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TECHNICAL MEMORANDUM: TASK 7.4

ANALYSIS OF PROPOSED DRAINAGE PLANS

FOR THE SECOND YEAR--COASTAL ZONE MANAGEMENT STUDY

WORKING DOCUMENT

Prepared by the Department of City Planning--The City of New York

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Task 7.4b - Analysis of Proposed Drainage Plans

Introduction

The purpose of this report is to identify and analyze a potential major conflict proposed drainage plans may contribute to the destruction of natural features in the New York City coastal zone.

The development of Brooklyn, Manhattan, Bronx and Queens historically has not considered management of ecosystems. In the last decade, eingineers have become more aware of natural systems. Legislation has been passed to enforce recognition of the environmental and economic importance of maintaining the land/water interface in its natural state. Such laws as the New York State Tidal Wetlands Act, the New York State Freshwater Wetlands Act, the Federal Water Pollution Control Act Amendments of 1972, the National Environmental Policy Act, and the State Environmental Quality Review Act mandate protection of vital resources and/or comprehensive evaluations of the effect of development proposals. As a result, a number of approved drainage plans have been questioned and minor modifications required. However, a comprehensive investigation of this potential problem has never been done.

This report will review the function of natural storm water management systems, past storm water management practices in New York City, identify remaining natural watersheds, and analyze future storm water management plans for New York City. The last item will include a discussion of Staten Island Drainage Plans and the methodology used to identify their effects on existing natural features. The report will conclude with recommendations for future strategies.

Natural Storm Water Management

In natural watersheds storm water management systems are supplied by nature. The cycle begins with rainfall. Some water stays where it falls on leaves then evaporates; some is absorbed into the ground surface to feed trees and plants and transpired into the atmosphere; some percolates into the ground to replenish aquifers. The remainder gradually, sometimes quickly, collects into rivulets, which grow larger and travel faster as they hurry down the watershed through drainageways and streams to a river or the sea, where moisture evaporates into the atmosphere to collect in rain clouds.

In nature, a stream handles runoff from any average rainfall. Flooding occurs naturally to some extent after heavy precipitation or spring thaws. Natural flooding is seldom catastrophic, because of the moderating effects of vegetation, soil and organic litter and wetlands.

Urbanization in a watershed changes its reaction to precipitation. The most common effects, reduced infiltration and decreased travel time, cause higher peak runoff rates which increase erosion and sedimentation. The more impervious surfaces there are in an area, such as roads and buildings, the more runoff is accelerated because it is not absorbed by the soil. Heat from impervious

surfaces makes snow and ice melt faster. Destruction of vegetation and wetlands, which absorb some precipitation, also increases the runoff rate. Development in upstream areas can increase runoff and erosion by removing vegetation, whose roots, leaves, and detritus litter retard erosion, or by grading hillsides, removing topsoil, leaving barren large land areas vulnerable to erosion during construction.

As integral parts of the hydrologic and nutrient cycles, streams are crucial resources for people, other forms of life and ecological communities. Marshes need streams for water and nutrients. Many species of food, game and fish depend on streams for breeding, nurturing, watering, and feeding areas.

If a community wants to maintain general environmental health, it must consider the effect of development on more than its water supply. Wetlands and aquatic life are equally important.

Past New York City Storm Water Management Practices

More than 200 years before Greater New York City was founded, the first sewer was put into Broad Street in Manhattan. In 1902 sewerage responsibilities were decentralized to the five Borough Presidents resulting in separate design standards and financing. Problems of financing massive sewer works fostered use of septic tanks or seepage areas instead of well-planned drainage systems, continued use of combined sewers and construction of homes below legal grade.

As natural areas throughout the City were covered with concrete and asphalt, deficiencies in the sewer system began to tell. The mission of designing, building and maintaining sewers was transferred, on January 1, 1963, from the five Borough Presidents to the Department of Public Works and the Bureau of Water Pollution Control, later incorporated into by the Department of Water Resources. The burden of funding was shifted from individual homeowners to New York City.

The legacy of the centralized department in 1963 was a system of public sewers comprised of the 5,200 miles of sanitary, combined and storm sewers shown in the following table:

BOROUGH	Miles of Sewers			
	Total	Sanitary	Storm	Combined
Bronx	659	47	7	605
Brooklyn	1721	172	172	1377
Manhattan	570	-	-	570
Queens	1950	800	254	896
Staten Island	314	266	43	5
	5214	1285	476	3423

The private sewer system included 900 miles of sewers built under different provisions of the Administrative Code. Unsewered developed areas were, and still are, served by septic tanks or cesspools for sanitary sewage. They rely on natural drainage to drain storm water.

The condition of many existing sewers, undersized hydraulically and unsound, showed that the former storm water management principle was convenience. On individual sites the fastest method of removing excess surface water after rain was sought. Runoff water was contained as quickly as possible and disposed of through a closed system without regard, except in park areas, for maintenace of the natural state.

Unsewered Areas

The Department of City Planning identified and mapped vital natural features last year. Unsewered areas, areas without storm water runoff collection systems, were mapped. Information was gleaned from maps produced by the Department of Water Resources for Section 208 Water Quality Management Planning and "as-built" engineering drawings (See Plates 1 & 2). Maps were overlayed with other natural resource maps produced under Coastal Zone Management Program (CZM) Task 6.1 (Delineation of Coastal Zone Boundaries) and Task 7.3 (Identification of Geographic Areas of Particular Concern).

The overlays include scenic and aesthetic areas, areas without public water supply, drainage basins, tidal wetlands, wildlife habitat areas, freshwater wetlands, geology, flood hazard areas, parks and beaches, steep slopes, landmarks, and sites of archaeological significance.

Unsewered areas shown on Plates 1 & 2 have most of the surviving natural features worth preserving.

Staten Island, which will be the focus of the remainder of this report, has more than 65% of the unsewered ares in the City and, as documented in the next section of this report, is slated for intense sewer construction activities.

Future Storm Water Management Plans

As stated earlier, from 1945 to 1965, sewer construction projects, under the jurisdiction of the Borough Presidents, were undertaken on piece-meal ad hoc basis. When the department was centralized, an annual average of 10-15 miles of sewers were built in the whole City. By 1972 the rate rose to 60 miles per year. The rate increase was preceded by the following decisions:

- Immediate concentration on construction of major outlets
- Design contracts given to outside consultants
- Development of computerized management information systems
- Mandate of uniform City-wide specifications
- Ten-year Comprehensive Accelerated Sewer Construction Program

The Ten-year Comprehensive Accelerated Sewer Construction Program was planned by an interagency task force which studied the five-year sewer program proposed in the Capital Budget. After analysis of each project, the total cost was estimated to be $500 million. The study reviewed sewer needs in the boroughs, and broke down projects into two phases over the following 10 years. Though City fiscal problems have delayed the schedule, the goal was to relieve communities with

the most severe problems and correct the planning and development deficiencies of the two decades after World War II. New projects, costing $300 million for which all basic studies had been completed, were added to the first year program for an estimated total cost of $800 million. The second five years had two kinds of projects. First, sewer projects for which drainage studies would have been completed during the first five years, costing $200 million, and, second, another series of projects for which drainage studies would be developed in the second five years. Total cost for the program was to be $1.5 billion.

The program proposals are summarized on Plate 3. Staten Island is the focus of a major construction program in the near future. The Staten Island allotment in the first five year program is $227.5 million or $750 per capita. The City-wide per capita rate is $100.

The next sections of the report explain the methodology for assessing the impact of Staten Island sewer plans on vital features and presents the conclusions.

METHODOLOGY

Contour maps of the existing topography of Staten Island were superimposed on proposed contours which were found by mapping legal grade from proposed drainage plans for two major drainage basins in Staten Island.

Oakwood Beach

The Oakwood Beach Water Pollution Control Plant Tributary Drainage Area from Quintard Street to Great Kills Park, bounded by Hylan Boulevard (Plate 4: OB-3 to OB-8).

This part of the Oakwood Beach Drainage Area has had a lot of residential construction since the 1960s. Many of the newer homes and streets were built at new legal grades; older homes, built at existing grade, will be surrounded and act as catchment basins during heavy storms. No natural watersheds with vital features worth preserving with proposed legal grades requiring extensive changes in existing topography were located.

Developed areas such as this Oakwood Beach study area are in critical need of storm and sanitary drainage facilities. Addition of environmental elements to site-specific reviews of proposed developments should protect remaining natural features.

Lemon Creek

The Lemon Creek drainage basin of the Oakwood Beach Water Pollution Control Plant Tributary Drainage Area is bounded by Bloomingdale Road, Sharrott Avenue, Princess Bay, Holten Avenue, Marcy Avenue, and Mason Boulevard. (Plate 4-S D-1). The area has expanses of heavily-wooded, unspoiled acreage with valuable tidal and freshwater wetlands and other features. Most of the area lacks sewers. Existing development is served by individual septic tanks.

Comparing existing topography with proposed legal grade shows that most of the area is planned for radical topographic change. Additional cross sections drawn through the centerline of Lemon Creek show that the Creek is to be filled and eradicated if proposed drainage plans are followed. Site reviews including elements will have to be more rigorous to insure support of existing ecosystems in regraded areas. In some cases, a redesign of existing plans may be necessary.

Natural watersheds were identified in areas beyond those covered by the topographic overlay study. They were designated Geographic Areas of Particular Concern (GAPCs) (See Plate 5) and will be studied thoroughly in the coming program year. (For description of these areas, see Task 7.3).

The next section discusses policies which led to these conditions in Staten Island.

Staten Island Drainage Plans

A drainage engineer determines the hydrology of an area from meteorological records and sets criteria for the design of storm sewers. In New York City engineers use the "rational formula" with five year rainfall frequency. Because rainfall intensity is a function of time of concentration it is a variable. For a given drainage area, the engineer follows existing topography as closely as possible to move as little earth as possible at the least cost. After the most economical collection pattern has been found for a drainage area, the engineer must set elevations on the proposed layout so that pipes will flow as planned. The elevations or proposed final grades are predicated on:

- Proposed development layouts
- Alleviation of existing ponding and drainage problems
- Pipe cover standards and other criteria prescribed by Department of Water Resources
- Hydraulic design factors of pipe gravity flow and pipe economy
- Mean high water at outfall(s)
- Maintenance policies and constraints

None of the above factors, per se, lead to the development of drainage plans which fail to respect environmental conditions. Other policy decisions and administrative history imposed in engineering show a pattern of environmental callousness.

- The Borough of Staten Island is the only one in New York City with a comprehensive plan for separate storm and sanitary sewers. Between 1965 and 1971 the plan was designed by a consulting engineering firm. The drainage plan was laid over an old rectilinear street layout for the borough. As mandated by law, the drainage plans must be approved before construction can be allocated. The Departments of Water Resources, Health, City Planning, and the Borough President and Board of Estimate participate in approval.

Use of the grid, a common engineering pattern at the time plans were drawn for the area, has been questioned. City Planning proposed a Planned Unit Development concept for the area which eliminates the rectilinear plan. Streets are laid out around an open space network. The South Richmond Special Zoning District demapped many streets to eliminate those mapped but not built which conflict with the open space to permit a system more sensitive to local conditions. When this special district was passed, the Department of Water Resources was expected to release a contract for the preparation of final drainage maps based on the South Richmond plan. Though a contract was drawn up, it was not let.

- In the past, the Department of Water Resources has found it economical in the long-term to use artificial outlets for storm water in City-owned easements rather than maintain natural watercourses. In fact, New York City is not allowed to maintain watercourses in sewers on private property without a health emergency order.

The long-term cost benefit ratio of maintaining natural water courses versus total piping was determined without assigning monetary benefits to natural resources or their role in supporting valuable ecosystems. This procedure has changed in the last few years.

- Development proposals are not required to provide sewers in accordance with City-wide drainage plans. In a court case in the late 1950's the City lost the power to enforce installation of drainage plan sewers. Sewer requirements for specific developments are usually less than drainage plan requirements but consistent with legal mandate.

Drainage plan design is based on the underlying mapped street grid and the site plan. Inclusion of environmental considerations at early stages of site planning has not been the practice. Recent State legislation, specifically tidal and freshwater wetland protection laws, have been forcing developers to plan for maintenance of existing ecosystems.

Conclusion

The proposed drainage plans for Staten Island will change existing topography and destroy valuable natural resources and vital physical features, a situation which persists because existing plans could not accommodate changes in land use patterns, because of existing legislative constraints, and because of assumed long-term cost benefit ratios calculated without assigning value to natural systems.

Drainage planning is inconsistent with the objectives of the Coastal Zone Management Act. The intention of this report is identification of problems for Task 7.4 which designates future permissible and priority uses in the coastal zone and management techniques for protection and preservation of existing vital features. The crux of the conflict is antiquated drainage plans for the unsewered areas. A comprehensive evaluation of the social and economic

impacts of changing existing drainage plans is needed.

Recommended Strategies

City Drainage Plans - Whole drainage areas designated Geographic Areas of Particular Concern (See Plate 5) will require redesign as soon as possible unless economic or social considerations outweigh potential adverse environmental effects.

Strip Plans in Unapproved Whole Drainage Areas - Strip plans, in which a sewer line subarea is extracted from a whole drainage area by the Department of Water Resources and submitted for review to the Departments of City Planning and Health, are used to proceed on specific budget line sewer construction projects. Generally, the policy has been to approve strip plans to satisfy Bureau of the Budget design or construction funding schedules. It is recommended that the policy be continued. Developed land tributary to strip plans usually need storm and sanitary drainage facilities and most natural features disruption issues no longer exist once development has occurred. Existing environmental review procedures and legislation are able to isolate conflicts in strip planning.

Strip Drainage Plans as Modifications of Approved Whole Drainage Areas - The decision to modify drainage plans after approval is passed upon field investigation of data. Past practice has been approval of requested modifications after minimal review. The practice should be continued for the same reasons as cited for strip plans.

Private Developments Requiring Drainage Plan Modification and Review - Because private developers are not required to conform to City drainage plans, environmental concerns must be raised in the early stages of site plan development to ensure protection of natural resources. In the third year, the Coastal Zone Management Program will study methods for environmental review early in the planning process.

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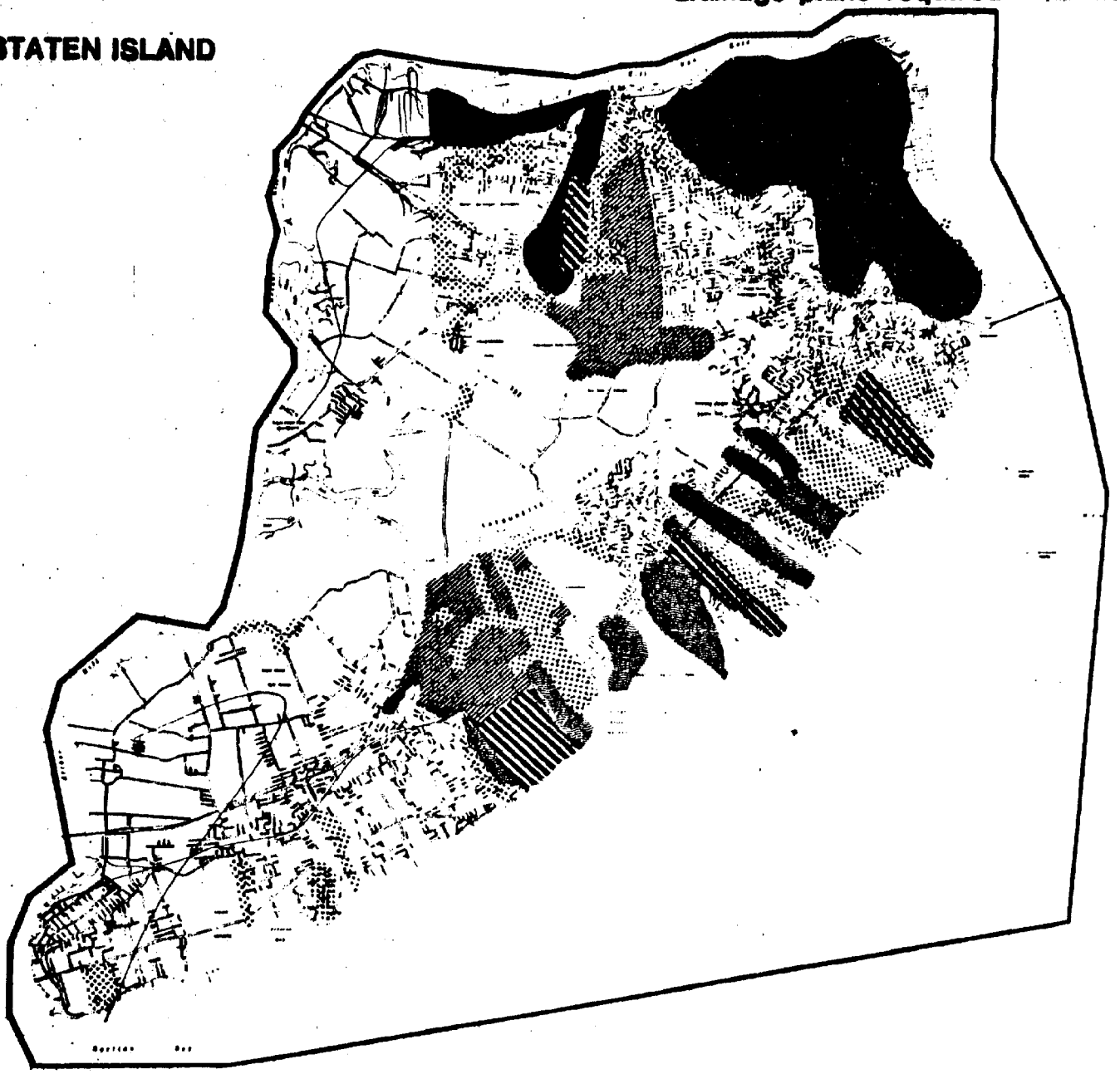
PLATE 1

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
ARTHUR KILL QUADRANGLE
NEW YORK NEW JERSEY
7.5 MINUTE SERIES (TOPOGRAPHIC)
WOODBRIDGE
LA TOURETTE PARK
Grant Kills Harbor
RARITAN BAY
Round Sheet
SCALE 1:24 000
CONTOUR INTERVAL 10 FEET
DATUM IS MEAN SEA LEVEL
DEPTH CURVES AND SOUNDINGS IN FEET DATUM IS MEAN LOW WATER
THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
FOR SALE BY U S GEOLOGICAL SURVEY WASHINGTON, D C 20242
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST
ROAD CLASSIFICATION
Heavy duty
Light duty
Medium duty
Unimproved dirt
Interstate Route
U S Route
State Route
NEW YORK CITY
COASTAL ZONE MANAGEMENT
PRELIMINARY BOUNDARIES
ARTHUR KILL, N.Y. - N.J.
1966
SPECIAL PRINTING

PLATE 2

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
THE NARROWS QUADRANGLE
NEW YORK NEW JERSEY
7.5 MINUTE SERIES (TOPOGRAPHIC)
THE NARROWS
BROOKLYN
GRAVESEND BAY
AMBROSE
CHANNEL
SWASH
CHANNEL
LOWER BAY
KINGS CO
QUEENS CO
RICHMOND CO
MONMOUTH CO
NEW YORK
NEW JERSEY
NEW YORK CITY
COASTAL ZONE MANAGEMENT
PRELIMINARY BOUNDARIES
THE NARROWS, N.Y. - N.J.

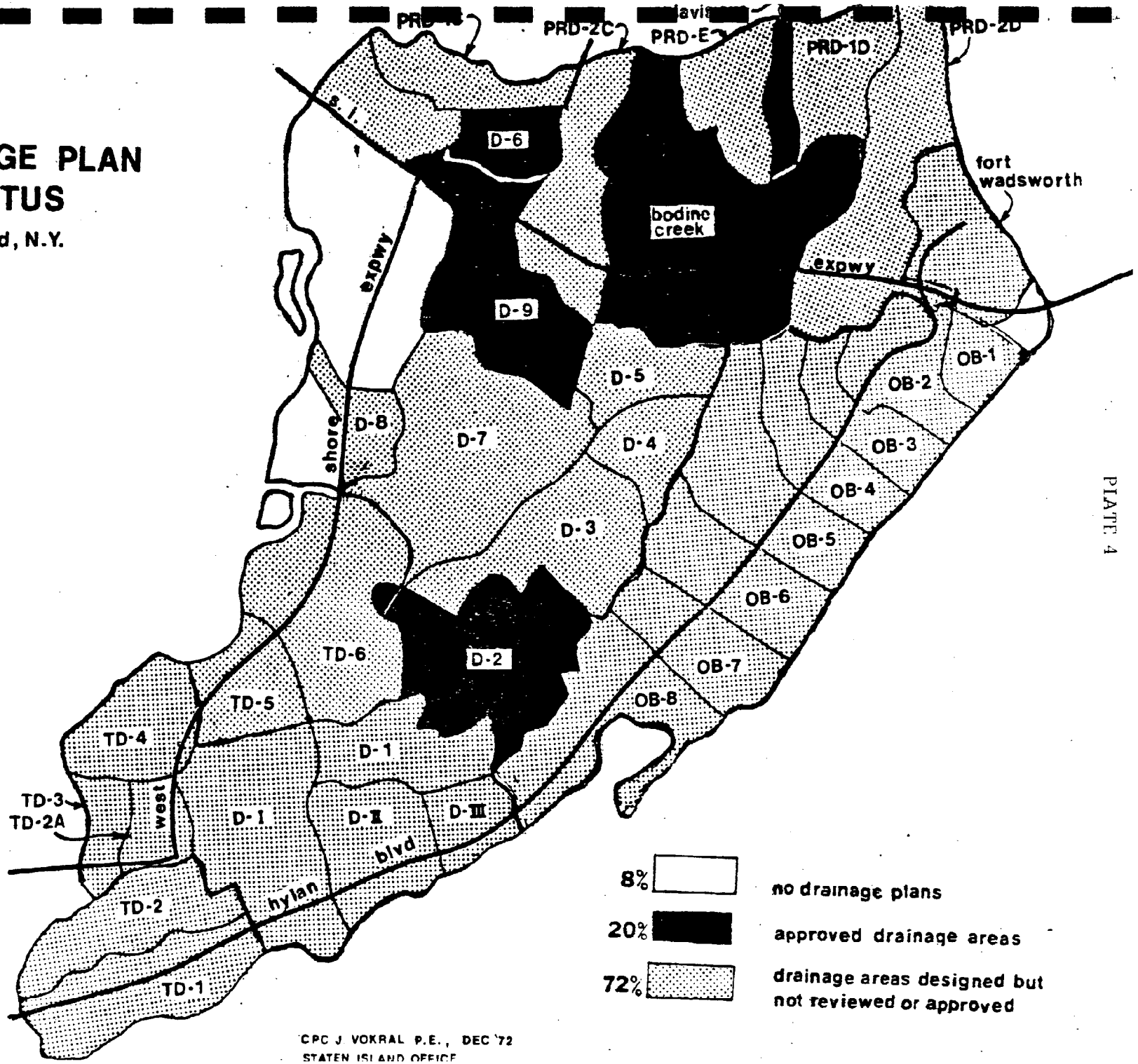
sewer projects committed to construction since 1966 –
sewer projects in scheduled program (fy '73 to fy '79) 500m.–
accelerated program (fy '73 to fy '79) – construction within 5 years 300m.–
accelerated program – construction 5–10 years –
– drainage plans required –



Source: Comprehensive Accelerated Sewer Program, Department of Water Resources, 1973

DRAINAGE PLAN STATUS

Staten Island, N.Y.



CPC J VOKRAL P.E., DEC '72
STATEN ISLAND OFFICE

PLATE 4

SOUTH RICHMOND NATURAL DRAINAGE BASINS AREA
STATEN ISLAND CPD 3

Scale: 1" = 1 mile.

(1) Arden Heights Woods

(2) Claypit Pond

(3) Lemon Creek

(4) Wolfe's Pond

(5) Arbutus Lake

(6) Lipset Avenue Creek

EXHIBIT I

SPECIFIC REQUIREMENTS
OF CONTRACT FOR

SERVICES OF ENGINEER
IN CONNECTION WITH

CAPITAL PROJECT NO. EP-1, PREPARATION AND FURNISHING A REPORT ON A GRADE, STREET, DRAINAGE, STREAM AREA AND COST STUDY IN THE SOUTH RICHMOND AREA, BOROUGH OF RICHMOND

Provisions Referenced With Agreement

SCOPE OF GRADE, STREET, DRAINAGE, STREAM AREA: COST STUDY PROJECT (Pursuant to Article "3")

A. AREA - BOUNDARY LIMITS OF STUDY AREA

The entire study area for this project is listed below:

Emmet Avenue extended southeasterly, Emmet Avenue, southerly limits of Oakwood Beach Pollution Control Plant, Emmet Avenue, Willowbrook Parkway, Clarke Avenue, Richmond Town Road, Arthur Kill Road, West Shore Expressway, Richmond Parkway, Arthur Kill, Atlantic Ocean, Emmet Avenue extended southeasterly. This area is contained within Community Planning Board #4.

However, in the review of the existing drainage plan sewers any flow originating in the hereinbefore described study area that has its final point of discharge outside this study area must be investigated to its final point of discharge.

B. REQUIRED WORK

To provide for development of South Richmond while recognizing existing communities, in terms of homes, schools, institutions, roads, and the existing topography and natural land features, a DRAFT LAND USE PLAN was developed. This draft plan designates an open space and park network which essentially reflect areas to be maintained in their existing natural state, and a street system which recognizes

the park network, existing communities and natural features.

The proposed draft land use plan has a direct affect upon the existing drainage plans. It is the intent of this study to evaluate this affect in terms of changes in generated flow distribution and the alignment of storm water and sanitary sewers and also to determine the feasibility of preserving the stream areas named below and to determine the overall cost implication.

Therefore, in terms of the above intent, the Engineer will perform the following work:

1. Establish maximum conformance of legal street grade with existing topography. This will be accomplished by a comparison between existing or proposed legal street grade and existing street grade. When the difference is more than 4 feet $\pm$ an attempt shall be made to reduce this difference while still maintaining positive street and adjacent property drainage. Any resultant changes shall be incorporated when revising the drainage plan for this project.

2. As a result of the analysis in Section B I recommend a final street layout which can proceed to final mapping.

3. The overall maximum population achievable in the DRAFT LAND USE PLAN will be about the same as that under the present zoning but its distribution will affect the existing drainage plans. Therefore, based on the DRAFT LAND USE PLAN prepared by the Department of City Planning, the revised final street layout and the existing drainage plans available for the area covered by this project, determine those sanitary sewers and storm water sewers shown on these existing drainage plans that may be retained.

a) The criteria to be used for this study of the drainage

plan work will be furnished by the Drainage Section, Division of Sewer Design of the Department of Water Resources.

b) When reviewing the existing drainage plan sewers in areas where the streets shown on the existing drainage plan are not to be retained, assume the flow distribution shown on these existing drainage plans in areas other than parks.

c) Sanitary and storm water sewers already committed to design and/or construction at the time of this study shall be retained in the general layout.

d) The sanitary sewer connection locations with the intercepting sewer itself must be held. The storm water outfalls should be held, wherever feasible. Where the above cannot be complied with, the Drainage Section of the Department of Water Resources shall be consulted.

e) The street system shown on the DRAFT LAND USE PLAN will be the basis for this study whether final mapped or not.

Where the existing drainage plan sewers cannot be retained, a sewer scheme shall be prepared showing the general layout for draining the remaining study area with sanitary and storm water sewers.

When submitting the report for this study project a plan shall be included which will show on one plan the existing drainage plan sewers that may be retained and the sewer scheme for the remaining study area for both the sanitary and storm water sewers.

4. Evaluate the feasibility of preserving the stream areas of Lemon Creek, Arbutus Lake and Arden Heights. This feasibility analysis shall consider, but not be limited to, the maintenance aspect of preserving the above mentioned stream areas including

the frequency of each operation required, and the equipment and manpower requirements for the removal of siltation deposits and floating and submerged debris, and the re-shaping of cross-sections. Sound engineering practice shall be used in this feasibility study influenced to a high degree by the present City institutional arrangement for the maintenance of watercourses.

5. Determine the overall cost implication of the drainage system which will be recommended from this study in comparison to the drainage system proposed in the existing drainage plans. This cost analysis will include all the drainage facilities for both the sanitary and storm water sewer systems, grading of streets and area of streets required, but excluding the sanitary intercepting sewer. The cost analysis shall also include present open areas required for future sewer construction.

Upon the completion of the above work the Engineer shall submit twenty (20) copies of a report of his findings and recommendations in narrative, tabular and graphic form and shall revise the report as may be required by the Department of Water Resources until final acceptance by the Commissioner.

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