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STATE OF NEW JERSEY
HACKENSACK MEADOWLANDS DEVELOPMENT COMMISSION

FEASIBILITY REPORT
WATER POLLUTION CONTROL SYSTEMS

IN CONNECTION WITH
THE DEVELOPMENT OF THE

HACKENSACK MEADOWLANDS

BERGEN AND HUDSON COUNTIES

1971

JOHN J. KASSNER & CO., INC.
CONSULTING ENGINEERS

STATE OF NEW JERSEY

HACKENSACK MEADOWLANDS DEVELOPMENT COMMISSION

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JOHN J. KASSNER & CO., INC.
CONSULTING ENGINEERS

HACKENSACK MEADOWLANDS DEVELOPMENT COMMISSION

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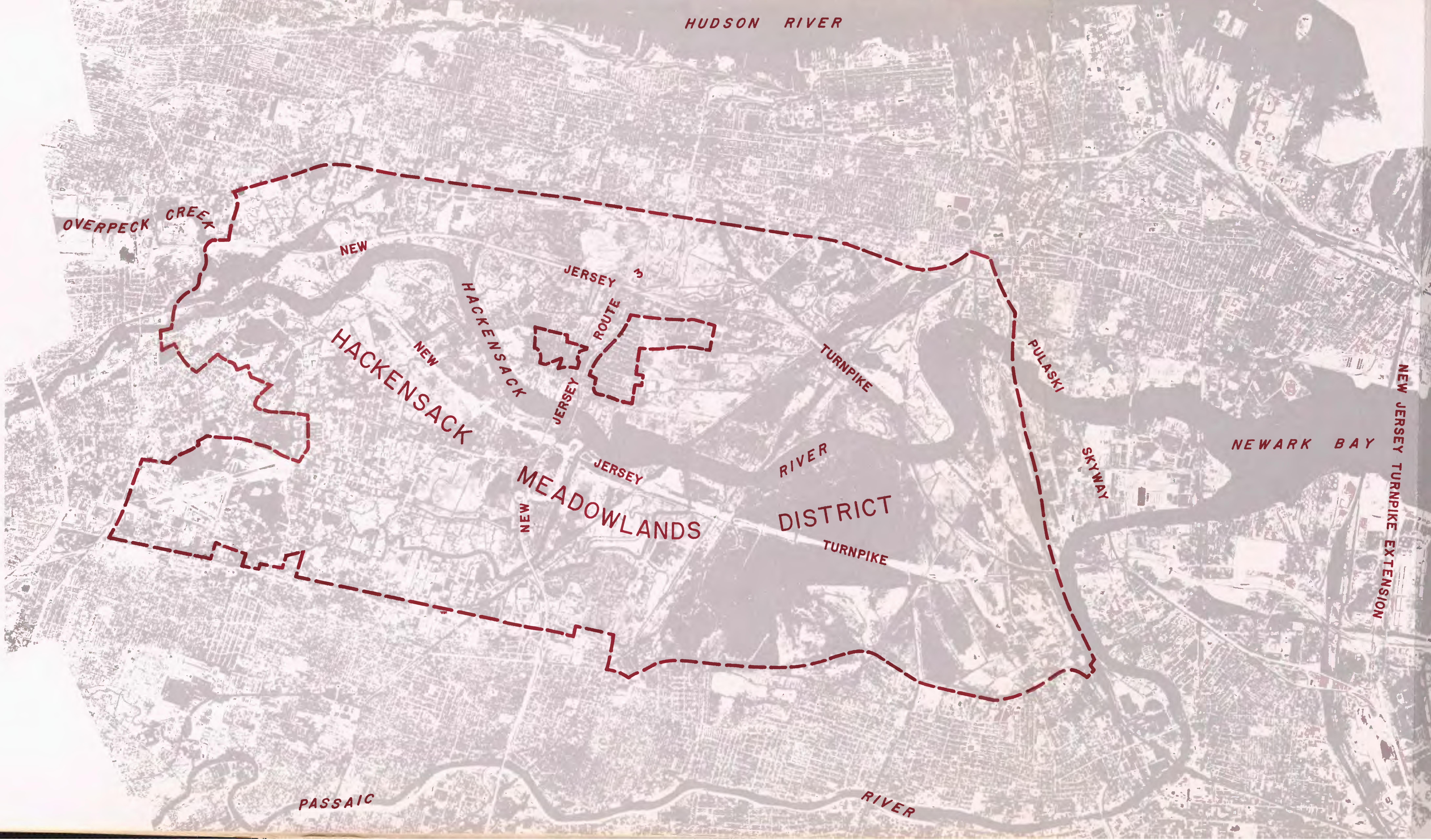
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PASSAIC RIVER

JOHN J. KASSNER & CO., INC.
CONSULTING ENGINEERS
475 PARK AVENUE SOUTH
NEW YORK, N. Y. 10016
(212) 685-8511

JOHN J. KASSNER
DAVID LEVINE
LAWRENCE W. LANE
VINCENT S. FOX

ASSOCIATES
BENJAMIN OPEROWSKY
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February 10, 1972

Hon. Lawrence F. Kramer,
Chairman
Hackensack Meadowlands
Development Commission
363 West State Street
Trenton, N. J. 08625

Re: Feasibility Report on Water Pollution Control Systems in connection with the Development of the Hackensack Meadowlands in Bergen and Hudson Counties New Jersey

Dear Sir:

We are pleased to submit herewith the Feasibility Report on Water Pollution Control Systems for the Development of the Hackensack Meadowlands. This Report has been completed in accordance with the terms of our Agreement for Engineering Services dated October 6, 1969.

A draft of this Report was submitted to the Commission and to the New Jersey Department of Environmental Protection on September 17, 1970. This printed Report incorporates comments received on this draft, and also includes an Addendum which takes further cognizance of and comments upon the proposals set forth in a report entitled "Feasibility Study - Regional Sewage Facilities - Hudson County - March 1970" prepared by others for the Hudson County Board of Chosen Freeholders. The Addendum was prepared and is included in compliance with a request made by the Department of Environmental Protection on August 23, 1971.

Bound in the Report book are also Appendix A, listing the present water quality standards for the State of New Jersey; Appendix B, listing the present water quality standards of the State of New York; and Appendix C, listing detailed criteria for recommended water quality standards for the Hackensack River. Appendix D, a map showing the extent of existing sewerage facilities in the Hackensack Meadowlands District and its environs, has been delivered to your staff and is on file in your office.

The Report includes data collected pertaining to existing water pollution control facilities and to Hackensack River water quality affecting the Hackensack Meadowlands District. This has formed the basis for the conclusions drawn as to the present inadequacy of water pollution control systems and the need to improve the present water quality standards for the Hackensack River. In order to insure the attainment of a River water quality within the Hackensack Meadowlands District that will be compatible with the type of development envisaged by the Comprehensive Master Plan, the Report recommends the adoption of new water quality standards for surface waters, establishes qualitative and quantitative parameters defining the water quality standards, as well as for the effluents discharged thereto; and presents a schedule for their implementation which is related to the projected schedule for development of the Hackensack Meadowlands District.

Based on flows which would ultimately emanate from the type of land use and development proposed for the Hackensack Meadowlands District in the Comprehensive Master Plan, as well as flows which would be produced by the projected population and development of the upland areas tributary to the District, three conceptually different sewerage schemes were investigated, each of which produced equal results by application of the degree of water pollution control necessary to insure required River water quality. Alternate C, the recommended system, considers the elimination of all existing treatment facilities which discharge effluent to the waters within the Hackensack Meadowlands District with the exception of the Bergen County Sewer Authority Plant at Little Ferry, which with upgraded treatment would serve its present tributary flow together with all flow which would emanate from the northerly portion of the Hackensack Meadowlands District. In addition, a new treatment plant would be constructed in the southerly meadowlands to process all flow which would emanate from the Hackensack Meadowlands District south of approximately N.J. Route No. 3, as well as the flow from the upland areas tributary to existing treatment plants south of that same line.

The Report recommends that the Hackensack Meadowlands Development Commission create a subdivision, which agency would have jurisdiction over the administration and enforcement of the recommended water quality and effluent standards as well as the administration, construction, maintenance and use of the proposed new treatment facility and all new interceptor and major trunk sewers within the Hackensack Meadowlands District. Direct control by the Hackensack Meadowlands Development Commission will enhance the successful, timely development of land as proposed in the District's Comprehensive Master Plan. Also, control by the Hackensack Meadowlands Development Commission of the administration and financing of the required Water Pollution Control Systems will enhance the feasibility of their successful implementation by virtue of the unique advantages contained in the enabling legislation which created the Hackensack Meadowlands District.

Alternate C lends itself favorably to construction in stages and the Report presents and recommends a staged construction schedule which closely complies with needs arising from the projected development proposed by the Comprehensive Master Plan.

We therefore urge prompt implementation of Alternate C and adoption of the recommended water quality standards so that the water quality of the Hackensack River may be sufficiently improved for scheduled implementation of the Comprehensive Master Plan.

Acknowledgment is gratefully made to the Hackensack Meadowlands Development Commission staff whose help and guidance was essential to the completion of this Report, in particular, former Acting Executive Director Clifford A. Goldman and former Acting Chief Engineer Clayson W. Foley, and in addition, to the staffs of the New Jersey Department of Community Affairs, the New Jersey Department of Environmental Protection, the Federal Environmental Protection Agency and to all other officials and members of the many other cooperating public agencies.

We are pleased to have had the collaboration of our professional associates, Alfred Crew Consulting Engineers, Inc. and Professor Gerald A. Palevsky of the University of the City of New York in the preparation of this most interesting and challenging assignment.

Respectfully submitted,

JOHN J. KASSNER & CO., INC.

STATE OF NEW JERSEY
JOHN J. KASSNER
7670
LICENSED
PROFESSIONAL ENGINEER

John J. Kassner

John J. Kassner, P.E.

STATE OF NEW JERSEY
LAWRENCE W. LANE
9690
LICENSED
PROFESSIONAL ENGINEER

Lawrence W. Lane

Lawrence W. Lane, P.E.

ADDENDUM — JANUARY 1972

INTRODUCTION

At the request of the New Jersey Department of Environmental Protection, Division of Water Resources, this Addendum to the "Feasibility Report on Water Pollution Control Systems in Connection with the Development of the Hackensack Meadowlands in Bergen and Hudson Counties" has been prepared. The original Report was prepared and submitted on September 17, 1970 to the Hackensack Meadowlands Development Commission and to the Department of Environmental Protection.

At the request of the Department of Environmental Protection a meeting was held on August 23, 1971, attended by representatives of the Department's Bureau of Water Pollution Control, a representative of the consulting engineers to the Hudson County Board of Chosen Freeholders, and representatives of the consulting engineers to the Hackensack Meadowlands Development Commission. This meeting was scheduled by the Department to attempt to resolve apparent differences between recommendations of the Hackensack Meadowlands Report and the "Feasibility Study - Regional Sewage Facilities - Hudson County - March 1970" prepared for the Hudson County Board of Chosen Freeholders.

As a result of the discussions at the meeting, it was determined that each Report should contain an Addendum which would take cognizance of and comment upon the proposals set forth in the other Report. More specifically, Alternates II and III in the Hudson County Report would be summarized and commented upon in the Hackensack Meadowlands Report and Alternate C of the Hackensack Meadowlands Report would be summarized and commented upon in the Hudson County Report.

OBJECTIVES

The objective of the Hackensack Meadowlands Study and Report was to determine the most feasible method of improving the quality of the surface waters within the Meadowlands District to a degree which would be compatible with the water-oriented land use proposed in the Master Plan for the development of the Meadowlands District. The Report also was to recommend a system of water pollution control facilities to properly serve the development of the Meadowlands District and to attain the required water quality standards.

The objective of the Hudson County Report was to determine the most feasible method of regionalizing water pollution control facilities only within the limits of Hudson County to conform to present water quality and pollution control standards established by the New Jersey Department of Environmental Protection.

The Hackensack Meadowlands Report employed a regional, river basin approach towards meeting its objective while the Hudson County Report limited itself to the area encompassed by the political jurisdiction of Hudson County. Each Report investigated the feasibility of three different schemes to attain its objectives.

HACKENSACK MEADOWLANDS REPORT

In order to assure the attainment of a surface water quality within the Hackensack Meadowlands District that will be compatible with the type of development envisaged by the Master Plan, the Hackensack Meadowlands Report recommended the adoption of new water quality standards for the surface waters within the Hackensack Meadowlands District, as well as for contiguous areas outside the District which will have an effect on the Hackensack River. It established qualitative and quantitative parameters defining these water quality standards, as well as for the effluents discharged thereto. These recommended classifications were identified as "Recreational Waters", "Primary Contact Waters" and "Harvest Waters", listed in order of increasing water quality. The Report recommended adoption and enforcement of these classifications within the entire Hackensack River Basin and contiguous waters according to a schedule related to the projected schedule for District development.

Alternate A of the Hackensack Meadowlands Report considered the retention of all existing sewerage agencies which presently serve the Hackensack River watershed with the sewage emanating from the Hackensack Meadowlands District being treated at existing treatment plants by means of enlarged and upgraded facilities. Alternate B considered treating the major flow from the Hackensack Meadowlands District at an enlarged and upgraded Bergen County Sewer Authority Plant. In addition, upgrading and enlargement would be necessary for the Kearny treatment plant, which would serve that portion of the municipality outside of the Meadowlands District and for the Jersey City Sewerage Authority West Side treatment plant which would serve its present service area and that portion of the Hackensack Meadowlands District lying within the corporate limits of Jersey City.

Alternate C, the Recommended Plan, considered retention of the Kearny, Jersey City Sewerage Authority West Side and Bergen County Sewer Authority treatment plants together with the construction of a new Hackensack Meadowlands District treatment plant to be located at the proposed Corps of Engineers tidal barrier approximately 4.3 miles upstream of the mouth of the Hackensack River. This new plant will treat all of the flows emanating from the Hackensack Meadowlands District south of an east-west line in the vicinity of N.J. Route 3 together with the uplands flow from the existing systems of Secaucus, North Bergen, North Arlington-Lyndhurst Joint Meeting and that portion of the Jersey City Sewerage Authority West Side tributary area upstream of Manhattan Avenue. The Kearny plant would continue to serve its present tributary area while the Jersey City Sewerage Authority West Side treatment plant would serve its present tributary area, reduced by the flow from the area north of Manhattan Avenue which is to be diverted to the Hackensack Meadowlands District treatment plant. The Bergen County Sewer Authority plant would continue to serve its present service area and that portion of the Hackensack Meadowlands District lying north of the east-west line near Route 3.

Under the various Alternates the possibilities were recognized of treating flows tributary to the Kearny plant at the Jersey City Sewerage Authority West Side plant and for treating tributary flows to both Kearny and Jersey City Sewerage Authority West Side plants at the Hackensack Meadowlands District plant.

The degree of treatment under all Alternates will have to be such that the effluent meets the recommended upgraded water quality standards and be discharged directly to the Hackensack River. Under Alternate C the initial wastewater treatment standards for the Hackensack Meadowlands District and the Bergen County Sewer Authority plants will have to conform to "Recreational Waters" standards and the Kearny and Jersey City Sewerage Authority West Side plants will have to conform to TW-2 standards.

The Hackensack Meadowlands Report recommended that the Hackensack Meadowlands Development Commission establish a Division of Environmental Protection to implement and administer the water pollution control system for the District and to have jurisdiction over sanitary code and pollution control enforcement for the entire Hackensack Meadowlands District as well as control over all effluents discharged within the District into the Hackensack River and its tributaries.

HUDSON COUNTY REPORT

Alternate I considered dividing the County into four regional sub-districts, each served by a secondary wastewater treatment facility. A treatment plant located in North Bergen discharging to Cromakill Creek, a tributary of the Hackensack River, would serve all of North Bergen, West New York and Guttenberg and portions of Secaucus, Union City and Weehawken. The Jersey City Sewerage Authority West Side treatment plant discharging into Newark Bay would serve its present service area, Kearny, Harrison, East Newark and a portion of the Secaucus meadowlands. The Jersey City Sewerage Authority East Side treatment plant, discharging into New York Harbor, would serve its present service area, Hoboken, and a portion of Union City and Weehawken. The Bayonne treatment plant, discharging into the Kill Van Kull, would serve its present service area. The Department of Environmental Protection has determined that this Alternate is no longer to be considered.

Alternate II considered the County being subdivided into three regional subdistricts, each served by a secondary wastewater treatment facility. The Bayonne treatment plant would serve its present service area. The Jersey City Sewerage Authority East Side treatment plant would serve the remainder of the County lying east of the ridge between the Hackensack River and Hudson River watersheds. The Jersey City Sewerage Authority West Side treatment plant would serve the remainder of Hudson County west of the watershed divide, including all of the Hackensack Meadowlands District within the County.

Alternate III considered the County being subdivided into the same three regional subdistricts as proposed under Alternate II, except that only primary treatment would be provided at the Bayonne and the Jersey City Sewerage Authority West Side treatment plants, with primary effluent pumped to and treated at a central secondary wastewater treatment facility to be located at the site of the Jersey City Sewerage Authority East Side treatment plant. All treated secondary effluent would be discharged to New York Harbor.

The Hudson County Report recommended the establishment of a Hudson County "autonomous commission or authority" to implement and administer the entire sewerage system and pointed out Alternate III as having the advantage of lowest original capital cost and probable lowest operating cost. The Report did not include details for providing sewerage facilities for that portion of the Hackensack Meadowlands District within Bergen County, but assumed that the Bergen County Sewer Authority would provide for the sewage flow from that area.

EFFECT OF IMPLEMENTATION OF HUDSON COUNTY REPORT RECOMMENDATIONS

Alternate III in the Hudson County Report proposed to divert into New York Harbor all treated sanitary sewage effluent generated within that area of Hudson County west of the Hackensack River-Hudson River ridge. The diversion of this quantity of tributary flow from the Hackensack River Basin will reduce the already inadequate advective fluvial flow during times of dry weather and will tend to further deter the flushing out to Newark Bay of effluents discharged to the river. The resulting tendency of the River to stagnate, and the possibility of a rise in the rate of eutrophication must also be taken into consideration.

The environmental ramifications of a concentrated discharge of the pollutional load contained in the effluent emanating from all of Hudson County at one point in New York Bay in close proximity to the discharge of effluents from New York City and the Passaic Valley Sewer Commission outfalls must also be considered. Removal of this flow from the Hackensack River Basin will also eliminate the possibility of future recycling for use as cooling water, process water, incinerator quench water or even potable water. This may become extremely important as the demand on available water supplies increases.

The construction schedule proposed in the Hudson County Report does not serve the needs of the Master Plan for the development of the Hackensack Meadowlands District in that the schedule proposed for implementation of Alternate III defers the construction of interceptor sewers in the Kearny portion of the District until 1980. The portion of this municipality lying within the Hackensack Meadowlands District contains 3, 550 gross acres of which approximately 50 percent is slated to be developed for non-public use in conformance with the Comprehensive Land Use Plan. This constitutes approximately 14.4 percent of all non-public land use in the entire Hackensack Meadowlands District. Deferring construction of sewerage facilities in this area for a long period will restrict development and will seriously affect the logical and orderly sequence of development of the entire Hackensack Meadowlands District.

Both Alternates II and III proposed to extend the tributary area of the Jersey City Sewerage Authority West Side treatment plant, conducting the sewage collected from the extended service area to and through the existing West Side interceptor sewer to the treatment plant. This interceptor sewer carries combined sewage and is equipped with ten overflow regulators north of the plant which discharge raw sewage into tributaries of the Hackensack River when storm water flows exceed 160 percent of average dry weather flow. Adding additional sanitary sewage flows to this line can only tend to increase the frequency and/or total amount of untreated sewage discharged to the River to the general detriment of River water quality.

If Alternate II is implemented the recommended water quality standards for the development of the Hackensack Meadowlands District in accordance with the Master Plan must still be implemented. This will require more stringent treatment standards and strict enforcement of the sanitary code requirements. The initial wastewater treatment standards for the Jersey City Sewerage Authority West Side plant will have to conform to the recommended Hackensack Meadowlands District "Recreational Waters" standards.

Regionalizing water pollution control systems within County limits as opposed to watershed limits, which would result from implementing the Hackensack Meadowlands District system, has several disadvantages. The Hudson County Report proposes that the Bergen County Sewer Authority can, and in fact will, accept all the sewage flow emanating from all of the Bergen County portion of the District. It is of course physically possible to accomplish this, but the attendant increase in cost to the Bergen County Sewer Authority must be considered. In addition, the disadvantages that accrue to implementation of Alternate II or III are similar to those inherent in Alternate B of the Hackensack Meadowlands Report. These are the necessity for enlarging the existing Bergen County Sewer Authority treatment plant and sewer facilities to accommodate the increased Hackensack Meadowlands District flow beyond that which would have been otherwise necessary, as well as the necessity of constructing additional pumping stations and force mains and larger and additional interceptor sewers. The Hudson County Report also proposes several pumping stations and force mains in the tributary area of the Hackensack Meadowlands District within Hudson County whereas Alternate C of the Hackensack Meadowlands Report provides for gravity sewer flows throughout.

The fact that two different sewerage Authorities will have jurisdiction in the Hackensack Meadowlands District will result in two different rate charges being applied to properties within the

District. This will tend to discourage development of land located in the portion of the District served by the County having the higher user rate. This might tend to restrict planned development of the Hackensack Meadowlands District according to the proposed schedule for implementation of the Master Plan. Under the implementation scheme proposed in the Hackensack Meadowlands Report, capital construction costs can be assessed against property benefited whereas County sewerage agencies can only recover costs through user charges to local communities, resulting in increased local property taxes.

EFFECT OF IMPLEMENTATION OF HACKENSACK MEADOWLANDS REPORT RECOMMENDATIONS

The recommended Alternate C of the Hackensack Meadowlands Report meets the objectives of the Hackensack Meadowlands Development Commission's Master Plan, increases the likelihood of its successful fulfillment and at the same time provides advantages to Hudson and Bergen Counties, as well as attendant improvements to the environment which are of benefit to everyone.

The proposed diversion of that portion of the tributary area of the Jersey City Sewerage Authority West Side treatment plant lying upstream of Manhattan Avenue in Jersey City into the new Hackensack Meadowlands treatment plant will reduce the hydraulic loading on the West Side interceptor sewer downstream from this point, thereby reducing the amount of untreated sewage discharged to the Hackensack River during storm periods. Reduction of the tributary flow will also reduce the necessity of expanding the Jersey City Sewerage Authority West Side treatment plant. The construction of the new Hackensack Meadowlands wastewater treatment plant does not preclude the abandonment of the existing Kearny treatment plant with sewage from its service area being treated at the Jersey City Sewerage Authority West Side treatment plant and also provides the possibility of treating the total flow from both of these existing plants at the new Hackensack Meadowlands facility. If this option were exercised, the existing plant sites would be available to treat storm water flows.

The location of the proposed Hackensack Meadowlands treatment plant is in proximity to the proposed regional solid wastes incinerator. This will permit disposal of sewage sludge by incineration, with better control over air pollution loadings, and for use of sewage effluent for quench water. Disposal of sludge in a modern central incinerator facility has environmental advantages over dumping at sea or incineration in older, less technologically advanced incinerators and financial advantage over the construction of incineration facilities to dispose of sewage sludge alone.

Alternate C divides the Meadowlands District into areas which result in shorter sewer systems, no pumping facilities, and gravity sewers installed at shallower depths. The east-west line which divides the Bergen County portion of the Meadowlands into proposed service areas is based on limiting the quantity of sewage flow from this area to the Bergen County Sewer Authority treatment plant to no more flow than would have emanated from the entire Bergen County portion of the Meadowlands District had the Comprehensive Land Use Plan not transcended existing municipal zoning. Therefore, projected planning and scheduling for the expansion of the Bergen County Sewer Authority system is not adversely affected. Implementation of Alternate C also permits the earliest elimination of all existing inadequate local treatment facilities presently contributing to water pollution in the Hackensack River basin.

Finally, the implementation of Alternate C as recommended in the Hackensack Meadowlands Report allows the Hackensack Meadowlands District to be developed in accordance with the projected schedule for implementing the Master Plan for the development of the Hackensack Meadowlands District. It lends itself to staged implementation with minimum expenditures of required capital at any given time while insuring the availability of facilities required for Hackensack Meadowlands District development. Direct ownership of and control over sewerage facilities by an agency of the Hackensack Meadowlands Development Commission precludes the possibility of individual County needs transcending Meadowlands requirements, which could be the case if such jurisdiction were fragmented between the two Counties.

The enabling legislation creating the Hackensack Meadowlands Development Commission allows it to assess improvement costs against District lands and permits these costs to be financed with bonds having a fifty-year term. These unique advantages can be utilized by creation of an agency within the Hackensack Meadowlands Development Commission to implement the construction of a Hackensack Meadowlands District water pollution control system resulting in attractive sewer rate charges throughout the life of the system. Centralizing jurisdiction over sewage facilities in the Hackensack Meadowlands District under one agency which has an interest in providing facilities when and where needed; which will vigorously enforce environmental control regulations throughout the Hackensack Meadowlands District to make the environment compatible with the types of land use proposed in the Comprehensive Land Use Plan; and which is capable of imposing uniform and attractively low sewerage charges will tend to accelerate and enhance District development to the end of increasing tax ratables in both Counties. This would particularly benefit Hudson County, since the development of its Meadowlands is just about its last opportunity to significantly increase its ratables.

CONCLUSIONS

From the foregoing comments, it is concluded that the implementation of either Alternate II or Alternate III as proposed in the Hudson County Report, even with modifications, would not best serve the objectives of the Hackensack Meadowlands Development Commission and might limit its capability to effectively develop the Hackensack Meadowlands District in conformance with the Master Plan. The implementation of Alternate C as proposed in the Hackensack Meadowlands Report will best meet the objectives of the Hackensack Meadowlands Development Commission for development of the District and will enhance the environment in the District as well as the contiguous region. In doing so it will provide greater benefit to both Hudson and Bergen Counties without limiting the scope of their action in attempting to resolve the environmental problems of their areas outside of the Hackensack Meadowlands District.

The proposed mathematical model study of the Hackensack River Basin may provide more definitive answers as to the effect on water quality of various degrees of treatment and points of effluent discharge. However, this should not change the basic concept of regionalization and advantages inherent in Alternate C of the Hackensack Meadowlands District Report. If the mathematical model study indicates that the regional plant effluent discharges should be made outside of the Hackensack River Basin, Alternate C of the Hackensack Meadowlands District Report has the flexibility to be adapted to such a proposal, and all other benefits derived from the implementation of Alternate C still would obtain.

Implementing Alternate C of the Hackensack Meadowlands Report does not negate the regionalization of water pollution control for the remaining area of Hudson County along the lines proposed in the Hudson County Report alternates, but in fact enhances their feasibility. If the option of providing secondary wastewater facilities at the Jersey City Sewerage Authority West Side plant is implemented, the presence of the Meadowlands Plant some four miles upstream discharging a significant amount of effluent treated to more stringent standards allows the West Side plant to discharge an effluent one water quality standard below that recommended for the Hackensack Meadowlands plant. If the new plant were not constructed and Alternate II of the Hudson County Report were implemented, treatment standards recommended for the Hackensack Meadowlands plant would be required at the Jersey City Sewerage Authority West Side plant. The presence of the Hackensack Meadowlands plant contributing advective fresh water flow to the Hackensack River somewhat reduces the objection to diverting the remaining Jersey City Sewerage Authority West Side tributary flow to New York Bay as proposed in Alternate III of the Hudson County Report, since all dry weather advective flow in the lower reach of the Hackensack River is not eliminated.

PRESENT STATUS

The New Jersey Department of Environmental Protection, by letter dated August 25, 1971 to the Hudson County Sewerage Authority, directed the Authority to abandon the existing North Bergen Township treatment plants at 91st Street and 43rd Street. This is to be accomplished by construction of an interceptor sewer and appurtenances to convey the sewage from areas tributary to these plants to the existing Jersey City Sewerage Authority west side interceptor sewer in Tonnelle Avenue at the North Bergen Township-Jersey City municipal boundary. The Authority was further directed to abandon the existing Kearny treatment plant, except for necessary pretreatment facilities, and to construct a pumping station and force main to convey the sewage presently being treated at the Kearny treatment plant to the Jersey City West Side treatment plant. To accomplish these directives the Jersey City West Side treatment plant is to be modified to adequately accommodate the Kearny and North Bergen Township flows.

Compliance with these directives by the Hudson County Sewerage Authority will not seriously affect the feasibility of implementing the recommendations of the Hackensack Meadowlands Report. The desirability of converting the Kearny Treatment Plant into a pumping station to convey flows from the presently sewered area of Kearny to the Jersey City Sewerage Authority West Side plant for treatment was recognized in the Hackensack Meadowlands Report for all Alternates studied. Similarly, the elimination of the two North Bergen Township treatment plants was also recommended in the Hackensack Meadowlands Report, but their flows were to be conveyed to the proposed Hackensack Meadowlands wastewater treatment plant. However, connection of these flows to the Jersey City Sewerage Authority West Side system does not preclude eventually diverting them to a Hackensack Meadowlands treatment plant. It should be noted that the Hackensack Meadowlands Report recommended the ultimate diversion to the Hackensack Meadowlands treatment plant of all flow in the Jersey City west side interceptor sewer north of Manhattan Avenue to reduce the amount of untreated flow discharged to the Hackensack River.

Initial connection of the sewage flow from North Bergen Township to the Jersey City west side interceptor sewer will increase the discharge of raw combined sewage through that system's regulators during periods of wet weather. However, as an interim measure this may be more desirable to the Meadowlands environment than having improperly treated effluent from both North Bergen Township treatment plants to continue to discharge to the waters of Cromakill Creek and Bellmans Creek at all times.

Accompanying the letter from the Department of Environmental Protection was a map delineating the regional planning concepts accepted by the Department at that time. This map indicates the various tributary areas in the Region and divides the Hackensack Meadowlands Distrist west of the River along the line approximating Route 3. This dividing line agrees with the recommendations of the Hackensack Meadowlands Report in that flows from the portion of the Meadowlands District north of Route 3, on the west side of the River, will be discharged to the Bergen County Sewer Authority treatment plant at Little Ferry.

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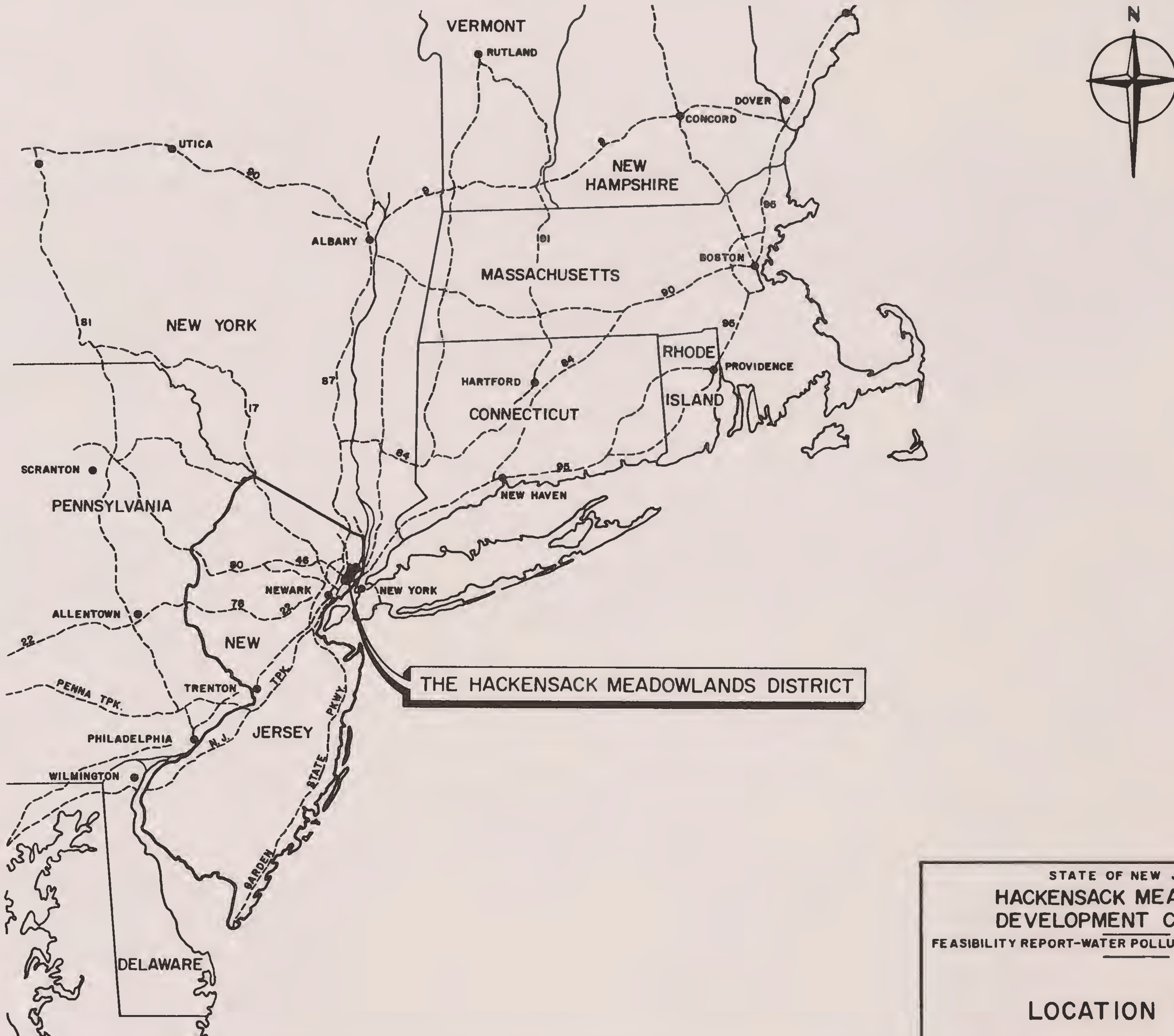


STATE OF NEW JERSEY

HACKENSACK MEADOWLANDS DEVELOPMENT COMMISSION

FEASIBILITY REPORT-WATER POLLUTION CONTROL SYSTEMS

LOCATION PLAN

JOHN J. KASSNER & CO., INC.
Consulting Engineers

SECTION I. INTRODUCTION

A. Background

The area of northeastern New Jersey, commonly known as the Hackensack Meadowlands, has over the past 200 years evolved into what may constitute the most valuable area of undeveloped land in the region. It has in fact been called "a resource of incalculable opportunity" by the New Jersey State Legislature.

That the Meadowlands, which lie within a teeming metropolitan district, pressed on its periphery by concentrated development of all types, yet remains relatively dormant, would seem an anachronism. There are however difficult administrative and physical problems which have slowed orderly and effective utilization of this vacant land.

Fragmented jurisdiction over the area has been a major contributor to its dormancy, and the efforts of public and private organizations to utilize the full potential of the Meadowlands have over the years been fruitless. The Meadowlands have become a transportation corridor and a depository for wastes from surrounding communities in the metropolitan area. The development that has taken place has been dictated by the interests of local jurisdictions with little consideration for its regional impact.

Difficult physical problems, including tidal inundation, fresh water flooding and unfavorable geologic formation, have been deterents to orderly utilization, a result of which has been development in the higher areas only, again with little regard to regional impact.

Recognizing the importance of this valuable land resource to the entire State and region and the imminency of its loss, the New Jersey State Legislature enacted a statute entitled "The Hackensack Meadowlands Reclamation and Development Act of 1968" which became law on January 13, 1969. This legislation defined the boundaries of "The Hackensack Meadowlands District" and established the "Hackensack Meadowlands Development Commission" as the agency to have regional jurisdiction over the District. The statute gives the Commission broad and extensive powers to plan for and implement the development of the area within the District. Among the powers granted the Commission is the authority to adopt and implement a Comprehensive Master Plan for the development of the Meadowlands.

B. Authorization

In order to implement the Comprehensive Master Plan it will be necessary to formulate a plan for the abatement and control of water pollution in the Hackensack River, the Meadowlands District and its environs. An Agreement between the Hackensack Meadowlands Development Commission and John J. Kassner & Co., Inc. dated October 6, 1969 authorized this firm to conduct a Study and prepare a Feasibility Report on Water Pollution Control Facilities required for the development of the Hackensack Meadowlands in accordance with the Comprehensive Master Plan.

C. Scope

The Feasibility Report on Water Pollution Control Systems for the Hackensack Meadowlands covers the preparation of an inventory and analysis of existing sewerage facilities located within and adjacent to the Hackensack Meadowlands District and makes recommendations for upgrading existing waste water treatment facilities and/or construction of new waste water treatment facilities. The Agreement specifically requires consideration of the following items:

1. Determination of the sources of pollution and analysis of the types, volumes and strengths of pollutants contributing to pollution of the Hackensack River.

2. Calculation of the capacities of existing major interceptors and wastewater treatment plants.

3. Review of the present water quality standards within the District and evaluation of the existing water quality data in the Hackensack River and adjacent waterways.

4. Estimation of future requirements for interceptors and sewage treatment facilities based upon the Master Plan for Development of the District prepared by the Commission and the anticipated development of peripheral areas in accordance with present planning reports for those areas.

5. Development of a long-range improvement program for sewer facilities and water pollution control, including consideration of storm water overflows from combined sewerage systems.

6. Development of regional water pollution control systems with construction schedules.

7. Development of cost estimates, and financial and administrative criteria for the construction and operation of the systems.

This Report contains an inventory which identifies, locates and describes the known existing pollution sources and wastewater treatment systems within the Hackensack Meadowlands District, as well as its contiguous areas, that presently contribute organic and inorganic loadings to the Hackensack River, together with the reported types, volumes and strengths of the effluents being discharged from these sources and their subsequent effect on the overall quality of the water in the Hackensack River. This inventory is within the limitations of the pertinent data collected from the records of the New Jersey State Department of Health, more recently known as the Department of Environmental Protection, the Federal Water Pollution Control Administration, more recently known as the Federal Environmental Protection Agency, and such local records as were made available for the Study.

Based on the inventory of existing conditions the Report contains the conclusions derived from a study of three (3) alternative methods for the control of water pollution and river water quality for ultimate development of the District according to the Master Plan prepared for the Commission; the determination of the most feasible method of abating water pollution and achieving the desired river water quality compatible with the type and extent of development contemplated; and the recommendation of a long range improvement program for achieving and maintaining the required quality of water by construction of the most desirable, effective and economically feasible water pollution control system.

SECTION II. DESCRIPTION OF STUDY AREA

A. The Hackensack River Watershed

Situated in the greater metropolitan region of New York City, between the watersheds of the Passaic River on the west and the Hudson River on the east, the Hackensack River drainage basin covers approximately half the area of Bergen and Hudson Counties in northeastern New Jersey, and the southerly half of Rockland County in the State of New York. This relatively narrow watershed varies in width from four to seven miles and extends northerly from Newark Bay in New Jersey to the vicinity of Haverstraw, New York, a distance of approximately 34 miles. The river has a drainage area of approximately 197 square miles, about two-thirds of which lies in New Jersey. The location of the District within the larger region is shown on Exhibit No. 2, Location Plan.

The terrain bordering the west side of the Hackensack Valley consists of low, rolling hills, ranging in elevation from 100 feet above sea level in the southerly portion of the valley to 600 feet above sea level in the north. The southerly third of the valley has a wide, flat, low floor which is covered by the extensive tidal marshes that typify the Hackensack Meadowlands. The upper two-thirds of the valley is composed of low, broad hills. North of the Meadowlands, the hills increase in elevation and the extent of marshland bordering the river progressively decreases. The river, throughout most of its length, has a relatively broad channel and low banks, usually only a few feet high.

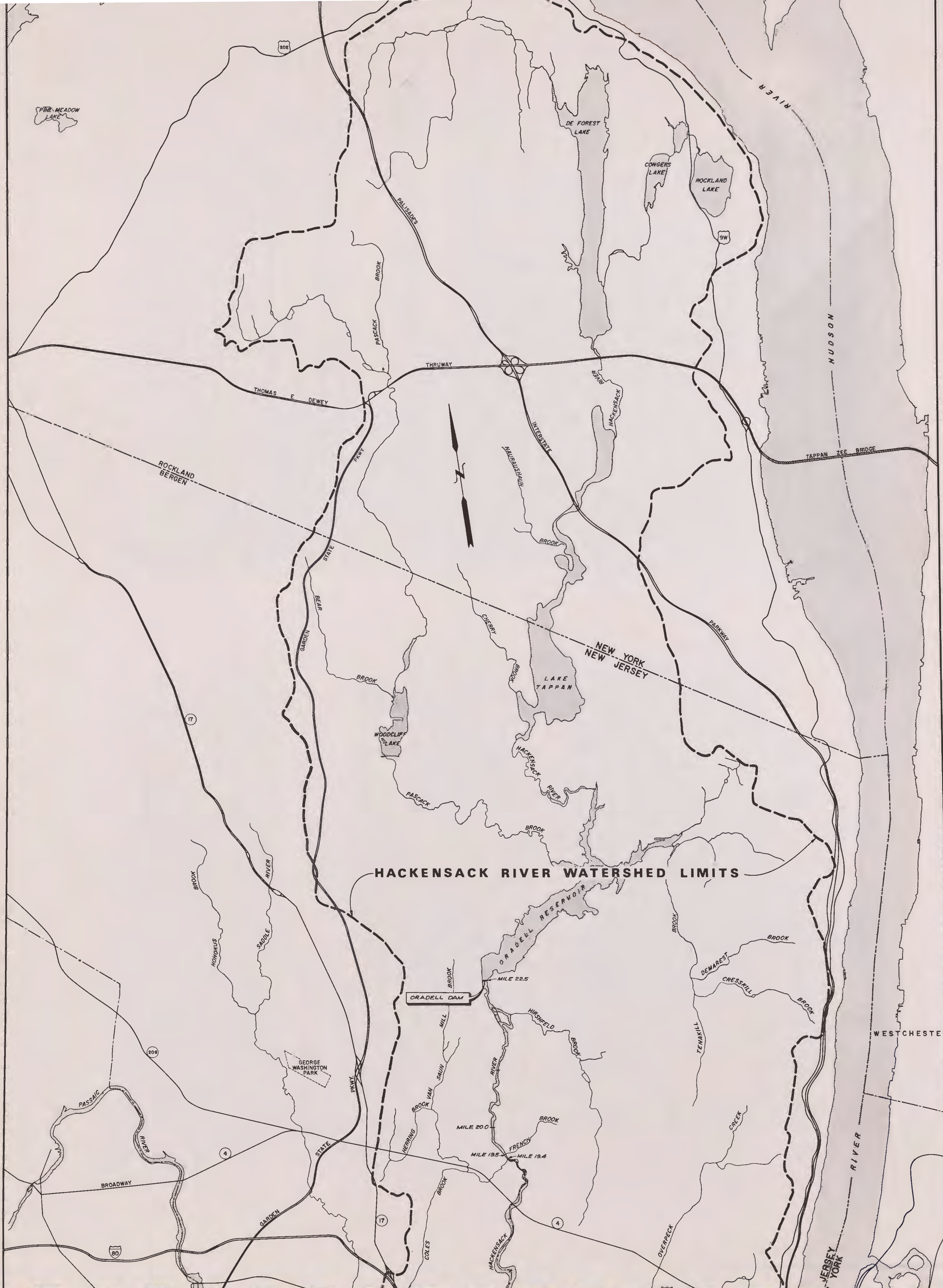
B. The Hackensack River

From its headwaters which originate in the Palisades, in the vicinity of Haverstraw, New York, the Hackensack River flows southerly paralleling the Hudson River for a meandering distance of some fifty miles to its mouth at Newark Bay. For expediency in correlating with previously published data, the mouth of the Hackensack River has been termed "Zero Mile" for the River and has been established at the point where U.S. Coast and Geodetic Survey navigation aid R "N" 2 in Droyers Point Reach is delineated on Coast and Geodetic Survey Map No. C.G.& S. 287, said point being opposite Roosevelt Stadium in Jersey City, New Jersey.

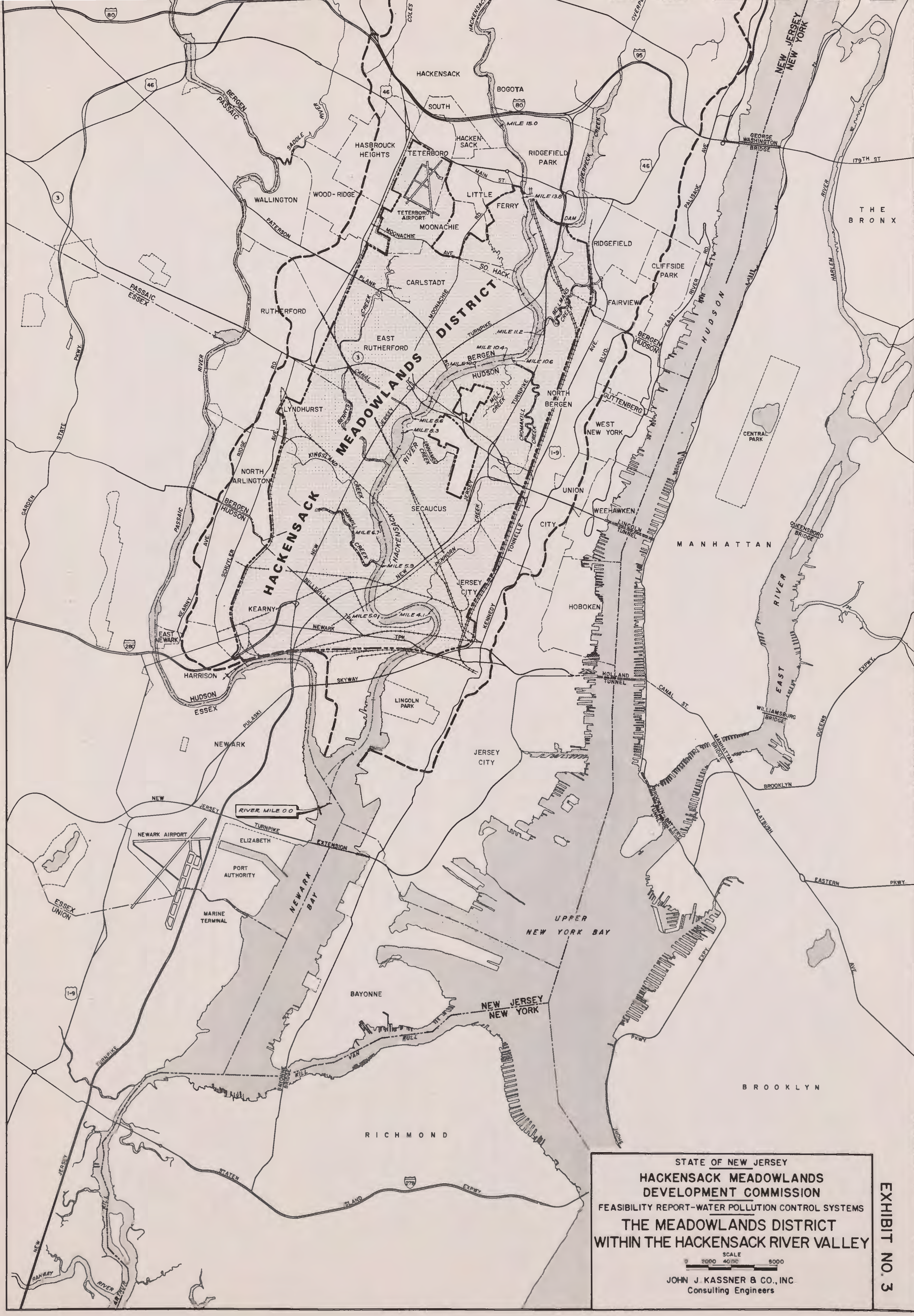
For purposes of description and discussion, it is convenient to consider the River and its watershed area, to be divided into two sections. The creation of the Oradell Reservoir in the early 20th century, and the subsequent development of the other lakes and reservoirs for potable water supply divided the Hackensack River and basin into these fresh water and tide water segments.

The Oradell Dam, which is located approximately 22-1/2 miles upstream from Mile Point Zero is the property of a privately owned public utility, the Hackensack Water Company. The fresh water impounded behind the dam in the Oradell Reservoir, together with fresh water impounded at three other locations above the Oradell Dam, is the Company's principal source of potable water for the approximately 900,000 persons who reside within the Company's 260 square mile service area. The area above the Oradell Dam and Reservoir is a controlled watershed, utilized exclusively for a drinking water supply and having only fresh water runoff feeding into it. Most of the area tributary to the water supply reservoirs and lakes of the Hackensack Water Company, are low rolling hills upon which have been constructed primarily private residences with a minor amount of industry. The watershed area is protected and patrolled by the Water Company which prohibits the general public from using either the reservoirs or the immediately abutting properties for any purpose.

For large portions of the year the total safe yield of the River system above the Oradell Dam is captured and used as drinking water supply by the Hackensack Water Company. In particular, during the critical period of the summer months, there is little or no flow into the upper portions of the tidal segment of the Hackensack River. The United States Geological Service gaging station, located on the Hackensack River at New Milford, at a point some 22 miles upstream from the mouth of the river, and which has been in operation for a period of 44 years, records fresh water influx into the River from a tributary drainage area of some 113 square miles. Its records show an average yearly discharge of 115 cubic feet per second. The flow which this gage records is the excess water which is not impounded in the facilities of the Hackensack Water Company in its various facilities at DeForest Lake Reservoir, Woodcliff Lake Reservoir, Lake Tappan and the Oradell Reservoir. The maximum rate of discharge recorded by this gaging station is 3660 cfs, but during 90 to 100 days per year, no flow is recorded and therefore no fresh water contribution is made to the tidal estuary. In the four



PINE MEADOW LAKE
202
DE FOREST LAKE
CONGERS LAKE
ROCKLAND LAKE
9W
HUDSON
RIVER
PALISADES
PASCACK
BROOK
THRUWAY
THOMAS E. DEWEY
HACKENSACK RIVER
INTERSTATE
MAURAUSHAUN
BROOK
PKWY
ROCKLAND
BERGEN
TAPPAN ZEE BRIDGE
STATE
GARDEN
BEAR
CHERRY
BROOK
NEW YORK
NEW JERSEY
PARKWAY
LAKE TAPPAN
BROOK
17
WOODCLIFF LAKE
HACKENSACK RIVER
PASCACK
BROOK
HACKENSACK RIVER WATERSHED LIMITS
BROOK
RIVER
ORADELL RESERVOIR
HOHOKUS
SADDLE
BROOK
DEMAREST
CRESSKILL
BROOK
MILE 22.5
ORADELL DAM
MILL
HIRSHFELD
BROOK
TENAKILL
WESTCHESTER
208
GEORGE WASHINGTON PARK
PKWY
VAN SAUN
BROOK
RIVER
HERRING
BROOK
MILE 20.0
FRENCH
MILE 19.5
MILE 19.4
CREEK
PASSAIC
RIVER
4
STATE
BROADWAY
GARDEN
COLES
BROOK
17
HACKENSACK
OVERPECK
80
95
JERSEY
NEW YORK



STATE OF NEW JERSEY
HACKENSACK MEADOWLANDS
DEVELOPMENT COMMISSION
FEASIBILITY REPORT-WATER POLLUTION CONTROL SYSTEMS
THE MEADOWLANDS DISTRICT
WITHIN THE HACKENSACK RIVER VALLEY
SCALE
0 2000 4000 8000
JOHN J. KASSNER & CO., INC.
Consulting Engineers

EXHIBIT NO. 3

year period from 1961 to 1964, discharge over the dam was less than 46 cfs (cubic feet per second) for 70% of this period, and less than 1 cfs for 30% of this period. Although there have been several flood flows of over 3000 cfs recorded at the New Milford gaging station, and a reported flood of record in October 1903, exceeding 15,000 cfs, fluvial flooding is of itself not a major problem. Inasmuch as the flow from upper portion of the Hackensack River is so minimal, this portion of the River and its tributaries has no significant effect on the lower, tidal portion of the River.

The portion of the total watershed which lies below the Oradell Dam is a tidal estuary subject to tidal fluctuations and to the effects of contaminated salt water carried upstream from the New York Harbor system through Newark Bay. The river meanders through the Meadowlands, which for the most part is a flat, salt marsh, covered with extensive tidal flats which are only a few inches above the banks of the River. This broad valley is traversed by major highways and railroad lines, with light and heavy industry interspersed. Where the ground is slightly higher and can support major structures urban areas have developed. The River is used by these communities to discharge liquid wastes, both treated and untreated; industrial cooling waters; and for barge traffic and other navigation purposes.

The watershed, including the Meadowland's District, has an annual temperature average of 51°F. The average low temperature is approximately 29°F occurring in January with the average high temperature of about 73°F occurring in mid July through mid August. The prevailing winds in the Meadowlands blow from a southerly direction during the summer months, which is the period of heaviest rainfall and maximum storm tides.

A study dated June 1966 prepared by the U.S. Army Corps of Engineers, New York District, entitled "Tides, Hackensack River, New Jersey," stated that the semidiurnal tide has a cycle of approximately 12.4 hours. Tide measurements taken over a 24 year period indicate a mean tide range of just over 5 feet. Spring tides are generally 120% of mean tide range, and hurricane tides have reached levels of 8.3 feet above mean sea level. Storm surge tide, which is the height of the water above the level of the predicted normal tide, reached a height of 9 feet above mean sea level. High tides have remained at a level greater than 6 feet above mean sea level for extended periods of time. The Corps of Engineers' Report on storm tides within the existing Hackensack River estuary also shows that the tidal range is generally two feet less in the upstream area of the Meadowlands than at the river mouth, primarily due to the spreading of the storm tide water over the low, flat areas of the Meadowlands.

The Hackensack River Watershed, its relationship to the Meadowlands District, existing roads, railroads and surrounding communities together with the various tributaries of the River below the Oradell Dam are shown on Exhibit No. 3, The Meadowlands District Within The Hackensack River Valley, and further delineated in the following tabulation which also lists their drainage areas and Mile Point locations.

HACKENSACK RIVER TRIBUTARIES,
RIVER MOUTH TO ORADELL DAM

Tributary	Distance of Confluence Above River Mouth	Approximate Drainage Area
Penhorn Creek	4.1 miles	4 sq. mi.
Saw Mill Creek	5.9 miles	2 sq. mi.
Kingsland Creek	6.7 miles	2 sq. mi.
Unnamed Creek	8.3 miles	Indeterminate
Berrys Creek Canal	8.6 miles	8 sq. mi.
Mill Creek	10.4 miles	1 sq. mi.
Cromakill Creek	10.6 miles	5 sq. mi.
Bellmans Creek	11.2 miles	4 sq. mi.
Overpeck Creek	13.8 miles	17 sq. mi.
Coles and Mill Brook	19.4 miles	8 sq. mi.
French Brook	19.5 miles	1 sq. mi.
Oradell Dam	22.5 miles	113 sq. mi.

C. The Study Area

The Study Area is principally the 84.2 square mile area drained by the Hackensack River and its tributaries downstream from the Oradell Dam.

Development in this portion of the Hackensack River basin has been generally confined to the higher elevations not affected by tides or flooding. The areas on the slopes which rim the Meadowlands and the more elevated portions of Secaucus have been intensely developed to almost complete utilization of available land by mixed residential, industrial and commercial construction. The areas in Kearny and Jersey City on both sides of the river mouth have been developed with heavy industrial complexes, but north of Kearny Point the Meadowlands are, for the most part, vacant and unused except as a regional disposal area for refuse and solid wastes. The portions of this area that have been used for construction have thus far been located along its outer fringe, abutting the developed upland areas, and in isolated pockets along the road corridors traversing the Meadowlands. Most of this development has been of an industrial nature since the greater part of the Meadowlands area has been zoned for industrial use by local jurisdictions.

Treated and untreated liquid wastes emanating from municipal and industrial facilities within and contiguous to the study area are discharged into the waters of the Hackensack River at various points below the Oradell Dam. These contaminants as well as contaminants from other sources have deteriorated the quality of the tidal portion of the river in the lower valley to the extent that pollution imposes a serious environmental detriment to the future regional development of the Hackensack Meadowlands District.

D. The Hackensack Meadowlands District

The District was established by the enactment of "The Hackensack Meadowland Reclamation and Development Act of 1968". Its boundaries encompass much of the generally vacant and undeveloped tidal marsh which characterizes the lower Hackensack River valley.

The Hackensack Meadowlands District, located in the lower Hackensack River valley, extends approximately eight miles from the Town of Kearny at its southern end to the Borough of Ridgefield on the north. The district encompasses an area of approximately 28 square miles including portions of the municipalities of Carlstadt, East Rutherford, Little Ferry, Lyndhurst, Moonachie, North Arlington, Ridgefield, Rutherford, South Hackensack and Teterboro in Bergen County; and portions of Jersey City, Kearny, North Bergen and Secaucus in Hudson County. The District, however, does not include those previously developed portions of Secaucus that occupy the naturally higher ground. Included in the District is that portion of the Hackensack River and its tributaries between River Mile 3.1 and River Mile 13.8.

Extremely flat topography is typical of the District with slopes much flatter than one percent. Much of its land area is at a low elevation, generally less than ten feet above mean sea level and more than seventy (70%) percent of the natural ground lies below an elevation of six feet above mean sea level, with some areas being below mean sea level. A major segment of the District is inundated by the intrusion of normal high tides and an extraordinarily high tide, such as the 7.6 foot tide recorded in March 1962, causes as much as seventy (70%) percent of the area to be covered by the contaminated waters of Newark Bay.

Underlying the tidal marshlands of the District are strata of marine, fresh water and glacial deposits laid down 8,000 to 10,000 years ago, subsequent to the retreat of the Wisconsin Glacier. Triassic sandstone and shale bedrock, approximately 100 million years old, outcrop in the easterly portion of the District at Laurel Hill and Little Snake Hill. In general the depth of the bedrock varies widely, ranging from near surface to a depth of 220 feet. The major portion of the soil which overlies this bedrock consists of varved clays, overlain with a deposit of organic silt. The surface of the Meadowlands is composed of a peaty deposit which is the residue from vegetation, such as foxtails, marsh grasses and other salt water plants which grow there.

The District is ringed and traversed by a network of roads, railroads and utilities which were constructed primarily to serve the surrounding metropolitan area, and is further subdivided by the river tributaries and drainage ditches which crisscross the area.

The Hackensack Meadowlands District and its geographical relationship to the Hackensack River watershed is depicted by Exhibit No. 3, The Meadowlands District Within The Hackensack River Valley.

E. The Hackensack River in the New York Harbor Tidal Complex

From earliest recorded history, man has built his cities adjacent to flowing streams, with major commercial centers located at the mouths of rivers where they join the sea. In these reaches of the rivers it is usual to find the highest concentrations of population and industry and the greatest utilization of the water surface for transportation.

A typical river increases in quantity of flow progressively with its increase in length, as it moves from its upland source to ultimate discharge into the ocean. At the point where the river reaches the ocean, there is an intermingling of fresh water from the river with the salt waters of the ocean. When a river's gradient is steep and the bottom of the channel slopes downward to meet the sea bottom there is little visible effect from the mixing of the fresh water with the salt water. However, when a river's gradient is flat and the bottom of the river is an old scoured out valley lying well below mean sea level through much of its length, then the daily rise and fall of tides in the ocean can have a very noticeable effect on the river and its quality. As the tides rise they may introduce distinctly troublesome features into the river, such as pollution and contamination being forced upstream, or being held upstream, for significant periods of time.

In a typical stream the advective flux, that is the flow of fresh water from the upland portions of the drainage area, transports pollutants and contaminants seaward. The slug of fresh water within a normal river system can be readily observed in its daily motion to the ocean outfall. Even if a tidal rise were to cause some hold back in the fresh water outfall for a short period of time, the river would tend to flush itself seaward when the tide falls. Most rivers, even if they are heavily used and highly polluted in the tidal areas where the mouth of the river enters the salt water, maintain their water quality by a combination of continuous large stream flow and fairly rapid and extensive circulation of tidal current, coupled with the assimilative capacity of the waters themselves.

The lower Hackensack River and its watershed is a unique tidal estuary. Tidal circulation and advective fresh water dispersion, found in typical fresh water streams which rapidly discharge to the ocean, is not found here since it has a very restricted fresh water addition. The seaward movement of surges of fresh water, which might be expected within this tidal estuary as a series of pulsations, do not wholly materialize. As the tide rises the fresh water inflow is held back and as the tide falls, the fresh water advection is insufficient to push itself and the tidal waters back through Newark Bay and outward through the Kills.

The consequences of the absence of sufficient fresh water inflow into the upstream portion of the tidal estuary is far reaching. The Hackensack River has become a dead ended tube in which the tidal water surges and retreats in rhythmic fashion, but from which there is little flushing of accumulated pollutants and contaminants. The tidal cycles, pushing in and out of Newark Bay, which serves as a mixing device for all of the pollutants in the river, causes a smoothing out of peaks and dispersion within the estuary of localized sources of wastes. Since the flow of fresh water into the estuary is negligible, there is no net motion seaward of the mass of pollutants introduced into the River. Therefore, any attempt to analyze the Hackensack River as a stream separate from its larger complex, New York Harbor, could lead to false conclusions.

New York Harbor forms part of an hydraulically complex tidal water system with interconnections between Raritan Bay, Newark Bay, Long Island Sound, the East River, the Harlem River, the Hudson River, Arthur Kill, Kill van Kull and the Atlantic Ocean. Exhibit No. 3, The Meadowlands District Within the Hackensack River Valley, shows the complex inter-relationship between the various channels and straits comprising the New York Harbor system and indicates the difficulties in attempting to establish a simple regimen of flow.

In the continuing efforts to more clearly define and evaluate the full complexity of the New York Harbor area, a physical model has been constructed by the U. S. Army, Corps of Engineers and studied by various governmental agencies. Mathematical models have been prepared by a number of private and regulatory groups and colleges and each has been variously investigated. The effect of fresh water inflow from the many diverse sources, the tidal oscillations which pulsate through the intricate network of constricted openings and channels with varying time and phase relationships, and the massive discharges of treated, untreated and partially treated waste effluents and storm water runoffs from within and around the megalopolis have all been under investigation separately and together in order to discern how these various components mix and disperse. The one conclusive fact to be derived from these studies is that there is no simple solution to the problems created by and within this complex.

The Hackensack and Passaic Rivers, which drain the northeasterly portion of New Jersey are the two major tributaries bringing fresh water into the northerly portion of Newark Bay. At the southerly end of Newark Bay, Kill van Kull connects to the Upper New York Bay and Arthur Kill connects with Raritan Bay and the Atlantic Ocean.

Newark Bay is a broad, shallow expanse of water which except for its dredged channels, has no water depths of greater than six feet at low tide. Since the inflow of fresh water from the major tributaries is negligible during the summer, or drought periods, it is the tidal fluctuations that keep those areas outside of the main dredged channels in the Bay from becoming stagnant.

As the tide rises, the waters from both Raritan Bay and from Upper New York Bay flow through the Kills into Newark Bay which acts as a holding and mixing basin for waters from many areas. As the waters rise over the surface of the Bay, they flow through it and up the Hackensack and Passaic River valleys. When the tide has reached its maximum height it should start to recede. However in the Kills, because of their shapes and the patterns of tidal flows within them, restrictions develop to outflow. In addition, the marshlands themselves tend to restrict tidal outflow. The net result is that tidal waters in the Hackensack River tend to remain at the high crest of flood tide for approximately three hours, and at low tide for a period of not more than one hour. Since the tidal waters are held at the high crest longer, and are drained out slower, part of the tidal waters within Newark Bay are pushed back into the estuary on the next incoming tide, reaching to the low weirs of the outlet works of the Hackensack Water Company at New Milford, at the head of the estuary.

From the study dated June 1966, prepared by the U. S. Army Corps of Engineers, New York District, entitled "Tides, Hackensack River, New Jersey", the following table indicated tidal conditions observed in 1962 by the U. S. Coast & Geodetic Survey:

	Kearny	Secaucus	Little Ferry
Mean High Tide	2.94	2.89	2.93
Mean Tide	0.44	0.34	0.28
Mean Low Tide	-2.06	-2.21	-2.37
Mean Range	5.00	5.10	5.30

All values are given in feet and the low, mean and high tides are referenced to Mean Sea Level, Sandy Hook.

The tidal currents within the Hackensack River are moderate. Maximum current velocities at the mouth of the river average 0.9 knot on flood tide, and 0.8 knot on ebb tide. During times of spring tides, which are generally taken as 120% of mean range of tides, the flood and ebb tide velocities increase to 1.1 knots.

Based on normal water surface elevations, the tidal prism for a normal tidal cycle within the Hackensack River has been calculated at slightly less than 800 million cubic feet of water, or approximately 4.5 billion gallons of water per tidal cycle.

SECTION III. EXISTING CONDITIONS

A. General

Use has been made of data and records of existing pollution contributors as well as pollution control facilities in the files of the New Jersey State Department of Health, the Metuchen, New Jersey office of the Federal Water Pollution Control Administration and various other State and Federal agencies. In addition, a program of meetings and discussions with local sewerage agencies and their engineers was held.

A series of guide line questionnaires was prepared for use at meetings covering the following broad categories of the Study:

1. Treatment Plants, Outfall Sewers and Sludge Disposal

2. Sewerage Collection Systems

3. Water Quality - Streams and Effluents

4. Fiscal and Administrative Matters

As an examination of the files and records at the Department of Health progressed, a series of meetings was arranged with the other agencies where possible. The inter-relationship between municipalities, authorities and their respective engineers and consultants proved to be extremely intricate and the data was sometimes widely dispersed for a given individual municipality or authority.

Known water pollution control facilities and significant sources of organic and inorganic loading have been identified and their outfalls located relative to base lines so that the effect of the discharge from the outfalls may be correlated with the existing quality of the water in the Hackensack River. Each facility has been inventoried separately from data of record made available. Due to the many active developments and changes in status that have been and are occurring with respect to water pollution control systems in the Study Area, and the uncertainty associated with the implementation of present planning in progress, the base date of the inventory was chosen as of December 1, 1969. Information regarding such planning is included in this Report where such information is known and deemed pertinent.

A portion of this inventory has been devoted to the identification of known sources of pollution where there are little or no present controls. It must be recognized that it is not the intent of this portion of the inventory to imply that the uncontrolled sources of pollution herein designated comprise the whole of such sources.

Coordination of the data presented in the Report has been accomplished by use of reference base lines. The River base line chosen follows the approximate center of the Hackensack River channel as previously defined. Locations by "River Mile" indicate a location on the Hackensack River base line for river crossings, and a location normal to the base line for shore based facilities. "Tributary Mile" locations assigned to facilities are similar, with the origin of the tributary base line being at the intersection of the Hackensack River base line with the subject Tributary base line. All mile references increase progressively upstream. Choice of this reference base line permits indentification of locations of pollutional loadings and further permits correlation with previous reports.

Existing community water pollution control systems have been categorized as "Municipal", whether owned by a municipality or authority, and "Private" where owned by an individual or a single industry. These installations have been further categorized into those treating predominantly domestic wastes and those treating predominantly industrial wastes.

B. Existing Water Pollution Control Facilities

Descriptions of existing water pollution control facilities, both Municipal and Private which discharge their effluents into the lower Hackensack River Basin, together with a description of their sewerage collection systems have been prepared. These individual descriptions are arranged according to River Mile or Tributary Mile, as applicable, starting at the mouth of the Hackensack River and progressing upstream. As each tributary is met, the tributary is traversed upstream toward its source before a return is made to the River to continue upstream toward its source. The respective "Mile" designation identifies the outfall location of each facility.

Table No. 1A is a list of the water pollution control facilities which treat predominantly domestic wastes and Table No. 1B lists the water pollution control facilities which treat predominantly industrial wastes. The number assigned to each facility in the column labeled "Facility Identification" in the Tables corresponds to the number appearing in the descriptive text following the Tables. Each facility is identified by both number and River or Tributary Mile.

The location of each water pollution control facility is shown on Exhibit No. 6, Hackensack River Water Quality.

TABLE IA

HACKENSACK RIVER

EXISTING WATER POLLUTION CONTROL FACILITIES
PREDOMINANTLY DOMESTIC WASTES

FACILITY IDENTIFICATION	LOCATION		OUTFALL	REPORTED FLOWS (MGD)				WASTE TREATMENT	SLUDGE		CHLORINATION		N.J.D.H. POLLUTION ABATEMENT ORDERS
	Municipality	River or Tributary Mile		Max.	Min.	Avg. Daily	Plant Cap'y		Treatment	Disposal	Pre-	Post	
2. Jersey City Sewerage Authority West Side Plant	Jersey City (Hudson County)	1.1	Hackensack River	75	--	16	36	Screening, grit removal and primary settling	Sludge Thickening & Vacuum Filtration	Incineration	Yes	Yes From May 15 to Sept. 15	Issued April, 1967
6. State of New Jersey-Division of Motor Vehicles	Secaucus (Hudson County)	2.3 (4.1 HR)	Penhorn Creek	--	--	0.002	0.0025	Package-Type Extended Aeration	Sludge Holding Tank	Scavenger Service	--	Yes	None
7. N.J. Motor Lodge-Howard Johnson	Secaucus (Hudson County)	3.1 (4.1 HR)	Penhorn Creek	0.02	--	0.015	0.02	Package-Type Extended Aeration	Sludge Holding Tank	Scavenger Service	--	Yes	None
8. Sears, Roebuck & Co.	North Bergen (Hudson County)	3.2 (4.1 HR)	Penhorn Creek	--	--	0.01±	0.01	Package-Type Extended Aeration	Sludge Holding Tank	Scavenger Service	--	Yes	None
11. North Arlington-Lyndhurst Joint Meeting Plant	North Arlington (Bergen County)	2.2 (6.7 HR)	Ditch to Kingsland Creek	8	--	1.5	1.7	Screening, grit removal and primary settling	Digestion & Air Drying	Land Fill	--	Yes	Issued May, 1967
12. Hudson County Mental Hospital	Secaucus (Hudson County)	1.2 (8.3 HR)	Unnamed Creek	--	--	0.2±	0.4	Package-Type Extended Aeration	Sludge Drying Beds (not used)	Land Fill	--	Yes	Issued Jan., 1968
13. Rutherford-East Rutherford-Carlstadt Joint Meeting Plant	Rutherford (Bergen County)	1.8 (8.6 HR)	Berrys Creek	11	--	3+	2.9	Screening, grit removal, primary settling, trickling filters, & secondary settling	Digestion and Wet Lagooning	Land Fill	Yes	Yes	Issued May, 1967

TABLE IA (Cont'd)

HACKENSACK RIVER

EXISTING WATER POLLUTION CONTROL FACILITIES PREDOMINANTLY DOMESTIC WASTES

FACILITY IDENTIFICATION	LOCATION		OUTFALL	REPORTED FLOWS (MGD)				WASTE TREATMENT	SLUDGE		CHLORINATION		N.J.D.H. POLLUTION ABATEMENT ORDERS
	Municipality	River or Tributary Mile		Max.	Min.	Avg. Daily	Plant Cap'y		Treatment	Disposal	Pre-	Post	
16. Wood-Ridge Municipal Plant	Wood-Ridge (Bergen County)	4.2 (8.6 HR)	Berrys Creek	1.2	--	0.6	0.7	Grit removal, primary sedimentation, trickling filter and secondary sedimentation	Digestion & Air Drying	Land Fill	--	Yes	None
17. Secaucus Municipal Plant	Secaucus (Hudson County)	1.0 (10.4 HR)	Mill Creek	3	--	0.65	2.25	Screening, grit removal, primary sedimentation, trickling filters & secondary sedimentation	Digestion, Elutriation & Air Drying	Land Fill	Yes	Yes	None
18. North Bergen Municipal, Central Plant	North Bergen (Hudson County)	2.2 (10.6 HR)	Cromakill Creek	2.5	--	2.0	4.0	Grit removal, Screening and primary settling	-	Scavenger Service	--	Yes	Issued Sept., 1967
Northern Plant		1.9 (11.2 HR)	Bellmans Creek	2.5	--	2.0	--	Flow-through with little treatment	None	Unknown	No	No	Issued Sept., 1967
19. Bergen County Sewer Authority Plant	Little Ferry (Bergen County)	12.7	Hackensack River	175	--	48	50	Screening, Grit Removal, Primary Settling, Contact Stabilization with Step Aeration, and Secondary Settling	Thickening and Digestion	Barging to Sea	--	Yes From May 15 to Sept 15	None

TABLE IB

HACKENSACK RIVER

EXISTING WATER POLLUTION CONTROL FACILITIES
PREDOMINANTLY INDUSTRIAL WASTES

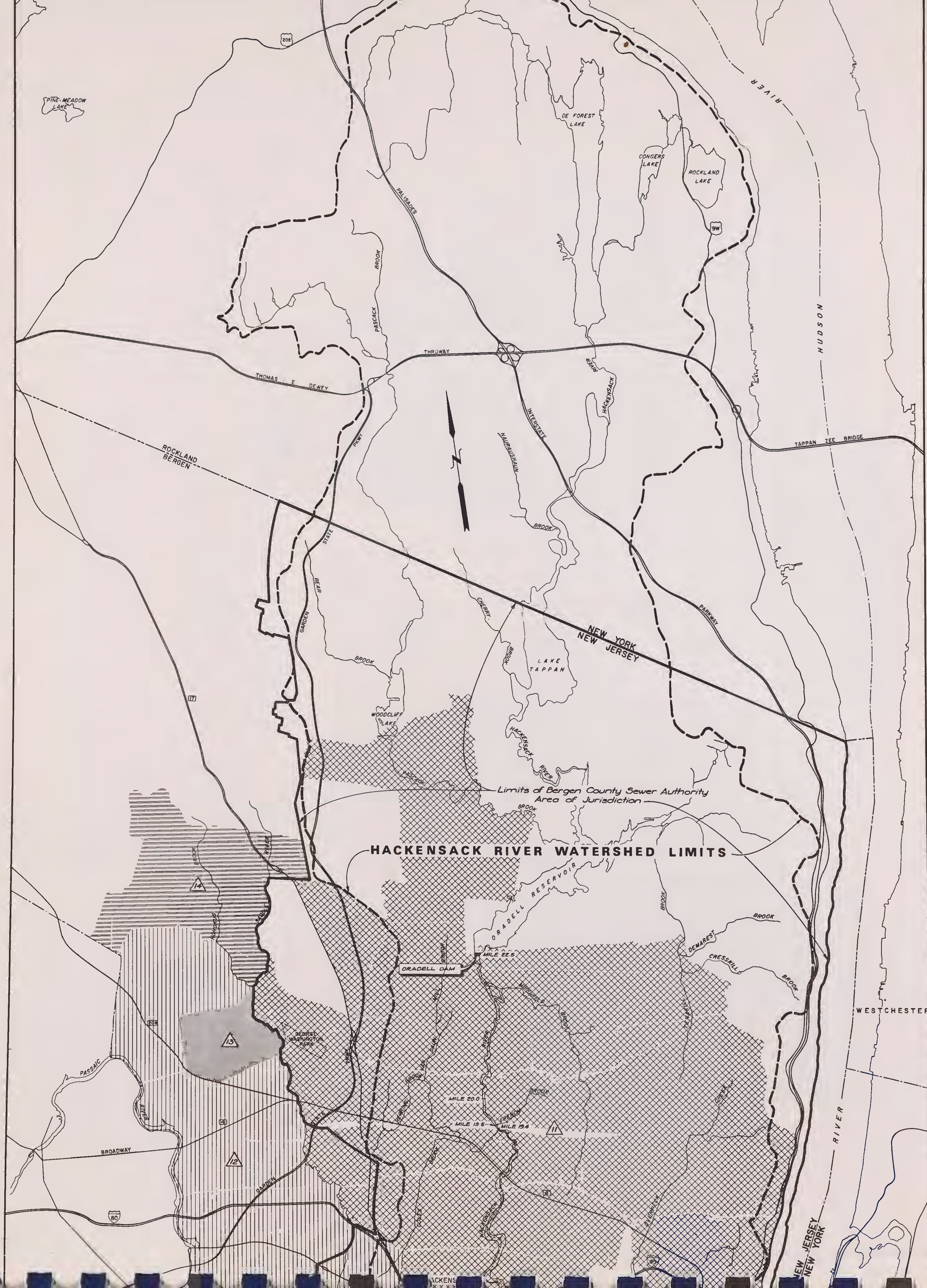
FACILITY IDENTIFICATION	LOCATION		OUTFALL	REPORTED FLOWS (MGD)				CHARACTER OF WASTE	WASTE TREATMENT	N. J. D. H. POLLUTION ABATEMENT ORDERS
	Municipality	River or Tributary Mile		Max.	Min.	Avg. Daily	Plant Cap'y			
1. Kearny Municipal Plant	Kearny (Hudson County)	0.7	Hackensack River	4.25	1.55	2.75	4	Paints, dyes and diverse chemicals and elements and some domestic waste	Primary Sedimentation, Chlorination, sludge digestion & lagooning	Issued May 1967
3. Public Service Electric & Gas Co. Kearny Generating Station	Kearny (Hudson County)	2.4	Hackensack River	-	-	625 ± and 0.01 ±	-	625 ± MGD Cooling Water containing 0.01 ± MGD acid and alkaline waste. Thermal Pollution.	pH adjustment, chlorination, & some settling.	
4. Public Service Electric & Gas Co. Hudson Generating Station	Jersey City (Hudson County)	3.7	Hackensack River	-	-	900 ± and 0.15 ±	-	900 ± MGD Cooling water containing 0.15 ± MGD acid & alkaline wastes from ion-exchange processes Thermal Pollution.	Aeration, pH adjustment, chlorination, and some settling.	
5. Koppers Co., Inc.	Kearny (Hudson County)	3.9	Hackensack River	-	-	2.9 including Cooling Water.	0.05	Domestic wastes and cooling water, oils, tar fractionation wastes and boiler blowoff wastes from manufacture of coke, light oil, gas, tar products and Naphthalane.	Gravity type oil separation	
9. Lloyd A. Fry Roofing Co.	Kearny (Hudson County)	4.7	Hackensack River	0.008	-	0.0025 ±	0.0084	Combined Industrial & Domestic (details not available).	Imhoff tank.	

TABLE IB (Cont'd)

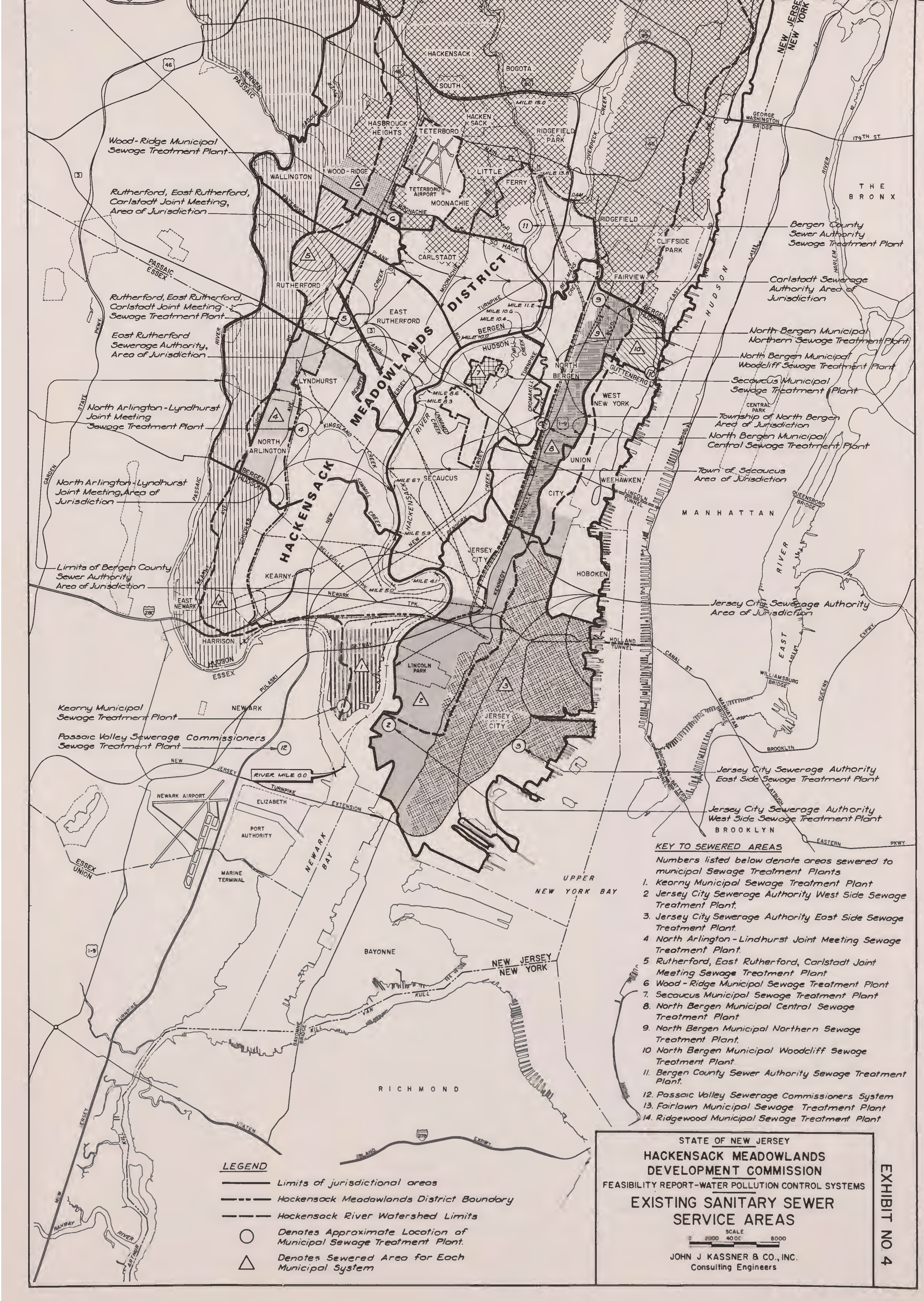
HACKENSACK RIVER

EXISTING WATER POLLUTION CONTROL FACILITIES PREDOMINANTLY INDUSTRIAL WASTES

IDENTIFICATION	LOCATION		OUTFALL	REPORTED FLOWS (MGD)				CHARACTER OF WASTE	WASTE TREATMENT	N. J. D. H. POLLUTION ABATEMENT ORDERS
	Municipality	River or Tributary Mile		Max.	Min.	Avg. Daily	Plant Cap'y			
10. Haward Corp.	North Arlington (Bergen County)	2.9 (5.9 HR)	Ditch to Saw Mill Creek	-	-	0.02 ±	0.005	Industrial metal finishing wastes, primarily acidic.	Neutralization and some settling.	
14. Universal Oil Products	East Rutherford (Bergen County)	2.2 (8.6 HR)	Berrys Creek	-	-	0.3	-	Domestic plus acid & alkaline wastes and grease from chemical refining solvent, pharmaceutical & other manufacturing processes	Screening, Lime Neutralization, Settling and Sludge Lagooning.	
15. Wood-Ridge Chemical Corp.	Wood-Ridge (Bergen County)	4.2 (8.6 HR)	Berrys Creek	0.05 to 0.1	-	0.01 to 0.06	-	Alkaline, toxic wastes with high solids and some mercury and zinc content from manufacture of organic and inorganic mercury and boron compounds.	Present facilities for pressure filtration, neutralization, sedimentation & lagoon equalization are not in use. Sludge hauled to land fill.	
20. Public Service Electric & Gas Co.- Bergen Generating Station	Ridgefield (Bergen County)	13.4	Hackensack River	-	-	600 ± and 0.15 ±	-	600 ± MGD cooling water containing 0.1 to 0.2 MGD acid & alkaline wastes from ion - exchange processes. Thermal Pollution.	pH adjustment, and some settling.	



HACKENSACK RIVER WATERSHED LIMITS
Limits of Bergen County Sewer Authority
Area of Jurisdiction
PINE MEADOW LAKE
DE FOREST LAKE
CONGERS LAKE
ROCKLAND LAKE
HUDSON
RIVER
PALISADES
PASCACK
BROOK
THRUWAY
THOMAS E DEWEY
HACKENSACK
RIVER
INTERSTATE
TAPPAN ZEE BRIDGE
ROCKLAND
BERGEN
NAURAUSHAUN
BROOK
STATE
PKWY
BEAR
GARDEN
CHERRY
BROOK
PARKWAY
NEW YORK
NEW JERSEY
LAKE TAPPAN
WOODCLIFF LAKE
ORADELL RESERVOIR
DEMAREST
CRESSKILL
ORADELL DAM
MILE 22.5
MILE 20.0
MILE 13.6
MILE 13.4
GEORGE WASHINGTON PARK
WESTCHESTER
PASSAIC
BROADWAY


Wood-Ridge Municipal Sewage Treatment Plant
Rutherford, East Rutherford, Carlstadt Joint Meeting, Area of Jurisdiction
Rutherford, East Rutherford, Carlstadt Joint Meeting Sewage Treatment Plant
East Rutherford Sewerage Authority, Area of Jurisdiction
North Arlington-Lyndhurst Joint Meeting Sewage Treatment Plant
North Arlington-Lyndhurst Joint Meeting, Area of Jurisdiction
Limits of Bergen County Sewer Authority Area of Jurisdiction
Kearny Municipal Sewage Treatment Plant
Passaic Valley Sewerage Commissioners Sewage Treatment Plant
Bergen County Sewer Authority Sewage Treatment Plant
Carlstadt Sewerage Authority Area of Jurisdiction
North Bergen Municipal Northern Sewage Treatment Plant
North Bergen Municipal Woodcliff Sewage Treatment Plant
Secaucus Municipal Sewage Treatment Plant
Township of North Bergen Area of Jurisdiction
North Bergen Municipal Central Sewage Treatment Plant
Town of Secaucus Area of Jurisdiction
Jersey City Sewerage Authority Area of Jurisdiction
Jersey City Sewerage Authority East Side Sewage Treatment Plant
Jersey City Sewerage Authority West Side Sewage Treatment Plant
HACKENSACK MEADOWLANDS DISTRICT
RIVER MILE 0.0
UPPER NEW YORK BAY
NEWARK BAY
MANHATTAN
THE BRONX
BROOKLYN
RICHMOND
KEY TO SEWERED AREAS
Numbers listed below denote areas sewered to municipal Sewage Treatment Plants
1. Kearny Municipal Sewage Treatment Plant
2 Jersey City Sewerage Authority West Side Sewage Treatment Plant.
3. Jersey City Sewerage Authority East Side Sewage Treatment Plant.
4 North Arlington - Lindhurst Joint Meeting Sewage Treatment Plant.
5 Rutherford, East Rutherford, Carlstadt Joint Meeting Sewage Treatment Plant
6 Wood - Ridge Municipal Sewage Treatment Plant
7. Secaucus Municipal Sewage Treatment Plant
8. North Bergen Municipal Central Sewage Treatment Plant
9. North Bergen Municipal Northern Sewage Treatment Plant.
10 North Bergen Municipal Woodcliff Sewage Treatment Plant
11. Bergen County Sewer Authority Sewage Treatment Plant.
12. Passaic Valley Sewerage Commissioners System
13. Fairlawn Municipal Sewage Treatment Plant
14. Ridgewood Municipal Sewage Treatment Plant
LEGEND
Limits of jurisdictional areas
Hackensack Meadowlands District Boundary
Hackensack River Watershed Limits
Denotes Approximate Location of Municipal Sewage Treatment Plant.
Denotes Sewered Area for Each Municipal System
STATE OF NEW JERSEY
HACKENSACK MEADOWLANDS DEVELOPMENT COMMISSION
FEASIBILITY REPORT-WATER POLLUTION CONTROL SYSTEMS
EXISTING SANITARY SEWER SERVICE AREAS
SCALE
0 2000 4000 8000
JOHN J KASSNER & CO., INC.
Consulting Engineers
EXHIBIT NO 4

1. Kearny Municipal Plant

Hackensack River Mile 0.7

The Kearny South Side Plant is located at the southerly tip of Kearny Point immediately east of Central Avenue and south of the tracks of the New Jersey Central Railroad. Drawings furnished by the municipality indicate that this plant was designed in 1948, but that the Plant was constructed in 1955 for the purpose of treating the wastes from approximately 6.6 square miles of industrially zoned meadowland within the Town's corporate limits. The Kearny Point area presently served by this plant, has been intensely developed with heavy industries. Although this area has no resident population, it has been estimated that approximately 60,000 people are employed by these industries.

According to municipal officials, the so called "upland" area of Kearny, located astride the ridge which separates the Passaic River and the Hackensack River watersheds, has an area of approximately 2.25 square miles and houses the Town's resident population, estimated at approximately 40,000 persons. The character of development in this area is primarily residential with about 10 to 15 percent commercial development. Observation verifies that development of this area approaches saturation. The sewage from this upland area is discharged into the Passaic Valley Sewerage Commissioners trunk sewer for treatment by that agency.

Plant location and the area served have been delineated on Exhibit No. 4, Map - Existing Sanitary Sewer Service Areas.

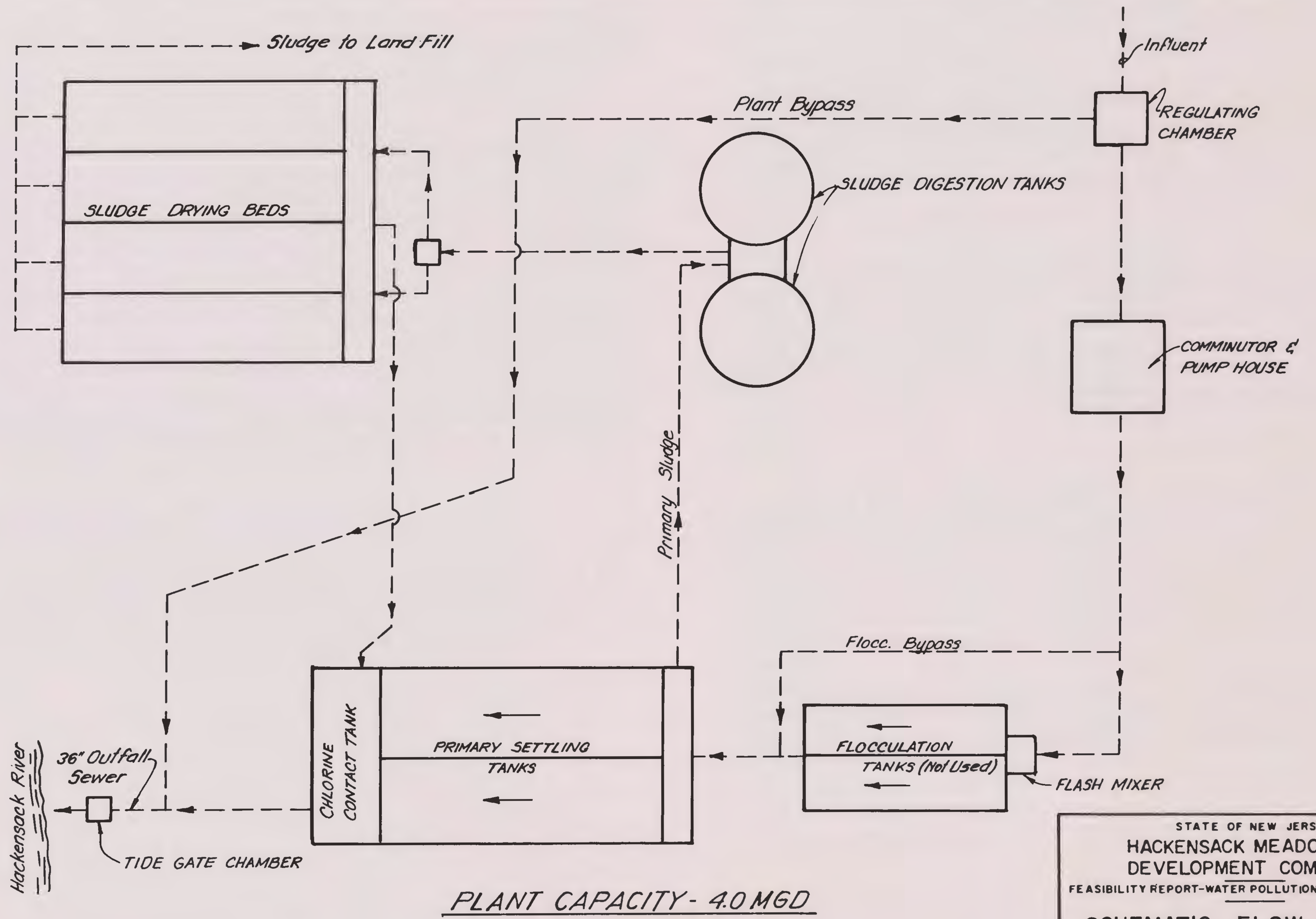
The 1969 Kearny municipal budget indicates appropriations of $47,513 for salaries and wages, $20,000 for other expenses in connection with the operation and maintenance of the Municipal Treatment Plant, and $131,208.74 for payment for treatment by the Passaic Valley Sewerage Commissioners. The revenue necessary to meet these costs is obtained from taxes levied on local property and no separate sewer charges are imposed.

Sewage enters the plant through a 48 inch diameter sewer extending northerly to Second Street. Sewers in Hackensack Street on the east and Jacobus Avenue on the west feed the Second Street branches. The Jacobus Avenue sewer is 18" x 27" and north of Second Street it is further fed by east and west branches from Pennsylvania Avenue. A pumping station maintained by the municipality pumps the discharge from the Monsanto Chemical Company into the westerly Pennsylvania Avenue branch. The remainder of the system operates by gravity. According to municipal officials, the sewers are generally thirty to forty years old and of the combined type which causes problems of high flows at the plant during periods of precipitation. The existence of overflow regulating devices is unknown. Available data does not include precise data on existing sewer sizes or inverts. However, the details of the sewer system, to the extent data was available, are shown on Appendix D, Existing Sewerage Facilities.

According to information obtained from the New Jersey State Department of Health, the plant design was predicated on an average daily flow of 4 mgd and with a peak flow of 8 mgd and it was constructed to provide only primary treatment of the wastes.

The Kearny Plant was designed and constructed primarily for the treatment and disposal of industrial wastes. However, some of the domestic sewage produced by the non-resident population working in the area is also received at the treatment plant. The industrial wastes received at the plant contain paints, dyes, petrochemical wastes and other diverse elements.

A pollution abatement order issued by the New Jersey State Department of Health dated May 11, 1967 directed the Town of Kearny to upgrade the plant to produce at least 80% BOD removal, with a maximum BOD of 50 ppm. Subsequently, a report prepared for the Town by Edward R. Grich, Inc., Sanitary Chemists dated June 5, 1969, was submitted to the State Department of Health in response to the order received. The report recommended chemical treatment to produce the required results in terms of plant effluent.



STATE OF NEW JERSEY
HACKENSACK MEADOWLANDS DEVELOPMENT COMMISSION
FEASIBILITY REPORT-WATER POLLUTION CONTROL SYSTEMS

SCHEMATIC FLOW DIAGRAM
KEARNY MUNICIPAL PLANT
FEBRUARY 1970

JOHN J. KASSNER & CO., INC.
Consulting Engineers

According to State Department of Health records, average flows through the plant for April and May, 1969 were 1.55 mgd minimum, 2.75 mgd average and 4.25 mgd maximum.

Examination of aerial photographs indicates that the Kearny Plant is presently occupying an area of approximately 8 acres. There appears to be additional vacant land of undetermined ownership contiguous to the plant which, if necessary, could possibly be used for plant expansion.

A schematic flow diagram of the Kearny Plant is shown on Exhibit No. 5A. Sewage flow to the plant first passes through a regulating chamber which bypasses an undetermined amount of the influent flow directly to an outfall tide gate chamber and thence into the Hackensack River. Initial plant design provided for a regulator setting in the chamber which would bypass all flow in excess of 4 mgd.

Although details of the actual treatment afforded at this time are not available, the aforementioned 1969 sanitary chemists' report indicates that the present treatment consists of sedimentation, chlorination and anaerobic sludge digestion. As constructed, however, the plant includes structures for comminution, raw sewage lift pumping, chemical feed and flash mixing, flocculation, sedimentation, prechlorination and post chlorination with chlorine contact tank, sludge digestion and sludge drying. Dried sludge is presently disposed of as fill in the low areas of the Town, presumably in the Meadowlands. No information on the quantities of sludge developed or of chlorine used could be obtained. A field inspection of this plant was not conducted.

Detailed data on reduction of BOD and suspended solids; bacteriological quality of the influent and effluent; and information on special problems encountered in the operation of the plant which occur due to the presence of combined sewers, with the exception of the aforementioned heavy storm flows was not available.

The 1969 sanitary chemists' report recommended chemical treatment of the wastes by the addition of lime and alum, followed by flash mixing, flocculation and sedimentation. Chlorination of the effluent from sedimentation and digestion of sludge removed from the sedimentation tanks would be continued. Records indicate that the digestors were not functioning at one time in 1967, but present conditions are unknown. The report further indicated that the elimination of 'slugs' of strong chemical wastes to the plant would have to be accomplished by Town ordinance in order to achieve and maintain satisfactory results from the proposed chemical treatment. Use of the existing physical plant for the chemical treatment was proposed, supplemented by necessary new or replacement equipment. No recommendations were made for the treatment and disposal of sludge.

The Kearny Plant was placed in State receivership on May 15, 1970 as a result of non compliance with a court order obtained on July 9, 1969 which called for the elimination of the source of pollution to Newark Bay by effecting an upgrading of the plant process. The new Court orders have given the State the right to hire outside engineers to plan and carry out the necessary improvements under State supervision.

2. Jersey City Sewerage Authority, West Side Plant

Hackensack River Mile 1.1

The Jersey City West Side Plant is located just north of Roosevelt Stadium at Droyers Point on the westerly side of N. J. Route 440 opposite Carbon Place in Jersey City. This plant is one of two existing water pollution control facilities located in Jersey City which treat waste water generated from within its corporate limits as well as from portions of the municipalities of Union City and Bayonne. The location of the plant and its service area are shown on Exhibit No. 4, Map - Existing Sanitary Sewer Service Areas.

The two plants and the interceptor sewers tributary to them are operated and maintained by the Jersey City Sewerage Authority, a separate and autonomous agency entirely independent from the Corporate Civil City. This Authority was established by the municipality of Jersey City in 1949, and the water pollution control plants and intercepting sewers were placed in service in 1957. Prior to this construction, raw sewage had been discharged from the City's collection system directly into the Hudson and Hackensack Rivers.

The Jersey City East Side Plant serves the easterly slope of Jersey City and discharges its effluent into the Hudson River.

The West Side Plant serves the City's westerly slope, the southerly portion of the municipality of Union City and a small area containing about 250 homes within the City of Bayonne. According to information from municipal officials, approximately 4.1 square miles or 38% of the area of Jersey City and 0.4 square mile or 46% of the area of Union City presently contribute sewage to this plant. Included in the westerly portion of Jersey City are approximately 1.1 square miles of presently unsewered meadowlands. It was reported by the Public Health Service, U. S. Department of Health, Education and Welfare that in 1962 this system served approximately 300,000 people. According to municipal officials and personal observations, the developed portion of the West Side service area consists principally of medium and high density residential development, but also contains a significant amount of commercial and industrial development. The preponderance of Jersey City's heavy industry is located in the area served by the Authority's East Side Plant.

Authority officials report that at the present time, Jersey City is actively engaged in a large scale urban renewal program and that this redevelopment activity is causing population shifts within the City. Demolition projects are causing a loss of operating revenue since billing to individual sewer users within the limits of Jersey City is predicated on the amount of water consumed. The Authority also bills the City of Bayonne on the basis of metered water consumption by individual consumers located in the contributing area. Service is rendered to Union City on the basis of a negotiated, fixed annual charge. The Authority also derives some revenue from treatment of waste trucked to the West Side Plant by an industry located in Boonton, N. J.

The individual collection systems tributary to the West Side Plant are owned and maintained by the respective municipalities. With the possible exception of the small portion of Bayonne served, the collection systems are fifty or more years old and almost entirely of the combined type. The old combined sewers in Jersey City present many problems, among them being surcharging during periods of even moderate rainfall, with attendant surface ponding and backwash in many low lying areas.

The sanitary wastes and storm water run-off from these combined sewers on the City's westerly slope is intercepted by the Jersey City Sewerage Authority West Side Interceptor Sewer and conducted to the plant. The southerly portion of this interceptor is a 48 inch diameter pipe which originates south of the Penn-Central Railroad tracks and runs northerly via N. J. Route 440 to the plant. The northerly portion of the interceptor originates at the North Bergen Township line as a 48 inch diameter pipe. It runs south along Tonnelle and Carroll Avenues to a crossing of the Erie and Lackawanna Railroad as a 54 inch pipe, changes direction several times in the vicinity of the Pulaski Skyway where it becomes 72 inches in diameter, continuing southerly along U. S. Route 1 and N. J. Route 440 to the treatment plant. The interceptor enters the plant as an 84 inch diameter sewer pipe. The entire sewerage system, which includes both collecting and intercepting facilities, if of the gravity type.

Drawings obtained from the Authority indicate the locations of thirteen overflow regulators along the line of the West Side Interceptor Sewer. To prevent hydraulic overloading of the plant during periods of precipitation these regulators were constructed

West Side Plant operating records indicate that the influent sewage had an average value of 153 ppm of suspended solids during the period 1967, 1968 and 1969 and an average value of 183 ppm for the period from 1960 through 1966. Likewise, for the same periods, BOD values were 261 ppm and 241 ppm respectively.

The West Side Plant occupies about 10.5 acres of an irregularly shaped 18 acre site owned by the Sewerage Authority between N. J. Route 440 and the Hackensack River. The Mayo-Lynch report indicates that consideration has been given to stacking of proposed new plant units on top of existing units because of a lack of suitable space for the proposed new facilities.

Exhibit No. 5B is a schematic flow diagram of the West Side Plant. As indicated on the diagram, sewage enters the plant through the 48 inch and 84 inch West Side interceptor sewers, then passes through mechanically cleaned bar screens for removal of large debris. After screening, sewage passes through grit collectors and comminutors into a wet well, from which it is pumped to the primary sedimentation tanks. The comminution equipment consists of three Chicago Pump "Barminutors" installed in the outlet ends of the three grit collection chambers. Raw sewage pumping capacity, with the largest pump considered to be out of service, is provided by three pumps with a total capacity of 90 mgd.

Sewage then passes through primary settling tanks, chlorine contact tanks and is discharged into the Hackensack River through a 54 inch diameter outfall sewer. There are apparently no plant by-pass structures. However, the high peak storm flows have reportedly caused flooding and flow-through of the plant with attendant complete disruption of treatment processes.

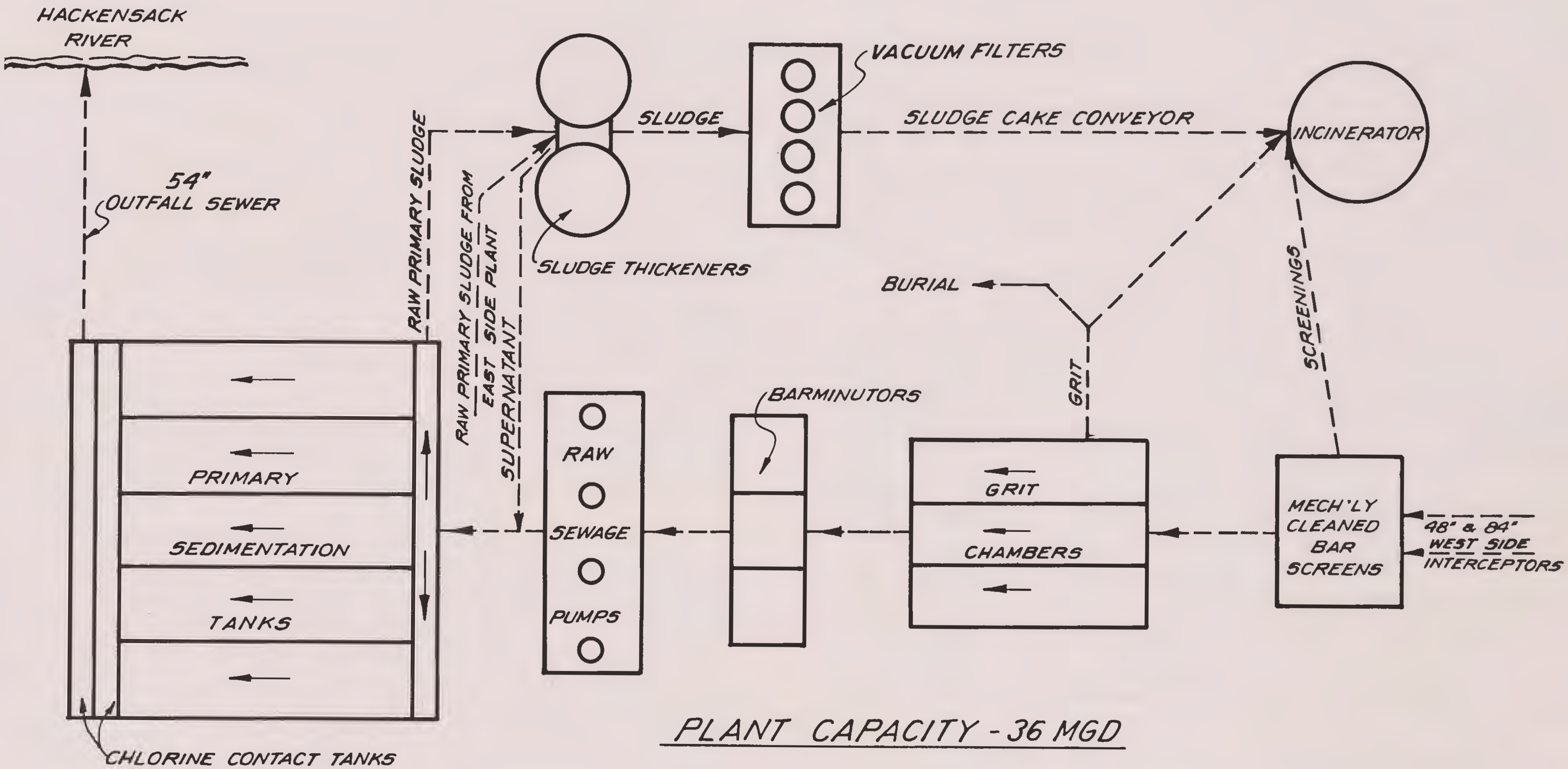
There are five sedimentation tanks, each providing a surface area of approximately 10,000 square feet. Past records of plant operation indicate that usually only two of the tanks have been in service at one time. The chlorine contact tanks are reported to provide approximately 20 minutes of detention time at the plant design flow of 36 mgd. The 54 inch outfall sewer extends approximately 100 feet into the Hackensack River from the pierhead line, and from this point reduces in successive steps over an additional 140 feet to a 30 inch diameter at the open end of the sewer. A total of 64 outlets, 6 inches in diameter, spaced along the last 140 feet of to overflow when the flow in the interceptor sewer exceeds 160% of average flow. Thus raw sewage, albeit diluted to some extent, is discharged directly into the receiving waters between Secaucus Road (into Penhorn Creek) on the north and Mina Drive (into Newark Bay) on the south. In addition, several other outfalls, presumably storm sewers, have reportedly shown evidence of discharging grease, oil and dye. The interceptor sewers which are pertinent to the Report are shown, to the extent was available, on Appendix D, Existing Sewerage Facilities.

The West Side Treatment Plant was designed for a 36 mgd capacity, but provides only primary treatment of wastes.

Inadequacy of the original grit removal and sludge handling facilities, as well as other difficulties, were encountered as early as 1961, according to the consulting engineers to the Authority. Efforts were subsequently made toward the solution of these problems. Nevertheless, in April 1967, the New Jersey State Department of Health issued an administrative pollution abatement order which required the Authority to improve the plant to accomplish a minimum 80% reduction of BOD and to provide effective post-chlorination. Subsequently Mayo-Lynch Associates, consulting engineers to the Authority, prepared a report entitled "Proposed Additional Water Pollution Control Facilities", which the Authority submitted to the State Department of Health. The post-chlorination facilities required by the Department of Health were installed in 1968, replacing the plant's original facilities.

New Jersey State Department of Health records state that the average daily flow to the plant for 1967 and 1968 was 16 mgd and that peak storm flows as high as 75 mgd have reached the plant. This high value of peak flow can be attributed to the combined sewer collection system and probably occurred during a combined storm and high tide.

The wastes received at the West Side Plant have been characterized as predominantly domestic in nature, the heavier industrial contributions being treated at the East Side Plant. However, Sewerage Authority officials report that a blue dye received at the West Side Plant from a nearby industry has been a recurring problem over a considerable period of years. It was reported that construction of pre-treatment facilities at the industrial source of the dye was begun in 1969.



STATE OF NEW JERSEY
HACKENSACK MEADOWLANDS DEVELOPMENT COMMISSION
FEASIBILITY REPORT–WATER POLLUTION CONTROL SYSTEMS

SCHEMATIC FLOW DIAGRAM
JERSEY CITY SEWERAGE AUTHORITY
WEST SIDE PLANT
JANUARY 1970

JOHN J. KASSNER & CO., INC.
Consulting Engineers

pipe, project upward from the top of the pipe through the river bottom, providing dispersal of the effluent discharge.

Sludge from the West Side primary sedimentation tanks and primary raw sludge pumped across town from the East Side Plant is collected in two sludge concentration tanks, where concentration takes place over a two day period to a 6% to 9% solids condition. The concentration tanks are 45 feet in diameter and 35 feet deep. In 1967, the Sewerage Authority's consulting engineers reported that approximately 480,000 gallons of sludge per day were being received from the East Side Plant and approximately 290,000 gallons of sludge per day were produced at the West Side Plant. Sludge is then pumped from the thickeners to the four vacuum filters and approximately 700,000 gallons per day of supernatant are returned to the primary settling tanks. Following vacuum filtration, employing sludge conditioning by addition of polymer, sludge cake is transported by conveyor belt to the municipal incinerator. Incineration capacity is 6,150 pounds per hour of dry solids with moisture content of not less than 30%. The unit is also capable of burning ground screenings and grit, although at present only the screenings are incinerated while the grit removed from the sewage is disposed of by on-site burial.

Chlorination facilities consist of two gas chlorinators with a zero to 8,000 lb. per day capacity each and two evaporators of like capacity which are automatically paced by plant flow and chlorine residual. No information regarding the operation of the new post-chlorination equipment installed in 1968 was available.

The original plant was modified by the addition of grit removal and comminution facilities. Use of the sludge digesters constructed with the original 1957 plant was discontinued about 1962 or prior thereto, for reasons which cannot be ascertained from the information available. A 1962 report by the Sewerage Authority's Consulting Engineers recommended the construction of incineration facilities for sludge disposal. These facilities were eventually placed in service in 1967 and in the interim period before the new incineration facilities began operation, raw vacuum filtered sludge was stored on-site.

From the standpoint of effectiveness of treatment afforded by the plant, operating records furnished by the Sewerage Authority for 1967 and 1968 indicate that an average 18-1/2% removal of suspended solids and an average 12-1/2% BOD removal were achieved during this period. This data and a review of prior years' operating data indicate that the plant does not produce results which should be obtained from a properly functioning primary plant. Determination of the cause of the present poor results of plant operation, whether due to inadequate design or operation, or other causes, is beyond the scope of this Report.

A number of specific problems, however, are already a matter of record. The previously mentioned recurring dye component of the influent wastes is a definite color pollutant of the Hackensack River. A high grease and oil content of the East Side Plant sludge which is pumped to the West Side Plant for treatment is reported to create problems in sludge handling and disposal facilities. In addition, the rate of sludge production at the East Side Plant has at times exceeded the available capacity for transmission of the sludge to the West Side Plant, with the result that accumulation of sludge has been a problem at the East Side Plant. The report submitted to the State Department of Health in response to the pollution abatement order stated that sludge concentration, dewatering and incineration facilities must be provided at the East Side Plant to overcome this problem. It also reported that the recirculation of 700,000 gallons per day of sludge thickener supernatant into the primary settling tanks of the West Side Plant created shock loadings on the treatment process of that plant.

The report outlined required alterations and additions to the existing West Side Plant in order to upgrade it to a high-rate trickling filter plant capable of attaining a BOD reduction of 85 to 90%. The basic steps in the altered treatment process as proposed would consist of aeration, primary clarification, biological treatment in trickling filters, secondary clarification and chlorination. Under this proposed secondary treatment plant scheme, the existing primary sedimentation tanks would be converted to secondary clarifiers and new primary clarifiers would be constructed on top of the present primary sedimentation tanks. Six 150 foot diameter high-rate trickling filters would be constructed on the site of the existing four sludge digesters which would be removed for the new construction. The present system in which East Side Plant sludge is being pumped to the West Side Plant for treatment and disposal would be discarded and provision would be made to concentrate, dewater and incinerate sludge at the East Side Plant. The proposed alterations consist only of upgrading the process, and the hydraulic capacity of the plant would be retained at its present value of 36 mgd. The status of the implementation of the proposed secondary treatment facilities at the West Side Treatment Plant is not known at this time.

3. Public Service Electric and Gas Company, Kearny Generating Station, Kearny

Hackensack River Mile 2.4

The Kearny Generating Station is located in the South Kearny meadowlands, occupying a site on the west shore of the Hackensack River south of Pennsylvania Avenue, north of 3rd Street and east of a line approximately 650 feet west of, and parallel to, Central Avenue. In their 1966 preliminary report, the Public Health Service of the Department of Health, Education and Welfare stated that this facility had a rated capacity of 625,000 kilowatts.

The records of the New Jersey State Department of Health indicate that the waste water treatment consists of approximately the same process as will be subsequently described in more detail for the Public Service Electric and Gas Company, Hudson Generating Station in Jersey City. The Kearny Plant employs water pollution controls to the extent of pH adjustment and some incidental settling in a waste water basin as basic treatment processes. There is, however, no indication that aeration for mixing purposes is employed as it is at the Hudson Station. Chlorination facilities were added to the Kearny Station facilities in 1968 or 1969 at the same time as at the Hudson Station.

It also appears that the same basic types of wastes are produced at the Kearny Station as at the Hudson Station, these being acid and alkaline in nature. The greater portion of the flow from the Kearny Station is cooling water waste which constitutes a potential source of thermal pollution of the river. The quantity of cooling water flow has been estimated to be 625 mgd including approximately 0.01 mgd of acid and alkaline wastes. With reference to the effect on the Hackensack River of the discharge of cooling water from this generating station, the aforementioned Public Health Service Report indicated that no significant temperature rise in the river had been noted.

Surveillance records of the New Jersey State Department of Health indicate generally satisfactory maintenance at this plant. No formal pollution abatement orders have been issued against this facility by the Department.

4. Public Service Electric and Gas Company, Hudson Generating Station, Jersey City

Hackensack River Mile 3.7

The Hudson Generating Station, sometimes referred to as the Marion Power Plant, is located in the Jersey City meadowlands on the east shore of the Hackensack River, north of Van Keuren Avenue, and generally west and south of the tracks of the Erie-Lackawanna Railroad. In their 1966 preliminary report, the Public Health Service of the Department of Health, Education and Welfare stated that this facility had a rated capacity of 125,000 kilowatts. It is probable that this indicated capacity has been increased by subsequent additions.

The wastewater treatment plant at this generating station was constructed and placed in operation under a permit dated February 20, 1964, issued by the New Jersey State Department of Health. Initially the wastewater plant was placed in service to treat the wastes resulting from the operation of the power plant's one turbine-generator unit. In 1967, Public Service Electric and Gas Company began construction for the addition of a second turbine-generator unit. At that time, the Company submitted a report entitled "Proposed Method of Chemical Waste Disposal, Nos. 1 and 2 Units, Hudson Generating Station", dated Revised April 26, 1967, to the New Jersey State Department of Health indicating that enlargement of the existing wastewater treatment facilities was not required to accommodate the anticipated additional wastes. No pollution abatement orders have been issued by the Department of Health and their records indicate that the waste treatment is satisfactory.

In the course of normal operation, a maximum of 900 mgd of river water is diverted from the Hackensack River and is pumped through the plant condenser for cooling water. Data collected to date has not yielded any information on minimum flows. This cooling water is returned to the river by way of a discharge canal. According to the Public Health Service Report, no noticeable temperature effects on the Hackensack River have been found due to this discharge.

According to the Public Service Electric and Gas Company Report, a number of waste products generated by various operations within the power plant are added to the discharge canal which carries the condenser cooling waters back to the river. The major waste from these operations is an acid waste produced by the use of dilute sulphuric acid and caustic soda solutions for regeneration of ion exchange resins. In addition, the Company has indicated to the Department of Health in the aforementioned report that approximately 11,000 gallons of spent hydrochloric acid solution used for boiler cleaning may require treatment and disposal on an infrequent basis of not more than once every one or two years. It was also anticipated that the ion exchange resins may occasionally require special chemical cleaning which would result in additional quantities of sodium chloride, caustic soda and hydrochloric acid to be treated and discharged. The report further stated that a total of 2,440 pounds of net excess acid would be produced from the regeneration of the ion exchange resins and that this amount of net excess acid would be contained in a solution of 150,000 gallons per day of dilution water. The 150,000 gallons per day constitutes the main flow through the wastewater treatment plant and the discharge canal to the Hackensack River. It was anticipated by the Company that the quantities of flow of the other two wastes mentioned may be handled with proper neutralization by the addition of required chemicals in the existing wastewater plant, along with the normal daily discharge of the major waste.

The acid and caustic wastes produced separately from different portions of the resin regeneration process are placed together in a chemical waste tank from which they are pumped into the waste disposal basin. A partial neutralization normally takes place within the chemical waste tank which results in the production of net excess acid in the amount previously mentioned.

The waste disposal basin has a structural concrete lining with an inner liming of caustic and acid proof brick, and provides a capacity of 75,000 gallons. The wastes are mixed in the basin and discharged from the basin into the discharge canal at a maximum rate of 100 gpm through a flow control valve at the outlet of the basin. A diffuser is provided at the point of discharge into the discharge canal to provide dispersal of the wastes in the canal. The net result, as indicated in the Public Service Electric and Gas Company Report, of adding the dilute regeneration acid wastes to the discharge canal for further dilution, is approximately 0.3 ppm of acid in the canal waters. Sludge removed from the waste disposal basin is disposed of by land fill. A pH indicator-recorder is provided for monitoring the discharge of canal effluent to the river.

New Jersey State Department of Health records indicate that chlorination of the cooling water was begun in early 1969, apparently because of high coliform test results. Chlorination, in one instance, has been reported to be at the rate of 3.6 ppm.

New Jersey State Department of Health surveillance records indicate that the wastewater plant maintenance is generally good.

5. Koppers Company, Incorporated, Kearny

Hackensack River Mile 3.9

Koppers Company, Incorporated operates an industrial complex in the Kearny meadowlands located north of the Jersey City and Newark Turnpike at Fish House Road in Kearny.

The Koppers Company reportedly operates both a coke and a tar plant at this location which occupy approximately 100 acres and employ approximately 300 people. The plants operate 24 hours per day every day of the year. According to a preliminary report dated January 1966, prepared by the Public Health Service of the Department of Health, Education and Welfare, this industrial complex also contains a light oil manufacturing plant occupying an additional 79 acres and employing approximately 300 persons. The report states that the domestic and industrial wastes from all three plants are channeled into a common collection system.

Koppers Company presently provides gravity oil separation of its wastes at certain points in the manufacturing processes. The gravity oil separator reportedly has a design capacity of 0.05 mgd. The New Jersey State Department of Health has notified the Company on a number of occasions in recent years of certain deficiencies in the effluent which it discharges into the Hackensack River. The Company has responded with plans for improvement of its waste treatment procedures to reduce the volume and improve the quality of its discharge into the river.

The present estimated volume of flow being discharged into the River by the Company is approximately 2.9 mgd. The wastes include water condensate containing ammonia liquor from a volatile gas cooling operation; cooling waters initially taken from the

River for indirect cooling of volatile gases, and for a direct contact final cooling operation for the volatile gases; water discharge from a light oil decanting system; wastes from steam jet ejectors used with tar fractionating columns; and boiler blow-off waters. Analysis of a sample of the combined discharges from the primary and final volatile gas cooling systems by the New Jersey State Department of Health in 1969 yielded a BOD of 271 ppm, COD of 1,070 ppm, suspended solids of 94 ppm, 54 ppm of phenols, 300 ppm of ammonia, 0.01 ppm of cyanide, total solids of 15,410 ppm and a pH of 9.2. Possible thermal pollution also exists in the return of the various cooling waters to the river.

Present waste treatment consists of one gravity oil separation system for water discharged from the decanter and from an indirect cooling water system within the wash oil scrubbing system, and a second gravity oil separation system for the effluent from the steam jets of the tar fractionating columns.

Plans prepared by the Engineering and Construction Division of the Company for their coke plant have been described as including a system for the recovery and disposal of ammonia from the plant effluents, conversion of the present direct cooling system of the final cooling phase of the coke processing to an indirect cooling system for the purpose of reducing the volume of effluent discharged, and the installation of a one million gallon capacity holding tank for subsequent disposal by barging to sea. Revisions to be made in the tar plant would consist of the installation of a vacuum pump system replacing the present use of steam jets which is intended to reduce the effluent volume, and also the installation of an inert gas generator for cleansing of pipe lines in place of the presently used live steam cleansing system, thereby further reducing the volume of effluent discharges. These proposed revisions in the plant operations and waste treatment processes were submitted to the State Department of Health in November of 1968 as a five year improvement program. The Health Department has approved this proposal and the schedule submitted for its implementation.

6. <u>State of New Jersey, Division of Motor Vehicles, Secaucus</u>

<u>Penhorn Creek - Tributary Mile 2.3</u>

The New Jersey Division of Motor Vehicles operates a motor vehicle inspection station located at the northeasterly corner of County Avenue and Secaucus Road in Secaucus.

Treatment for the domestic wastes produced by this facility is by means of an "Amcodyne Treatment System" plant located on the site. According to New Jersey State Department of Health records, this package plant has a design capacity of 0.0025 mgd. with an average daily flow of approximately 300 to 2,000 gallons per day. In their surveillance reports, the State Department of Health has evaluated plant maintenance as being marginal.

The treatment system consists of a bar screen, extended aeration tank, sedimentation tank, hypochlorination, chlorine contact tank and sludge holding tank. Sludge disposal is reportedly by scavenger service. Plant effluent is discharged into an unnamed ditch which is tributary to Penhorn Creek.

The Division of Motor Vehicles has been notified by the New Jersey State Department of Health on a number of occasions in recent years to correct deficiencies in its plant effluent. The deficiencies cited were BOD, suspended solids, color, odor and coliform density, inadequate chlorination and low pH. At this time, it is not known what remedial actions have been taken.

7. New Jersey Motor Lodge, Inc. (Howard Johnson), Secaucus

Penhorn Creek - Tributary Mile 3.1

The New Jersey Motor Lodge, Inc. operates a Howard Johnson Motel and restaurant located immediately south of the eastbound lane of N.J. Route 3 in Secaucus, just west of the North Bergen Township Line.

The New Jersey Motor Lodge, Inc. produces domestic waste which is treated in a package type, extended aeration plant situated on the premises. According to information obtained from records of the New Jersey State Department of Health, the plant consists of a bar screen, comminutor, aeration tank, sedimentation tank, hypochlorination, chlorine contact tank and aerated sludge holding tank. Sludge disposal is reportedly by scavenger service.

In their 1966 preliminary report, the Public Health Service of the Department of Health, Education and Welfare stated that the nominal size of this facility is 0.02 mgd and the average flow in 1962 was reported as being 0.008 mgd. The surveillance reports of the New Jersey State Department of Health indicate present average daily flow to be approximately 0.015 mgd with peak flows of approximately 0.02 mgd. The surveillance reports submitted since October 1966 have evaluated the condition of plant maintenance as marginal. Prior to that time, plant maintenance had been rated as good.

The Motor Lodge has been notified on one occasion, February 19, 1969, of deficiencies in the plant effluent consisting of excessive suspended solids in the amount of 86 ppm and excessive odor.

8. Sears Roebuck and Company - North Bergen

Penhorn Creek - Tributary Mile 3.2

The Sears Roebuck Fashion Distribution Center is located at No. 2701 N.J. Route 3, just south of the eastbound lane and east of the Secaucus Town Line, adjacent to the property occupied by the New Jersey Motor Lodge, Inc.

Sears Roebuck and Company treats the domestic sewage produced by its facility in a Chicago Pump Company Extended Aeration Treatment system plant located on the premises. According to information obtained from the files of the New Jersey State Department of Health, the plant has a capacity of 0.01 mgd. Departmental surveillance reports indicate average daily flows of 0.01 mgd.

The plant owners have been notified by the State Department of Health on a number of occasions in recent years of deficiencies in the plant effluent. Departmental surveillance reports evaluate plant maintenance as good to marginal.

The plant equipment includes a bar screen, comminutor, extended aeration tank, hypochlorination, chlorine contact tank and sludge holding tank. Sludge disposal is reportedly by scavenger service.

Deficiencies cited by the State Department of Health in the notices sent to the Company include 350 ppm BOD, 1,892 ppm suspended solids, insufficient post chlorination (0.0), malfunctioning treatment units, excessive coliform density of 2,400 MPN/100 ml, excessive turbidity and color, and insufficient dissolved oxygen.

9. Lloyd A. Fry Roofing Company, Kearny

Hackensack River Mile 4. 7

The Lloyd A. Fry Roofing Company is located in the South Kearny Meadowlands abutting the westerly line of the Koppers Company Plant and is situated on the north side of the Jersey City and Newark Turnpike.

New Jersey State Department of Health records state that the industrial and domestic wastes produced by this industry are treated in an Imhoff tank having a design capacity of 0. 0084 mgd after pre-chlorination at a rate of 3 to 4 pounds of chlorine per day. Sludge is removed one to two times a year by scavenger service.

According to State Department of Health surveillance reports, average daily flows over a two year period have ranged from 0. 0002 mgd to 0. 008 mgd. Most of the reported flows were in the magnitude of 0. 0025 mgd. Various evaluations of plant maintenance made in these reports have ranged from good to marginal to unsatisfactory.

The Company has been notified by the New Jersey State Department of Health on a number of occasions in recent years of deficiencies in the effluent produced by its waste water treatment. The deficiencies noted were excessive color and odor in the final effluent.

10. Haward Corporation, North Arlington

Saw Mill Creek - Tributary Mile 2. 9

Haward Corporation is located at No. 29 Porete Avenue in the Borough of North Arlington.

According to information obtained from the files of the Hudson-Delaware Basins Office of the Federal Water Pollution Control Administration, this firm occupies a plant area of approximately 15, 000 square feet, employs approximately 30 employees and conducts various industrial metal finishing operations during a normal 8 hour, 5 day week throughout the year. These operations produce wastes which are principally acidic in nature.

According to surveillance reports of the New Jersey State Department of Health, average daily flows have been estimated to be 0. 02 mgd. In these reports, the State Department of Health has evaluated treatment facility maintenance to be generally marginal.

The treatment of the wastes by the Company consists of screening and the addition of caustic in the first of three tanks for pH adjustment. A pH meter is maintained in the third tank for monitoring the effluent flow. According to State Department of Health records, these facilities have a design capacity of 0. 005 mgd. The plant outfall consists of a storm drain which flows to an unnamed ditch tributary to Saw Mill Creek.

Heavy solids have been noted in the plant effluent during State Department of Health inspections. Haward Corporation has been notified by the State Department of Health of deficiencies in the plant effluent. One such notice indicated a pH of 3. 3, COD of 151 ppm and excessive ether soluble matter in the amount of 166 ppm.

11. North Arlington-Lyndhurst Joint Meeting Plant, North Arlington

Kingsland Creek - Tributary Mile 2.2

The North Arlington-Lyndhurst Joint Meeting Plant is located east of the right-of-way of the Erie-Lackawanna Railroad Kingsland Line, south of Canterbury Avenue and east of Schuyler Avenue in the Borough of North Arlington. This facility is owned and operated by the North Arlington-Lyndhurst Joint Meeting, an independent agency established by the two municipalities in 1954 for the purpose of treating the sewage generated by the eastern portions of both municipalities. The sewage from the portion of each municipality which lies generally to the west of Ridge Road is independently collected by each respective municipality and is discharged into the facilities of the Passaic Valley Sewerage Commissioners for treatment and disposal by that agency. The sewage emanating from the areas of each municipality lying generally to the east of Ridge Road is also independently collected by each municipality and is independently conducted to the Joint Meeting Plant for treatment.

According to the 1960 census, the population of North Arlington was 17,477 and the population of Lyndhurst was 21,867. The Division of Economic Development of the New Jersey Department of Conservation and Economic Development has estimated the combined population of these two municipalities to be 43,490 persons as of July 1, 1969. In their January 1968 Engineering Report on water pollution control facilities prepared for the North Arlington-Lyndhurst Joint Meeting, Elam and Popoff Engineering Associates, consulting engineers to the Joint Meeting, estimated that approximately 34 percent of the total population, or 14,300 persons, were presently sewered to the facilities of the Joint Meeting. Plant location and area served have been delineated on Exhibit No. 4, Existing Sanitary Sewer Service Areas.

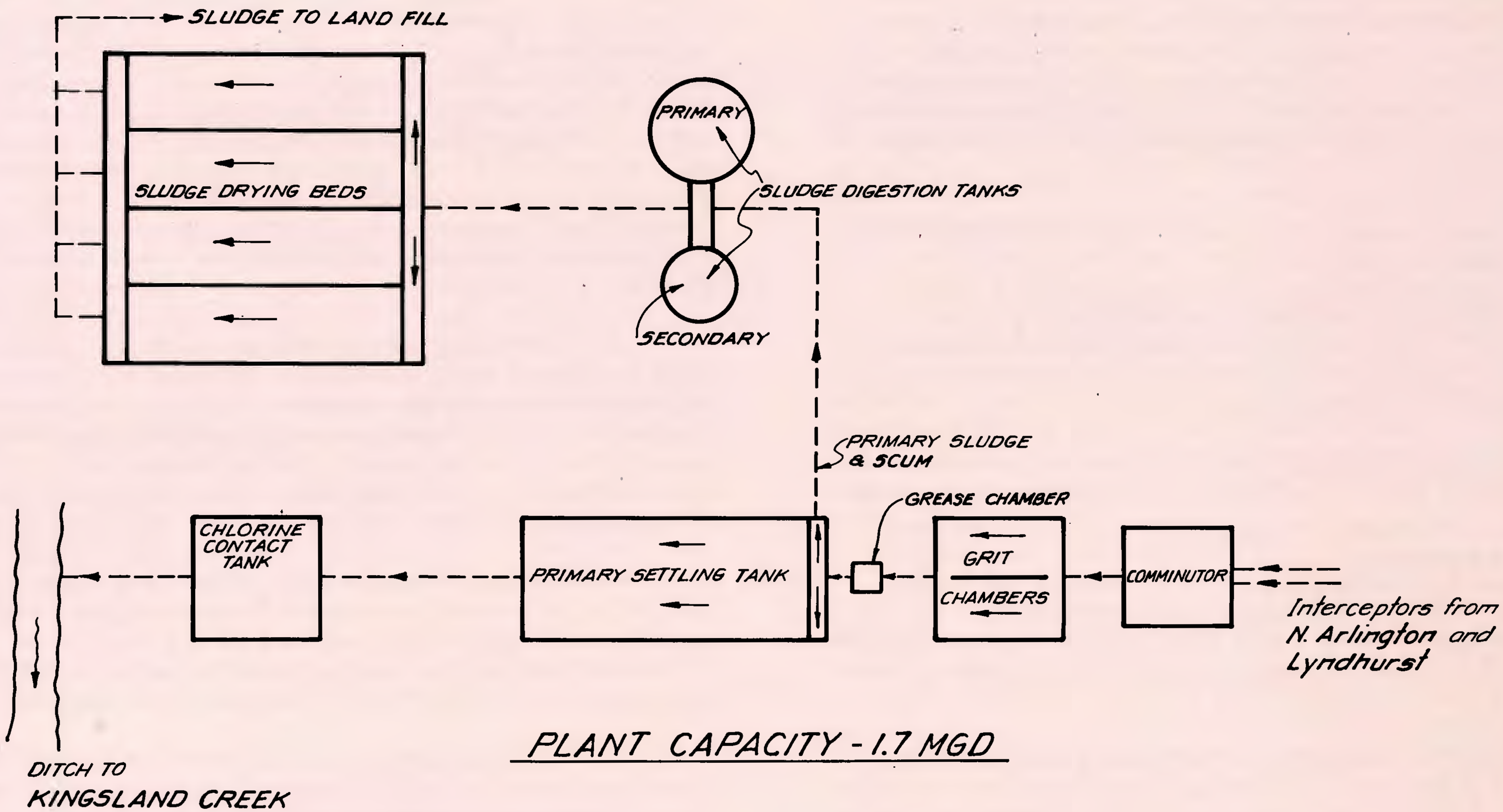
Observation indicates that the more elevated portions of these communities within the Joint Meeting service area appear to have been developed to near saturation with mixed residential and commercial development. Although a considerable amount of mixed industrial development is located astride Schuyler Avenue, the overall character of development in the service area can be described as being essentially low to medium density residential. Included in the Joint Meeting service area are approximately 1,800 acres of meadowlands. These meadowlands are for the most part vacant, although the area in the vicinity of Polito Avenue in the Town of Lyndhurst is presently being developed for industrial and commercial uses.

Expenses incurred by the Joint Meeting are shared on an equal basis by the two participating municipalities. The 1969 North Arlington municipal budget indicates appropriations of $20,000 to support the Joint Meeting expenditures. This budget further indicates an appropriation of $18,000 to pay for that municipality's share of expenses incurred by the Passaic Valley Sewerage Commissioners. The budget gave no information concerning appropriations for the operation and maintenance of the municipal collection system. Neither the Joint Meeting nor the individual municipalities impose special charges or fees for the use of their sewers, the revenue to pay for the cost of operation and maintenance being obtained from municipal property taxes.

Neither the Joint Meeting nor the municipalities have ordinances or formal regulations to control the character and strength of sewage discharged to their systems. In the case of the Joint Meeting and the Borough of North Arlington, officials indicated success in handling these matters informally. Lyndhurst Town officials indicated that they were actively working on a draft of an ordinance which would regulate the discharge of waste into their sewage collection system and that introduction of this legislation was imminent. The preparation of this ordinance was precipitated because of the occurrence of severe corrosion in the newly installed pumping station serving the Polito Avenue development. Officials believe this problem was caused by the discharge of corrosive waste by two chemical manufacturing plants located in this area.

The sewers in each municipality's system are of varying age, the oldest portions of which were installed about 1917. Each municipality maintains a collection system of separate sanitary sewers in which infiltration is reported to be excessive, the probable cause being that older sewers have developed open joints, and the presence of a fluctuating and sometimes extremely high water table. The existence of many suspected illegal roof drain connections and the admitted general inadequacy of the local storm drains also probably intensifies peak flows.

North Arlington's sewage is conducted to the plant through an 18 inch diameter sewer which crosses the Erie-Lackawanna Rail-



STATE OF NEW JERSEY
HACKENSACK MEADOWLANDS DEVELOPMENT COMMISSION
FEASIBILITY REPORT–WATER POLLUTION CONTROL SYSTEMS

SCHEMATIC FLOW DIAGRAM
NORTH ARLINGTON - LYNDHURST JOINT MEETING PLANT
JANUARY 1970

JOHN J. KASSNER & CO., INC.
Consulting Engineers

road near Cary Avenue. This sewer runs to Schuyler Avenue via Verhoff Place and Canterbury Avenue where it branches into two 18 inch sewers, one entering from the Borough line to the north and one entering from a point just south of Noel Drive to the south. South of this point, the sewer continues as a 15 inch diameter pipe through a cemetery, along a line approximately 600 to 900 feet west of and roughly parallel to the line of Schuyler Avenue, to the intersection of Park Avenue and Devon Street. South of this point, the sewer extends as a 12 inch diameter pipe in Devon Street to the Borough line at the Belleville Turnpike.

Lyndhurst's sewage is conducted to the Joint Meeting Plant through a 16 inch diameter cast iron sewer installed at the time that the Plant was constructed. It intercepts the flow from a 16 inch diameter sewer at Swane Avenue just north of the Erie-Lackawanna Railroad. This flow previously had been conducted to the former Lyndhurst Municipal Plant which was abandoned at the time the Joint Meeting Plant became operational.

The sewerage systems tributary to the Joint Meeting Plant operate by gravity with the exception of the previously mentioned newly developed meadowland area in the Town of Lyndhurst near Polito Avenue. The sewage emanating from this area is pumped by a station located near the intersection of Polito Avenue and Valley Brook Avenue across the Erie-Lackawanna Railroad to a gravity sewer in Orient Way. The sewers which are pertinent to the Report are shown to the extent data was available, on Appendix D, Existing Sewerage Facilities.

Following the formation of the North Arlington-Lyndhurst Joint meeting, the North Arlington Municipal Plant was altered for use as a primary treatment facility. Construction of the Joint Meeting Plant was begun in 1955 and the Plant was placed in service in August 1957. The original plant had been constructed by the Borough of North Arlington in 1922, and the Joint Meeting incorporated several of the original structures in the 1955 plant.

A pollution abatement order was issued to the Joint Meeting by the New Jersey State Department of Health in May 1967, requiring a minimum reduction of BOD of 80% and an effluent concentration of BOD not to exceed 50 ppm, thus necessitating the upgrading of the present primary treatment system. Subsequent to the receipt of the order, an Engineering Report dated 1968 was submitted to the State Department of Health. It contained the recommendation that the present Joint Meeting Plant be expanded to a capacity of 2.5 mgd and upgraded to provide secondary treatment.

According to the report, present population served by the Joint Meeting Plant is approximately 14,300 persons and it projects a 1985 population of approximately 16,000 persons which would produce a flow of 2.5 mgd and include development of approximately 400 acres of presently vacant, industrially zoned meadowland. Present average daily flow is presented as being approximately 1.5 mgd, with peak dry weather flows of approximately 2.0 mgd. Peak storm flows of 8 mgd which are indicative of excessive infiltration have been reported, during which time excess flows were bypassed around the plant.

Although composition of the wastes is primarily domestic at this time, industrially zoned meadowlands area lying within the two municipalities of the Joint Meeting has been estimated to be approximately 1,300 acres presenting a potential for significant additional industrial waste contribution to the system. Ultimate flow from the two municipalities has been estimated at 4.3 mgd in the 1968 Report.

The 1968 Engineering Report indicates that land available for expansion of the present treatment facilities to the ultimate capacity is limited to that required for the plant alone. It was therefore recommended that the Joint Meeting acquire additional adjacent property to serve as a buffer zone around the expanded plant.

A schematic flow diagram of the present facilities is shown on Exhibit No. 5C. The sewage flow, which is carried to the plant by a separate interceptor serving each community, passes successively through a comminutor, a grit chamber, a grease removal chamber, two primary settling tanks and a chlorine contact tank, and is then discharged into an open ditch which flows to Kingsland Creek and thence to the Hackensack River. Primary sludge removed from the settling tanks is digested and dried on open beds prior to final disposal as land fill in the Meadowlands. A plant by-pass is provided at the effluent end of the grit chamber which permits discharge directly into the ditch which normally receives the treated plant effluent.

There is one comminutor, which is the type with submerged, revolving drum and special U-shaped outfall channel. The grit removal facilities include two channels, one of which contains mechanical grit removal equipment. Grease removal prior to the primary settling tanks is presently a manual operation. Two primary settling tanks with mechanical sludge and scum collection equipment provide approximately 4, 000 square feet of surface area. Scum and sludge are pumped to the primary digester from the primary settling tanks. One chlorine contact tank provides a total contact volume of approximately 5, 500 cubic feet. Chlorination equipment consists of one vacuum-type, gas chlorinator with a capacity of 50 to 500 pounds per day of chlorine.

Sludge digestion is presently a two stage process, the primary digester being a 50 foot diameter by 21 foot side water depth unit, and the secondary digester being a 28 foot diameter, 23 foot side water depth unit. The secondary digester was previously converted from its initial function as an Imhoff tank in the 1922 plant. The primary digester is heated and is equipped with a Pearth gas recirculation unit on a floating cover. The existing open sludge drying beds furnish a total area of approximately 30, 000 feet.

The 1968 Engineering Report indicates that the capacity of the present plant is limited to 1. 7 mgd, this being the lowest rated capacity from among the various individual plant units. The present chlorine contact chamber, the digesters and the sludge drying beds are the units which thus limit the plant capacity.

According to the information supplied by Joint Meeting officials, present rate of chlorine dosage is from 90 to 100 pounds of chlorine per day.

Based on a physical inspection of the facilities, it may be stated that the physical plant is in good condition and generally reflects good maintenance and housekeeping procedures.

State Department of Health records indicate the not infrequent occurrence of coliform densities up to 240, 000 MPN/100 ml., 5 day BODs over 200 ppm and suspended solids from 100 to 200 ppm in the plant effluent.

The Joint Meeting has been notified by the State Department of Health, on a number of occasions in recent years, of excessive BOD, suspended solids, coliform density, turbidity and color and insufficient post chlorination.

Among the problems reported to be presently experienced in operation of the plant is the fact that head losses through the comminutor during peak flows create a back-up condition into the Parshall flumes, thus interfering with accurate metering of plant flows. In addition, excessive maintenance is required on the cutting assemblies of the comminutor, as grit is not removed from the sewage prior to flow through the comminutor. The present manual method of grease removal is inadequate.

The 1968 Engineering Report states that some portions of the plant hydraulic profile are presently not correct for proper plant operation. Problems are experienced in the operation of the digesters, some of which are the frequent introduction of low pH sludge created by acid wastes which interfere with the digestion process, malfunctioning of the sludge heating boiler, lack of sludge recirculation facilities and inadequate provision for sludge sampling from the digesters.

Recommended alterations to the existing plant consist essentially of enlarging the chlorine contact chamber, digesters and sludge drying beds to provide a capacity of 2. 5 mgd in each unit, thus increasing the plant capacity to 2. 5 mgd also, and generally improving and upgrading other areas of the plant. Recommended additions to the plant to provide secondary treatment consist of two high rate trickling filters with recirculation chamber and two secondary settling tanks. Improvements to the sludge handling and disposal facilities were recommended, and alternatives given for the continued disposal of sludge by drying bed and land fill, or of installing new vacuum filtration facilities with sludge cake disposal by land fill. The adoption of the recommendations contained in the 1968 Engineering Report is suggested to insure the adequacy of the plant to approximately 1985. The Joint Meeting engineering report is currently being reviewed by the New Jersey State Department of Health. Final decision as to the disposition of this plant is being held in abeyance pending the submission by others of engineering reports more regional in scope.

12. Hudson County Mental Hospital - Secaucus

Unnamed Creek at River Mile 8.3 - Tributary Mile 1.2

The Hudson County Mental Hospital, sometimes referred to as Meadowview Hospital, is located on the westerly side of County Avenue between Electric Avenue and Center Avenue in Secaucus.

The domestic sewage produced by this facility is treated in an extended aeration type treatment plant, with a capacity of 0.4 mgd, located on the hospital site. According to information obtained from the files of the New Jersey State Department of Health, the plant treats an estimated average flow of 0.2 to 0.3 mgd.

The Hudson County Board of Freeholders has been ordered by the New Jersey State Department of Health to cease pollution of waters flowing to the Hackensack River from this plant. The State Department of Health surveillance reports evaluate plant maintenance to be generally unsatisfactory and poor.

The plant facilities include a bar screen, a comminutor, two extended aeration tanks, two secondary sedimentation tanks, one of which has been largely out of service, unused sand filter structures without sand, one chlorinator and one chlorine contact tank.

Specific deficiencies recorded as to the plant itself are the lack of maintenance of a proper chlorine residual in the effluent, no apparent use of sludge handling facilities although sludge drying beds are available in the plant, and the by-passing of some of the plant influent into an open ditch at a point near the plant inlet. One notice issued by the State Department of Health citing plant effluent deficiencies indicated 185 ppm BOD, 138 ppm suspended solids, insufficient post chlorination, malfunctioning treatment units, inadequate plant maintenance, excessive turbidity, excessive color, excessive odor and insufficient dissolved oxygen as reasons for the notice.

A report prepared by consulting engineers to the Hudson County Board of Freeholders dated February 27, 1969 was submitted to the State Department of Health, followed by an addendum of the same date, in response to the order issued by the Department. The addendum listed supplemental detailed items of work to be performed at the existing treatment plant to comply with the directive of the State Department of Health.

The New Jersey State Department of Health is presently preparing to take legal action against the Hudson County Board of Chosen Freeholders for non-compliance with the required implementation of pollution abatement. Hudson County is reportedly undertaking the design of an alternate proposal that would allow the hospital to be connected to the sewage system of the Town of Secaucus.

13. Rutherford, East Rutherford, Carlstadt Joint Meeting Plant Berrys Creek (via Berrys Creek Canal) - Tributary Mile 1.8

The Rutherford, East Rutherford, Carlstadt Joint Meeting (Tri-Borough) Plant is located east of N. J. Route 17 at the foot of Borough Street in the Borough of Rutherford near the westerly right-of-way line of the Erie-Lackawanna Railroad.

The Tri-Borough Joint Meeting is an independent agency established by the Boroughs of Rutherford, East Rutherford and Carlstadt in 1938 for the purpose of providing interceptor sewers and sewage treatment facilities for approximately 1,040 tributary acres which lie in these three communities, generally to the west of N. J. Route 17. The sewage emanating from approximately 860 acres of Rutherford and East Rutherford, lying in the Passaic River drainage basin, is independently collected by the respective Boroughs and discharged to the system of the Passaic Valley Sewerage Commissioners. The present area served by the Tri-Borough Plant lies to the east of the Passaic Valley-Hackensack Valley ridge line and generally to the west of Berrys Creek. The location of the Tri-Borough Plant and its present service area is shown on Exhibit No. 4, Existing Sanitary Sewer Service Areas.

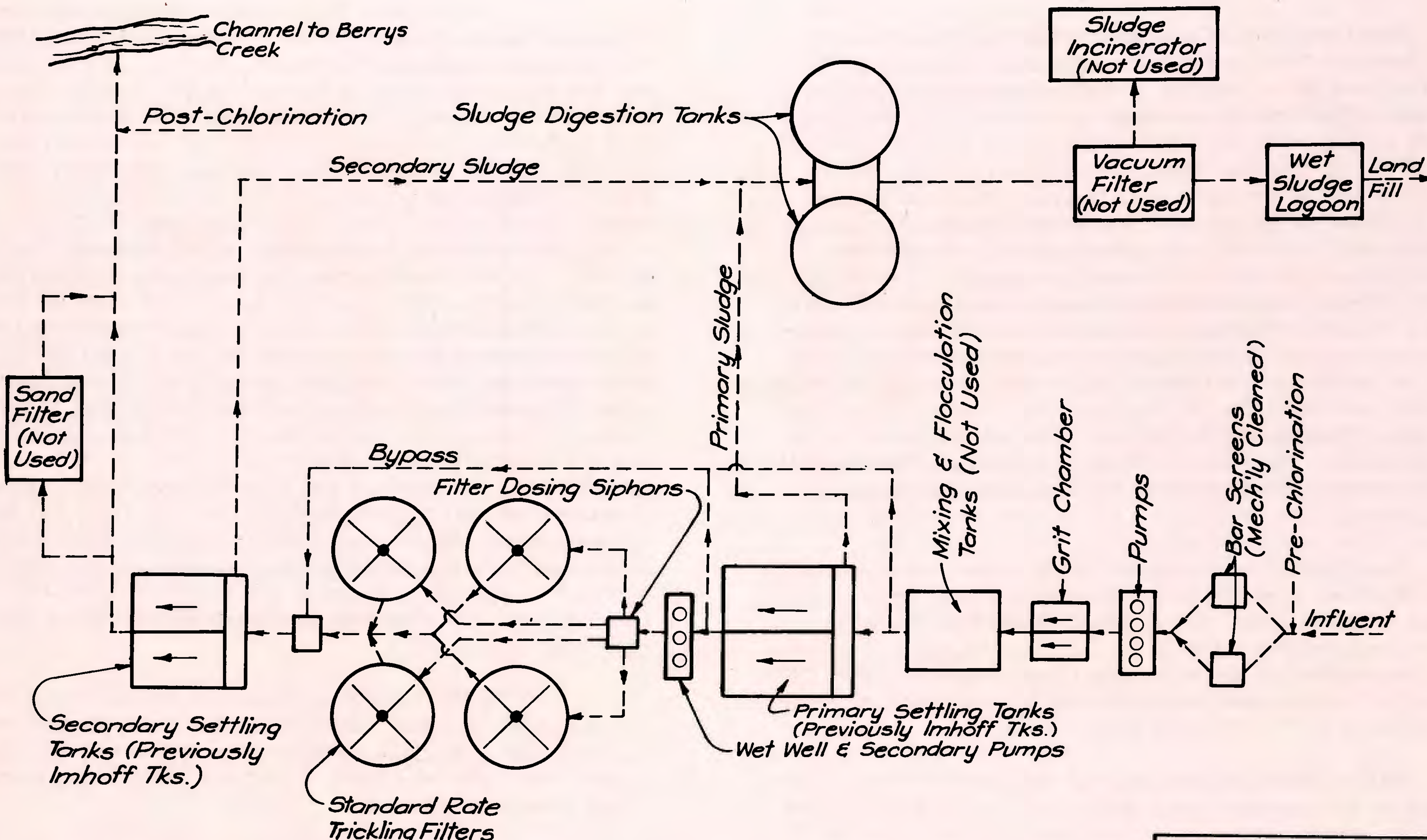
The Public Health Service, U. S. Department of Health, Education and Welfare, reported that this system served approximately 32,100 persons in 1962. According to the 1960 census, the three Boroughs had a resident population of 34,284 persons. The Division of Economic Development of the New Jersey Department of Conservation and Economic Development has estimated the population of these three communities to be 38,570 as of July 1, 1968.

Observations indicate that the area of these three communities, lying on the westerly slope of the Hackensack River Valley to the west of N. J. Route 17 has been developed to almost complete saturation with mixed residential, commercial and industrial development. For the most part, however, this upland area can be characterized as being essentially residential in character of low to medium density. The area to the east of Route 17 and west of Berrys Creek is low-lying meadowland which has been intensely developed for industrial use with some being heavy-industrial in nature. The meadowlands to the east of Berrys Creek is zoned for industry and is mostly vacant but has been developed for industrial use along existing roads. Vacant areas between these arteries are receiving heavy pressure for industrially oriented development.

From the 1969 municipal budgets and from information obtained from municipal officials, it was reported that the Borough of Carlstadt appropriated $40,065, the Borough of East Rutherford $42,000 and the Borough of Rutherford $45,000 for their respective shares of the expenses of Tri-Borough Joint Meeting 1969 budget and East Rutherford appropriated $21,026.67 and Rutherford $14,900 for payment of their respective shares of the Passaic Valley Sewerage Commissioners expenses. The Borough of Rutherford further appropriated $16,000 for salaries and wages, and $2,400 for other expenses in connection with the maintenance of that Borough's sewage collection system. No information was available relative to appropriations made by the Boroughs of Carlstadt and East Rutherford for the maintenance of their collection systems. Neither the Joint Meeting nor the three Boroughs impose separate sewer charges for the use of their facilities, the revenue for these purposes being derived from taxes on local property. However, it is understood that the Borough of Rutherford receives an annual payment from a dye plant located within its corporate limits presumably because of the character of the waste discharged by that industry. Rutherford has an ordinance which regulates the discharge of industrial waste to its system and the Joint Meeting has regulations controlling the character of the waste to be treated. However, according to municipal officials, the Boroughs of Carlstadt and East Rutherford have no ordinances which impose municipal control over the character and strengths of sewage allowed to be discharged to their systems.

The individual municipal sewage collection systems located in the present Joint Meeting service area are owned and maintained by the individual municipalities and are of the separate sanitary sewer type. These collection systems drain to the Joint Meeting trunk sewers by gravity.

The Joint Meeting trunk sewers are separate gravity sewers owned and maintained by the Joint Meeting. Sewage from the north and east enters the plant through a 36 inch diameter sewer from Borough Street in Rutherford. This sewer extends along the southerly right-of-way of the Erie-Lackawanna Railroad, crossing the railroad at a point approximately 250 feet east of N. J. Route 17. This 36 inch sewer continues along the northerly line of the Railroad to Route 17 where it proceeds in a northerly direction along the east side of Route 17



PLANT CAPACITY - 2.9 MGD

STATE OF NEW JERSEY
HACKENSACK MEADOWLANDS DEVELOPMENT COMMISSION
FEASIBILITY REPORT-WATER POLLUTION CONTROL SYSTEMS

SCHEMATIC FLOW DIAGRAM
RUTHERFORD-EAST RUTHERFORD CARLSTADT JOINT MEETING PLANT
FEBRUARY 1970

JOHN J. KASSNER & CO., INC.
Consulting Engineers

to Union Avenue in East Rutherford. A 24 inch and 18 inch diameter spur extends westerly in Union Avenue to Hackensack Street. The main trunk continues northerly some 150 feet to the east of Route 17, along William Street to the Carlstadt boundary at Paterson Plank Road. The line continues in Carlstadt in Twelfth Street to Broad Street where two 18 inch diameter lines join, one from the east from Fourteenth Street and one from the west from Route 17. At Route 17, a 10 inch spur enters from the west on Broad Street from Eighth Street. The trunk extends as a 12 inch diameter sewer along Route 17 to the north, terminating at Berry Avenue. These trunk sewers were constructed by the Joint Meeting in 1938 together with some 8 inch diameter sewers in Hackensack Street from Monroe Avenue to Mozart Street, in Union Avenue from Broad Street to Hackensack Street, and in Hackensack Street from just west of Union Street to Poplar Street and Paterson Avenue in East Rutherford. Information relative to the slopes or elevations of these Joint Meeting trunk sewers was not available.

According to a report entitled "Preliminary Report on Sewerage Facilities" prepared by Ronald B. Brown and Clinton Bogert Associates, consulting engineers to the Joint Meeting, in June 1966, a 30 inch diameter trunk extends in Borough Street from the Plant to Route 17 and an 18 inch diameter trunk is located in Veterans Boulevard extending southwardly to N. J. State Highway Route 3. Information relative to the age, slopes or elevations of these sewers was not available. However, the sewers which are pertinent to the Report are shown, to the extent data was available, on Appendix D, Existing Sewerage Facilities.

The present Tri-Borough Joint Meeting Treatment Plant was placed in service in 1941 as a modern secondary treatment facility having a design capacity of 4.0 mgd. It replaced the existing Borough of Rutherford municipal plant which was an obsolete, primary facility using Imhoff tanks.

According to New Jersey State Department of Health records, a pollution abatement order was issued to the Joint Meeting in May 1967, requiring a minimum reduction of BOD of 80% and an effluent concentration of BOD not greater than 50 ppm.

According to the 1966 engineering report, the present effective plant hydraulic capacity would be 2.9 mgd at average flow based upon present design requirements, and is established by the lowest rated capacity from among the various plant units.

Present flows to the Joint Meeting Plant have been variously estimated as being in excess of 3 mgd average daily, with estimated peak flows of 11 mgd due to combined storm flow and industrial peak flows. Peak flows presently impose excessive hydraulic loadings on various plant units, which in turn contribute to the inability of the present plant to meet New Jersey State Department of Health requirements. Not only is the existing plant hydraulically overloaded but organic overloading also occurs due to the deleterious effect that strong plating, dye and chemical wastes have on the biological filter media.

According to the municipal tax assessment maps of the Borough of Rutherford, the Joint Meeting Plant occupies a site consisting of approximately 10.7 acres, most of which appears to be occupied or used by the existing facilities.

A schematic flow diagram is shown on Exhibit No. 5D and is a composite of information obtained from the 1966 Brown & Bogert Report, the New Jersey State Department of Health and from data furnished by officials of the Joint Meeting as to treatment presently being afforded.

Flow into the plant first passes through two mechanically cleaned bar screens into a wet well and is then pumped into the grit chamber. There are four raw sewage lift pumps providing a total capacity of 11 mgd, however, standby electric power facilities provide only 4 mgd of dependable pumping capacity. One of the grit channels is presently equipped with mechanical grit removal equipment installed about 1966.

Flow next passes through rapid mix and flocculation chambers which were initially provided for the addition of a flocculant chemical prior to primary sedimentation. This equipment has seriously deteriorated and chemicals are not presently being added, so that the units apparently now contribute little to the treatment process. From the rapid mix and flocculation chambers, flow enters two primary settling tanks, each of which is equipped with sludge collectors, but not equipped for grease and scum removal. These units were converted from their previous function as Imhoff tanks to their present usage as primary settling tanks. These tanks are the plant units which limit present plant hydraulic capacity to 2.9 mgd. During periods of peak flow, a by-pass from the influent channel of the tanks normally conducts flow around the tanks and the trickling filters to the secondary settling tank.

Following the completion of primary treatment in the primary treatment tanks, flow enters the secondary pumping station. The station has one 4 mgd unit and two 2 mgd units, but there is no standby power available for the station.

Flow from the secondary pumping station is fed to standard rate trickling filters by a filter dosing chamber with dosing siphons. There are four units, of which three are normally in service. Each filter is 110 feet in diameter and has an 8 foot deep crushed stone bed.

From the trickling filters, flow enters two secondary settling tanks which were also converted from Imhoff tanks.

Chlorination facilities include an evaporator and three chlorinators. Chlorine is presently applied to the plant influent and to effluent from the secondary settling tanks. There is, however, no chlorine contact tank to provide required contact time before the plant effluent is discharged into Berrys Creek. Operating records of the Joint Meeting indicate that chlorine dosage varies from 150 to 200 pounds per day.

Sludge removed from the primary and secondary settling tanks is pumped into two digesters. The plant, as originally designed, provided for two stage digestion with sludge heating and utilization of gas produced during digestion. At present, only the sludge pumps are operable. Digester No. 1 was initially equipped with a floating cover and Digester No. 2 with a fixed cover, both of which are reported to be in a seriously deteriorated condition. Facilities for the chemical conditioning of sludge, vacuum filtration and incineration of sludge cake were installed with the initial plant. However, this equipment reportedly has not been used since 1945. From the digesters, sludge is discharged into wet lagoons at the plant site for drying and ultimate disposition in the Meadowlands as land fill.

New Jersey State Department of Health records indicate that the plant efficiency and continuity of operation is seriously affected by malfunctioning of deteriorated equipment in practically all of the plant units. In addition, it appears that some structural deterioration has also taken place in certain plant units, most notably, in the uneven subsidence of foundations of two of the trickling filters and in one area of the plant administration building. In addition to other causes, plant flow data must be considered to be inaccurate because of deterioration and loss of concrete from the Parshall flume.

Problems being experienced in the operation of the plant are many. The lack of grease and scum collection equipment allows floating material to pass to the trickling filters with resultant clogging and inefficient performance of the filters. Plant pumping facilities, both raw sewage and secondary, are unreliable and experience considerable downtime. In addition, the mode of operation of the secondary pumps is not proper for uniform dosing of the trickling filters and contributes, along with the lack of grease and scum collection equipment, to poor filter performance. The industrial components of the flow are apparently of appreciable strength, since it is reported that corrosion of plant equipment represents a major operating problem. In addition to problems internal to the plant, high tides created by storm conditions and high winds are reported to completely flood the plant at times. The inadequate treatment presently afforded to the wastes from this plant has been the subject of much attention from the State Department of Health for a number of years in their efforts to secure correction of plant deficiencies. The plant has at various times been cited for excessive BOD's and suspended solids, by-passing of plant units, coliform bacteria, color and odor, and for insufficient chlorine residual.

The conclusion drawn in the 1966 engineering report was that the most feasible solution for the Joint Meeting's problem is the expansion and upgrading of the present Joint Meeting Plant, provided that a Federal construction grant could be obtained for such a project. The recommended program of improvements includes the construction of a new pumping station with screenings removal, sewage pumping and laboratory facilities, the installation of new chemical feed, chlorination and vacuum filtration equipment in the existing Administration Building, construction of new primary settling tanks and grit removal facilities, modifications and repairs to the existing trickling filters with conversion to high rate dosage, construction of new secondary settling tanks, conversion of the existing secondary settling tank to a chlorine contact tank, addition of new sludge thickeners, modifications and repairs to the sludge digesters, and the restoration of sludge incineration and other sludge handling and disposal facilities. The report indicated that the alternate course of action, in the event that a Federal Grant were not available, should be to investigate service from the Bergen County Sewer Authority for sewage treatment.

The New Jersey State Department of Health recently disapproved an application by the Joint Meeting for a Federal-State Grant-in-Aid to expand and upgrade the facilities at the Joint Meeting Plant on the basis that retention of this plant was not compatible with the regional approach to pollution abatement preferred for this area.

The aforementioned 1966 engineering report to the Joint Meeting also recommended that the Borough of Carlstadt should enter into independent negotiations with the Bergen County Sewer Authority to have that agency provide sewerage facilities for and treatment of the sewage generated in that portion of the Borough's meadowlands lying outside of the Joint Meeting service area. In 1967, the Borough of Carlstadt created the Carlstadt Sewerage Authority as an independent agency to provide service for that portion of its meadowlands lying east of Berrys Creek. The Carlstadt Sewerage Authority subsequently negotiated an agreement with the Bergen County Sewer Authority to have that agency treat the sewage emanating from the Carlstadt Sewerage Authority district.

According to a report and construction plans prepared by Clinton Bogert Associates, consulting engineers to the Carlstadt Sewerage Authority, construction of Stage I sewerage facilities were initiated in 1967 to serve the northeasterly portion of the Authority's district located west of Washington Avenue and generally north of the New Jersey and New York Railroad. This area of approximately 180 acres of improved meadowland contained approximately 55 existing industries which were to be served by this Stage I improvement. The collection system is designed to drain to a pumping station located opposite the end of Jony Drive south of the New Jersey and New York Railroad on the southerly projected line of Commercial Avenue. This system reportedly became operational in 1968 with the completion of construction of the Bergen County Sewer Authority's Hasbrouck Heights Sewer Extension. The outlet from these Stage I facilities is into this sewer extension via a 12 inch diameter force main running northerly along Commercial Avenue from the pumping station.

According to a sewer inventory report prepared by the Bergen County Planning Board, Stage II improvements were under construction as of March 1969. Construction plans prepared by the Authority's consulting engineer indicate that Stage II improvements would serve the southeasterly portion of the district west of Washington Avenue which portion of the district would drain to a pumping station located on Paterson Plank Road approximately 2,900 feet west of Washington Avenue. The pumping station would lift the sewage to enable it to drain into the Stage I improvement by gravity.

Stage II improvements would also serve the area of the district immediately east of Washington Avenue. The sewage from this portion of the district would drain to a new pumping station located on Barrell Street some 2,200 feet east of Washington Avenue. A new outlet for this sewage would be provided by the construction of an 18 inch diameter force main and/or a 36 inch diameter gravity sewer extending northerly in Central Boulevard and Central Boulevard Extension to the Bergen County Sewer Authority Hasbrouck Heights Sewer Extension. It is understood that at least a portion of these Stage II improvements are presently operational.

The Carlstadt Sewerage Authority imposes sewerage charges on the users of its system and uses the revenue thus derived to amortize their sewerage construction bonds, to pay for the treatment charges made by the Bergen County Sewer Authority and to offset administrative and maintenance costs. The service charges imposed by the Carlstadt Sewerage Authority take the form of a one-time connection fee to the system and a use charge schedule based on type of use, water consumption and building area served. These charges and fees are in addition to revenues in the form of real estate taxes which are collected by the Borough of Carlstadt, a portion of which taxes are allocated to that municipality's sewerage maintenance and sewage treatment expenses.

In 1968, the Borough of East Rutherford likewise created an independent agency, the East Rutherford Sewerage Authority, to undertake the planning, financing and construction of a sewerage system in this Borough's meadowland area. This action was taken in response to recommendations contained in a report to the Borough of East Rutherford prepared by Elam and Popoff Engineering Associates in August 1968 entitled "Report on the Feasibility Study for Sanitary Sewerage".

From information, plans and design reports prepared by Pandullo, Chrisbacher, Price Associates, engineering consultants to the Authority, plans for the first four phases of construction of this sewerage system were completed by September of 1969. Contract No. 1 is comprised of a system of sanitary sewers to serve Marietta Parkway, Metro Boulevard and a portion of Montgomery Drive as well as sewers to serve N. J. State Highway Route 20 between Paterson Plank Road and the N. J. State Highway Route 3 ramping system. Contract No. 2 consists of a system of sewers to serve Paterson Plank Road, Murray Hill Parkway and Manor Road. Contract No. 3 encompasses the construction of a permanent pumping station at Gotham Parkway and Paterson Plank Road. The pumping station will discharge into the sewerage system of the Carlstadt Sewerage Authority and thence into the Bergen County Sewer Authority System for treatment. The ultimate design of the entire East Rutherford Sewerage Authority's system envisions collecting the sewage emanating from the "uplands" area of East Rutherford currently served by the Joint Meeting Plant, as well as from the meadowlands area, and discharging it into the Bergen County Sewer Authority facilities for treatment. However, in order to make the initial sewer installations immediately operational, the construction of a temporary pumping station is provided in Contract No. 3-A, at the same location, as an interim measure. The East Rutherford Sewerage Authority has executed a renewable agreement with the Carlstadt Sewerage Authority which covers the discharge of East Rutherford sewage into the Carlstadt Authority's system. The Bergen County Sewer Authority has agreed to this interim method of sewage disposal by the East Rutherford Sewerage Authority. The agreement sets an interim maximum discharge rate of 1.0 mgd and provides for re-evaluating this flow restriction prior to the renewal of the agreement.

Contract No. 4 consists of the installation of sewers in East Union Avenue, Meadow Lark Drive, Bergen Boulevard, Heritage Drive and a portion of Montgomery Drive. It is believed that Contracts Nos. 1, 2, 3-A and 4 were in the process of construction as of the date of this Report, but the systems are not yet in operation.

The Bergen County Sewer Authority filed a preliminary application during 1969 for a Federal Grant for part of the cost of a proposed 36 inch diameter force main through the Borough of Carlstadt. The capacity of this force main was to be sufficient to accommodate the ultimate flow from the Borough of East Rutherford and the remainder of the southerly portion of the Bergen County Sewer Authority District, including those portions of the municipalities of Carlstadt, East Rutherford, Rutherford, Lyndhurst and North Arlington lying within the Hackensack River Valley in Bergen County.

In order for the Tri-Borough Joint Meeting to implement the recommendations made in the 1966 Brown and Bogert Engineering Report, it would be necessary for the three municipalities to act in concert. No firm action or commitment is known to have been taken by the Joint Meeting but the previously mentioned independent actions taken by the participating municipalities tends to put the future continuance of this Joint Meeting as a separage entity in doubt. The Borough of Carlstadt is considering diverting the flow from the presently sewered area of its jurisdiction directly into the Bergen County Sewer Authority System, by-passing the Joint Meeting Facilities, in accordance with recommendations contained in a 1967 feasibility study. The Borough of East Rutherford is also considering the possibility of taking similar unilateral action. As far as is known at this time, the Borough of Rutherford has taken no action.

14. U.O.P. Chemical Division, Universal Oil Products Company, East Rutherford

Berrys Creek (via Berrys Creek Canal) - Tributary Mile 2.2

U.O.P. Chemical Division, Universal Oil Products Company is located on New Jersey State Route 17 at East Union Avenue in the Borough of East Rutherford.

According to information obtained from the files of the Hudson Delaware Basins Office of the Federal Water Pollution Control Administration, this firm occupies a plant and office area of 25 acres on a site having a total area of 79 acres, employs approximately 260 industrial employees and 90 office workers, and manufactures a wide variety of aromatic and aliphatic organic products during a 24-hour, 7 day workweek throughout the year. As indicated by surveillance reports of the New Jersey State Department of Health, average daily flows have been estimated to be approximately 0.3 mgd. In these reports, the State Health Department has evaluated treatment facility maintenance to be generally marginal.

The wastes produced by the U.O.P. Chemical Division may be generally characterized as acids and alkalis from the manufacture of chemical refining solvent, pharmaceuticals and a wide variety of other products. A high grease and oil content of the wastes reportedly constitutes a treatment problem.

The wastes are treated by facilities which were installed in 1955. The present treatment of the wastes consists of screening, addition of lime for pH adjustment, settling and sludge disposal by lagooning. The lime neutralization includes automatic pH control. However, the treatment facilities are not capable of producing an effluent which meets the present State standards for stream quality. Consequently the Company has been notified by the New Jersey State Department of Health to eliminate existing deficiencies in the treatment of its wastes.

In a letter dated April 21, 1969, the Company advised the State Department of Health that it had received assurances from the East Rutherford Sewerage Authority that a connection would be furnished to its system.

The New Jersey State Department of Health recently approved an application by the Company, issuing a permit to allow connection to the East Rutherford Sewerage Authority as soon as that system is put into operation.

15. Wood-Ridge Chemical Corporation, Wood-Ridge

Berrys Creek (via Berrys Creek Canal) - Tributary Mile 4.2

The Wood-Ridge Chemical Corporation is located east of New Jersey State Route 17 on Park Place East in the Borough of Wood-Ridge.

The present waste water treatment facilities of the Wood-Ridge Chemical Corporation have proven incapable of producing an effluent which meets requirements of State surface water classifications, and the New Jersey State Department of Health has placed the Corporation on notice to take corrective action. The Corporation engaged Metcalf & Eddy, Inc., consulting engineers to investigate and recommend solutions to the waste water treatment and disposal problem. Their report dated December 6, 1968 was submitted to the State Department of Health. Studies presented in the report indicate that, based upon toxicity of the wastes alone, discharge into the Borough of Wood-Ridge municipal collection system is not feasible. A pretreatment process was therefore recommended which is intended to render the wastes suitable for discharge directly into the Bergen County Sewer Authority system through its Hasbrouck Heights interceptor, when connection to that system becomes possible.

From information obtained from the New Jersey State Department of Health, the volume of flow produced by the Company's operations is estimated to be at an average rate of 0.01 mgd to 0.06 mgd, with peaks of from 0.05 mgd to 0.10 mgd. The wastes are generally characterized as alkaline, toxic wastes containing mercury and boron compounds with high solids content. New Jersey State Department of Health records indicate that average characteristics of the waste are a pH of about 10, nitrogen between 800 and 900 ppm, BOD between 500 and 900 ppm, and toxicity due to the presence of mercury compounds. One set of detailed analyses in April of 1969, for which the company was notified of deficiencies, indicated a BOD of 138 ppm, suspended solids of 708 ppm and excessive turbidity, color and odor.

The existing waste water treatment facilities which are presently not in use because of inability to produce adequate treatment consist of a pressure filter, neutralization tank, sedimentation tank and lagoon. The wastes are discharged into Berrys Creek approximately 1/4 mile from the plant. Sludge removed from the process is hauled to land fill.

The method of pretreatment recommended in the aforementioned engineering report consists of clarification with four hours of detention, lagooning of approximately ten hours detention, with mixing and neutralization if necessary, and disposal of sludge and floating solids removed from the clarification into settling lagoons. Two sludge lagoons would be provided, each sized for one year's production of sludge. The lagoon sludge would be dewatered, dried and removed for burial once a year. Overflow from the sludge lagoons would be returned to the plant inlet.

The New Jersey State Health Department has concurred with the recommended method of sewage disposal. The Company is presently negotiating with the Bergen County Sewer Authority in order to secure a connection to that system.

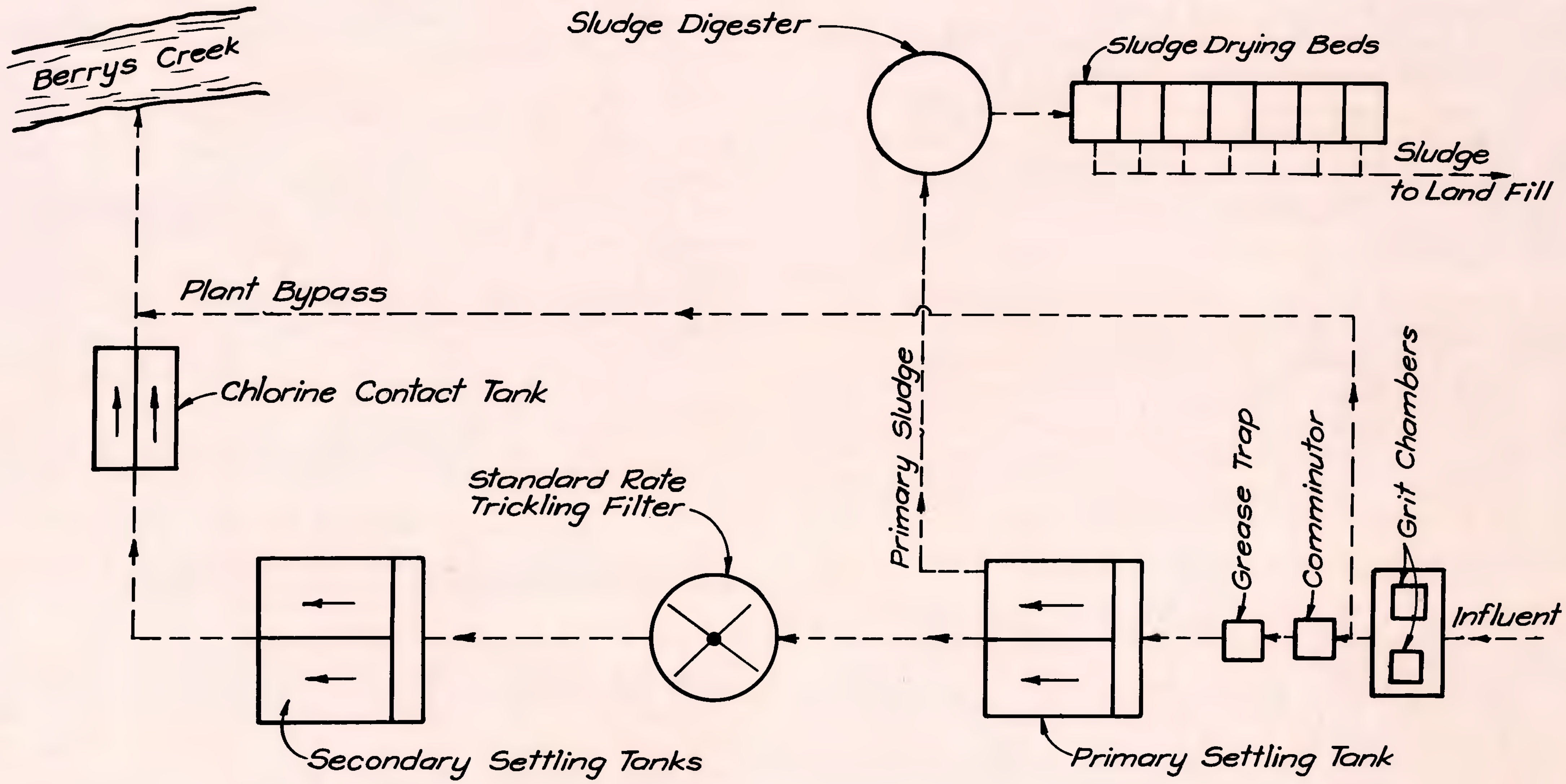
16. Wood-Ridge Municipal Plant

Berrys Creek (via Berrys Creek Canal) - Tributary Mile 4.2

The Borough of Wood-Ridge Municipal Plant is located near the westerly bank of Berrys Creek on Concord Street in Wood-Ridge, N.J. This facility and its sewerage system is owned and operated by the Borough of Wood-Ridge. The system serves a total area of approximately 1.1 square miles encompassed within the Borough's municipal boundaries with the exception of a large industrially zoned tract occupied by the Curtiss-Wright Corporation in the northwesterly quadrant of the Borough. Curtiss-Wright is sewered into the collection system of the Borough of Lodi, whose sewage is treated by the Passaic Valley Sewerage Commission. The location of the municipal plant and its service area is indicated on Exhibit No. 4, Existing Sanitary Sewer Service Areas.

According to the 1960 census, Wood-Ridge had a population of 7,964 persons. The Division of Economic Development of the New Jersey Department of Conservation and Economic Development has estimated this municipality's population to be 8,560 persons as of July 1, 1968.

Observation verifies the fact that Wood-Ridge is essentially a residential community principally developed with a preponderance of single family, detached dwellings. Only a small percentage of the area is devoted to commercial and multi-family residential uses. In addition to the aforementioned Curtiss-Wright site, the area east of New Jersey State Route 17 is also zoned for industry. The municipal zoning ordinance is quite restrictive with respect to the type and nature of manufacturing activity which is allowed. The upland area of the Borough, primarily zoned for low density residential use, appears to have been developed almost to saturation.



PLANT CAPACITY - 0.7 MGD

STATE OF NEW JERSEY
HACKENSACK MEADOWLANDS DEVELOPMENT COMMISSION
FEASIBILITY REPORT-WATER POLLUTION CONTROL SYSTEMS

SCHEMATIC FLOW DIAGRAM
WOOD-RIDGE MUNICIPAL PLANT
FEBRUARY 1970

JOHN J. KASSNER & CO., INC.
Consulting Engineers

The 1969 Wood-Ridge municipal budget indicates appropriations of $35,100 for salaries and wages and $16,500 for other expenses in connection with the operation and maintenance of the municipal treatment plant and sewerage system.

According to municipal officials, the Borough does not have any ordinance or formal regulations to control the character and strength of wastes allowed to be discharged into the system. These officials indicate that the restrictive zoning ordinance gives the municipality adequate control over the types of industry which can be built and thus contribute to the system. They further stated that the Borough's sewerage system is of the separate sanitary sewer type. The Borough maintains three relatively small sewage lift stations in their collection system to lift sewage from certain districts in order to conduct it to the plant.

According to records of the New Jersey State Department of Health, the initial treatment plant was constructed in 1925 as a primary treatment facility and included a grit and screen chamber, an Imhoff tank and sludge drying beds. Subsequent additions to this initial plant were constructed in 1936, 1939, 1941 and 1959. The 1959 improvements upgraded the plant to a secondary treatment facility, the design of which was predicated on a design period of ten years and a design flow of 0.6 mgd. The present plant reportedly has a design capacity of 0.7 mgd.

Although the Borough of Wood-Ridge has not been issued a formal pollution abatement order by the New Jersey State Department of Health, the Borough has been cited by the Department on numerous occasions in recent years for failure to meet the various criteria for satisfactory treatment as established by the Department. A feasibility study is now being conducted by consulting engineers to the Borough, to determine the course of action for the Borough to take to correct these deficiencies. Although this report has not yet been finalized, the more obvious alternatives appear to be connection of the Borough's collection system to the Bergen County Sewer Authority System or upgrading the facilities at the existing treatment plant.

According to State Department of Health records, average daily flow through the plant is 0.6 mgd. Normal daily peak flow of 1.2 mgd has been reported.

The waste flows to the plant are predominantly domestic in nature, although some industrial wastes are received.

A schematic diagram of flow through the plant is shown on Exhibit No. 5E. Information relative to the flow through the plant and the descriptions of the plant units were taken from a report entitled "Report of Final Design of Proposed Facilities at the Wood-Ridge, N.J. Sewage Treatment Plant", prepared by Ronald Brown, engineer, in June 1959.

Flow entering the plant passes successively through two grit chambers, a comminutor, a grease trap, two primary settling tanks, a standard rate trickling filter, two secondary settling tanks, and a chlorine contact tank (or tanks), after which plant effluent is discharged to Berrys Creek. Sludge treatment and disposal facilities consist of one digester, sludge drying beds and a sludge lagoon. The two primary settling tanks furnish a total area of 960 square feet. The standard rate trickling filter is 118 feet in diameter and has a side water depth of six feet. The secondary settling tanks provide a surface area of 314 square feet. There are two chlorinators, one of which serves as a standby unit. The plant pumping station contains one 500 gpm pump, one 300 gpm pump and one 200 gpm pump.

State Department of Health records indicate the rate of chlorine dosage to be from 70 to 80 pounds of chlorine per day. Ultimate sludge disposal is reportedly by land fill.

In their quarterly surveillance reports, State Department of Health inspectors have evaluated plant maintenance to be generally marginal and sometimes unsatisfactory and poor. An inspection of the plant on September 12, 1967 by the State Department of Health indicated removals of 86% of BOD and 76% of suspended solids on that date. State Department of Health records indicate that the plant may be capable of producing better results than are being attained. Industrial wastes apparently create some problems in the plant. The digester is cited as presently furnishing inadequate treatment of sludge, with no gas production because of a leaking wood dome cover.

17. Secaucus Municipal Plant, Secaucus

Mill Creek - Tributary Mile 1.0

The Secaucus Municipal Plant is located on the easterly side of Koelle Boulevard approximately midway between Mill Ridge Road and Central Lane in the Town of Secaucus. The Plant and its appurtenant sewerage system is owned and operated by the municipality. The location of the plant is shown on Exhibit No. 4, Existing Sanitary Sewer Service Areas.

The 1960 census indicated the population of Secaucus to be slightly over 12,000 persons residing in the more elevated portions of the Town immediately astride N. J. Route 3. It has been estimated that approximately 6,000 persons are presently served by this facility. Observation indicates the predominantly suburban character of development of this area. The relatively large portion of the Town's gross land area lying within the Meadowlands District is zoned for industry. The area north of Secaucus Road between County Road and Frozen Food Plaza has been developed industrially and the contiguous vacant areas have reportedly been receiving heavy pressure for further industrial development.

The 1969 Secaucus municipal budget indicates appropriations of $53,014 for salaries and wages, and $20,000 for other expenses in connection with the operation of the municipal treatment plant and sewerage system. The revenues for these purposes are derived entirely from local property taxes with no separate sewer use charges imposed.

According to municipal officials, the Town has entered into a contract with their consulting engineers to design sewers for their presently developed but unsewered areas. The exact extent of the existing sewered area is not known but it is purported to be of the separate type, with some evidence of excessive infiltration.

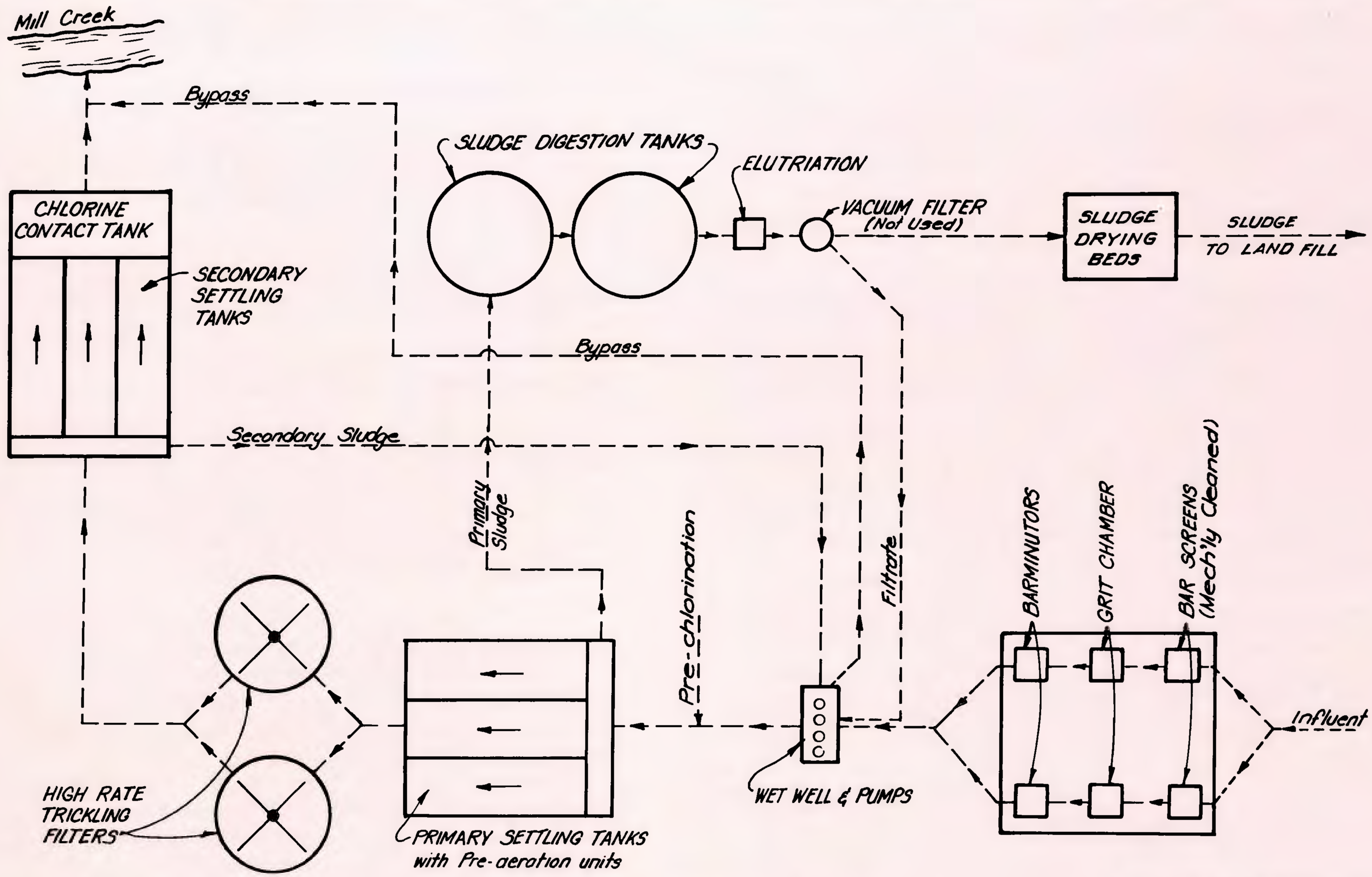
According to data from the files of the New Jersey State Health Department, the Secaucus Plant was constructed and placed in service as a secondary treatment facility in 1964. The Plant has a design capacity of 2.25 mgd.

Although occasional problems have been experienced in maintaining plant effluent quality, the plant appears to function at required levels of performance, or somewhat better. No pollution abatement orders have been issued to the Town of Secaucus by the State Department of Health.

State Health Department records indicate an average daily flow of 0.65 mgd with normal maximum flow of approximately 1.5 mgd. The plant presently is operating at less than 30% of design capacity which allows for considerable flexibility in its operation. Peak flows of approximately 3.0 mgd have been experienced, indicative of the aforementioned infiltration.

Although complete data is not available on industrial contributions, it is known from survey data of the Federal Water Pollution Control Administration that one metal finishing industry contributes from 0.1 mgd to 0.14 mgd of plating wastes. Pretreatment consisting of neutralization is afforded the plating wastes, however, so that the wastes received in the municipal plant are characterized as predominantly domestic in nature. Since a significant portion of the Town's area is zoned for heavy industry, the nature of the sewage may tend to change as these industrial areas are developed and tie into the municipal system. Municipal officials report that the Town presently has no ordinance or regulation controlling industrial waste discharge into the system.

EXHIBIT NO. 5F



PLANT CAPACITY - 2.25 MGD

STATE OF NEW JERSEY
HACKENSACK MEADOWLANDS DEVELOPMENT COMMISSION
FEASIBILITY REPORT-WATER POLLUTION CONTROL SYSTEMS

SCHEMATIC FLOW DIAGRAM
SECAUCUS MUNICIPAL PLANT
FEBRUARY 1970

JOHN J. KASSNER & CO., INC.
Consulting Engineers

The treatment process is shown in a schematic flow diagram on Exhibit No. 5F. Flow entering the plant successively flows through mechanically cleaned bar screens, grit chambers, barminutors, wet well and pumping station, three primary settling tanks with pre-aeration units, two high rate trickling filters, three secondary settling tanks and a chlorine contact tank. Plant effluent is discharged into Mill Creek. Secondary sludge is returned to the wet well. Primary sludge is pumped to two sludge digestion tanks, after which the digested sludge is elutriated and dried on open beds. Dried sludge is disposed of as land fill. A vacuum filter is available for use following sludge elutriation, but is not presently being used. The primary digester is heated and both digesters are equipped with a "Pearth" gas recirculation system. Sludge gas is used for heating the primary digester. Chlorination equipment consists of two chlorinators, each having a capacity of 500 pounds of chlorine per day. The plant is also equipped with a laboratory capable of performing analyses for dissolved oxygen, BOD, suspended solids, suspended ash and chlorine residuals. Average chlorine feed rate is reported to be 60 pounds of chlorine per day.

Because the present average flow is low in comparison to the design capacity, the plant operates with two of the three primary tanks, one of the two high rate trickling filters and one of the three settling tanks normally in service. Surveillance reports of plant operation by the New Jersey State Department of Health generally indicate that the plant is well operated and maintained.

Results of analyses of samples taken by the State Department of Health in September 1969 indicated BOD removal of 89% with a final value of 20 ppm, suspended solids removal of 98% with a final value of 12 ppm and a chlorine residual 2.5 ppm developed. At the same time, coliform counts of 90; 24,000+; 90 and 230 MPN/100 ml were obtained.

Although the plant is generally affording satisfactory treatment, due at least in part to operating at approximately 30% of design capacity, it is possible to improve the system by the correction of infiltration presently being received from the collection system.

18. North Bergen Municipal Plants

Central Plant, Cromakill Creek - Tributary Mile 2.2
Northern Plant, Bellmans Creek- Tributary Mile 1.9

The Township of North Bergen owns and operates three sewage treatment plants which treat the waste water generated from within its corporate limits, as well as from the entire Town of Guttenberg and a small portion of Union City.

The North Bergen Central Plant is located on the north side of 43rd Street and its site is bounded by 43rd Street on the south, West Side Avenue on the west, the projection of 45th Street on the north and the right-of-way of the New York, Susquehanna and Western Railroad on the east. The North Bergen Northern Plant is located on the south side of 91st Street and its site is bounded by 91st Street on the north, Nolan Avenue on the east, 89th Street on the south, and a line approximately 400 feet east of and parallel to the Erie-Lackawanna Railroad on the west. The North Bergen Woodcliff Plant is located on the west side of River Road at the projection of 72nd Street. The Central and Northern Plants discharge their effluents into tributaries of the Hackensack River while the Woodcliff Plant discharges directly into the Hudson River.

The Central Plant serves the sewered area of the Township of North Bergen lying east of the Erie-Lackawanna Railroad and generally south and west of a district boundary line which extends southeasterly from the Railroad at 80th Street to Tonnelle Avenue at 75th Street, easterly to the intersection of J. F. Kennedy Memorial Boulevard and 75th Street, and thence southerly along J. F. Kennedy Memorial Boulevard to the Township boundary at the Guttenberg Town line just north of 70th Street, and includes that portion of Union City lying to the west of J. F. Kennedy Memorial Boulevard. The Woodcliff Plant serves the entire Town of Guttenberg and that portion of the Township of North Bergen lying to the east of Bergenline Avenue. The Northern Plant serves the remaining sewered portion of the Township of North Bergen lying to the east of the Erie-Lackawanna Railroad. The locations of the three plants and their respective service areas are shown on Exhibit No. 4, Existing Sanitary Sewer Service Areas.

According to the 1960 Census, the population of North Bergen was 42, 387 and the population of Guttenberg was 5, 118. The Division of Economic Development of the New Jersey Department of Conservation and Economic Development has estimated the populations of North Bergen and Guttenberg to be 43, 840 and 5, 420 respectively, as of July 1, 1968. In their 1966 preliminary report, the Public Health Service of the U. S. Department of Health, Education and Welfare estimated that approximately 30, 000 people were served by the Central Plant and approximately 15, 200 people were served by the Northern Plant.

As determined by observations, the more elevated portion of the Township appears to have been developed to near saturation, mostly with mixed residential, commercial and light industrial development. The entire area lying to the west of Tonnelle Avenue has been zoned for heavy industrial use, but this type of development has occurred principally to the east of the Erie-Lackawanna Railroad. The area lying to the west of the Railroad can be characterized as generally vacant and undeveloped marshland.

The 1969 North Bergen municipal budget indicates appropriations of $116, 700 for salaries and wages, and $50, 000 for other expenses in connection with the operation and maintenance of the three treatment facilities. According to municipal officials, the annual cost of maintaining and operating the Township's sanitary sewer system was approximately $33, 000.

In 1946, the Township entered into an agreement with the municipality of Union City which provided that sewerage and treatment service would thenceforth be supplied by the Township of North Bergen for that portion of Union City lying to the west of J. F. Kennedy Memorial Boulevard. In consideration of these arrangements, Union City was to pay North Bergen the total sum of $75, 000 in annual installments over a 15 year period.

In 1957, North Bergen entered into an agreement with the Town of Guttenberg which provided that sewage treatment service for the Town of Guttenberg would be provided by North Bergen at the then proposed Woodcliff Plant. The agreement stipulates that Guttenberg pay North Bergen an annual service charge of $2. 70 per capita of the population of Guttenberg, as determined by the U. S. Census. Included in the agreement is a schedule which allows for an increase in the basic charge if the daily per capita flow to North Bergen is in excess of the 1957 to 1960 Guttenberg average per capita flow, and further contains a stipulation whereby the costs of any capital improvements required to be made at the Woodcliff Plant by a higher authority having jurisdiction would be shared by the two municipalities on a pro-rata basis according to the respective population of each municipality being served by that facility.

Additional information obtained from municipal officials indicates that the Township of North Bergen does not have a separate ordinance or code to control the character and strength of sewage that may be discharged into their sewerage system except for a regulation which probhibits the dumping of explosives and noxious substances. However, the agreement with the Town of Guttenberg contains restrictions on the composition and strength of sewage which Guttenberg may discharge into the North Bergen sewerage system. North Bergen does not impose special charges or fees for the use of their facilities, the revenue to pay the cost of operation and maintenance being obtained solely from municipal property taxes, except for the intermunicipal agreement with the Town of Guttenberg.

North Bergen officials report that a major portion of the sewerage system is composed of separate sanitary sewers but contains some combined sanitary-storm sewers. Information in the files of the New Jersey State Department of Health states that North Bergen has 42 miles of separate sanitary collection sewers and 8 miles of combined sanitary collection sewers. Of a total municipal area of 3, 500 acres, 2, 030 acres are served by separate sanitary sewers and 270 acres are served by combined sewers. It was reported that there were no known areas where heavy infiltration or flooding adversely affects the efficiency of the system. A drawing furnished by the municipality of North Bergen denotes the general location of eleven overflow regulators, eight of which are in the service area of the Central Plant, two in the Northern Plant service area and one in the Woodcliff Plant service area. It was reported that these regulators were constructed to divert storm flows in excess of 165 percent of dry weather flow into the storm drainage system. In general, the natural drainage of the Central Plant area is to Cromakill Creek and that of the Northern Plant is to Bellmans Creek.

North Bergen maintains four sewage pumping stations. One pumping station is located on 8th Street between Dell Avenue and Tonelle Avenue, and pumps sewage collected from an approximate one square mile area in the southern end of the municipality to a discharge point at the intersection of Grand Avenue and Paterson Plank Road, from whence it flows via gravity sewers to the Central Plant. Another pumping station is located at 60th Street. The other pumping stations are a lift station at 43rd Street which pumps sewage into the Central Plant and a lift station at 91st Street which pumps sewage into the Northern Plant. The remainder of the sewerage system is reported to operate by gravity.

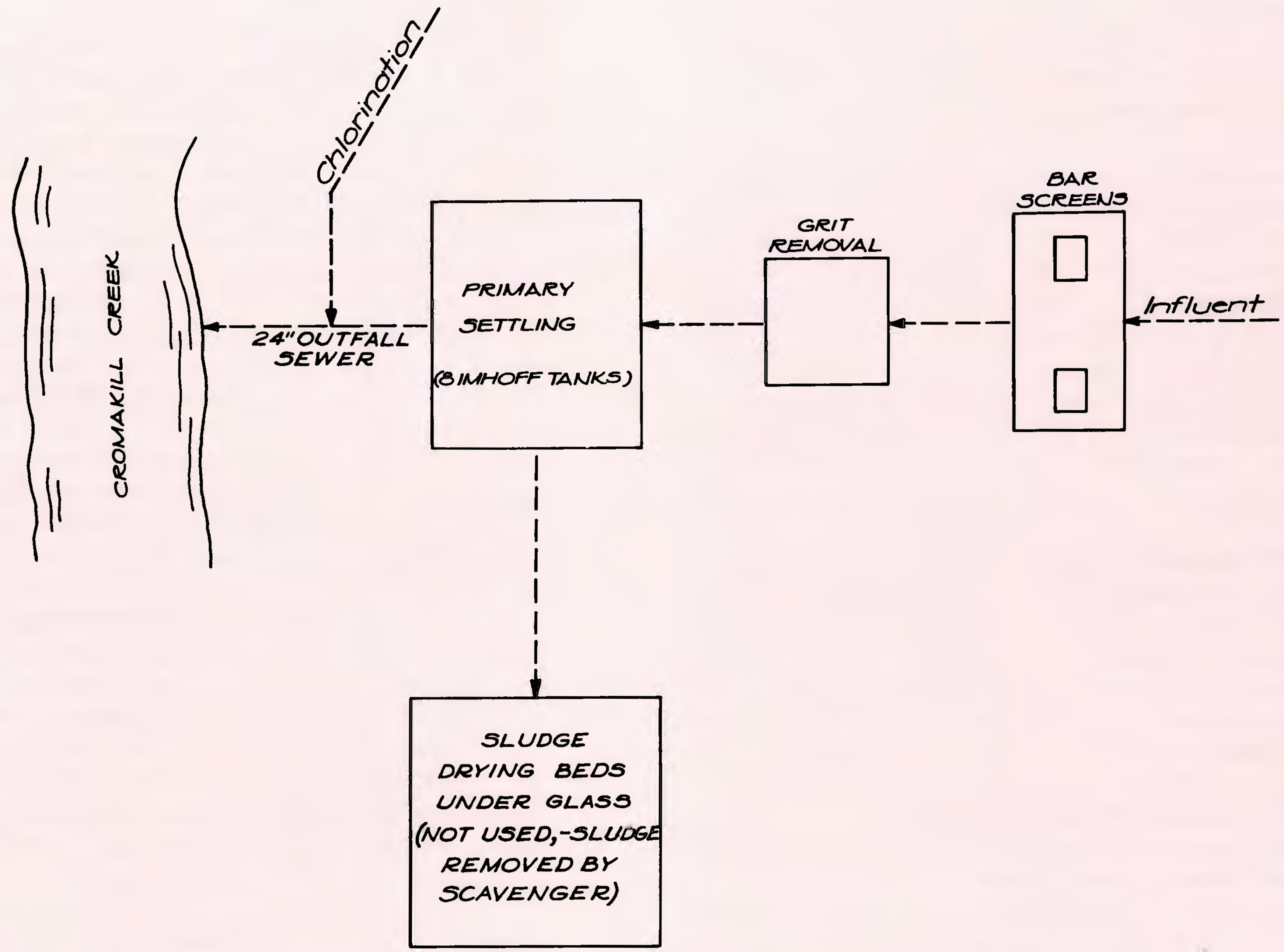
A design report prepared by the Newkirk Engineering Company titled "Preliminary Report, Central Wastewater Treatment Plant, North Bergen, New Jersey" was submitted to the New Jersey State Department of Health on November 12, 1968 and again on February 18, 1969. According to the report, construction of a trunk sewer was initiated by North Bergen in 1964 along West Side Avenue under a Federal Grant for the express purpose of making a connection to the system of the Jersey City Sewer Authority, in order to enable that agency to treat the sewage from North Bergen. Municipal officials of North Bergen described the constructed portion of the trunk sewer as extending westwardly in 91st Street from a point east of Nolan Avenue to the Erie-Lackawanna Railroad, crossing the Railroad and continuing in a sewer right-of-way in a westerly direction to a point on the west side of the New York, Susquehanna and Western Railroad. The trunk sewer then extends in a southerly direction along the westerly side of the Railroad to 83rd Street, where it further continues in a southerly direction in West Side Avenue to 43rd Street. That portion of the proposed trunk sewer south of 43rd Street, which would have connected to the existing 48 inch diameter Jersey City Sewer Authority West Side Interceptor Sewer by means of a proposed 20 mgd pumping station was not constructed as North Bergen decided not to implement the connection or effect a sewage treatment agreement with the Jersey City Sewer Authority. The construction of the trunk sewer north of 43rd Street was reported complete but not operational as of the date of this Report. Information obtained from the files of the New Jersey State Department of Health indicates the size of this sewer to be 27 inch diameter at 91st Street and Nolan Avenue, 30 inch diameter at 69th Street and West Side Avenue, 33 inch diameter at 50th Street and West Side Avenue and 36 inch diameter at 43rd Street and West Side Avenue, constructed at a 0.1 percent slope throughout its length. These indicate a pipe capacity of 6.3 mgd to 13.7 mgd progressively along the length of the sewer. Sewers in the area pertinent to the Report are shown to the extent data was available, on Appendix D, Existing Sewerage Facilities.

According to the Newkirk report, the Central and Northern Plants were constructed as primary treatment facilities and placed in service about 1928. The Woodcliff Plant, also constructed as a primary facility, was placed in service about 1959.

Pollution abatement orders were issued to the Township by the New Jersey State Department of Health in connection with all three treatment plants in September 1967. Subsequent to the issuance of these orders, the Newkirk report was submitted to the New Jersey State Department of Health for their review. This report proposed that all three existing plants be abandoned and be replaced by a new secondary treatment facility to be constructed at the location of the present Central Plant. New temporary chlorination facilities were completed in March 1969 and a new pumping station to eventually serve the proposed new secondary plant was placed under construction in 1969, both at the Central Plant Site. Both of the above installations were approved by the State Department of Health as interim measures.

The Newkirk report states that the existing total tributary population contributing waste flows is estimated to be 46,000

EXHIBIT NO. 5G



PLANT CAPACITY - 4.0 MGD

STATE OF NEW JERSEY
HACKENSACK MEADOWLANDS DEVELOPMENT COMMISSION
FEASIBILITY REPORT-WATER POLLUTION CONTROL SYSTEMS

SCHEMATIC FLOW DIAGRAM
NORTH BERGEN CENTRAL MUNICIPAL PLANT
MARCH 1970

JOHN J. KASSNER & CO., INC.
Consulting Engineers

persons and that industrial contributions will reach 2.0 mgd by the year 1993. The types of industry that are presently contributing to flows are listed as cloth dyeing, plating, paper making, truck terminals, railroad yards, steel fabrication, embroidery, fur dyeing, bleaching, paper works, plastics and a slaughter house. Analysis of catch samples indicates values of BOD from 260 to 280 ppm, suspended solids from 260 to 280 ppm, and pH from 6.2 to 6.8 at the three existing plants.

There is reportedly insufficient space at the Woodcliff Plant to permit upgrading the present primary treatment and this plant presently has no sludge treatment facilities. According to North Bergen municipal officials, as soon as fresh sludge settles to the bottom of the Woodcliff Plant clarifiers, it is pumped via a force main installed in J. F. Kennedy Boulevard and 79th Street to the Northern Plant sewage collection system at Bergenline Avenue, from whence it flows by gravity to the Northern Plant.

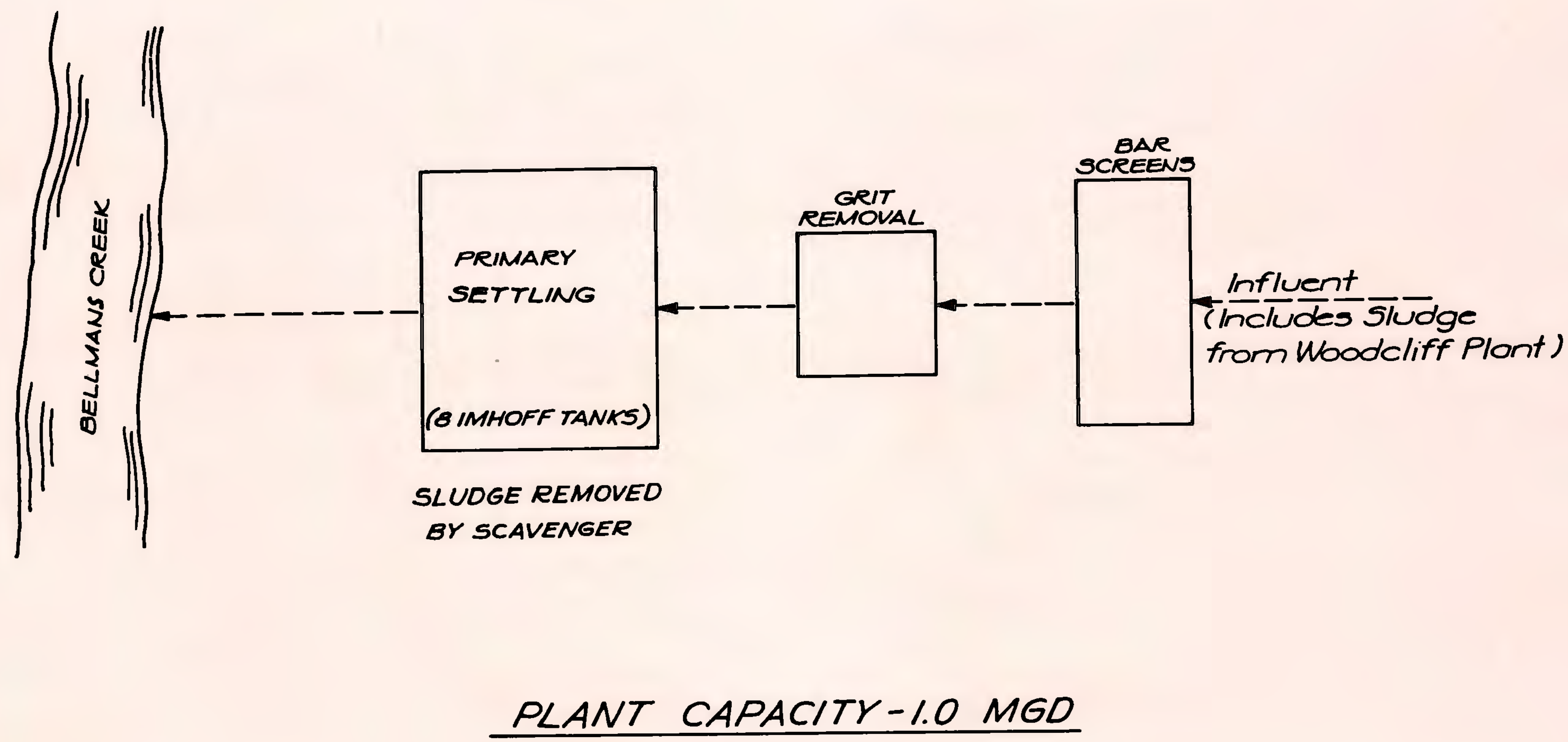
Exhibit No. 5G is a schematic flow diagram of the existing Central Plant. Sewage enters the plant from the discharge of a lift station which reportedly also handles storm water flow. Sewage flow then passes successively through hand cleaned bar screens, a grit removal chamber and Imhoff tanks having a reported capacity of 4.0 mgd based on a detention time of 2.5 hours and a surface settling rate of 600 gallons per square foot per day. The plant effluent is discharged to Cromakill Creek through a 24 inch diameter cast iron pipe approximayely 300 feet long. A recently installed vacuum type, solution feed chlorinator, having an adjustable capacity of 1,000 pounds per day, diffuses chlorine at the plant outfall sewer. Original construction provided for the removal of sludge from the Imhoff tanks to drying beds under glass.

Exhibit No. 5F is a schematic flow diagram of the existing Northern Plant. Sewage enters the plant from the discharge of a lift station and passes through hand cleaned bar screens, grit removal and Imhoff tanks, and is discharged into Bellmans Creek. Original construction provided means for removing sludge from the Imhoff tank to uncovered drying beds.

As indicated by their surveillance reports, the New Jersey State Department of Health has evaluated treatment facility maintenance at both of these plants to be marginal, unsatisfactory and poor. As indications of the effectiveness of treatment provided at the existing Central and Northern Plants, the State Department of Health surveillance reports note that the flow through these plants is either straight through the units with little or no treatment afforded, or is bypassed entirely around the plants and directly into the receiving creeks. Sludge drying beds are not in use and are, in fact, reported to be inoperable due to deficiencies in the sludge pumping facilities. Sludge scavenger service has presumably been provided at one or both plants on an "as needed" basis. Present average daily flows at each plant have been estimated to be 2.0 mgd with estimated peak flows of 2.5 mgd. Neither plant is reported to be equipped with reliable flow metering equipment.

The Woodcliff Plant reportedly treats an average daily flow of 1.5 mgd. The treatment consists of screening, grit removal, barminutors, primary settling in two tanks, pre-chlorination and post-chlorination. The plant effluent is presently discharged into the Hudson River and as previously mentioned, the sludge is pumped into the collection system of the Northern Plant. The plant provides only primary treatment with no provision for proper chlorine contact time and no sludge handling facilities. With this present degree of treatment capability, the plant is unable to meet the present standards required for discharge into TW-2 waters. The facility is not amenable to expansion for secondary treatment and the New Jersey State Department of Health evaluates the maintenance of the facilities at this plant to be satisfactory.

The new secondary treatment facilities at the site of the present Central Plant, proposed in the Newkirk report, would be based upon a design flow of 8.5 mgd, which is the projected estimate for the year 1993. This design flow includes an allowance of 2 mgd for industrial wastes. The proposed treatment process would include two mechanically cleaned coarse bar screens, two mechanically cleaned grit collectors approximately 16 feet in diameter with subsequent grit washing, three comminutors, a plant pumping station with



STATE OF NEW JERSEY
HACKENSACK MEADOWLANDS DEVELOPMENT COMMISSION
FEASIBILITY REPORT-WATER POLLUTION CONTROL SYSTEMS

SCHEMATIC FLOW DIAGRAM
NORTH BERGEN NORTHERN MUNICIPAL PLANT
MARCH 1970

JOHN J. KASSNER & CO., INC.
Consulting Engineers

variable speed sewage pumps, four primary settling tanks equipped with sludge collectors, scum collectors and pre-aeration facilities, four high rate trickling filters fed by distribution manhole, four secondary settling tanks equipped with sludge and scum collectors, and pumping facilities for return of sludge to the primary settling tanks before pre-aeration, chlorination equipment with chlorine feed paced by flow measurement and chlorine demand, and a chlorine contact tank. Plant effluent would be discharged to Cromakill Creek. Sludge handling and disposal facilities would consist of holding and thickening tanks, vacuum filtration with chemical conditioning, and incineration with disposal of ash by pumping of ash slurry to lagoons on the site. Miscellaneous proposed plant facilities are an administration building containing main control center, offices, laboratory, garage and workshops, and standby power plant.

The Newkirk report proposes to use the West End Avenue trunk for conveying Northern Plant sewage to the proposed new 43rd Street facility. A pumping station would be constructed at the Woodcliff Plant which would convey the sewage from the Woodcliff Plant service area to the Northern Plant service area by means of a force main. The existing 43rd Street Plant, Northern Plant and Woodcliff Plant would be abandoned and all sewage would be treated at the new 43rd Street secondary facility.

The New Jersey State Health Department has reportedly rejected an application to construct the new Central treatment plant as proposed in the Newkirk report. As of the date of this Report it is understood that the new 43rd Street Pumping Station is operational and is receiving flow from the Northern Plant through the West Side Interceptor Sewer. The Woodcliff Plant is still operational and discharges into the Hudson River.

19. Bergen County Sewer Authority Plant - Little Ferry

Hackensack River - Mile 12.7

The Bergen County Sewer Authority's Plant is located on the west bank of the Hackensack River on Mehrhof Lane in Little Ferry, N. J. This facility, and the trunk and interceptor sewers tributary to it, are operated and maintained by the Bergen County Sewer Authority, an independent, autonomous agency established by the Bergen County Board of Chosen Freeholders in 1947 to have jurisdiction over the administration, construction, maintenance and operation of trunk and intercepting sewers, and sewage treatment works within the Bergen County-Hackensack River Sanitary Sewerage District which was also established at that time.

The Bergen County-Hackensack River Sanitary Sewerage District is presently comprised of the following 50 municipalities, most of which lie, in whole or in part, within the Hackensack River drainage Basin: Alpine, <u>Bergenfield</u>, <u>Bogota</u>, <u>Carlstadt</u>, <u>Cliffside Park</u>, Closter*, <u>Cresskill</u>, Demarest*, <u>Dumont</u>, <u>East Rutherford</u>, <u>Emerson</u>, <u>Englewood</u>, <u>Englewood Cliffs</u>, <u>Fairview</u>, <u>Fort Lee</u>, <u>Hackensack</u>, Harrington Park*, <u>Hasbrouck Heights</u>, Haworth*, <u>Hillsdale</u>, <u>Leonia</u>, Lodi, <u>Little Ferry</u>, Lyndhurst, <u>Maywood</u>, <u>Montvale</u>, <u>Moonachie</u>, <u>New Milford</u>, North Arlington, Northvale*, Norwood*, <u>Oradell</u>, Old Tappan, <u>Palisades Park</u>, <u>Paramus</u>, <u>Park Ridge</u>, <u>Ridgefield</u>, <u>Ridgefield Park</u>, <u>River Edge</u>, <u>River Vale</u>, Rockleigh, Rutherford, <u>South Hackensack</u>, <u>Teaneck</u>, <u>Tenafly</u>, <u>Teterboro</u>, <u>Washington Township</u>, <u>Westwood</u>, <u>Woodcliff Lake</u> and Wood Ridge. According to reports prepared by Clinton Bogert Associates, engineering consultants to the Sewer Authority and a March 1969 report titled "Sewer Facilities" prepared by the Bergen County Planning Board, the Sewer Authority had service contracts with the 36 member municipalities that are <u>underlined</u> above and, in addition, with the municipality of Rochelle Park which lies outside of the Bergen County-Hackensack River Sanitary Sewerage District. Reportedly 29 of these municipalities are fully connected to the Authority's facilities with others expected to be connected by 1971. The Authority expects that it will soon enter into agreements to serve those communities listed above which have been marked with an asterisk (*) and anticipates that at some time in the future it will serve all of the remaining member municipalities with the exception of Lodi which is sewered into the system of the Passaic Valley Sewerage Commissioners and, in addition, will also serve the municipality of Edgewater which lies outside of the Authority's District. Location of the plant and the area it serves is shown on Exhibit No. 4, Existing Sanitary Sewer Service Areas.

The Little Ferry Treatment Plant, with an original design capacity of 20 mgd, was put into operation in 1951 upon the completion of the Authority's Overpeck Trunk Sewer. It initially served, in whole or in part, the municipalities of the Cliffside Park, Englewood, Fairview, Fort Lee, Leonia, Palisades Park, Ridgefield, Ridgefield Park, Teaneck and Tenafly. A portion of the municipality of Cresskill was connected to the Sewer Authority's System in 1957.

The Authority's Stage II improvements, the final phase of which was completed in 1964, increased the capacity of the Little Ferry Plant to 50 mgd. These improvements were necessitated as other municipalities executed contracts to have their sewage treated by the Sewer Authority. With the construction of trunk sewerage facilities along the Hackensack River in 1960, the municipalities of Bergenfield, Bogota, Dumont, Emerson, Hackensack, Little Ferry, Maywood, New Milford, Oradell, Paramus, River Edge, Rochelle Park, South Hackensack, Teterboro, and Westwood were served. The Borough of Moonachie was connected to the Sewer Authority's system in 1961.

In 1967, the municipality of Hillsdale joined the Authority. The completion of the Hasbrouck Heights Extension this same year provided for servicing Hasbrouck Heights and a small portion of the Meadowlands in the Borough of Carlstadt. Hasbrouck Heights ceased operating its municipal treatment plant in 1969.

A November 1969 Project Report prepared by Clinton Bogert Associates indicates completion of the Washington Township Extension, a trunk sewer to serve that municipality.

Since its inception, the Bergen County Sewer Authority has provided treatment and trunk facilities which have allowed discontinuing the operation of 24 separate municipal treatment plants and numerous individual industrial package plants, as well as providing service for many industrial establishments which formerly discharged their wastes with little or no treatment to the Hackensack River and its tributaries.

Reported sewerage construction in progress as of the date of this Report includes construction of Stage 1 collection facilities by the municipality of Woodcliff Lake, construction of Stages I, II, III-A and IV collection facilities in the Meadowlands by the East Rutherford Sewerage Authority, construction of Stage II collection facilities in the Meadowlands by the Carlstadt Sewerage Authority and construction of the remainder of its sewage collection system by the municipality of Park Ridge.

The Bergen County Planning Board reports that the municipalities of Closter, Demarest, Harrington Park, Hayworth, Montvale, Northvale, River Vale and Washington Township had sewage collection systems in the design stage as of March 1969.

According to the 1969 Project Report and the March 1969 Sewer Facilities Report prepared by the Bergen County Planning Board, Bergen County Sewer Authority projects in the design phase include the Northern Valley trunk extension, the Pascack Valley East trunk extension, the Pascack Valley West trunk extension, the Hackensack Valley Phase 2 trunk sewer enlargement, the Little Ferry Sewage Treatment Plant Expansion and the East Rutherford Extension.

The Bergen County Planning Board report anticipates that Washington Township and Montvale will be connected to the Sewer Authority system during 1970 and that Park Ridge, which presently has the sewage from about 600 of its citizens treated by the Authority, should be fully connected in 1971, as will be the municipality of Northvale. The municipalities of Demarest, Haworth, Norwood and River Vale are expected to join the Authority in 1972 and Closter is expected to be fully connected at that time. Harrington Park should be connected in 1973.

The Authority service district includes an area of about 115 square miles containing a resident population of approximately 660,000. At the time of this Report, the Authority was reported to be serving a tributary area of about 55 square miles and a population of approximately 480,000 persons.

In general, the developed area presently being served by the Authority is essentially residential in character and is typical of most of the development in the upper Hackensack Valley. Recent building trends have largely been in the direction of constructing high density multiple dwelling units in the more populated areas, with low density, single family units being constructed in the relatively less developed northern communities. Nevertheless, there are several large areas, as well as some portions of several municipalities within the present service area, that have been developed with industrial and commercial establishments. Although most of the waste from this type of use is discharged into the Authority's facilities by means of municipal collecting systems, the Authority has entered into separate contracts with some of these contributors.

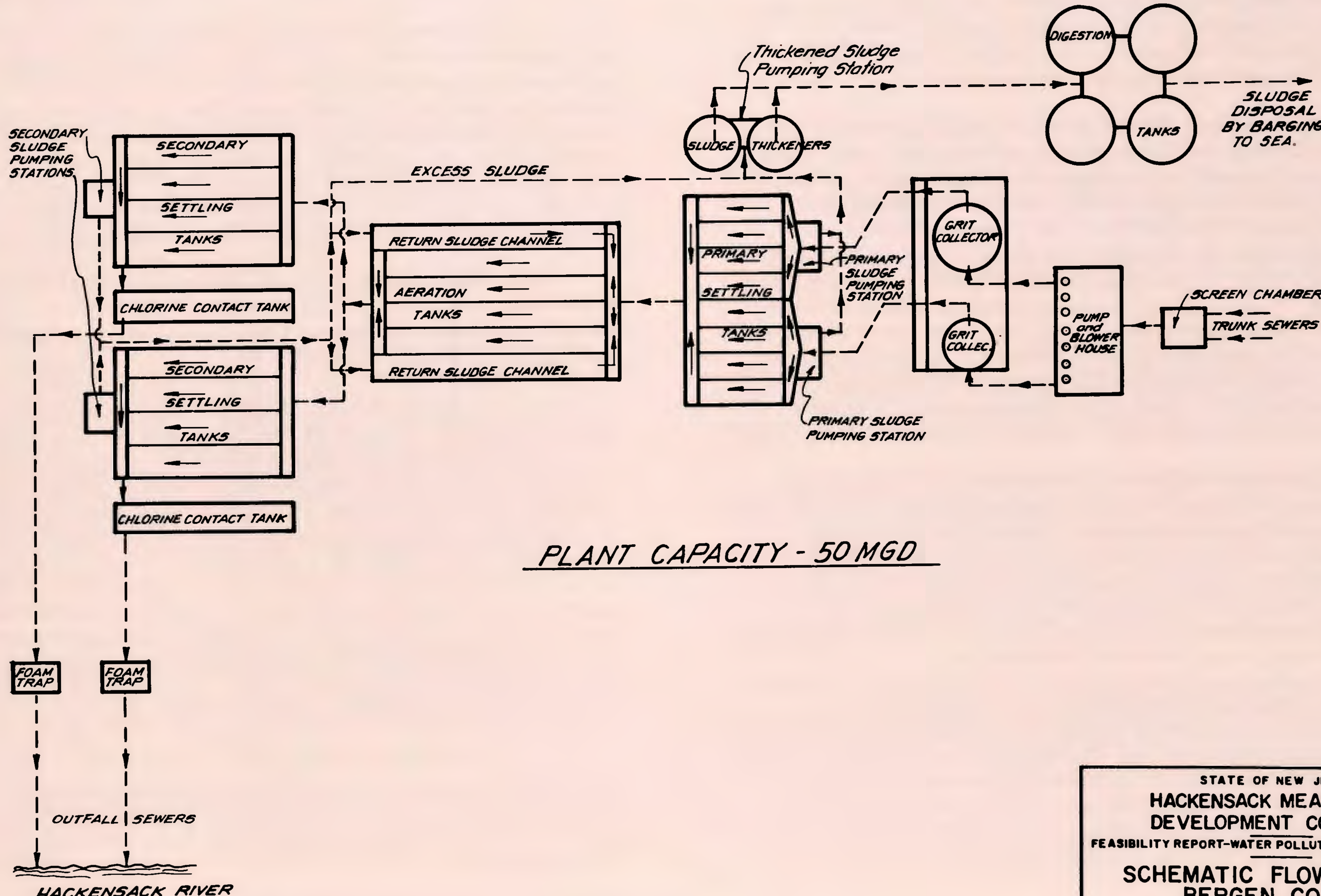
Each sewage collection system tributary to the Authority's interceptor facilities is owned, operated and maintained by the respective individual municipality. These collection systems are of the separate sanitary sewer type except for those in Englewood Cliffs, Fort Lee, Hackensack, Ridgefield Park and Palisades Park which have combined sewerage systems, and Cliffside Park, a portion of whose system is of the combined sewer type. The first four of the above listed municipal systems are equipped with regulators which bypass excessive peak storm flows. Nevertheless, storm flows at the Plant reportedly exceed those that would normally be expected to occur from facilities entirely of the separate sanitary sewer type. Hackensack and Cliffside Park have applied for Federal aid in separating their combined sewers and the municipality of Dumont has applied for Federal aid in reconstructing their existing sewerage system. The more recently installed sewerage systems are located in the municipalities of Carlstadt, Cresskill, Emerson, Hillsdale, Moonachie, Paramus, Teterboro and Westwood. The more northerly communities joining the system will have new separate sewerage collection systems since they are presently being served by individual disposal systems.

The Little Ferry Treatment Plant is fed by two major interceptor facilities. The Overpeck Trunk Sewer, constructed in 1953 to serve the Overpeck Creek Valley and a portion of the area on the east side of the Hackensack River, enters the plant from the east after crossing beneath the Hackensack River as a 60 inch diameter sewer. It reportedly has a permissible capacity of 57 mgd. The Stage II Trunk Sewer, constructed in 1960 to serve the Hackensack River Valley enters the plant from the north as a 96 inch diameter sewer. It reportedly has a permissible capacity of 185 mgd.

Major Bergen County Sewer Authority Sewers in the immediate proximity of the Meadowlands include the Hasbrouck Heights Extension Southwest Trunk Sewer and the Fairview Extension of the Overpeck Trunk Sewer.

The Hasbrouck Heights Extension Southwest Trunk Sewer discharges into the 96 inch diameter Stage II Trunk Sewer as a 48 inch diameter pipe immediately north of the treatment plant site. This 48 inch diameter sewer extends in a generally southwesterly direction through easements to the easterly terminus of Empire Boulevard and continues westerly in Empire Boulevard and Moonachie Avenue as a 48 inch diameter sewer to Commercial Avenue in the Borough of Carlstadt. It continues westerly in Moonachie Avenue as a 36 inch diameter sewer to a point immediately west of Berrys Creek. From this point, the sewer continues as a 36 inch diameter pipe in a generally northerly direction, through easements generally parallel to Berrys Creek, to the former Hasbrouck Heights Municipal Treatment Plant.

The upstream portion of the Fairview Extension of the Overpeck Trunk Sewer originates as a 21 inch diameter pipe at a point in Fairview Avenue approximately 75 feet east of Bellman Street. This sewer continues as a 21 inch diameter pipe for some 350 feet northerly through easements to a point in Bellman Street



STATE OF NEW JERSEY
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FEBRUARY 1970

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where the sewer increases in diameter to 30 inches. The trunk continues in a generally northerly and westerly direction, changes direction several times, crosses into the Borough of Ridgefield and continues in an easement along the northerly side of Wolf Creek to a point on the westerly side of the Northern Railroad of New Jersey. The line continues in a northerly direction parallel to the railroad to the Corn Products Refining Company, skirting it to the south and west, and continues westerly along and in Hendricks Causeway to discharge into the 60 inch diameter Overpeck Trunk Sewer at Victoria Terrace. The Overpeck Trunk Sewer flows some 4,000 feet in a generally westerly direction, crosses under the Hackensack River and enters the plant. The interceptor sewers pertinent to the Report are shown, to the extent data was made available, on Appendix D, Existing Sewerage Facilities.

A feasibility report prepared by the Authority's consulting engineers and submitted to the New Jersey State Department of Health states that the average flow to the present 50 mgd capacity Treatment Plant is approximately 48 mgd and is expected to exceed the present plant capacity by 1970. It further indicates that planning is under way for plant expansion to a capacity of 75 mgd which is expected to be adequate up to the year 1982.

Population data compiled in connection with the studies for expansion of the Authority plant indicate that the present residential population served by the plant is 511,100 and with the population of areas presently under negotiation to enter into service contracts with the Authority, the residential population served will soon become 552,400. Of the present plant flow, it is estimated that approximately 11% of the total flow is received from industrial and commercial sources. It is also reported that peak flows to the plant from 1961 through 1968 were from 270% to 440% of actual average flows, and up to 350% of the design flow of 50 mgd. In anticipation of high peak flows to the plant, present facilities include provision for bypassing flows which exceed 250% of average design flow. Measurements of storm flow bypassing during the 5 year period from June 1964 through July 1969 reportedly indicate that bypass flow was less than 0.3% of total flow during that period, and that the bypassing took place in five separate occurrences during the period.

Characteristics of the plant inflow sewage are reported to have averaged approximately 211 ppm BOD and approximately 292 ppm suspended solids through 1968. In view of the anticipated extensions of the Authority service area into the predominantly residential northern valley of the Hackensack River basin, the influent sewage is expected to contain somewhat lower BOD and suspended solids in the future. The industrial wastes component of the influent sewage has apparently not created unusual problems in the treatment process.

The plant presently occupies about 15 acres of a total of approximately 74 acres owned by the Authority at the plant site. The areas immediately surrounding the plant property are at present largely undeveloped.

A schematic flow diagram for the plant is shown on Exhibit No. 5I. As indicated on the flow diagram, incoming sewage is carried to the plant in 96 and 60 inch diameter interceptor sewers which enter the plant screening chambers. Two mechanically cleaned bar screens with a total capacity of 60 mgd remove large debris for protection of the raw sewage pumps. Sewage then enters the wet well beneath the pump and blower house and is lifted approximately thirty-five feet from the wet well to the grit collectors. Present pumping capacity, with one of the larger units considered to be out of service, is 150 mgd. Flows in excess of 125 mgd (250% of average design flow) are bypassed through a bypass structure on the pump discharge channel.

Grit removal and washing of the grit is accomplished in one 35 ft. diameter unit rated at 50 mgd and in a second 45 ft. diameter unit rated at 75 mgd. Disposal of grit removed from the sewage is by burial at the treatment plant site.

From the grit collectors, sewage enters the primary settling tanks. There are eight settling tanks providing a total surface area of 26,300 square feet. The tanks are equipped with longitudinal and cross sludge collectors and skimming facilities. Two primary sludge pumping stations, each contiguous to one battery of four primary settling tanks, normally transit primary sludge to the sludge thickeners or, if necessary, directly to the sludge digesters.

After primary settling, sewage flow then enters the aeration tanks which are comprised of six units with a total volume of 837,000 cubic feet. Biological treatment is accomplished here by a contact-stabilization and step-aeration process. Under normal conditions of operation, four or five of the tanks are used for contact stabilization or re-aeration of returned sludge and the remaining tanks for aeration of mixed liquor.

Following the aeration tanks, sewage enters the secondary settling tanks, eight in number, which provide a total area of 50,600 square feet. The tanks are equipped with longitudinal and cross sludge collectors and skimming equipment. Two secondary sludge pumping stations, one for each battery of four settling tanks, pump return sludge at a 25% return rate to the aeration tanks. Excess sludge is pumped to the sludge thickeners or, if necessary, may also be returned to the plant inlet.

Following chlorination after secondary settling, sewage passes through two chlorine contact tanks, one for each group of four secondary settling tanks, and is then conducted to the Hackensack River by two 72 inch outfall sewers, one from each chlorine contact tank. Total chlorine contact tank volume is 108,000 cubic feet. Each outfall sewer is provided with a foam trap which is designed to recycle foam to the plant and prevent its accumulation on the surface of the Hackensack River. Chlorination is performed by two automatic proportional feed chlorinators, each rated zero to 6,000 pounds and one chlorine evaporator rated 8,000 pounds per day. Chlorinators are automatically paced, based upon total plant flow as measured by Parshall flumes. Chlorination capacity, based upon design average flow of 50 mgd, is 38 ppm. Chlorination is presently performed from May 15th through October 15th of each year.

The sludge thickeners, which receive primary and excess secondary sludge, consist of two 65 foot diameter units having a total surface area of 6,630 square feet. Elutriation and manual screening of the sludge, the latter having been installed as an innovation during plant operation, are employed at the inlet to the sludge thickeners. It is reported that approximately 40% more screenings than removed by the raw sewage bar screens are thus obtained from the sludge and these screenings are also buried on-site. A thickened sludge pumping station contiguous to the sludge thickeners transports sludge averaging 5% to 8% solids to the four sludge digestion tanks.

The digesters are each equipped with a floating cover and gas recirculation equipment. Total volume of the four digesters is 643,000 cubic feet. Initially, sludge disposal was accomplished by lagooning in an area adjacent to the treatment plant. However, in May of 1967, lagooning was abandoned and disposal of sludge by barging and dumping at sea was commenced and is practiced to date. Permanent facilities for maintaining the barging operations are presently under construction to replace the temporary facilities pressed into service in 1967. The permanent facilities will consist of two 100 foot diameter sludge storage tanks with a total volume of 334, 000 cubic feet, a sludge pumping station and barge docking facilities suitable for a 6, 000 ton sludge barge. The Authority expects that these new barging facilities will be adequate for a plant flow of 75 mgd.

It may be noted that the present secondary treatment process consisting of a contact-stabilization type of activated sludge with step-aeration was developed by in-plant experimentation prior to expansion of the plant to its present 50 mgd capacity. The initial treatment process employed in the initial 20 mgd plant was one of the conventional activated sludge type.

An inspection of the treatment plant in November 1969 indicated that the plant is generally well run and maintained. Process control appears to be closely maintained through the use of adequate plant laboratory facilities.

From plant operating data contained in their consulting engineer's feasibility report on the proposed plant expansion to 75 mgd, it is noted that BOD of the plant effluent, during the period from January 1966 through July 1969, was an average of 28 ppm, with a monthly high of 43 ppm (in 1968) and a low of 15 ppm (in 1966). BOD values of 40 ppm were reported for three months consecutively during this period. Similarly, plant effluent suspended solids averaged 32 ppm during the same period, with a monthly high of 48 ppm (in 1967) and a low of 20 ppm (in 1966). No pollution abatement orders have been issued to the Authority by the New Jersey State Department of Health for inadequate treatment or other cause.

The proposed plant expansion to a 75 mgd capacity was proposed as a two stage construction program, the first stage of which would increase plant capacity to 62.5 mgd, the estimated requirement for the year 1972, and the second stage would accomplish the final planned increase to a capacity of 75 mgd. The first stage of construction would consist generally of an increase in raw sewage pumping capacity within the existing pump house to 230 mgd and the addition of four secondary settling tanks, a secondary sludge pumping station, chlorination facilities, a chlorine contact tank, an outfall sewer with foam trap, two sludge thickeners, a thickened sludge pumping station and miscellaneous improvements. The second stage of construction would consist of the addition of a screen chamber, a pump house providing additional capacity of 180 mgd or a total firm capacity of 300 mgd with the largest pump in each pump house out of service, a primary sludge pumping station, a blower house, a grit collector, four primary settling tanks and four aeration tanks.

The new plant units would generally be of the same type and size as existing plant units, and would be designed to treat an average flow of 25 mgd and be hydraulically capable of handling at least 250% of design flow. It is proposed that peak flows in excess of 250% of design flow continue to be bypassed to the Hackensack River. The average domestic sewage flow rate which was used for estimating design flows is 100 gallons per capita per day based on records of plant flows to date. The average commercial and industrial flow rate is estimated at 2, 500 gallons per acre per day.

20. Public Service Electric and Gas Company, Bergen Generating Station, Ridgefield

Hackensack River - Mile 13.4

The Bergen Generating Station is located on a promontory southeast from the confluence of Overpeck Creek and the Hackensack River, at the foot of Victoria Terrace.

Most of the station facilities are located to the west of the New Jersey Turnpike and to the east of the New York, Susquehanna and Western Railroad. In their 1966 preliminary report, the Public Health Service of the Department of Health, Education and Welfare stated that this facility had a rated capacity of 600,000 kilowatts.

A review of the records of the New Jersey State Department of Health indicates that waste water treatment consists of approximately the same process as was heretofore described in detail for the Hudson Generating Station of the Public Service Electric and Gas Company in Jersey City. The Bergen Generating Station employs pH adjustment and some incidental settling in a waste water basin for the basic treatment process, with no chlorination provided. There is no indication that aeration for mixing purposes is employed as it is at the Hudson Generating Station.

It appears that the same basic types of wastes are produced at the Bergen Generating Station as at the Hudson Generating Station, these being acid and alkaline in nature. The greater portion of the flow from the Bergen Generating Station is also comprised of cooling water which in this case is taken from Overpeck Creek and discharged into the Hackensack River at a point downstream from its confluence with Overpeck Creek. This discharge constitutes a potential source of thermal pollution of the river. The quantity of cooling water discharged has been estimated to be approximately 600 mgd, including approximately 0.15 mgd of acid and alkaline wastes. With reference to the effect of the discharge of cooling water from this plant, the aforementioned Public Health Service Report indicated that the water in the Hackensack River in the immediate area of the outfall was raised in temperature from 4 to 7 degrees centigrade and that higher temperatures than that of normal river water persist for a distance of approximately 1.5 miles upstream and downstream from the point of discharge. No effects were noted due to the discharge of the acid waste.

Although no formal pollution abatement orders have been issued to this facility by the New Jersey State Department of Health, the Department's records indicate that the Bergen Generating Station has received notice of deficiencies in the plant effluent waters consisting of excessive COD, suspended solids, settleable solids and turbidity. Departmental surveillance records indicate a generally satisfactory level of plant maintenance.

C. Other Sources of Pollution

1. Industrial, Commercial and Municipal

The New Jersey State Department of Health, in its continuing efforts to upgrade and maintain the water quality of the streams of the State, has extended its inspection and surveillance procedures in the Hackensack River watershed to include some of the industrial establishments not heretofore made subject to inspection.

Bergen County, through its engineering staff and its Health Department personnel, in conjunction with the State Department of Health, has also been conducting inspections and surveys of the Hackensack River, particularly in the area between the Meadowlands and the Oradell Dam.

Beginning in the Summer of 1968 and continuing to the present, the Health Departments have been surveying and testing individual industrial establishments which, although sometimes connected to sanitary sewers or septic tanks for domestic waste, discharge their industrial wastes directly or indirectly into water courses by means of discharge into storm drainage systems or into drainage courses, all of which ultimately empty into the River.

At some of these industrial plants, an attempt is made to control the level of wastes through the use of some type of treatment, usually primary settling tanks or lagoons. Unfortunately, the greater number of the plants surveyed appear to furnish no treatment of any type.

The New Jersey State Department of Health requested the Hudson-Delaware Basin Office of the Federal Water Pollution Control Administration to aid in their inspection program. Consequently during 1969 a total of nineteen plants, some being the same ones surveyed by the State Department of Health, were visited for the express purpose of discussing the industrial wastes created by these industrial operations as they relate to pollution of the Hackensack River Basin. The manufacturing procedures, raw materials and waste streams were discussed and evaluated. A significant number of the establishments surveyed by the Federal Water Pollution Control Administration have indicated their willingness to connect to waste treatment facilities, either existing or proposed.

Table 2 is a compilation of data from the test reports made by the New Jersey State Department of Health on a number of industrial establishments having diverse end products, within the Hackensack River watershed. The tabulation shows the number of times tests were made for various parameters and the number of times each parameter was exceeded when compared to workable standards established by the State Department of Health. Test sample results shown in the table were from isolated grab samples and as such did not provide a quantitative description of the total amount of pollutant being discharged into the water course. However, it is significant to note that in general, tests of the grab samples taken show a consistent pattern of being above the limits used by the New Jersey State Department of Health for industrial wastes being discharged into streams.

Table 3 is a compilation of data extracted from a report of a survey conducted by the Bergen County Health Department entitled "Hackensack River Water Quality Survey Project", dated October 27, 1969. This report cites the existence of approximately one hundred outfall pipes and tributaries leading into the Hackensack River between the proposed Bergen County Dam site near the Midtown Bridge in the City of Hackensack and the Oradell Dam. According to the report, records were kept of all one hundred possible sources of pollution to determine their degree of activity during tidal action. All active sources were tested, where applicable, for presence and quantity of coliform bacteria, biochemical oxygen demand (B. O. D.), chemical oxygen demand (C. O. D.), Ether Solubility, pH, dissolved oxygen, temperature, color and odor. This table is arranged to indicate conclusions drawn from the results of tests of samples taken from the positive sources of pollution, numbering fifteen, categorized as to bacterial, chemical, industrial, thermal and aesthetic. The general location of the fifteen sources are depicted on Exhibit No. 6, Hackensack River Water Quality, and are cross referenced to Table 3.

The intent of Table 2 and Table 3 is to signal the total problem of pollution emanating from industrial and other establishments and not to impute the specific establishments tabulated herein.

TABLE 2

SOURCES OF INDUSTRIAL WASTES POLLUTION

(INFORMATION SOURCE - NEW JERSEY STATE DEPARTMENT OF HEALTH)

TEST RESULTS (2-4 DENOTES THAT 2 OF 4 SAMPLES TESTED EXCEEDED TEST CRITERIA)

INDUSTRY IDENTIFICATION	LOCATION	POLLUTION CONTROLS	RECEIVING STREAM	NO. OF SAMPLES TAKEN	EST. DISCH. M.G.D.	B.O.D.	C.O.D.	S.S.	pH	CN	Eth. Sol.	Phenol	T.S.	S. Ash	T. Ash	Det.	Chr. H.	Chr. T.	Cu.	Turb.	Color	Odor	NO_3	NH_3	PO_4	COMMENTS BY HEALTH DEPT. INSPECTOR
Carlton-Cooke Plating Co.	Carlstadt	Cooling Tank - Limestone Pit	Pond to Berrys Creek	3	0.20		0-3	3-3	2-3	3-3			1-2							3-3	3-3	1-3				
Airwick Industries Inc.	•	None	Ditch to Berrys Creek	1		0-1	1-1	0-1	0-1																	
Grobet File Corp. of America, Inc.	•	Cesspools	Berrys Creek	0																						
Fred Heinzman & Sons, Inc.	•	Lagoon	Ditch to Berrys Creek	1	0.02	0-1	0-1	0-1	0-1	*1-1																Industrial wastes to lagoon, no discharges. *Cooling water to ditch sampled (28°C)
Interchemical Corp.	•	Lagoon	Ditch to Berrys Creek	2		1-1	2-2	1-2	1-2		2-2	2-2									2-2	2-2				
Penn Anodizing Corp.	•	None	Berrys Creek	1		0-1	0-1	0-1	0-1																	
Diamond Shamrock Corp. - Nopco Chemical Co.	•	Lagoon	Ditch to Berrys Creek	4		0-4	4-4	2-4	3-4		2-2	3-3	1-1							2-4	4-4	3-4				Under orders
New Jersey Refining Co.	E. Rutherford	None	Ditch to Berrys Creek	2	0.25	0-2	1-2	0-1	0-2																	Oil in ditch
Yoo-Hoo Beverage Co.	Carlstadt	None	Berrys Creek	1		1-1	1-1														1-1					Plans to connect to Carlstadt Sewer Authority.
Tony's Truck Stop	•	None	Berrys Creek	1			1-1	1-1								1-1				1-1						
Armour Coated Products & Adhesives	E. Rutherford	None	Swamps of Berrys Creek	1	0.05	0-1	1-1	1-1	1-1		1-1									1-1	1-1	1-1				
DuBois Chemical Div. of W.R. Grace Co.	•	2 Settling Tanks	Storm Sewer	4		2-2	3-4	3-4	3-4		2-3	2-2	2-3	3-3	2-2	3-3				3-4	4-4	4-4				Settling tanks on 1 of 2 discharge pipes to Storm Sewer.
Becton Dickinson & Co.	•	None	Storm Sewer	1		1-1	1-1	0-1	1-1		1-1										1-1	1-1				
Top Notch Metal Finishing Co.	•	None	Swamp to Berrys Creek	3		0-1	1-3	2-3	1-3				1-2				3-3	1-3	1-3		3-3					
Olin Mathieson Gas Products	•	None	Berrys Creek	1	0.05	0-1	0-1	0-1	0-1																	
Humble Oil & Refining Co.	Hackensack	None	Tributary to Hackensack River	0																						Possible for dumped or spilled oils to enter stream and/or storm sewer.
Diamond Shamrock Co.	Kearny	None	Hackensack River	3	0.05	0-1	1-2	2-2	2-3		0-2	1-2	1-1	0-2			2-2	0-2		1-1	2-3					
Spotless Car Wash	Hackensack	None	Hackensack River	1	0.02		1-1	1-1	0-1		1-1			0-1		1-1				1-1	1-1	0-1				
Standard Chlorine & Napthalene	Kearny	Unknown	Hackensack River	0																						
Benedict Miller, Inc.	Lyndhurst	None	Berrys Creek	1		0-1	0-1	0-1	0-1		0-1									0-1	0-1	0-1		0-1	0-1	
Refined-Onyx Div. of Millmaster Onyx Corp.	•	Equalization Basin & Skimmer	Berrys Creek	2	0.05	2-2	2-2	1-1	1-1	0-2	2-2	0-1	0-1	0-1		1-1		1-1	0-1	2-2	2-2	2-2				
Concrete Specialties	•	None	Berrys Creek	1	0.05	0-1	1-1	0-1	1-1		1-1			0-1						0-1	0-1	0-1	0-1		0-1	
Tanatex Chemical Corp.	•	None	Hackensack River	1		0-1	1-1	0-1	0-1					0-1		0-1				0-1	0-1	0-1				Floor drain
President Container Co.	Moonachie	None	Tributary to Berrys Creek	2		1-1	1-1	2-2	2-2		2-2	1-2		0-1						2-2	1-1	1-1				Samples from 1 of 3 pipes
F & B Metal Plating Co.	•	None	Tributary to Berrys Creek	4	0.05	0-3	1-3	3-3	3-3	3-3			2-2	1-3	2-2		0-4	0-4		3-3	3-3	3-3	0-3	0-3		Sanitary wastes to municipal sewer. Industrial to tributary
Concrete Plank Co., Inc.	N. Arlington	None	Berrys Creek	1	0.10		1-1	1-1	1-1					0-1						1-1	1-1	1-1	0-1	0-1	1-1	
Superior Bearing Bronze Co., Inc.	Moonachie	Unknown	Not indicated	1		1-1	1-1	1-1	0-1	0-1				0-1			0-1	0-1	0-1	1-1	1-1	0-1	0-1	0-1		Sample from pipe at top of septic tank
Public Service Bus Co.	Oradell	None	Hackensack River	3	0.10	0-1	2-3	3-3	2-3		3-3	0-2	0-1	1-3		1-1				3-3	2-2	2-2				Oil flow from repair shop to river. Oil on river surface.
Lincoln Paper Co.	Ridgefield Park	Unknown	Overpeck Creek	1			1-1	1-1	0-1				1-1	0-1	0-1					1-1					0-1	40°C Sample from ditch
Arnsco Wire Products Co., Inc.	Ridgefield	None	Tributary to Overpeck Creek	0																						Ditch coated with oil and floc material.
Spinnerin Yarn Co., Inc.	S. Hackensack	Unknown	Tributary to Berrys Creek	1	0.07	1-1	0-1	1-1	0-1					0-1						1-1	0-1	0-1	0-1	0-1		33°C (Fe 0-1)(CL 0-1)
Cayauga Pumping Station - Hudson Co. Mosquito Control Comm.	Kearny	None	Hackensack River	0	36to5.0																					Interior land area drainage with variable characteristics. (Intermittant discharge)
Navigation & Control Div. Bendix Corp.	Teterboro																									

TEST RESULTS LEGEND

B.O.D.	Biochemical Oxygen Demand	T.S.	Total Solids	Turb.	Turbidity
C.O.D.	Chemical Oxigen Demand	S. Ash	Ash of suspended solids	Color	Color
S.S.	Suspended Solids	T. Ash	Ash of total solids	Odor	Odor
pH	Hydrogen - Ion Concentration	Det.	Detergents	NO_3	Nitrate
CN	Cyanide	Chr. H.	Hexavalent chromium	NH_3	Ammonia
Eth. Sol.	Ether soluable	Chr. T.	Trivalent chromium	PO_4	Phosphate
Phenol	Phenol	Cu.	Copper		

TABLE 3

SOURCES OF POLLUTION – HACKENSACK RIVER
HACKENSACK TO ORADELL

(INFORMATION SOURCE – BERGEN COUNTY HEALTH DEPARTMENT)
OCTOBER 1969

NO.	POLLUTION SOURCE	MUNICIPAL LOCATION	HACKENSACK RIVER OR TRIBUTARY MILE	POLLUTION CATEGORY
			HACKENSACK RIVER	
1	Hackensack Municipal Sewage Pumping Station	Hackensack	17.4	Bacterial
2	Spotless Car Wash	Hackensack	17.4	Chemical
3	Holly's (Restaurant)	Hackensack	18.2	Aesthetic
4	Bridgeway Friendly Service (Service Station)	Hackensack	18.2	Bacterial
5	Teaneck Municipal Dog Pound	Teaneck	19.2	Bacterial
6	New Milford Municipal Sewer (Leak)	New Milford	20.5	Bacterial
7	Public Service Coordinated Transport	Oradell	21.2	Industrial
			EAST BRANCH	
8	Hackensack Water Co.	New Milford	0.1	Thermal
9	Hackensack Water Co.	New Milford	0.2	Aesthetic
10	Hackensack Water Co.	New Milford	0.3	Aesthetic
11	Bergen County Sewer (Access Manholes)	New Milford	0.4	Bacterial
			COLES BROOK	
12	Compressor and Rock Service Co.	Hackensack	0.1	Industrial
13	Karkleen Car Wash	Hackensack	0.2	Chemical
14	Old Dominion Tavern	Hackensack	0.4	Bacterial
15	Intercity Bus Terminal and Garage	Maywood	2.2	Industrial

TABLE 3A

ESTIMATED B. O. D. LOAD FROM MUNICIPAL DISCHARGES AND COMBINED SEWER OVERFLOWS

Taken from Table B-1 of:

"An Evaluation of the Significance of Combined Sewer Overflows in The Hudson River Enforcement Conference Area", June 1969.

Estimated B. O. D. Load from Municipal Discharges
Hudson River Conference Area

Municipal Sewerage System	Estimated Population Served	Treatment Plant Capacity MGD and Type	Average Dry Weather Flow MGD	Municipal Discharge B. O. D. Load	
				Present, Million Lbs/Yr.	Future, Million Lbs/Yr.
Bayonne	74, 000	20 (Primary)	8	2. 99	. 459
Jersey City-West Side	110, 000	36 (Primary)	15. 7	4. 45	. 683
Kearny	32, 100	4 (Primary)	3. 2	1. 29	. 199

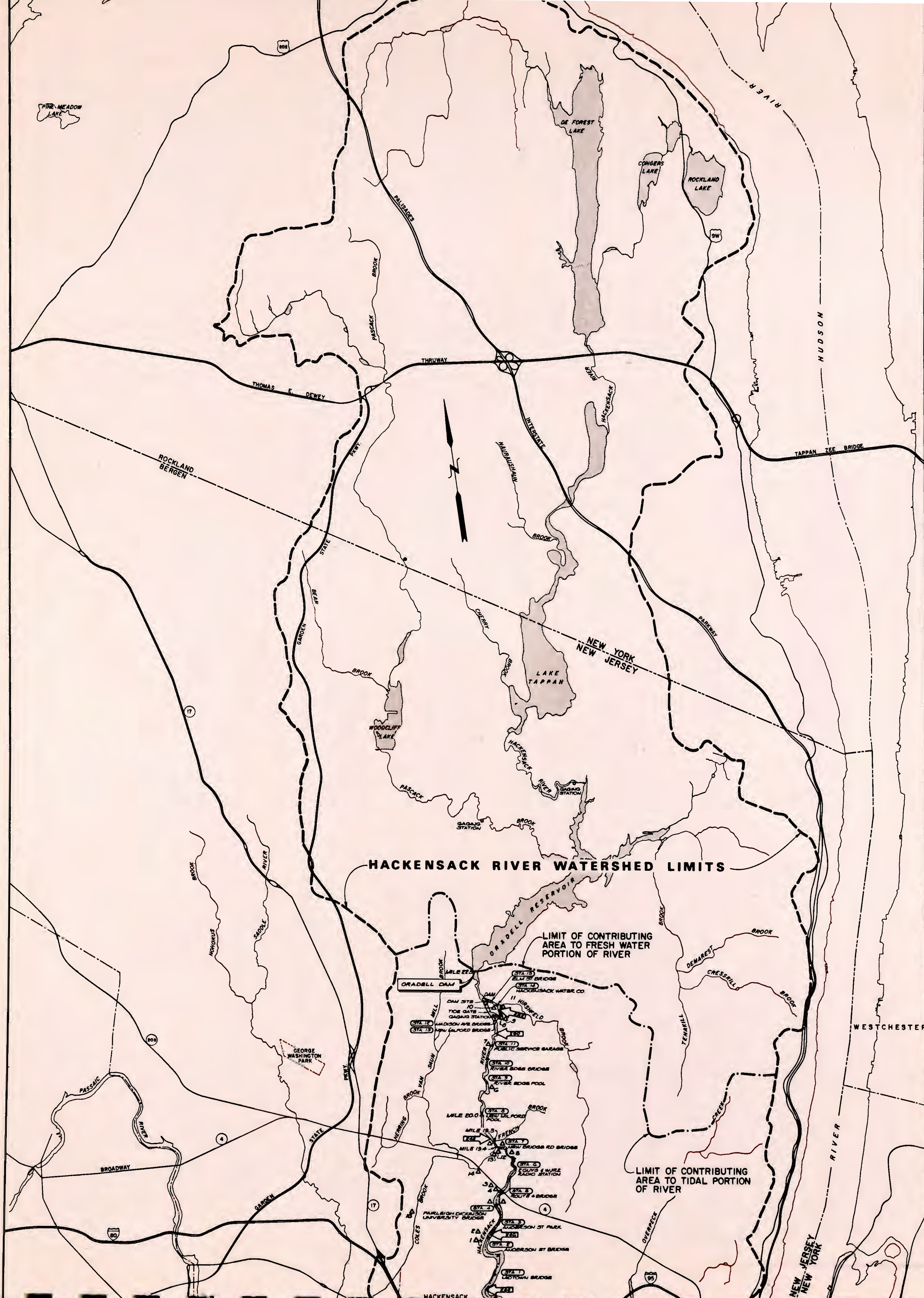
Future B. O. D. loads were calculated on the assumption that all wastes will receive an average of 90 percent removal of B. O. D.

Taken from Table B-2 of:

"An Evaluation of the Significance of Combined Sewer Overflows in The Hudson River Enforcement Conference Area", June 1969.

Estimated B. O. D. Load from Combined Sewer Overflows
Hudson River Conference Area

Combined Sewer Systems	Area Served (Acres)	Population Density (persons/acre)	Runoff Coefficient (Percent)	Average Storm Intensity (in. /hr.)	Combined Sewer Overflow (MGD)	Combined Sewer B. O. D. Load Million Lbs/Yr.	
						Present	Future
Bayonne	1, 260	58. 7	40	. 076	12. 7	. 340	. 340
Jersey City-West Side	4, 470	24. 6	40	. 063	52. 3	1. 745	1. 745
Kearny	1, 692	19. 0	40	. 063	26. 7	. 237	. 237



PINE MEADOW LAKE
DE FOREST LAKE
CONGERS LAKE
ROCKLAND LAKE
9W
HUDSON RIVER
PALISADES
PASCACK BROOK
THRUWAY
THOMAS E. DEWEY
TAPPAN ZEE BRIDGE
INTERSTATE
HACKENSACK RIVER
NAURAUSHAUN BROOK
ROCKLAND
BERGEN
GARDEN STATE PKWY.
BEAR BROOK
CHERRY BROOK
NEW YORK
NEW JERSEY
LAKE TAPPAN
PARKWAY
WOODCLIFF LAKE
17
HACKENSACK RIVER
GAGING STATION
PASCACK BROOK
GAGING STATION
HACKENSACK RIVER WATERSHED LIMITS
ORADELL RESERVOIR
LIMIT OF CONTRIBUTING AREA TO FRESH WATER PORTION OF RIVER
MILE 22.5
ORADELL DAM
STA 15 ELM ST BRIDGE
STA 14 HACKENSACK WATER CO.
DAM
DAM SITE
10
TIDE GATE
GAGING STATION
11
HIRSHFELD BROOK
STA 12 MADISON AVE BRIDGE
STA 13 NEW MILFORD BRIDGE
STA 11 PUBLIC SERVICE GARAGE
RIVER
STA 10 RIVER EDGE BRIDGE
STA 9 RIVER EDGE POOL
MILL BROOK
SAUN VAN BROOK
HERRING BROOK
MILE 20.0
STA 8 NEW MILFORD POOL
FRENCH BROOK
MILE 19.5
STA 7 NEW BRIDGE RD BRIDGE
MILE 19.4
STA 6 2 GUYS & WJRZ RADIO STATION
STA 5 ROUTE 4 BRIDGE
STA 4 FAIRLEIGH DICKINSON UNIVERSITY BRIDGE
STA 3 ANDERSON ST PARK
STA 2 ANDERSON ST BRIDGE
STA 1 MIDTOWN BRIDGE
HACKENSACK
COLES BROOK
DEMAREST BROOK
CRESSKILL BROOK
TENAKILL BROOK
WESTCHESTER
CREEK
LIMIT OF CONTRIBUTING AREA TO TIDAL PORTION OF RIVER
OVERPECK
RIVER
NEW JERSEY
NEW YORK
HOHOKUS BROOK
SADDLE RIVER
GEORGE WASHINGTON PARK
208
PASSAIC RIVER
BROADWAY
GARDEN STATE PKWY.
4
80
95

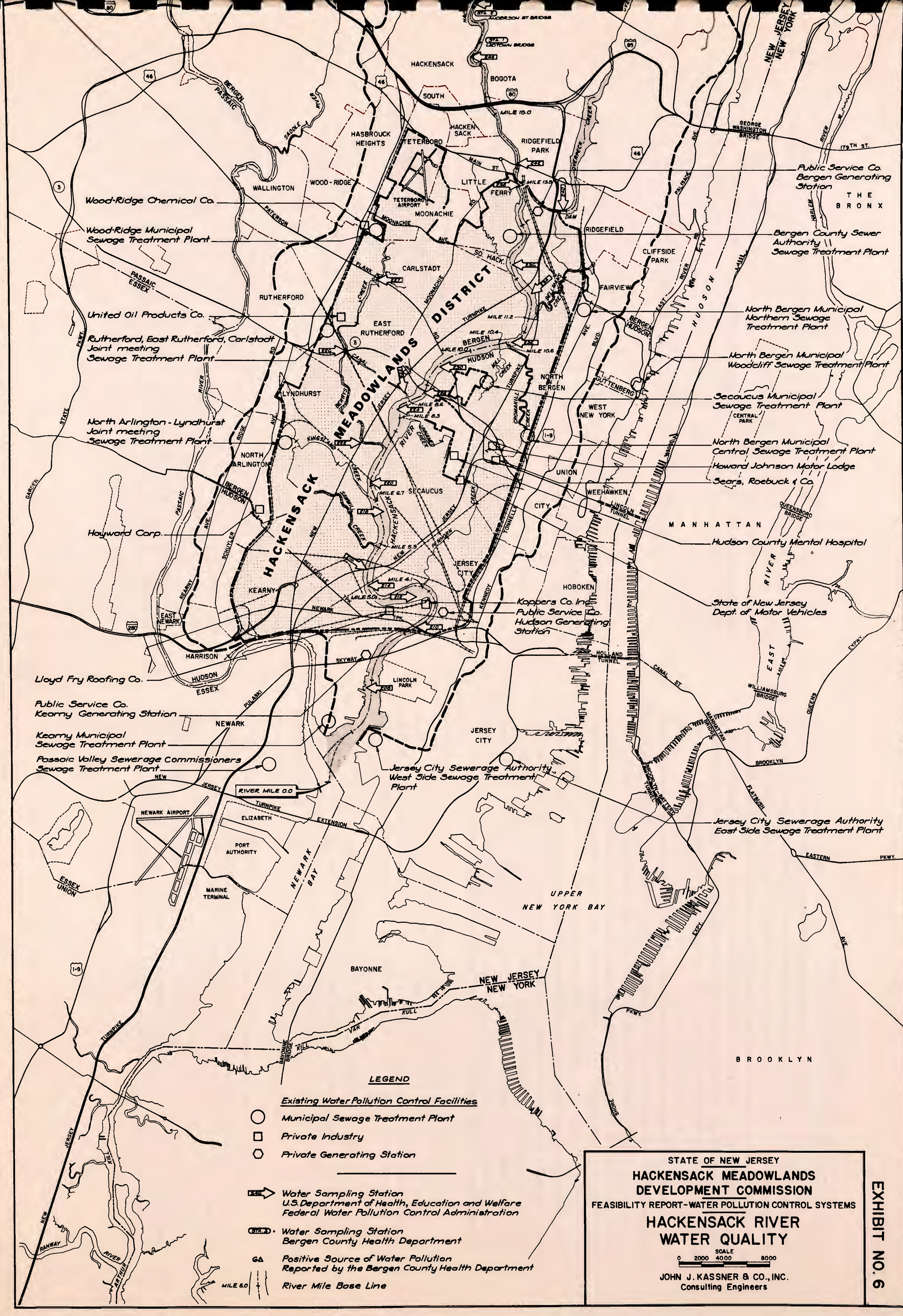

HACKENSACK MEADOWLANDS DISTRICT
Wood-Ridge Chemical Co.
Wood-Ridge Municipal Sewage Treatment Plant
United Oil Products Co.
Rutherford, East Rutherford, Carlstadt Joint meeting Sewage Treatment Plant
North Arlington - Lyndhurst Joint meeting Sewage Treatment Plant
Hayward Corp.
Lloyd Fry Roofing Co.
Public Service Co. Kearny Generating Station
Kearny Municipal Sewage Treatment Plant
Passaic Valley Sewerage Commissioners Sewage Treatment Plant
Jersey City Sewerage Authority West Side Sewage Treatment Plant
RIVER MILE 0.0
Public Service Co. Bergen Generating Station
Bergen County Sewer Authority Sewage Treatment Plant
North Bergen Municipal Northern Sewage Treatment Plant
North Bergen Municipal Woodcliff Sewage Treatment Plant
Secaucus Municipal Sewage Treatment Plant
North Bergen Municipal Central Sewage Treatment Plant
Howard Johnson Motor Lodge
Sears, Roebuck & Co.
Hudson County Mental Hospital
State of New Jersey Dept. of Motor Vehicles
Koppers Co. Inc.
Public Service Co. Hudson Generating Station
Jersey City Sewerage Authority East Side Sewage Treatment Plant
HACKENSACK
BOGOTA
SOUTH HACKENSACK
HASBROUCK HEIGHTS
TETERBORO
RIDGEFIELD PARK
LITTLE FERRY
WALLINGTON
WOOD-RIDGE
MOONACHIE
RIDGEFIELD
CLIFFSIDE PARK
FAIRVIEW
CARLSTADT
RUTHERFORD
EAST RUTHERFORD
LYNDHURST
NORTH ARLINGTON
NORTH BERGEN
WEST NEW YORK
SECAUCUS
UNION CITY
WEEHAWKEN
HOBOKEN
JERSEY CITY
KEARNY
EAST NEWARK
HARRISON
NEWARK
BAYONNE
MANHATTAN
THE BRONX
BROOKLYN
NEWARK AIRPORT
PORT AUTHORITY
MARINE TERMINAL
ELIZABETH
NEWARK BAY
UPPER NEW YORK BAY
HUDSON RIVER
EAST RIVER
KILL VAN KULL
NEW JERSEY
NEW YORK
GEORGE WASHINGTON BRIDGE
HOLLAND TUNNEL
LINCOLN TUNNEL
MILE 15.0
MILE 13.8
MILE 11.2
MILE 10.4
MILE 10.0
MILE 10.6
MILE 8.6
MILE 8.3
MILE 6.7
MILE 5.9
MILE 4.1
MILE 5.0
LEGEND
Existing Water Pollution Control Facilities
Municipal Sewage Treatment Plant
Private Industry
Private Generating Station
Water Sampling Station
U.S. Department of Health, Education and Welfare
Federal Water Pollution Control Administration
Water Sampling Station
Bergen County Health Department
Positive Source of Water Pollution
Reported by the Bergen County Health Department
River Mile Base Line
STATE OF NEW JERSEY
HACKENSACK MEADOWLANDS
DEVELOPMENT COMMISSION
FEASIBILITY REPORT-WATER POLLUTION CONTROL SYSTEMS
HACKENSACK RIVER
WATER QUALITY
SCALE
0 2000 4000 8000
JOHN J. KASSNER & CO., INC.
Consulting Engineers

EXHIBIT NO. 6

2. Storm Sewer Flows

In urban areas, heavy precipitation produces storm water runoff which is a hazard and hindrance to pedestrian and vehicular movement. A system of pipes, appurtenances and structures collects that portion of the precipitation which flows over the ground surface during and after a storm, and carries it to a safe point of discharge. This arrangement of piping, usually referred to as a storm drainage system, generally discharges to the nearest local watercourse.

Only within relatively recent times have storm water flows, coupled with urban street runoff, been recognized as a pollution source of significance. These flows, resulting from precipitation, street washings, lawn watering fire fighting and other domestic and public maintenance activities, carry tars, oils, greases, animal excrement, road salts, fertilizers, chemicals from weed and insect control, soot, fly ash, and other products developed within and deposited on the roads and streets of our urban ecosystem. Recent studies have shown that there are significant quantities of inorganic solids, organic matter both in suspended and dissolved form and even high counts of coliform bacteria in storm water runoff. All of these constituents are detrimental to water quality in the receiving watercourse.

Within the Hackensack River basin, presently built up areas contribute all of these pollutants and contaminants. In addition, because of the use of the Meadowlands as a site for dumping of refuse and industrial wastes, where storm waters can flow over and through the waste accumulations, there are added leached pollutants which adversely affect the water quality. Industrial wastes may be discharged into and carried through existing storm water drains to the tidal portion of the Hackensack River. These discharges compound the problems and degrade both the biologic and aesthetic quality of the receiving watercourse.

Anticipated quantities of storm water runoff may be computed through the use of acceptable empirical parameters. However, the quality of the runoff, the kinds of wastes, their strengths and their effects on the receiving watercourse, cannot be assessed at this time. The amount of test data is still small and not statistically consistent to permit empirical design parameters to be quoted. Only through continued sampling, testing and surveillance will specific values be developed.

Factual data as to the quality of storm water and urban runoff for the Meadowlands District is not available, nor can future values be predicted. Similarly, the specific effects of these pollutants on the Hackensack River cannot be given a quantitative value. Consequently, recognition of the fact that storm sewer flows are yet another source of pollution of the Hackensack River must suffice at this time.

3. Combined Sewer Overflows and By-pass Discharges

Combined sewers are those systems of pipes and appurtenances intended to receive both wastewater and storm runoff water. Many communities throughout the United States, and in fact throughout the world, have such combined sewerage systems. Combined systems, constructed for the sake of economy, before the seriousness of river pollution was fully understood, are generally found in older municipalities.

As the detrimental effects of untreated sewage on receiving water courses became a recognized fact, and became intolerable from both health and aesthetic aspects, treatment facilities were constructed. However, it is not economically feasible to treat all of the combined wastewater, that is domestic and industrial wastes combined with storm water runoff, at treatment plants. Consequently combined sewers were provided with storm overflow provisions or relief sewers to carry the excess storm flow from a combined sewer to an independent outlet. Many combined sewers are equipped with flow regulators or by-passes which permit only a predetermined amount of combined wastewater to enter a treatment facility, thus preventing the safe maximum capacity of the treatment facility from being exceeded.

A generally accepted engineering design parameter has been to size sewerage systems to handle combined flows of up to three times the dry weather flow. When this rate of flow is exceeded the combination of sewage and storm water is diverted through regulators and by-passes to the receiving water. Overflow, which can occur as often as once a week during the summer months, results in substantial organic loadings being discharged to the receiving water. Combined sewer overflows are a direct source of pollution of water courses since diluted raw sewage, together with surface water run-off are being discharged to water courses during periods of precipitation. Storm water overflows tend to negate the benefit the expensive and worthwhile treatment that complete sewage treatment plants have been constructed to accomplish.

In addition to regulated overflows, sewerage systems that require pumping stations are usually equipped with by-passes. A by-pass is an arrangement of pipes which permits flow to be diverted around an hydraulic structure as a protective measure. The by-pass flow is usually discharged directly to a local water course.

Similarly, sewage treatment plants are equipped with by-passes to protect the installation from inundation or from conditions of "flow-through" which result in the reduction or elimination of effective treatment. Treatment plant by-passes may also be activated during malfunctions of the facility which requires the elimination of flow from the plant during time of repair.

The Hackensack River is subjected to pollution from sewage pumping station and treatment plant by-passes, and from regulated combined sewer overflows. It is reported that combined or partially combined sewerage systems presently exist in the municipalities of Englewood Cliffs, Fort Lee, Hackensack, Ridgefield Park, Palisades Park, Cliffside Park, Jersey City, North Bergen and Kearny, all of which discharge combined sewer overflows into the Hackensack River or its tributaries.

In a report entitled "An Evaluation of the Significance of Combined Sewer Overflows in the Hudson River Enforcement Conference Area" prepared by United States Department of the Interior, Federal Water Pollution Control Administration, Northeast Region, Hudson-Delaware Basin Office, dated June 1969, the problem of combined sewers in the Newark Bay-Kill Van Kull area is discussed, as are seven other areas. The report comments: "Overflows from combined sewer collection systems can create pollution problems. The extent of these problems in the Hudson River Conference area are not known. Studies have been carried out in other areas to evaluate the quality of combined sewer overflows, and to a lesser extent, their effect on the receiving water. The purposes of this study are to review briefly the work already done, assess the problem as it relates to the Hudson River Conference Area and offer suggestions to the conferees regarding a solution to the problem."

The report explains that since by-passes and combined sewer system overflows are a mixture of sanitary wastewater and stormwater, such diversions result in the discharge of untreated wastes to the stream. Overflows also flush out any organic matter which may have accumulated in the collection system during the dry weather, low flow periods. This phenomenon is one of the many factors responsible for substantial organic loading of streams during storms. There have been few studies conducted which provide information on the quantity and quality of overflow from either combined sewers or separate stormwater systems. The limited studies show that the quality of both combined sewer overflows and stormwater runoff is highly variable and dependent on the particular characteristics of an individual drainage or catchment area. Data collected in one area are not generally applicable to areas of similar or different characteristics.

From the data collected it appears that the combined sewer overflow from developed areas could be expected to be an estimated 11% of the total municipal load, but in the area of Newark Bay-Kill Van Kull, the combined sewer overflow was found to be approximately one third of the total municipal load. This is due to the large metropolitan service area which is characterized by dense urban development having generally high runoff coefficients which increases the runoff and the number and severity of the combined sewer overflows. At the same time, in this urban area, there is a significant reduction of the municipal waste discharge load through the use of waste water treatment facilities.

The actual values derived for estimated B.O.D. loads for combined sewer overflows for the Newark Bay area is 30% of the municipal discharge, or 3,185,000 pounds per year. The total B.O.D. load from the four (4) combined sewer systems tributary to the Newark Bay area is 10,550,000 pounds per year.

Overflows from combined sewers contain suspended solids which are normally found in municipal sewage and also contain accumulated solids that have settled in sewers and are flushed out during periods of storm flow. This material constitutes a portion of the B.O.D. contained in combined sewer overflows. These suspended solids increase the turbidity of the receiving waters and may settle to form benthic deposits which exert an effect on the D.O.

Combined sewer overflows have been found to contain densities of coliform organisms comparable to densities present in raw sewage. Other studies have indicated that coliform densities increased by a factor of ten in the vicinity of combined sewer overflows, and persisted for periods of several days.

Combined sewer overflows will continue to introduce constituents into receiving waters which will violate the standards for prescribed water uses. Overflows contribute organic material which decreases D.O., introduces floating, suspended and settleable material which reduces the aesthetic and recreational values of the receiving water and increases the bacterial densities which can constitute a danger to public health.

To illustrate the importance of combined sewer overflows as a significant pollution source, the data shown in Table No. 3A was extracted from the report, listing however only those sources cited which discharge combined sewer effluent into the lower Hackensack River and Newark Bay.

Much time, effort and money is now being expended by Federal, State and local governmental agencies, as well as by private industry, in programs designed to determine economically feasible methods for handling combined sewer overflows. It is generally recognized that complete separation of combined systems is, for the most part, usually not economically feasible, and that other methods of pollution control of combined sewer overflows must be developed.

A study, conducted by the United States Public Health Service, to establish the amount and character of combined sewer overflows, entitled "A Preliminary Appraisal, Pollution Effects of Storm Water and Overflows from Combined Sewer Systems" resulted in the formulation of several conclusions:

a) "The annual average combined sewer overflow volumes may represent some five percent of the total pollutional discharge into the nation's water courses;

b) The average overflow from a combined sewer may contain from three to five percent raw sewage; and

c) During storm peaks, as much as 95 percent of the sanitary sewage in the sewer may overflow directly to the receiving stream."

It can be readily seen that combined sewer overflows and bypasses for pumping stations and treatment plants play a significant part in the degradation of streams into which they discharge. The meagre data accumulated for the Newark Bay and Hackensack River area show that these waters have not escaped the problem.

Combined sewer overflows presently adversely affect the water quality within the tidal portion of the Hackensack River. As the Meadowlands District is developed and urbanized, this problem must be forcefully addressed to prevent its subsequent, ever greater impact.

4. Leachates

Water, the universal solvent, will in time dissolve and carry away all soluble constituents of matter with which it is in contact. The removal of soluble constituents from surface soil and its underlying strata, by rainfall, by surface runoff, by ground water movement or by tidal action, in a slow orderly process, is usually considered to be natural leaching. It is the natural leaching process which adds mineral matter to well water, forms caves in limestone deposits and concentrates mineral deposits.

When man adds to this natural process by irrigating land, by diverting water to flood areas to be irrigated, by sinking wells and rapidly withdrawing ground water, or by adding new and different materials to the surface of the ground, the rate of natural reaction is altered, usually in a detrimental fashion.

In the case of the Hackensack Meadowlands, there is a natural exchange of nutrients and chemicals in the tidal marsh interface. The mineral matter from the salt water is deposited and the organic matter within the marsh is leached and flushed out. Man has been depositing refuse, industrial wastes, sludges and the like, on the surface of this marsh area. These wastes contain many materials which have soluble constituents. These wastes also undergo aerobic and anaerobic decomposition which, in turn, makes more materials available for leaching.

Studies to date on sanitary land fills indicate that the mineral leachate from such land fills contains high values of sodium, potassium, calcium, magnesium, chlorides, sulphates, and bicarbonates. Local increases of mineral elements may be as great as 20 times that of the same area prior to placing the sanitary land fill in operation.

Where sanitary land fills may be inundated by tides and remain saturated for extended periods of time, as is the case in the Meadowlands District, the total solids can increase tenfold, the BOD increase 50 fold, and bacterial loadings can reach values in excess of 250,000 per 100 ml.

When large volumes of water stay in contact with large masses of sanitary land fills, an adverse effect to the physical, chemical and biological quality of the receiving stream occurs. As the volume of water first leaches material from the wastes and then carries these leachates back into the river and disperses them in the river, taste and odor problems, color, possible turbidity and reduced dissolved oxygen may occur. The leachate may contain hydrogen sulphide, ammonia, nitrate-nitrogen and carbon dioxide.

The leachate, having all of the nutrient constituents present, may cause rapid growth of bacteria and related organisms, hasten an organic buildup or algae bloom, and physically transport harmful organisms from the land fill site to the river.

The leaching of organic materials will further result in high bio-chemical oxygen demands on the river. This may aggravate the dissolved oxygen balance causing it to drop, reaching anaerobic conditions, or situations where no fish life can exist.

Once again, the specific effects of these pollutants on the Hackensack River cannot be given a quantitative value. Consequently, recognition of the fact that this is yet another source of pollution of the Hackensack River must suffice at this time.

5. Thermal Pollution

Water temperature plays a major role in maintaining the water quality of an estuary. The effect of rapid or prolonged temperature changes of a body of water is intricate, influencing the physical, chemical and biological properties thereof.

An adequate supply of oxygen must be available within the water-based ecological system for a productive, healthy and aesthetically satisfactory aquatic environment. As water temperature rises, the amount of dissolved oxygen contained within the water decreases. Low or minimal quantities of dissolved oxygen will adversely effect the fish life and the other organisms in the aquatic community. Low dissolved oxygen can preclude proper assimilation of organic BOD loadings in the river, can lead to anaerobic conditions, giving rise to odors and poor aesthetic conditions.

Most of the chemical effects on water quality, which are influenced by temperature, center around bio-chemical reactions. Bio-chemical reactions rely mainly on enzymes. It is generally agreed that since enzymes are temperature sensitive, the rate and activity of enzyme reactions increase with rising temperature to about 99° F, and then fall off rapidly. At the same time, BOD, which must be satisfied before assimilation of the organic matter is completed is also temperature related and is being acted on in much more intensive fashion by other micro-organisms. At higher temperatures these organisms use up the available dissolved oxygen at a much more rapid rate, yet due to the elevated temperatures, there is a reduced amount of dissolved oxygen available. The net result is a still more rapid decrease in dissolved oxygen and the possibility for an anaerobic situation being developed with concomitant nuisance conditions.

Rapid, or successive temperature changes, usually result in the elimination of desirable species and the establishment of rough, undesirable or nuisance fish and aquatic plants and algae.

Thermal pollution has been defined as man caused deleterious changes in the normal temperature of water. Water temperature may be changed directly by the addition of heat. Thus, waste heat becomes a pollutant equally as dangerous to water quality as the more tangible forms of waste.

The increasing incidence of the introduction of heated waste waters into rivers has become a subject of concern. The most significant source of thermal pollution is used cooling waters.

The Federal Water Pollution Control Administration in its report "Industrial Waste Guide on Thermal Pollution", September

1968, has reported that the electric power generating industry accounts for 80% of all cooling water used. Primary metals, chemical and petroleum industries account for nearly all of the remaining cooling water used. Almost one half of all water used in the United States is utilized for cooling and condensing by the power and manufacturing industries. In 1964, this amounted to about 50 trillion gallons.

It can be generally concluded that the demand for power will continue to rise, at least in the same ratio as in the past, or virtually doubling every ten years. As this demand for power increases, the waste heat problem will become more acute.

The Hackensack River, lying as it does in the midst of a large industrialized area, is no exception to the national scene. The river is being used as a source of cooling water for three power generating plants, as well as other smaller industrial and manufacturing establishments. The spent cooling waters are returned to the river.

The specific effect of thermal pollution on the Hackensack River cannot be given a quantitative value. Consequently, recognition of the fact that this is yet another source of pollution of the Hackensack River must suffice at this time.

6. Navigation

Newark Bay with its deep draft channels leading into Port Newark is a major hub of international maritime traffic. The Hackensack River has a channel of approximately 25 feet in depth for a distance of 3.8 miles above its mouth at Newark Bay, and a shallow draft channel of approximately 15 feet in depth for an additional 12.5 miles upstream. Large vessels use Newark Bay and the lower Hackensack River, while shallow draft vessels of the barge type travel upstream as far as the City of Hackensack. Small commercial boats as well as pleasure craft can use the tidal portion of the Hackensack River and portions of its tributaries.

The use of the Hackensack River as a navigable waterway by commercial and private vessels of all sizes, classes and types, is another source of water pollution.

The accidental or intentional discharge of waste material, deposition of refuse, spills of oils or cargo, pumping of bilges or discharge of galley and sanitary wastes, be they from industrial, commercial or pleasure craft, contribute to the ever increasing pollutional load on the waters of the Hackensack River.

In the Proceedings of the Conference in the Matter of Pollution of the Interstate Waters of the Hudson River and its Tributaries-New York and New Jersey, held on September 28, 29, 30, 1965 by the United States Department of Health, Education and Welfare, Volume 1, Col. R. T. Batson, District Engineer, U. S. Army Engineer District, N.Y. makes the following statements:

"The most general law associated with pollution enforced by the Corps of Engineers, is Section 13 of the Rivers and Harbors Act of 3 March 1899. The law in essence states that it is unlawful to throw, discharge or deposit any refuse matter of any kind or description into navigable waters of the United States. You will note that water pollution in its broadest interpretation is not unlawful under the statute, but only the deposit or refuse material which is injurious to navigation. Also, specifically excluded from the definition of refuse in the Act is matter 'flowing from streets and sewers and passing therefrom in a liquid state'. These distinctions limit the role of the Corp of Engineers in the prevention of pollution."

"Since 1952, by an Act of Congress of 1888, as amended, I, as the Supervisor of New York Harbor, seek to prevent obstruction and injurious deposits in the tidal water of the Harbor of New York, or its adjacent tributary waters or those of Long Island Sound. The prohibited materials covered by this statute are described more specifically as refuse, dirt, ashes, cinders, mud, sand, dredgings sludge, acid or any other material of any kind other than that flowing from streets, sewers, and passing therefrom in liquid state."

"Incidentally, in association with these duties we designate the dumping areas outside of the harbor for these kinds of materials."

"By the Federal Oil Pollution Act of 1924, the discharge of oil of any kind, or in any form, including fuel oil, oil sludge and oil refuse into tidal navigable waters of the United States from vessels is prohibited."

The State of New York has recently enacted legislation prohibiting the discharge of sanitary wastes from all vessels into navigable waters of the State of New York, and the Federal government is also contemplating similar legislation.

Legislation designed to prevent pollution and contamination of our tidal areas, is only as effective as the enforcement thereof. This is recognized as a difficult endeavor, even if enforcement were the responsibility of only one authority.

Factual data of occurrence of wastes being added to the Hackensack River due to navigation is not available, nor can future values be predicted. Further, the specific effects of these pollutants on the Hackensack River cannot be given a quantitative value. Consequently, recognition of the fact that contamination from navigation and river traffic is yet another source of pollution of the Hackensack River must suffice at this time.

7. Tidal Exchange

The major source of water within the tidal portion of the Hackensack River comes from the daily tidal exchange. Since normal daily fresh water flow from the upland areas of the Hackensack River is severely curtailed by the Oradell Dam there are many periods when there is little other than the tidal waters to dilute and disperse pollutional material which finds its way into this river.

Because of the interconnections between the many bodies of water comprising the New York Harbor Tidal Complex, pollutional loads from many diverse areas are intermingled and develop the basic water quality of the entire tidal region.

In studies which have been conducted over extended periods of time, the strength of the organic waste load within the Newark Bay-Kill Van Kull area has been assessed at 487,000 P.E. (P.E. indicates population equivalents. P.E. is a means of expressing the strength of organic material in wastewater. Domestic wastewater contains, on an average, 0.17 pound of biochemical oxygen demand per person per day. Thus it is possible to describe the strength of an organic waste in terms of an equivalent number of persons.) At the same time, during the same survey, coliform densities observed in the Kill Van Kull and the mouth of Newark Bay have been found to exceed 20,000 colonies per 100 ml on a regular basis. Water acceptable for swimming may be expected to have coliform counts of less than 2,400 colonies per 100 ml and water acceptable for shellfish culture may be expected to have coliform counts of less than 70 colonies per 100 ml.

At each tidal cycle the waters from the Kills and from Newark Bay are carried into the Hackensack River. These waters remain within the tidal reach of the Hackensack River and slowly cycle back and forth, ultimately reaching an equilibrium condition.

Thus the quality of the waters which enter from Newark Bay establish the base line. To this is added additional pollutional loads originating within the Meadowlands and in those upland areas directly tributary to the tidal portion of the river.

The volume of purified waste water and fluvial advective flow is insufficient either to restrain or to flush out pollutants brought into the Hackensack River by the daily volume of 4.5 billion gallons of tide water from Newark Bay.

The full impact of the regional approach to wastewater treatment and pollution abatement must be re-emphasized if any significant change within the tidal area of the Hackensack River is to be effectuated.

SECTION IV. EXISTING WATER QUALITY

A. Introduction

The terms "water pollution" and "water quality" mean vastly different things to different persons. To the conservationist, the introduction to waters of any material which alters the appearance of, or affects the propagation of fish and other wildlife is gross pollution. To those persons engaged in industry or manufacturing processes requiring water use, any materials in the water supply which increase production costs, which cause scaling or corrosion, or which decreases the efficiency of cooling and quenching, are gross pollution. To the layman, the word pollution may be illustrated by water fouled so as to be obnoxious to sight and to smell. Negative reactions such as these may be caused by the fact that the waters cannot be used for purposes for which each individual wishes the water to be used.

The years have seen water described in terms of its pollution, in terms of its fitness for use, and in terms of water quality. Difficulty with attempting to codify concepts of fitness of water for various uses hinge on the various definitions of the word 'quality'. It has generally been agreed that the word pollution means the addition of domestic sewage, industrial wastes, or other harmful or objectionable material to water. The more generally inclusive term of contamination has been used to signify the introduction of microorganisms, chemicals, wastes or sewage into water which renders it unfit for its intended use.

Water 'quality' is defined in the "Glossary, Water and Wastewater Control Engineering" as: "The chemical, physical, and biological characteristics of water with respect to its suitability for a particular purpose. The same water may be of good quality for one purpose or use, and bad for another, depending on its characteristics and the requirements for the particular use".

Thus, after all the impurities, all the additives, and all the natural and man-made residues and effluents which flow into and become a part of the water have been cataloged, quantified and fully identified, their significance can only be interpreted relative to the needs and tolerances of each beneficial use to which the water is to be put.

There is a distinction between the terms 'effluent' and 'discharge'. An effluent is usually defined as being wastewater or other liquid, partially or completely treated, flowing out of a wastewater plant or portion thereof. It may generally be inferred that an effluent carries some degree of pollution.

Under many conditions a waste, which has been treated in a satisfactory manner, may be discharged to a water course without causing measurable quality deterioration to it or adversely affecting subsequent anticipated water use. Hence even though by definition it is an effluent, by connotation it should be classified a discharge. A discharge is the rate of flow, or volume of water flowing in or into a stream or conduit at a given place and within a given period of time.

With respect to the Hackensack River, we are essentially concerned with the quality of the water within its tidal portion within and adjacent to the Meadowlands District, and with all of those factors which can affect, influence and alter this quality.

For years nature's ecological balance has maintained this important natural resource, this aquatic environment of streams and estuaries, in harmony with the demands placed upon it by man. However, as man has concentrated his numbers, multiplied his waste production, concentrated industrial activities in small geographic areas, and developed new and voluminous solid and liquid wastes far beyond the capacity and capability of nature to effectively neutralize and return them to the ecological cycle, there has been deterioration and degradation of this environment.

Earle B. Phelps in his book "Stream Sanitation" states in the opening paragraph: "A stream is something more than a geographic feature, a line on a map, a part of the fixed permanent terrain. It cannot be adequately portrayed in terms of topography and geology. A stream is a living thing, a thing of energy, of movement, of change".

A typical stream increases in size, depth and volume of flow as it travels from its upland source to its ultimate discharge into the sea. In the tidal zone of a river it is usual to find the greatest concentration of population, of industry, of transportation and of commerce. As a consequence, a river is usually heavily polluted in this location. Fortunately, in most rivers a combination of continuous large stream flow, fairly rapid and extensive circulation of tidal currents and the assimilative capacity of the waters themselves tend to maintain water quality.

As long as the introduction of contaminants is not great enough to upset the balance of life and cause the area to become toxic to plant and animal life, as long as the ecology can be maintained, then the quality of the water can be maintained and can be improved. In our crowded urban areas, the water quality necessary for the continued growth and development of planned human habitation can only be achieved through the orderly symbiotic actions of men and nature. Water quality standards are designed to enhance the quality of water, to make the environment a more pleasing and enjoyable one, and to permit greater utilization of the aquatic environment for recreational pursuits and for a place of tranquil and aesthetic enjoyment.

B. Hackensack River Flow

In a tidal area, the influx of new upland water has the effect of diluting and cleaning the area, and counteracting the debilitating effect of pollution. The Hackensack River is unique in that it has a very restricted fresh water addition. A general discussion of the Hackensack River watershed and its inter-relationship with the New York Harbor Complex has been presented earlier in this Report. The Hackensack River within the Meadowlands District is a "dead ended" tidal estuary receiving minimal amounts of fresh water, receiving the wastes of many communities and industries, being subjected to fouling by oils and bilge water from navigation, being used as the source of cooling water and depository for thermal pollution therefrom, and receiving the runoff from natural and man-made wastes in the marsh flats.

Since there is generally such a very low influx of fresh water at the top of the tidal estuary, there is no significant hydraulic gradient developed to flush out the tidal waters during a tidal cycle. The greatest quantities of flush-out water generally occur at times of heavy rains, during storms, and those times when there is significant flow over the weirs at the Oradell Reservoir. It should be noted that during periods of heavy rainfall or storm, the prevailing winds are stronger and the tides are higher than normal, and as a result the Meadowlands become flooded. The benefit of added quantities of runoff which might be available for flushing out the river at such times is negated by the presence of excess volumes of flood tide water. At the same time, the effect of existing combined sewer overflows and bypasses also adds to the pollutional load within the estuary.

Based on a series of studies completed by Bergen County, the Regional Plan Association, Rutgers University, the United States Public Health Service and the Tri-State Transportation Commission, it would appear that the total Hackensack River Basin might require some 300 MGD of potable water by the year 2000. It has been reported that there will be a greater demand than the present sources of supply, even fully utilized, will be able to supply to the extent of some 45 MGD by the year 1980. Assuming that the required quantity of water can and will be developed from the existing watershed, then there must be a reduction, rather than necessary increase, in fresh water input to the upper reaches of the tidal portion of the Hackensack River.

C. Stream Water Quality Parameters

1. General

To assess the present water quality of a body of water such as the tidal portion of the Hackensack River, an inventory of the existing stream and its condition should be made. Effective water pollution control is dependent upon having objective and accurate scientific data on existing water quality. These data are needed to pinpoint offenders and identify specific pollutants, define their concentrations and describe their effects on present and potential water uses.

The basic inventory needs to produce a picture of the normal stream flow with its quantity, direction, duration and velocity. Following this, an actual tabulation of location of all of the known effluents and discharges with their types of contaminants, strengths, and quantities should be made and kept current. These inputs, or pollutional loads, should indicate the chemical, physical and biological constituents which are being added to the river from the centers of population, from industrial discharges, from the land adjacent to the river, from storm water flows and from thermal pollution sources.

In addition to being a complex mixture of all these physical and chemical components, a river system is also a dynamic system containing millions of micro-organisms which continually consume available organic matter, upset balances of dissolved oxygen and significantly alter the water's chemical and physical constituents.

The Hackensack River is a part of the New York Harbor Tidal Complex and is particularly affected by Newark Bay. A complete inventory of the Tidal Complex area should include all factors which will affect the ultimate composition of the water and the water quality of the Hackensack River. Based on the input of all of this data, a model could be developed and a balance could be arrived at which should indicate the present status of the tidal estuary, and from which a prognosis for the continuation or improvement of the present water quality might be made.

Much of this inventory has been made and a basic knowledge of the existing quality of the waters of the Hackensack River is known. As more data is developed, from continued and better surveillance, more definitive information can be fed into and read out of this model.

2. Dye Study

A series of studies was conducted by the United States Public Health Service, Department of Health, Education and Welfare. In one of the studies, conducted September and October 1965, photofluorescent dye was released at the outfall of the Bergen County Sewer Authority Treatment Plant, at Little Ferry, Hackensack River Mile 12.7. The dye distribution and dispersion was monitored for a period of 19 days by the use of sensitive photometers which detected the concentration of the reactive dye. It was noted that with no fresh water inflow at the headwaters of the tidal estuary at the Oradell Dam, it took approximately three days for the first trace of dye to reach the mouth of the Hackensack River, River Mile Zero. It is evident that with no fresh water inflow, there is little net seaward movement of any material within the Hackensack River. It was further noted that the peak dye concentration remained in the vicinity of the point of discharge and did not change appreciably during the 19 days the dye was monitored. The dye concentration peak did flatten out, and yielded a more uniform concentration within the river with time. This again is an indication that when there is no appreciable fresh water flow from the upland areas, pollution or contamination introduced into the Hackensack River will tend to disperse and diffuse in the immediate area of local introduction, and will merely oscillate tidally with its centroid returning to the point of release with each cycle.

3. Dissolved Oxygen

Wastes, be they domestic sewage, industrial waste or urban runoff, contain organic matter that will be decomposed by micro-organisms. These organisms exert a demand on the dissolved oxygen (D. O.) present in the receiving waters. In the process of stabilizing the organic wastes the D. O. is decreased below its normal level. High concentrations of oxygen demanding materials, those which exert a high biochemical oxygen demand (B. O. D.) will cause a sharp reduction in the D. O. which can result in the reduction or elimination of desirable aquatic life.

Adequate levels of D. O. in water are necessary to provide a healthy environment suitable for normal growth of aquatic life. The amount of D. O. in a water body depends on the inter-relations of temperature, water salinity, natural re-aeration from the atmosphere, existence of photosynthetic organisms, and the demand the pollutional load exerts on the receiving waters. A generally accepted D. O. value for good quality water for the protection of aquatic life is 5.0 milligrams per liter (mg/1). The ability of a water body to retain D. O. is inversely related to the temperature and the salinity. Because of the tidal characteristics of the Hackensack River, with its concomitant mixing and retention of waters within the river, a lower quality water in any section of the tidal area has a direct effect on an area of higher quality.

As previously stated, temperature has a direct effect upon the capacity of a receiving water to assimilate B. O. D. without nuisance. Water temperatures also act as limiting factors in the propagation and survival of aquatic life.

4. Physical Characteristics

Other physical parameters of water quality are based on clarity of the water and how the water affects the aesthetic senses, particularly with regard to suspended solids, color, odor, taste and turbidity.

Suspended solids are those solids which are visible and in suspension in the water. They are solids which can be removed by physical or mechanical means such as sedimentation or filtration. The suspended solids are an important measure of the potential stream load that will form bottom sediments. The need for frequent dredging of navigational channels is a corollary to heavy suspended solids. At the same time, dredging imposes a heavy oxygen demand on the waters by resuspending organic matter which was part of the semi-stabilized benthic layers.

Color is commonly caused by the extraction of coloring materials from humus or vegetable matter in forests or swampy and low lying areas. Color may also be imparted to water by leachings from man-made wastes, from the decomposition of iron, from other fine materials in suspension, by discharges from industrial activities, from street and surface runoff and by the presence of microscopic organisms. In general, color has little significance as a parameter of degradation of water quality, except that from an aesthetic viewpoint, the attractiveness of water is dependent upon the absence of any color which will detract from its enjoyment.

Odors in water, generally related to and measured with taste, are caused by extremely small concentrations of volatile compounds. Since odorous materials are detectable when present in only a few micrograms per liter, the introduction of small quantities of odor producing materials into the Hackensack River will remain within the area for considerable periods of time. Some odors are produced when organic matter decomposes such as those that are typically present when surface wash of low lying marsh areas occurs. Industrial wastes, with particular emphasis on phenols, oils, aromatics and petrochemicals, are responsible for odors within tidal areas. Another major source of odor is that caused by the death and decomposition of plankton which liberate minute traces of volatile essential oils.

Phenolic type compounds in water can result in inhibitions of growth of necessary aquatic organisms, can result in the tainting of fish flesh and shellfish meats, and can act as a general biostatic or disinfectant. Oils and grease in waters can result in formation of objectionable surface slicks which reduce the potential use of the surface water for recreational purposes. Oil on the surface prevents natural re-aeration of the water, thus enhancing the degrading effects of organic materials in the water, preventing a stabilization of D. O. in the water, leading to other odor problems and decrease of aquatic organisms and fish life. Oils and greases settle as they age, thus becoming part of the benthic layer where they inhibit normal bottom growths and further upset the ecology of the estuary. Oils too can taint the meat of fish and shellfish.

Turbidity is the optical effect caused by the interception and dispersion of light rays passing through water containing small particles in suspension. It may be caused by silt, clays, surface wash from urban areas, suspended organic matter, microscopic organisms, precipitation of materials where the surface wastes and industrial wastes mix with salt waters from the tidal flow, or heavy concentrations of microscopic organisms. Turbidity effects the light penetration into water and thus effects the photosynthetic actions which may be taking place. Turbidity is also a limiting aesthetic factor in the acceptance of a surface water for recreational purposes.

5. Chemical Characteristics

Water quality of a tidal estuary is quite different from that of a surface stream being used for a source of drinking water. In the latter, the chemical constituents are more critical. In an estuary the chemical tests are for acidity (pH) and for chlorides, together with the earlier tests mentioned for D. O. and B. O. D. with its companion test for chemical oxygen demand (C. O. D.). On occasion, special tests for toxic materials are made. Nutrient levels are a special category.

The pH test is used as a general descriptive term for the possibility of coagulation, disinfection, corrosion control, natural biota habitat and the presence of special industrial pollutants.

Chlorides are a measure of the degree of salt water intrusion, and hence a measure of the amount of mixing which takes place within the estuary. The strength of the chloride concentration is a further measure of the amount of fresh water influx from the inlet to the tidal reach at Oradell, and is a further indication of the suitability of this water for use as industrial process waters.

Nutrient levels are significant parameters in the tidal estuary ecology. When other environmental factors are satisfactory, nitrogen and phosphorous become critical nutrients for the growth of algae. Although algae are desirable in limited quantities, if the waters are highly fertilized by these nutrients, if eutrophication takes place, then algal growths can exceed desirable limits, and cause nuisance conditions to develop. Eutrophication means that the contained body of water, or ecosystem under study, is high or rich in nutrients. The ecosystem is characterized by a large quantity of planktonic algae, low water transparency, low to zero dissolved oxygen in the lower layers of the water, colored, odorous deposits giving off hydrogen sulphide and an absence of larger or higher forms of aquatic organisms. The presence in the environment of compounds containing these nutrients result from both natural and man-made sources. The frequent inundation and the usual saturation of tidal areas can and do add significant quantities of leachate to the estuary daily. These marsh lands which have been disturbed by excavation and filling for various purposes, resulting in the disruption of the natural ecology, are a constant, present, and possibly future source of odors as well as a source of soluble nutrient materials which add significantly to the eutrophication of the estuary. Ammonia, nitrates, and nitrites are the nitrogen compounds which form the soluble constituents for plant growth. These come from rainfall, storm water runoff, from domestic and industrial wastes, and from the leachings from solid wastes. The phosphorous compounds known by the general term "orthophosphates" are generally derived from man-made pollutants with the polyphosphates used in detergents as one of the major sources. Many industrial wastes contain other forms of phosphates which add to the total nutrient imbalance. When advanced eutrophication of the receiving stream is evidenced, all of the anticipated problems of a highly productive ecosystem may be expected.

6. Bacteriological Characteristics

Coliform organisms are a group of bacteria predominantly inhabiting the intestinal tract of warm blooded animals. They include all aerobic and facultative anaerobic, Gram-negative, non-spore forming bacilli that ferment lactose with the production of gas. Coliform bacteria are not usually pathogenic. The presence of pathogenic bacteria in water, as a result of the contamination by sewage, is dependent upon the warm blooded animal contributing to that sewage being ill of an intestinal disease, and upon the survival of the pathogen in an environment which is not favorable to it. Coliform bacteria are always present if sewage is present and are generally much more hardy than pathogens. It is for this reason that the bacteriological evaluation of water is always based upon a determination of whether or not coliform organisms are present and in what concentrations. Total coliform densities, as determined by the Most Probable Number (MPN) test procedure, have traditionally served as the indicator of pollution. Most established standards relating to water use and water quality are based on this indicator organism.

White total coliform densities are used as indicators of pollution, it is recognized that these organisms may originate from non-human sources. Hence other indicator organisms such as fecal coliform group and fecal streptococci are used to further identify possible human contamination. The presence of such specific organisms above certain acceptable levels is indicative of the presence of human fecal wastes which may contain pathogenic organisms capable of causing disease in humans.

During the summer of 1965 the United States Public Health Service conducted a preliminary study of the water quality of the tidal portion of the Hackensack River. A series of 27 stream sampling stations were established and routine data collected. Additional special studies were also conducted to establish temperature profiles, nutrient profiles and coliform concentrations. The locations of the sampling stations have been indicated on Exhibit No. 6, Hackensack River Water Quality. Based on the data collected, the following graphs were prepared indicating the average profiles within this portion of the stream.

The C. O. D. profile, Exhibit No. 7A, which is the measure of all substances which could potentially be oxidized to carbon dioxide (CO_2) and water, shows a significantly high value throughout nearly the entire length of the stream. Once again the similarity in values throughout the reach, both at high and low slack tides, is further indication that the waters within the river do not tend to flush out, but merely shuffle back and forth, developing a uniformity throughout.

The B. O. D. profile, Exhibit No. 7B, which is the measure of the amount of oxygen utilized by bacteria while stabilizing decomposable organic matter under aerobic conditions, is significantly higher for low slack values than for high slack. Even high slack values are much above normally unpolluted surface waters' values of from 2 fo 3 mg/1. The high slack values are lower than low slack values due to the presence of the very large dilutional flow of the tidal prism. The fact that even with a tidal prism of some 4.5 billion gallons, the pollutional load within the Hackensack River does not drop to values under 3 mg/1 consistently is a dual indication of the extent of pollution within the tidal portion of the Hackensack River coupled with the obvious fact that the waters of Newark Bay are in themselves also highly polluted.

The D. O. profiles, Exhibit No. 7C and Exhibit No. 7D, show the amount of dissolved oxygen present within the water, and are futher indications of the health of the aquatic environment. D. O. is essential, not only to keep organisms living, but also to sustain species' reproduction, to maintain vigor in all biologic colonies and to help develop biota populations. Oxygen enters the water by adsorption directly from the atmosphere, by surface diffusion, or by surface water agitation. The oxygen is removed by respiration of organisms and by decomposition. In photosynthesis, aquatic plants utilize carbon dioxide and liberate oxygen which is re-absorbed by the water. Since photosynthesis is limited to the photic zone where light is sufficient to permit the process, the water must be clear enough to allow the light to penetrate. When the water body is highly turbid, when oils and tars are present on the surface and when colors are added to the water from leachates and surface wash, even if the nutrients are present, the environment is not conducive to production of phytoplankton. Temperature is also a significant factor affecting the amount of D. O. present in a water body in that the higher the water temperature, the less D. O. is found present. Concurrently, the higher the water temperature, the greater the rate of biological activity or demand for available dissolved oxygen.

Because all desirable living things are dependent on oxygen to maintain life processes that produce energy for growth and reproduction, dissolved oxygen is critical in the aquatic environment. When oxygen metabolism increases because of higher temperatures, organism development is speeded and greater amounts of D. O. are required to maintain existence. Natural purification processes to break down and stabilize organic matter is also accelerated with increased temperatures, thus reducing the dissolved oxygen that might remain available in the warmer, summer waters.

It has been established that a minimum D. O. level of 4 mg/1 is necessary to merely support most fish life and other aquatic forms. The profile indicates that near the mouth of the river and up past the Overpeck Creek the D. O. level is well under this minimum value.

Based on the percentage of saturation, the D. O. profile shows that the river is less than 50% of saturation throughout most of its length. The fact that there is no significant increase in D. O. saturation, but rather a decrease in the level, during the high slack values, is a serious indictment of the quality of the water within the Newark Bay area.

The profiles of coliform and fecal coliform organisms, Exhibit No. 7E, show that the entire reach of the Hackensack River is subjected to high levels of sewage pollution and fecal contamination. The peak, occurring near the mouth at high slack, can be attributed to the poor water quality in Newark Bay. Since it has been reported that the Jersey City and the Kearny treatment plants, which discharge their effluents to the River near the head of the Bay, are not functioning at adequate treatment levels, the presence of fecal coliform colonies could be anticipated.

Fecal and coliform contamination of the Hackensack River was further substantiated during the survey conducted by the Bergen County Health Department in the summer and early fall of 1969. Sixteen (16) sampling stations were established at the locations shown on Exhibit No. 6, Hackensack River Water Quality. Tests were conducted on samples collected for the presence and quantity of coliform bacteria along the seven mile distance of the Hackensack River between the site of the proposed Bergen County dam near Midtown Bridge in the City of Hackensack, and the Oradell Dam. The test results are depicted as profiles on Exhibit No. 7F and Exhibit No. 7G and illustrate the continued relatively high concentration of coliform densities present in the upper portion of the tidal estuary.

D. Measures of Pollution

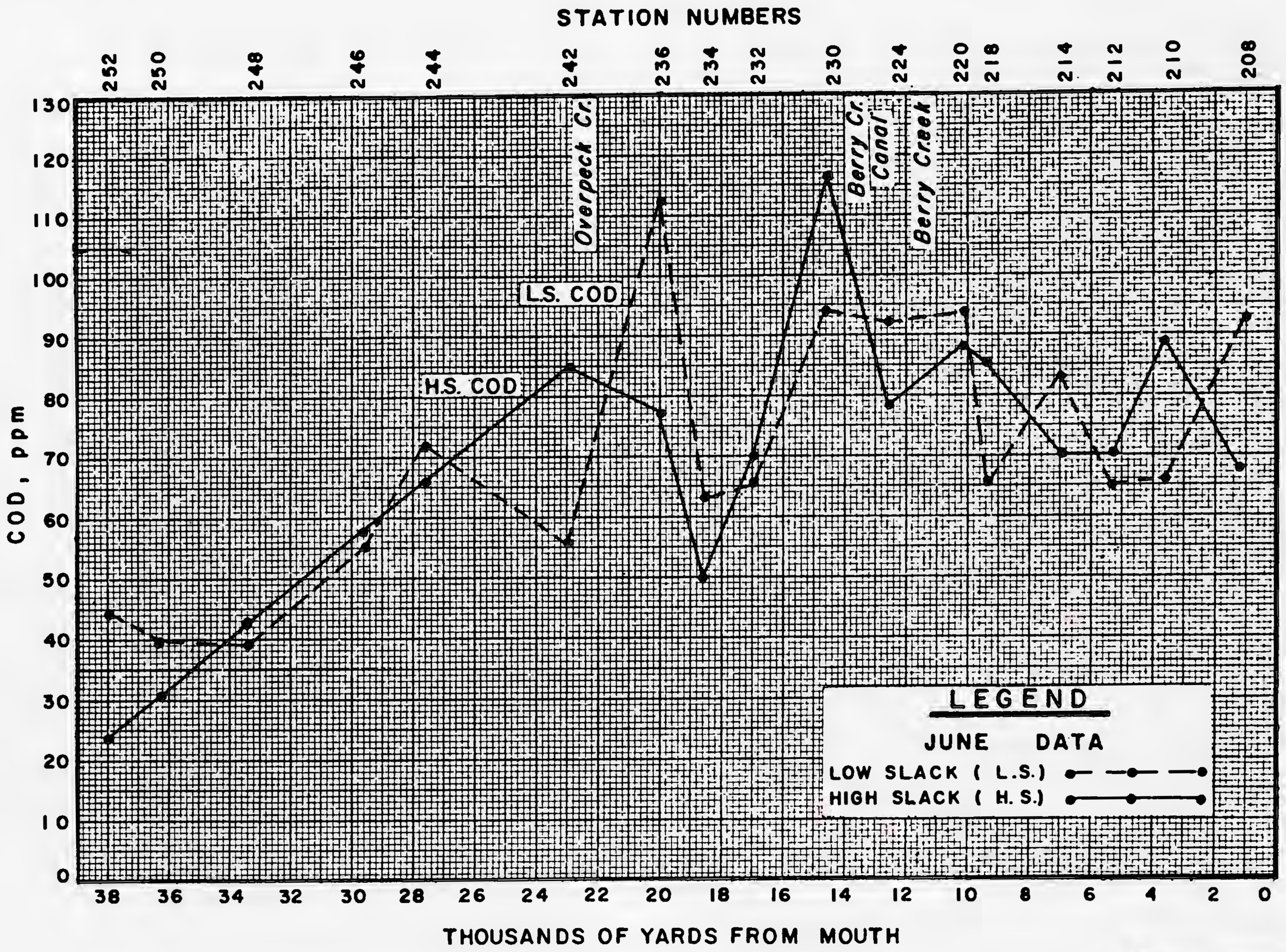
1. Measured B. O. D. Load

In addition to the data compiled by the United States Public Health Service on the tidal portion of the Hackensack River, there have been other studies conducted with respect to New York Harbor and Newark Bay which add significantly to the overall picture of the present state of the water quality within the estuary.

In the Proceedings of the Conference in the Matter of Pollution of the Interstate Waters of the Hudson River in its Tributaries-New York and New Jersey, held on September 28 to 30, 1965 by the United States Department of Health, Education and Welfare, Volume I, Paul DeFalco, Jr., Director of the Project Study, Public Health Service, Metuchen, N. J. states: "Pollutional discharges to the Hudson River from the New York City line to the Narrows amount to 5,091,000 P.E. Because of the tidal nature of New York Harbor, wastes from the East River, the Harlem River, the Kill Van Kull, and Newark Bay, enter the lower Hudson and Upper Bay and increase the pollutional loadings. 487,000 P.E. come from the Newark Bay-Kill Van Kull area".

Mr. DeFalco further states: "In the Kill Van Kull and in the mouth of Newark Bay, coliform densities have been observed to exceed 20,000/100 ml regularly".

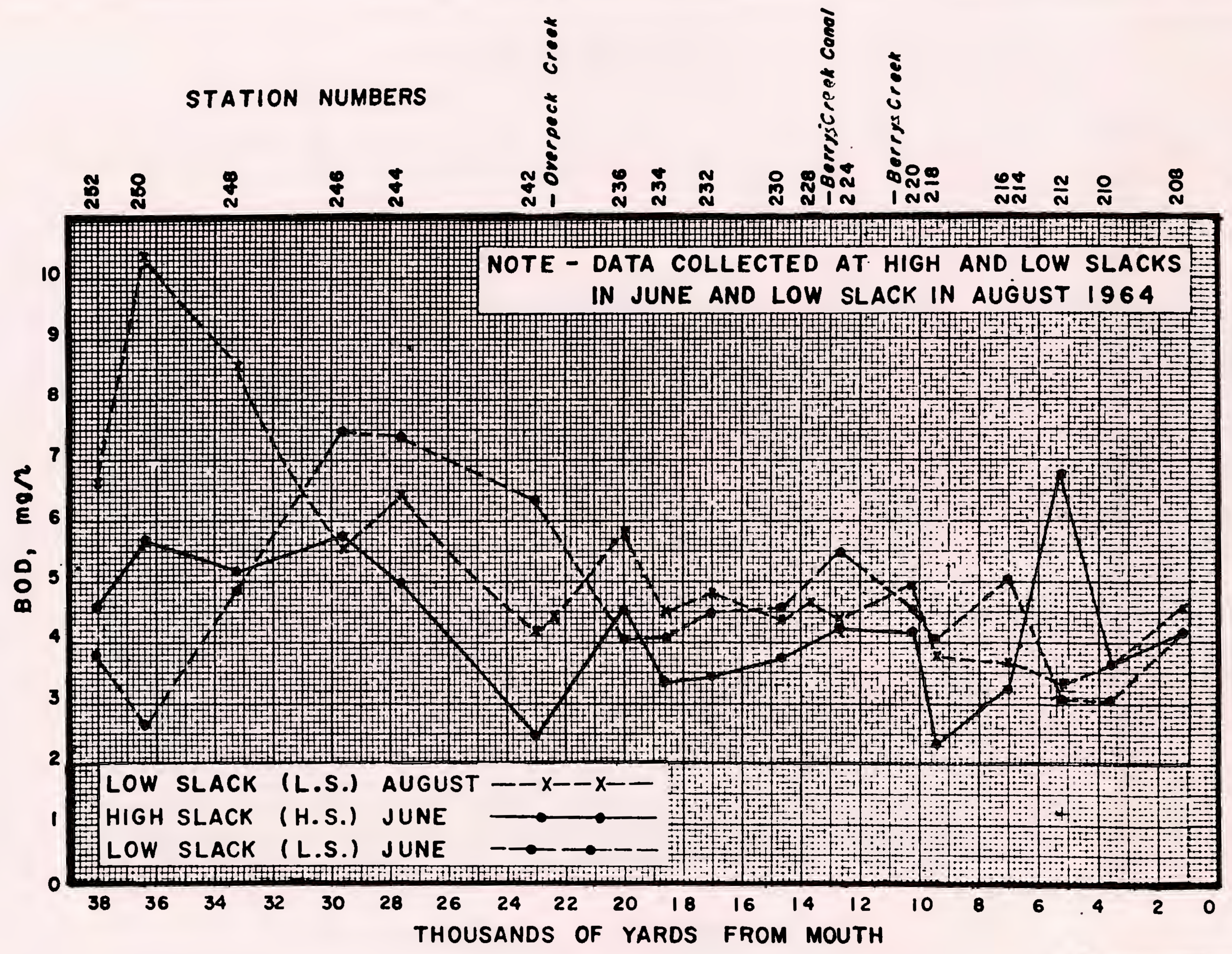
EXHIBIT NO. 7A



STATE OF NEW JERSEY
HACKENSACK MEADOWLANDS DEVELOPMENT COMMISSION
FEASIBILITY REPORT-WATER POLLUTION CONTROL SYSTEMS

HACKENSACK RIVER
C. O. D. PROFILE
SUMMER 1964

JOHN J. KASSNER & CO., INC.
Consulting Engineers

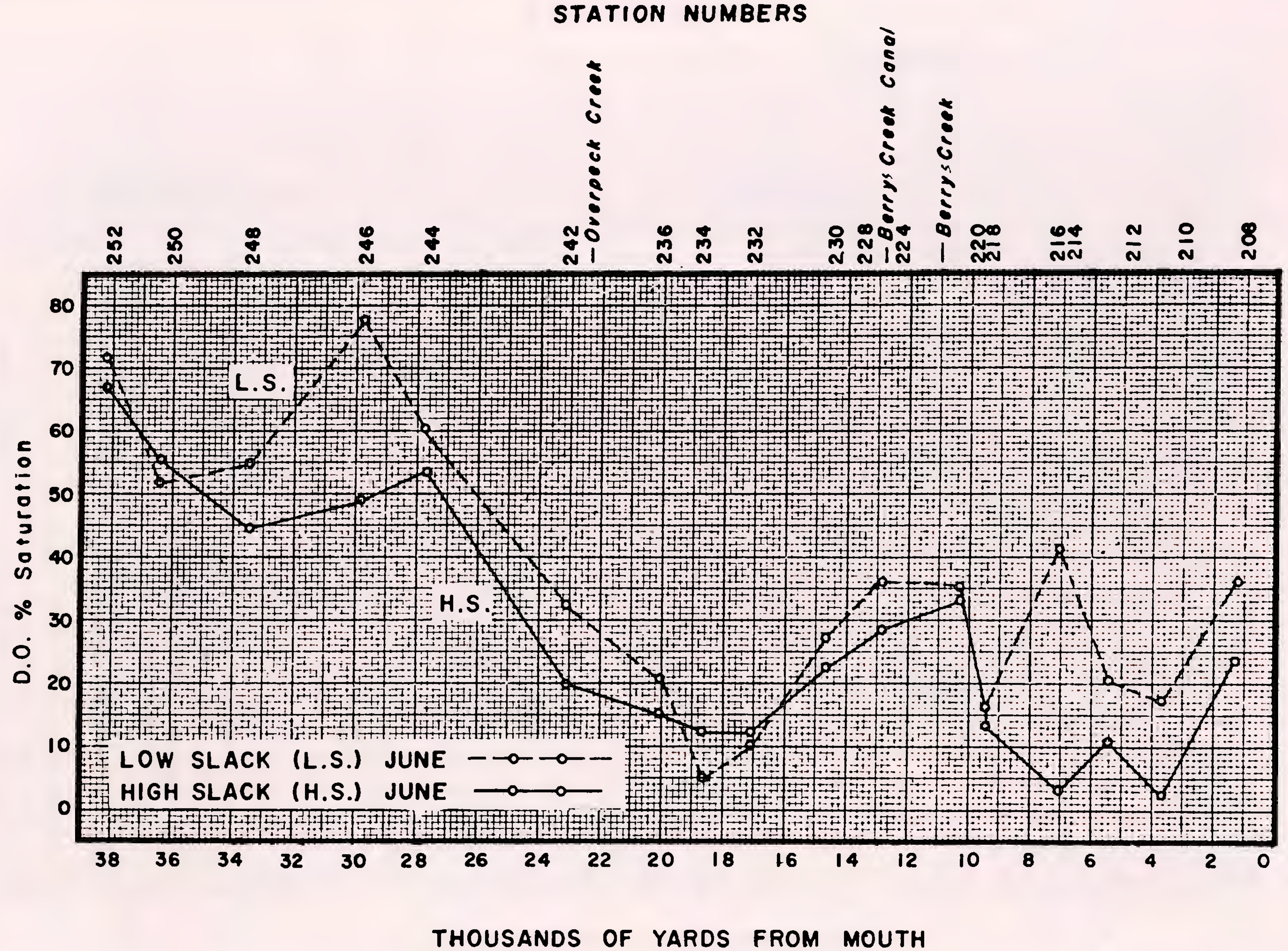


STATE OF NEW JERSEY
HACKENSACK MEADOWLANDS DEVELOPMENT COMMISSION
FEASIBILITY REPORT-WATER POLLUTION CONTROL SYSTEMS

HACKENSACK RIVER
B. O. D. PROFILE
SUMMER 1964

JOHN J. KASSNER & CO., INC.
Consulting Engineers

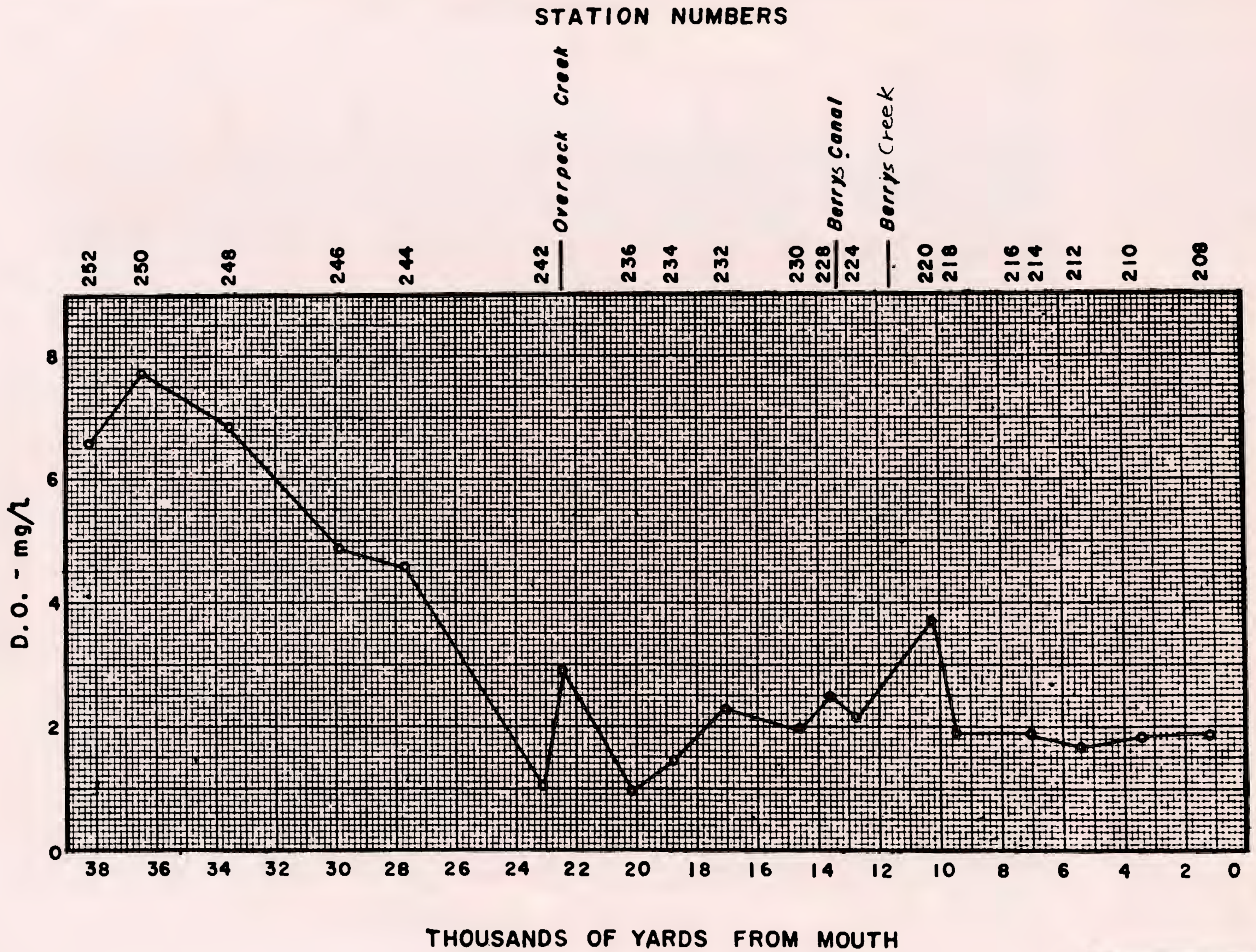
EXHIBIT NO. 7C



STATE OF NEW JERSEY
HACKENSACK MEADOWLANDS DEVELOPMENT COMMISSION
FEASIBILITY REPORT-WATER POLLUTION CONTROL SYSTEMS

HACKENSACK RIVER
D. O., % SATURATION PROFILE
SUMMER 1964

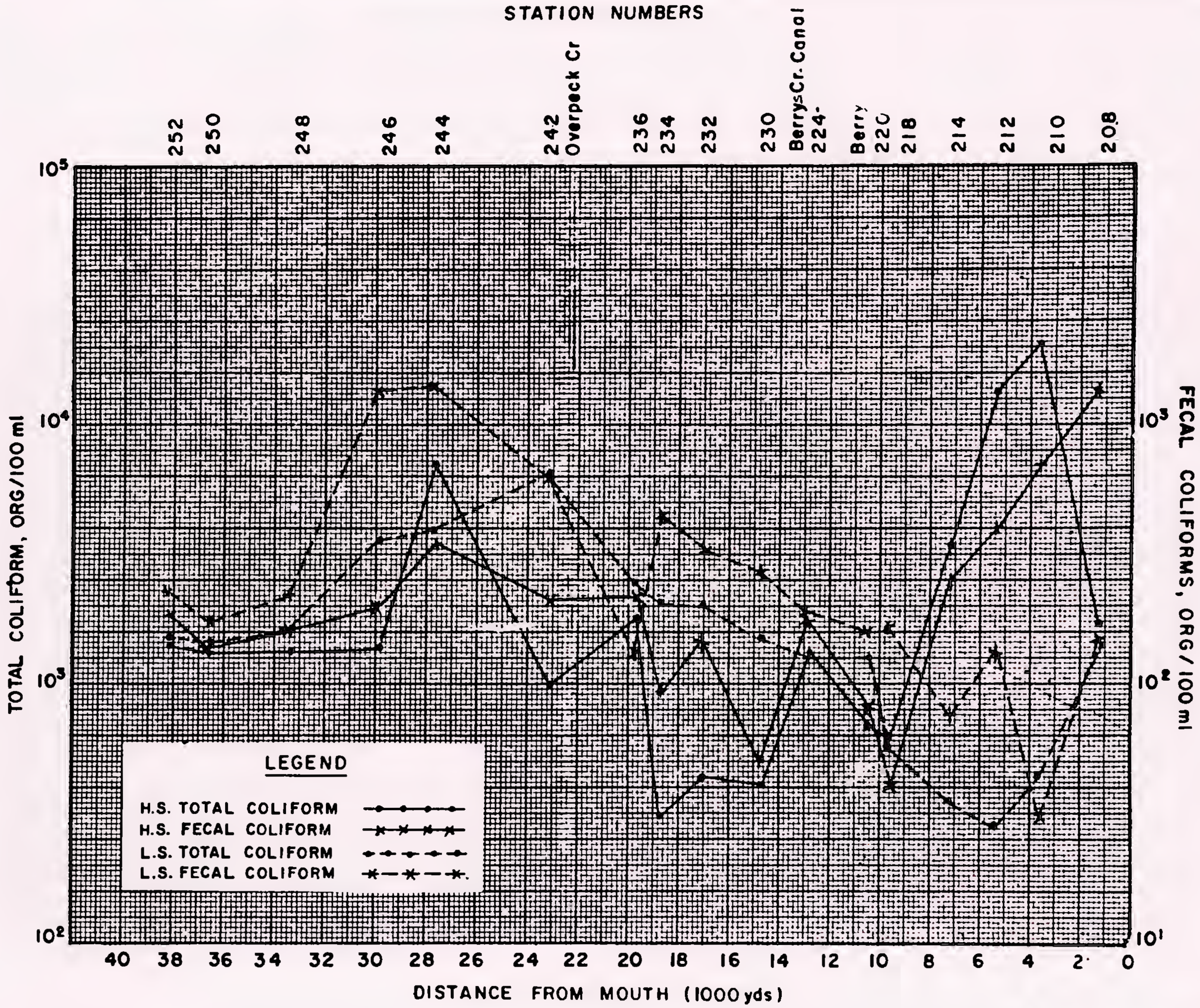
JOHN J. KASSNER & CO., INC.
Consulting Engineers



STATE OF NEW JERSEY
HACKENSACK MEADOWLANDS DEVELOPMENT COMMISSION
FEASIBILITY REPORT-WATER POLLUTION CONTROL SYSTEMS

HACKENSACK RIVER
D. O., MG/L PROFILE
SUMMER 1964

JOHN J. KASSNER & CO., INC.
Consulting Engineers

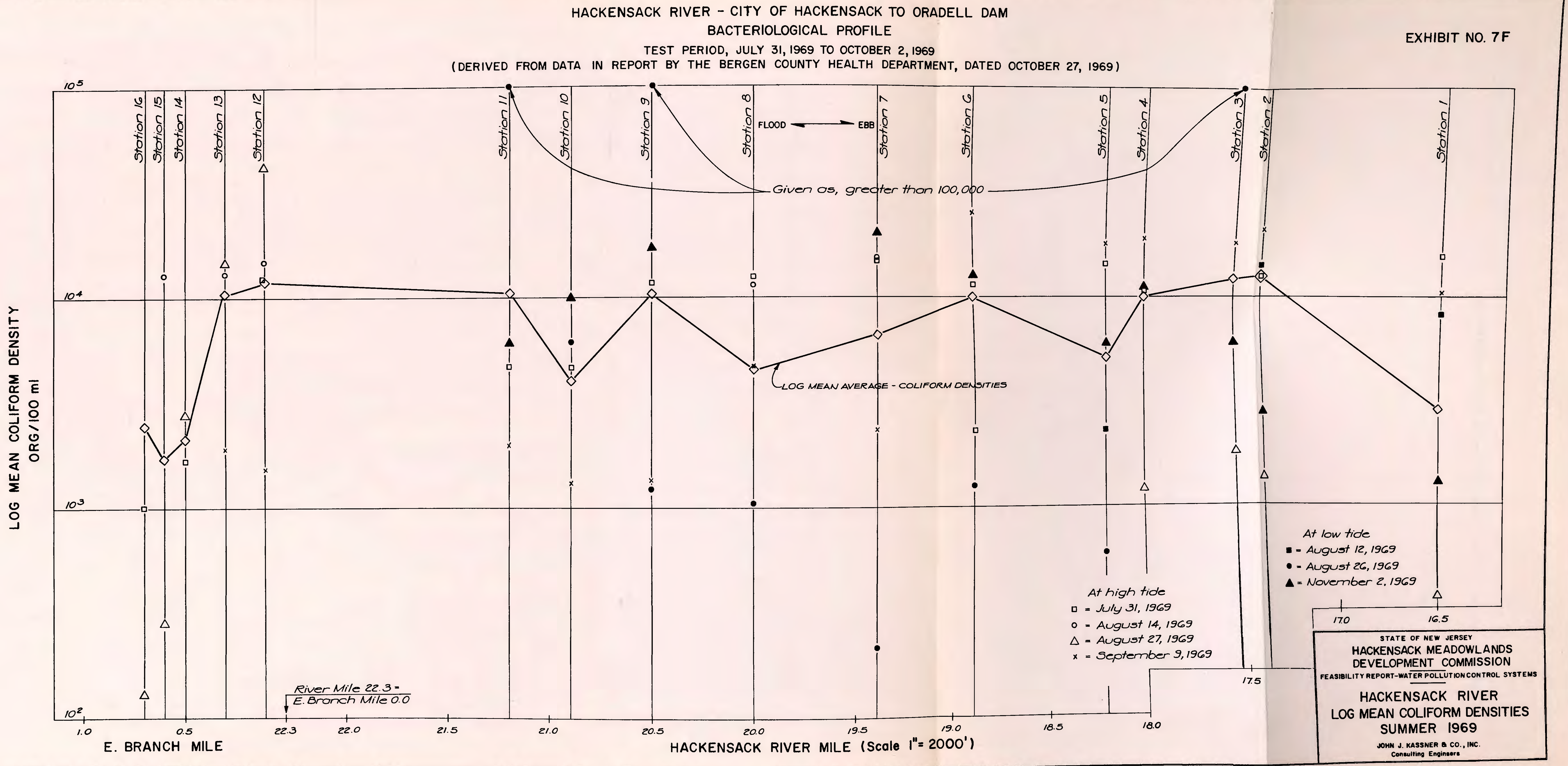


STATE OF NEW JERSEY
HACKENSACK MEADOWLANDS DEVELOPMENT COMMISSION
FEASIBILITY REPORT-WATER POLLUTION CONTROL SYSTEMS

HACKENSACK RIVER COLIFORM PROFILES SUMMER 1964

JOHN J. KASSNER & CO., INC.
Consulting Engineers

EXHIBIT NO. 7F



STATE OF NEW JERSEY
HACKENSACK MEADOWLANDS DEVELOPMENT COMMISSION
FEASIBILITY REPORT-WATER POLLUTION CONTROL SYSTEMS

HACKENSACK RIVER
LOG MEAN COLIFORM DENSITIES
SUMMER 1969

JOHN J. KASSNER & CO., INC.
Consulting Engineers

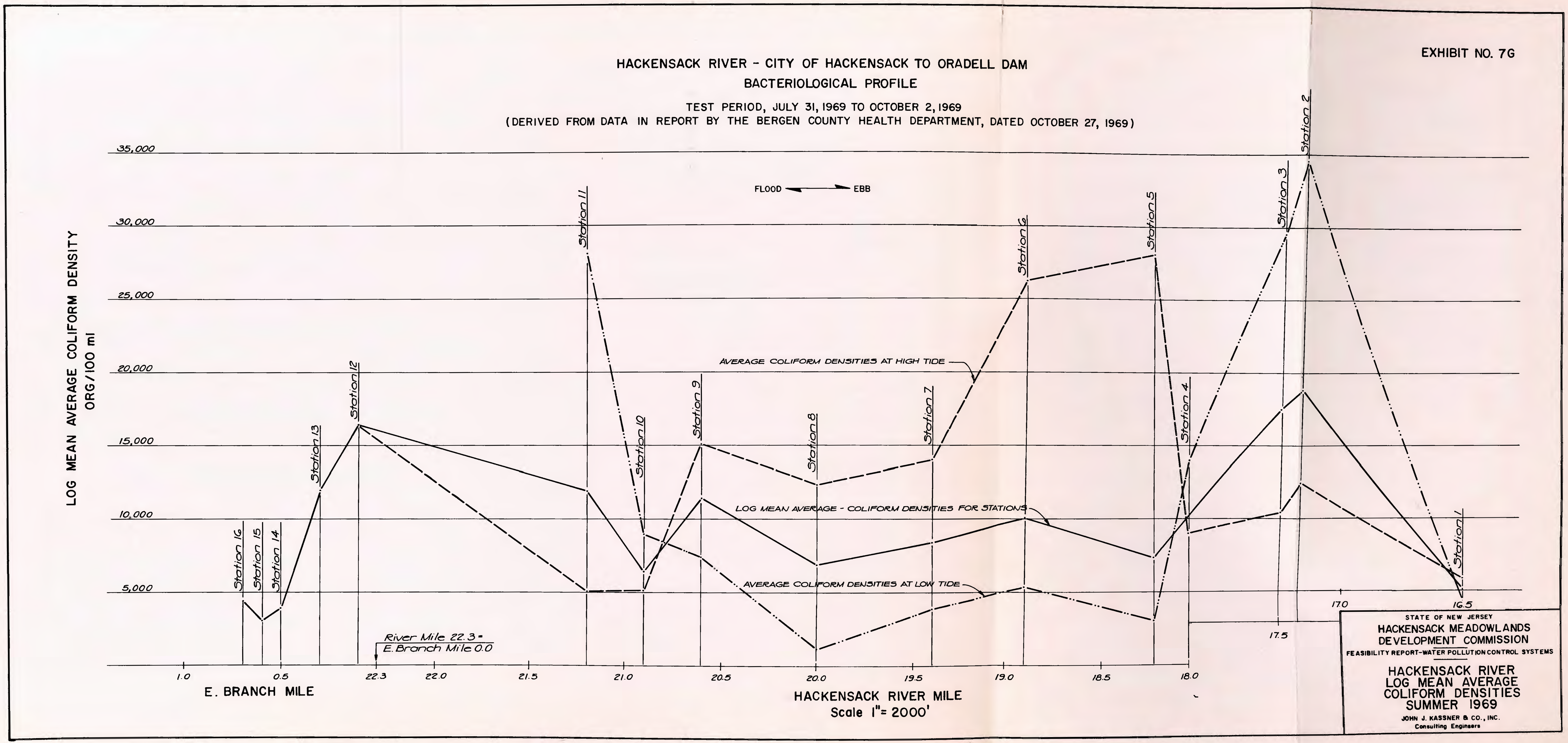


EXHIBIT NO. 7G
HACKENSACK RIVER - CITY OF HACKENSACK TO ORADELL DAM
BACTERIOLOGICAL PROFILE
TEST PERIOD, JULY 31, 1969 TO OCTOBER 2, 1969
(DERIVED FROM DATA IN REPORT BY THE BERGEN COUNTY HEALTH DEPARTMENT, DATED OCTOBER 27, 1969)
LOG MEAN AVERAGE COLIFORM DENSITY
ORG / 100 ml
35,000
30,000
25,000
20,000
15,000
10,000
5,000
FLOOD
EBB
Station 16
Station 15
Station 14
Station 13
Station 12
Station 11
Station 10
Station 9
Station 8
Station 7
Station 6
Station 5
Station 4
Station 3
Station 2
Station 1
AVERAGE COLIFORM DENSITIES AT HIGH TIDE
LOG MEAN AVERAGE - COLIFORM DENSITIES FOR STATIONS
AVERAGE COLIFORM DENSITIES AT LOW TIDE
River Mile 22.3 =
E. Branch Mile 0.0
1.0
0.5
22.3
22.0
21.5
21.0
20.5
20.0
19.5
19.0
18.5
18.0
17.5
17.0
16.5
E. BRANCH MILE
HACKENSACK RIVER MILE
Scale 1" = 2000'
STATE OF NEW JERSEY
HACKENSACK MEADOWLANDS
DEVELOPMENT COMMISSION
FEASIBILITY REPORT-WATER POLLUTION CONTROL SYSTEMS
HACKENSACK RIVER
LOG MEAN AVERAGE
COLIFORM DENSITIES
SUMMER 1969
JOHN J. KASSNER & CO., INC.
Consulting Engineers

In another report prepared by the Division of State and Regional Planning entitled "Technical Report #5A, Engineering & Environmental Health Aspects and Effects of Meadowland Development", dated December 1967, based on data from Public Health Service, it is stated:

"In 1962, for the 853,000 people served in the Hackensack River Basin, the total organic waste from municipal and industrial waste treatment plants that entered the Hackensack River was estimated to be 125,000 pounds of ultimate B.O.D. daily, or the equivalent raw sewage discharged by a population of 500,000".

"Pollution at the mouth of the river near Newark Bay is due to inadequate treatment by the Jersey City West Side Plant and the Kearny Municipal Plant. Both are primary, with Jersey City serving 300,000 people and providing little or no effective B.O.D. reduction. Kearny Plant serves 39,500 people and many industries and provides less than half the removal of the ultimate B.O.D.".

2. Measured D.O. Concentration

The report further states: "The lower portion of the river has approximately 21 sources of waste disposal. The waters of Newark Bay, which are badly polluted, wash periodically through the Meadows. The operation of the Oradell Dam reduces fresh water inflow to zero, and no fresh water flows into the lower portion of the river. This meager flow inhibits natural flushing out of wastes. Also, in this portion of the river, there is relatively low waste assumilative capacity, due to low reareation and low tidal dispersion".

In a separate Proceedings Conference in the Matter of Pollution of the Interstate Waters of the Hudson River and Its Tributaries-New York and New Jersey, Third Session, June 18-19, Albert Bromberg, Chief of Operations, Hudson-Delaware Basins Office, Federal Water Pollution Control Administration, Edison, New Jersey, states in his discussion of the Passaic River and Newark Bay:

"The Passaic River is tidal for about 17 miles from Dundee Dam, located near the Garfield-East Paterson Township lines, to Newark Bay. The remaining portion of the basin is non-tidal".

"D.O. in the tidal portion decreases rapidly to 0.0 mg/1 in the vicinity of Harrison. It increases gradually to about 2.0 mg/1 in the upper portions of Newark Bay".

3. Measured Coliform Organism Densities

Mr. Bromberg further states: "Total coliform concentrations dropped to about 20,000/100 ml just below Dundee Dam and increased to 500,000/100 ml at the confluence of the Passaic River with Newark Bay. Concentrations dropped to 17,000/100 ml in the Bay".

"Fecal coliform concentrations followed the same pattern as total coliform. Below the dam, concentrations were about 2,100/100 ml and increased to about 70,000/100 ml in Newark Bay".

It is of interest to note that the State of New Jersey's established classification for surface waters for Newark Bay is TW-3, which is defined as: "Tidal surface waters used primarily for navigation not recreation. These waters, although not expected to be used for fishing, shall provide for fish survival. These waters shall not be an odor nuisance and shall not cause damage to pleasure craft traversing them".

E. New York University Study of Harbor Water Quality

Since the waters of the tidal portion of the Hackensack River are so intimately associated with the quality and use of the rest of the waters of the New York Harbor Tidal Complex, and particularly Newark Bay, all of these indications of the degree of water pollution, and water quality in these other areas are essential to an understanding of the total problem facing the Meadowlands District. In keeping with this, the following statement by the late Eugene E. Hult, Commissioner of Public Works of the City of New York, made at the Second Session of Conference in the Matter of Pollution of the Interstate Waters of the Hudson River and Its Tributaries-New York and New Jersey, September 20-21, 1967 is cited:

"The city was committed to the program described to insure safe bathing waters at the location of proposed beaches. Unfortunately, however, continued sampling of the receiving waters disclosed a problem concerning the persistent apparent high level of dry weather coliform counts. Since 1946 there has been observed a steady rise in the coliform count in the New York City Harbor, despite the fact that New York City has steadily increased its sewage treatment facilities under the Basic Program over the same period of time. The apparent rise in coliform counts is as yet unexplainable in terms of concomitant population growth or other more readily perceived factors. One recognized source of coliform bacteria has been combined overflows. Of pertinent interest with regard to coliforms from this source is the fact that during a period of drought during the summer of 1964, when storm waters could not be blamed as a significant source of coliform bacteria, no appreciable reduction in coliform occurred, despite that previous die-away studies of coliforms predicted a decrease in coliform density.

Inasmuch as it was expected that the proposed construction of combined overflow treatment plants would remove a major source of coliform bacteria and hence make possible new bathing beaches at proposed locations in Jamaica Bay and the Upper East River, the Department of Public Works felt that prior to undertaking construction of the storm overflow plants it would be prudent to seek more definite information with regard to coliform densities and survival in the New York Harbor over the past 20 years.

New York University was engaged to study and evaluate the New York Harbor coliform density problem with the objective of determining from the available data for the period of time in question, whether the apparent rise in coliform bacteria density has in effect occurred, and if data analysis so indicated, the study would then be shifted to determine the possible cause or causes of the increased coliform density in the New York Harbor. The New York University study was completed and a report entitled 'New York Harbor Coliform Density Pollution Study', dated December 1966, was submitted to the City.

The study based on an extensive analysis of all coliform data collected by the New York City Department of Public Works (New York Harbor Pollution Survey) is summarized in part as follows:

(1) The apparent rise in coliform densities is real, meaningful and significant.

(2) The coliform die-away rates in the harbor waters have not changed significantly.

(3) A definite explanation for the coliform rise is not apparent.

Part of the summary indicates that 'there is an obvious lack of basic information regarding the ecology of the harbor'.

The report recommends that:

(1) The harbor survey program conducted by the City of New York be continued and extended to include improved data processing methods and electronic calculations;

(2) A program to determine the effectiveness of coliform removal by biological, physical or chemical treatment processes be initiated;

(3) The installation of effective coliform reduction facilities at wastewater treatment plants discharging to New York Harbor waters be included in pollution abatement planning;

(4) An ecological base line for the New York Harbor waters be established;

(5) Further investigation of harbor pollution should not be solely concerned with any one individual parameter, but rather should be conducted on the basis that the harbor is a single unified ecological system".

One additional comment made by Mr. Paul DeFalco at the Conference in the Matter of Pollution of the Interstate Waters of the Hudson River and Its Tributaries-New York and New Jersey held on September 28-30, 1965 in discussing D. O.:

"On the basis of the criteria of D. O. content, the river during the survey this August, demonstrated the impact of the wastes discharged to it. The river never returned to a state of relatively complete oxygen saturation until it reached the ocean in the New York Bight. This was the result of additional waste discharge downstream which were sufficient to prevent full recovery. In the immediate city area, from the George Washington Bridge to the Narrows, D. O. levels of less than 4 mg/1 generally prevailed. In general, mean values during warm weather periods are less than 4.0 mg/1 throughout the entire section under consideration.

Oxygen levels in the major tributary areas of New York Harbor similarly showed severly depressed conditions due to large volumes of urban wastes discharged to the system in this area.

Dissolved oxygen values in the Kill Van Kull have often been observed at values less than 2 mg/1 and in the main channel of Newark

Bay at less than 2.5 mg/1. Newark Bay is, in effect, a vast holding pond with little net movement of the wastes discharged to it. These wastes exercise their B.O.D. in the immediate area of the discharge to such an extent as to make the conditions of these waters offensive. In instances when the Passaic Valley sewage treatment plant was discharging to Newark Bay, values of D.O. approaching septicity were experienced throughout Newark Bay and Kill Van Kull".

F. Present Surface Water Classifications and Standards

The New Jersey State Department of Health is empowered to regulate and control wastewater effluents that are discharged to the waters of the State. Toward that end, Surface-Water Classifications and Water Quality Standards have been established by that agency for all water bodies in the State. These classifications, as amended, set up eight specific water classes as follows: Fresh Water (FW)-1, FW-2, and FW-3; Tidal Water (TW)-1, TW-2, TW-3; and Coastal Water (CW)-1 and CW-2. Specific classifications were applied to certain of the river basins including the Hackensack, Passaic and Hudson river basins.

The State Department of Health further promulgated regulations concerning treatment of wastewater, both domestic and industrial, discharged into the waters of certain water systems among which are included the Hackensack River basin and the Passaic River basin, including Newark Bay. These regulations set standards concerning the reduction of bio-chemical demand (B.O.D.) in wastewater before its discharge, and further permit the State to require whatever treatment is needed for compliance with the established water classifications. A copy of the rules and regulations pertaining to water classification and water quality is appended to this Report as Appendix Á, and defines the State of New Jersey's established policy.

Similarly, the State of New York Water Resources Commission has established standards for that State. A copy of "Classifications and Standards of Quality and Purity for Waters of New York State" is also appended to this Report, as Appendix B.

The present water classifications applied to the Hackensack River and to the New York Harbor Complex are depicted on Exhibit No. 8, Present Surface Water Classifications.

These classifications and wastewater treatment regulations represent the goals that the States have set in upgrading the quality of surface water supplies.

G. Summary

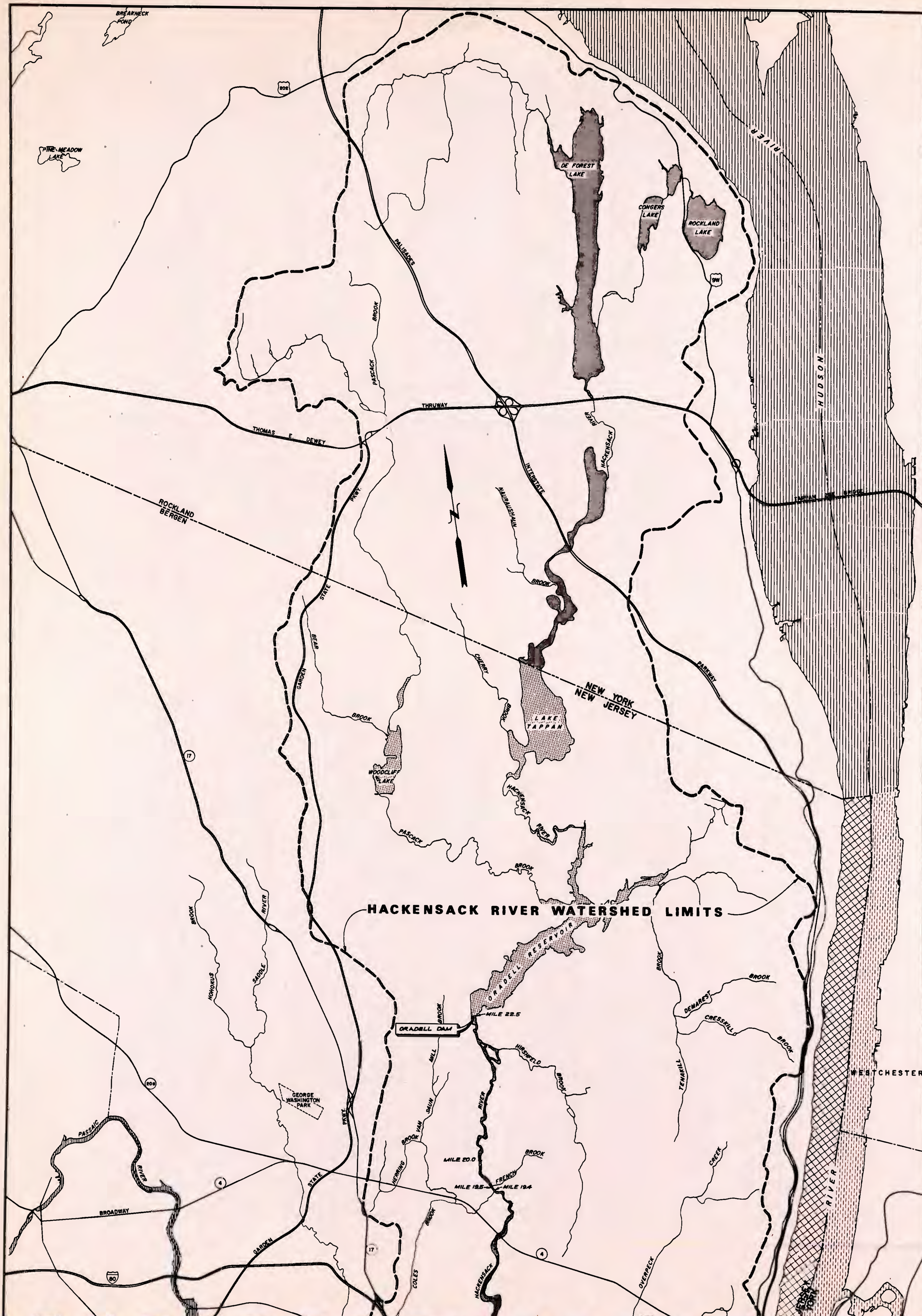
It becomes apparent then, that the present water quality must be evaluated in conjunction with the anticipated land use adjacent to the Hackensack River.

As long as the Meadowlands area and portions of the Newark Bay area were to be mere navigation centers, industrial complexes and dumping grounds for the solid wastes and refuse, the existing water quality in the Hackensack River might continue to be tolerated. However, since the Rivers and adjacent land areas of New Jersey are no longer considered merely dumping grounds for man's wastes, the combined information gathered from the many diverse sources all point inexorably to the unhappy conclusion that the present water quality within the Hackensack River is far from satisfactory.

The low dissolved oxygen, the high organic loading, the presence of excess turbidity, floating oil and taste and odor producing substances, the existence of benthic deposits, the lack of adequate advective flow and the continued discharge of surface water, industrial wastes and inadequately treated sanitary wastes all combine to degrade the quality of the River.

There is small hope for significant improvement in the existing water quality if the goals set forth in the present water quality standards are set so low and even these are not strictly and forcefully adhered to. The present water quality, as has been found and reported by all the individuals and agencies that have studied the Hackensack River, is a picture of continuing degradation.

Only a strong, concerted, well monitored and effectively enforced policy of improved collection and treatment will reverse the present trend of degradation of the River quality and permit the planned development of the Meadowlands District.



HACKENSACK RIVER WATERSHED LIMITS
HUDSON RIVER
DE FOREST LAKE
CONGERS LAKE
ROCKLAND LAKE
LAKE TAPPAN
WOODCLIFF LAKE
ORADELL RESERVOIR
ORADELL DAM
MILE 22.5
MILE 20.0
MILE 19.5
MILE 19.4
NEW YORK
NEW JERSEY
ROCKLAND
BERGEN
WESTCHESTER
THRUWAY
THOMAS E. DEWEY
PALISADES
INTERSTATE
PARKWAY
GARDEN STATE PKWY.
TAPPAN ZEE BRIDGE
HACKENSACK RIVER
PASCACK BROOK
BEAR BROOK
CHERRY BROOK
NAURAUSHAUN BROOK
SADDLE RIVER
HOHOKUS BROOK
MILL BROOK
VAN SAUN BROOK
HERRING BROOK
COLES BROOK
HIRSHFELD BROOK
FRENCH BROOK
TENAKILL BROOK
CRESSKILL BROOK
DEMAREST BROOK
OVERPECK CREEK
PASSAIC RIVER
BROADWAY
GEORGE WASHINGTON PARK
BREAKNECK POND
PINE MEADOW LAKE

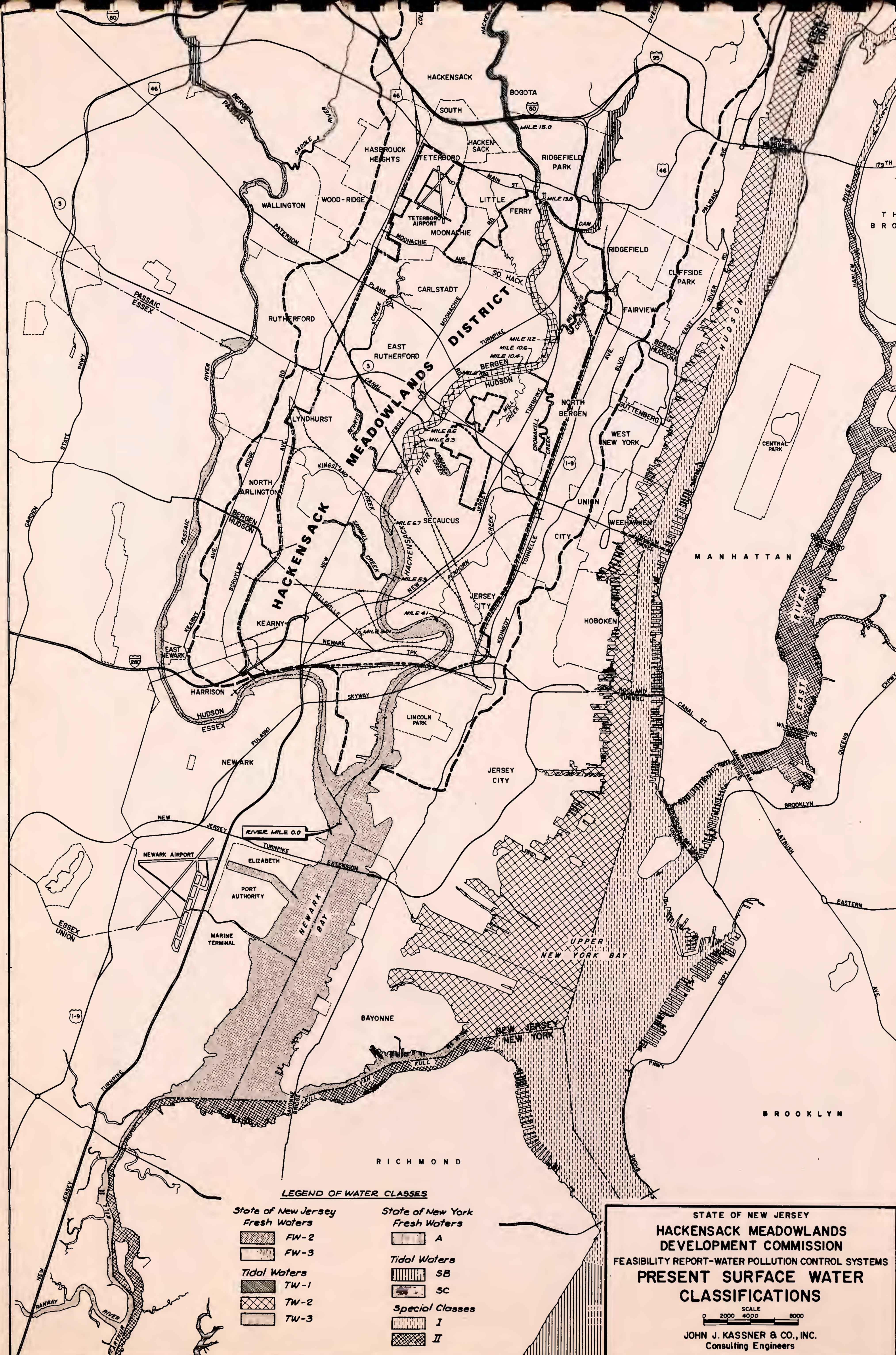

STATE OF NEW JERSEY
HACKENSACK MEADOWLANDS
DEVELOPMENT COMMISSION
FEASIBILITY REPORT-WATER POLLUTION CONTROL SYSTEMS
PRESENT SURFACE WATER
CLASSIFICATIONS
SCALE
0 2000 4000 8000
JOHN J. KASSNER & CO., INC.
Consulting Engineers
LEGEND OF WATER CLASSES
State of New Jersey
Fresh Waters
FW-2
FW-3
Tidal Waters
TW-1
TW-2
TW-3
State of New York
Fresh Waters
A
Tidal Waters
SB
SC
Special Classes
I
II
HACKENSACK MEADOWLANDS DISTRICT
HACKENSACK
SOUTH HACKENSACK
BOGOTA
HASBROUCK HEIGHTS
TETERBORO
TETERBORO AIRPORT
RIDGEFIELD PARK
WALLINGTON
WOOD-RIDGE
LITTLE FERRY
MOONACHIE
RIDGEFIELD
CARLSTADT
CLIFFSIDE PARK
FAIRVIEW
RUTHERFORD
EAST RUTHERFORD
NORTH BERGEN
GUTTENBERG
WEST NEW YORK
LYNDHURST
NORTH ARLINGTON
SECAUCUS
UNION CITY
WEEHAWKEN
KEARNY
JERSEY CITY
HOBOKEN
EAST NEWARK
HARRISON
NEWARK
LINCOLN PARK
NEWARK AIRPORT
ELIZABETH
PORT AUTHORITY
MARINE TERMINAL
NEWARK BAY
BAYONNE
UPPER NEW YORK BAY
RICHMOND
BROOKLYN
MANHATTAN
CENTRAL PARK
THE BRONX
QUEENS
HUDSON RIVER
EAST RIVER
HARLEM RIVER
HACKENSACK RIVER
PASSAIC RIVER
SADDLE RIVER
KILL VAN KULL
ARTHUR KILL
RAHWAY RIVER
BERGEN PASSAIC
PASSAIC ESSEX
BERGEN HUDSON
HUDSON ESSEX
ESSEX UNION
NEW JERSEY NEW YORK
MILE 15.0
MILE 13.8
MILE 11.2
MILE 10.6
MILE 10.4
MILE 8.6
MILE 8.3
MILE 6.7
MILE 5.9
MILE 4.1
MILE 3.01
RIVER MILE 0.0
DAM
GEORGE WASHINGTON BRIDGE
179TH ST.
HOLLAND TUNNEL
LINCOLN TUNNEL
CANAL ST.
WILLIAMSBURG BRIDGE
MANHATTAN BRIDGE
BROOKLYN BRIDGE
QUEENSBORO BRIDGE
BAYONNE BRIDGE
NEW JERSEY TURNPIKE
TURNPIKE EXTENSION
PULASKI SKYWAY
GARDEN STATE PKWY
EASTERN PKWY.
FLATBUSH AVE.
BELT PKWY.

EXHIBIT NO. 8

SECTION V. THE COMPREHENSIVE MASTER PLAN

A. Proposed Development

The Comprehensive Master Plan promulgated by the Hackensack Meadowlands Development Commission for orderly development of the Meadowlands envisions a "reconstituted urban environment" in the area already subjected to the many pressures of an urban economy, as compared to a "new town" or a "planned community" if the Meadowlands were an untouched piece of real estate. The Comprehensive Master Plan together with its companion Land Use Plan provide the framework for such orderly development.

Recognition of the inherent problems that political, financial and physical pressures have created in the heretofore somewhat disorderly development of portions of the Meadowlands was a major factor in the Plan's creation. These general problems have been recognized and solutions are being provided through the Plan and the efforts of the Hackensack Meadowlands Commission, its staff and consultants.

The approach used to prepare the Land Use Plan is best defined in the words of the planners as being based on the following criteria:

> "that it serve the physical and environmental needs of the communities and the region concerned; that it be economically feasible; that it can begin to be implemented in the near-term; that it serve the long-range needs of the area as well as those of the short-term; that it can be phased in logical steps; that it be 'balanced' in terms of industrial, residential, commercial, recreational and open space uses; that it be flexible (the needs of the communities involved will undoubtedly change over the time frame of the development of the Meadowlands); that it be imaginative; that it employ new technology in the implementation of the plan and its physical development; that it minimize the disruption of and attempt to preserve the ecological balance of the area."

The Plan provides for a balance of land use aimed to meet the needs of the communities directly involved and the region as a whole and, in addition, provides the flexibility required to meet changing needs as encountered during the term of development. The largest single allocation of land use is for conservation, recreation and open space with accompanying areas of development for warehousing and industrial use; office and research facilities; residential development; educational facilities and cultural activities. Services such as roads and highways, mass transit systems; water supply, solid waste disposal and sewage treatment have all been considered in the Plan.

Once again quoting the planners:

> "Basically, the land development plan which is recommended attempts to focus the future development at the Meadowlands on a precise objective, namely, the <u>improvement of the total environment and the creation of a sound, balanced, flexible, economically feasible development system which maximizes the benefits and reduces costs to the point where optimum and judicious utilization of the land is achieved in a series of phased development elements, each one of which relates to that which has preceded it and that which follows.</u> Those portions of the land in the Meadowlands which can best be developed will be developed under this plan. Those portions which are best retained as open space have been retained for open space.".

B. Engineering Elements

Engineering elements vitally influencing the preparation and implementation of the Plan are listed below:

1. <u>Reclamation and Flood Control:</u> Recommendation is made for the implementation of a modification of a plan developed by the U.S. Army, Corps of Engineers. The planners recognized that commencement of a reclamation and flood control project by the Corps is not probable in the near future and have therefore recommended interim measures designed to permit development of portions of the Meadowlands during the intervening period.

2. <u>Soil and Foundation Conditions:</u> Land use areas were allocated to uses which would be most compatible with the expected type of soil structure to be encountered in the given area.

3. Solid Waste Disposal: The relative instability of solid waste land fill dictated use of such areas for permanent park areas, golf courses, parking lots, open commercial recreation areas, and for building material storage areas. The Comprehensive Master Plan locates high density structures in some of the areas filled with solid wastes but provides that the structure be supported independently of the land fill and be surrounded by extensive lawns or landscaped areas.

4. Transportation: The Comprehensive Master Plan envisions a comprehensive transportation system encompassing shipping and water transport, air transport, highways, freight and passenger railroads and rail rapid transit.

Continuation of river transport of cargo is planned to serve existing and new industries. Marinas and water-oriented commercial recreation areas are proposed along the river and use of water buses is planned for local passenger service in lieu of the usual dependence on automotive transport.

Air transport facilities are presently provided at Teterboro Airport and the Plan proposes an adjacent transportation center and improved highway access to this existing, expanding facility.

The Plan recognizes the necessity, and provides for the expansion of existing highways serving the areas surrounding the Meadowlands and addition to highways to serve increased traffic to be generated by the Meadowlands development. These roads are to be designed for both "through" and "local" traffic as required for an orderly flow.

Freight and passenger railroads presently cross the Meadowlands and maintain extensive freight yard facilities therein. The Comprehensive Master Plan proposes the retention of these existing facilities and anticipates an expansion of rail transport oriented industrial use.

The Comprehensive Master Plan proposes the creation of an overall transit system to provide rail rapid transit between New York City and its westerly environs. This system envisions the use of modified present railroad facilities augmented by new lines and equipment as needed to create an attractive and efficient rapid transit system. It also proposes that four transportation centers be provided to intercept automobile commuters, provide parking areas and rail transit facilities leading to New York, Newark and other destinations. These centers will also provide office and commercial facilities making them destination points for future New Jersey commuters.

5. Utilities: This is generally subdivided into three categories, Sanitary Sewage Disposal, Water Supply and Electric Power, Natural Gas and Telephone.

The Comprehensive Master Plan proposals for Sanitary Sewage Disposal are best presented in the words of the planners:

> "The Plan proposes that all sanitary sewage draining into the Planning Area be collected and delivered to a treatment facility or facilities that will provide a high quality effluent.
>
> The sewer collection system, treatment plant location and method of treatment should be as recommended by your sanitary engineering consultants, however, the result should produce an effluent that in itself would not make the Hackensack River and planned water areas unsuitable for boating or esthetically displeasing.
>
> The system should provide that one day the quality of the effluent would meet the requirements of water contact sports.
>
> The Plan proposes that steps should be taken to upgrade the present treatment plants at the head of Newark Bay.
>
> Although a major source of pollution in the Meadowlands is in the exchange of water from Newark Bay, the intent is that the measures described above will raise the water quality of the Hackensack River and the planned water areas to a point where boating will be pleasurable and where living on or adjacent to the River will not be unpleasant.

The Plan proposes that no water-oriented residential uses be constructed until the water quality level of the Hackensack River is improved as set forth above. This time period is assumed to be about 10 years.

The Plan assumes that the growing national interest in curbing pollution and protecting water resources will, over a longer period of time, result in lowering the pollution of Newark Bay and the Hudson River, and thereby further increasing the quality of water areas within the Meadowlands."

Sanitary sewage disposal as outlined in the Comprehensive Master Plan is the subject of this Feasibility Report on Water Pollution Control Systems which has been developed within the general framework of the Comprehensive Master Plan proposals presented.

On the strength of an expression of confidence by the water supply agencies that water supplies can be developed on a state-wide basis to meet anticipated demands created by Meadowlands development, the Comprehensive Master Plan envisions no deterrent to the planned development.

Electrical power, natural gas and telephone service companies have also expressed confidence in their ability to meet demands created by the proposed development, according to the planners.

6. Pollution Controls: This is divided into two categories, water pollution and air pollution.

The Comprehensive Master Plan proposals for the control of river and ground water pollution are broad in concept and envision the collection and treatment of all sanitary sewage originating in or draining into the Meadowlands; zoning controls to prohibit the development of industries producing unacceptable waste water discharge; stringent control and limitation of solid waste disposal in the Meadowlands; and exploration of alternative methods for solid waste disposal.

Proposals for control of air pollution are similarly broad in concept and treat with zoning control of air polluting industries; design controls for public or quasi-public installations; reduction of automotive use through use of alternative modes of transportation; and the limitation of potential sources of pollution through reservation of permanent land and water open areas.

C. The Land Use Plan

1. General

The Land Use Plan, Exhibit No. 9, is reproduced from the Comprehensive Master Plan Report and graphically illustrates the Master Plan. It shows the locations assigned to categories of planned land use and shows present and proposed waterways, highways, railroads and transit lines.

The Comprehensive Master Plan provides for continuing development of the perimeter areas of the Meadowlands District as extensions of the surrounding communities. The land uses allocated include those uses already being utilized, and further provides for uses necessary to implement the balance of the Plan. The land uses planned for the perimeter areas are distribution and warehousing; manufacturing; research parks and transportation terminals, all interspersed with public parks.

The central section of the Meadowlands District is planned to contain a predominance of open areas encompassing six square miles of marshlands and open water together with 1000 acres of public parks, 500 acres of commercial recreation areas and 250 acres of school-related parks. Within the central core are planned residential units of varied types, some being "water oriented" or built over the undisturbed marshlands and some "parkside oriented" or directly related to major park and recreational facilities. Schools, local commercial centers and parking areas are to be included as appropriate. A "central business district" oriented to Berrys Creek Canal and accessible to both Meadowlands residents and residents from peripheral areas, will serve to provide commercial opportunities not available at the local level. Also recommended are cultural facilities such as museums, art galleries and botanical gardens; facilities for the performing arts; hotel accommodations; and other facilities necessary to the balance of the Comprehensive Master Plan.

EXHIBIT NO. 9

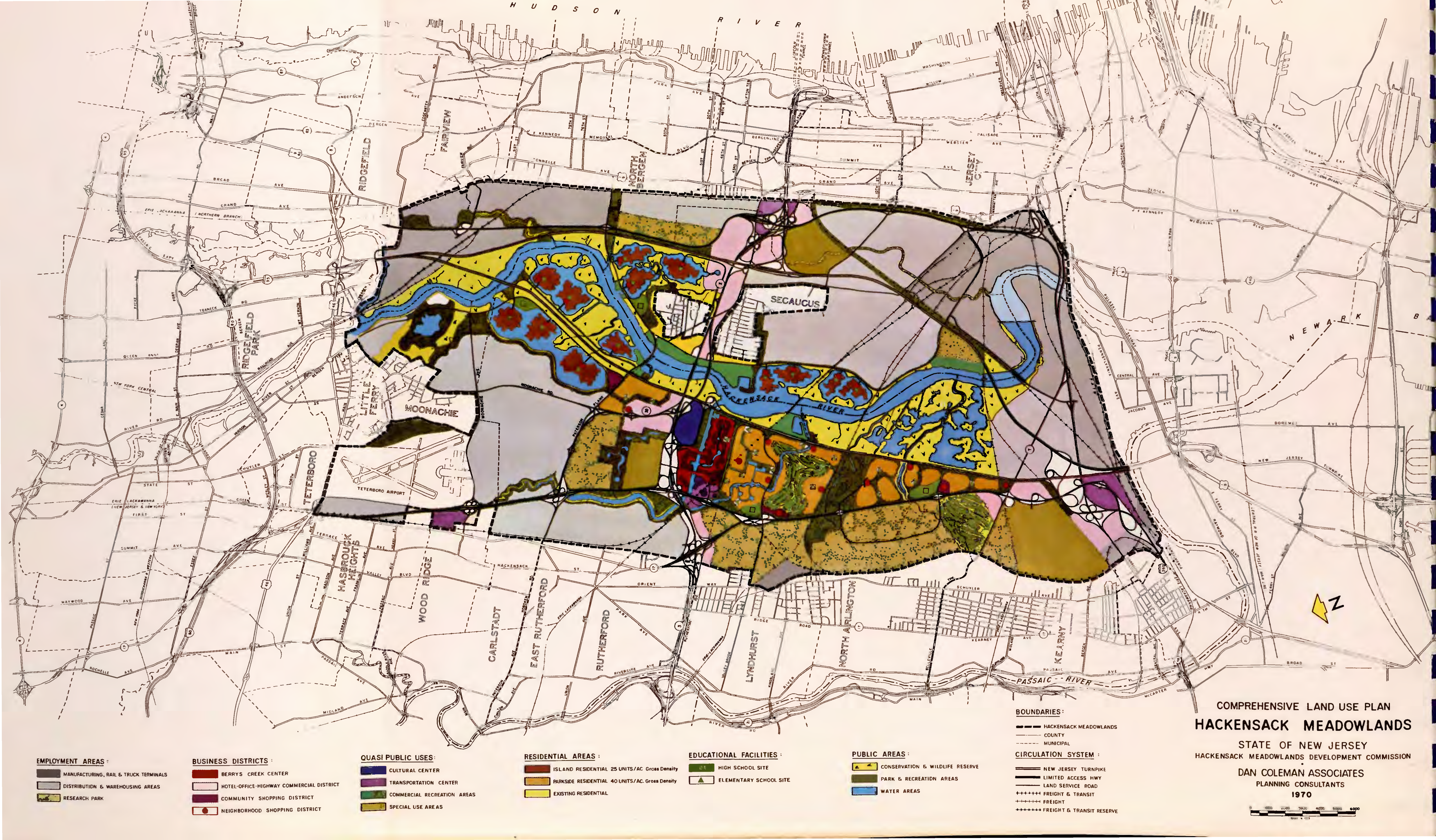
STATE OF NEW JERSEY

HACKENSACK MEADOWLANDS
DEVELOPMENT COMMISSION

FEASIBILITY REPORT-WATER POLLUTION CONTROL SYSTEMS

COMPREHENSIVE
LAND USE PLAN

JOHN J. KASSNER & CO., INC.
Consulting Engineers


HUDSON RIVER
FAIRVIEW
RIDGEFIELD
NORTH BERGEN
JERSEY CITY
SECAUCUS
RIDGEFIELD PARK
LITTLE FERRY
MOONACHIE
TETERBORO
TETERBORO AIRPORT
HACKENSACK RIVER
NEWARK BAY
HASBROUCK HEIGHTS
WOOD RIDGE
CARLSTADT
EAST RUTHERFORD
RUTHERFORD
LYNDHURST
NORTH ARLINGTON
KEARNY
PASSAIC RIVER
EMPLOYMENT AREAS:
MANUFACTURING, RAIL & TRUCK TERMINALS
DISTRIBUTION & WAREHOUSING AREAS
RESEARCH PARK
BUSINESS DISTRICTS:
BERRYS CREEK CENTER
HOTEL-OFFICE-HIGHWAY COMMERCIAL DISTRICT
COMMUNITY SHOPPING DISTRICT
NEIGHBORHOOD SHOPPING DISTRICT
QUASI PUBLIC USES:
CULTURAL CENTER
TRANSPORTATION CENTER
COMMERCIAL RECREATION AREAS
SPECIAL USE AREAS
RESIDENTIAL AREAS:
ISLAND RESIDENTIAL 25 UNITS/AC Gross Density
PARKSIDE RESIDENTIAL 40 UNITS/AC. Gross Density
EXISTING RESIDENTIAL
EDUCATIONAL FACILITIES:
HIGH SCHOOL SITE
ELEMENTARY SCHOOL SITE
PUBLIC AREAS:
CONSERVATION & WILDLIFE RESERVE
PARK & RECREATION AREAS
WATER AREAS
BOUNDARIES:
HACKENSACK MEADOWLANDS
COUNTY
MUNICIPAL
CIRCULATION SYSTEM:
NEW JERSEY TURNPIKE
LIMITED ACCESS HWY
LAND SERVICE ROAD
FREIGHT & TRANSIT
FREIGHT
FREIGHT & TRANSIT RESERVE
COMPREHENSIVE LAND USE PLAN
HACKENSACK MEADOWLANDS
STATE OF NEW JERSEY
HACKENSACK MEADOWLANDS DEVELOPMENT COMMISSION
DAN COLEMAN ASSOCIATES
PLANNING CONSULTANTS
1970

A map and a rendering of the Land Use Plan for the Meadowlands are presented on the facing fold-out pages.

The pivotal part of the plan is a central, six square mile regional breathing space, recreational water park and marsh conservation-wildlife preserve running the length of the District.

Main Features of the Plan

- a water-oriented business, shopping, civic and cultural complex, built along parks and plazas, pedestrianways and the restored Berrys Creek Canal. The complex is planned to include educational and medical institutions, museums, art galleries, facilities for the performing arts, office buildings and a regional shopping area.

- new and improved commuter and rail transit facilities.

- Transportation Centers, where commuters can transfer to rail and bus facilities leading into New York, Newark and other destinations. The Transportation Centers also will include office buildings, making them destination points for a significant number of future New Jersey commuters.

- 1,000 acres of public park and 500 acres of commercial recreation space, such as marinas and golf courses, buffering existing uses and extending in fingers from the water areas to residential zones in the plan and to upland communities.

- complete residential communities directly related to major parks and recreation areas, with internal linear parks and pedestrianways connecting all school, recreation and commercial facilities within these planned neighborhoods.

- island residential clusters, built along the water and over looking the preserved marshlands with neighborhood shopping, elementary schools and parking facilities planned as part of each island development.

- the logical filling out and extension of existing development meeting the local needs of job opportunities and tax ratables.

- upgraded employment zones with increased office, business, hotel, entertainment and research uses.

- transformation of abandoned landfill sites into appropriate uses, mainly park and recreation, to remove blight and enhance the attractiveness of adjacent lands.

2. Land Use Zones

The Land Use Plan encompasses an area of approximately 19,600 acres and allocates specific uses to the various areas depicted on the Land Use Plan. These zones fall into the following seven (7) major categories:

a. Employment Areas

Manufacturing Rail, and Truck Terminals, encompassing 1,500 acres of which 800 are presently undeveloped. Based on projected trends the planners anticipate that population density in this category will be 15 employed people per acre.

Railroads, encompassing 1,000 acres of which 25 acres are presently undeveloped, with an assigned population density of 1 employed person per acre.

The areas thus designated lie along the southerly, southeasterly and northeasterly limits of the planning area and it is proposed that rail and truck terminals, open building material storage and heavier manufacturing be permitted in these areas.

Distribution and Warehousing, encompassing 4,000 acres of which 2,200 acres are at present undeveloped. The assigned population density for this land use is 9 employees per acre.

The areas assigned to distribution and warehousing use lie generally on the perimeter of the planning area where this general type of development has already been established.

Research Park, encompassing 1,400 acres of which 1,300 acres are presently undeveloped. A population density factor of 15 employed people per acre has been assigned to this land use category.

The areas in this category lie along the southwesterly perimeter and near the center of the easterly perimeter. The Plan foresees development in this category to be "extensively landscaped campus type" development.

b. Business Districts

Berrys Creek Center, referred to in the Comprehensive Master Plan as the "Central Business District", encompasses approximately 200 acres of which the planners have assigned 100 acres to be used for high density residential use, 50 acres for office use and the remaining 50 acres for the commercial elements of the Central Business District. To each of the above, the planners have assigned population density factors of 140 employees per acre, 500 employees per acre and 50 employees per acre, respectively.

The planners have designated the Central Business District as a regional shopping center readily accessible to water, rail and automobile transit. Located along the water astride Berrys Creek Canal, embodying far sighted architectural concepts, this water-oriented center should have all the aesthetic charm of Venice's San Marco Plaza and will be the focal point of the Meadowlands District.

Hotel-Office-Highway Commercial District areas, encompassing a total of 500 acres which include 200 acres devoted to hotel, motel and convention space with a total of 10,000 rooms; 200 acres devoted to office use with a total of ten million square feet of office space; and 100 acres devoted to commercial uses such as showrooms similar to automobile dealerships. To each of these prospective uses, the planners have assigned population density factors of 25 employees per acre, 250 employees per acre and 10 employees per acre respectively. Of the total 500 acres, 310 acres are presently undeveloped. The remaining 190 acres are presently developed but some redevelopment is anticipated.

These combined use areas are seen as a series of service centers conveniently located near Transportation Centers, near the Civic and Cultural Center, and on main arterial routes to New York City. These service centers would serve nearby industries and others desiring headquarters facilities, in addition to providing restaurants, recreation and entertainment facilities.

Community Shopping District areas encompassing 45 acres, all presently undeveloped, in addition to the similarly allocated acreage in Berrys Creek Center. To this use, the planners have assigned a population factor of 15 employees per acre. The Comprehensive Master Plan envisions each Community Shopping District as supporting a population of about 50,000 persons, three being conveniently located west of the Hackensack River and a fourth being the existing shopping district in the Town of Secaucus.

Neighborhood Shopping District areas encompassing 120 acres, all presently undeveloped, to which a population density of 15 employees per acre has also been assigned. The Comprehensive Master Plan envisions twenty-four Neighborhood Shopping Districts, each being located immediately adjacent to its supporting population of 5,000 to 10,000 persons.

c. Special Facilities and Quasi-Public Uses

Cultural Center, encompassing 50 presently undeveloped acres, to which the planners have assigned a population density factor of 10 employed persons per acre.

This facility, which could contain museums, art galleries, botanical gardens, theatres and public buildings, is envisioned as serving all of the Northern New Jersey as well as the Meadowlands. It is centrally located adjacent to the Central Business District and is accessible by all modes of transportation.

Transportation Center areas, encompassing 150 acres at four strategically located points of which 130 acres are presently undeveloped. It is anticipated that some redevelopment will be required in the remaining 20 acres. In addition to furnishing 100 acres of parking space and functioning as commuter interception points where automobile commuters could transfer to rail or bus transit, these centers are planned to include 50 acres of employment facilities, primarily office space. Population density factors assigned are 500 employed persons per acre for the office space and 5 employees per acre for the parking space.

Commercial Recreation areas will encompass 500 acres of land planned for quasi-public uses which might include such facilities as golf courses, archery ranges, stable areas and in the areas adjacent to open waters, related uses such as marinas and "fisherman's wharf" type development. Of the 500 acres, 450 acres are presently undeveloped and it is anticipated that some redevelopment will be required in the remaining 50 acres. A population factor of one employee per acre has been assigned to this use.

Special Use areas of 700 presently undeveloped acres in three tracts located near Transportation Centers and the Central Business District to which has been assigned a population factor of one employee per acre.

d. Residential Areas

Island Residential, encompassing a total of 650 presently undeveloped acres, to which population factors of 125 residents per acre and 1 employee per 20 dwelling units have been assigned.

Park Side Residential, encompassing a total of 750 acres of presently undeveloped acres, to which population factors of 140 residents per acre and 1 employee per 20 dwelling units have been assigned.

All planned housing in the Meadowlands District is placed in or adjacent to the open water conservation areas or park areas with the residential units being in cluster groups with a proposed mix of townhouses, garden or medium use apartments and high rise apartments. Housing unit density would average approximately 25 units per acre for waterfront areas and from 40 to 50 units per acre for parkside areas.

Existing Residential encompassing a total area of 235 presently developed acres within the Hackensack Meadowlands District in the Town of Secaucus and Borough of Little Ferry. The existing development in these areas is considered to be low density residential to which a population factor of approximately 16 residents per acre has been assigned.

e. Educational Facilities

High School Sites, encompassing a total of 100 presently undeveloped acres in four, 25 acre sites.

Elementary School Sites, encompassing a total of 150 presently undeveloped acres in thirty, 5 acre sites.

A population factor of 4 employees per acre has been assigned to all school sites.

f. Public Areas

Conservation, encompassing 1,500 acres of existing tidal marshland in an undisturbed state generally along the River and containing isolated areas as well as areas in which residential "islands" are planned.

Park and Recreation Areas, encompassing a total of 1,000 presently undeveloped acres, are generally located adjacent to waterways but also, to quote the planners, "extending as a series of green fingers from the central conservation and water park area to the residential areas of the surrounding communities".

Water Areas, encompassing approximately 2,200 acres.

g. Circulation System

Areas encompassing an approximate total of 2,200 of which 1,180 acres are undeveloped and 1,020 presently developed acres occupied by local service roads, the New Jersey Turnpike and limited access roads.

\- - - - - -

The foregoing planned land uses, together with their assigned population factors, are basic determinants for the location and size of interceptor sewers in the water pollution control systems.

Table 4, Summary of Land Use and Table 5, Summary of Population Factors, are tabulations of statistical data pertaining to land use and to anticipated population factors derived from the Master Plan.

D. Plan Implementation

A number of factors concerning implementation of the Comprehensive Master Plan bear directly on possible water pollution control systems for the Meadowlands:

1. Reclamation and Flood Control Facilities

The Corps of Engineers has made preliminary studies of seven (7) plans to control flooding of the Meadowlands. These plans fall into three basic categories:

a. The river remaining open to tidal variations.
b. The river being permanently closed by a tidal barrier.
c. The river remaining open to tidal variations except in times of tidal surges, when the River is temporarily closed by a tidal barrier.

The Comprehensive Master Plan advocates a modified Corps of Engineers plan which provides for a tidal barrier to be built across the Hackensack River at the south edge of the Meadowlands District with a sector gate and a series of spillway bays. The sector gate will be open to permit water traffic except during periods of high tidal surges, when the sector gate will be closed. At such times, the water level in the River will be maintained by pumping River flow to a point downstream of the barrier.

This Report considers that this modified Corps of Engineers plan will be constructed and be in operation concurrently with the recommended water pollution control system.

2. Potable Water Supply

It has been reported that a shortage of potable water may soon occur in the Hackensack River basin unless new potable water sources outside the basin are developed and utilized. Comprehensive development of the Hackensack Meadowlands District can be expected to compound the possibility of a water shortage. As the availability of useable water has a direct relationship to the production of waste waters requiring treatment for pollution control, the amount of water available can influence the amount of sewage generated. The Comprehensive Master Plan and this Report assume that sufficient potable water will be available as needed for the orderly development of the Meadowlands.

3. Conservation and Water Areas

The Comprehensive Master Plan allocates a total of 3,700 acres to remain permanently in marshland conservation and water use. The water quality of the River will have a direct effect on the preservation of the present, and enhancement of the future ecology of those areas to be devoted to conservation. The quality of the water will also directly effect the degree to which recreational use of the River may be developed. The Comprehensive Master Plan has established broad goals to achieve the preservation and improvement of the conservation areas and to improve the River to the end that "boating will be pleasurable and where living on or adjacent to the River will not be unpleasant". The Comprehensive Master Plan further assumes that growing national interest in curbing pollution and protecting water resources will result in an area-wide general improvement of the waterways and thereby further improve the quality of the Hackensack River in the Meadowlands District.

Degree of treatment of waste waters is generally governed by the desired quality in the receiving water body. Degree of treatment of waste waters also directly effects the cost of achievement thereof. Lower goals would logically result in lower costs. The water quality standards recommended in this Report and the water pollution control systems developed to affect the desired quality are predicated on the goals of the Comprehensive Master Plan.

4. Solid Wastes Disposal

The Meadowlands District has been a repository for solid wastes produced by many municipalities in the surrounding area. The Comprehensive Master Plan is charged with providing that at least the present solid waste disposal capacity of the Meadowlands be maintained; however, the method of disposal is not mandated.

Land fills made from solid wastes of varying age and composition presently exist in the Meadowlands District. Some of these fills are in contact with the tidal waters thereby contributing to the pollution of the River through a leaching process. Similar fills which are not in direct contact with the tidal waters contribute polluting leachates through infiltration of rainfall and stormwater runoff into the ground water and progressively into the river. A separate study is being made of the solid wastes disposal aspect of the Comprehensive Master Plan by the Commission's consultants.

The River water quality and the water pollution control systems recommended in this Report recognize that land fill leachates are present but do not provide for the collection and treatment thereof. This Report does, however, provide for the treatment of wastewaters emanating from regional incinerators, should the Commission elect incineration as the type of solid waste disposal to be implemented.

5. Developed Topography

The Comprehensive Master Plan proposes that land reclamation and development may continue in the Meadowlands District prior to the construction of the tidal barrier and its supplementary pumping systems. The Plan proposes that land to be so developed must be protected by filling above flood levels or by construction of dikes. Land development will take place in an orderly sequential manner with certain water oriented housing to be constructed over existing or dredged out waterways.

It is the intention of this Feasibility Report on Water Pollution Control Systems to provide the medium whereby interceptor sewers and sewage treatment facilities may be made available when needed according to the time table established by the Comprehensive Master Plan.

The River water quality and the water pollution controls recommended in this Report assume that satisfactory methods will be utilized to prevent impedance of free circulation of tidal flow and surface water runoff.

6. Staging

The Land Use Plan proposes "that it can be implemented in the near-term; that it serve the long-range needs of the area as well as those of the short-term; that it can be phased in logical steps". In this connection, the Comprehensive Master Plan provides for continued development on the perimeter of the Meadowlands where utilities, including sanitary sewerage facilities, are available or will be available in the very near future. Later development will progress within the designated "planning area", upon which area a temporary moratorium against development has been placed by the Meadowlands Commission. An approximate period of thirty years is expected to be required for the ultimate development which is planned to follow a logical sequence of demand for certain land uses. Availability of such land for development will be dependent upon land reclamation together with provision of utilities, including sanitary sewers and sewage treatment as well as improvement of the River water quality.

TABLE 4

SUMMARY OF LAND USE ALLOCATION ACCORDING TO THE COMPREHENSIVE MASTER PLAN

LAND USE CATEGORY	TOTAL AREA (ACRES)	FUTURE USE AREA (ACRES)	EXISTING USE AREA (ACRES)
Distribution & Warehousing	4,000	2,200	1,800
Manufacturing & Truck Terminals	1,500	800	700
Research Parks	1,400	1,300	** 100
Hotel-Office-Highway Commercial	500	310	** 190
Transportation Center	150	130	** 20
Commercial Recreation	500	450	** 50
Business Districts	265	265	--
Cultural Center	50	50	--
Special Use	700	700	--
Island Residential	* 650	* 650	--
Parkside Residential	* 750	* 750	--
Low Density Residential	235	-	235
Schools	250	250	-
Airport	750	100	650
Conservation	1,500	1,500	-
Park	1,000	1,000	-
Water	2,200	800	1,400
Rail	1,000	25	975
Local Service Roads	200	130	70
Turnpike & Limited Access Roads	2,000	1,050	950
TOTALS	19,600	12,460	7,140

* Net developable area.
** Area to be redeveloped for higher use.

TABLE 5

SUMMARY OF POPULATION FACTORS ACCORDING TO THE COMPREHENSIVE MASTER PLAN

LAND USE CATEGORY	COMPONENT AREAS	POPULATION			
		RESIDENTIAL		EMPLOYED	
		PER UNIT	TOTAL	PER GROSS ACRE	TOTAL
Distribution & Warehousing				9.0	36,000
Manufacturing & Truck Terminals				15.0	22,500
Research Parks				15.0	21,000
Hotel-Office-Highway Commercial					
Highway Commercial				10.0	1,000
Office				250.0	50,000
Hotels				25.0	5,000
Transportation Center					
Office				500.0	25,000
Parking				5.0	500
Commercial Recreation				1.0	500
Business Districts					
Regional Commercial				50.0	2,500
Office				500.0	25,000
Community Commercial				15.0	2,500
Neighborhood	24 @ 5 = 120				
Community Centers	3 @ 15 = 45				
Cultural Center				10.0	500
Special Use				1.0	700
Water Oriented Residential					
Employee				1/20 units	1,600
Resident		2.5	81,250		

TABLE 5
(Continued)

SUMMARY OF POPULATION FACTORS ACCORDING TO THE COMPREHENSIVE MASTER PLAN

LAND USE CATEGORY	COMPONENT AREAS	POPULATION			
		RESIDENTIAL		EMPLOYED	
		PER UNIT	TOTAL	PER GROSS ACRE	TOTAL
Park Oriented Residential					
Employee				1/20 units	1,900
Resident		2.8	105,000		
Low Density Residential					
Employee				-	-
(Existing) Resident		3.7	3,750		
Secaucus (Not in District)			10,000		
Public Ownership or Use					
Schools					
Elementary	30 @ 5 = 150			4.0	1,000
High School	4 @ 25 = 100				
Airport					
Employee				1.0	750
Passengers				-	-
Conservation				-	-
Park				-	-
Water				-	-
Ground Transportation					
Rail				1.0	1,000
Local Service Roads				-	-
Turnpike & Limited Access				-	-
TOTALS			200,000		198,950

SECTION VI. RECOMMENDED WATER QUALITY STANDARDS

A. Limitation of Present Water Quality Standards

All the evidence included in previous Sections clearly demonstrates that the present water quality of the tidal portions of the Hackensack River and its tributaries does not meet the standards established by the State. It is also clear that the presently established water quality standards for the Hackensack River when met, will still be inadequate for the fulfillment of the goals of the Comprehensive Master Plan for the development of the Hackensack Meadowlands District. In order to achieve those goals, the necessity for drafting water quality classifications and standards compatible with the Comprehensive Master Plan becomes apparent. It then follows that adequate classifications and standards, once established, must be augmented by parameters of measurement of water quality by which degree of compliance may be ascertained.

Preparation of such classifications, standards and parameters of measurement requires that certain terms be defined so that there is no ambiguity in meaning.

Contamination is defined as being an impairment of the quality of water by sewage, industrial or other waste to a degree which creates an actual hazard to public health through poisoning or through the spread of disease.

Pollution is defined as an impairment of the quality of water by sewage, industrial or other waste to a degree which does not create an actual hazard to public health, but which does adversely and unreasonably affect such waters for domestic, industrial, navigational or recreational or other beneficial use.

Nuisance is defined as damage to any community by odors or unsightliness resulting from unreasonable practices in the disposal of domestic, industrial or other wastes.

Each substance that may enter a water course is deemed a potential pollutant, since if it were sufficiently concentrated it can adversely and unreasonably affect such waters and preclude one or more beneficial uses. Yet, if it were adequately diluted and were compatible with the aquatic ecosystem, it could be harmless to all beneficial uses.

The concentration of a particular pollutant in water is effected by a combination of many factors including the amount of pollutant added; the conditions under which it is added to the water; dilution, self purification, chemical, physical and biological make-up of the water. However, the concentration of many pollutants in water depends primarily upon the two variables of pollutant strength at the point of introduction to the receiving water, and of the volume of diluting water.

In tidal estuaries normal dilution is a function of tidal action, littoral current, fresh water advection, wind action, density currents, temperature and the coagulating and flocculating effects of saline waters, and in the particular case of the Hackensack River, the configurations and interrelationships of the New York Harbor Tidal Complex. Concentrations of specific substances in a water body vary from hour to hour. The discharge of a pollutant will seldom be constant throughout any period of time, and the quantity of diluting water will be constantly changing as a result of tides, currents, stream flow and other factors.

As outlined in Section IV, Existing Water Quality, the present water quality of the Hackensack River appears to be very poor, and in certain aspects is continuing to decline. There is progressively less fresh water flow over the Oradell Dam as the waters of the upper portion of the drainage basin are more completely used for a potable water supply. As the area continues to be built up and to be urbanized, the runoff and sewage flows increase, thus increasing the organic loadings on the River. The industrial utilization of the River water for cooling purposes is still continuing, thus adding to the thermal pollutional load. Dumping of solid and industrial wastes continues at the same, if not a greater rate than previously, thus adding new sources of nutrient leachate to the tidal estuary. The assimilative capacity of the estuary is static or decreasing as the eutrophic load increases. In addition, with accelerated use of the harbor area, the chance of oil spills and the formation of oil slicks is increasing, and concurrently the probability for further decrease in the reaeration capability of the estuary also increases. The study by the Bergen County Health Department has also recorded the presence of several discharges having high coliform count, such as from breaks in sanitary sewer lines, uncontrolled bypasses from sanitary waste water pumping stations, and combined sewer overflows, all of which are significant sources of continuing pollution to the Hackensack River.

These discharges, be they within the Meadowlands District or above, must ultimately flow through the tidal estuary on their way to Newark Bay. As has been shown from the dye studies made on the Hackensack River by the United States Public Health Service, the passage downstream of the upland waters, without the benefit of fresh water additions to cause seaward movement, is a slow process.

The tidal waters of the Hackensack River as they flow through the Meadowlands District must be enhanced and upgraded to permit the full utilization of the river within the concept of the ultimate planned land development of the District. Since all of the Hackensack River and its tributaries which flow through the District are subject to the same degree of tidal fluctuation, dilution, mixing and disperson, all waters within that area should have the same water quality standards.

B. Recommended Water Quality Standards

There are two basic types of criteria or standards that are utilized for water pollution control. One type deals with the quality of the receiving watercourse, and is generally referred to as a "receiving water standard". The second type refers to the quality of the wastes to be discharged from a source and is termed "effluent standard". Effluent standards may further be of two categories in which the first restricts the strength and the amount of a pollutant that may be discharged, while the second specifies the degree of treatment or percent of removal of a specific pollutant prior to discharge.

It is felt that although the receiving water standard takes into account the values of dilution and assimilative capacity, and may lead to some economy in design and operation of pollution control plants, these standards are extremely difficult to define, evaluate, test for and administer.

Effluent standards have the advantage of simplicity and ease of administration. Further, as a minimum, any dilution or assimilative capacity of the receiving stream becomes a further asset to improving water quality.

Since general classifications by number or symbol convey little to the lay populace of the objectives desired, it is recommended that water classifications to be applied to Meadowlands District waters should have descriptive titles.

The recommended water quality classifications for the Meadowlands District are:

RECREATIONAL WATERS: Waters which shall be suitable for use in all activities not involving significant risks of ingestion.

PRIMARY CONTACT WATERS: Waters which shall be suitable for those recreational activities carried out within the water medium, and in which the body is immersed in the liquid and there is significant risk of ingestion of the waters.

HARVEST WATERS: Waters which shall be suitable for the propagation of marine organisms and the use thereof for food by humans.

The standard recommended to be implemented at this time for Meadowlands District waters is Recreational Waters and shall be an interim standard. This standard should be superseded as soon as it is attained, but in no case should it be kept in effect for longer than 20 years. The next higher water quality standard, Primary Contact Waters, should become effective at that time. It is hoped that ultimately the highest standard of Harvest Waters will be applied to the waters of the Hackensack River.

When treatment plants discharging into the River within the District initially become subject to the requirements of Recreational Water Quality Standards, those treatment plants discharging into other waters affecting the River (i.e. Newark Bay, lower Hudson River, Kill Van Kull, etc.) would become subject to the requirements for TW-2 water quality. Also when treatment plants discharging into the River within the District are later made subject to the next higher level of standards, Primary Contact Water Quality, treatment plants outside of the District will be made subject to the provisions for Recreational Waters.

Detailed criteria for each recommended water quality standard is included in the Report as Appendix C.

In order to achieve these standards it will be necessary to control and/or treat all discharges into the River and its tributaries which contain pollutants. This includes effluents from existing treatment plants, industrial flows, combined sewer regulators and other sources of pollution.

SECTION VII. DESIGN PARAMETERS

A. General

In order to design a comprehensive water pollution control system that is both economical and will be adequate for anticipated growth of the District, it is necessary to ascertain the amount, nature and distribution of the sewage that will have to be accommodated by that system. The criteria used in determining this information as well as other factors used in this study are presented in this Section.

B. Sewage Contribution from within the Meadowlands District

The amount and distribution of sewage that will emanate from within the Meadowlands District has been predicated on the development and allocation of land use as promulgated by the Comprehensive Master Plan. A sewage contribution factor has been estimated for each separate category of land use. These factors, based on assumed conditions at the time of ultimate Meadowlands District development, are presented in Table 6.

TABLE 6

AVERAGE SEWAGE CONTRIBUTION RATES

LAND USE ZONE	Average Rate of Sewage Flow in Gallons per Acre per Day
Manufacturing, Railroad and Truck Terminals	2, 975
Distribution and Warehousing Areas	1, 825
Research Parks	2, 475
Berrys Creek Center	12, 250
Hotel-Office-Highway Commercial Districts	7, 200

TABLE 6
Continued

AVERAGE SEWAGE CONTRIBUTION RATES

LAND USE ZONE	Average Rate of Sewage Flow in Gallons per Acre per Day
Community Shopping Districts	2, 475
Neighborhood Shopping Districts	2, 475
Civic and Cultural Center	2, 850
Transportation Centers	4, 350
Commercial Recreation - Land Oriented Areas	150
Commercial Recreation - Water Oriented Areas	2, 625
Special Use Areas	1, 000 to 3, 600
Island Residential Areas	14, 550
Park Side Residential Areas	16, 250
Existing Residential Areas	2, 025
High School Sites	2, 700
Elementary School Sites	200
Conservation Areas	0
Park and Recreation Areas	0
Water Areas	0

In general, these contribution factors were based on the following assumptions:

1. The resident population contributes sewage at an average rate of 85 gallons per capita per day (gcd) in the year 1970. This contribution is assumed to increase at the rate of 1 gcd per year to reach a total of 115 gcd by the year 2000, the time of ultimate development of the District.

2. The employee population contributes sewage at a uniform average rate of 25 gcd.

3. The transient population contributes sewage at a uniform average rate of 5 gcd when using quasi-public facilities.

4. General industrial and commercial uses generate sewage at average rates of 1500 to 2500 gallons per acre per day respectively, plus sewage generated by employees.

5. High Schools contribute sewage at a uniform average rate of 25 gcd. Elementary Schools were not considered as making a significant sewage contribution additional to residential contribution.

6. Hotels contribute sewage at a uniform average rate of 10,000 gallons per acre per day.

7. Infiltration adds flow volume at the rate of 100 gallons per acre of sewered area per day.

8. Each of two assumed regional solid waste incinerators, one located in the northerly portion of the Meadowlands and one in the southerly portion are assumed to contribute sewage at the uniform average rate of 2.5 million gallons per day (mgd).

9. Three areas have been allocated to "Special Uses" for which detailed plans will be developed when specific needs are more readily apparent. It has been assumed that these areas will produce sewage flow in the range of from 1,000 to 3,600 gallons per acre per day.

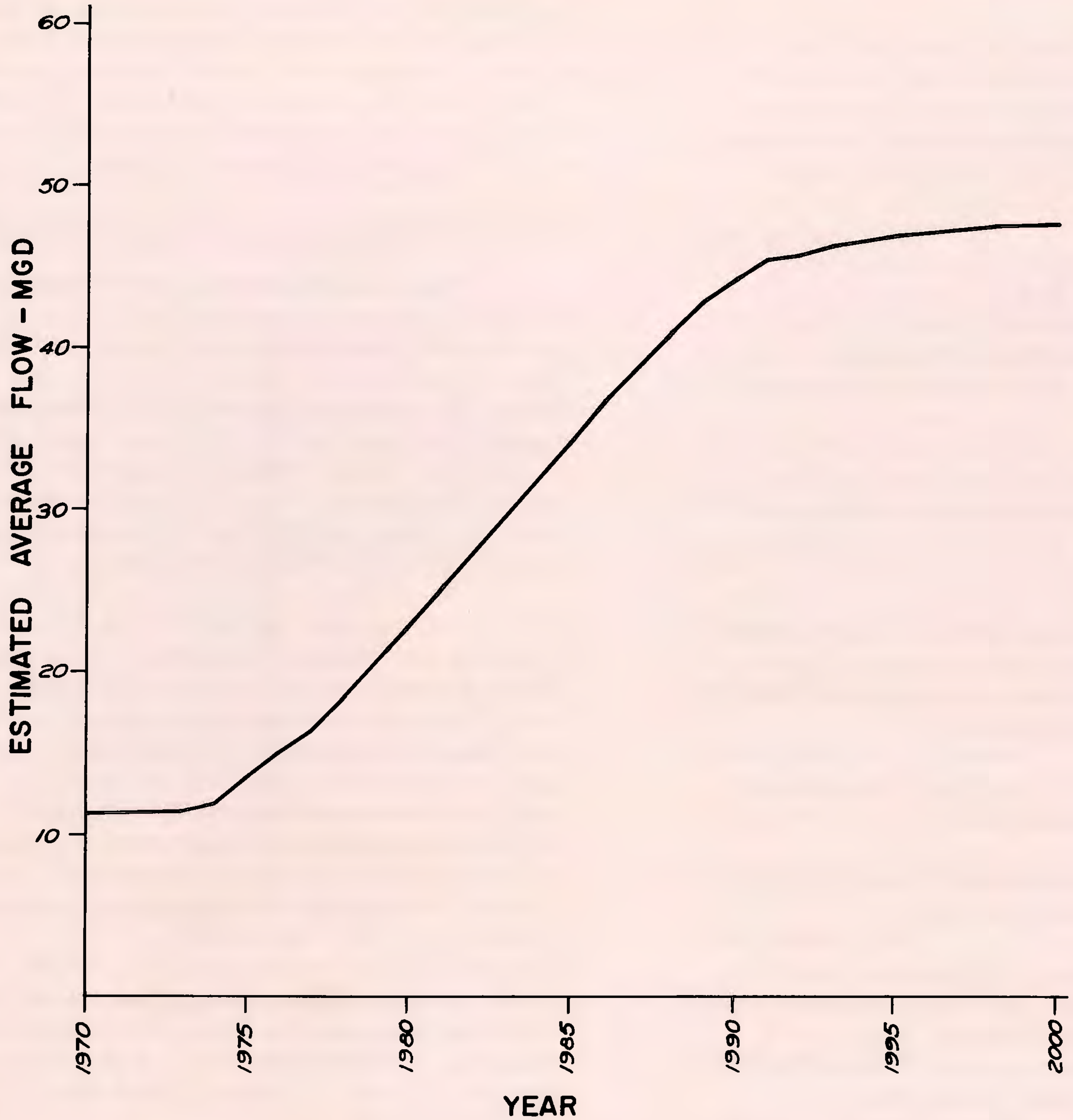
As previously discussed in Section V, The Comprehensive Master Plan, an approximate period of thirty years is expected to be required for the ultimate development of the Meadowlands District, following a sequence of demand for certain land uses. Exhibit No. 10, Growth of Flows from the Hackensack Meadowlands District, is an expression of the quantity of sewage flow which will be generated by development of the District in accordance with the time table established by the Comprehensive Master Plan.

C. Sewage Contribution from Outside the Meadowlands District

The estimated quantity of sewage flow which will emanate from the District is predicated on assumed conditions at the time of the ultimate development of the District, which according to the Master Plan will be the year 2000. Similarly the sewage flows from the areas outside the District were based on assumed conditions in the year 2000. These adjacent areas are, for the most part, already developed to various land uses, which in some cases do not conform to present zoning ordinances. Therefore these sewage flow quantities were estimated by applying a per capita contribution rate factor to projected population in these tributary areas.

Individual municipal population projections were developed by taking into account population trends based on U.S. census data and by judgment of the degree of existing population saturation together with the effect of the implementation of the Comprehensive Master Plan on these surrounding communities. The population projections were compared to population projections prepared by or for agencies such as the Bergen County Planning Board, the Hudson County Board of Chosen Freeholders, the municipalities of Lyndhurst, Rutherford, East Rutherford and North Bergen, the Tri-State Transportation Commission, the Bergen County Sewer Authority and a study by Dr. Bruce E. Newling, The City College, New York, entitled "Population Projections for New Jersey to 2000", which study was financially supported by the Office of Water Resources Research, U.S. Department of the Interior and the New Jersey Department of Conservation and Economic Development. It was found that in most cases the various projections were in close agreement with those presented in Dr. Newling's study.

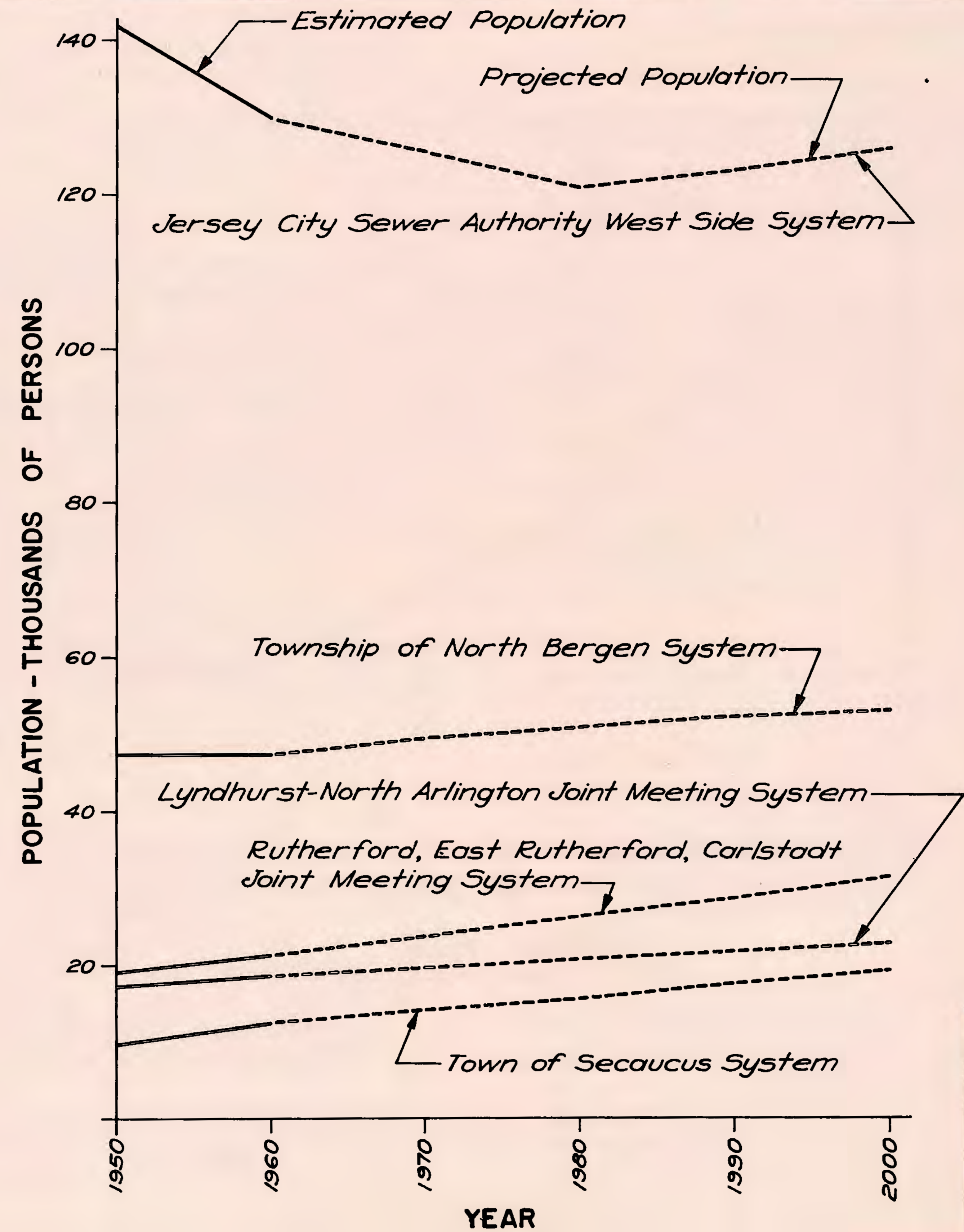
Exhibit No. 11, Population Projections for Tributary Uplands Areas Hackensack Meadowlands, was prepared showing the population projections for only those portions of municipal system areas which will contribute sewage to the District. The individual



STATE OF NEW JERSEY
HACKENSACK MEADOWLANDS DEVELOPMENT COMMISSION
FEASIBILITY REPORT-WATER POLLUTION CONTROL SYSTEMS

GROWTH OF FLOWS FOR THE HACKENSACK MEADOWLANDS DISTRICT

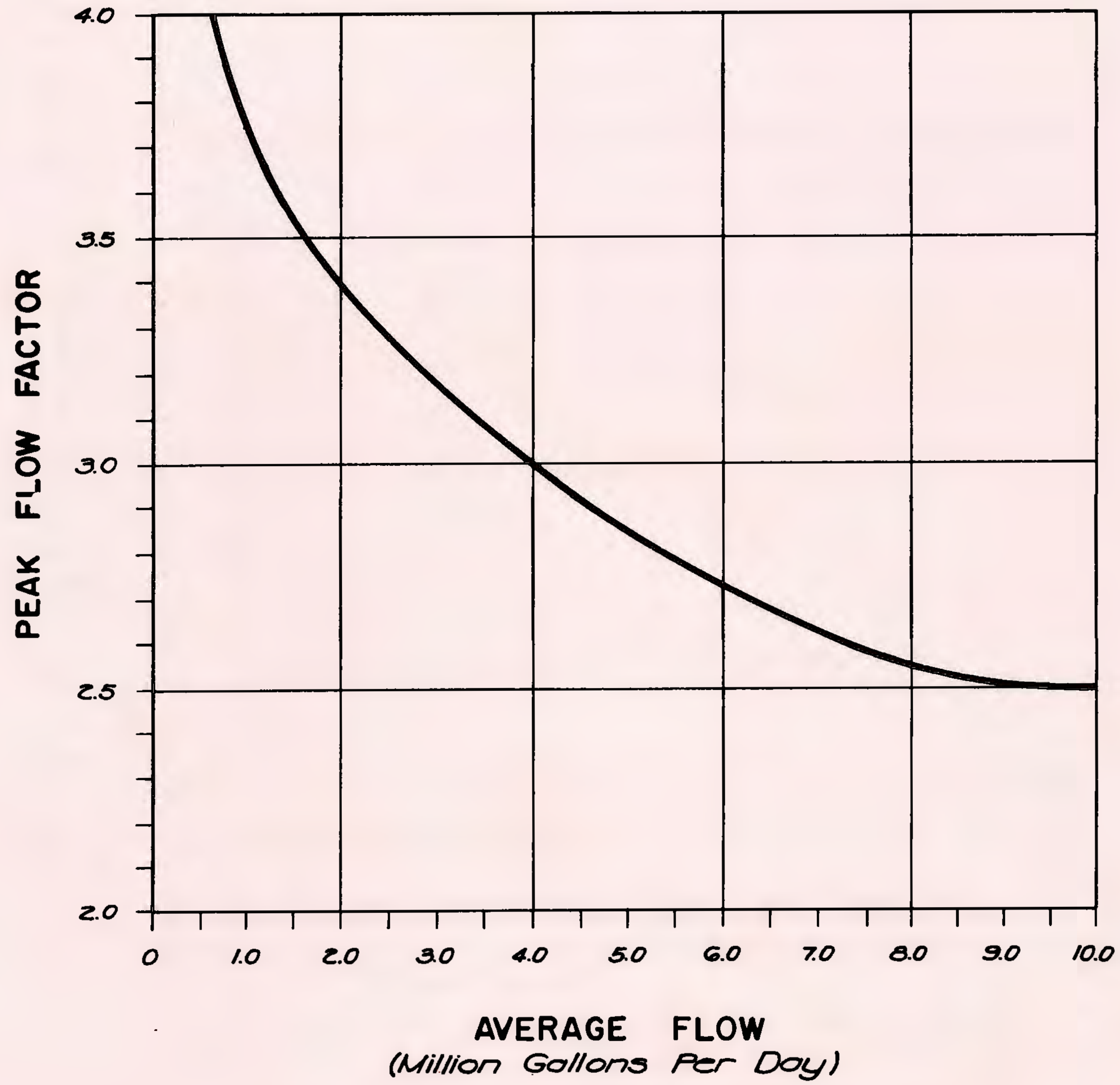
JOHN J. KASSNER & CO., INC.
Consulting Engineers



STATE OF NEW JERSEY
HACKENSACK MEADOWLANDS
DEVELOPMENT COMMISSION
FEASIBILITY REPORT-WATER POLLUTION CONTROL SYSTEMS

POPULATION PROJECTIONS FOR
TRIBUTARY UPLANDS AREAS
HACKENSACK MEADOWLANDS

JOHN J. KASSNER & CO., INC.
Consulting Engineers



STATE OF NEW JERSEY
HACKENSACK MEADOWLANDS
DEVELOPMENT COMMISSION
FEASIBILITY REPORT-WATER POLLUTION CONTROL SYSTEMS

SEWER DESIGN
PEAK FLOW FACTORS
HACKENSACK MEADOWLANDS

JOHN J. KASSNER & CO., INC.
Consulting Engineers

municipal projected population estimates were prorated to take into account the portion of each municipality lying within the tributary area. An average sewage contribution factor of 140 gcd was applied to these populations. This factor assumes a domestic contribution of 115 gcd for the year 2000, with an added allowance of 25 gcd for industrial and commercial contributions and infiltration.

D. Sewer Criteria

The rate at which waste is discharged into sanitary sewers is not constant, but varies with the rate of water used.

Peak flows may be assumed to originate at the same approximate point in time throughout the system, but must travel varying distances within the system to reach a given destination. Because of this, a reduction of the peak of the cumulative flow results. This peak dampening effect in a sanitary sewerage system may be related to the number of people sewered, expressed in terms of flow volume, but is not generally treated as a directly proportionate unit value of design to the rate of discharge or to the tributary population.

Peak design flows were derived by multiplying the average flow rate by a variable ratio of Peak flow to Average flow. A modified curve, Exhibit No. 12, Sewer Design - Peak Flow Factors Hackensack Meadowlands was used in which this peaking factor varies between 4.0 for average rates of flow of less than 0.6 mgd, to 2.5 for average rates of flow greater than 10 mgd.

Interceptor sewer sizes selected were based upon a design depth of flow of two-thirds of the pipe diameter when carrying the peak design flow, and sewer slopes were established to provide a velocity of not less than the minimum allowable 2.0 feet per second when flowing full or half full. In general, the depth of invert for sewers designed to intercept flows along their route, was established at a minimum elevation of -5.0 mean sea level, with the crown of the sewer no higher than elevation 0.0 mean sea level, in order to provide a nominal depth of not less than twelve feet at the pipe invert.

All aspects of design considered in this study conform to standards which meet or exceed those of the New Jersey State Department of Health.

E. Treatment Plant Criteria

1. General Requirements - Design Periods

The proposed River water quality and waste water treatment plant effluent quality standards set forth in SECTION VI - RECOMMENDED WATER QUALITY STANDARDS have been promulgated to meet the anticipated growth and rate of development of the Meadowlands District in accordance with the Comprehensive Master Plan projections for full development of the District within a thirty year period.

The recommended initial water quality standards should be adopted as soon as possible in order that development may begin and proceed in accordance with the Comprehensive Master Plan. Sewage treatment plant effluent requirements under Recreational Water standards, which would apply initially to all plants discharging within the District, are attainable by well functioning secondary treatment processes presently in general use. It should be noted that present New Jersey State Department of Health water quality standards for the waters of the Hackensack River require the use of secondary treatment for sewage discharging into the Hackensack River watershed.

The goal of realizing Primary Contact water quality in the Meadowlands District waters within a period not exceeding twenty years requires that the next higher level of standards be promulgated within 10 to 12 years; that is, Primary Contact for plants discharging within the District. This will coincide with the start of construction of water oriented housing. As a matter of practicality, the designs of all new plants or upgrading of existing plants which are undertaken upon the promulgation of initial water quality standards should be such as to facilitate later upgrading for the next higher water quality standards by addition to the basic process rather than by major revision of the process.

For the development of water-oriented land use areas along the Hackensack River, Primary Contact Water Quality conditions in the River must be created to make such development desirable. These water quality conditions must then be maintained with a high degree of infallibility, and without significant risk to public safety or health. This, in turn, dictates that a higher degree of dependability be provided for those treatment works discharging into the River than is generally the case at present.

Apart from Comprehensive Master Plan requirements, present emphasis on pollution control with resultant increasing stringency of governmental requirements, and the rapid pace of developmental work in the pollution control field also require that plant modifications or new plants constructed at this time be provided with maximum operational flexibility and stability within economical limits and that maximum provision be made for new process additions or revisions which may become desirable or required in the future, such as phosphorus and nitrogen removal, micro-straining or others.

2. Hydraulic Factors

Preliminary designs considered in this Report generally follow standards and regulations of the New Jersey State Department of Health, modified for more stringent requirements of the proposed water quality standards.

The design of piping, channels, flumes, and pumps will be for a minimum flow of 250 per cent of the average design flow. Whatever the actual hydraulic capacity selected for the design of these components, it is not uncommon for plants to include provision for the by-passing of all flows in excess of this hydraulic capacity. For example, the Bergen County Sewer Authority Plant, which is the major plant in the District at the present time, presently by-passes flows exceeding 250 per cent of average design flow. It has been reported that a total of four such uses of the by-pass have occurred at the plant, during storms, over a five year period, and that the total flow by-passed constituted 0.3% of the total flow to the plant during the period. The theory behind such by-passing, where practiced, is three-fold: first, to place an economical limit on the hydraulic capacity to be provided in channels, flumes, etc.; second, to prevent inundation of the treatment plants by peak storm flows in excess of the hydraulic capacity provided; and third, to take advantage of the fact that normally the increased dilution and flushing action in receiving streams during storm by-passing minimizes the undesirable effects in the receiving streams.

Within the tidal reach of the Hackensack River, the pollutional effect of combined sewer overflows, storm water flows, and by-pass discharges are of such significance as to require separate control, and no enlargement of by-pass discharge lines at existing treatment plants is therefore planned in this Report. To the contrary, it is expected that as Meadowlands District development proceeds and separate controls for combined sewer overflows and storm sewer flows are constructed, the need for treatment plant by-passes will be eliminated.

3. Pollutional Loading - Influent Characteristics

Based upon records and experiences of similar areas and upon projected land usage as set forth in the Master Plan, the use of a five day BOD content of 250 mg/l in raw sewage generated in the District is assumed for preliminary designs in this Report. Similarly, a suspended solids content of 300 mg/l is assumed for design purposes in this Report.

New industrial development conforming to the Master Plan and control of the quality of industrial discharge to the District collection system should insure that excessive industrial waste loading will not be experienced in the future at the treatment plants of the District.

4. Sewage Treatment Processes and Sludge Disposal

The most important single criteria for the selection of processes for treatment plants discharging their effluent into waters affecting the Meadowlands District is the attainment of a high degree of dependability of the basic process. Such processes should embody the highest practical factor of safety against process failure in order to consistently meet the required standards. Selection of a process or processes with high overall efficiency and with maximum practical flexibility for the meeting of shock pollutional flows to the plant is therefore essential. It is felt that this approach to process selection and design will minimize process "upsets" which may otherwise occur from time to time due to shock pollutional loadings, peak flows, and other causes.

Most of the existing treatment plants, both primary and secondary, now discharging into the Hackensack River or its tributaries within the District, are either trickling filter plants or are proposed to be expanded into trickling filter plants, as indicated in various submissions made to the New Jersey State Department of Health. It is generally considered that the trickling filter process efficiency of BOD removal lies in the range of 85-90% removal. Since the plant effluent standards recommended for Primary Contact water quality require an effluent BOD not to exceed 25 mg/l, it can be seen that the trickling filter process alone will not be able to meet the Primary Contact standards, with the required degree of reliability when they are promulgated in approximately ten to twelve years. Since Primary Contact water quality will require that all plants consistently operate at 90% or greater efficiency some form of tertiary treatment, such as sand filtration, microstraining or other, would be required following the trickling filter process.

The conventional activated sludge process is generally accepted as producing a higher quality effluent than the trickling filter process, operating in the range of 90 to 95% efficiency of BOD removal. The conventional process, however, has come to be recognized as lacking in stability and operational flexibility and does not produce effluent of a consistent quality. It is also somewhat more expensive to construct than the trickling filter process. Numerous modifications of the conventional activated sludge process have been developed over the years. These modified processes have been considered for their applicability to the requirements in the Meadowlands District. Of these modifications, it appears that the contact-stabilization process generally, and most consistently, offers the desired features. Re-aeration of activated sludge, as practiced in this process, provides a controllable reserve of activated sludge within the process to give a greater process stability against shock polutional loads. The addition of variable step-aeration to the contact stabilization process, as presently employed in the Bergen County Sewer Authority Plant, allows, in addition, an increase in the safe BOD loading which may be applied in design of the aeration tanks with a corresponding decrease in aeration tank volume requirements. Reduced solids loading to the secondary settling tanks and some increase in settling efficiency of these tanks may also be expected from the use of step-aeration. For smaller sized plants, typical of a number of the existing plants discharging within the District, the contact-stabilization process may be too sophisticated, requiring operational capability in terms of skilled personnel and budgetary requirements which may not be available to small agencies. In these cases, less sophisticated modifications of the activated sludge process may have to be permitted, with accompanying decrease in plant stability and flexibility.

Handling and ultimate disposal of the solid wastes produced by sewage treatment have been brought into focus as a major problem in sewage treatment. Anaerobic sludge digestion as presently practiced must now be considered unsatisfactory as a method of sludge treatment within the District because of the low reductions in organic content so obtained and the subsequent difficulty of ultimate disposal of the digested sludge, even when dewatered. Land filling with digested sludge, presently practiced by many of the sewerage agencies within and adjacent to the District, must likewise be considered unsatisfactory as a means of ultimate disposal.

Consultants to the Hackensack Meadowlands Commission in the matter of solid wastes disposal have suggested to the Commission several alternative methods for solid waste management, among them being that land filling with solid wastes may be permitted to continue for a limited period of years. Regional incinerators that would have sludge burning capabilities are being contemplated, and for the purpose of this Report it is assumed that regional incinerators will be provided. This would carry with it the additional advantage of obviating the need for sludge digestion.

Pipe-line transportation of sludge by pumping to the proposed regional incinerators was considered for use in the alternate water pollution control systems investigated. At small plants, the relatively small volumes of sludge to be handled, coupled with the long pipe-line runs required, indicates that long detention periods of the sludge within the pipe lines would be experienced. Together with other attendant difficulties of pumping sludge over long distances, this method of sludge handling appears unsatisfactory in the case of the smaller existing sewerage agencies. It is known that sludge pumping systems are presently in use in some of the larger cities, notably Cleveland, Philadelphia, Chicago and others, and that a potential for savings in total annual cost of sludge handling does exist by this method. Additional detailed research and investigation appear required, however, before the method should be considered practical for application to the small existing sewerage agencies within the District.

Trucking may be an alternative method for transport of sludge between the smaller treatment plants and the regional incinerators. However, since there are a number of inherent disadvantages to this system including public objection, trucking has not been deemed a satisfactory method of sludge transport.

The current practice of many sewerage agencies in the New Jersey-New York area of barging sewage sludge to sea has been criticized by technical and governmental spokesmen alike as becoming a major polluter of our ocean resources. Although to date the technical aspects have not been clearly resolved, this means of sludge disposal appears clearly to be the type of solution which merely buries the problem from view, leaving the very real possibility of again having to face the same problem in the perhaps not too distant future. It is assumed therefore that barging of sludge as a means of disposal will eventually be discontinued and accordingly, barging is not considered to be an ultimate means of sludge disposal.

For those existing sewerage agencies which are considered to be unable to avail themselves of the proposed regional incinerators for sludge disposal, there are a number of more recently developed sludge treatment methods which may be applicable. One of these is the "wet oxidation" method, or as it is also commonly called, the Zimpro Process. This process accomplishes the destruction of organic putrescible solids in sludge by chemical oxidation under increased temperature and pressure applied to the sludge and is usually followed by dewatering of the ash on vacuum filters or by other means. The degree of destruction of solids may be varied by variations of the applied temperature and pressure. The process is competitive with incineration techniques such as contemplated for the proposed regional incinerators and also eliminates the need for sludge digestion. The liquid effluent of the process is usually returned to the treatment plant for reprocessing with raw sewage, and the vacuum filter dewatered ash requires disposal by land fill or other method. Disadvantages of the process include the need for odor control, high capital and operating costs and the need for high quality supervision and maintenance.

Another sludge treatment method applicable to the needs of the smaller existing sewerage agencies is incineration by the fluidized-bed technique, which, in essence, is reported as being a more efficient incineration method. The process also produces an effluent which is usually returned to the raw sewage at the treatment plant inlet for reprocessing, and an ash end product which is acceptable for disposal by land fill. Fluidized-bed systems are competitive with other incineration techniques and are reported as being applicable to towns and cities as small as 10,000 population.

In summary, it is concluded that the trickling filter secondary process is not practically suitable for application to sewage treatment plants discharging within the Meadowlands District since it would require the addition of tertiary treatment steps with resultant large expenditures in the future to meet Primary Contact water quality standards. It appears that the contact-stabilization process with step-aeration will best provide the desired process stability and operating flexibility for the maintenance of river water quality consistent with the Comprehensive Master Plan objectives for the Meadowlands District.

If the contact-stabilization process, which requires a high degree of close supervision of operation, is not applied to the smaller existing plants, some other modification of the activated sludge process amenable to consistent effluent quality maintenance is desirable instead of the trickling filter process for these plants.

Although not included in subsequent cost studies of this Report, provisions should be made where possible in all new treatment plant construction, or construction of modifications to existing plants, for the addition of treatment steps such as phosphorus and nitrogen removal, microstraining or others which may be required in the future.

Regional incinerators will be utilized, where possible, for raw sludge disposal. Where not possible, as in the case of the smaller existing sewerage agencies, some newer form of sludge processing must be used in lieu of conventional anaerobic sludge digestion to accomplish greater destruction of organics and greater reductions of volume for ultimate disposal of residue.

F. Outfall Sewers

From earlier discussions of tidal action and river flow characteristics, it is concluded that adequate dispersal of plant effluents is an important factor to be considered. Dye tests and other similar studies in the Hackensack River within the District have demonstrated the inadvisability of depending upon natural dispersion. Accordingly, it is recommended that sewage treatment plant outfalls should be carried as submerged pipe buried in the river bottom to a point at or near the center of the main current flow in the river. Construction of outlet crib structures on the river bottom will be necessary at the ends of the outfall pipes.

G. Soils Considerations

The topography of the Hackensack Meadowlands District is low and flat, with the only natural relief of consequence occurring in northern Carlstadt and at Laurel Hill and Little Snake Hill in Secaucus. The higher areas of Secaucus are the largest areas of natural relief, but are, for the most part, excluded from the Meadowlands District. Topography varies, rising from the general meadow level at approximate elevation +2 to approximate elevation +20 in the northern Carlstadt area, to +70 at Little Snake Hill and higher at Laurel Hill. The higher areas of Secaucus reach to approximate elevation +90. Other areas of relief involve man-made fills for airport, highway and railroad use. Depressions are encountered along major waterways, such as the Hackensack River, Berrys Creek, and others, as well as along man-made mosquito control ditches which lace the site.

The Meadowlands District is entirely within the area which is geologically termed Lake Hackensack. This area was formed by the obstruction of the glacial drift in a preglacial valley to the south of the area, which halted the progress of glacial travel. Shale is expected to be the predominant form of bedrock in the area, although diabase related to the Palisades Ridge has also been mapped in areas where bedrock is shallow. Sandstone bedrock has also been encountered at depth. The Triassic Sandstone and Shale are overlain with a thin stratum of Glacial Till, averaging no more than 10 feet in thickness. South of Berrys Creek Canal and N. J. State Route 3, the depth to bedrock averages in excess of 80 feet and may be encountered at depths of as much as 120 feet below the marsh surface which substantially covers the entire site. To the north of N. J. State Route 3, the average depth of bedrock may be expected to be 60 feet.

The marsh surface varies between approximate elevations zero and +2 for almost the entire extent of the District. The Organic Soils (Peat and Silt) at the surface are normally from 5 feet to 10 feet thick, with some variations across the site. Below the Organic Soil deposits, varved Glacial Lake Clay is encountered for almost the full depth to the Glacial Till overlying bedrock. In some instances, a coarse Sand stratum, sometimes 10 feet or more in thickness, is encountered between the Organic Soil and the Clay subsoil. The water table is at approximate elevation +2.

The upper portion of the Organic Soil is thickly laden with Marsh Grass and related root systems, which forms a fairly sturdy material termed Meadow Mat. This material is highly permeable, not only because of the vegetation but also due to the very loose nature of the Peat.

The underlying Silt is encountered normally after a transition from highly decayed vegetation and Peat. This lower material is highly impermeable. Both the Meadow Mat and Organic Silt soils are subject to large volume changes when loaded. The high permeability of the Meadow Mat results in its rapid consolidation when subjected to loading without prior special treatment. The consolidation of the Silt, however, occurs only after an extended period of time, on the order of many years, to achieve its substantially full consolidation when loaded without prior special treatment.

The inorganic soils (Sand and Clays) underlying the surface deposits are preconsolidated to varying degrees. The upper Sands, where encountered, are considered to be incompressible under normal loading. The upper portion of the Clay, to depths of 50 feet or so below the ground surface, are expected to be preconsolidated to varying degrees. The lower reaches of the deposits are not expected to be preconsolidated more than 0.25 ton per square foot above loading presently found in nature. The Clay subsoil is varved fairly uniformly. However, the varve sizes in many instances are so thin as to be considered more in the size of "partings". Although the varves are sometimes found to include fine Sand sizes, the partings are principally Silt sizes. The varved Clay soil is compressible.

The strength of the Organic Soils is very low, and may average on the order of 0.1 ton per square foot in shear (Unconfined Compression). The strength of the Clay Soils is not expected to be less than about 0.35 ton per square foot.

Detailed subsurface information is available with respect to the Meadowlands District. Principal sources of information are the New Jersey Turnpike Authority, which is involved in the construction of the Turnpike roadways which traverse the site, the United States Army Corps of Engineers, for which an investigation was made in recent years and the New Jersey Department of Transportation, as they are involved in all State Highway projects around and through the District. Other sources of information would include the New Jersey Bureau of Geology and the Towns and Boroughs, as well as public and private agencies involved in the development of the Meadowlands.

H. Special Construction Requirements

This major water pollution control system, when constructed, will be composed of large sewer pipes installed at considerable depths and major treatment plant and pumping station structures, and will involve numerous water course, railroad and highway crossings. All of these facilities will be constructed in a somewhat unique area. In order to more accurately apply the engineering experience of this firm to the particular area of the Meadowlands, contact was made with various governmental agencies and contractors and others who have performed construction of a like nature in the Meadowlands or similar areas.

It was concluded that the basic pipe trench cross-section might consist of 3 or 4 feet of construction berm overlaying organic soils of 10 feet in thickness, all lying above varved clay, in which the pipe will be installed to a maximum total depth of approximately 30 feet. Recognition is given to the presence of rock strata in some areas, though rock is not considered to be present in the basic pipe trench. It is further recognized that great variations to this basic premise can occur, and such variations have been considered.

In determining methods of construction and for preparation of cost estimates consideration was given to the factors of State labor laws, soils stability, water control, depth of trench, width of trench, protection of property and disposal of excavated material, together with its effect on the area ecology. All of these considerations tend to point toward the necessity for a fully supported trench of minimum width and the use of sheeting. It is recognized that the use of sheeting provides the maximum trench stabilization and that in some areas less costly types of trench support might be adequate. However, this Report assumes that all pipe trenches and excavations will be fully sheeted.

Control of water in any excavation is also a major cost factor requiring consideration. In the establishment of basic criteria, it is presumed that the water table is on a level with the surface of the meadow mat. Even though there is a high water table due to the low permeability of the material under the meadow mat, it can be expected that the volume of water entering the trench can be controlled without difficulty. Once the trench is excavated it can be dewatered and maintained "in the dry" by means of pumps of adequate capacity operating in sump pits. It can further be expected that most of the water will percolate through the meadow mat to the organic silt or to the impermeable clay layer, and will enter the trench at the juncture of these two layers. Use of well points in a silty layer is usually not desirable or practical; however, well points with sand wicks have been used in similar areas in order to intercept the water flow before it could enter the trench, thereby minimizing the amount of pumping required. However, for this Report, dewatering by means of sump pits and pumping is considered.

Depending upon the depth, pipes and structures will be installed in either organic silt or varved clay. If a pipe is to be installed in the organic silt layer, all silt should be removed from the trench to the clay layer and be replaced with a granular material to the foundation level of the pipe. Similarly, when material removed from the pipe trench is deemed unsuitable for backfill, it should be discarded and replaced with granular material or some other suitable backfill material. All pipe should be placed on a concrete cradle underlain with a bed of broken stone. Piles are to be avoided wherever possible due not only to the considerable cost thereof but also because of the unavoidable probability for settlement of adjacent areas causing objectionable high points over the sewer pipes. It should be stated that the pipe installations will not necessarily add additional loads to the foundation soil since a hollow pipe, partially filled with flow, weighs less than the replaced soil. The pipe itself and the pipe joints must be of such design as to support the overlying soil loads to compensate for the settlement which is almost certain to occur. Even though the use of pile foundations for sewer pipes is to be avoided, it is recognized that use of pile foundations for pipes may be unavoidable in specific problem areas. It is also recognized that pile foundations will be mandatory for other structures with high load requirements such as sewage treatment plant structures and pumping stations.

In the basic pipe trench cross-section, mention was made of a "construction berm". This structure is in essence an access roadway which will serve a number of functions. It will serve to provide a working platform for access across the marsh and for construction equipment, through which pipe trenches may be excavated. Upon completion of the sewers, and during the period between sewer construction and land filling for development, it will serve as an access for sewer maintenance crews and equipment. Though the cost for construction of such an access roadway along the sewer locations is estimated in the initial construction cost of the sewers, an ancillary benefit will be derived in that the access roadway will serve as a portion of the fill required for land development. It would be preferable from an economic point of view to orient the sewer trenches to locations of proposed roads so that the road foundations could be constructed simultaneously with sewer construction and act as the construction berm. An attempt has been made to locate sewers in or adjacent to existing or graphically illustrated proposed highway locations, or along railroad embankments as delineated on the Land Use Plan. This Report, however, does not presume that such locations will, in fact, be available at the time of actual sewer construction.

The foregoing discussion with respect to sewer pipes was directed to the installation of pipes at a depth of 30 feet. The items pertaining to dewatering, pipe foundation and construction access for pipes installed at shallow and intermediate depths generally remain constant. Sheeting requirements will vary according to field conditions and will be expected to include such alternates as no sheeting for shallow pipes and wood sheeting or a sliding steel box for pipes installed at intermediate depth. For pipes at shallow depth founded in a deep silt layer, use of piles might still be considered more economical as compared to removing the entire layer of underlying silt.

A significant number of crossings of highways, railroads and water courses are anticipated, with their inherent, specific construction requirements. Various techniques such as tunneling, horizontal boring, pipe jacking, coffer dams, subaqueous pipe construction and other methods are all possibilities, and have been considered.

SECTION VIII. ALTERNATE WATER POLLUTION CONTROL SYSTEMS

A. Description of Alternates

1. General

Selection of an economical and logical water pollution control system for the proper development of the Hackensack Meadowlands District required study and evaluation of many alternates. With the multiplicity of existing wastewater treatment plants, municipal Sewer Districts, Joint Meeting Sewer Districts and County Sewer Districts, three (3) Alternates which represent distinctly different approaches were selected for detailed study.

All Alternates presented are based on implementation of the Land Use Plan in accordance with the Comprehensive Master Plan for development of the Hackensack Meadowlands District by the year 2000. It is also assumed that the effect on Hackensack River water quality inherent in the tidal exchange with the waters of Newark Bay will not be detrimental due to enhanced water quality standards and their strict enforcement.

The layouts of interceptor sewers follow existing and proposed roads and are designed to handle the wastes developed within the Meadowlands District and peripheral communities. The treatment facilities are designed to upgrade and maintain the water quality of the Hackensack River within the Meadowlands District and permit the utilization of the land adjacent to the river for recreational and aesthetic purposes.

The three Alternates are shown in outline on Exhibit Nos. 13, 14 and 15, including the interceptor sewer system, the waste water treatment facilities, and the manner of sludge disposal and effluent disposal.

2. Alternate A - Existing Sewerage Agencies System

This Alternate assumes that certain existing waste water treatment plants will remain in operation. These plants will be modified or reconstructed to meet the water quality standards required to implement the Comprehensive Master Plan for the development of the Hackensack Meadowlands District. Each plant and its interceptor sewers and pumping stations will be designed to handle anticipated future sanitary and industrial flows from those areas tributary to the existing plants. Treated wastes will be discharged into the main channel of the Hackensack River and be dispersed by use of diffusers. Sewage sludge will be incinerated at each plant and the resulting solid residue disposed of by land fill. Details and layout are shown on Exhibit No. 13, Alternate A, Existing Sewerage Agencies System.

3. Alternate B - Bergen County Sewer Authority System

This Alternate assumes that all sanitary and industrial wastes originating within the Meadowlands District, as well as from certain peripheral contributing areas, will be treated at the existing Bergen County Sewer Authority waste water treatment plant at Little Ferry. This plant will be enlarged and modified to meet the water quality standards required to implement the Comprehensive Master Plan for the development of the Hackensack Meadowlands. Interceptor sewers, pumping stations and wastewater treatment plant will be designed to handle anticipated future flows.

Treated wastes will be discharged into the main channel of the Hackensack River and be dispersed by use of diffusers. Sewage sludge will be incinerated at a proposed solid wastes incinerator, assumed to be at an adjacent location, and the resulting solid residue disposed of by land fill. Details and layout are shown on Exhibit No. 14, Alternate B, Bergen County Sewer Authority System.

4. Alternate C - Hackensack Meadowlands Development Commission System

This Alternate assumes that two regional wastewater treatment plants will serve the Meadowlands District and the peripheral tributary areas. One plant will be the existing Bergen County Sewer Authority wastewater treatment plant at Little Ferry which will serve the northerly portion of the District and a new Meadowlands Commission regional wastewater treatment plant in the southerly end of the District will serve the remainder of the area.

The Little Ferry plant will be enlarged and modified to serve the future needs of a portion of the Meadowlands District as well as handle increased flow from its other contributing and peripheral areas. The new Meadowlands Commission plant will be sized to handle the major portion of the flow from the District as well as the flow from certain contributing peripheral areas.

Interceptor sewers, pumping stations and wastewater treatment plants will be sized for anticipated future sanitary and industrial flows. Treated wastes from each plant will be discharged into the main channel of the Hackensack River and be dispersed by use of diffusers. Sewage sludge from each plant will be incinerated at the proposed solid waste incinerators assumed to be at adjacent locations, and the resulting solid residue disposed of by land fill. Details and layout are shown on Exhibit No. 15, Alternate C, Hackensack Meadowlands Development Commission System.

B. Details of Alternate A, Existing Sewerage Agencies System

1. General

This Alternate assumes existing sewer agencies will continue to collect and treat sewage flows generated within their areas of jurisdiction.

The New Jersey State Department of Health has issued formal orders to abate pollution in the Hackensack River and its tributaries to the municipalities of Kearny and North Bergen; to the Rutherford-East Rutherford-Carlstadt and the North Arlington-Lyndhurst Joint Meetings; and to the Jersey City Sewerage Authority. Each of the aforementioned has filed reports with the Department of Health proposing method of abating the pollution of the River. Alternate A presumes that the plans, presented in these reports, will be implemented with modifications required to accomplish the water quality standards recommended in Section IV, Recommended Water Quality Standards.

The Borough of Wood-Ridge plans to discharge its sewage flows to the facilities of the Bergen County Sewer Authority and to deactivate its existing wastewater treatment plant. The Carlstadt and East Rutherford Sewerage Authorities have been formed to provide sewerage facilities for the area of the Meadowlands which lies within their respective jurisdictions and to discharge their sewage flows to the facilities of the Bergen County Sewer Authority. (Alternate A assumes that these arrangements will remain unchanged.)

Alternate A assumes that the Rutherford-East Rutherford-Carlstadt Joint Meeting wastewater treatment plant will continue to treat sewage flows from its present tributary area and will also treat sewage flows from the Meadowlands area of Rutherford and from a portion of the East Rutherford Meadowlands lying in the proposed "Central Business District" shown on the Comprehensive Land Use Plan.

In the Boroughs of North Arlington and Lyndhurst, Alternate A assumes that the Joint Meeting wastewater treatment plant will continue to treat sewage flows from its present contributory area and will also treat sewage flows from the Meadowlands areas of the two Boroughs.

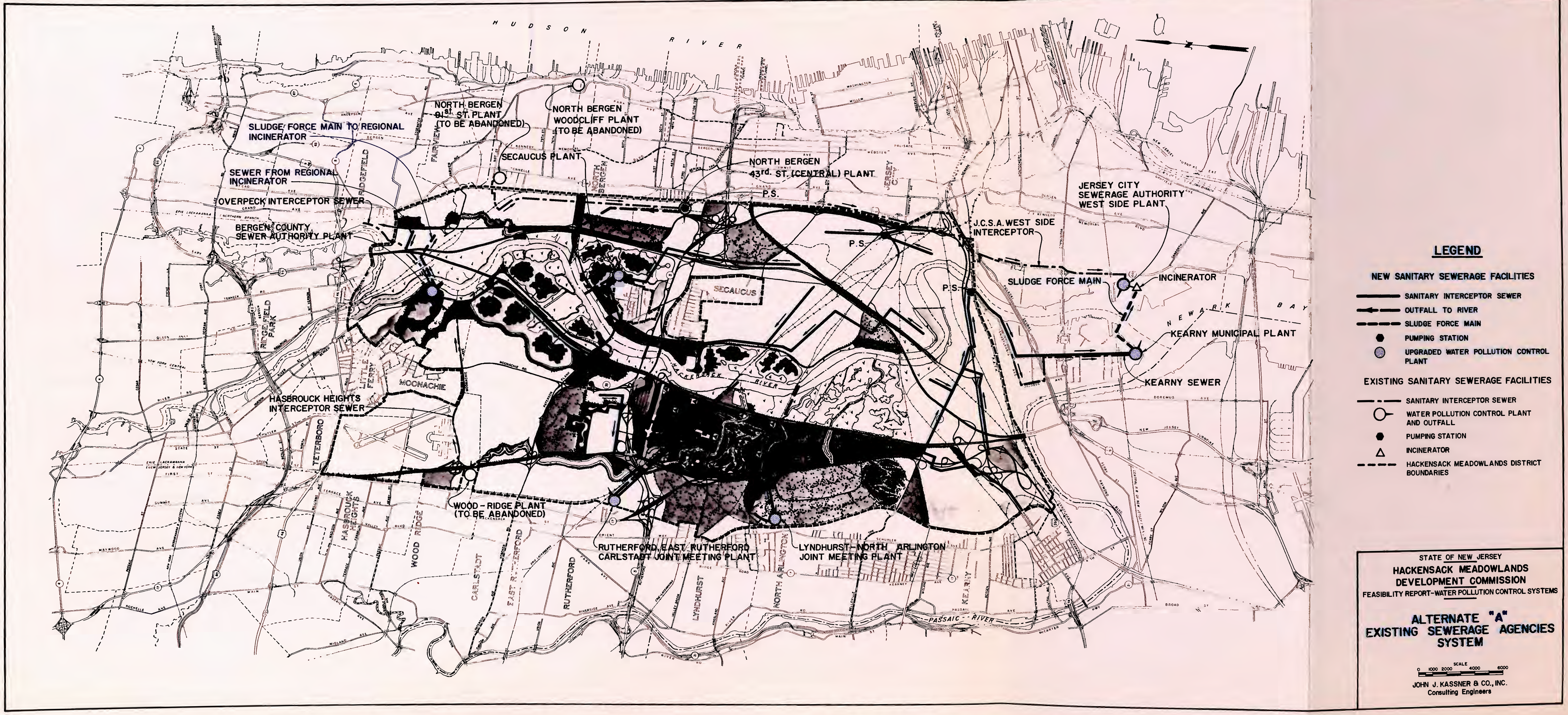
The Kearny municipal wastewater treatment plant now treats only sewage flows from Kearny Point. Alternate A assumes that it will continue to do so and will also treat sewage flows from the Meadowlands area lying within the Town of Kearny.

The Township of North Bergen has planned to abandon its Woodcliff and Northern wastewater treatment plants and to treat all sewage flows from the combined tributary areas at a new plant at the site of its existing Central wastewater treatment plant. Alternate A assumes the implementation of this plan and also assumes the treatment of sewage flows from the North Bergen Meadowlands area at the new Central plant.

In the Town of Secaucus, Alternate A assumes that sewage flows from the Meadowlands area within the Town as well as sewage flows from the remainder of the Town will be treated at the existing municipal wastewater treatment plant.

Alternate A assumes that the Jersey City Sewerage Authority West Side wastewater treatment plant will continue to treat sewage flows from its present tributary area and will also treat sewage flows originating in the Meadowlands area lying within the limits of Jersey City.

It is further assumed that the Bergen County Sewer Authority's wastewater treatment plant at Little Ferry will continue to treat sewage flows from its present tributary area, will treat sewage flows from the Carlstadt and East Rutherford Sewerage Authorities, and will treat sewage flows from certain areas in the northern portion of the Meadowlands.


HUDSON RIVER
NORTH BERGEN 81st. ST. PLANT (TO BE ABANDONED)
NORTH BERGEN WOODCLIFF PLANT (TO BE ABANDONED)
SLUDGE FORCE MAIN TO REGIONAL INCINERATOR
SECAUCUS PLANT
SEWER FROM REGIONAL INCINERATOR
NORTH BERGEN 43rd. ST. (CENTRAL) PLANT
OVERPECK INTERCEPTOR SEWER
P.S.
BERGEN COUNTY SEWER AUTHORITY PLANT
JERSEY CITY SEWERAGE AUTHORITY WEST SIDE PLANT
J.C.S.A. WEST SIDE INTERCEPTOR
P.S.
SECAUCUS
P.S.
SLUDGE FORCE MAIN
INCINERATOR
NEWARK BAY
KEARNY MUNICIPAL PLANT
KEARNY SEWER
HACKENSACK RIVER
RIDGEFIELD
RIDGEFIELD PARK
FAIRVIEW
NORTH BERGEN
JERSEY CITY
LITTLE FERRY
MOONACHIE
HASBROUCK HEIGHTS INTERCEPTOR SEWER
TETERBORO
HASBROUCK HEIGHTS
WOOD RIDGE
WOOD - RIDGE PLANT (TO BE ABANDONED)
CARLSTADT
EAST RUTHERFORD
RUTHERFORD
RUTHERFORD, EAST RUTHERFORD CARLSTADT JOINT MEETING PLANT
LYNDHURST
NORTH ARLINGTON
LYNDHURST-NORTH ARLINGTON JOINT MEETING PLANT
KEARNY
PASSAIC RIVER
LEGEND
NEW SANITARY SEWERAGE FACILITIES
SANITARY INTERCEPTOR SEWER
OUTFALL TO RIVER
SLUDGE FORCE MAIN
PUMPING STATION
UPGRADED WATER POLLUTION CONTROL PLANT
EXISTING SANITARY SEWERAGE FACILITIES
SANITARY INTERCEPTOR SEWER
WATER POLLUTION CONTROL PLANT AND OUTFALL
PUMPING STATION
INCINERATOR
HACKENSACK MEADOWLANDS DISTRICT BOUNDARIES
STATE OF NEW JERSEY
HACKENSACK MEADOWLANDS DEVELOPMENT COMMISSION
FEASIBILITY REPORT-WATER POLLUTION CONTROL SYSTEMS
ALTERNATE "A"
EXISTING SEWERAGE AGENCIES SYSTEM
SCALE
0 1000 2000 4000 6000
JOHN J. KASSNER & CO., INC.
Consulting Engineers

Under Alternate A the aforementioned wastewater treatment plants will up-grade their treatment processes and expand their capacity where necessary to accommodate the anticipated future flows. In order that the individual plants be of sufficient size to treat the anticipated quantities of sewage flow in the year 2000, Alternate A requires the plant capacities of the sizes shown in Table 7, Wastewater Treatment Plant Capacities, Alternate A.

TABLE 7

WASTEWATER TREATMENT PLANT CAPACITIES

ALTERNATE A

Wastewater Treatment Plant	Capacity - (mgd) Present	Capacity - (mgd) Required
Rutherford-East Rutherford-Carlstadt Joint Meeting	4.0	11.6
North Arlington-Lyndhurst Joint Meeting	1.7	10.3
Kearny Municipal	4.0	12.2
North Bergen Central	4.0	9.6
Secaucus Municipal	2.3	13.3
Jersey City Sewerage Authority West Side	36.0	Unchanged
Bergen County Sewer Authority	75.0	108.4

Capacity is expressed in mgd of average daily dry weather flow.

The 75.0 mgd capacity shown as the present capacity of the Bergen County Sewer Authority wastewater treatment plant is the design value for the expansion now being developed. It is assumed that this expansion will be completed prior to implementation of Alternate A.

An additional program for future expansion for the Bergen County Sewer Authority plant at Little Ferry includes provision for treating sewage flows from the Bergen County portion of the Meadowlands District as well as presently sewered areas in Bergen County south of the plant, all predicated on development of this area under present zoning. Since the Comprehensive Master Plan for development of the Meadowlands District stipulates a greater density of development, the tributary area of the Bergen County Sewer Authority plant at Little Ferry under Alternate A has been established so that the total sewage flow to that plant from the Meadowlands area will be less than that anticipated under the future plant expansion program of the Bergen County Sewer Authority.

The Jersey City Sewerage Authority West Side wastewater treatment plant treats sewage flows from a combined sewer system whose flow to the plant during periods of precipitation is controlled by regulators in the interceptor sewers. The plant has sufficient capacity to accommodate normal dry weather flows. As the treatment of combined sewer overflow is not economically feasible at this time and the sanitary and industrial dry weather flows to the plant from its tributary area is estimated to be 18.7 mgd, less than the present capacity, Alternate A does not consider the expansion of the Jersey City Sewerage Authority West Side plant to handle storm water flows.

With the exception of the Bergen County Sewer Authority plant at Little Ferry, all of the wastewater treatment plants which lie within the boundaries of the Meadowlands District discharge treated effluent to tributaries of the Hackensack River which contain insufficient water volume to afford adequate dilution and tend to become stagnant. This situation giving rise to odors and unsightly conditions will be magnified by increased demand on the present receiving waters due to future discharge of greater quantities of treated effluent. Alternate A requires that all treatment plant effluent shall be discharged directly into the main channel of the Hackensack River and diffused through submerged outlets on the River bottom.

Although the implementation of Alternate A is predicated on full development of the Hackensack Meadowlands within thirty (30) years it is recognized that portions of the expanded water pollution control system could be built sequentially as required. Under Alternate A, with implementation at the earliest possible time, sewage treatment processes would initially be such that all the plants discharging within the Meadowlands District produce effluents meeting the requirements of "Recreational Waters" and that the Kearny and Jersey City Sewerage Authority West Side plants and all others affecting Newark Bay waters produce effluents meeting the present New Jersey standards for "TW-2 Waters". At the time that construction of housing is imminent in the Meadowlands in approximately ten to twelve years, but not more than twenty years, the treatment processes for the plants producing "Recreational Waters" effluent must be upgraded to produce effluent meeting "Primary Contact Waters" standards, while those plants affecting Newark Bay waters must produce effluents meeting "Recreational Waters" standards. Beyond these stages of improvement of water quality consideration may be given to attempting to achieve "Harvest Waters" quality in the Hackensack River, by more sophisticated sewage treatment processes, by use of an ocean outfall, or by other means.

Exhibit 13, Alternate A - Existing Sewerage Agencies System, shows locations of major trunk sewers to be constructed; locations of waste water treatment facilities, including effluent and sludge disposal facilities to be constructed; and locations of pumping stations and force mains to be constructed under this Alternate to best serve the development of the Meadowlands District.

In addition to determination of trunk sewers and other collection facilities required, a general evaluation was made of each treatment plant to remain in operation under Alternate A. This evaluation, together with information contained in Section III, Existing Conditions, provides an indication of construction requirements for implementation of this Alternate.

2. Wastewater Treatment Plant - Rutherford-East Rutherford-Carlstadt Joint Meeting

Due to the age and the accompanying structural and mechanical deterioration of this plant, in addition to process improvement, a considerable amount of structural repair and replacement of mechanical equipment would be required. Required improvements to the primary treatment portion of process would consist generally of the construction of new raw sewage pumping facilities, screening facilities, grit removal facilities and primary settling tanks, as presently contemplated by the Joint Meeting and outlined in some detail in Section III, Existing Conditions. The presently contemplated improvement of the secondary treatment portion of the process consists of expansion and revision of the existing trickling filter installation, and the contemplated method of sludge handling and disposal is based upon the existence of an unused incinerator at the plant which has been assumed to be amenable to restoration and use along with proposed new vacuum filtration facilities. Under Alternate A the presently proposed expansion of the existing trickling filter process should be supplanted by some modification of the conventional activated sludge secondary treatment or by the use of some form of tertiary treatment following the trickling filtration. In addition, an outfall sewer with submerged outlet to the main channel of the Hackensack River would have to be provided for a distance of approximately 12,000 feet.

The economics of the two alternate courses of action with respect to secondary treatment cannot be evaluated in detail at this time, but it appears clear that the Joint Meeting faces total expenditures under Alternate A representing a very large portion of the cost of a new treatment plant.

3. Wastewater Treatment Plant - North Arlington-Lyndhurst Joint Meeting

The presently contemplated modifications to this plant consist of improvement of the existing primary treatment process and the addition of trickling filter secondary treatment. Based upon the studies by engineers for the Joint Meeting, the proposed improvements to the existing primary treatment plant appear to be straightforward. In order to comply with the recommended water quality standards for development of the Hackensack Meadowlands District the proposed new trickling filter secondary treatment should be supplanted by some modification of the activated sludge process. Vacuum filtration of sludge, as presently contemplated by the Joint Meeting, is satisfactory but new incineration facilities would also be required instead of the contemplated land fill disposal of filtered sludge cake. Additional studies could be made, however, to enlarge the available choices to include the fluidized bed process as well as the Zimpro process, the latter having also been considered by the Joint Meeting's engineers.

Extension of the existing plant outfall sewer for a distance of approximately 11,000 feet to the Hackensack River with a submerged outlet in the main channel of the River would be required.

It is noted that the ultimate sewage flow of the Joint Meeting under present conditions as projected by their engineers is 4.3 mgd, whereas the projected ultimate flow under conditions of the Master Plan would be 10.3 mgd. There is some question as to the availability of additional land adjacent to the existing plant site to accommodate plant expansion for the larger capacity.

4. Wastewater Treatment Plant - Town of Kearny

Sewage flow to the plant consists largely of industrial waste and includes some domestic waste contributed by the non-resident population employed in the Kearny industrial area. The treatment method presently contemplated by the Kearny authorities consists of chemical treatment of the waste flow by addition of alum and lime.

Because of the difficulty inherent in the adequate treatment of undiluted industrial wastes from Kearny Point, it might prove advantageous to combine sewage from Kearny and Jersey City, prior to treatment, to produce a better balance in quality. While this combining of sewage is recommended it has not been considered in the cost estimate.

In view of the predominantly industrial wastes character of the flow of the plant, a detailed study of the problem is necessary to ascertain the exact treatment requirements. The eventual treatment method to be employed, both for the liquid and solids portions of the flow, must, however, be in accord with pollution control standards established for the development of the Hackensack Meadowlands.

Although details of construction of the existing plant outfall sewer were not available, it is assumed that the extension of the present outfall sewer would be required to provide the recommended submerged outlet in the main channel of the River.

5. Wastewater Treatment Plant - North Bergen Township

North Bergen Township is unique among the municipalities and agencies considered under Alternate A in that the engineers for the Township have recommended the abandonment of the three existing North Bergen plants and the construction of new centrally located secondary facilities to replace them. The proposed new facilities as described in Section III, Existing Conditions, would provide secondary treatment by trickling filtration and sludge handling and disposal by means of vacuum filtration and incineration. The proposed new trickling filtration process should be replaced by some modification of the activated sludge process. The method of sludge treatment and disposal as proposed for the new facilities would be satisfactory relative to recommended Hackensack Meadowlands standards.

The proposed new North Bergen Treatment Plant should be provided with an outfall sewer to the main channel of the Hackensack River, a distance of approximately 9,000 feet.

6. Wastewater Treatment Plant - Town of Secaucus

The present plant, which was constructed in 1964, provides secondary treatment by trickling filtration. The presently employed sludge handling and disposal method is by elutriation, sludge drying on open beds and land fill disposal. It is considered that the present trickling filtration plant is capable of meeting "Recreational Waters" standards recommended to be initially imposed upon treatment plants affecting water quality in the River. Replacement of the present sludge handling and sludge disposal method would, however, be required initially under Alternate A by the construction of facilities for sludge incineration, the fluidized-bed process, the wet oxidation process or other similar method. A vacuum filter, which is apparently presently unused, could be placed into service for sludge dewatering.

Alternate A would also require extension of the existing plant outfall sewer for a distance of approximately 2,500 feet to the Hackensack River for discharge into the main channel through a submerged outlet.

The present satisfactory results of operation of the plant have been obtained at a plant loading of less than 50% of design capacity and it is therefore possible that under anticipated conditions of increased plant loading and with greater emphasis upon plant reliability, improvement in process control equipment and procedures will be required to maintain plant reliability at required levels. At the time when "Primary Contact" standards are placed into effect, the existing plant will probably require conversion to some modification of activated sludge process or the addition of some form of tertiary treatment, the choice being dependent upon economic factors at that time.

7. West Side Wastewater Treatment Plant - Jersey City Sewerage Authority

The plant presently provides primary treatment only. Sludge treatment and disposal is by vacuum filtration and incineration in the adjacent municipal solid wastes incinerator. It is assumed that the addition of trickling filtration as presently proposed by the Jersey City Sewerage Authority for secondary treatment will be capable of meeting the ultimate requirements of "Recreational Waters" standards, and that final design for the addition of secondary treatment would also include provisions for the correction of presently unidentified causes of poor performance in the existing primary treatment. Continuance of handling and disposal of sludge by vacuum filtration and incineration will likewise be satisfactory for Meadowlands requirements.

The effluent of the existing plant is presently discharged at the river bottom through a specially designed dispersion outfall sewer over an area approximately 200 feet from the easterly pierhead line and is satisfactory for Alternate A.

8. Wastewater Treatment Plant - Bergen County Sewer Authority

This plant now employs the contact-stabilization process, recommended in Section VII, Design Parameters, for large plants and is capable of meeting the proposed initial standards of "Recreational Waters" for the development of the Hackensack Meadowlands. In order to meet the standards for "Primary Contact Waters", however, upgrading of certain parts of the process will be required and must be included in designs for future plant expansions to the approximate ultimate capacity of 108 mgd as projected under Alternate A. There is, however, some question as to whether the existing plant can produce an effluent meeting initial "Recreational Waters" standards consistently enough to satisfy reliability requirements for Meadowlands development, and more detailed investigation in subsequent studies may indicate the advisability of undertaking required upgrading of process at an earlier date.

Analysis of the plant from data made available indicates that, although the total plant performance presently meets New Jersey State Department of Health requirements, the total amount of primary settling tankage proposed for the 75 mgd plant expansion is approximately 53% of the total tankage required by Department of Health regulations. It is felt that compliance with the Department of Health requirement of 1,000 gallons per square foot of tank area per day, at design flow, will be adequate to attain the recommended plant effluent standards promulgated in this Report. In the case of secondary settling, it is felt that a requirement of 700 gallons per square foot of tank area per day must be imposed to attain desired results. The total secondary tankage proposed for the 75 mgd expansion is approximately 70% of the total tankage required on this basis. This deficit in primary and secondary settling capacity presently prevents development of the full treatment capability of the process and, as previously indicated, would preclude the attainment of ultimate "Primary Contact" standards. Settling capacity within the BCSA plant must therefore be increased. This increase in capacity can be accomplished by the construction of additional tankage or, as is presently being investigated by engineers for the Bergen County Sewer Authority, through the use of supplemental settling devices in the tanks or by chemical treatment.

Disposal of digested sludge is presently accomplished by barging and dumping at sea. Alternate A presumes that two regional incinerators will be constructed in the Meadowlands for the disposal of solid wastes and that incineration of treatment plant sludge will be the method of sludge disposal used at the BCSA plant. Sewage sludge will be pumped from the BCSA plant to the northerly proposed regional incinerator. The location assumed for the proposed regional incinerator is across the Hackensack River from the BCSA plant, in an area zoned for light manufacturing. The addition of new sludge handling facilities at the plant are therefore required and would consist of revisions to existing sludge pumping facilities in the BCSA Plant, the addition of similar new sludge pumping facilities with subsequent plant expansion to ultimate capacity, a new sludge force main or mains across the Hackensack River to the vicinity of the regional incinerator and new vacuum filtration facilities to be constructed adjacent to the incinerator to enable the use of conveyor equipment for the movement of sludge cake from the vacuum filters to the incinerator.

Effluent of the BCSA Plant is presently conducted to the Hackensack River in two 72-inch outfall sewers which terminate and discharge at the edge of the River. These two outfall sewers and those constructed with future plant expansions, should be extended to submerged dispersion outlets in the main channel of the River.

C. Details of Alternate B Bergen County Sewer Authority System

This Alternate assumes that existing sewer agencies will continue to collect sewage flows generated within their areas of jurisdiction, but all treatment of sewage will be at the Bergen County Sewer Authority wastewater treatment plant at Little Ferry.

The Borough of Wood-Ridge plans to discharge its sewage flows to the facilities of the Bergen County Sewer Authority and to deactivate its existing wastewater treatment plant. The Carlstadt and East Rutherford Sewerage Authorities have been formed to provide sewerage facilities for that area of the Meadowlands which lies within their respective jurisdictions and to discharge their sewage flows to the facilities of the Bergen County Sewer Authority. Alternate B assumes that these arrangements will remain unchanged and will be augmented by new interceptor sewer facilities.

The existing Rutherford-East Rutherford-Carlstadt Joint Meeting wastewater treatment plant will be deactivated under Alternate B and will be connected to a trunk sewer belonging to the East Rutherford Sewerage Authority. Through the sewers of this latter agency and through sewers of the Bergen County Sewer Authority, sewage flows from the present tributary area of the Rutherford-East Rutherford-Carlstadt Joint Meeting will reach the BCSA plant at Little Ferry.

Under Alternate B, the North Arlington-Lyndhurst Joint Meeting Plant will also be deactivated and sewage flows from its tributary area will reach the BCSA plant by means of a new interceptor sewer.

North Bergen Township has planned to abandon its Woodcliff, Central and Northern plants and to treat all sewage at a new plant at the site of its existing Central plant. Alternate B assumes that the new plant will not be constructed and sewage flows from the North Bergen Township tributary area will reach the BCSA plant by means of a new interceptor sewer.

In the Town of Secaucus, Alternate B assumes that the existing wastewater treatment plant will be deactivated. However, since the existing Secaucus municipal plant is relatively new, with flow well below design capacity and apparently producing an effluent which is satisfactorily meeting present water quality standards, abandonment of the plant would be deferred to a later stage of implementation.

Alternate B assumes that the Jersey City Sewerage Authority West Side wastewater treatment plant will continue to treat sewage flows from its present tributary area and will also treat sewage flows originating in the Meadowlands area lying within the limits of Jersey City.

The Kearny municipal wastewater treatment plant now treats only sewage flows from Kearny Point, which lies wholly outside of the Meadowlands District. Alternate B assumes that its tributary area will not change but that its efficiency of treatment will be improved.

The possibility of treating sewage flows from Kearny Point at the Jersey City Sewerage Authority west side wastewater treatment plant, as discussed under Alternate A, is also applicable under this Alternate.

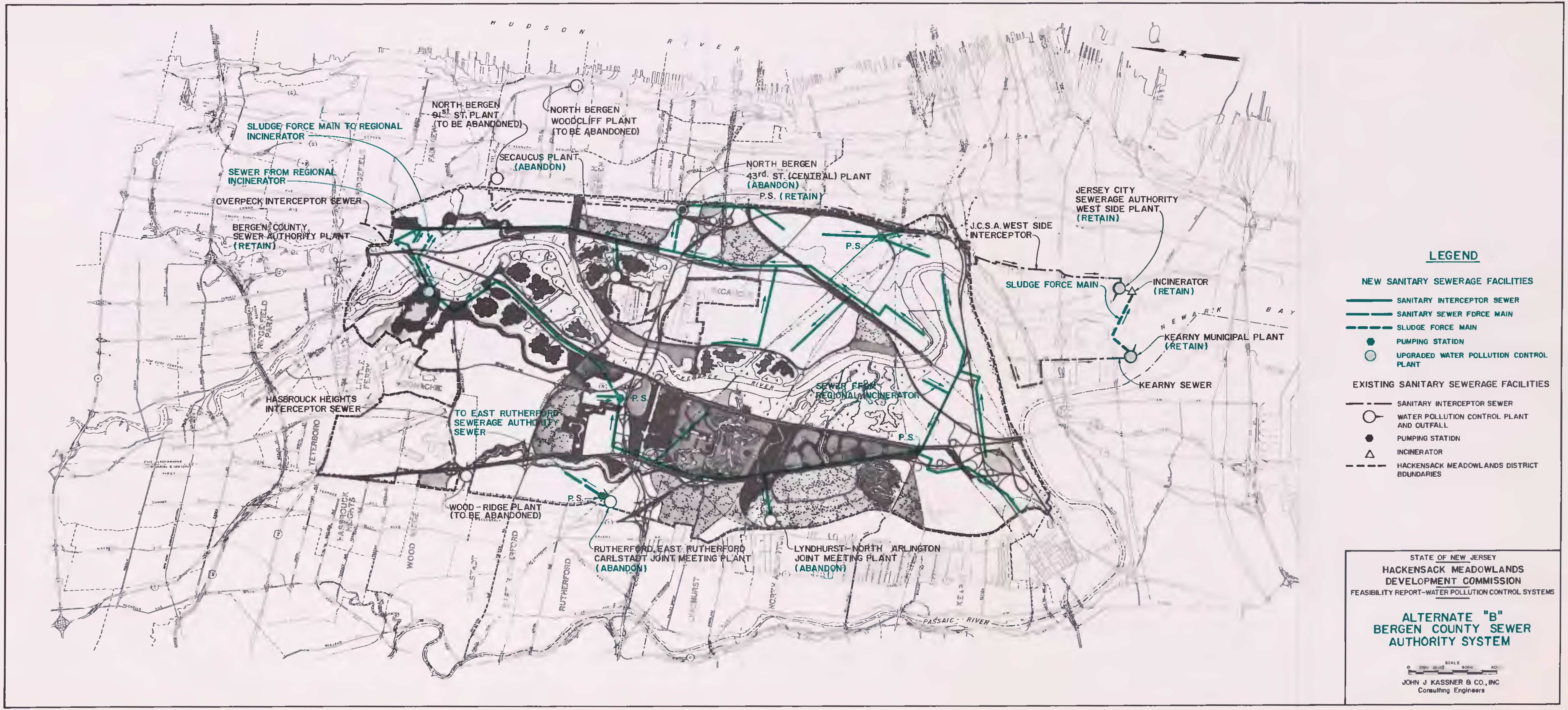
As a result of the above, the Bergen County Sewer Authority's wastewater treatment plant at Little Ferry will continue to treat sewage flows from its present tributary area and will treat all sewage flows from the Meadowlands District, and its eastern and western peripheral tributary areas, with the exception of that portion of the District lying within the borders of Jersey City.

Under Alternate B, the Bergen County Sewer Authority's wastewater treatment plant at Little Ferry will need to be expanded to accommodate the anticipated future flow. The Bergen County Sewer Authority is presently developing a program for future expansion of the plant at Little Ferry which includes provision for treating sewage flows generated in the Bergen County portion of the Meadowlands District as well as from presently sewered areas in Bergen County south of the plant, all predicated on development of the area under present zoning. Since the Master Plan for the development of the Meadowlands District stipulates a greater density of development, and since the tributary area of the Little Ferry plant under Alternate B will be increased substantially, the design capacity in terms of average daily dry weather flow will be 161.3 mgd, an increase of 34.4 mgd over that anticipated for the future plant expansion program of the Bergen County Sewer Authority and an increase of 86.3 mgd over the expansion presently under development.

The Jersey City Sewerage Authority West Side wastewater treatment plant treats sewage flows from a combined sewer system whose flow to the plant during periods of precipitation is controlled by regulators in the interceptor sewers. The plant has a design capacity of 36.0 mgd, sufficient to accommodate normal dry weather flows. As the treatment of combined sewer overflow is not economically feasible at this time, and the sanitary and industrial dry weather sewage flows to the plant from its tributary area is estimated to be 18.7 mgd, less than the present capacity, Alternate B does not consider the expansion of the Jersey City Sewerage Authority West Side plant to handle storm water flows. Similarly the Kearny municipal wastewater treatment plant which is also served by a combined sewer system and has a design capacity of 4.0 mgd does not need expansion to meet anticipated future needs if storm water flows are not considered.

Exhibit 14, Alternate B - Bergen County Sewer Authority System, shows locations of major interceptor sewers to be constructed; existing wastewater treatment facilities, including effluent and sludge disposal facilities to be constructed; existing facilities to be abandoned; and location of pumping stations and force mains to be constructed under this Alternate to best serve the development of the Meadowlands District.

EXHIBIT NO. 14



In order for sewage flows to reach the Little Ferry plant, Alternate B proposes the construction of strategically located interceptor sewers. One interceptor sewer will commence in the southerly portion of the District, proceed in a northerly direction west of the Hackensack River and terminate at the Little Ferry plant. It is anticipated that this interceptor sewer will be a combination of both gravity and force main sewers and will serve that portion of the Meadowlands District west of the River as well as intercept flows from the North Arlington-Lyndhurst Joint Meeting tributary area. A second interceptor sewer will originate at the southerly edge of the Town of Secaucus, proceed in a northerly direction east of the Hackensack River and terminate at the Little Ferry plant. It is anticipated that this second interceptor sewer will be a gravity sewer which will serve that portion of the Meadowlands District east of the River as well as intercept flows from the North Bergen and Secaucus tributary areas. Trunk sewer and collector sewer construction is not considered part of this Alternate.

The implementation of Alternate B is predicated on full development of the Hackensack Meadowlands within thirty (30) years. Construction of some portions of the system might be staged to demand, but construction of the major portion of the system would probably be required in the initial stage. Under Alternate B, the BCSA wastewater treatment plant at Little Ferry would initially be required to produce an effluent meeting "Recreational Waters" standards and the Kearny and Jersey City Sewerage Authority West Side plants, and all others affecting Newark Bay Waters, would be required to produce an effluent meeting present New Jersey standards for "TW-2 Waters", with implementation as soon as possible. At the time that construction of water-oriented housing is imminent in the Meadowlands, in approximately ten to twelve years, but not more than twenty years, the treatment process at the BCSA plant must be upgraded to produce effluent meeting "Primary Contact Waters" standards, while those plants effecting Newark Bay must produce effluents meeting "Recreational Waters" standards. Consideration may be given to achieving "Harvest Waters" quality in the Hackensack River at some future time through the use of more sophisticated treatment processes, ocean outfall or other means.

Details of new construction at the various existing wastewater treatment plants to remain in operation are the same as discussed under Alternate A for the Kearny Municipal Plant, the Jersey City Sewerage Authority West Side Plant and the Bergen County Sewer Authority Plant. In each case the extent of construction will be modified for the capacity anticipated under this Alternate.

The modifications involved in upgrading the proposed 75 mgd BCSA plant to 161.3 mgd would involve improvement of the present primary settling and secondary settling steps and the substitution of vacuum filtration and incineration for the present digestion and ocean disposal method of sludge handling. The sludge handling would require revision of sludge pumping facilities in the existing plant, a new sludge force main for transport of sludge from the BCSA plant across the Hackensack River to the assumed location of a regional incinerator and new vacuum filtration facilities. Extension of outfall sewers to the main channel of the River would be required.

D. Details of Alternate C - Hackensack Meadowlands Development Commission System

This Alternate assumes that existing sewer agencies will continue to collect sewage flows generated within their areas of jurisdiction, but all treatment of sewage will be divided between the Bergen County Sewer Authority (BCSA) wastewater treatment plant at Little Ferry and a new wastewater treatment plant to be constructed by the Hackensack Meadowlands Development Commission (HMDC) adjacent to the proposed flood control facilities in the southern portion of the District.

The Borough of Wood-Ridge plans to discharge its sewage flows to the facilities of the Bergen County Sewer Authority and to deactivate its existing wastewater treatment plant. The Carlstadt and East Rutherford Sewerage Authorities have been formed to provide sewerage facilities for that area of the Meadowlands which lies within their respective jurisdictions and to discharge their sewage flows to the facilities of the Bergen County Sewer Authority. Alternate C assumes that these arrangements will remain unchanged and will be augmented by new interceptor sewer facilities.

The existing Rutherford-East Rutherford-Carlstadt Joint Meeting wastewater treatment plant will be deactivated under Alternate C and will be connected to a trunk sewer belonging to the East Rutherford Sewerage Authority. Through the sewers of this latter agency and through sewers of the BCSA, sewage flows from the present tributary area of the Rutherford-East Rutherford-Carlstadt Joint Meeting will reach the BCSA plant at Little Ferry.

Under Alternate C, the North Arlington-Lyndhurst Joint Meeting plant will also be deactivated and sewage flows from its tributary area will reach the new HMDC plant by means of a new interceptor sewer.

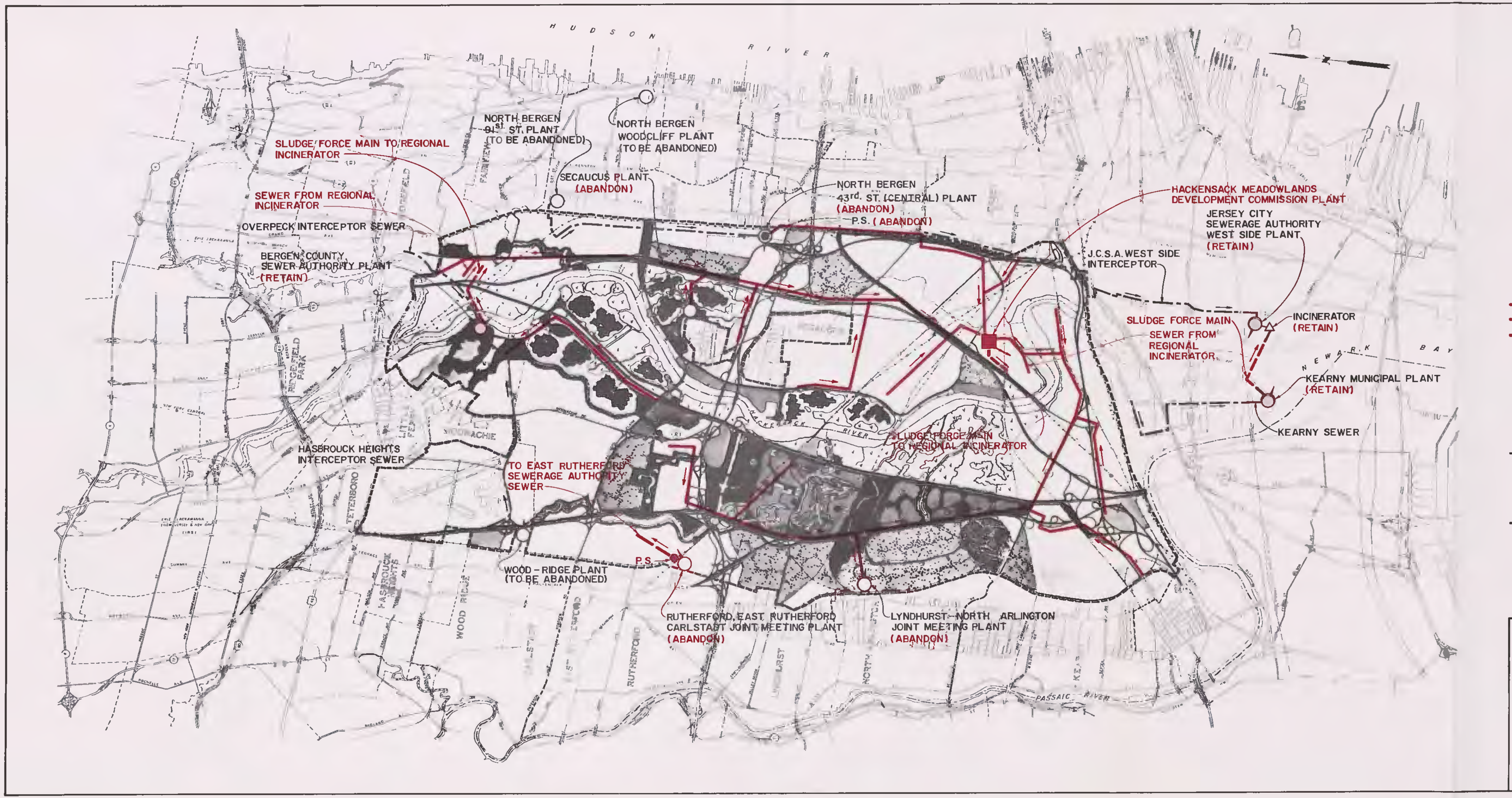
North Bergen Township has planned to abandon its existing Woodcliff, Central and Northern plants and to treat all sewage at a new plant at the site of the existing Central plant. Alternate C assumes that this new plant will not be constructed and sewage flows from North Bergen Township tributary area will reach the new HMDC plant by means of a new interceptor sewer.

In the Town of Secaucus, Alternate C assumes that the existing wastewater treatment plant will be deactivated and sewage flows from its tributary area will reach the new HMDC plant by means of a new interceptor sewer. As described under Alternate B, the immediate deactivation of the Secaucus wastewater plant is not essential.

The Kearny municipal wastewater treatment plant now treats only sewage flows from Kearny Point, which lies wholly outside of the Meadowlands District. Alternate C assumes that its tributary area will not change, but that its efficiency of treatment will be improved. The possibility of treating sewage flows from Kearny Point at the Jersey City Sewerage Authority West Side wastewater treatment plant, as discussed under Alternate A, is also applicable under this Alternate.

Alternate C assumes that the Jersey City Sewerage Authority West Side wastewater treatment plant will continue to function, but will be relieved of a portion of its hydraulic load by diverting sewage flows from the tributary area of Jersey City lying north of Manhattan Avenue to the new HMDC plant. This diversion may simplify the diversion of storm water overflows from the Hackensack River above the flood control gates.

Under Alternate C the BCSA plant at Little Ferry will continue to treat flows from its present tributary area; from the Carlstadt and East Rutherford Sewage Authorities; and will treat sewage flows from the northern portion of the Meadowlands District.



STATE OF NEW JERSEY
HACKENSACK MEADOWLANDS DEVELOPMENT COMMISSION
FEASIBILITY REPORT-WATER POLLUTION CONTROL SYSTEMS

ALTERNATE "C"
RECOMMENDED
HACKENSACK MEADOWLANDS DEVELOPMENT COMMISSION SYSTEM

SCALE

JOHN J. KASSNER & CO., INC.
Consulting Engineers

Under Alternate C the BCSA wastewater treatment plant will need to be expanded to treat sewage flows from the Meadowlands District, but not more than is presently contemplated under a program for future plant expansion. This program for future plant expansion includes provision for treating sewage flows from the Bergen County portion of the Meadowlands District as well as from presently sewered areas in Bergen County, south of the plant, all predicated on development of this area under present zoning. Since the Master Plan for the development of the Meadowlands District stipulates a greater density of development, the tributary area of the BCSA plant under Alternate C has been established so that the total sewage flow to that plant from the Meadowlands area will be 113.5 mgd, less than the total sewage flow anticipated under the future plant expansion program of the Bergen County Sewer Authority.

The Jersey City Sewerage Authority West Side wastewater treatment plant has a design capacity of 36.0 mgd and an anticipated average dry weather flow estimated to be 12.0 mgd. Similarly the Kearny municipal wastewater treatment plant has a design capacity of 4.0 mgd and will not require expansion. The adequacy of hydraulic capacity is predicated on dry weather flows, as previously discussed under Alternates A and B, even though both systems are combined.

Exhibit 15, Alternate C - Hackensack Meadowlands Development Commission System, shows locations of major interceptor sewers to be constructed; new wastewater treatment facilities, including effluent and sludge disposal facilities, to be constructed; existing facilities to be abandoned; and location of pumping stations and force mains to be constructed under this Alternate to best serve the development of the Meadowlands District.

In order for sewage flows to reach the BCSA and HMDC wastewater treatment plants, strategically located interceptor and trunk sewers will be constructed under Alternate C. The "Northeast Trunk Sewer" will commence in the Township of North Bergen meadowlands in the vicinity of Cromakill Creek and proceed in a northerly direction, east of the Hackensack River and discharge into the BCSA Overpeck Interceptor Sewer at Ridgefield. This sewer will serve the Meadowlands District in this area as well as the assumed northerly Meadowlands regional incinerator. The "North-Central Trunk Sewer" will start in the Borough of Carlstadt meadowlands north of Paterson Plank Road, traverse the west side of the Hackensack River and discharge into the BCSA Hasbrouck Heights Interceptor Sewer. This sewer will principally serve the high density water-oriented residential development proposed for this area by the Master Plan.

The HMDC wastewater treatment plant will be served by three new interceptor sewers. The "South-East Interceptor Sewer" will intercept the North Bergen tributary flow at the existing North Bergen 43rd Street pumping station, continue south along the easterly Meadowlands District boundary to a point opposite the proposed HMDC plant and enter the plant at its eastern end. A southeasterly spur from this sewer will intercept a portion of the Jersey City Sewerage Authority West Side tributary flow at Manhattan Avenue. The "South Central Interceptor Sewer" will begin at the New Jersey Turnpike in Secaucus just south of Cromakill Creek and proceed in a southerly direction generally along the line of the Turnpike, entering the plant from the north. This sewer will intercept the flow from the Secaucus Municipal plant and, together with its trunk sewer spurs, will serve the bulk of the Secaucus meadowlands area. The "South West Interceptor Sewer" will originate in the Borough of East Rutherford at a point near N. J. Route 20, north of N. J. Route 3. This sewer will follow N. J. Route 20 southerly to N. J. Route 3; follow N. J. Route 3 westerly to the proposed southerly extension of N. J. Route 17; follow the proposed southerly extension of N. J. Route 17 southerly to N. J. Route 7; follow N. J. Route 7 easterly to the Jersey City and Newark Turnpike; follow the Morris and Essex Division of the Erie-Lackawanna

Railroad in an easterly direction some 3,000 feet; cross the Hackensack River and traverse the opposite bank of the river in an easterly direction, entering the plant from the east. This sewer, together with its trunk sewer spurs will serve the westerly portion of the Meadowlands south of N. J. Route 3 and intercept the flow from the Lyndhurst-North Arlington Joint Meeting Plant.

The implementation of Alternate C is predicated on full development of the Hackensack Meadowlands within thirty (30) years. Construction of parts of the system can be staged to meet the anticipated demand. Under Alternate C, the BCSA and the HMDC plants would initially be required to produce effluents meeting "Recreational Waters" standards, and the Kearny and Jersey City Sewerage Authority West Side plants and all others affecting Newark Bay waters would be required to produce effluents meeting present New Jersey standards for "TW-2 Waters" with implementation as soon as possible. At the time that construction of water-oriented housing along the Hackensack River becomes imminent in approximately ten to twelve years, but not more than twenty years, the BCSA and HMDC plants will be required to produce effluent meeting the standards of "Primary Contact Waters" and those plants affecting Newark Bay waters will be required to meet effluent standards of "Recreational Waters". Consideration may be given to achieving "Harvest Waters" quality in the Hackensack River at some future time through more sophisticated treatment processes, ocean outfall or other means.

Details of new construction at the various existing wastewater treatment plants to remain in operation are the same as discussed under Alternate A for the Kearny Municipal Plant, the Jersey City Sewerage Authority West Side Plant and the Bergen County Sewer Authority Plant. In each case the extent of construction will be modified for the capacity anticipated under this Alternate.

The construction of the new Hackensack Meadowlands Development Commission wastewater treatment plant will incorporate the contact stabilization process with step aeration. The HMDC plant will be located in the southern part of the District, and will discharge its effluent just upstream of the proposed tidal barrier through a submerged dispersion outfall sewer. A schematic flow diagram of the plant process is shown on Exhibit No. 16. Sludge handling at the plant will consist of dewatering by vacuum filtration in a building adjacent to the proposed regional incinerator, with incineration of the filtered sludge cake and final disposal of incineration ash by land fill at or adjacent to the plant site.

The site tentatively selected for the plant lies within boundaries formed by the Penn-Central Railroad and New Jersey Turnpike to the west, the Erie-Lackawanna Railroad to the north, Penhorn Creek to the east and the Hackensack River to the south. The site has been designated for manufacturing purposes by the Comprehensive Master Plan and is presently being used for solid waste disposal. While details as to the availability of the site and other similar factors have not been investigated at this time, it has numerous advantages. It is convenient to a number of major traffic arteries, either existing or proposed under the Comprehensive Master Plan and it is convenient to major railroads for the delivery of chlorine and sludge conditioning chemicals, the latter being required for vacuum filtration. Present use of the property or properties for solid waste disposal has already accomplished some raising of ground elevation and some stabilization of sub-surface soils. A review of existing soils conditions in the area of the site indicates a relatively shallow elevation of bed rock, estimated at perhaps forty feet and evidenced by the close proximity of Little Snake Hill to the east and Laurel Hill along the New Jersey Turnpike to the west. This condition would serve to minimize the cost of pile foundations for plant structures. A Site Plan of the plant showing tentative arrangement of major structures and facilities is shown on Exhibit No. 17.

The treatment process will include mechanically cleaned bar screens for screening of the incoming raw sewage, influent pumping to lift raw sewage to the required level for plant flow by gravity and grit removal and comminution as preliminary treatment. Pre-aeration of sewage does not appear necessary at this time, but would be reconsidered in final design. Primary and secondary treatment will consist of prechlorination, primary settling, biological treatment in aeration tanks, secondary settling and chlorination of plant effluent. Consideration has been given in the plant layout, insofar as is practicable at this time, to the possible future need for additional units of treatment for nitrogen and phosphorus removal and also microstraining. In the case of nitrogen and phosphorus removal, it is

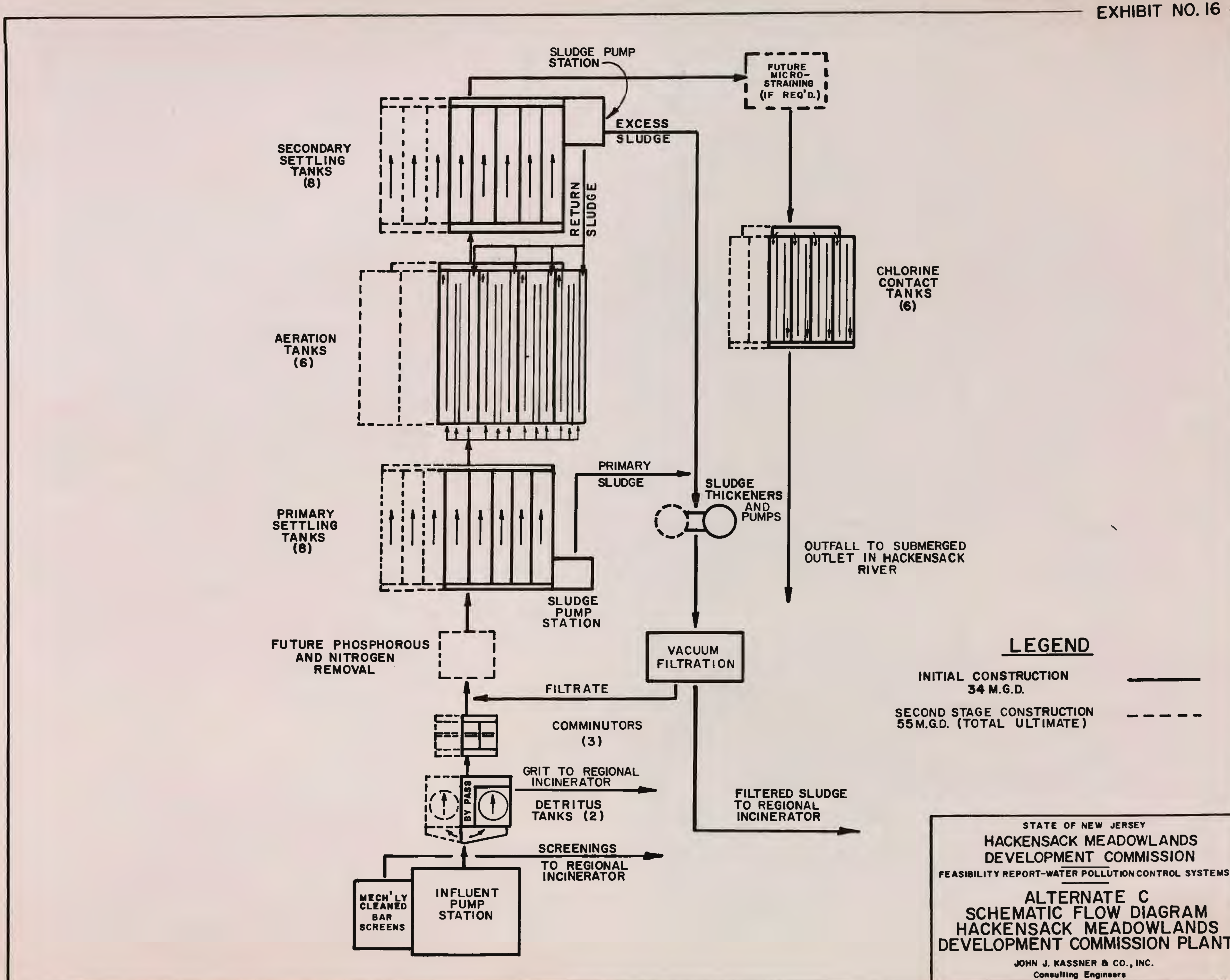


EXHIBIT NO. 16
SLUDGE PUMP STATION
FUTURE MICRO-STRAINING (IF REQ'D.)
EXCESS SLUDGE
SECONDARY SETTLING TANKS (8)
RETURN SLUDGE
CHLORINE CONTACT TANKS (6)
AERATION TANKS (6)
PRIMARY SLUDGE
SLUDGE THICKENERS AND PUMPS
PRIMARY SETTLING TANKS (8)
OUTFALL TO SUBMERGED OUTLET IN HACKENSACK RIVER
SLUDGE PUMP STATION
FUTURE PHOSPHOROUS AND NITROGEN REMOVAL
VACUUM FILTRATION
LEGEND
INITIAL CONSTRUCTION 34 M.G.D.
SECOND STAGE CONSTRUCTION 55 M.G.D. (TOTAL ULTIMATE)
FILTRATE
COMMINUTORS (3)
GRIT TO REGIONAL INCINERATOR
BY PASS
DETRITUS TANKS (2)
FILTERED SLUDGE TO REGIONAL INCINERATOR
SCREENINGS TO REGIONAL INCINERATOR
MECH'LY CLEANED BAR SCREENS
INFLUENT PUMP STATION
STATE OF NEW JERSEY
HACKENSACK MEADOWLANDS DEVELOPMENT COMMISSION
FEASIBILITY REPORT-WATER POLLUTION CONTROL SYSTEMS
ALTERNATE C
SCHEMATIC FLOW DIAGRAM
HACKENSACK MEADOWLANDS
DEVELOPMENT COMMISSION PLANT
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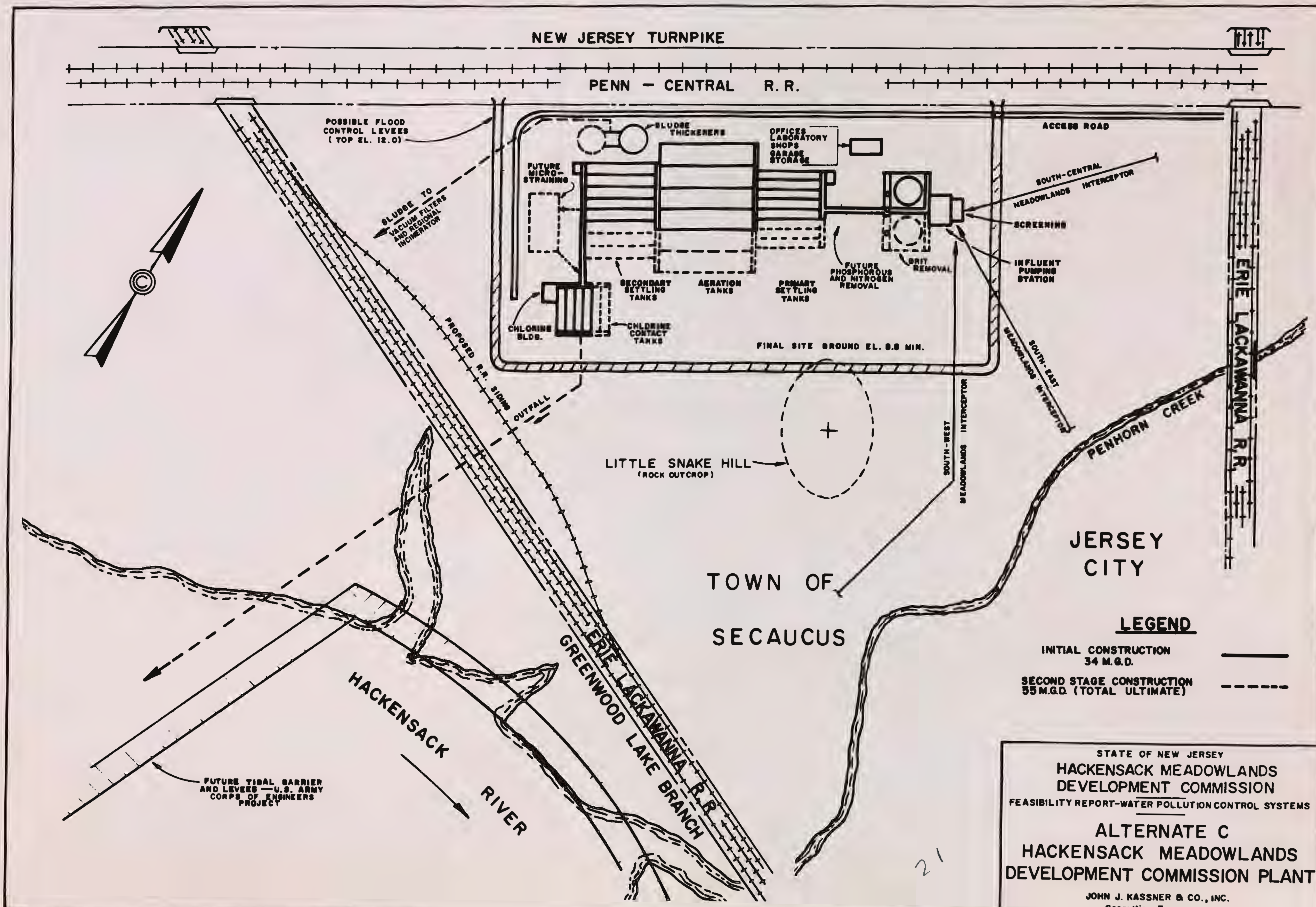
Consulting Engineers



STATE OF NEW JERSEY
HACKENSACK MEADOWLANDS DEVELOPMENT COMMISSION
FEASIBILITY REPORT-WATER POLLUTION CONTROL SYSTEMS

ALTERNATE C
HACKENSACK MEADOWLANDS DEVELOPMENT COMMISSION PLANT

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recognized that in the present state of the art the need of this treatment in the curtailment of stream eutrophication has not been definitely established and is in fact being challenged. The question may well be resolved by the time of final design of the plant and a reevaluation of the advisability of commitment of funds to provide for nitrogen and phosphorus removal will be made at that time. Conversely, it appears quite likely that microstraining or some other form of tertiary BOD removal lies in the future for plants of the District and provision of space for this likelihood can be made without initial commitment of funds, other than for land.

Sludge from the primary tanks and excess sludge from the secondary tanks will be pumped to sludge thickeners for concentration and thence to a vacuum filter building located adjacent to the proposed regional incinerator for dewatering of sludge prior to incineration. Screenings and possibly grit would also be incinerated.

The aeration tanks, which are the heart of the activated sludge process and provide biological treatment of the sewage, will be designed for varying the respective amount of aeration of return sludge and of mixed liquor by providing for the feed of primary settled sewage in varying amounts to the aeration tanks at three different points. This would enable adjustment of the process at any time during operation to select the more suitable mode of operation for prevailing conditions.

The Site Plan, Exhibit No. 17, indicates possible flood control dikes with a top elevation +12.0, mean sea level. According to the Comprehensive Master Plan, construction which precedes the construction of the tidal barrier and other flood control works will require protection dikes as a temporary measure. It is estimated that the operating floor of the plant influent pumping station, which represents the highest structure in the plant, would be at approximate elevation +18.0 and the top of the chlorine contact tanks, which are the last and lowest unit in the initial plant, would be at approximate elevation +8.0. The necessity for constructing temporary flood control levees around the plant is therefore dependent upon the timing of construction of the plant and the District flood control works. In the event that the levees are required, the embankment of the Penn-Central Railroad line to the west of the plant site will be considered.

The Comprehensive Master Plan, incorporating major features of U. S. Army Corps of Engineers studies of flood control in the Meadowlands District, also proposes that the maximum flood elevation upstream of the proposed tidal barrier will be limited to elevation +5.0 through the use of pumping facilities to discharge river flow to a point downstream of the closed barrier. Minimum ground elevation adjacent to the river has therefore been established in the Comprehensive Master Plan as elevation +6.0. A minimum amount of earth fill should therefore be required at the plant site, since the present site elevation is estimated to be approximately +6.0 to +8.0. The control of upstream flooding to a maximum elevation of +5.0 indicates the need for placing the plant outfall sewer just upstream of the tidal barrier, so that the plant is protected against inundation by backup of flood waters through the outfall pipe, and the plant profile can therefore be held as low as is hydraulically feasible.

Under Alternate C, the BCSA plant, the Kearny plant and the HMDC plants, will each require a submerged outfall sewer discharging into the main channel of the River with submerged dispersion outlets. The HMDC plant outfall sewer will extend to a point near the center of the proposed tidal barrier.

The desirability for combining the sewage flows from the Kearny and Jersey City Sewerage Authority West Side plants, as discussed in the preceding Alternates, is again applicable in Alternate C. Further, the technical desirability of connecting the Kearny municipal plant and the Jersey City Sewerage Authority West Side plant to the HMDC treatment system is recognized. Should it become practical to include these tributary areas in the Meadowlands District system it is technically feasible to do so.

E. Comparative Construction Cost Estimates

1. Introduction

In order to determine the economic feasibility of each Alternate studied and indicate approximate costs for development of recommended water pollution control facilities, construction cost estimates were prepared for Alternates A, B and C. For the purposes of comparison all phases of implementation of each Alternate were considered without regard to the agency making the expenditure. The various cost components estimated and included under each Alternate are such that approximately equal results in water pollution control and improvement of River water quality would be achieved by proper operation of the facilities thus provided.

Costs of financing, engineering and administration were not considered since they are all directly related to the construction cost and therefore apply proportionately to each Alternate. Unit prices and costs used for the comparative construction cost estimates are based upon estimated costs if these facilities were to be built this year (1970). It is recognized that costs will probably increase each year, but again for comparison of Alternates no future cost increases were considered.

Development of the construction cost estimates for the various Alternate Water Pollution Control Systems has of necessity been based upon a certain degree of generalization in the absence of preparation of detailed design drawings, specific subsurface investigations and tests and actual survey for location and condition of existing facilities. To compensate, a construction cost contingency of fifteen (15%) percent has been applied to estimated costs for additional unforeseen costs.

2. Wastewater Treatment Plant Costs

All Alternates consider that similar degree of satisfactory treatment will be given to all wastes emanating from sanitary sewerage systems discharging within the area of influence upon the District, regardless of the origin of these wastes. Therefore, the total volume of sewage flow considered is greater than that actually generated within the District. The total sewage flow volumes requiring treatment under Alternates A, B and C are equal for each Alternate, thus providing a valid basis for comparison of wastewater treatment plant capital construction costs.

The major elements of construction considered as accomplishing the necessary modifications and additions to existing wastewater treatment plans as well as the provision of a new plant are as follows:

a. Upgrading of existing treatment plants to meet Primary Contact effluent standards for Recreational Standards as required.

b. Expansion of existing treatment plants to provide additional capacity for estimated ultimate total sewage flows.

c. Special construction required due to unusual foundation conditions.

d. Addition of facilities required to modify existing sludge handling procedures to utilize incineration or equivalent methods.

e. Extension of outfall sewers at existing wastewater treatment plants for improved dispersion of effluent.

f. Land acquisition as required for the new plant.

g. Construction of new wastewater treatment facilities.

Data on costs of complete secondary wastewater treatment plants of the types involved in this study were assembled from various sources, were updated to January 1970 cost levels by use of the Engineering News-Record Index of Treatment Plant Costs and were plotted to obtain a graph of treatment plant costs covering a range of one to one hundred mgd plant design flow. The data used for plotting this graph include that obtained from United States Public Health Service Publication No. 1229, published material from various Journals of the Water Pollution Control Federation and information from our own files. The graph, shown on Exhibit No. 18, Sewage Treatment Plant Base Construction Costs, has been used to obtain base costs for expansion of existing wastewater treatment plants as well as for new plant construction and includes costs of sludge pumping, and vacuum filtration. Additional allowances have been added to these base costs to compensate for the extra expense of adding new construction to existing structures; for incremental or staged construction of treatment facilities, with its inherent higher total costs; for special foundation conditions; and for individual special conditions at specific sites.

Estimates of cost for upgrading of treatment processes at existing plants have been based on upgrading existing plant capacity, assuming that any additional plant capacity will be designed for the new recommended effluent quality standards. Cost estimates for the upgrading of the smaller wastewater treatment plants are based upon sufficient analysis for the purposes of this study and Report and have been formulated from assessment of the general requirements in each case. Costs for individual plants may vary, but are considered sufficiently accurate for comparison of total costs for the three (3) Alternates studied.

In the case of the Bergen County Sewer Authority plant, existing plant capacity is considered to be 75 mgd, based on the construction of the presently planned plant expansion from 50 to 75 mgd prior to implementation of any Hackensack Meadowlands Water Pollution Control System. Analysis of available data on the proposed 75 mgd plant indicates that the major revisions required to attain Primary Contact effluent standards consist of additional primary settling and secondary settling tankage. The costs of additional tankage; the additional cost of pile foundations; and the additional expense of adding new construction to existing plant structures have been considered. Additional costs have also been considered in determining the costs of upgrading the assumed existing 75 mgd plant for vacuum filtration, modification and additional sludge pumping, force main and extension of outfall sewers.

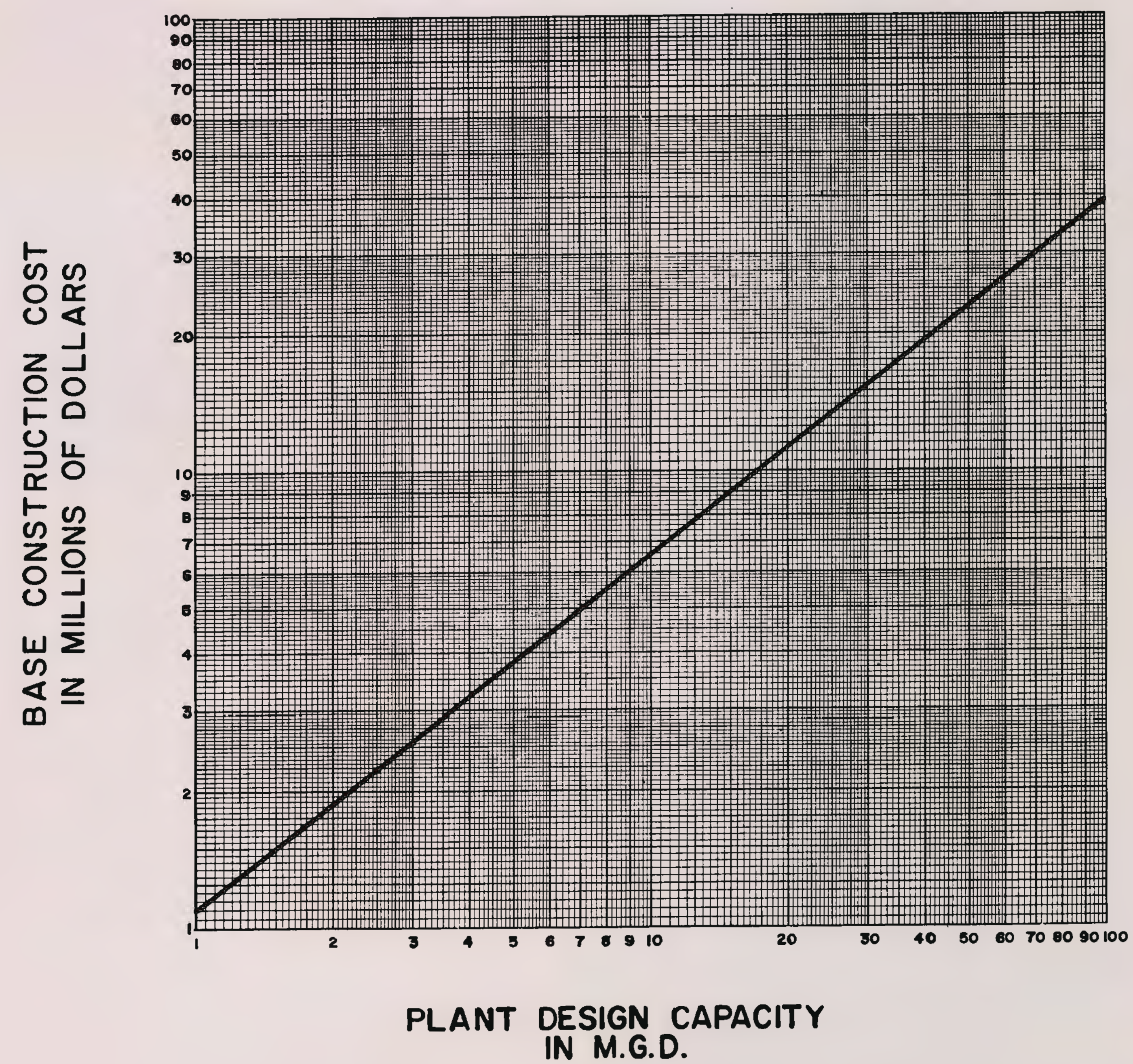
The cost estimate for the new Meadowlands Commission plant was based on the same considerations as for the BCSA plant, except that all factors were considered as being new construction.

The Comprehensive Master Plan suggests that low-lying areas to be developed prior to construction of the tidal barrier should be protected by local levees or dikes. The costs of these levees as delineated on Exhibit No. 17, Alternate C - Hackensack Meadowlands Development Commission Plant-Site Plan, have been included in the estimated plant construction costs.

The Jersey City Sewerage Authority has estimated that the cost for upgrading its West Side Plant to provide secondary treatment at the present plant hydraulic capacity of 36 mgd will be $30, 000, 000. This total estimated cost has been prorated on a straight line basis for treatment facilities to accommodate flows allocated to the plant under the three Alternates.

Cost estimates for improvements and/or expansion to the Kearny Municipal Wastewater Treatment plant have been based on the foregoing procedures with the addition of costs for extension of the outfall line to the main Channel of the River and for sludge force main.

Where deemed necessary land acquisition costs have been estimated as being $25, 000 per acre.



STATE OF NEW JERSEY
HACKENSACK MEADOWLANDS
DEVELOPMENT COMMISSION
FEASIBILITY REPORT-WATER POLLUTION CONTROL SYSTEMS

SEWAGE TREATMENT PLANT
BASE CONSTRUCTION COSTS

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3. Interceptor Sewer Costs

A detailed investigation was made of the interceptor sewer layouts for each Alternate studied to determine major items of construction cost. All systems are comparable since the tributary areas served and the ability to carry the anticipated ultimate flows are similar.

The major elements of new construction considered are as follows:

a. Furnishing and installing sewer pipes including excavation, bedding and backfill.

b. Manholes and sewer structures.

c. Pumping stations and force mains.

d. Miscellaneous items of construction such as highway and railroad crossings; River and waterway crossings; rock excavation; pavement restoration; utility interferences; and construction berms.

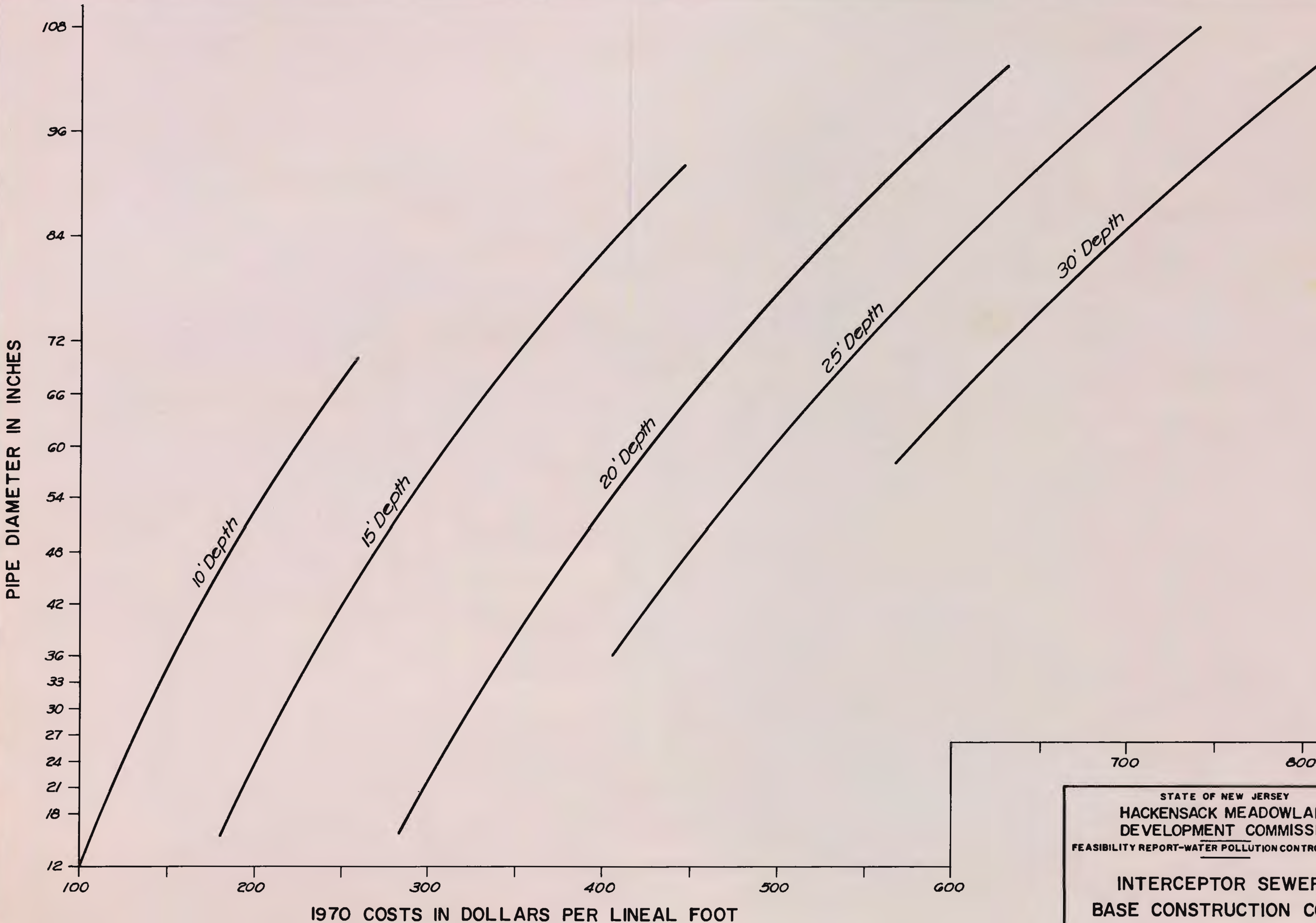
In establishing unit prices for the various items of construction consideration was given to varying depths of sewer installation, special foundation conditions and the many other factors discussed under "Special Construction Requirements", Section VII, "Design Parameters".

Unit prices based on recent bid prices in the local area and upon time and material analyses were developed for varying pipe installation conditions and for the other items of construction, all estimated as of the 1970 construction period. A series of curves were prepared, presented on Exhibit No. 19, "Interceptor Sewers Base Construction Costs", which show the estimated base construction costs of various sized interceptor and trunk sewers, at various depths, constructed in place. To these base costs additional allowances have been added to compensate for the extra expense of such work items as the construction berm; rock excavation; manholes; force mains and pumping stations and crossings of all types.

4. Comparative Construction Costs Estimates

Based on parameters presented hereinbefore, capital construction costs have been estimated for Alternates A, B and C, and are presented below. These comparative estimates of costs were made on the basis of the ultimate development of each Alternate to the year 2000 and on 1970 dollar values.

FACILITY	ALTERNATES A (In Millions of Dollars)	B	C
1. Treatment Plants	92.4	76.6	76.6
2. Interceptor Sewers	50.5	71.6	61.8
Sub-Totals	142.9	148.2	138.4
Miscellaneous (15%)	21.1	22.3	20.6
Total Estimated Construction Cost	$164.0	$170.5	$159.0



STATE OF NEW JERSEY
HACKENSACK MEADOWLANDS
DEVELOPMENT COMMISSION
FEASIBILITY REPORT-WATER POLLUTION CONTROL SYSTEMS

INTERCEPTOR SEWERS
BASE CONSTRUCTION COSTS

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Consulting Engineers

F. Additional Alternates Considered

1. Municipalities

The New Jersey State Department of Health has issued orders to abate pollution to a majority of the municipally owned and operated wastewater treatment plants which discharge into the waters of the Hackensack River basin. To comply with these abatement orders, studies have been made by or for these municipalities. For the most part the solutions presented, though presumably feasible for implementation on an individual basis and presumably designed to conform with present New Jersey water quality standards, are not consistent with the concept of regionalization being advanced by Federal and State water pollution control agencies and are not compatible with the Comprehensive Master Plan for the development of the Hackensack Meadowlands. The individual reports of studies, where made available to us for review, were considered for this Report and those features which were conceptually adaptable were incorporated. In general, Alternate A retains the "individual" plant approach, but was designed to conform to the recommended water quality standards for the development of the Meadowlands.

2. Bergen County Sewer Authority

The wastewater treatment plant at Little Ferry, owned and operated by the Bergen County Sewer Authority, is a regional facility. It is operated to conform with the present New Jersey water quality standards and has received no abatement orders. The Authority is presently planning an expansion of its plant at Little Ferry to accommodate steadily increasing sewage flow from its tributary area. Utilization of the expanded Little Ferry plant is anticipated in Alternates A, B and C to varying degrees and is in each case designed to conform to the recommended water quality standards for development of the Hackensack Meadowlands.

3. Bergen County

A report on water pollution control is presently being prepared for the Bergen County Planning Board by its engineers. At a meeting certain general information was made available on a preliminary basis for consideration in this Report.

The Bergen County report considers development of the Meadowlands, but the study area is limited by the County corporate boundary. The alternates being developed, in very general terms, utilize the existing facilities of the Bergen County Sewer Authority and the Passaic Valley Sewerage Commissioners augmented by some new facilities and by expansions to the existing systems. There are three tentative alternates being developed for the Bergen County Report which would serve the Meadowlands area lying within Bergen County. One alternate would transport all sewage emanating from the Bergen County portion of the Meadowlands to the Bergen County Sewer Authority plant at Little Ferry. A second alternate would provide for construction of a new sewage treatment plant in the southernmost area of the Bergen County portion of the Meadowlands District, which would treat all sewage contributed by the Meadowlands not treated by the Little Ferry plant. The third alternate would provide for the construction of a pumping station, in the same general location, designed to pump the same sewage flows from the Meadowlands to the facilities of the Passaic Valley Sewerage Commissioners. In this Alternate another new plant, to be located in the Passaic River Valley, would serve northwestern Bergen County as well as hydraulically relieve the southern portion of the existing Passaic Valley Sewerage Commissioners' system so that sewage flows pumped from the Meadowlands could be accepted.

Each of these tentative alternates is generally regional in concept from a county point of view. It should be noted that the tentative recommendations of the Bergen County report are somewhat similar in form to those propounded by this Feasibility Report, but are limited to only that portion of the Meadowlands District which lies within Bergen County and improved water quality standards are not considered.

4. Hudson County

A report to the Hudson County Board of Chosen Freeholders entitled "Feasibility Study Regional Sewerage Facilities," March 1970, has been filed with the New Jersey State Department of Health and made available by that agency for consideration in this Report. The Hudson County report discusses three alternates for regionalization of water pollution control on a county-wide basis.

One alternate envisions four sub-regions with a treatment plant for each sub-region, two of which would discharge effluent to the waters of the Hackensack watershed. A new plant in the Township of North Bergen would serve that community, West New York, Guttenberg, and a portion of the Town of Secaucus including contiguous parts of the Meadowlands District in North Bergen and Secaucus. This plant would discharge effluent to Cromakill Creek, with the disadvantage noted that the volume of dry weather flow in the receiving stream is inadequate for dilution. The existing Jersey City Sewerage Authority West Side plant, discharging effluent at the mouth of the Hackensack River, would serve its present tributary area, portions of the Secaucus and Jersey City Meadowlands and all of the Town of Kearny with an option for a portion of Kearny to continue to use the Passaic Valley Sewerage Commissioners' treatment facilities. The existing Bayonne and Jersey City Sewerage Authority East Side plants would serve Bayonne and the eastern side of the Palisades lying south of North Bergen and would discharge effluent to Kill Van Kull and to the Upper New York Bay respectively.

A second alternate provides for three sub-regions with a treatment plant for each sub-region. The existing Jersey City Sewerage Authority West Side plant would serve the west slope of the Palisades, the Town of Kearny with the same aforementioned option, and all of the Meadowlands within Hudson County. The east side of the Palisades would be served by the Jersey City Sewerage Authority East plant and Bayonne would be served by its existing plant.

The third alternate suggests serving all of Hudson County to the west of the Palisades by means of the existing Jersey City Sewerage Authority West Side plant, where sewage would be afforded primary treatment. Bayonne and the east side of the Palisades would be served by the existing Bayonne and Jersey City Sewerage Authority East Side plants, each affording primary treatment. Sewage from all of Hudson County would be given secondary treatment at the Jersey City Sewerage Authority East Side plant and would be discharged to Upper New York Bay.

In order to implement any of the foregoing alternates, Hudson County's consultants recommend the formation of a central authority with control over treatment of sewage.

5. <u>Summary</u>

All of the foregoing studies were limited in scope by nature of the fact that they were confined to existing political boundaries. Regionalization of water pollution control generally requires that the natural drainage area be the controlling factor without regard to local political subdivisions. It is conceivable that two or more of the Bergen and Hudson County plans could be implemented under the aegis of the counties in such a way as to conform to recommended water quality standards for development of the Meadowlands District. However, unless complete control over construction of sewerage facilities within the District as needed for the orderly development thereof is vested with the Hackensack Meadowlands Development Commission, it is also conceivable that County needs could transcend those of the Commission, thus retarding Meadowlands development.

G. Comparison and Recommendations

1. Regionalization

The present concept of regionalization being advanced by State and Federal water quality agencies is a major factor to be considered in evaluating alternative solutions to the problem of water pollution control. In general, regionalization treats with an area enclosed by natural physical and geographic boundaries, transcending political lines of jurisdiction.

Regionalization places control of design, construction, operation, maintenance and administration of water pollution control systems for an entire watershed or basin under unified control. This will provide the greatest benefits and in this instance simplify the development of the Meadowlands according to the Comprehensive Master Plan. Many benefits accrue to centralized control, among them being economy of construction in that the total cost for treatment facilities per unit of volume of treated sewage is generally smaller for large facilities; a large treatment facility has greater reserve capacity, flexibility and operational capability to overcome shock loads, be they hydraulic or organic; regional facilities attract higher caliber personnel and, through 24 hour per day operational procedures can provide better service and greater rapidity in maintenance and repair activities; large capacity plants have greater flexibility in treatment processes and therefore afford the ability for experimentation and testing.

If and when tertiary treatment is required and it becomes feasible to meet "Harvest Waters" quality standards, adaption of a large regional plant can be expected to involve less costs per unit volume of sewage treated. A large plant would also generally have higher caliber personnel and laboratory facilities with the skills and capabilities necessary for the proper operation of complex and sensitive treatment processes.

Alternates B and C are regional in concept, but Alternate A is not.

2. River Water Quality

Alternates A, B and C have been designed to be capable of producing treatment plant effluents which will be consistent in meeting design criteria established for required water quality. Hence none of the Alternates vary in this regard.

However, the dead-ended tidal system which exists in the Hackensack River coupled with the inadequate advective flow of fresh water over the Oradell Dam, affects the relative suitability of each Alternate. It has been demonstrated that any pollutional loading which is discharged well upstream from the mouth of the River takes a significant length of time to flush out and requires a significant number of tidal cycles to be completely mixed and dispersed. Therefore, any treatment plant effluent discharged into the Hackensack River at or near its mouth would have less detrimental impact on the River water quality than discharges farther upstream. This is primarily due to the proximity of Newark Bay with the opportunity for greater mixing and surface aeration afforded by the greater volume of water. This intermixing with Newark Bay also decreases the chance for the movement of such pollutional loads upstream.

At the same time it must be remembered that the River is an ecological system which is dynamic and changing. The organisms which make up this aquatic environment react to various stimuli, such as nutrient levels, concentration of pollutants, temperature, sunlight, oxygen level and the like. The introduction of concentrated pollutional loads in restricted locations could severely upset the balance of nature in that localized area. Thus, when very large volumes of wastes are discharged in one restricted location, even though these wastes may have been significantly treated, there may still be sufficient concentration of pollutants to be harmful to the river's ecological system.

The use of dispersed outfalls, possibly from many small plants having high degree of treatment as described under Alternate A, would tend to have the least harmful effect on the overall ecological system. The flow of highly purified plant effluent under Alternate C, discharged near the mouth of the Hackensack River, where outgoing tidal flows would have great mixing effect and cause rapid dispersion into the large surface expanse of an improved water quality within Newark Bay, and thus have a greater assimulative capability, could be nearly as harmless as the multi-point discharges of Alternate A.

The discharge of a major quantity of plant effluent far within the tidal estuary is the least satisfactory with respect to this area's water quality. Thus Alternate B, which would place the greater amount of treated effluent furthest from the mouth of the river, is less attractive than Alternate C which divides the total waste water flows and places a significant part of the pollutional material in a more assimilative environment.

Introduction of all of the flow further up the tidal estuary would slightly increase the advective flow. The maximum daily treated effluent flow would be approximately 200 mgd and when compared to the tidal flow during the same period of some 4, 500 mgd, does not appear to have great significance.

With regard to water quality requirements, Alternates A and C would provide equal benefit and either would be preferred to Alternate B.

3. Capital Construction Costs

On the basis of capital construction costs the order of preference for each Alternate is:

Alternate C	$159, 000, 000
Alternate A	$164, 000, 000
Alternate B	$170, 500, 000

Consideration, however, must be given to methods of financing these capital construction costs.

Alternate A would require expenditure of large amounts of capital construction funds by local municipalities, further straining their ability to finance other needed improvements such as schools, parks and roads within their debt limits. Substantial tax increases could result.

Alternate B would have to be financed by the Bergen County Sewer Commission and to be paid by individual tributary areas through user charges. These charges would be extremely high so as to tend to discourage development of the Meadowlands.

Alternate C could be financed by the Hackensack Meadowlands Development Commission through their powers of special assessment of property within the Meadowlands District. This would be the most equitable procedure since these property owners would receive the maximum benefit from improved water quality in the Hackensack River. Some portion of the capital costs could also be borne by the peripheral communities to the extent they benefit from the construction of Alternate C.

With regard to capital construction costs Alternate C is the preferable plan, with Alternates B and A following in that order, particularly when methods of financing are considered.

4. Operation and Maintenance Costs

In addition to capital construction costs, the cost of operating and maintaining a water pollution control system must be considered in evaluating the Alternates.

Alternate A consists of numerous small capacity systems, most of which do not presently produce effluents meeting present New Jersey water quality standards. Present costs per unit of treatment published by each agency therefore do not reflect true treatment costs and cannot be used as a base upon which to estimate costs for upgraded treatment. In some instances, the present records of quantity of flow treated are not reliable due to malfunctioning equipment, thereby again rendering base information useless. Costs for maintenance of sewers are also sometimes included in unidentifiable budgetary items by the municipalities further eliminating the validity of the information. However, it is reasonable to assume that operational costs per unit of treatment would be much greater for the sum of numerous smaller systems, with inherent duplication of effort, than similar costs for one or two large systems.

Alternates B and C are similar in that treatment plants are of large capacity and interceptor systems are of comparable magnitude. It can be assumed that operation and maintenance costs for these two Alternates would be the same if methods of sewage flow in the interceptors were also identical. However, Alternate C utilizes gravity flow throughout as opposed to the requirement for major pumping facilities in Alternate B.

It is therefore apparent that operation and maintenance costs per unit of treatment will be the least under Alternate C, followed by Alternate B and A.

5. Miscellaneous

Certain other advantages and disadvantages accrue to each Alternate system for water pollution control. Enumerated hereinbelow are some of the more important:

Alternate A - Advantages

a. Continued use of a portion of the capital investment represented by existing treatment facilities.

b. Trunk sewer sizes would be smaller and installed at shallower depths than for Alternates B and C.

c. Treatment plant effluents would be discharged to the Hackensack River at numerous points, effecting a wider dispersal of the total effluent load.

d. Retaining existing agencies precludes the necessity for negotiating interagency agreements with their inherent legal and practical complications.

e. Each agency would retain greater freedom in the selection of methods of sewage treatment and sludge disposal to meet or exceed required standards.

Alternate A - Disadvantages

a. The regional approach to water pollution control would not be achieved, resulting in not gaining benefits inherent in regionalization through efficiency of operation.

b. Administrative control would not be vested with the Meadowlands Commission with the possible result that desired water quality would not be achieved or maintained.

c. Lack of administrative control by the Meadowlands Commission would make optimum staging of construction to meet the needs of the development of the Meadowlands District difficult to implement.

d. Scattered authority would make administrative and technical efficiency difficult to obtain.

e. Industrial waste flows could be expected to have a greater impact and tend to disrupt the process in smaller plants, thus adversely affecting plant reliability.

f. Treatment plant expansion costs and process improvement costs per unit would be relatively high for these small plants as compared to unit costs in larger facilities and would be burdensome to the revenue producing capabilities of the respective municipalities.

g. Effluent quality control usually achieved through the use of more highly trained operating personnel and through use of more mechanical controls would be difficult to obtain.

h. Sludge disposal facilities would be duplicated at several locations.

i. Maximum use of pumping stations and force mains would be required.

Alternate B - Advantages

a. With the Bergen County Sewer Authority plant rendering treatment of virtually all effluent discharged into the Hackensack River within the District, the full benefit of regionalization embodied in a single central agency would be realized.

b. Administrative and technical efficiency should be relatively easy to obtain in two major facilities.

c. The discharge of highly purified effluent from treatment facilities at the head of the Meadowlands would have a dual benefit of causing a slight increase in advective flow in the Hackensack River through the Meadowlands District, and provide a potential source of additional water within the District in an area where it can be economically used.

d. Treatment plant expansion, process improvements and operating costs per unit should be lower.

e. Sludge incineration would be feasible due to the availability of incinerators to treatment plants.

f. Financing of capital construction costs should be simpler as compared to Alternate A through existing bonding capabilities of the two "Authorities".

Alternate B - Disadvantages

a. Administrative control would not be vested directly with the Meadowlands Commission with the possible result that desired effluent quality would not be achieved or maintained.

b. Lack of administrative control by the Meadowlands Commission would make optimum staging of construction to meet the needs of the development of Meadowlands District difficult to implement.

c. New legislation may be required to permit the Bergen County Sewer Authority to provide sewage treatment for flows from areas outside of its present service area in Bergen County and for areas in Hudson County.

d. Sewer construction costs would be relatively high due to the necessity for larger diameter pipes in deeper trenches and pumping stations.

e. Pumping would increase operating and maintenance costs.

f. Major portions of the system would have to be constructed in the early stages of implementation of the Master Plan.

g. Difficulty might be encountered in the incorporation of some municipalities into the Bergen County Sewer Authority System as that Authority's structure operates on a "join voluntarily" principle.

h. Should such an action be desired at a future time, it is not practical to incorporate the Town of Kearny and Jersey City Sewerage Authority West Side plants into the Bergen County Sewer Authority System.

Alternate C - Advantages

a. The full benefit of the regional approach to water pollution control would be effected.

b. Participation in pollution control by the construction and operation of the Hackensack Meadowlands Development Commission plant will furnish the Commission with the necessary personnel and equipment to deal with the problems of pollution control in the Meadowlands District.

c. Operation of the Hackensack Meadowlands Development Commission plant by the Commission would afford the opportunity to "set the pace" of pollution control within the area and to encourage compliance by others through example.

d. Administrative and technical efficiency would be obtainable, resulting in savings for operation and maintenance.

e. Sequential staging of construction to meet the development schedule for the Meadowlands District is possible.

f. The need for pumping facilities is minimized.

g. The planned ultimate capacity of the Bergen County Sewer Authority plant would not have to be changed.

h. Treatment of sewage flows from the Town of Kearny and the Jersey City Sewerage Authority West Side plants is technically feasible.

Alternate C - Disadvantages

a. Advective flow in the Hackensack River through the Meadowlands District would be slightly decreased.

6. Recommendation

A review of the foregoing comparisons of Alternates A, B and C indicates that Alternate A should be eliminated from further consideration under almost all parameters presented.

Alternates B and C have similar advantages, particularly benefits derived from operation of regional systems. However, consideration of all factors leads to the inescapable conclusion that Alternate C should be constructed as it provides the best means of achieving the standards of water quality required for development of the Hackensack Meadowlands in accordance with Comprehensive Master Plan.

SECTION IX. IMPLEMENTATION

A. General

Implementation of a regional water pollution control system for the Hackensack Meadowlands will benefit the entire River basin and surrounding areas and will enable the Meadowlands to develop in accordance with the Comprehensive Master Plan.

The water quality standards recommended herein should be adopted for the Hackensack River and its tributaries and discharges into the water of Newark Bay and the Kills should be improved. Construction should start as soon as possible on the various elements of the Hackensack Meadowlands Development Commission Water Pollution Control System.

The implementation of the recommended system, Alternate C, is shown on Exhibit No. 20, Construction Staging, Hackensack Meadowlands Development Commission System which indicates the timing of the various Stages.

The recommended water pollution control system for the Hackensack Meadowlands as shown in Alternate C can be implemented in stages which will keep pace with the requirements for development of the Meadowlands District as set forth in the Comprehensive Master Plan. Operation of wastewater treatment facilities under this system can be programmed to produce a quality of River water environmentally compatible with any of the planned phases of Meadowlands District development. Sewerage facilities can be made available at the appropriate time to allow reclamation and development of the Meadowlands District to proceed on an orderly schedule. This staging of construction allows the gradual expenditure of capital funds, thus reducing the overall financing and operating costs.

B. Construction Stages

Construction of Stage I of the Hackensack Meadowlands Development Commission System is recommended for immediate implementation, including the improvement of treatment facilities at the Bergen County Sewer Authority Plant to produce an effluent meeting the recommended requirements for "Recreational Waters" quality standards and at the Jersey City Sewerage Authority West Side and the Kearny Municipal plants to produce effluents meeting "TW-2 Waters" quality standards.

Stage I construction will consist of construction of a new 35 mgd wastewater treatment facility on the Hackensack River in the southerly Secaucus Meadowlands area. This plant will be designed to produce an effluent meeting the recommended requirements for "Recreational Waters" quality standards. Interceptor sewers constructed under this Stage include the construction of that portion of the Southeast Interceptor Sewer that will permit connection of the North Bergen Township sewage flow at 43rd Street; that portion of the South-Central Interceptor Sewer that will permit the sewering of the developing industrial tracts in the Secaucus meadowlands; and that portion of the main Southwest Interceptor Sewer that will permit connection of the sewage flow tributary to the Lyndhurst-North Arlington Joint Meeting plant. Also included under Stage I is the construction of a pumping station at the site of the Rutherford-East Rutherford-Carlstadt Joint Meeting plant together with a force main to permit connection of the tributary sewage flow to that plant to the Bergen County Sewer Authority plant, through the East Rutherford Sewerage Authority System.

Construction under Stage I allows for elimination of all of the smaller existing treatment plants within the District with the exception of the Secaucus Municipal plant which presently has surplus capacity and is producing a satisfactory effluent. By providing wastewater treatment facilities Stage I will permit orderly development of approximately 3, 000 acres of the Meadowlands. With the completion of Stage I construction almost all of the sewage flow presently discharged into the District will be treated at two modern regional wastewater treatment facilities producing "Recreational Waters" quality effluents while the two existing primary wastewater treatment plants located immediately south of the District will be improved to provide secondary treatment. A schematic illustration of this proposed construction staging is presented on Exhibit No. 20, Construction Staging, Hackensack Meadowlands Development Commission System.

The schedule for construction under Stage II is flexible and can be adjusted as needed for the orderly development of the Meadowlands District. Construction will consist of extensions to the interceptor sewers constructed under Stage I, together with the installation of strategically located trunk sewers to serve the remaining unsewered Meadowlands areas. Construction under this Stage will permit connection of sewage flows tributary to the existing Secaucus Municipal Plant and the diversion of a portion of the sewage flows tributary to the Jersey City Sewerage Authority West Side Plant flows to the Hackensack Meadowlands Development Commission plant by means of the Southeast Interceptor Sewer.

At the time that the sewage flows to the Hackensack Meadowlands Development Commission wastewater treatment plant approaches the initial capacity of 35 mgd, anticipated to be approximately 10 to 12 years after the completion of Stage I construction, it is recommended that as part of Stage II construction this plant be expanded to the design year 2000 capacity of 55 mgd. At this time its treatment processes, as well as those of the Bergen County Sewer Authority plant should be further improved to produce effluents meeting the recommended requirements of "Primary Contact Waters" quality standards, while those of the Jersey City Sewerage Authority and Kearny Municipal plants should be improved to produce effluents meeting "Recreational Waters" quality standards. Some time prior to the Stage II Hackensack Meadowlands Development Commission plant construction, the tributary flows to the Secaucus plant should be connected to the South-Central Interceptor Sewer. In any event, the improvement of treatment facilities to the recommended quality standards should be implemented no later than twenty years after the start of the Meadowlands development program.

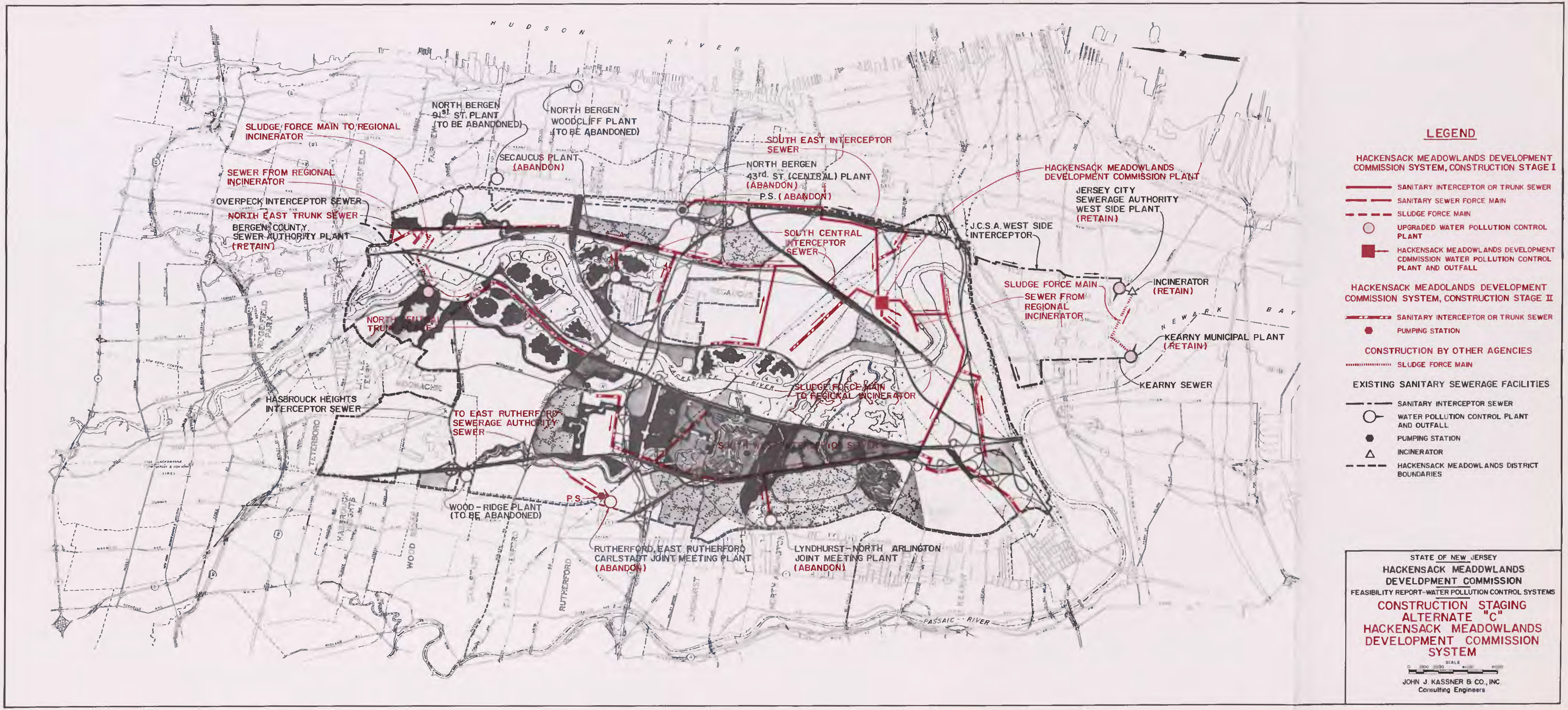
C. Administration and Financing

The Hackensack Meadowlands Reclamation and Development Act established a Commission with certain authority and responsibilities. This permits the Hackensack Meadowlands Development Commission to directly construct, finance and operate necessary pollution control facilities in connection with the development of the District. In order to reclaim the lands of the Meadowlands District in accordance with the Comprehensive Master Plant, it is important that suitable sewerage facilities be made available for use where and when needed. Because a separate sewerage agency may have other interests which might conflict with the Comprehensive Master Plan schedule for Meadowlands reclamation, there can be no guarantee that such an independent agency would provide these vital services when required. It is therefore incumbent upon the Commission to retain a full measure of control over these matters and it is recommended that an administrative department to be known as the "Hackensack Meadowlands Development Commission, Division of Environmental Protection" be created for the purpose of constructing and operating the recommended Water Pollution Control System. This Division could also be the means by which the Commission could provide for the disposal of solid wastes from the region, as mandated by the enabling legislation. Other facets of environmental protection could also be included in the Division's responsibilities.

The Hackensack Meadowlands Commission will thereby exercise control over all of the effluent discharged to the Hackensack River and its tributaries from within the Meadowlands District; will control construction of all of the interceptor and major trunk sewers within the District; and will control construction and operation of the Meadowlands wastewater treatment facility. The Bergen County Sewer Authority will continue to operate its Little Ferry wastewater treatment plant, in accordance with the treatment standards recommended in this Report. Individual municipalities or agencies will still have the responsibility for installing and operating the sewage collection systems tributary to these trunks and interceptor sewers.

It is suggested that the Hackensack Meadowlands Development Commission obtain funds for the construction of the recommended sewerage facilities through the sale of bonds. The principal of these bonds can be paid for by special assessments imposed on property located within the District. These assessments would be equitably imposed and prorated on the amount of benefit each property would receive by virtue of the construction of the improvements. The maintenance, operating, administrative and financing costs incurred by the Division of Environmental Protection would be met from revenues obtained by the payment of user fees equitably charged on a flow basis to the individual collector sewer agencies. It is anticipated that the user fee charged within the District will be less than those charged to upland users discharging flow into the Meadowlands. However, the fees to be charged to upland area users are subject to negotiation since it is possible that these agencies could contribute directly to the capital construction cost of the water pollution control facilities, with a resulting reduction in their user fees.

Construction and operation of a water pollution control system by the Hackensack Meadowlands Development Commission has a distinct advantage in its ability to levy special assessments for improvements, which authority is not possessed by other sewerage agencies. A "Sewerage Authority" can only pay its capital indebtedness by means of funds derived from user charges. If there are few users, these charges must necessarily be high, thus discouraging use of the sewerage facilities. This in turn would tend


HUDSON
RIVER
SLUDGE FORCE MAIN TO REGIONAL INCINERATOR
SEWER FROM REGIONAL INCINERATOR
OVERPECK INTERCEPTOR SEWER
NORTH EAST TRUNK SEWER
BERGEN COUNTY SEWER AUTHORITY PLANT (RETAIN)
NORTH BERGEN 91st ST. PLANT (TO BE ABANDONED)
NORTH BERGEN WOODCLIFF PLANT (TO BE ABANDONED)
SECAUCUS PLANT (ABANDON)
SOUTH EAST INTERCEPTOR SEWER
NORTH BERGEN 43rd. ST. (CENTRAL) PLANT (ABANDON)
P.S. (ABANDON)
SOUTH CENTRAL INTERCEPTOR SEWER
HACKENSACK MEADOWLANDS DEVELOPMENT COMMISSION PLANT
JERSEY CITY SEWERAGE AUTHORITY WEST SIDE PLANT (RETAIN)
J.C.S.A. WEST SIDE INTERCEPTOR
SLUDGE FORCE MAIN
SEWER FROM REGIONAL INCINERATOR
INCINERATOR (RETAIN)
NEWARK BAY
KEARNY MUNICIPAL PLANT (RETAIN)
KEARNY SEWER
HASBROUCK HEIGHTS INTERCEPTOR SEWER
TO EAST RUTHERFORD SEWERAGE AUTHORITY SEWER
SLUDGE FORCE MAIN TO REGIONAL INCINERATOR
HACKENSACK RIVER
P.S.
WOOD-RIDGE PLANT (TO BE ABANDONED)
RUTHERFORD, EAST RUTHERFORD CARLSTADT JOINT MEETING PLANT (ABANDON)
LYNDHURST-NORTH ARLINGTON JOINT MEETING PLANT (ABANDON)
PASSAIC RIVER
RIDGEFIELD PARK
TETERBORO
WOOD
RUTHERFORD
LEGEND
HACKENSACK MEADOWLANDS DEVELOPMENT COMMISSION SYSTEM, CONSTRUCTION STAGE I
SANITARY INTERCEPTOR OR TRUNK SEWER
SANITARY SEWER FORCE MAIN
SLUDGE FORCE MAIN
UPGRADED WATER POLLUTION CONTROL PLANT
HACKENSACK MEADOWLANDS DEVELOPMENT COMMISSION WATER POLLUTION CONTROL PLANT AND OUTFALL
HACKENSACK MEADOLANDS DEVELOPMENT COMMISSION SYSTEM, CONSTRUCTION STAGE II
SANITARY INTERCEPTOR OR TRUNK SEWER
PUMPING STATION
CONSTRUCTION BY OTHER AGENCIES
SLUDGE FORCE MAIN
EXISTING SANITARY SEWERAGE FACILITIES
SANITARY INTERCEPTOR SEWER
WATER POLLUTION CONTROL PLANT AND OUTFALL
PUMPING STATION
INCINERATOR
HACKENSACK MEADOWLANDS DISTRICT BOUNDARIES
STATE OF NEW JERSEY
HACKENSACK MEADOWLANDS DEVELOPMENT COMMISSION
FEASIBILITY REPORT-WATER POLLUTION CONTROL SYSTEMS
CONSTRUCTION STAGING ALTERNATE "C" HACKENSACK MEADOWLANDS DEVELOPMENT COMMISSION SYSTEM
SCALE
JOHN J. KASSNER & CO., INC
Consulting Engineers

to discourage development of property, since undeveloped land does not use the facilities and pays no fees. On the other hand, an assessment against the property for its share of the cost of the constructed facilities constitutes an investment by the property owner in those facilities. In order for the property owner to realize a return on this investment, he will have to develop the land. In addition, the lower user fees would also tend to encourage land development.

Construction of the recommended Water Pollution Control System by the Hackensack Meadowlands Development Commission will not affect the bonded indebtedness of the participating municipalities, which is an important advantage to them. In addition, the enabling legislation allows the Commission to float bonds with a life of 50 years, a longevity that is not presently available to any other similar agency, and under assessment procedure, the value of the land stands behind the bonds and makes their sale more attractive. All these advantages are further reasons for immediate implementation of the recommended system.

The financing recommendations are flexible and are offered in the nature of a guideline to be used in implementing the recommended Water Pollution Control System. It is further recommended that the design and construction of these facilities be started promptly. When estimates of construction costs based on detailed designs and firm construction schedules are obtained, it will be necessary to prepare a financial rate and assessment study to determine approximate assessments and user charges which are equitable and reasonable for the benefits derived by individual property owners and the various sewer agencies. This detailed study showing the basis of financial return of investment and of operating costs can then be used to obtain financing.

D. Federal and State Grants-in-Aid

Federal and State financial aid in the form of construction grants is available to eligible agencies contemplating the construction of water pollution control facilities. These construction grants when executed within the scope of the rules and regulations of the administering agencies of the Federal and State governments are, in effect, gifts to the applicant agency and need not be repaid.

The Federal Water Pollution Control Act, Public Law 84-660, 1956, as amended, provides for Federal construction grants for the purpose of aiding in the construction of water pollution control treatment facilities to a maximum of 50% of the construction costs. Only those costs which are deemed eligible for participation in the grant program by the United States Department of the Interior, Federal Water Quality Administration are considered reimbursable to the applicant agency, and are determined by guide lines interpreted by the administering agency. In general, wastewater treatment plants together with their interceptor sewer systems are eligible. The Federal statute further provides for a maximum increase of 10% to the original grant when a planned facility meets the requirements of regionalization.

Although the Federal grant program provides for reimbursement of a maximum of 50% of the eligible costs and a 10% increase to the grant for "regional" projects, it is administered to individual States, or groups of States, following certain stipulated conditions then prevailing and as influenced by the action of a State acting unilaterally or two or more States acting in concert.

Appropriations by Congress to enable funding of the Federal program is the major factor effecting administration of the program. Some States have enacted legislation and appropriated matching funds for construction grants and further have provided for pre-financing of Federal grants when Federal funding lags behind demand for grants for eligible projects. Those States having pre-financing provisions in their statutes are sometimes alloted grants to the maximum stipulated 50% of eligible costs.

The State of New Jersey statute, State Public Sanitary Sewerage Facilities Act of 1965 (Chapter 26; 2e-2) permits construction grants to the maximum amount of 25% of eligible costs to be made to agencies constructing water pollution control facilities. This legislation, however, makes no provision for pre-financing Federal grants.

The Federal and State programs are administered concurrently, with grant application processing being the function of a designated State agency. The agency so designated for the State of New Jersey is the Department of Environmental Protection.

According to current advice from Federal and State administering agencies, the maximum grants presently being allocated to eligible projects in the State of New Jersey are:

Federal Grant	30% of eligible costs
Federal, 10% of grant for regionalization	3% of eligible costs
State Grant	25% of eligible costs
Maximum Total	58% of eligible costs.

Legislation is presently being considered by the Congress pertaining to grants for water pollution control, and the outcome cannot be foreseen. The Federal laws now in effect expire June 30, 1971.

A companion Federal construction grant program, (42 USC 3103-3108) administered by the Department of Housing and Urban Development, provides for construction grants-in-aid for basic water facilities construction and for basic sewer facilities construction, including storm water sewers, when deemed eligible by that agency. The "basic" sewers which may participate in this program generally are collection system sewers and not wastewater treatment facilities which become eligible under the Federal Water Quality Administration program. The program permits grants to the maximum amount of 50% of the costs deemed eligible but due to the heavy demand on this program and shortage of funds with which to administer it, eligibility is determined on need, benefit to depressed areas and other factors and there is usually a limit set to the amount any one agency may receive in grants in any one year.

Federal and State grant programs also provide for "planning loans" for financing the costs for planning and designing water pollution control systems, and are funds which must be repaid by the applying agency to the granting agency.

Several other Federal Programs which presently exist, though probably not applicable to this project are generally structured to aid rural areas and economically depressed areas, and should be investigated for applicability.

All applications for Federally funded projects discussed herein must be submitted initially to the State Review Coordinator who refers them to the proper agency or agencies, for the purposes of insuring coordination between projects by eliminating conflict and to insure consistency with State, County and local development plans and objectives.

The foregoing information is based on current advice from Federal and State agencies, but the status of aid programs is subject to constant change. It is recommended that a comprehensive investigation of the availability of Federal and State aid for the implementation of the recommended Water Pollution Control System be conducted as part of the financial rate and assessment study suggested hereinbefore.

E. Implementation Costs

1. General

The estimated construction costs presented in Section VIII, "Alternate Water Pollution Control Systems", for the purpose of comparing the Alternates, were based on 1970 estimated cost levels for the ultimate implementation of each System to meet the needs of the Meadowlands development for the year 2000 in accordance with the Comprehensive Master Plan. Additional costs for administrative, engineering and legal services will be incurred in implementing the recommended Water Pollution Control System, and these are presently estimated to be approximately fifteen (15) per cent of the construction cost.

In the light of the large increases in construction costs which have occurred in the recent past, it is evident that costs over the 30 year period of Meadowlands development will not remain at 1970 levels. However, it would be unrealistic to assume a rate of cost increase over such an extended period of time, even if it were based on trends established from data reflecting historical trends. Since there is little possibility that any projection of future costs would be accurate, the estimated costs for implementing the recommended System are given in terms of 1970 cost levels.

The estimated construction costs shown in Section VIII, "Alternate Water Pollution Control Systems", were prepared only for comparison of the Alternates and include work that will be performed and paid for by other agencies. For financial studies cost estimates were prepared for work to be performed by the Hackensack Meadowlands Development Commission for implementing each Stage, based on 1970 cost levels.

2. Capital Costs and Assessments

The capital costs to be incurred by the Hackensack

Meadowlands Development Commission for implementing Stage I construction of the recommended System, are as follows:

STAGE I CAPITAL COSTS

H. M. D. C. Treatment Plant (35 mgd capacity)	$23, 700, 000
South East Interceptor Sewer	7, 700, 000
South Central Interceptor Sewer	6, 500, 000
South West Interceptor Sewer	24, 900, 000
Rutherford-East Rutherford-Carlstadt Joint Meeting Connection to B. C. S. A.	350, 000
Financing, Engineering and Legal (15%)	9, 450, 000
Total	$72, 600, 000

The capital costs to be incurred by the Hackensack Meadowlands Development Commission for implementing Stage II construction of the recommended System are as follows:

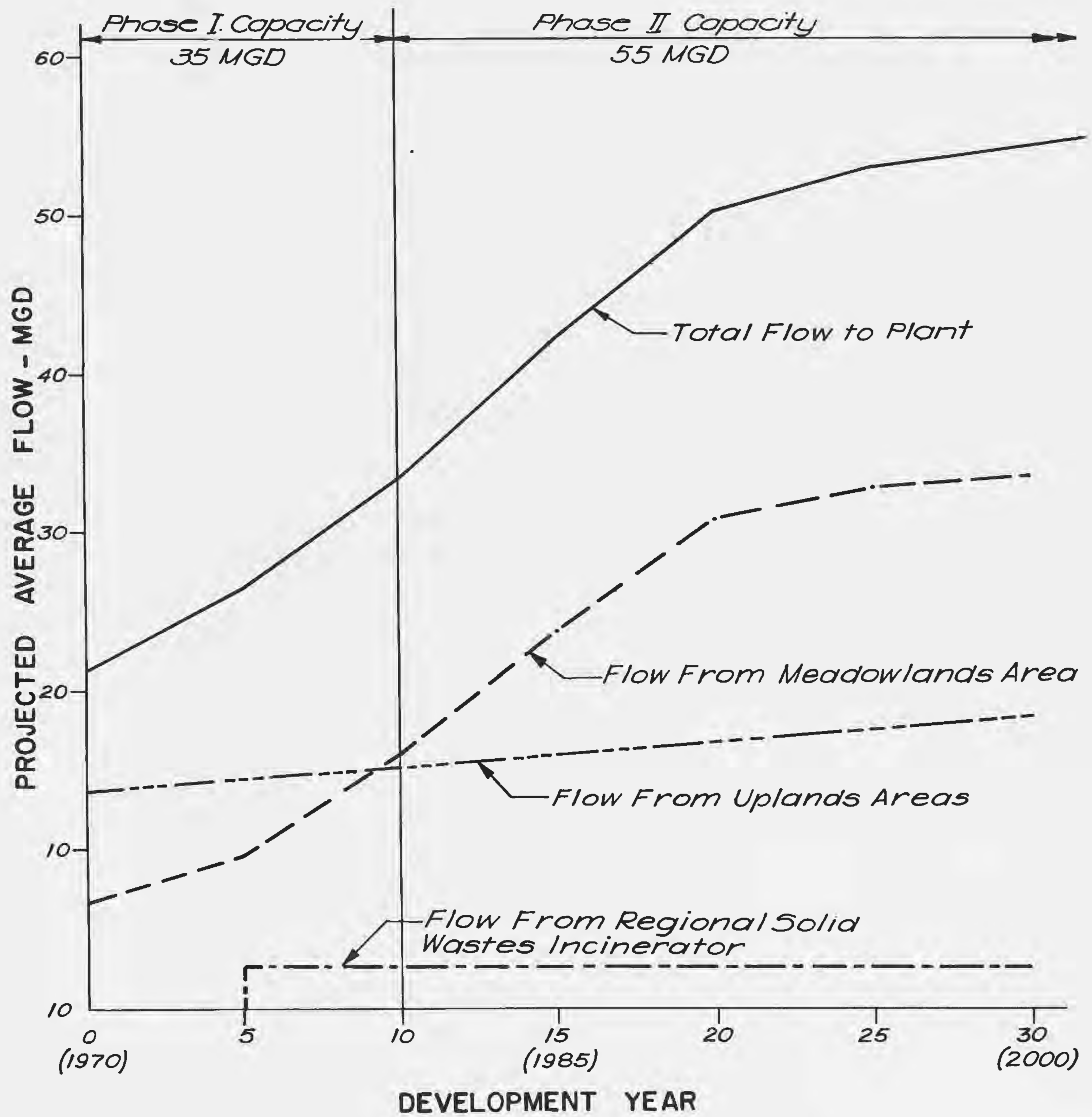
STAGE II CAPITAL COSTS

H. M. D. C. Treatment Plant (improve treatment and 20 mgd. addition)	$13, 800, 000
South East Interceptor Sewer	800, 000
South Central Interceptor Sewer	11, 600, 000
South West Interceptor Sewer	12, 600, 000
North East & North Central Trunk Sewers	6, 800, 000
Financing, Engineering and Legal (15%)	6, 800, 000
Total	$52, 400, 000

The Meadowlands District comprises an area of approximately 19, 600 acres. For the purposes of assessment of capital costs it has been assumed that areas devoted to school, airport, conservation, park, water and land transportation uses, all of which are areas designated in the Master Plan as being owned by the public or for public use, would not be subject to an assessment. This would leave approximately 10, 700 net acres within the District to be assessed for the capital costs expanded for the construction of the Sewage facilities. If the entire capital expenditure for the facilities were assessed uniformly on this net area, the average assessment per Meadowlands acre would approximate $6, 800 for Stage I improvements and $4, 900 for Stage II improvements. The total average assessment of approximately $11, 700 per acre does not appear to be unreasonable when the value of the property is considered. According to the Comprehensive Master Plan Report, the estimated value at 1970 sales price levels of Meadowlands property varies from $20, 000 to $400, 000 per acre with average land value of approximately $115, 000 per acre. Application of the maximum 58% Federal-State grants presently being allocated to eligible projects in the State of New Jersey would allow the total assessments for both Stages of construction to be reduced to approximately $4, 900 per acre.

In addition to the costs to be incurred by the Hackensack Meadowlands Development Commission for construction of the recommended System, the individual municipalities or other designated agencies would bear the costs of installation of the local sewage collection systems tributary to the Interceptor and Trunk sewers. The costs to upgrade and/or expand other wastewater treatment plants would be borne by the respective operating agencies. It was also assumed that costs required to combine the sewage flows from the North Bergen tributary area at the 43rd Street pumping station for discharge into the Hackensack Meadowlands Development Commission System would be borne by that municipality and that the costs of connecting sewage flows from the Wood-Ridge tributary area to the Bergen County Sewer Authority System would not be borne by the Meadowlands Commission.

The capital expenditures for Stage I waste water treatment plant and interceptor sewer construction must be expended at the beginning of the program. The cost to upgrade the initial Hackensack Meadowlands Development Commission treatment facilities and to construct 20 mgd of additional plant capacity can be deferred until such time that it is required. This expenditure will be required in year 12, if the future flows to this facility grows in accordance with the projections presented in Exhibit No. 21, Estimated



STATE OF NEW JERSEY
HACKENSACK MEADOWLANDS
DEVELOPMENT COMMISSION
FEASIBILITY REPORT-WATER POLLUTION CONTROL SYSTEMS

ESTIMATED FLOW TO HACKENSACK MEADOWLANDS DEVELOPMENT COMMISSION PLANT

JOHN J. KASSNER & CO., INC.
Consulting Engineers

flow to Hackensack Meadowlands Development Commission Plant. The construction of Stage II interceptor and trunk sewers could begin upon the completion of Stage I facilities at the earliest, and could be completed just prior to the termination of the District development program. The total capital expenditure for Stage II sewers might therefore be expended over an approximate 25 year period which could involve a uniform expenditure of approximately $1,500,000 per year beginning at year 4 and terminating at year 28.

3. User Charges

An average user charge of approximately $140 per million gallons of sewage treated has been estimated with consideration being given to the expenditure of capital as outlined hereinabove. This average user charge was computed by dividing the sum of the capitalized costs for interest, capitalized cost for depreciation and capitalized costs for operation, maintenance and administration by the average annual projected volume of sewage anticipated to be treated at the Hackensack Meadowlands Development Commission plant over the 30 year District development program. Disbursements for repayment of construction cost principal were not included in computing this user charge since these costs will be repayed from funds derived from assessments against Meadowlands District properties.

In computing the user charge, interest on borrowed principal was computed at the rate of 6% per year. A bonding period of 50 years was used with the principal and interest assumed to be amortized in equal annual installments over the 50 year period. Depreciation of interceptor and trunk sewers was considered negligible and it was assumed that approximately one-third of the treatment plant capital cost was invested in mechanical equipment that depreciates at a rate requiring replacement every 25 years. Investment in treatment plant structures was assumed to approximate two-thirds of total estimated treatment plant capital costs that depreciated to an extent requiring replacement of 50% of their cost at approximate 50 year intervals. Maintenance for the sewer system was assumed to cost $120 per mile of sewer pipe per year. Operating and maintenance costs of treatment facilities and costs of system administration were estimated to vary from $35,600 per year per mdg of sewage flow treated in year 1 to $25,900 per year per mgd of sewage flow treated in year 30. Approximately 40% of the foregoing amounts represent costs of materials, supplies and power used in the treatment processes, with the remainder representing plant labor costs and administrative overhead.

The components of the average annual cost determined as outlined hereinabove, are as follows:

Interest		$682,000
Depreciation		$290,000
Maintenance and Operation		$1,100,000
Total Annual Cost	=	$2,072,000

This amount divided by the average annual flow of 14,600 million gallons projected for the plant yields a user charge of approximately $140 per million gallons treated based on present (1970) costs. This calculated rate compares favorably with the proposed rates for the Bergen County Sewer Authority as presented in their 1970 Feasibility Report on Treatment Plant Expansion. These rates without benefit of Federal or State grants are quoted as varying from $221.46 per mg for 1970 to $317.11 per mg for 1982.

Neglecting the possibility of obtaining Federal and State grants that would significantly reduce the capital construction investment as well as the financing costs, the average assessment, which represents the amount of principal borrowed for constructing the improvement, could be paid back, free of interest, over as long a period as the life of the bonds. Paying the assessment in 50 equal annual installments of approximately $234 per acre could not in any way impose undue hardship on the owners of property within the District, nor should such an amount tend to discourage development in the District. The relatively modest user charge should likewise offer no detriment to District development. Although user charges to uplands agencies will probably be higher than the average Meadowlands District rates, it nevertheless should tend to encourage the upland agencies to join the System. Such action would involve no capital expenditure on their part and their user charges would probably be low when compared to other alternates available to them. In addition to these advantages, the fact that the assessments for capital costs would constitute a lien on Meadowlands District property, and that this lien would stand behind the bond principal, should tend to make the bonds a more secure investment and therefore more attractive to prospective investors.

SECTION X. ADDITIONAL POLLUTION SOURCES

A. Introduction

Pollution is a generic term encompassing a myriad of problems with the identification of the sources and the full effect on man and his environment sometimes difficult to ascertain. Water pollution control is even more complex since the type, extent and severity of the water pollution must first be determined before adequate control can be initiated. Such controls require legal, economic and administrative actions to enforce compliance, followed by engineering design and operational surveillance, to be certain that the desired end results are achieved.

The need for safe and reliable collection of wastes; adequate and rapid treatment of wastes; and disease-free and nuisance-free disposal of wastes from urban living has long been recognized. Lack of funds, lack of foresight, neglect and apathy have permitted this impairment of the environment to become as serious and widespread as it is today.

Technology necessary for coping with this constantly growing problem is presently available and being continuously improved. With the greater public awareness of ecology and aroused public sentiment for a cleaner, safer and better environment, implementation of newer and more improved methods for renovating and upgrading polluted waters seems inevitable.

Only relatively recently, as greater study and vigorous actions have initiated removal of the most onerous and most pressing pollutional constituents from the waters surrounding urban areas, have certain seemingly innocent activities associated with masses of people living in confined, high density areas been recognized as serious factors detrimental to the environment, and as a consequence, a threat to human survival in the urban ecosystem. In various parts of the country, and indeed throughout the world, surveys and studies are being conducted, legislation being enacted, and newer technological facilities being constructed to deal with the control and/or elimination of those contaminants which pollute the environment.

In addition to pollution from human and industrial wastes other critical sources of contamination are combined sewer overflows, by-passes and diversions, storm sewer flows, leachates, eutrophication, thermal water flows, navigational wastes and tidal exchange.

All of these sources contributing to water pollution have been identified as occurring within the Hackensack River watershed. These additional pollution sources as well as discharge of inadequately treated residential and industrial wastes will grow with the increased land use and population within the Meadowlands and their surrounding areas, unless a systematic, economically feasible and technologically integrated water pollution control program is developed and maintained.

B. Combined Sewer Overflows, Storm Sewer Flows and By-pass Discharges

Several of the communities in and around the Meadowlands District have totally or partially combined sanitary-storm sewer systems which discharge raw, untreated sewage into the Hackensack River and its tributaries during storms. In areas where development of sewer systems have been accomplished more recently, separation of sanitary wastes from storm drainage flows was instituted as a means of reducing pollution and economically treating sewage flows. Recent studies conducted by the Federal Water Quality Administration have shown, most conclusively, that storm water runoff from urban areas "in many instances is akin to sanitary sewage in its pollutional characteristics, and in a few instances some parameters of pollution are even greater".

Since all areas to be developed within the Meadowlands District will utilize separate sanitary and storm sewer construction, the problems inherent in discharging storm water directly into the tidal estuary must be considered and their impact on the water quality of the Hackensack River evaluated. Suggested corrective measures and innovative technological solutions to remove the contiminants from combined sewer overflows and from storm sewer flows are frequently quite similar and can therefore be considered simultaneously. It must be understood that there is no panacea, for each community or area has its own particular problems to solve.

In general it has been deemed economically impractical and sometimes physically impossible to design, construct and maintain sewage treatment plants of a size sufficient to treat all the flow developed by both sanitary sewage and storm drainage flows from a combined sewer system. A number of alternative methods for solving this problem of existing combined systems have been investigated, and in some instances, implemented.

The most obvious solution to existing combined systems with large discharges of raw sanitary wastes during storm periods is the complete separation of the sanitary and storm sewer systems to permit separate treatment of each component. This solution has frequently been found prohibitively expensive since it requires the installation of new sanitary and/or storm sewers in virtually every street in which a combined sewer now exists. It may further necessitate new plumbing connections to existing buildings and major alterations to building structure and building plumbing. Besides the cost, this construction in built-up urban areas would result in traffic problems of major proportions, would seriously curtail the flow of goods, services and materials to the area, would require the relocation of other underground utilities, and in general would completely disrupt the normal daily activities of the community for protracted periods of time.

A second alternative involves the construction of chlorination detention tanks at strategic locations near selected outlets. These detention tanks, applicable to either combined sewer overflow lines or storm drain outfall lines, could take many forms, depending on the individual requirements of the community, the area, and the receiving water course. Chlorination detention tanks serve to collect and detain the outflow from the sewers served for a period of time long enough to permit some settling of suspended solids and also to afford time to apply chlorine and permit it to reduce the organic pollutional load. The detention time and the amount of chlorine applied can be established to provide a satisfactory degree of pollution abatement. In some instances the costs of land acquisition, together with the costs of operating and maintaining the facility would be quite high. Maintenance costs for pumping, chlorinating and cleaning as well as the costs of power and chemicals could render this type of facility prohibitive in cost.

A third alternative involves the construction of holding tanks, strategically located to collect and store the combined sanitary sewage and storm water flow until the cessation of a storm. Water thus retained is fed back into the sewerage system for treatment at the pollution control facilities when the waste water treatment plant can handle the load without strain. Holding tanks in a given area would be much larger than chlorination detention tanks and would require more area. In urban and fully developed suburban areas, cost of land acquisition for the tanks could be a serious deterrent to implementation of such a system.

New York City is presently constructing a prototype combined sewer overflow pollution control system for a portion of the City which utilizes the concepts of two of these methods. The area for which the study was made and for which the facility is being constructed is approximately 5 square miles, roughly equivalent to the area of the Town of North Bergen. This facility, which consists of a number of tanks, first acts as a holding tank during a storm. The stored waste waters are fed back into the interceptor system when the storm ceases and are conveyed to a sanitary sewage treatment facility for routine treatment with other sanitary wastes. If the holding capacity of the tank is exceeded, the excess flow, having been retained for a sufficient length of time to settle a significant amount of the solids, is chlorinated and is then discharged to the receiving water body, with the facility thus acting as a chlorination detention tank. This sytem is expected to afford ultimate treatment at a sewage treatment plant to all of the combined sewer overflow wastewater for most storm flow conditions and treatment by chlorination and settling at all other times. The design anticipates the period of chlorine contact will be 10 to 15 minutes which is generally considered to be an effective contact time; 5 minute contact time is the anticipated absolute minimum for the maximum overflow condition. Solids settled from the wastewaters are to be re-introduced into the interceptor system for normal processing at the sewage treatment plant. It is presently expected that the system will become operative during 1971 and is expected to produce definitive data which should prove of great value to the field of water pollution control.

Another solution to the problem which has been considered by two major metropolitan areas, Chicago and Boston, lends itself to a regional approach when favorable geologic features exist. This solution consists of the construction of wastewater storage tunnels mined in solid rock deep below the surface of the earth. Deep rock storage tunnels can be constructed so that in conjunction with suitable pumping facilities for emptying them, they are of sufficient magnitude to store the combined wastewater and storm water overflows generated in a given area during a storm of given intensity. Storm frequency and intensity must of course be given consideration in determination of tunnel storage capacity.

The Chicago solution, as presented in a paper by Victor A. Koelzer, William J. Bauer, and Frank E. Dalton, published in the Journal, Water Pollution Control Federation, April 1969, entitled "The Chicago Area Deep Tunnel Project - A Use of The Underground Storage Resource", considered four solutions to its complex problem for the elimination of discharge of polluted wastewater and local flooding during storms. The first three solutions considered resulted in the successive percentage decrease of volume of polluted water being discharged to the receiving waterway, but none totally eliminated such discharge nor totally eliminated local flooding. The fourth solution named "The Chicago Area Deep Tunnel Project" was developed to permit an ultimate 100 percent effective solution and is the solution recommended for implementation. This project consists generally of a series of conveyance tunnels leading to a mined storage chamber deep below the surface in the underlying rock. In this instance the tunnels are planned to be very deep with the storage chamber to be some 800 feet below the surface. The project envisions the utilization of a surface reservoir in conjunction with a reversible pumped storage hydroelectric plant which will permit sufficient storage capacity so that all storm flows may ultimately be conveyed to the existing water pollution control facility for treatment. Excess electric power generated is envisioned as being a marketable by-product of the system. The first construction zone is proposed to serve 62 square miles with service to 300 square miles of the existing combined sewer area being the ultimate goal.

The Boston solution, as presented in a paper by Charles A. Parthum, published in the Journal, Water Pollution Control Federation, April 1970, entitled "Building for the Future - The Boston Deep Tunnel Plan", differs in that it provides for the water from storm water sewers and from combined sewers to be collected in tunnels and discharged therefrom. The collected waters will be pumped without treatment to a discharge approximately ten (10) miles offshore in the Atlantic Ocean. In this instance it has been concluded that when combined sewer overflows and storm sewer flows are collected in combination in the tunnel storage facilities, the quality of the mixed water upon being pumped from the tunnels through the diffuser system can be expected to be of better quality than that discharged from conventional treatment plants. However, chlorination of the effluent is also planned. The tunnels are planned to be constructed about 300 feet below the ground surface, with the 10 mile long discharge line to be laid on the ocean floor. The area to be served in the plan is approximately 17,000 acres. This is very similar to the total area of the Meadowlands District.

Comparable physical conditions exist in the Meadowlands District area, with its deep underlying rock; with adjacent large water bodies for dispersal of discharge within workable distances; and with an area encompassing the Meadowlands District and its immediate environs topographically restricted and yet large enough to be treated as a true "region". A comprehensive study would be necessary to determine the adaptability of this concept.

Sewage treatment facilities cannot be designed to handle the overly large volumes of storm water flow which will develop within the Meadowlands District as the area is built up and truly urbanized. A separate mode of collection and treatment must be considered and evaluated for the Meadowlands area. This area is unique in that it is not yet developed and built up, and that patterns of handling storm and waste flows have not been set and constructed.

In their article "Characterization, Treatment and Disposal of Urban Stormwater," by S. R. Weibel, R. B. Weidner, A. G. Christianson and R. J. Anderson, the authors sum up the problems of urban stormwater disposal as follows:

"Faced with increasing technical difficulties and high costs for elaborate drainage conduit systems, with flooding problems, decreasing ground water supplies, growing demands for aesthetic and recreational waters, and generally improved water quality in streams and lakes, we may expect to see considerable interest in storm water detention and ground water recharge works. In connection with disposal to soil or surface waters, quite possibly treatment may be necessary to avoid nuisance, to insure acceptance in the soil, and to ensure a hygienically safe water".

Many possible innovative methods, using the best known and most economic concepts of local recharge basins, man made lakes, deep tunnel storage, mechanical or physical-chemical treatment or combinations of these, should be thoroughly investigated. A comprehensive study of the integrated pollutional problems created by combined sewer overflows, storm sewer flows, related treatment plant by-passes and tidal flooding, coupled with the singular problems of the water quality within the "dead ended" tidal estuary is recommended in order to arrive at the best technological, and economically feasible solution consistent with the intended land use, while maintaining the marsh land ecosystem.

C. Leachates

The disposal of solid wastes, industrial residues and sludges is a rapidly burgeoning problem in urban areas. Since leachates from solid waste deposits, when subject to contact with water, can impair the quality of the water body to which such leachates drain, this problem assumes even greater proportions when solid wastes are disposed of in wet areas or areas subject to flooding.

As discussed earlier in this Report, the Meadowlands District has all of the interrelated component features which can cause major water quality deterioration due to leachates.

As the Meadowlands District develops, only controlled sanitary landfills can be permitted. A true sanitary landfill is designed and operated to dispose of solid wastes on land without creating a nuisance or a hazard to public health or safety. A sanitary landfill confines the disposed solid wastes to the smallest practical volume and covers them with a layer of soil to prevent access to the working face.

Leachates are developed when water is permitted to be in contact with solid wastes. This water can come from rainfall and run-off infiltrating the solid waste fill or percolating through it; from ground water or tide water rising and contacting the solid wastes; or from waters being trapped in and over the filled area.

When sanitary land fills are properly located, constructed and controlled, it may be possible to control leachates to acceptable limits. Studies conducted for the California State Water Pollution Control Board have shown that rainfall will not penetrate a properly compacted land fill and that leaching, if it should occur, consists primarily of salts which diminish within a year to negligible amounts.

In general, if sanitary land fills are placed in areas not affected by ground water, and are located, constructed and maintained in accordance with acceptable standards and practices, they should not generate leachates in the volume and strength sufficient to affect the water quality of the tidal estuary.

It can be expected that leachates emanating from existing, improperly controlled solid waste deposits in the Meadowlands will deteriorate in pollutional strength within a relatively short time.

In order that leachates from new deposits of solid wastes be minimized as a source of pollution of the waters of the Hackensack River, it becomes incumbent upon the Commission to develop and to maintain sanitary landfill practices designed to accomplish this end.

D. Thermal

The tidal portion of the Hackensack River is subjected to the pollutional effects caused by the introduction of cooling water containing waste heat from electric power generating plants and other diverse sources.

Waste heat producing industries, and particularly the electric power generating industry, use tremendous quantities of water for the dissipation of waste heat. It has been previously cited in this Report that the electric power generating industry alone accounts for 80% of all cooling water used in the nation, with all other industries accounting for the remaining 20%. The amount of cooling water used by all industries is reported to be equal to nearly one-half of all water used in the United States. It has been predicted that the production of waste heat by the electric power generating industry from both nuclear and fossil fuel plants will increase nine fold in the next 30 years. Since water for cooling purposes by all industries in the nation has been reported to be approximately 50 trillion gallons, and for the electric power generating industry alone over 40 trillion gallons, the magnitude of this problem is readily recognizable.

The fact that thermal pollution is detrimental to our aquatic environment is being accepted, but the degree or level of severity of introduction of this contaminant to the water is still in contention. With thermal pollution controls being quite costly and complicated, and with "tolerable levels" subject to dispute and various interpretations in different areas, progress toward practical solutions are somewhat slow.

Establishment of "tolerable levels" and surveillance and enforcement of those levels, once established, should be the first responsibility of government. The actual burden for physical control of thermal pollution to meet the accèptable norms seems to lie with the producers of these wastes.

The complexity and magnitude of the problem is indicated by testimony attributed to a representative of the electric power industry appearing before a committee of the United States Senate in which it was stated that if legislation being considered by a Senate committee were enacted, it would force "the arbitrary application of cooling towers to existing and future thermal power plants". The testimony further contended that the "consumptive loss of water from cooling towers is about two and a half times as great as the same heat dissipation from a body of water". It was further stated that by the year 2000, if cooling towers were used for all of the electric power generating industry, the additional consumptive loss would reach 20 billion gallons per day. This is the equivalent of the current water supply needed for over 100 million people.

The continued growth of our urban areas, the increased demand for goods and services, and the continued increase in population and population densities, will all increase the demand for power, and concomitantly place an increased thermal impact on our environment. Change in temperature of the ambient air in urban areas, effect on the aquatic environment, and potential increase in localized humidity are all related facets of thermal pollution which must receive thoughtful and careful consideration.

Each body of water subjected to receipt of waste heat is an independent problem, and the tidal portion of the Hackensack River, within the Meadowlands District, is no exception. The State of New Jersey is presently engaged in establishing thermal standards for waters within the state, including the Hackensack River. Thus the first step, the establishment of "tolerable limits" is being taken. It is necessary to await the effect of these "tolerable limits" on the aquatic environment and water quality when implemented.

It should be noted that no pollution abatement orders have been issued against the three electric power generating stations presently discharging cooling waters to the Hackensack River. Surveillance reports of the New Jersey State Department of Health indicate that maintenance at these plants is generally satisfactory. No data is available on thermal loadings from sources other than these generating facilities. Furthermore there is insufficient data presently available either within the profession generally or for the Hackensack River specifically, from which to draw adequate conclusions. The Hackensack River "dead ended" tidal estuary is influenced by the daily exchange of some 4.5 billion gallons of water, a condition which is quite different from most other water bodies.

Further study of this aspect of water pollution, and its ultimate effect on the water quality of the Hackensack River is desirable. Data should be continually collected and analyzed so that realistic and economically sound actions can be taken to enhance and maintain the waters within the Meadowlands District.

E. <u>Navigation</u>

The Hackensack River is navigable and used by deep and shallow draft commercial vessels as well as by pleasure craft, with such use being predicated on the controlling depths of the river. These vessels themselves, coupled with the actions of their occupants, create water pollution, the magnitude of which is not well established. In addition to such contaminants as sanitary and galley wastes, garbage, oil, bilge water, deck washings, engine wastes, spills and the like which enter the waters from the vessels, abandoned wharves and derelict vessels can also be a source of floating debris.

Existing laws and regulations seek to prevent the introduction into tidal waters of such deleterious materials as earth, ashes, cinders, mud, sand, dredgings, sludge and acid from any source, other than when these same materials are discharged from sewers or flushed into the tidal waters by surface run-off carried by storm drains. Another statute prohibits the discharge of oil from any boat or vessel into or upon navigable waters of the United States. The United States Army Corps of Engineers, charged with enforcing these laws, statutes and regulations, patrols the New York Harbor area in patrol vessels and patrol cars in search of violations. In addition, the Corps of Engineers routinely collects floating debris which may be a hazard to navigation. This latter activity is confined almost exclusively to Upper New York Bay on a regular basis, with infrequent patrol of the rivers tributary to New York Harbor.

The Corps of Engineers has recently constructed a new incinerator at Cavin's Point for the express purpose of cleanly and safely disposing of the debris which they collect. A study has been made by the Corps of Engineers of the source of drift materials and debris in the New York Harbor area, including Newark Bay and the Hackensack River with the object of removing such sources on a "once only" basis. The study identified the three primary sources of drift wood and debris as being miscellaneous loose material along the shores, dilapidated structures and derelict vessels.

A number of earlier studies have indicated that pleasure craft are a serious source of water pollution when they are berthed and maintained in confined anchorages or harbors. The State of New York has recently enacted legislation designed to eliminate the deposit of untreated human excrement and galley wastes from all boats in the waters of New York State. The State of New Jersey as well as the Federal Government are presently studying similar legislation.

Since the Comprehensive Master Plan for the Meadowlands District envisions greatly increased use of the Hackensack River for recreational boating and intra area transportation, the development of marinas is a foregone conclusion. The control of the sanitary facilities at these locations, as well as sanitary waste discharges from water craft, either traveling or berthed, must be strictly enforced. As newer and better sanitary facilities and general technology are developed, every effort should be made to update and incorporate these new ideas into the Comprehensive Master Plan.

Records and data are a necessity with respect to pollution attributable to navigation. The absence of these data precludes any reliable evaluation or forecast of the future water quality within the District. The use of boats can be a significant feature of water polution control planning for the Meadowlands, and should not be overlooked.

F. Tidal Exchange

As detailed earlier in this Report, the tidal exchange which takes place between Newark Bay and the Hackensack River acts as a major contributor to the total pollutional load of the River. The unique inter-relationship with the New York Harbor Complex, coupled with the dearth of fresh water from upland sources, which can only become more critical as the population and its water demand increases, causes Newark Bay and the tidal estuary to take on a uniform degree of contamination.

Even if the entire flow of the Hackensack River were "clean", that is, free of significant pollution, there is insufficient combined flow from treatment plant effluents and fluvial flow from upland areas of the Hackensack watershed either to restrain the pollutants from entering from Newark Bay, or to flush the pollutants from the tidal estuary once introduced therein by the tide.

A closed barrier across the lower entrance to the Hackensack River could prevent the tidal exchange and could convert the lower reach of the Hackensack River into a fresh water lake. However, the contemplated barrier as conceived by the United States Army Corps of Engineers is designed as a hurricane protection and flood control device. As such, it is designed to be closed only at times of very high storm induced tides, resulting in a stoppage of tidal exchange only when flooding is imminent. The period of time the barrier will be closed is measured in only hours per year. It must be pointed out that considerations other than water quality entered into the decision relating to the tidal barrier. These other questions included free navigation up the river, maintenance of salt water marsh lands, and costs of landfill and waterfront construction.

If the desired water quality in the Hackensack River is to be attained, it becomes quite obvious that to eliminate, or even to significantly reduce the pollutional contribution to the River by the action of tidal exchange, the quality of the waters of Newark Bay together with the Kills and New York Bay, must be improved. The presumption has been made that in time, the water quality standards for Newark Bay, and the entire New York Harbor, will be upgraded, and that enforcement of these higher standards will result in the ultimate improvement of the water quality in the degree that tidal exchange will no longer be a pollutional factor for the Hackensack River. Should this presumption not be brought to fruition in the time that the Meadowlands District develops, the Hackensack River will continue to contain undesirable levels of pollution. There is the possibility that with time some new technological advances will permit the cleansing of these large volumes of tidal water in a practical and economically feasible method.

Improvement of the water quality within Newark Bay is expected to lag behind the progressive improvement of water quality in the Hackensack River. The relationship of water quality in each segment of the system should be carefully monitored. Based on present and future organic loadings, and the evaluation of results of upgraded treatment of waste waters entering the Hackensack River, such future studies as feasibility of mechanical aeration of the tidal flow might be considered.

The Commission will need to restudy and evaluate the full impact of the tidal exchange pollution after the land development has significantly progressed, the regional waste water facility is in operation and all other existing pollutional sources have been brought under control.

SECTION XI. SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

A. Conclusions

1. Water Quality

Analysis of the data presently available on water quality as it relates to the development of the Hackensack Meadowlands District in accordance with the Comprehensive Master Plan, reveals that the present water quality within the tidal portion of the Hackensack River, Newark Bay and the interconnecting waters of the New York Harbor Complex is unsatisfactory.

The data presented in this Report shows that the bacteriological quality within the tidal portion of the River and Newark Bay precludes the use of these waters for contact water sports, fishing, and related activities. The same area suffers from odors and nuisance conditions due to the excessive organic load which, if not radically reduced in the immediate future, will cause these conditions to become steadily worse and more offensive.

The need for the fresh water supplied by the upper portion of the Hackensack River watershed as a source of potable water is steadily increasing, but the supply of rainfall-runoff remains constant. Hence more and more of this resource is being captured and retained in upland reservoirs and lakes. The net result is that there is an ever decreasing quantity of fresh water available for advective flow to flush out this dead ended estuary, the tidal portion of the River.

Concurrently, the lower Hackensack River is receiving larger and larger inflows of wastewater plant effluent, which is often not treated to a sufficiently high degree of purity. Industrial activity has been increasing and is using the tidal waters of the River for process cooling and other purposes.

Though the present water quality in the Hackensack River is poor, the possibility for its improvement to a desirable condition is feasible.

2. Sewage Treatment

The existing wastewater treatment plants have been surveyed, evaluated and classified. The general situation found is that an insufficient degree of treatment is afforded to waste waters and in some cases hydraulic overload occurs. The New Jersey State Department of Health is cognizant of these facts and has issued orders to most of the existing plants to conform, as a minimum, to present State statutes. Conformance would require that plants which presently provide primary treatment, merely removing the visible floating and settleable solids, must add new facilities which will biologically treat the remaining organic load. Such remedial measures would require the construction of trickling filters or biological aeration tanks to stabilize organic wastes, reduce their oxygen consuming potential, thus rendering them incapable of causing odors, nuisance or unsightly aesthetic conditions, or of harming fin fish. Secondary waste water treatment facilities, aside from occupying large land areas relative to the initial plant size, also produce organic humus or sludge. These sludges must be rendered innocuous, rendered unable to cause nuisance, and rendered safe from a public health standpoint. The disposal of sludges must be accomplished in a satisfactory manner, consistent with the Comprehensive Master Plan land use provisions, and conforming to health and safety regulations of other governmental agencies having jurisdiction.

3. Additional Pollution Sources

As the effluent from existing waste water treatment plants is of inferior quality and the volumes of waste water effluent entering the tidal reach is large, other sources of pollution are hidden. However, when treatment plant effluents are improved, the effect of presently uncounted and uncataloged outfalls with their discharges will become discernible. Among these other sources are small industries, local storm drains, combined sewer overflows, pumping station and treatment plant bypasses, and other unconnected discharges which are not presently treated.

The pollutional effects and hazards of improperly connected or non-connected sanitary flows are obvious. Not so obvious may be industrial waste discharges. It must be recognized that the wastes from industry may, and usually do, contain physical and chemical constituents which may be harmful to the aquatic environment. The harm may be purely aesthetic by adding unwanted color to the water or putting a film over the surface of the water. It may be biologically harmful by preventing light from penetrating, or coating the bottom with layers of materials which smother and obliterate aquatic flora and fauna. In addition the damage from chemical actions of toxic materials, or materials which impart taste and odor, or those which deplete the oxygen and prevent fish growth and propagation are all well documented and publicized.

The special case of thermal pollution is not yet fully documented. It is known that excess heat in water bodies has a very marked effect on growth rates, spawning cycles and lives of aquatic organisms. As yet, it has not been definitely established that all of these effects are detrimental. However, during summer periods, when receiving waters have the greatest difficulty maintaining the dissolved oxygen balance, the addition of heat increases the organisms' need for oxygen while at the same time decreases the waters ability to retain the oxygen. Thus the waste heat, or thermal pollution, is a significantly detrimental factor during warm weather periods and must be controlled.

As the masking pollutional effects of inadequately treated wastes are removed, the discharge of storm water and combined sewer overflows and bypasses assume greater importance as contaminators of the River water. The full extent of their effect has been defined in this Report.

4. Water Classifications

In every situation in organized society, a goal is set and rules are established in order to achieve the predetermined goal. The same is true for the Hackensack River and the Meadowlands District. As long as there was no high goal for the utilization of the Meadowlands, the rules for its use were relatively undemanding. Now, a new, higher goal has been established in the Comprehensive Master Plan for development of the Hackensack Meadowlands District. This new goal being much higher than previously requires that the water quality in the Hackensack River must be upgraded and that the River is no longer to be the recipient of drainage from a refuse dumping area but a River which people can enjoy as it washes the shores of new urban development and recreational facilities.

The present water quality classifications, fully described and presented in the Report, must be upgraded. The recommended water quality standards will at first permit the possibility for enjoyment of the aquatic areas in a truly aesthetic fashion by the elimination of odors and by the elimination of floating debris, both of which offend the senses. Within a short period the water quality will be further upgraded to permit the utilization of the waters for swimming, boating, water skiing and other recreational activities. Ultimately the waters will be of such quality that fin fishing and shell fishing will be permitted in safety.

But desirable water quality does not occur by the mere changing of the color on a map or by passing legislation. Desired water quality can only be achieved when the wastes emanating from the communities bordering or tributary to the Hackensack River are totally collected and satisfactorily treated before being returned to the River. These waters are not only the sanitary wastes from the community, but also include all industrial discharges, leachates, storm water runoff and combined sewer overflows.

5. Surveillance and Control

Just as every society has established rules by which to grow in an orderly fashion, so men have sought ways to circumvent these rules. In order to protect the total society from the thoughtless actions of some portions thereof, adequate controls must be established to see to it that the rules are followed. These controls must be in the form of surveillance operations, maintenance and inspection operations and legal action.

Minimum standards must be established and the facilities to produce the required results designed, constructed and placed in operation. Routine inspection of waste water treatment plants, and the flows entering and leaving them as well as the quality of the water course, must be made. The Hackensack Meadowlands District, which is the major beneficiary of these improvements, must be the most interested party.

6. Additional Studies

Until the present time, the major effort has been expended toward concern with domestic sanitary wastes and their immediate effect on the water quality. Some efforts have been expended on industrial wastes, leachates from refuse, storm water drainage, and combined sewer overflows. However, it is increasingly clear that more studies in greater detail are mandatory to accomplish the required degree of water quality.

The extent of storm water drainage, combined sewer overflows and bypasses on river water quality is a nebulous area where factual data is imperative, as are cost studies for mitigation of these sources of pollution.

The presence of existing industrial complexes within the District, as well as the newer industries which will be attracted to the area and periphery, will have a profound effect on the water quality of the River. As demand for power in the area multiplies, new power plants will probably need to be developed. This in turn will lead to greater pressures for use of River water for cooling processes with the concomitant problem of thermal pollution. In the event that nuclear power is considered, other aspects of pollution must be faced. An alternate source of power may be the use of processed refuse as fuel. This in turn may affect water quality through leachates from residue, quenching or other operations. Thus power as it affects water quality is another area to be investigated.

The specific areas requiring study are many, and must be fully explored in depth as they will have a marked effect on the development of the Meadowlands District.

B. Recommendations

1. Division of Environmental Protection

In order that the Hackensack Meadowlands Development Commission has total control of the planning, construction, operational and administrative aspects of water pollution control and water quality control, it is recommended that a Division of Environmental Protection of the Hackensack Meadowlands Development Commission be formed to accomplish that end.

It is further recommended that the Hackensack Meadowlands Development Commission implement Alternate C to be administered by its Division of Environmental Protection.

The Division of Environmental Protection will control all effluents discharged into the Hackensack River or its tributaries within the Meadowlands District.

2. Water Pollution Control System

a. Stage I Construction

Forming an integral part of the water pollution control system, the present Bergen County Sewer Authority wastewater treatment plant in the northern portion of the District should be retained and its treatment facilities immediately be upgraded to produce an effluent which will meet the requirements of "Recreational Waters" quality standards as an interim measure.

At the earliest possible time, the existing Rutherford-East Rutherford-Carlstadt Joint Meeting plant and the Wood-Ridge plant should be abandoned and the flow from these plants conveyed to the Bergen County Sewer Authority plant for treatment by means of additional interceptor sewers constructed by the Hackensack Meadowlands Development Commission.

In the southern portion of the District, it is recommended that the Hackensack Meadowlands Development Commission immediately construct a new wastewater treatment plant on the Hackensack River in the Secaucus meadowlands with an initial capacity of 35 mgd. This plant should be designed to produce an effluent meeting the "Recreational Waters" quality standards.

Initial interceptor sewer installation will include the construction of that portion of the South-East Interceptor Sewer which will permit interception of the flow from the Township of North Bergen; that portion of the South-Central Interceptor Sewer that will permit servicing of the developing industrial tracts in the Town of Secaucus meadowlands; and that portion of the South-West Interceptor Sewer which will permit the flow from the North Arlington-Lyndhurst Joint Meeting plant to be conveyed to the new wastewater treatment facility. This initial construction will permit the elimination of all the small waste water treatment plants presently in the District with the exception of the Town of Secaucus plant, which presently has surplus capacity and is producing an effluent satisfactorily meeting present water quality requirements.

Construction of these first stage facilities will provide service to approximately 3,000 acres of the Meadowlands District as well as portions of the surrounding uplands areas.

b. Stage II Construction

Interceptor sewer construction can be progressed over a period of time as need for sewerage facilities arises. In both the Bergen County Sewer Authority area and the Hackensack Meadowlands Development Commission area of the District this construction will take the form of extensions to the existing interceptor sewers and the installation of strategically located trunk sewers to serve the remaining unsewered Meadowlands areas.

At the time that the flow to the Hackensack Meadowlands Development Commission plant approaches the initial design capacity of 35 mgd, anticipated to be approximately 10 to 12 years after the implementation of the Stage I improvements, it is recommended that this plant be expanded to its ultimate design capacity of 55 mgd. Concurrently, it is recommended that the Hackensack Meadowlands Development Commission plant treatment processes as well as those of the Bergen County Sewer Authority plant be further improved to produce effluents meeting the requirements of "Primary Contact Waters" quality standards. It is also recommended that the Town of Secaucus plant cease operations by connecting into the Hackensack Meadowlands Development Commission System prior to this time. In any event, it is recommended that upgrading to "Primary Contact Waters" quality standards should be implemented no later than twenty years after the start of the Meadowlands development program.

3. Water Quality Control

The degree of treatment and the quality of the effluent discharged to the Hackensack River must be maintained at a level to permit the intended use of the area to be developed. New water quality criteria, more stringent than those now in existence, must be promulgated, adopted and enforced. The recommended criteria for "Recreational Waters", "Primary Contact Waters" and ultimately "Harvest Waters" should be implemented as rapidly as is feasible. Recommended Water Quality Standards are given in Appendix C.

4. Sewer Regulations

In order to maintain adequate and reliable operation of the wastewater treatment facilities there must be control of the raw wastes entering the System. This control can only be exercised through rigid enforcement of sewer regulations. The Division of Environmental Protection should promulgate detailed sewer regulations. These regulations should be specific with respect to the maximum allowable concentrations of physical, chemical and biological constituents of the materials permitted to be discharged to the sewerage system. The regulations must be strict and contain provisions for enforcement and control, and the District should adhere to the letter of the regulations in observing the enforcement provisions.

The Division of Environmental Protection should establish and maintain the necessary laboratory control on all effluents discharging to the River. As the central administration in the environmental field it should also have the enforcement power to assure the attainment of the goals desired. The Meadowlands Commission could then, through systematic release of lands, permit the orderly development of the District which would be moved along concurrently with the construction of sewerage facilities.

5. Financial Implementation

In order to acquire the necessary funds with which to finance implementation of the water pollution control system, it is recommended that the Hackensack Meadowlands Development Commission exercise the bonding procedures with which it was empowered. Further, in order to retire the bonds and to fund operation of the system, it is recommended that assessments be made on District properties in the amount of the capital costs. Maintenance and operational costs should be financed through the application of user fees. User fees and assessments should be equitably distributed among land owners and users in the Meadowlands District, and users in the adjacent peripheral area.

C. Additional Pollution Control Studies

1. General

Although careful consideration was given to the various alternatives for collecting the wastes of the District and treating these wastes to improve and maintain the water quality of the Hackensack River, it is recommended that other factors which merit careful study be considered by the Commission.

2. Physical Model Study

As has been pointed out several times in this Report, all of the measures recommended for the District are intimately related to the waters of the New York Harbor Complex. Any study of the effect of pollution abatement procedures within the District must include the effect of the waters adjacent to and connected with the Hackensack River. Because of the number of variables and the many sources of pollutional discharge, it is necessary to study the entire New York Harbor Complex as one system. It is recommended that a coordinated study be developed with the Corps of Engineers, using their model of New York Harbor, to physically establish the degree of improvement which might be anticipated from the various proposed water pollution control systems of the several States, counties and municipalities involved.

3. Mathematical Model Study

It is further recommended that the Commission take steps toward the development of a mathematical model of the Hackensack River within the District. This auxiliary study would permit the listing of hypothesis of outfall locations, degree of treatment, effect of timed releases and variation in advective flow in the River.

4. Advective Flow

Since one of the major problems of the Hackensack River is that the stream is dead-ended with negligible advective flow, the possibility for developing a means of circulation and flushing of the estuary merits further detailed study. The use of an existing railroad tunnel may be a means of carrying significant volumes of water from the Hudson River through the Palisades to the upper reaches of the Hackensack estuary. The continuous addition of Hudson River water might serve to establish a gradient in the Hackensack River which would move the concentration of pollutants out of the District to be dispersed in Newark Bay.

The full effect of this study may also be checked mathematically and physically by the various model studies.

5. Aeration

A further study which can be undertaken in order to evaluate additional methods to further enhance the quality of the River water would be the effect of massive aeration on the Hackensack River and Newark Bay. Massive aeration can be accomplished through bubbling compressed air into the River through pipes laid in the River, through use of fountains and water displays as part of the overall recreational water area development or by other methods.

This heavy aeration would aid in maintaining fish life and other forms of the aquatic ecology, decrease the biochemical oxygen demand of any organic wastes which enter the stream, and generally improve the aesthetic quality.

The effects of aeration can also be evaluated through the use of a mathematical model.

6. Water Reuse

One of the major factors which will influence the planned orderly development of the Hackensack Meadowlands District is the availability of potable water.

It is recognized that present sources of raw potable water may at some time need to be augmented by sources other than natural ones. One potential auxiliary source may be found in the principal of a total water use cycle; from source through use and final treatment to reuse. Thus a logical further study should be the feasibility for utilizing the final treated effluent from the wastewater treatment plants as a source of raw drinking water. The study should evaluate the amount of water required and the feasibility of using the proposed plant effluent as a source of raw water. Careful studies must be undertaken of the final constituents of the plant effluent and the manner in which these residuals can be removed economically.

7. Combined Sewer Overflows, Storm Water Flows and By-pass Discharges

As the degree of treatment of sanitary waste water improves, plant effluents and river quality will also improve. However, such sources of pollution as combined sewer outflows, bypasses and storm flows will gain greater importance. A detailed survey of all such conditions in the District should be undertaken and the means of eliminating or curtailing these pollution sources should be determined. As part of this study an economic evaluation should be made of the costs for separating and reconstructing existing combined sewers and bypasses. Coupled with this study should be the feasibility of treating the rainfall runoff from the newly developed land area.

8. Ocean Outfall Sewer

A final study which should be considered is that of a single ocean outfall for all of the treated liquid wastes and pollutional flows from any and all sources within the District. This single ocean outfall should intercept the treated flows from surrounding areas as well as from the District. The total flow could be carried out past the headlands. By placing these pollution loads outside the New York Harbor Complex, there should be a significant improvement in the water quality of the Hackensack River.

APPENDIX A

STATE OF NEW JERSEY
QUALITY STANDARDS FOR SURFACE WATERS

RULES AND REGULATIONS

* * *

REGULATIONS ESTABLISHING CERTAIN CLASSIFICATIONS TO BE ASSIGNED TO THE WATERS OF THIS STATE AND STANDARDS OF QUALITY TO BE MAINTAINED IN WATERS SO CLASSIFIED.

WHEREAS, Chapter 12 of Title 58 of the Revised Statutes of New Jersey (N.J.S.A. 58:12-3) provides that no plant for the treatment of domestic or industrial wastes or other polluting substance, from which the effluent is to flow into any of the waters of this State, shall be constructed except under such conditions as shall be approved by the State Department of Health, and

WHEREAS, The conservation of the quality and function of the waters of the streams of this State into which effluente from sewerage facilities are discharged and the minimizing of pollution of these waters is the over-riding consideration of the Department of Health of the State of New Jersey in its considerations of the approvals of designs for such treatment works, and

WHEREAS, The maintenance of reasonable quality of the waters of the streams of this State is the primary basis upon which the State Department of Health approves of the design of proposed sewerage facilities, and

WHEREAS, The Interdepartmental Committee on Stream Pollution Control Problems, established by the State Commissioners of Health and Conservation and Economic Development, on April 9, 1964, recommended certain classifications be assigned to the waters of this State and standards of quality to be maintained in waters so classified, be promulgated as regulations by the State Department of Health, and

WHEREAS, The State Department of Health has determined that classifications of the waters of this State and standards of quality to be maintained in such waters as proposed and recommended by the Interdepartmental Committee on Stream Pollution Problems in this State are reasonable and constitute a valuable administrative instrument to the Department in the administration of the New Jersey Stream Pollution Control Program,

NOW THEREFORE, The State Department of Health, pursuant to authority vested in it, promulgates the following regulations establishing certain classifications to be assigned the waters of this State and standarde of quality to be maintained in such waters which are to be implemented from time to time by further regulations promulgated after public hearing defining the water or waters of this State to be assigned certain classifications and standards of quality to be maintained in such waters.

NEW JERSEY STATE DEPARTMENT OF HEALTH

Roscoe P. Kandle

Roscoe P. Kandle, M.D.
State Commissioner of Health

Filed with Secretary of State: August 10, 1964

Effective Date: September 1, 1964

Amended: January 5, 1966, effective March 1, 1966; and, March 6, 1967, effective May 1, 1967.

REGULATIONS ESTABLISHING CERTAIN CLASSIFICATIONS TO BE ASSIGNED TO THE WATERS OF THIS STATE AND STANDARDS OF QUALITY TO BE MAINTAINED IN WATERS SO CLASSIFIED.

FRESH WATERS

The fresh non-tidal surface waters of the State are herein classified as Classes FW-1, FW-2, and FW-3. For each classification there follow definitions and stream quality criteria.

Class FW-1

Definition: Fresh surface waters designated by authorized State Agencies as being set aside for posterity to represent the natural aquatic environment and its associated biota.

Criteria

These waters shall be maintained, as to quality, in their natural state.

Class FW-2

Definition: Fresh surface waters approved as sources of public potable water supply. These waters are to be suitable for public potable water supply after such treatment as shall be required by the State Department of Health. These waters shall be suitable also for all recreational purposes including fishing, the propagation and migration of native fish species desired for angling and other fish and aquatic life necessary thereto as well as any other reasonable uses.

Criteria

Conditions	Allowable Limits
1. Floating solids, settleable solids, oil, grease, artificial coloring matter and turbidity.	None of which are noticeable in the water or are deposited along the shore or on the aquatic substrata in quantities detrimental to the natural biota.
2. Toxic or deleterious substances (including mineral acids, caustic alkali, cyanides, heavy metals, carbon dioxide, ammonia or ammonium compounds, chlorine, etc.)	None which would effect humans or be detrimental to the natural aquatic biota.
3. Odor and taste producing substances.	None which are offensive to humans, detrimental to the aquatic biota or capable of producing offensive tastes and/or odors in water supplies and fauna used for human consumption.
4. pH.	Between 6.5 and 8.5 unless naturally outside thereof.
5. Dissolved Oxygen.	Not less than 5.0 p.p.m. for trout waters; otherwise 4.0 p.p.m.
6. Thermal Discharges.	None which detrimentally affect the natural aquatic biota, or reasonably anticipated reuse of the waters.

Class FW-3

Definition: Fresh surface waters suitable for all purposes provided for under Class FW-2 except public potable water supply.

Criteria

Conditions	Allowable Limits
1. Floating solids, settleable solids, oil, grease and turbidity.	None which are noticeable in the water or are deposited along the shore or on the aquatic substrata in quantities detrimental to the natural biota.
2. Toxic or deleterious substances (including mineral acids, caustic alkali, cyanides, heavy metals, carbon dioxide, ammonia or ammonium compounds, chlorine, etc.)	None which would affect humans or be detrimental to the natural aquatic biota.
3. Color, odor and taste producing substances.	None which are offensive to humans, detrimental to the aquatic biota or capable of producing offensive tastes and/or odors in fauna used for human consumption.
4. pH.	Between 6.5 and 8.5 unless naturally outside thereof.
5. Dissolved Oxygen.	Not less than 5.0 p.p.m. for trout waters; otherwise 4.0 p.p.m.
6. Thermal Discharges.	None which detrimentally affect the natural aquatic biota, or reasonably anticipated reuse of the waters.

TIDAL WATERS

The tidal surface waters of the State, including interstate waters, are herein classifisd as Classes TW-1, TW-2 and TW-3. For each classification there follow definitions and stream quality criteria.

Class TW-1

Definition: Tidal surface waters suitable for all recreational purposes, as a source of public potable water supply where permitted, and, where shellfishing is permitted, to be suitable for such purposes.

Criteria

Conditions	Allowable Limits
1. Floating solids, settleable solids, oil, grease, sleek and turbidity.	None which are noticeable in the water or are deposited along the shore or on the aquatic substrata in quantities detrimental to the natural biota.
2. Toxic or deleterious substances (including mineral acids, caustic alkali, cyanides, heavy metals, carbon dioxide, ammonia or ammonium compounds, chlorine, etc.)	None which would affect humans or be detrimental to the natural aquatic biota.
3. Color, odor and taste producing substances.	None which are offensive to humans, dstrimental to the aquatic biota or capable of producing offensive tastes and/or odors in water supplies and fauna used for human consumption.
4. pH.	Between 6.5 and 8.5 unless naturally outside thereof.
5. Dissolved Oxygen.	Not less than 50% of saturation.
6. Thermal Discharges.	None which detrimentally affect the natural aquatic biota, or reasonably anticipated reuse of the waters.
7. Coliform Bacteria.	The median MPN value in shellfish growning areas shall not be in excess of 70 per 100 milliliters.

Class TW-2

Definition: Tidal surface waters having limited recreational value and ordinarily not acceptable for bathing but suitable for fish survival although perhaps not suitable for fish propagation. These waters shall not be an odor nuisance and shall not cause damage to pleasure craft having occastion to traverse the waters.

Criteria

Conditions	Allowable Limits
1. Floating solids, oil and grease.	None which are noticeable in the water or contribute to the formation of sludge deposits along the shores.
2. Toxic and deleterious substances.	None in such concentrations as to cause fish mortality or inhibit their natural migration.
3. Taste and odor-producing substances.	None, either alone or in combination, which are offensive or that would produce offensive tastes and/or odors in fauna used for human consumption.
4. pH.	Between 6.5 and 8.5 unless naturally outside thereof.
5. Dissolved Oxygen.	Not less than 50% saturation.
6. Thermal Discharges.	None which detrimentally affect reasonable anticipated reuse of the waters.

Class TW-3

Definition: Tidal surface waters used primarily for navigation, not recreation. These waters, although not expected to be used for fishing, shall provide for fish survival. These waters shall not be an odor nuisance and shall not cause damage to pleasure craft traversing them.

Criteria

Conditions	Allowable Limits
1. Floating solids, settleable solids, oil and grease.	None which are noticeable in the water or contribute to the formation of sludge deposits along the shores.
2. Toxic and deleterious substances.	None in such concentrations as to cause fish mortality or inhibit their natural migration.
3. Taste and odor producing substances.	None which shall be offensive or that would detrimentally affect finfish, shellfish or other aquatic life in higher quality waters.
4. pH.	Between 6.5 and 8.5 unless naturally outside thereof.
5. Dissolved Oxygen.	Not less than 30% of saturation or 3.0 p.p.m., whichever is less.

COASTAL WATERS

The waters of the Atlantic Ocean within 1500 feet from mean low tide or to a depth of 15 feet, whichever is more distant from the mean low tide line, are classified as CW-1.

The waters of the Atlantic Ocean not included under Class CW-1 are classified as CW-2, out to the three (3) mile limit.

Class CW-1

Definition: Ocean waters expected to be suitable for all recreational purposes including fishing, the propagation and migration of native fish species desired for angling and other fish and aquatic life necessary thereto as well as any other reasonable use.

Criteria

Conditions	Allowable Limits
1. Floating solids, settleable solids, oil, grease and turbidity.	None of which are noticeable in the water or contribute to the formation of sludge deposits along the shores.
2. Toxic and deleterious substances.	None which would affect humans or be detrimental to the natural aquatic biota.

Conditions	Allowable Limits
3. Color, taste and odor producing substances.	None which are offensive to humans, capable of producing offensive tastes and/or odors in fauna used for human consumption.
4. pH	Between 6.5 and 8.5 unless naturally outside thereof.
5. Dissolved Oxygen.	Not less than 50% saturation.
6. Thermal Discharges.	None which detrimentally affect the natural aquatic biota.

Class CW-2

Definition: Ocean waters expected to be suitable for all recreational uses, including those in Class CW-1, except bathing.

Criteria

Conditions	Allowable Limits
1. Floating solids, settleable solids, oil, grease and turbidity.	None of which are noticeable in the water or contribute to the formation of sludge deposits along the shores.
2. Toxic and deleterious substances.	None which would affect humans or be detrimental to the natural aquatic biota.
3. Color	None which would impair the quality of CW-1 waters or detrimental to aquatic biota.
4. Taste and odor producing substances.	None which are offensive to humans, or capable of producing tastes and/or odor in fauna used for human consumption.
5. Dissolved Oxygen.	Not less than 50% saturation.
6. Thermal Discharges.	None which detrimentally affect the natural aquatic biota.

REGULATIONS CONCERNING CLASSIFICATION OF THE SURFACE WATERS OF THE HACKENSACK RIVER BASIN

WHEREAS, the State Department of Health filed with the Secretary of State on August 10, 1964, regulations establishing certain classifications to be assigned the waters of this State and standards of quality to be maintained in such waters which are to be implemented from time to time by further regulations promulgated after public hearing defining the water or waters of this State to be assigned a certain classification and standards of quality to be maintained in such waters, said regulations bearing an effective date of September 1, 1964, and

WHEREAS, in public hearing conducted by the State Department of Health on July 15, 1965, classifications of the surface waters of the Hackensack River and tributaries, as proposed by the State Department of Health, were presented to the general public, and

WHEREAS, the State Department of Health has given careful and thorough consideration to all statements submitted at said hearing, as well as statements and briefs submitted thereafter by proponents and opponents of the proposed classifications of the surface waters of the Hackensack River Basin,

NOW, THEREFORE, the State Department of Health promulgates the following regulations entitled "Classification of the Surface Waters of the Hackensack River Basin."

NEW JERSEY STATE DEPARTMENT OF HEALTH

Roscoe P. Kandle, M. D.
State Commissioner of Health

Filed with Secretary of State: December 30, 1965

Effective Date: March 1, 1966

CLASSIFICATION OF THE SURFACE WATERS OF THE HACKENSACK RIVER BASIN

Pursuant to authority vested in it under the provisions of Chapter 12, Title 58 of the Revised Statutes, the State Department of Health hereby promulgates the following classifications of the surface waters of the Hackensack River Basin. Standards of Quality to be maintained in these waters, as established by the State Department of Health, are attached hereto.

I. Class FW-2 - Hackensack River Basin above Oradell Dam.

II. Class FW-3 - Overpeck Creek and tributaries to tide dam and nontidal portions of tributaries to Hackensack River downstream from Oradell Dam.

III. Class TW-1 - Hackensack River and all tidal portions of tributaries from Oradell Dam to confluence with Overpeck Creek.

IV. A. Class TW-2 - Overpeck Creek and tidal tributaries from tide dam to confluence with Hackensack River.

B. Class TW-2 - Berry's Creek and all tidal tributaries to Hackensack River below its confluence with Overpeck Creek.

C. Class TW-2 - Hackensack River main stem from Overpeck Creek to the confluence with Berry's Creek.

V. Class TW-3 - Hackensack River main stem downstream of Berry's Creek.

* * * * * * * *

The State Department of Health acknowledges that, with the exception of shellfish waters, no criteria for bacterial content of the various surface waters of the State have been established. This is not an oversight on the part of the Department and it is not to be interpreted as indicating that the Department does not consider bacterial content of significance. The Department has found no accepted consensus as to needed bacterial limitations on surface waters in general and no practical administrative procedures have been found for a program based upon bacterial content as a criterion of surface water quality. The Department is confident that proper maintenance and operation of wastewater treatment facilities will assure bacterial content of the surface waters of the State within limits sufficient to protect the interests of the citizens of this State.

REGULATIONS CONCERNING TREATMENT OF WASTEWATERS, DOMESTIC AND INDUSTRIAL SEPARATELY OR IN COMBINATION, DISCHARGED INTO THE WATERS OF THE HACKENSACK RIVER BASIN

WHEREAS, the State Department of Health is charged with the responsibility for the Stream Pollution Control Program, including the approval of the designs of wastewater treatment facilities, in the State of New Jersey, and

WHEREAS, the citizens of this State, particularly the citizens in the Hackensack Valley, have been obliged in recent years to suffer repeatedly the consequences of serious oxygen depletion and other exemplifications of stream pollution in fresh water sections of the Hackensack River as well as in the tidal estuary thereof, said exemplifications of stream pollution constituting threats to the public health, comfort or property of citizens of this State, and

WHEREAS, the State Department of Health did promulgate rules and regulations entitled "Regulations Establishing Certain Classifications to be Assigned to the Waters of this State and Standards of Quality to be Maintained in Waters so Classified," effective September 1, 1964, and

WHEREAS, the State Department of Health did promulgate rules and regulations entitled "Regulations Concerning Classification of the Surface Waters of the Hackensack River Basin," effective March 1, 1966, and

WHEREAS, the State Department of Health has concluded after extensive investigations and analyses of factual data assembled thereby that more intensive treatment of wastewaters must be provided throughout the Hackensack River Basin in order to attain water quality specified by the aforesaid regulations of the Department, and

WHEREAS, the State Department of Health is of the opinion that the attainment and maintenance of water quality in the Hackensack River Basin as specified by the aforesaid regulations of the Department is necessary in order to abate a present threat to the public health, comfort or property of citizens of this State,

NOW, THEREFORE, the State Department of Health promulgates the following regulations entitled "Regulations Concerning Treatment of Wastewaters, Domestic and Industrial, Separately or in Combination, Discharged into the Waters of the Hackensack River Basin."

NEW JERSEY STATE DEPARTMENT OF HEALTH

Roscoe P. Kandle, M. D.
State Commissioner of Health

REGULATIONS CONCERNING TREATMENT OF WASTEWATERS, DOMESTIC AND INDUSTRIAL, SEPARATELY OR IN COMBINATION, DISCHARGED INTO THE WATERS OF THE HACKENSACK RIVER

Pursuant to the authority vested in it under the provisions of Chapter 12, Title 58 of the Revised Statutes, the State Department of Health hereby promulgates the following regulations concerning treatment of wastewaters, domestic and industrial, separately or in combination, discharged into the waters of the Hackensack River Basin.

I. Henceforth, domestic wastes, separately or in combination with industrial wastes, prior to discharge into waters of the Hackensack River Basin classified as FW-2, FW-3, or TW-1 shall be treated to a degree providing, as a minimum, ninety percent (90%) of reduction of biochemical oxygen demand at all times, including any four-hour period of a day when the strength of the wastes to be treated might be expected to exceed average conditions; it is the objective of this regulation that the biochemical oxygen demand of effluents discharged shall not exceed 25 parts per million.

II. Henceforth, industrial wastes, prior to discharge into waters of the Hackensack River Basin, classified as FW-2, FW-3 or TW-1 shall be treated to a degree providing, as a minimum, ninety percent (90%) of reduction of biochemical oxygen demand at all times and such further reduction in biochemical oxygen demand as may be necessary to maintain water in the River after dispersion of treated industrial waste effluents as specified in the rules and regulations entitled "Regulations Concerning Classification of the Surface Waters of the Hackensack River Basin," effective March 1, 1966; it is the objective of this regulation that the biochemical oxygen demand of effluents discharged shall not exceed 25 parts per million.

III. Henceforth, domestic wastes, separately or in combination with industrial wastes, prior to discharge into waters of the Hackensack River Basin classified as TW-2 or TW-3 shall be treated to a degree providing, as a minimum, eighty percent (80%) of reduction of biochemical oxygen demand at all times, including any four-hour period of a day when the strength of the wastes to be treated might be expected to exceed average conditions; it is the objective of this regulation that the biochemical oxygen demand of effluents discharged shall not exceed 50 parts per million.

IV. Henceforth, industrial wastes prior to discharge into waters of the Hackensack River Basin, classified as TW-2 or TW-3, shall be treated to a degree providing, as a minimum, eighty percent (80%) of reduction of biochemical oxygen demand at all times and such further reduction of biochemical oxygen demand as may be necessary in order to maintain the waters of the River of a quality as specified by the rules and regulations entitled "Classification of the Surface Waters of the Hackensack River Basin," effective March 1, 1966; it is the objective of this regulation that the biochemical oxygen demand of effluents discharged shall not exceed 50 parts per million.

V. It is recognized, especially in connection with some industrial wastes, that the pollution load imposed upon the waters of the Basin cannot be evaluated fully exclusively by the biochemical oxygen demand test; therefore, each industrial waste problem shall be considered individually and treatment shall be required as needed to effect compliance with the Water Quality Criteria established for the various classifications of waters in the Basin.

VI. Treatment standards set by these regulations are the minimum acceptable for the Hackensack River Basin. Treatment more intensive than that specified hereinabove shall be provided whenever it is determined by the State Department of Health in a particular situation that such treatment is necessary.

Filed with Secretary of State: February 21, 1967

Effective Date: March 17, 1967

REGULATIONS CONCERNING CLASSIFICATION OF THE SURFACE WATERS OF THE PASSAIC RIVER BASIN

WHEREAS, The State Department of Health filed with the Secretary of State on August 10, 1964, regulations establishing certain classifications to be assigned the waters of this State and standards of quality to be maintained in such waters which are to be implemented from time to time by further regulations promulgated after public hearing defining the water or waters of this State to be assigned a certain classification and standards of quality to be maintained in such waters, said regulations bearing an effective date of September 1, 1964, and

WHEREAS, in public hearing conducted by the State Department of Health on May 19, 1966, classifications of the surface waters of the Passaic River Basin, as proposed by the State Department of Health were presented to the general public, and

WHEREAS, The State Department of Health has given careful and thorough consideration to all statements submitted at said Hearing, as well as statements and briefs submitted thereafter by proponents and opponents of the proposed classifications of the surface waters of the Passaic River Basin,

NOW, THEREFORE, The State Department of Health promulgates the following regulations entitled "Classification of the Surface Waters of the Passaic River Basin."

NEW JERSEY STATE DEPARTMENT OF HEALTH

Roscoe P. Kandle, M. D.
State Commissioner of Health

Filed with Secretary of State: August 11, 1966

Effective Date: September 11, 1966

CLASSIFICATION OF THE SURFACE WATERS OF THE PASSAIC RIVER BASIN

Pursuant to authority vested in it under the provisions of Chapter 12, Title 58 of the Revised Statutes, the State Department of Health hereby promulgated the following classifications of the surface waters of the Passaic River Basin. Standards of Quality to be maintained in these waters as established by the State Department of Health are attached hereto.

I. Class FW-1

Waters having the potential for this Class but that are not classified as such at this time may be recommended for such classification by public or private interests controlling the land area draining to the watercourse. Since the characteristics of surface waters are sometimes changed to the detriment of their natural biota by seemingly minor associations with domestic and/or agricultural activities, they must be inspected and approved before being classified. Requests for consideration in the classification of FW-1 waters should be directed to:

New Jersey State Department of Health
P. O. Box 1540
Trenton, New Jersey 08625

A. State Forests and Parks

1. Cooley Brook, tributaries and Surprise Lake within A. S. Hewitt State Forest boundaries.

2. Green Brook, tributaries and West Pond within A. S. Hewitt State Forest boundaries.

B. Newark Watershed

1. Echo Lake tributaries, except the southeasterly tributary.

2. Tributary of Pequannock River at Green Pond Junction.

3. Clinton Brook and tributaries, north of a point 2000' ± northwest of LaRue Road at a confluence, including Cedar Pond, Buckahear Pond, Clinton Reservoir, Hanks Pond and all tributaries thereto.

4. Dunker Pond Brook, Dunker Pond and all tributaries thereto from a confluence 3000' ± north of Route 23 bridge.

5. Tributary to the Pequannock River joining the main stem 3500' ± southeast of the Sussex-Passaic County line, in the vicinity of Jefferson.

6. Pascack Brook and tributaries thereto north of Canistear Reservoir.

7. Cherry Ridge Brook and tributaries thereto north of Canistear Reservoir.

8. Easterly tributary to Canistear Reservoir.

9. Pequannock River and tributaries thereto upstream from the confluence with Pascack Brook.

10. Northwestern tributary to Oak Ridge Reservoir.

11. Tributary to Lake Stockholm Brook from the Route 23 bridge westerly within the Newark Watershed boundaries.

12. Lud-Day Brook downstream to its confluence with a tributary from Camp Garfield.

13. Brook between Hamburg Turnpike and Williamsville-Stockholm Road, downstream to its confluence with Lake Stockholm Brook, north of route 23.

C. State Fish and Game Lands

Stephens Brook north of State Division of Fish and Game Berkshire Valley Tract boundary.

II. Class FW-2

A. Main stem and tributaries of Passaic River above the Little Falls, except FW-1 cited above.

B. Saddle River and tributaries thereto and Hohokus Brook and tributaries thereto, upstream from the confluence of Saddle River with Hohokus Brook.

C. Molly Ann Brook and tributaries thereto upstream of the Borough of Haledon potable water supply dam.

III. Class FW-3

A. Saddle River and tributaries thereto upstream from head of tide to its confluence with Hohokus Brook.

B. Main stem and tributaries of Passaic River between Dundee Lake Dam and the Little Falls.

C. Nontidal reaches of tributaries to the Passaic River, below Dundee Lake Dam.

D. Bound Creek upstream from head of tide, the Lake Weequakic.

IV. Class TW-2

A. The tidal reaches of tributaries to the Passaic River.

B. Tidal stretches of Bound Creek, and other tributaries to Newark Bay not otherwise classified.

V. Class TW-3

Newark Bay from Central Railroad of New Jersey Bridge and main stem of Passaic River to head of tide at Dundee Lake Dam and Saddle River to head of tide.

REGULATIONS CONCERNING TREATMENT OF WASTEWATERS, DOMESTIC AND INDUSTRIAL, SEPARATELY OR IN COMBINATION, DISCHARGED INTO THE WATERS OF THE PASSAIC RIVER BASIN INCLUDING THE NEWARK BAY

WHEREAS, the State Department of Health is charged with the responsibility for the Stream Pollution Control Program, including the approval of the designs of wastewater treatment facilities, in the State of New Jersey, and

WHEREAS, the citizens of this State, particularly the citizens in the Passaic Valley, have been obliged in recent years to suffer repeatedly the consequences of serious oxygen depletion and other exemplifications of stream pollution in fresh water sections of the Passaic River as well as in the tidal estuary thereof, said exemplifications of stream constituting threats to the public health, comfort or property of citizens of this State, and

WHEREAS, the State Department of Health did promulgate rules and regulations entitled "Regulations Establishing Certain Classifications to be Assigned to the Waters of this State and Standards of Quality to be Maintained in Waters so Classified," effective September 1, 1964, and

WHEREAS, the State Department of Health did promulgate rules and regulations entitled "Regulations Concerning Classification of the Surface Waters of the Passaic River Basin," effective September 11, 1966, and

WHEREAS, the State Department of Health has concluded after extensive investigations and analyses of factual data assembled thereby that more intensive treatment of wastewaters must be provided throughout the Passaic River Basin in order to attain water quality specified by the aforesaid regulations of the Department, and

WHEREAS, the State Department of Health is of the opinion that the attainment and maintenance of water quality in the Passaic River Basin as specified by the aforesaid regulations of the Department is necessary in order to abate a present threat to the public health, comfort or property of citizens of this State,

NOW, THEREFORE, the State Department of Health promulgates the following regulations entitled "Regulations Concerning Treatment of Wastewaters, Domestic and Industrial, Separately or in Combination, Discharged into the Waters of the Passaic River Basin including the Newark Bay."

NEW JERSEY STATE DEPARTMENT OF HEALTH

Roscoe P. Kandle

Roscoe P. Kandle, M. D.
State Commissioner of Health

REGULATIONS CONCERNING TREATMENT OF WASTEWATERS, DOMESTIC AND INDUSTRIAL, SEPARATELY OR IN COMBINATION, DISCHARGED INTO THE WATERS OF THE PASSAIC RIVER INCLUDING THE NEWARK BAY

Pursuant to the authority vested in it under the provisions of Chapter 12, Title 58 of the Revised Statutes, the State Department of Health hereby promulgates the following regulations concerning treatment of wastewaters, domestic and industrial, separately or in combination, discharged into the waters of the Passaic River Basin.

I. Henceforth, domestic wastes, separately or in combination with industrial wastes, prior to discharge into waters of the Passaic River Basin classified as FW-2 or FW-3, shall be treated to a degree providing, as a minimum, ninety percent (90%) of reduction of biochemical oxygen demand at all times, including any four-hour period of a day when the strength of the wastes to be treated might be expected to exceed average conditions; it is the objective of this regulation that the biochemical oxygen demand of effluents discharged shall not exceed 25 parts per million.

II. Henceforth, industrial wastes, prior to discharge into waters of the Passaic River Basin, classified as FW-2 or FW-3, shall be treated to a degree providing as a minimum, ninety percent (90%) of reduction of biochemical oxygen demand at all times and such further reduction in biochemical oxygen demand as may be necessary to maintain water in the River after dispersion of treated industrial waste effluents as specified in the rules and regulations entitled "Regulations Concerning Classification of the Surface Waters of the Passaic River Basin," effective September 11, 1966; it is the objective of this regulation that the biochemical oxygen demand of effluents discharged shall not exceed 25 parts per million.

III. Henceforth, domestic wastes, separately or in combination with industrial wastes, prior to discharge into waters of the Passaic River Basin classified as TW-2 or TW-3 shall be treated to a degree providing, as a minimum, eighty percent (80%) of reduction of biochemical oxygen demand at all times, including any four-hour period of a day when the strength of the wastes to be treated might be expected to exceed average conditions; it is the objective of this regulation that the biochemical oxygen demand of effluents discharged shall not exceed 50 parts per million.

IV. Henceforth, industrial wastes prior to discharge into waters of the Passaic River Basin, classified as TW-2 or TW-3, shall be treated to a degree providing, as a minimum, eighty percent (80%) of reduction of biochemical oxygen demand at all times and such further reduction of biochemical oxygen demand as may be necessary in order to maintain the waters of the River of a quality as specified by the rules and regulations entitled "Classification of the Surface Waters of the Passaic River Basin," effective September 11, 1966; it is the objective of this regulation that the biochemical oxygen demand of effluents discharged shall not exceed 50 parts per million.

V. It is recognized, especially in connection with some industrial wastes, that the pollution load imposed upon the waters of the Basin cannot be evaluated fully exclusively by the biochemical oxygen demand test; therefore, each industrial waste problem shall be considered individually and treatment shall be required as needed to effect compliance with the Water Quality Criteria established for the various classifications of waters in the Basin.

VI. Treatment standards set by these regulations are the minimum acceptable for the Passaic River Basin. Treatment more intensive than that specified hereinabove shall be provided whenever it is determined by the State Department of Health in a particular situation that such treatment is necessary.

Filed with Secretary of State: December 13, 1966

Effective Date: February 1, 1967

NEW JERSEY STATE DEPARTMENT OF HEALTH
DIVISION OF CLEAN AIR AND WATER
WATER POLLUTION CONTROL PROGRAM

REGULATIONS CONCERNING CLASSIFICATION OF THE SURFACE WATERS OF THE HUDSON RIVER, ARTHUR KILL AND TRIBUTARIES

WHEREAS, the State Department of Health filed with the Secretary of State on August 10, 1964, regulations establishing certain classifications to be assigned the waters of this State and standards of quality to be maintained in such waters which are to he implemented from time to time by further regulations promulgated after public hearing defining the water or waters of this State to be assigned a certain classification and standards of quality to be maintained in such waters, said regulations bearing an effective date of September 1, 1964, and

WHEREAS, in public hearing conducted by the State Department of Health on February 15, 1966, classifications of the surface waters of the Hudson River, Arthur Kill and tributaries, as proposed by the State Department of Health were presented to the general public, and

WHEREAS, the State Department of Health has given careful and thorough consideration to all statements submitted at said hearing, as well as statements and briefs submitted thereafter by proponents and opponents of the proposed classification of the surface waters of the Hudson River, Arthur Kill and tributaries,

NOW, THEREFORE, the State Department of Health promulgates the following regulations entitled "Classfication of the Surfaca Waters of the Hudson River, Arthur Kill and Tributaries."

NEW JERSEY STATE DEPARTMENT OF HEALTH

Roscoe P. Kandle

Roscoe P. Kandle, M.D.
State Commissioner of Health

Filed with Secretary of State: April 15, 1966

Effective Date: May 16, 1966

CLASSIFICATION OF THE SURFACE WATERS OF THE
HUDSON RIVER, ARTHUR KILL AND TRIBUTARIES

Pursuant to authority vested in it under the provisions of Chapter 12, Title 58 of the Revised Stetutes, the State Department of Health hereby promulgates the following classifications of the surface waters of the Hudson River, Arthur Kill and tributaries. Standards of Quality to be maintained in these waters as established by the State Department of Health are attached hereto.

I. Hudson River and its New Jersey tributaries: TW-2, main stem from Hudson County-Richmond County line (confluence with Kill Van Kull), upstream to the Rockland County (N.Y.) - Bergen County (N.J.) boundary line.

1. Green Brook: FW-3 (tributary in Bergen County).

II. Arthur Kill: TW-3, main channel from New York Bay, Constable Hook - St. George (Kill Van Kull) and by the Central R.R. of N.J. bridge crossing Newark Bay, south to the Outerbridge Crossing.

TW-2, for stretch between Outerbridge Crossing and Ferry Point-Wards Point at the Raritan Bay.

TW-3, tidal stretches of tributaries to Arthur Kill.

1. Elizabeth River: TW-3, up to Broad Street Bridge.

FW-4, Broad Street bridge to Ursino Pond.

FW-3, upstream from Ursino Pond dam.

2. Morses Creek: TW-3, tidal portion thereof, and Peach Orchard Brook drainage to head of tide.

FW-3, above head of tide on Morses Creek and Orchard Brook, including Warinanco Lake.

3. Piles Creek: TW-3.

FW-3, any fresh water tributaries thereto.

4. Rahway River: TW-3, up to head of tide.

FW-3, below intake of Rahway Water Department to head of tide.

FW-2, above intake of Rahway Water Department.

a. Robinson's Branch: TW-3, head of tide (Hamilton Street) to Rahway River.

FW-3, downstream from Middlesex Water Company reservoir to Hamilton Street.

FW-2, upstream from the Middlesex Water Company reservoir dam.

b. South Branch Rahway River: TW-3, head of tide (Hazelwood Avenue) to Rahway River.

FW-3, upstream from Hazelwood Avenue.

5. Woodbridge Creek and its tributaries: TW-3, head of tide (vicinity of New Jersey Turnpike) to Arthur Kill.

FW-3, all waters upstream from head of tide.

6. Smith Creek: FW-3, for Creek and tributaries thereto above head of tide.

III. All fresh, nontidal waters not mentioned herein to be Class FW-3 and tidal waters as TW-2.

Filed with Secretary of State: April 15, 1966.

Effective Date: May 16, 1966.

APPENDIX B

STATE OF NEW YORK
QUALITY STANDARDS FOR SURFACE WATERS

Classifications and Standards

of

Quality and Purity

for

Waters of New York State

(Parts 700-703, Title 6, Official Compilation of Codes, Rules and Regulations)

Prepared and Published for

WATER RESOURCES COMMISSION
R. Stewart Kilborne, Chairman

by

New York State Department of Health
Hollis S. Ingraham, Commissioner

November, 1968

PART 700

TESTS OR ANALYTICAL DETERMINATIONS

(Statutory authority: Public Health Law, art. 6.)

Section 700.1 Collection of samples. In making any tests or analytical determinations of classified water to determine compliance or non-compliance of sewage, industrial wastes or other wastes discharges with established standards, samples shall be collected in such manner and at such locations as are approved by the Water Pollution Control Board as being representative of the receiving waters after opportunity for reasonable dilution and mixture with the wastes discharged thereto.

700.2 Tests or analytical determinations. Tests or analytical determinations to determine compliance or non-compliance with standards shall be made in accordance with methods and procedures approved by the Water Pollution Control Board.

PART 701

CLASSIFICATIONS AND STANDARDS OF QUALITY AND PURITY

(Statutory authority: Public Health Law, art. 6)

Section 701.1 Definitions. The several terms, words or phrases hereinafter mentioned shall be construed as follows:

(a) *Best usage* of waters as specified for each class shall be those uses as determined by the board in accordance with the considerations prescribed by section 109 of the Public Health Law.

(b) *Approved treatment* as applying to water supplies means treatment accepted as satisfactory by the authorities responsible for exercising supervision over the sanitary quality of water supplies.

(c) *Source of water supply for drinking, culinary or food processing purposes* shall mean any source, either public or private, the waters from which are used for domestic consumption or used in connection with the processing of milk, beverages, foods or for other purposes which require finished water meeting U.S. Public Health Service drinking water standards.

(d) *Fishing* shall include the propagation of fish and other aquatic life.

(e) *Agricultural* shall include use of waters for stock watering, irrigation and other farm purposes but not as source of water supply for drinking, culinary or food processing purposes.

(f) *Tidal salt waters* shall mean all tidal waters which are so designated by the board and which generally shall have a chloride ion content in excess of 250 parts per million.

701.2 Conditions applying to all classifications and standards. (a) In any case where the waters into which sewage, industrial wastes or other wastes effluente discharge are assigned a different classification than the waters into which such receiving waters flow, the standards applicable to the waters which receive such sewage or wastes effluents shall be supplemented by the following:

"The quality of any waters receiving sewage, industrial wastes or other wastes discharges shall be such that no impairment of the best usage of waters in any other class shall occur by reason of such sewage, industrial wastes or other wastes discharges."

(b) Natural waters may on occasion have characteristics outside of the limits established by the standards. The standards adopted herein relate to the condition of waters as affected by the discharge of sewage, industrial wastes or other wastes.

701.3 Classes and standards for fresh surface waters.

CLASS AA

Best usage of waters. Source of water supply for drinking, culinary or food processing purposes and any other usages.

Conditions related to best usage. The waters, if subjected to approved disinfection treatment, with additional treatment if necessary to remove naturally present impurities, meet or will meet U. S. Public Health Service drinking water standards and are or will be considered safe and satisfactory for drinking water purposes.

Quality Standards for Class AA Waters

Items	*Specifications*
1. Floating solids; settleable solids; oil; sludge deposits; tastes or odor producing substances	None attributable to sewage, industrial wastes or other wastes.
2. Sewage or wastes effluents	None which are not effectively disinfected.
3. pH	Range between 6.5 and 8.5.
4. Dissolved oxygen	For trout waters, not less than 5.0 parts per million; for non-trout waters, not less than 4.0 parts per million.
5. Toxic wastes, deleterious substances, colored or other wastes or heated liquids	None alone or in combination with other substances or wastes in sufficient amounts or at such temperatures as to be injurious to fish life, make the waters unsafe or unsuitable as a source of water supply for drinking, culinary or food processing purposes or impair the waters for any other best usage as determined for the specific waters which are assigned to this class.

Note 1: In determining the safety or suitability of waters in this class for use as a source of water supply for drinking, culinary or food processing purposes after approved treatment, the Water Pollution Control Board will be guided by the standards specified in the latest edition of *Public Health Service Drinking Water Standards* published by the United States Public Health Service.

Note 2: With reference to certain toxic substances as affecting fish life, the establishment of any single numerical standard for waters of New York State would be too restrictive. There are many waters, which because of poor buffering capacity and composition will require special study to determine safe concentrations of toxic substances. However, based on non-trout waters of approximately median alkalinity (80 p.p.m.) or above for the State, in which groups most of the waters near industrial areas in this State will fall, and without considering increased or decreased toxicity from possible combinations, the following may be considered as safe stream concentrations for certain substances to comply with the above standard for this type of water. Waters of lower alkalinity must be specially considered since the toxic effect of most pollutants will be greatly increased.

Ammonia or Ammonium compounds	Not greater than 2.0 parts per million (NH_3) at pH of 8.0 or above
Cyanide	Not greater than 0.1 part per million (CN)
Ferro- or Ferricyanide	Not greater than 0.4 parts per million ($Fe(CN)_6$)
Copper	Not greater than 0.2 parts per million (Cu)
Zinc	Not greater than 0.3 parts per million (Zn)
Cadmium	Not greater than 0.3 parts per million (Cd)

CLASS A

Best usage of waters. Source of water supply for drinking, culinary or food processing purposes and any other usages.

Conditions related to best usage. The waters, if subjected to approved treatment equal to coagulation, sedimentation, filtration and disinfection, with additional treatment if necessary to reduce naturally present impurities, meet or will meet U.S. Public Health Service drinking water standards and are or will be considered safe and satisfactory for drinking water purposes.

Quality Standards for Class A Waters

Items	*Specifications*
1. Floating solids; settleable solids; sludge deposits	None which are readily visible and attributable to sewage, industrial wastes or other wastes or which deleteriously increase the amounts of these constituents in receiving waters after opportunity for reasonable dilution and mixture with the wastes discharged thereto.
2. Sewage or waste effluents	None which are not effectively disinfected.
3. Odor producing substances contained in sewage, industrial wastes or other wastes	The waters after opportunity for reasonable dilution and mixture with the wastes discharged thereto shall not have an increased threshold odor number greater than 8, due to such added wastes.
4. Phenolic compounds	Not greater than 5 parts per billion (Phenol).
5. pH	Range between 6.5 and 8.5
6. Dissolved oxygen	For trout waters, not less than 5.0 parts per million; for non-trout waters, not less than 4.0 parts per million.
7. Toxic wastes, oil, deleterious substances, colored or other wastes or heated liquids	None alone or in combination with other substances or wastes in sufficient amounts or at such temperatures as to be injurious to fish life, make the waters unsafe or unsuitable as a source of water supply for drinking, culinary or food processing purposes or impair the waters for any other best usage as determined for the specific waters which are assigned to this class.

Note. Refer to notes 1 and 2 under class AA, which are also aplicable to class A standards.

CLASS B

Best usage of waters. Bathing and any other usages except as source of water supply for drinking, culinary or food processing purposes.

Quality Standards for Class B Waters

Items	*Specifications*
1. Floating solids; settleable solids; sludge deposits	None which are readily visible and attributable to sewage, industrial wastes or other wastes or which deleteriously increase the amounts of these constituents in receiving waters after opportunity for reasonable dilution and mixture with the wastes discharged thereto.
2. Sewage or wastes effluents	None which are not effectively disinfected.
3. pH	Range between 6.5 and 8.5
4. Dissolved oxygen	For trout waters, not less than 5.0 parts per million; for non-trout waters, not less than 4.0 parts per million.
5. Toxic wastes, oil, deleterious substences, colored or other wastes, or heated liquids	None alone or in combination with other substances or wastes in sufficient amounts or at such temperatures as to be injurious to fish life, make the waters unsafe or unsuitable for bathing or impair the waters for any other best usage as determined for the specific waters which are assigned to this class.

Note: Refer to note 2 under class AA, which is also applicable to class B standard.

CLASS C

Best usage of waters. Fishing and any other usages except for bething as source of water supply for drinking, culinary or food processing purposes.

Quality Standards for Class C Waters

Items	*Specifications*
1 Floating solids; settleable solids; sludge deposite	None which are readily visible and attributable to sewage, industrial wastes or other wastes or which deleteriously increase the amounts of these constituents in receiving waters after opportunity for reasonable dilution and mixture with the wastes discharged thereto.
2. pH	Range between 6.5 and 8.5
3. Dissolved oxygen	For trout waters, not less than 5.0 parts per million; for non-trout waters, not less than 4.0 parts per million.
4. Toxic wastes, oil, deleterious substances, colored or other wastes, or heated liquids	None alone or in combination with other substances or wastes in sufficient amounts or at such temperatures as to be injurious to fish life or impair the waters for any other best usage as determined for the specific waters which are assigned to this class

Note: Refer to note 2 under class AA, which is also applicable to class C standards

CLASS D

Best usage of waters. Agricultural or source of industrial cooling or process water supply and any other usage except for fishing, bathing or as source of water supply for drinking, culinary or food processing purposes.

Conditions related to best usage. The waters will be suitable for fish survival; the waters without treatment and except for natural impurities which may be present will be satisfactory for agricultural usages or for industrial process cooling water; and with special treatment as may be needed under each particular circumstance, will be satisfactory for other industrial processes.

Quality Standards for Class D Waters

Items	*Specifications*
1. Floating solids; settleable solids; sludge deposits	None which are readily visible and attributable to sewage, industrial wastes or other wastes or which deleteriously increase the amounts of these constituents in receiving waters after opportunity for reasonable dilution and mixture with the wastes discharged thereto.
2. pH	Range between 6.0 and 9.5
3. Dissolved oxygen	Not less than 3.0 parts per million.
4. Toxic wastes, oil, deleterious substances, colored or other wastes, or heated liquids	None alone or in combination with other substances or wastes in sufficient amounts or at such temperatures as to prevent fish survival or impair the waters for agricultural purposes or any other best usage as determined for the specific waters which are assigned to this class.

Note: Refer to note 2 under class AA, which is also applicable to class D standards.

Historical Note

Sec. amd., filed May 26, 1967 to be eff. May 26, 1967. Class E and F deleted.

701.4 Classes and standards for tidal salt waters.

CLASS SA

Best usage of waters. Shellfishing for market purposes and any other usages.

Quality Standards for Class SA Waters

Items	*Specifications*
1. Floating solids; settleable solids; oil; sludge deposits	None attributable to sewage, industrial wastes or other wastes.
2 Garbage, cinders, ashes, oils, sludge or other refuse	None in any waters of the marine district as defined by State Conservation Law.

Items	Specifications
3. Sewage or waste effluents	None which are not effectively disinfected.
4. Dissolved oxygen	Not less than 5.0 parts per million.
5. Toxic wastes, deleterious substances, colored or other wastes or heated liquids	None alone or in combination with other substances or wastes in sufficient amounts or at such temperatures as to be injurious to edible fish or shellfish or the culture or propagation thereof, or which in any manner shall adversely affect the flavor, color, odor or sanitary condition thereof or impair the waters for any other best usage as determined for the specific waters which are assigned to this class.
6. Organisms of coliform group	The median MPN value in any series of samples representative of waters in the shellfish growing area shall not be in excess of 70 per 100 milliliters.

CLASS SB

Best usage of waters. Bathing and any other usages except shellfishing for market purposes.

Quality Standards for Class SB Waters

Items	Specifications
1. Floating solids; settleable solids; oil; sludge deposits	None attributable to sewage, industrial wastes or other wastes.
2. Garbage, cinders, ashes, oils, sludge or other refuse	None in any waters of the marine district as defined by State Conservation Law.
3. Sewage or waste effluents	None which are not effectively disinfected.
4. Dissolved oxygen	Not less than 5.0 parts per million.
5. Toxic wastes, deleterious substances, colored or other wastes or heated liquids	None alone or in combination with other substances or wastes in sufficient amounts or at such temperatures as to be injurious to edible fish or shellfish or the culture or propagation thereof, or which in any manner shall adversely affect the flavor, color, odor or sanitary condition thereof; and otherwise none in sufficient amounts to make the waters unsafe or unsuitable for bathing or impair the waters for any other best usage as determined for the specific waters which are assigned to this class.

CLASS SC

Best usage of waters. Fishing and any other usages except bathing or shellfishing for market purposes.

Quality Standards for Class SC Waters

Items	Specifications
1. Floating solids; settleable solids; sludge deposits	None which are readily visible and attributable to sewage, industrial wastes or other wastes or which deleteriously increase the amounts of these constituents in receiving waters after opportunity for reasonable dilution and mixture with the wastes discharged thereto.
2. Garbag[illegible]rs, ashes, oils, sludge or othe[illegible]e	None in any waters of the marine district as defined by State Conservation Law.
3. Dissolv[illegible]ygen	Not less than 5.0 parts per million.
4. Toxic w[illegible]es, oil, deleterious substances, colored or other wastes or heated liquids	None alone or in combination with other substances or wastes in sufficient amounts or at such temperatures as to be injurious to edible fish or shellfish or the culture or propagation thereof, or which in any manner shall adversely affect the flavor, color, odor or sanitary condition thereof or impair the waters for any other best usage as determined for the specific waters which are assigned to this class.

CLASS SD

Best usage of waters. Any usages except fishing, bathing, or shellfishing for market purposes.

Quality Standards for Class SD Waters

Items	*Specifications*
1. Floating solids; settleable solids; sludge deposits	None which are readily visible and attributable to sewage, industrial wastes or other wastes or which deleteriously increase the amounts of these constituents in receiving waters after opportunity for reasonable dilution and mixture with the wastes discharged thereto.
2. Garbage, cinders, ashes, oils, sludge or other refuse	None in any waters of the marine district as defined by State Conservation Law.
3. Dissolved oxygen	Not less than 3.0 parts per million.
4. Toxic wastes, oil, deleterious substances, colored or other wastes	None alone or in combination with other substances or wastes in sufficient amounts to prevent survival of fish life or impair the waters for any other best usage as determined for the specific waters which are assigned to this class.

701.5 Classes and standards for underground waters.

Historical Note

Sec. repealed, filed Mar. 20, 1967.

PART 702

SPECIAL CLASSIFICATIONS AND STANDARDS

(Statutory authority Public Health Law, art 12)

Section 702.1 Class A—special (International boundary waters).

(a) *Best usage of waters.* Those as stated under "Objectives for Boundary Waters Quality Control" in the 1951 *Report of the International Joint Commission United States and Canada on the Pollution of Boundary Waters*, subdivision (c) below; namely, source of domestic water supply (under the conditions stated below) or industrial water supply, navigation, fish and wildlife, bathing, recreation, agriculture and other riparian activities.

(b) *Conditions related to best usage.* (1) After waters in this class at points of water intakes are brought to compliance with the above referred to "Objectives for Boundary Waters Quality Control", when subjected to approved treatment equal to coagulation, sedimentation, filtration and disinfection, with additional treatment, if necessary, to reduce naturally present impurities, meet or will meet U.S. Public Health Service drinking water standards and are or will be considered safe and satisfactory for drinking water purposes.

(2) Until waters in this class at points of water intake are brought to compliance with the above referred to "Objectives for Boundary Waters Quality Control" they require (i) approved treatment equal to coagulation, sedimentation, filtration and disinfection, (ii) approved additional or special treatment for assurance of safety and for control of tastes and odors; and (iii) approved, adequate and effective controls over all water treatment processes in order to meet the U.S. Public Health Service drinking water standards and in order to be considered safe and satisfactory for drinking water purposes.

(3) Until waters in this class, in areas used or proposed for bathing use, are brought to compliance with the above-referred to "Objectives for Boundary Waters Quality Control" they shall be considered safe and suitable for bathing usage only upon aproval of local health officials.

(c) *Adoption of objectives for boundary waters quality control.* The "Objectives for Boundary Waters Quality Control" as published on pages 18 and 19 of the 1951 *Report of the International Joint Commission United States and Canada on the Pollution of Boundary Waters*, set forth below, are hereby adopted by the New York Water Pollution Control Board as objectives to be sought for in advancing and carrying out the program of pollution abatement in international boundery waters.

Objectives for Boundary Waters Quality Control

In order to permit a more accurate evaluation of the nature and extent of pollution, its effects and the remedial measures necessary, the commission, in the course of the investigation, adopted the following statement of objectives for boundary waters quality control which was developed by the technical advisers.

The term *boundary waters* as herein used shall include the waters defined in the references to the International Joint Commission dated April 1, 1946, October 2 and 3, 1946, and April 2, 1948 and are as follows:

St. Clair River, Lake St. Clair, the Detroit River, St. Marys River from Lake Superior to Lake Huron, and Niagara River from Lake Erie to Lake Ontario.

These objectives are for the boundary waters in general, and it is anticipated that in certain specific instances, influenced by local conditions, more stringent requirements may be found necessary.

General Objectives

All wastes, including sanitary sewage, storm water, and industrial effluents, shall be in such condition when discharged into any stream that they will not create conditions in the boundary waters which will adversely affect the use of those waters for the following purposes: source of domestic water supply or industrial water supply, navigation, fish and wildlife, bathing, recreation, agricultura and other riparian activities. In general, adverse conditions are caused by:

(A) Excessive bacterial, physical or chemical contamination.

(B) Unnatural deposits in the stream, interfering with navigation, fish and wildlife, bathing, recreation, or destruction of aesthetic values

(C) Toxic subatances and materials imparting objectionable tastes and odors to waters used for domestic or industrial purposes

(D) Floating materials, including oils, grease, garbage, sewage solids, or other refuse.

Specific Objectives

In more specific terms, adequate controls of pollution will necessitate the following objectives for:

(A) *Sanitary sewage, storm water, and wastes from water craft.* Sufficient treatment for adequate removal or reduction of solids, bacteria and chemical constituents which may interfere unreasonably with the usa of these waters for purposes aforementioned Adequate protection for these waters, except in certain specific instances influenced by local conditions, should be provided if the coliform M.P.N. median value does not exceed 2,400 per 100 ml. at any point in the waters following initial dilution.

(B) *Industrial wastes.*

(1) *Chemical wastes Phenolic type* Industrial waste effluents from phenolic hydro-carbon and other chemical plants will cause objectionable tastes or odors in drinking or industrial water supplies and may taint the flesh of fish

Adequate protection should be provided for these waters if the concentration of phenol or phenol equivalents does not exceed an average of 2 ppb and a maximum of 5 ppb at any point in these waters following initial dilution This quality in the receiving waters will probably be attained if plant effluents are limited to 20 ppb of phenol or phenol equivalents.

Some of the industries producing phenolic wastes are: coke, synthetic resin, oil refining, petroleum cracking, tar, road oil, creosoting, wood distillation, and dye manufacturing plants.

(2) *Chemical wastes — other than Phenolic* Adequate protection should be provided if:

(a) The pH of these waters following initial dilution is not less than 6.7 nor more than 8.5. This quality in the receiving waters will probably be attained if plant effluents are adjusted to a pH value within the range of 5.5 and 10.6.

(b) The iron content of these waters following initial dilution does not exceed 0.3 ppm. This quality in the receiving waters will probably be attained if plant effluents are limited to 17 ppm of iron in terms of Fe.

(c) The odor producing subetances in the effluent are reduced to a point that following initial dilution with these waters the mixture does not have a threshold odor number in excess of 8 due to such added material.

(d) Unnatural color and turbidity of the wastes are reduced to a point that these waters will not be offensive in appearance or otherwise unattractive for the aforementioned purposes.

(e) Oils and floating solids are reduced to a point that they will not create fire hazards, coat hulls of water craft, injure fish or wildlife or their habitat, or will adversely affect public or private recreational development or other legitimate shore-line developments or uses. Protection should be provided for these waters if plant effluents or storm water discharges from premises do not contain oils, as determined by extraction, in excess of 15 ppm, or a sufficient amount to create more than a faint iridescence. Some of the industries producing chemical wastes other than phenolic are: oil wells and petroleum refineries, gasoline filling stations and bulk stations, styrene copolymor, synthetic pharmaceutical, synthetic fibre, iron and steel, alkali chemical, rubber fabricating, dye manufacturing, and acid manufacturing plants.

(3) *Highly toxic wastes.* Adequate protection should be provided for these waters if subetances highly toxic to human, fish, aquatic, or wildlife are eliminated or reduced to safe limits.

Some of the industries producing highly toxic wastes are: metal plating and finishing plants discharging cyanides, chromium or other toxic wastes; chemical or pharmaceutical plants and coke ovens. Wastes containing toxic concentrations of free halogens are included in this category

(4) *Deoxygenating wastes.* Adequate protection of these waters should result, if sufficient treatment is provided for the substantial removal of solids, bacteria, chemical constitutents and other substances capable of reducing the dissolved oxygen content of these waters unreasonably Some of the industries producing these wastes are: tanneries, glue and gelatin plants, alcohol including breweries and distilleries, wool scouring, pulp and paper, food processing plants such as meat packing and dairy plants, corn products, beet sugar, fish processing and dehydration plants

(d) *Quality standards for class A special (International boundary waters).* Supplemental to the above-referred to "Objectives for Boundary Waters Quality Control", the following quality standards are established for waters of this class.

Items	*Specifications*
1. Floating solids; settleable solids; sludge deposits	None which are readily visible and attributable to sewage, industrial wastes or other wastes or which deleteriously increase the amounts of these constituents in receiving waters after opportunity for reasonable dilution and mixture with the wastes discharged thereto
2. Sewage or waste effluente	None which are not effectively disinfected
3. Odor producing substances contained in sewage, industrial wastes or other wastes	The waters after opportunity for reasonable dilution and mixture with the wastes discharged thereto shall not have an increased threshold odor number greater than 8, due to such added wastes.
4. Phenolic compounds	Not greater than 5 parts per billion (Phenol).
5. pH	Range between 6.7 and 8.5
6. Dissolved oxygen	Not less than 4.0 parts per million.
7. Toxic wastes, oil, deleterious substances, colored or other wastes or heated liquids	None alone or in combination with other subetances or wastes in sufficient amounte or at such temperatures as to adversely affect the usages recognized for this class of waters.

(e) *Standards subject to revision at any time.* If and when necessary to attain the above referred to "Objectives for Boundary Waters Control", the standards specified herein shall be subject to revision from time to time after further hearings on due notice.

702.2 Class AA—special (Lake Champlain drainage basin).

CLASS AA—SPECIAL (LAKE CHAMPLAIN DRAINAGE BASIN)

Best usage of water. Any usages except for disposal of sewage, industrial wastes or other wastes.

Quality Standards for Class AA-Special (Lake Champlain Drainage Basin)

Items	*Specifications*
1. Floating solids; settleable solids; oil; sludge deposits; toxic wastes; deleterious substances; colored or other wastes or heated liquide	None attributable to sewage, industrial waste or other wastes.
2. Sewage or waste effluents	None into waters of this class

702.3 [Special classes and standards for the Lower Hudson River, Arthur Kill, Kill Van Kull, Harlem River, Raritan Bay and Lower East River drainage basins; New York Bay area; Nassau County including Long Island Sound; and Suffolk County.]

(a) Pursuant to section 1205 of article 12 of the Public Health Law, the Water Resources Commission, after proper study and after public hearings held on due notice, hereby adopts and establishes two special classes and standards of quality and purity applicable thereto for particular application and assignment to certain tidal waters within the Interstate Sanitation District defined in article 12-B of the Public Health Law which certain tidal waters are within the following particular areas, State of New York.

(1) The drainage basin of the Lower Hudson River from the mouth to northern Westchester-Rockland county lines, except Saw Mill River and Sparkill Creek drainage basins.

(2) The drainage basins of Arthur Kill, Kill Van Kull the Harlem River, and Raritan Bay.

(3) The drainage basin of Lower East River from the mouth to a line across East River north of Wards Island between Stony Point in Bronx County and Lawrence Point in Queens County.

(4) New York Bay including Gravesend Bay, Coney Island Creek, Atlantic Basin, Erie Basin, Gowanus Bay, Gowanus Canal, The Narrows and Atlantic Ocean waters off Coney Island lying westerly of a north-south line from Light Inlet at the southeasterly tip of Coney Island Peninsula to the south tip of Rockaway Point, thence along the jetty to Rockaway jetty light, thence due south to the New York-New Jersey boundary line

(5) Nassau County including the waters of Long Island Sound between Nassau-Queens and Nassau-Suffolk county lines and the waters of Atlantic Ocean to the three mile limit between said county lines.

(6) The area within Suffolk County lying west of a north-south topographical limit line and its extensions to a point in Long Island Sound at the New York-Connecticut State boundary line due north of Miller Place Beach and to Blue Point on the south mainland thence southward across Great South Bay to Water Island, thence three miles due south to a point in the Atlantic Ocean at the south State boundary line

(b) Said classes and standards of quality and purity applicable thereto are set forth hereinafter and designated class I and class II.

CLASS I

Best usage of waters. Fishing and any other usages except bathing or shellfishing for market purposes.

Quality Standards for Class I Waters

Items	*Specifications*
1. Floating solids; settleable solids; sludge deposits	None which are readily visible and attributable to sewage, industrial wastes, or other wastes or which deleteriously increase the amounts of these constituents in receiving waters after opportunity for reasonable dilution and mixture with the wastes discharged thereto.
2. Garbage, cinders, ashes, oils, sludge, or other refuse	None in any waters of the marine district as defined by State Conservation Law
3 Sewage or waste effluents	Effective disinfection if required by Interstate Sanitation Commission
4. Dissolved oxygen	An average of not less than 50 per cent saturation during any week of the year but not less than 3 0 parts per million at any time.
5. Toxic wastes, oil, deleterious substances, colored or other wastes, or heated liquids	None alone or in combination with other substances or wasies in sufficient amounts to be injurious to edible fish and shellfish, or the culture or propagation thereof, or which shall in any manner affect the flavor, color, odor, or sanitary condition of such fish or shellfish so as to injuriously affect the sale thereof, or which shall cause any injury to the public and private shellfisheries of this State; and otherwise none in sufficient amounts to impair the waters for any other best usage as determined for the specific waters which are assigned to this class.

CLASS II

Best usage of waters. All waters not primarily for recreational purposes, shellfish culture or the davelopment of fish life.

Quality Standards for Class II Waters

Items	*Specifications*
1. Floating solids; settleable solids; sludge deposits	None which are readily visible and attributable to sewage, industrial wastes or other wastes or which deleteriously increase the amounts of these constituents in receiving waters after opportunity for reasonable dilution and mixture with the wastes discharged thereto
2. Garbage, cinders, ashes, oils, sludge, or other refuse	None in any waters of the marine district as defined by State Conservation Law.
3. Dissolved oxygen	An average of not less than 30 per cent saturation during any week of the year, provided such saturation levels insure adequate oxygen to support fish and shellfish life at all times.
4. Toxic wastes, oil, daleterious substances, colored or other wastes	None alone or in combination with other substances or wastes in sufficient amounts to be injurious to edible fish and shellfish, or the culture or propagation thereof, or which shall in any manner affect the flavor color, odor, or sanitary condition of such fish or shellfish so as to injuriously affect the sale thereof, or which shall cause any injury to the public and private shellfisheries of thla State

(c) This section shall be effective December 22, 1964

702.4 **[Special classes and standards for certain tidal waters within the Upper East River and the Long Island Sound drainage basins within Queens, Bronx and Westchester Counties.]**

(a) Pursuant to section 1205 of article 12 of the Public Health Law, the Water Resources Commission, after proper study and after public hearings held on due notice, hereby adopts and establishes two special classes and standards of quality and purity applicable thereto for particular application and assignment to certain tidal waters within the Interstate Sanitation District defined in article 12-B of the Public Health Law which certain tidal waters are within the Upper East River and Long Island Sound drainage basins within Queens, Bronx and Westchester Counties, State of New York.

(b) Said classes and standards of quality and purity applicable thereto are set forth hereinafter and designated class I and class II.

CLASS I

Best usage of waters. Fishing and any other usages except bathing or shellfishing for market purposes.

Quality Standards for Class I Waters

Items	*Specifications*
1. Floating solids; settleable solids; sludge deposits	None which are readily visible and attributable to sewage, industrial wastes, or other wastes or which deleteriously increase the amounts of these constituents in receiving waters after opportunity for reasonable dilution and mixture with the wastes discharged thereto.
2. Garbage, cinders, ashes, oils, sludge, or other refuse	None in any waters of the marine district as defined by State Conservation Law.
3. Sewage or waste effluents	Effective disinfection if required by Interstate Sanitation Commission.
4. Dissolved oxygen	An average of not less than 50 per cent saturation during any week of the year, but not less than 3.0 perts per million at any time.
5. Toxic wastes, oil, deleterious substances, colored or other wastes, or heated liquids	None alone or in combination with other substances or wastes in sufficient amounts to be injurious to edible fish and shellfish, or the culture or propagation thereof, or which shall in any manner affect the flavor, color, odor, or sanitary condition of such fish or shellfish so as to injuriously affect the sale thereof, or which shall cause any injury to the public and private shellfisheries of this State; and otherwise none in sufficient amounts to impair the waters for any other best usage as determined for the specific waters which are assigned to this class.

CLASS II

Best usage of waters. All waters not primarily for recreational purposes, shellfish culture or the development of fish life.

Quality Standards for Class II Waters

Items	*Specifications*
1. Floating solids; settleable solids; sludge deposits	None which are readily visible and attributable to sewage, industrial wastes or other wastes or which deleteriously increase the amounts of these constituents in receiving waters after opportunity for reasonable dilution and mixture with the wastes discharged thereto.
2. Garbage, cinders, ashes, oils, sludge, or other refuse	None in any waters of the marine district as defined by State Conservation Law.
3. Dissolved oxygen	An average of not less than 30 per cent saturation during any week of the year, provided such saturation levels insure adequate oxygen to support fish and shellfish life at all times.
4. Toxic wastes, oil, deleterious substances, colored or other wastes	None alone or in combination with other substance sor wastes in sufficient amounts to be injurious to edible fish and shellfish, or the culture or propagation thereof, or which shall in any manner affect the flavor, color, odor, or sanitary condition of such fish or shellfish so as to injuriously affect the sale thereof, or which shall cause any injury to the public and private shellfisheries of this State.

(c) This section shall be effective January 22, 1965.

702.5 **[Special classes and standards for Jamaica Bay drainage basin within Kings and Queens Counties including a certain portion of Rockaway Inlet.]**

(a) Pursuant to section 1205 of Article 12 of the Public Health Law, the Water Resources Commission, after proper study and after public hearings held on due notice, hereby adopts and establishes two special classes and standards of quality and purity aplicable thereto for particular application and assignment to certain tidal waters within the Interstate Sanitation District defined in article 12-B of the Public Health Law which certain tidal waters are within the following particular areas, State of New York: Jamaica Bay drainage basin within Kings and Queens Counties and including Rockaway Inlet east of a north-south line drawn from Light Inlet at the south easterly tip of Coney Island peninsula near Manhattan Beach to the westerly shoreline west of Lookout Tower on Rockaway Point.

(b) Said classes and standards of quality and purity applicable thereto are set forth hereinafter and designated class I and class II.

CLASS I

Best usage of waters. Fishing and any other usages except bathing or shellfishing for market purposes.

Quality Standards for Class I Waters

Items	*Specifications*
1. Floating solids; settleable solids; sludge deposits	None which are readily visible and attributable to sewage, industrial wastes, or other wastes or which deleteriously increase the amounts of these constituents in receiving waters after opportunity for reasonable dilution and mixture with the wastes discharged thereto.
2. Garbage, cinders, ashes, oils, sludge, or other refuse	None in any waters of the marine district as defined by State Conservation Law.
3. Sewage or waste effluents	Effective disinfection if required by Interstate Sanitation Commission.
4. Dissolved oxygen	An average of not less than 50 per cent saturation during any week of the year, but not less than 3.0 parts per million at any time.
5. Toxic wastes, oil, deleterious substances, colored or other wastes, or heated liquids	None alone or in combination with other substances or wastes in sufficient amounts to be injurious to edible fish and shellfish, or the culture or propagation thereof, or which shall in any manner affect the flavor, color, odor, or sanitary condition of such fish or shellfish so as to injuriously affect the sale thereof, or which shall cause any injury to the public and private shellfisheries of this Stats; and otherwise none in sufficient amounts to impair the waters for any other best usage as determined for the specific waters which are assigned to this class.

CLASS II

Best usage of waters. All waters not primarily for recreational purposes, shellfish culture or the development of fish life.

Quality Standards for Class II Waters

Items	*Specifications*
1. Floating solids; settleable solids; sludge deposits	None which are readily visible and attributable to sewage, industrial wastes, or other wastes or which deleteriously increase the amounts of these constituents in receiving waters after opportunity for reasonable dilution and mixture with the wastes discharged thereto.
2. Garbage, cinders, ashes, oils, sludge or other refuse	None in any waters of the marine district as defined by State Conservation Law.

3. Dissolved oxygen	An average of not less than 80 per cent saturation during any week of the year, provided such saturation levels insure adequate oxygen to support fish and shellfish life at all times.
4. Toxic wastes, oil, deleterious substances, colored or other wastes	None alone or in combination with other substances or wastes in sufficient amounts to be injurious to edible fish and shellfish, or the culture or propagation thereof, or which shall in any manner affect the flavor, color, odor, or sanitary condition of such fish or shellfish so as to injuriously affect the sale thereof, or which shall cause any injury to the public and privats shellfisheries of this State.

(c) This section shall be effective January 31, 1966.

702.6 Special class (lower Genesee River).

Historical Note

Sec. deleted, filed Mar. 22, 1968 to be eff. Mar. 22, 1968.

702.7 Special class (Cattaraugus Creek).

Historical Note

Sec. deleted, filed Mar. 22, 1968 to be eff. Mar. 22, 1968.

702.8 Class AA—special (upper Hudson River drainage basin).

Best usage of waters. Any usage except for disposal of sewage, industrial waste or other waste.

Quality Standards for Class AA—Special Waters (Upper Hudson River Drainage Basin)

Items	*Specifications*
1. Floating solids, settleable solids, oil, sludge deposits, toxic wastes, deleterious substances, colored or other wastes or heated liquids.	None attributable to sewage, industrial wastes or other wastes.
2. Sewage or waste effluents.	None into waters of this class.

This adoption of classification and standards of quality and purity of waters shall be effective May 24, 1967.

Historical Note

Sec. added, filed May 24, 1967 to be eff. May 24, 1967.

PART 703

GROUND WATER CLASSIFICATIONS AND STANDARDS

(Statutory authority: Public Health Law, § 1205)

Historical Note

Part (§§ 703.1-703.4) added, filed Mar. 20, 1967.

Section 703.1 Basis of classification. (a) The ground waters of the State are classified according to best use, and all fresh ground waters are best used as sources of potable water supply. Such fresh waters, when subjected to approved disinfection treatment and/or additional treatment to reduce naturally present impurities to meet New York State Health Department drinking waer standards are deemed satisfactory for potable purposes.

(b) The purpose of these classes and standards is to prevent pollution of ground waters and protect the ground waters for use as a potable water. The concentration listed in schedule I and II represent maximum allowable concentrations.

(c) Modifications of specific concentration of the constituents in schedule I and II and all toxic chemicals may be required where accumulative and synergistic effects can be established.

Historical Note

Sec. added, filed Mar. 20, 1967.

703.2 Definitions. For the purposes of these classifications and standards:

(a) *Fresh water* is that water having a chloride content equal to or less than 250 mg/l, or a total dissolved solids content equal to or less than 1000 mg/l.

(b) *Saline water* is that water having a chloride content of more than 250 mg/l, or a total dissolved solids content of more than 1000 mg/l.

(c) *Ground waters* are those waters in the zone of saturation.

(d) The *zone of saturation* is that extensive portion of the earth's crust which is saturated with water. (Does not include isolated perched water areas.)

(e) The *zone of aeration* is that portion of the earth's crust which is *above* the natural ground water table.

(f) *Unconsolidated deposits* are all soil materials above the bed rock.

(g) *Consolidated rock* or *bed rock* is the compact hard rock below the unconsolidated deposits.

(h) *Potable waters* are those fresh waters usable for drinking, culinary or food processing purposes.

(i) *Mg/l* is the weight in milligrams of any specific item or items in a liter of the solution containing the item or items.

(j) *Point of discharge* is point of initial contact of waste with the existing earth, soil or rock.

(k) *Water table* is the top of the zone of saturation. It fluctuates with seasons and is usually lowest in September or October.

Historical Note

Sec. added, filed Mar. 20, 1967.

703.3 Conditions. (a) Where natural fresh ground waters contain quantities of any chemical constituents in excess of standards set forth in schedule II, such water when removed from the zone of saturation and so used as not to be altered biologically and not to be unreasonably altered chemically or physically, may be discharged to the zone of aeration or returned directly to the zone of saturation.

(b) Class GSB will be assigned only by the Water Resources Commission after a public hearing and a thorough study to determine that such a class is required for a specific subsurface area, and to insure protection of adjacent and tributary ground waters.

(c) These classes and standards shall not be deemed to apply to the utilization of chemicals and fertilizers in normal accepted agricultural pursuits.

Historical Note

Sec. added, filed Mar. 20, 1967.

703.4 Classes and standards for ground waters.

CLASS GA

Fresh ground waters which are best used as sources of potable water supply. Found in the zone of saturation of unconsolidated deposits and consolidated rock or bed rock)

Quality Standards for Class GA Waters

Condition I: Fresh waters found where the top of the zone of saturation (water table) is in the unconsolidated deposits and total thickness of unconsolidated deposit is not less than 15 feet of which not less than 10 feet of unconsolidated deposit is in the zone of saturation at any time.

Items	*Specifications*
1. Raw or treated sewage, industrial wastes or ineffectively treated effluents, taste or odor producing substances, toxic wastes, thermo-wastes, radioactive substances, or other deleterious matter.	1. *None* into the zone of aeration which may impair the quality of the ground waters to render them unsuitable for a potable water supply. The concentration of various contaminants shall not exceed the standard set forth in schedule I at the point of discharge.
	2. *None* into the zone of saturation which may impair the quality of the ground water to render them unsuitable for a potable water supply.
	(a) Where discharge is in the unconsolidated deposits, the concentration of various contaminants at the point of discharge shall not exceed the standards set forth in schedule I, provided that the point of discharge is not less than 10 feet above the consolidated rock.
	(b) Where discharge is in the consolidated rock or within 10 feet of consolidated deposits, the concentration of various contaminants at the point of discharge shall not exceed the standards set forth in schedule II

Condition II: Fresh waters found where the top of the zone of saturation (water table) [illegible] the consolidated rocks or where the top of the zone of saturation is in the unconsolidated deposits and the minimum thickness of the zone of saturation in these deposits is less than 10 feet at any time.

Items	*Specifications*
1. Raw or treated sewage, industrial wastes or ineffectively treated effluents, taste or odor producing substances, toxic wastes, thermo-wastes, radioactive substances or other deleterious matter.	1. *None* into the zone of aeration which may impair the quality of the ground waters to render them unsuitable for a potable water supply. The concentration of various contaminants shall not exceed the standard set forth in schedule II at the point of discharge.
	2. *None* into the zone of saturation which may impair the quality of the ground water to render them unsuitable for a potable water supply. The concentration of various contaminants shall not exceed the standards set forth in schedule II at the point of discharge.

Schedule I

Analytical determinations. Conformance with the requirements of these standards shall be analytically determined on the basis of an accepted method approved by the New York State Department of Health.

Biological organisms. Biological organisms shall not be allowed in amounts sufficient to render the water detrimental to public health, safety and welfare.

Physical characteristics. To conform with these standards, the arithmetic average of all samples examined in any month shall not exceed the following:

1. *Color—30 units:* water, which when compared visually with a sample of known color concentration or with special calibrated color discs, matches the known standards of 30 color units.

2. *Threshold odor—6:* water, a 35 ml sample of which when diluted with odor free water to a volume of 200 ml has no detectable odor.

Chemical characteristics. To conform with these standards, the following values shall not be exceeded:

Substance	*Concentration in mg/l*
Alkyl benzene sulfonate (ABS)	1.5
Arsenic (As)	0.1
Barium (Ba)	2.0
Cadmium (Cd)	0.02
Carbon chloroform extract residue (CCE)	0.4
Chloride (Cl)	500
Chromium (hexavalent) (Cr+6)	0.10
Copper (Cu)	0.4
Cyanide (CN)	0.4
Fluoride (F)	3.0
Iron (Fe)*	0.6
Lead (Pb)	0.10
Manganese (Mn)*	0.6
Nitrate (N)	20.0

*Combined concentration of iron and manganese shall not exceed 0.6 mg/l

Substance	*Concentration in mg/l*
Phenols	0.002
Selenium (Se)	0.02
Silver (Ag)	0.10
Sulfate (SO_4)	500
Total dissolved solids	1000
Zinc	0.6
pH**	6.5—8.5

**When natural ground waters have a pH outside of range indicated above, that natural pH may be one extreme of the allowable range.

Schedule II

Analytical determinations. Conformance with the requirements of these standards shall be analytically determined on the basis of an accepted method approved by the State Department of Health.

Bacteriological characteristics. To conform with these standards, the number of organisms of the coliform group shall not exceed the following:

1. An arithmetic average of 50 coliform organisms per 100 milliliter sample in a series of four or more samples collected during any 30-day period.

2. A count of 50 coliform organisms per 100 milliliter samples is not more than 20 per cent of the samples collected during the period.

Biological organisms. Biological organisms shall not be allowed in amounts sufficient to render the water unsafe or otherwise objectionable, as determined by the State Commissioner of Health.

Physical characteristics. To conform with these standards, the arithmetic average of all samples examined by any month shall not exceed the following:

1. *Color—15 units:* water, which when compared visually with a sample of known color concentration or with special calibrated color discs, matches the known standards of 15 color units.

2. *Threshold odor—3:* water, a 70 ml sample of which when diluted with odor free water to a volume of 200 ml has no detectable odor.

Chemical characteristics. To conform with these standards, the following values shall not be exceeded:

Substance	*Concentration in mg/l*
Alkyl benzene sulfonate (ABS)	1.0
Arsenic (As)	0.05
Barium (Ba)	1.0
Cadmium (Cd)	0.01
Carbon chloroform extract residue (CCE)	0.2
Chloride (Cl)	250
Chromium (hexavalent) (Cr+6)	0.05
Copper (Cu)	0.2
Cyanide (CN)	0.2
Fluoride (F)	1.50
Iron (Fe)*	0.3
Lead (Pb)	0.05
Manganese (Mn)*	0.3
Nitrate (N)	10.0

*Combined concentration of iron and manganese shall not exceed 0.3 mg/l.

Substance	*Concentration in mg/l*
Phenols	0.001
Selenium (Se)	0.01
Silver (Ag)	0.05
Sulfate (SO_4)	250
Total dissolved solids	500
Zinc	0.3
pH**	6.5—8.5

**When natural ground waters have a pH outside of range indicated above, that natural pH may be one extreme of the allowable range.

CLASS GSA

Waters of GSA classification are those saline ground waters wherever found in the zone of saturation which are best used as a source of saline waters for potable mineral waters, for conversion to fresh potable waters, or as raw material for the manufacture of sodium chloride or its derivatives or similar products.

Items	*Specifications*
1. Sewage or industrial wastes or ineffectively treated effluents; taste or odor producing substances, toxic wastes, thermo-wastes, radioactive substances, or other deleterious matter.	1. *None* in such manner or amount as to impair the waters for use as sources of saline water for the best usage outlined above.

CLASS GSB

Waters of the GSB classification are those saline waters in the zone of saturation having a chloride content in excess of 1,000 milligrams per liter or a total dissolved solids content of over 2,000 milligrams per liter wherever found, which are best used as receiving waters for disposal of wastes.

Items	*Specifications*
1. Sewage and all other wastes.	1. *None* which are detrimental to public health, safety or welfare and only on permit of the State agency having jurisdiction.

Historical Note

Sec. added, filed Mar. 20, 1967.

703.5 Assignment of ground water classifications and standards. The ground water classifications and standards enumerated in section 703.4 of Part 703 are assigned to all the ground waters of the State of New York, except those ground waters within Newtown Creek Drainage Basin in the Counties of Chemung and Schuyler to which the ground water classifications and standards were duly assigned on December 7, 1967.

Historical Note

Sec. added, filed Apr. 15, 1968 to be eff. Apr. 15, 1968.

APPENDIX C

DETAILED CRITERIA
RECOMMENDED WATER QUALITY STANDARDS
FOR
HACKENSACK MEADOWLANDS
WATER POLLUTION CONTROL SYSTEMS

JOHN J. KASSNER & CO., INC.
CONSULTING ENGINEERS

DETAILED CRITERIA

RECOMMENDED WATER QUALITY STANDARDS FOR HACKENSACK MEADOWLANDS WATER POLLUTION CONTROL SYSTEMS

RECREATIONAL WATERS

a. Standards

These surface waters shall be free of all floating debris, oil, scum and other material capable of settlement and formation of objectionable bottom deposits. The water shall not contain substances which will produce objectionable tastes and odors, show color or turbidity. The water shall not contain materials, substances or conditions which alone, or in combination with each other may produce undesirable aquatic life, or which will inhibit natural growth and reproduction of aquatic life.

This standard is established, in essence, to protect and enhance the esthetic qualities of the waters, to permit the use and enjoyment of all the surface waters, and to maintain and encourage the growth and propagation of useful fish, waterfowl and marine life.

b. Criteria

Water classified as Recreational Waters shall as a minimum, have the following characteristics:

No floating solids, oils, greases or slicks of any nature visible to the eye. Turbidity shall be such that a Secchi disk shall be fully visible at a depth of six feet below the water surface. Color shall be less than 80 standard color units based on potassium chloroplatinate. Odors shall not be noticeable and fish flesh shall not be tainted with either taste or odor. The pH shall be from 6.5 to 8.3, and the dissolved oxygen shall never fall below 4 ppm. The water temperature shall never rise above 86°F. Bacterial loading, as determined by multiple tube lactose fermentation or millipore filtration procedures, shall not exceed a geometric mean of 2000 colonies/100 ml during any 20 day period, and during the same time period, not more than 10% of the samples tested shall exceed 4000 colonies/100 ml.

In order to obtain this objective of water quality, effluent standards must be established and enforced. The discharges into the river must be treated to such a degree that they will be unable, even under the limited conditions of advective flow and tidal exchange from Newark Bay, to cause the water quality to fall below that outlined above.

The point at which a liquid flow or discharge enters into the river shall be termed the "mixing zone". The mixing zone shall extend radially from the point of discharge. The radius of the mixing zone shall be defined by the formula a/b x 500 yards, where 'a' is the flow of the effluent in MGD and 'b' is the normal tidal exchange in feet per minute measured midway between slack tides, and the 500 yards is an empirical distance. At the zonal borders the values of all discharges to the river shall conform to the standards of river quality.

The flow from any pipe discharging into the river shall meet the following minimal values:

B.O.D. not to exceed 40 mg/1 during any period of discharge.

pH shall not be less than 6.0 nor greater than 9.0.

Turbidity shall not exceed 100 standard units based on SiO_2.

Color shall not exceed 100 standard units, based on potassium chloroplatinate.

Thermal discharge shall not be greater than 100°F.

Nitrates shall not exceed 30 mg/1 and phosphates shall not exceed 30 mg/1.

Phenols shall be less than 0.5 mg/1.

Coliform organisms shall be less than 25,000 colonies/100 ml, based on most probable number (MPN) values.

Such items as heavy metals, phenolic compounds, toxic substances and sodium alkyl benzene sulfonate (ABS) shall be kept to as low a value as is consistent with current technological practice.

Carbon chloroform extract values used to test for herbicides and pesticides shall not exceed 1 mg/1.

PRIMARY CONTACT WATERS

a. Standards

These surface waters shall in all cases meet the requirements for Recreational Waters, except that a Secchi disk shall be visible at nine feet, color shall be less than 60 standard color units, D. O. shall never fall below 5 ppm and bacterial loadings shall not exceed a coliform count in excess of 400 colonies/100 ml in any 20 day period, and during the same time the coliform count may not exceed 1000 colonies/100 ml in 10% of the samples.

In order to achieve this water quality, all discharges into the river must be controlled and the values at the zonal borders shall conform to the standards of river quality.

b. Criteria

The flow from any pipe discharging into the river shall meet the following minimal values:

Conformance with requirements for Recreational Waters except that;

B. O. D. shall not exceed 25 mg/1 during any period of discharge.

Turbidity shall not exceed 80 standard units based in SiO_2.

Color shall not exceed 80 standard color units based on potassium chloroplatinate.

Phenols shall be less than 0. 3 mg/1.

Coliform organisms shall be less than 5000 colonies/100 ml. based on MPN values.

Since the problem of eutrophication is such a critical one, the values of nitrogen and phosphorous which are deemed critical factors should be kept as low as possible. Because present technological processes are not able to reduce the values of nitrates and phosphates below approximately 30 mg/1 in any conventional secondary treatment plant, this value is being retained. If technology develops better methods which permit a reduction of these values, then the values should be lowered to conform with current scientific knowledge.

HARVEST WATERS

a. Standards

These surface waters shall meet the requirements for Primary Contact Waters, except that turbidity shall be low, with a Secchi disk visible in 12 feet of water and the coliform count shall not exceed a median MPN value, in any series of samples, of 70 colonies/100 ml. In addition, no toxic or deleterious substances which will affect the reproduction and growth of shellfish, fin fish or waterfowl shall be permitted.

b. Criteria

In order to achieve this water quality, all discharges into the river must be controlled and the values at the zonal borders shall conform to the standards of river quality.

The attainment of this ultimate objective of water quality will require that tertiary treatment be provided for all industrial and domestic wastes and special treatment will be required for storm water and surface runoff.

The flow from any pipe discharging into the river shall meet the following minimal values:

Conformance with requirements for Primary Contact Waters except that;

B. O. D. shall not exceed 20 mg/1 during any period of discharge.

Turbidity shall not exceed 20 standard units.

Color shall not exceed 30 standard units.

Phenols, toxic or heavy metals and radioactive substances shall be virtually absent.

Coliform organisms shall be less than 240 colonies/ 100 ml, based on MPN values.

Unwanted aquatic growths shall be controlled through the minimal discharge of nitrates and phosphates. Based on present data these values of nitrates and phosphates shall be reduced to less than 2 mg/1.

APPENDIX D

EXISTING SEWERAGE FACILITIES

MAP ON FILE WITH

HACKENSACK MEADOWLANDS DEVELOPMENT COMMISSION

JOHN J. KASSNER & CO., INC.
CONSULTING ENGINEERS