed conditions.

R23-1-SD 15.00 <u>PROCEDURES FOR GROUND WATER TABLE ELEVATION DETERMINATIONS</u>

SD 15.01 The ground water table elevation determination shall be made when the water table is highest; this occurs usually during the months of January through April. *(Specific dates may be determined on a yearly basis by the director).* In making this determination it is necessary to bore or dig an adequate number of holes of convenient size in the proposed leaching area to a depth of at least five (5) feet below the lowest point of the proposed sub-surface seepage system [redacted] An open perforated pipe at least 4 inches in diameter shall be installed. Such pipe should be installed at the beginning of the wet season and remain in place until a permit has been issued by the director. This pipe shall be capped at the top and mounded to prevent the collection of surface water. All water table test holes shall be witnessed by an agent of the director unless otherwise waived.

SD 15.02 Ground water table determinations made other than during the months of January thru April will be accepted provided the material in the test pit consists of uncompacted sand or gravel containing little or no fines, and the percolation rate is not greater than (5) min. per inch in the original soil; and the hole is dug to a depth of at least 15 feet below the lowest part of the proposed sub-surface seepage system and no water is encountered.

SEE ATTACHED AMENDMENTS

PART E. SUBDIVISIONS

SD 16.01 Subdivisions - Individual Sewage Disposal Systems - No person shall construct in any subdivision located in areas where sewage will have to be disposed of by means of individual sewage disposal systems until he has obtained certification from the director that the subsoil is suitable for disposal of sewage by individual sewage disposal systems. Application for such certification shall be made on forms provided by the director and accompanied by data described in *SD 16.02 through SD 16.06.*

SD 16.02 Topographic Map - A topographic map of the entire area under consideration shall be prepared to an appropriate engineering scale and submitted with the application. It should show existing conditions on the entire site including existing (a) houses, foundations and excavations for basements; (b) existing individual water supplies and sewage disposal systems; (c) right of ways or easements; (d) natural waters or water courses, swamps and marshes; (e) rock out-crops and wooden areas; (f) stone walls. There shall also be shown, designated, or reported for lands immediately adjacent--(a) natural waters or water courses within 200 feet from the property; (b) wells within 150 feet from the parcel being considered.

The topographic map shall show ground elevations on the tract as follows - (a) for land that slopes less than approximately 2% show spot elevations at all breaks in grade, along all drainage channels or swales, and at selected points not more than 100 feet apart in all directions; (b) for land that slopes more than approximately 2% show broken line contours with an interval of not more than 5 feet where ground slope is regular and intervals of not more than 2 feet where the ground slope is irregular. The datum on which the elevations or contours are based should be reported.

Where cut and/or fill of more than 1 foot can be anticipated and estimated, it should be indicated by solid line contours showing approximate finished grade. Plan and profile showing existing and proposed finished grades of proposed roads must be provided.

SD 16.03 Location Map - A location map or sketch showing existing highways, streets and/or other identifiable landmarks or distances thereto, shall be furnished to facilitate an inspection of the site. This may be incorporated on the topographic map.

SD 16.04 Percolation Tests - An adequate number of percolation tests not less than one to an acre, with a minimum of two tests in small areas shall be made by the developer, to indicate clearly the soil conditions throughout the property. These tests shall be made in accordance with the procedure outlined in *Sections SD 13.00 and SD 14.00.* Unfavorable soil conditions will require more tests, up to one per lot at the proposed site of each subsurface absorption unit. The results of each percolation test and pertinent information shall be recorded in the tabulation provided on the application and the location of the percolation tests shall be marked on the topographical map and indexed by the corresponding number used in the tabulation of results.

SD 16.05 Ground Water Table - An adequate number of borings, excavations or observations shall be made by the developer to clearly establish the elevation of the ground water table in accordance with the procedure outlined in *Sections SD 13.00 and SD 15.00.* The ground water table determinations should be made when the ground water table is at its highest level. The results of each observation and pertinent information shall be recorded in the tabulation of the application. The location of the ground water table observations shall be indicated on the topographical map together with the index letter used in the tabulation of the results.

SD 16.06 Certification - The engineer, surveyor, soil scientist, or sanitarian shall execute the certificate relating to the accuracy of the technical data on each sheet on which such technical data is recorded.

SD 16.07 Nothing in *Sections SD 16.01 through SD 16.06* shall prevent the director from requesting any or all of the procedures established in these regulations for a single lot if in his opinion the protection of the public health and environment so requires.

PART F. APPEAL PROCEDURE

Page 28 (See Amendments)

The foregoing rules and regulations, after due notice and hearing, are hereby adopted and filed with the Secretary of State this 6th day of July 1973, to become effective twenty (20) days thereafter, in accordance with the provisions of Chapter 23-1 and 42-35 of the General Laws of Rhode Island, 1956, as amended.

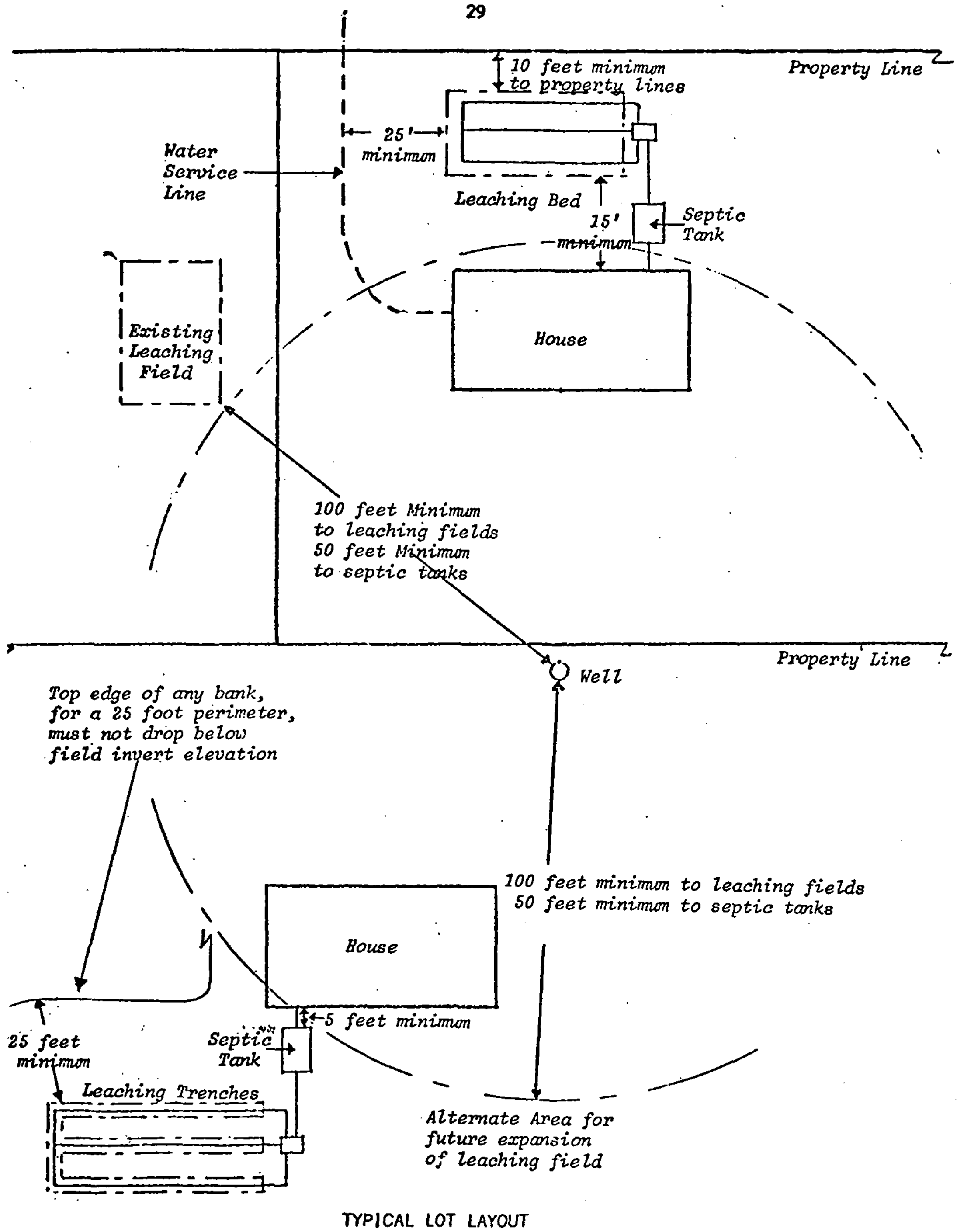
Joseph E. Cannon, M.D., M.P.H.
Director of Health

Notice given on *5 January 1973*

Hearing held on *25 January 1973*

Filed: 6th *July 1973*
Secretary of State

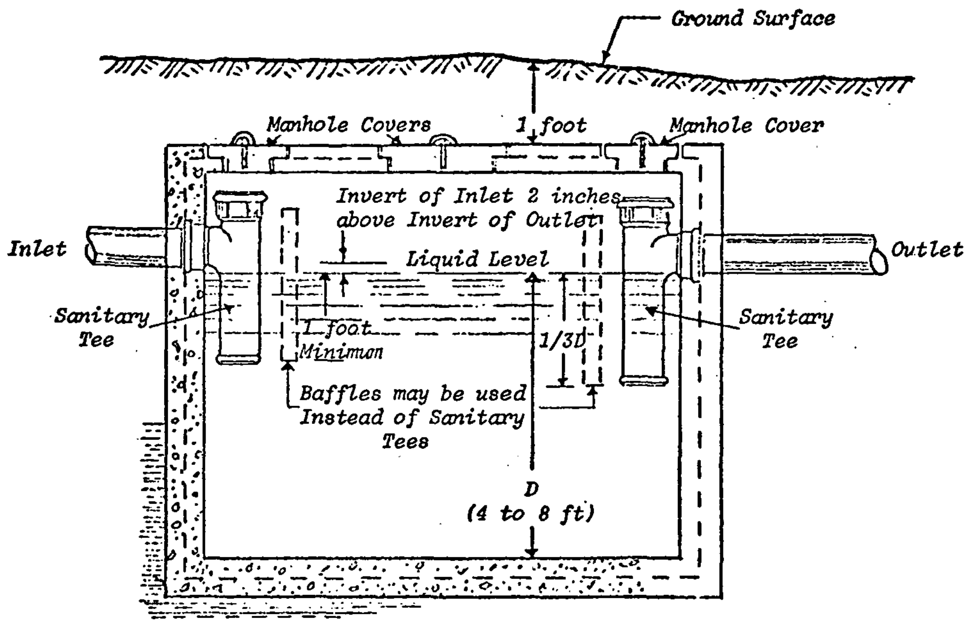
NEW AMENDMENTS EFFECTIVE 30 AUGUST 1974



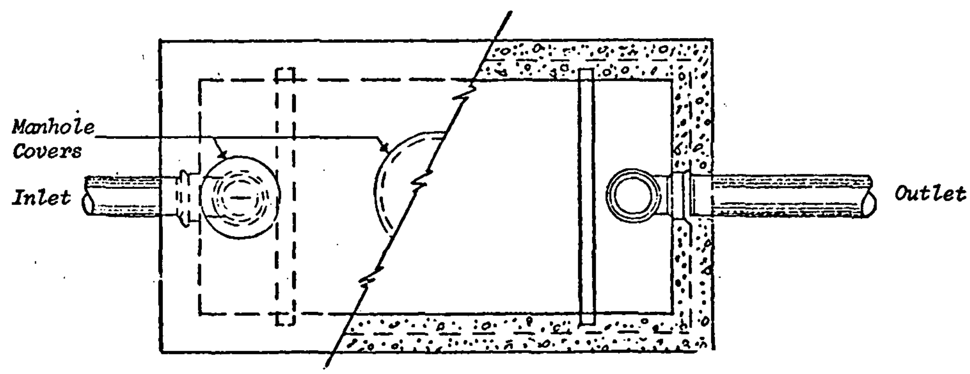
TYPICAL LOT LAYOUT

(No Scale)

Reference: See Sections SD 2.00 and 3.00



SECTION VIEW

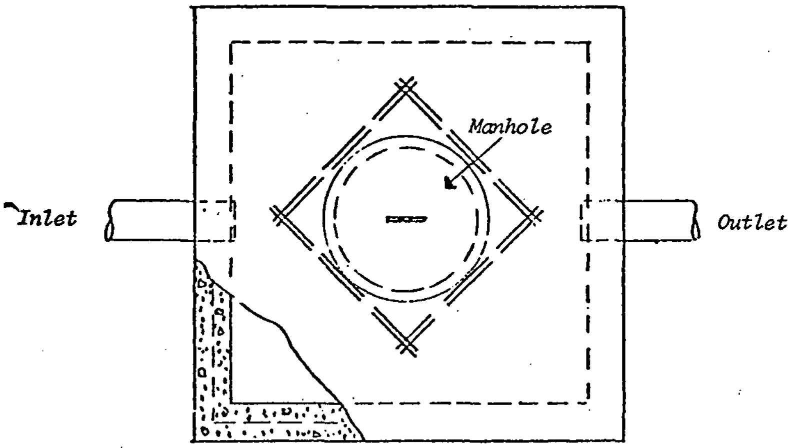


TOP VIEW

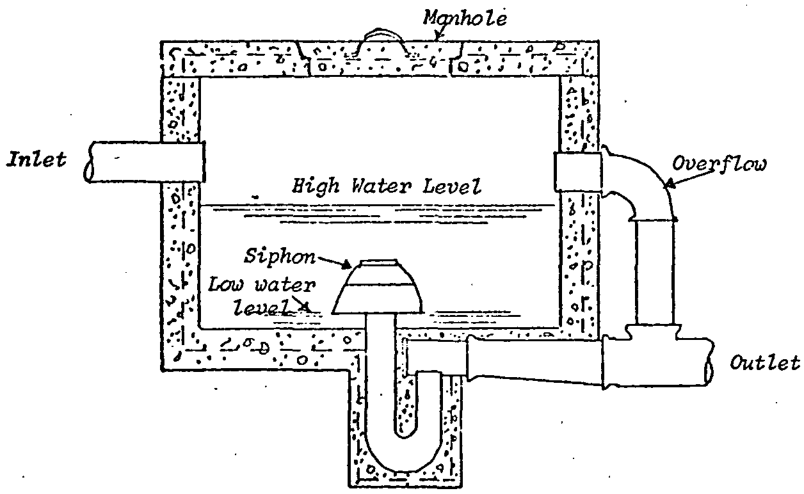
TYPICAL SEPTIC TANK

(No Scale)

Reference: See Section SD 5.00



TOP VIEW

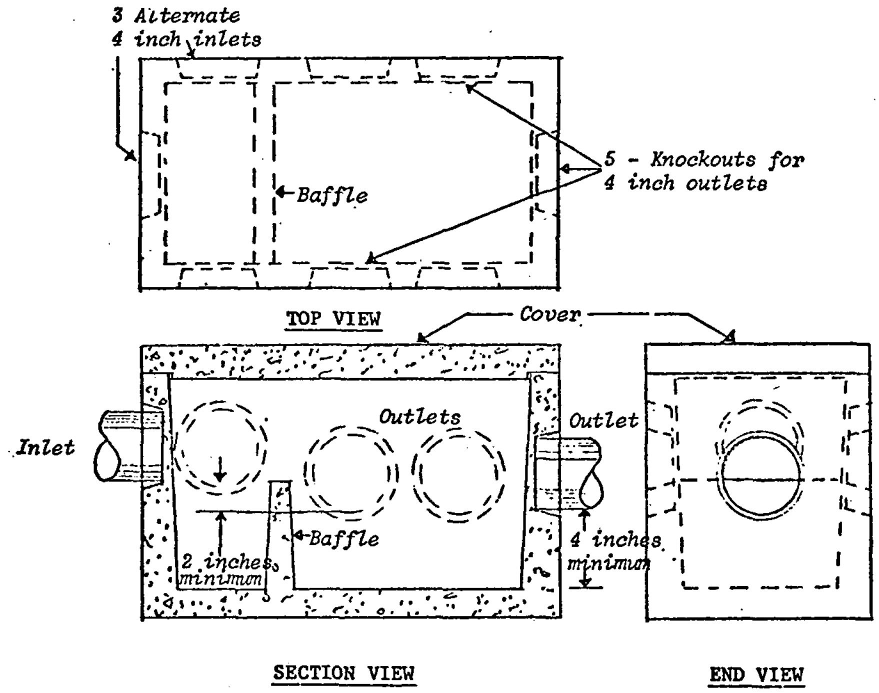


Section View

TYPICAL DOSING TANK

(No Scale)

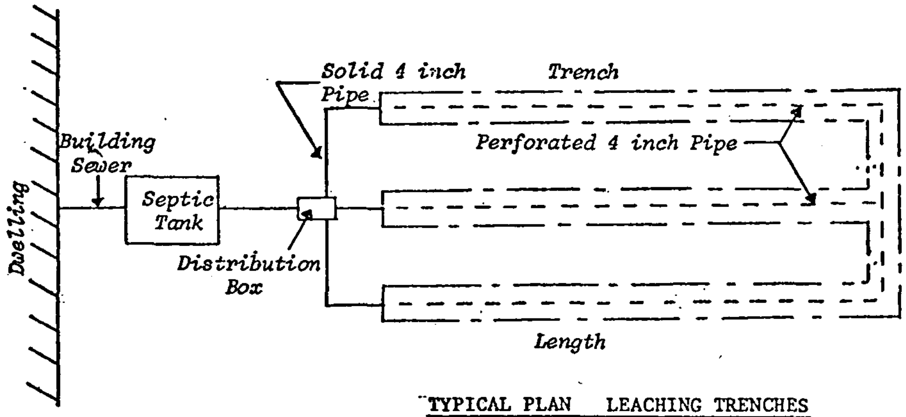
Reference: See Section SD 6.00



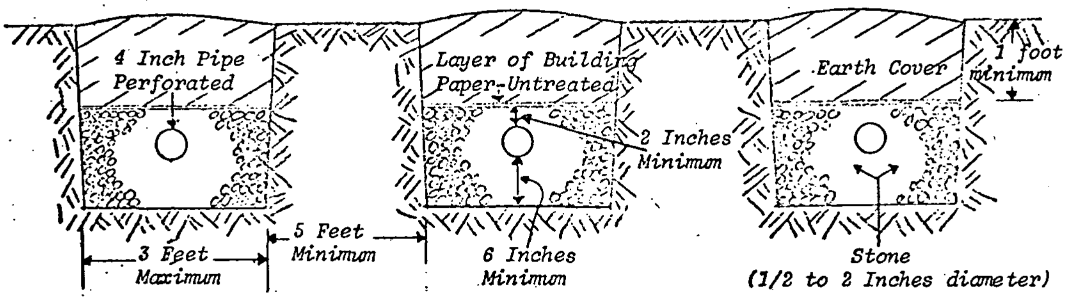
TYPICAL DISTRIBUTION BOX

(No Scale)

Reference: See Section SD 7.00



TYPICAL PLAN LEACHING TRENCHES

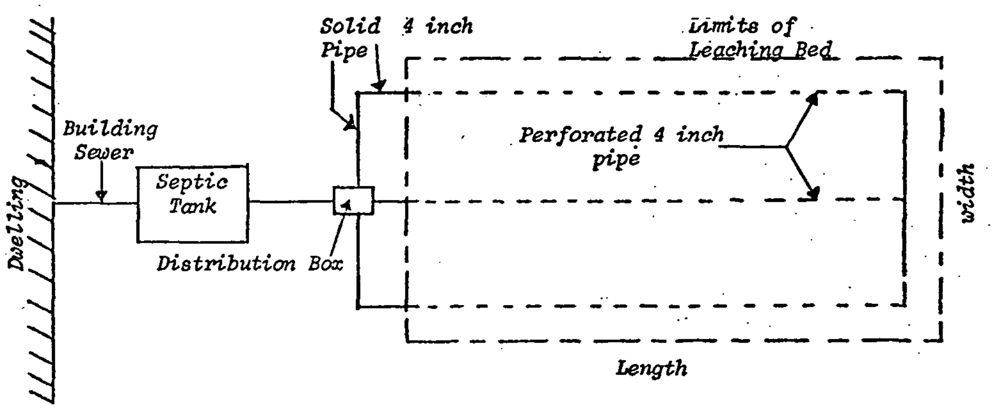


TYPICAL TRENCHES CROSS SECTION

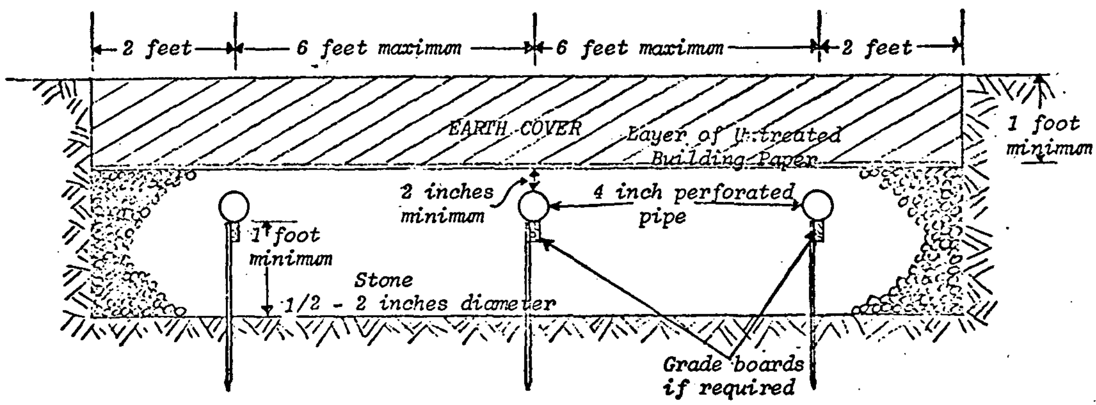
TYPICAL TRENCH TYPE FIELD

(No Scale)

Reference: See Section SD 8.00 and 9.00



TYPICAL PLAN LEACHING BED

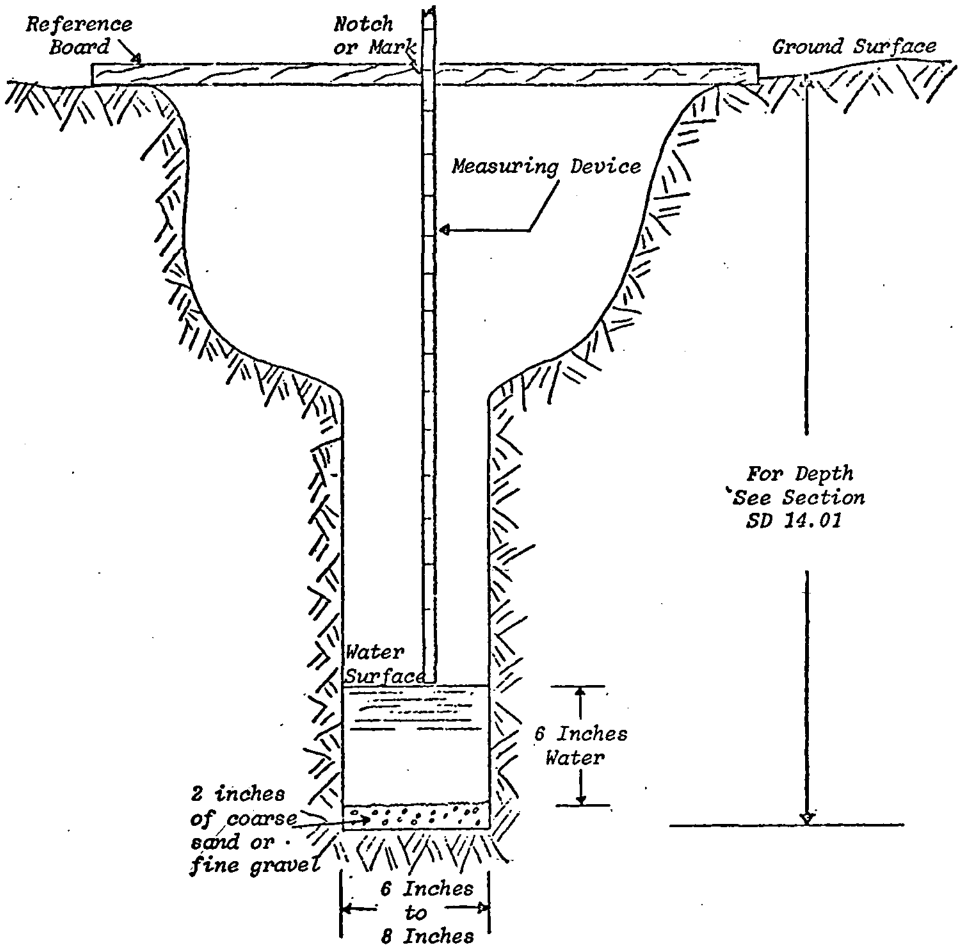


TYPICAL BED CROSS SECTION

TYPICAL BED TYPE FIELD

(No Scale)

Reference: See SD Section 8.00 and 9.00



TYPICAL SOIL PERCOLATION HOLE

(No Scale)

Reference: See Section SD 14.00

APPENDIX N - ENVIRONMENTAL EFFECTS OF SUBSURFACE DISPOSAL ON GROUND WATER QUALITY

An important consideration in the evaluation of alternative wastewater management schems for Block Island is the impact on ground water quality. This is particularly significant since the ground water is also the sole source of supply of water for commercial and domestic use on the Island.

A general assessment of the effects of subsurface disposal on ground water quality can be developed from the past experience of communities and individuals as well as scientific studies. A recent comprehensive evaluation of this question is a report titled The Long Island Sound Ground Water Pollution Study prepared by the New York State Department of Public Health and published in 1972. Another important study is the Report on the Investigation of Travel of Pollution prepared by the California Water Pollution Control Board in 1954. The information presented here is based in part on information obtained from these studies.

It can be confidently stated that the disposal of domestic wastes into the ground using subsurface disposal systems such as septic tanks and leaching fields will result in some degradation of the ground water quality. The important question is whether the changes in quality are significant relative to the usefulness of the water as a water supply.

A complex combination of physical, chemical and biological phenomena occur from the entrance of wastes into a subsurface disposal system and through the system, the unsaturated soil and saturated soil. Sorption, dilution, diffusion, chemical reaction, precipitation, filtration and biodegradation processes take place, reducing the pollution concentration of the wastewater. Nevertheless some fraction of the pollutants reach the groundwater. Based upon the information presented in the previously mentioned studies and accepted standards for drinking water quality, continued use of subsurface disposal systems on Block Island would not appear to constitute a significant threat to the ground water quality.

Many rural and suburban communities have utilized and continue to utilize subsurface waste disposal systems in combination with private individual water systems, or community water systems without effecting significant changes in the quality of the ground water supply. In many instances this preservation is sustained by requiring a physical separation of water supply wells from subsurface disposal systems. Distances ranging from 400 ft. to 1,000 ft. separation are general guidelines applied for community wells. For individual water supply systems distances of 50 ft. to 100 ft. are practiced.

Significant ground water quality problems have occurred, such as on Long Island, where the density of development and soil conditions have stressed environmental systems beyond their capability to respond. The contamination of individual water supply systems can usually be attributed to inadequate physical separation from the subsurface disposal system.

Based upon the information available, subsurface disposal systems now used on Block Island have not significantly impacted the quality of the ground water used for water supply. Previous scientific studies and investigations and past experience, indicate that continued use of subsurface disposal systems will not significantly impact the water quality of the island particularly in view of the currently proposed densities of development and the seasonal nature of the present population. In order to ensure the preservation of the ground water quality, it is recommended that presently proposed developmental densities be maintained or reduced. It is further recommended that community water systems from protected sources be provided in the more densely developed areas of the island.