FINAL
ENVIRONMENTAL IMPACT STATEMENT
FOR
NORTHWEST REGIONAL WASTEWATER FACILITIES

CITY OF HOUSTON

WPC-TEX-1020

OFFICE OF GRANTS COORDINATION, REGION VI
ENVIRONMENTAL PROTECTION AGENCY
DALLAS, TEXAS

JANUARY 1975

APPROVED BY

George J Putnicki

for ARTHUR W. BUSCH
REGIONAL ADMINISTRATOR

JANUARY 10, 1975

FINAL

ENVIRONMENTAL IMPACT STATEMENT

FOR

NORTHWEST REGIONAL WASTEWATER TREATMENT PLANT

CITY OF HOUSTON, TEXAS

WPC-TEX-1020

IMPACT STATEMENT NUMBER 7413

WATER DIVISION, REGION VI
ENVIRONMENTAL PROTECTION AGENCY
DALLAS, TEXAS

APPROVED BY

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JANUARY 10, 1975

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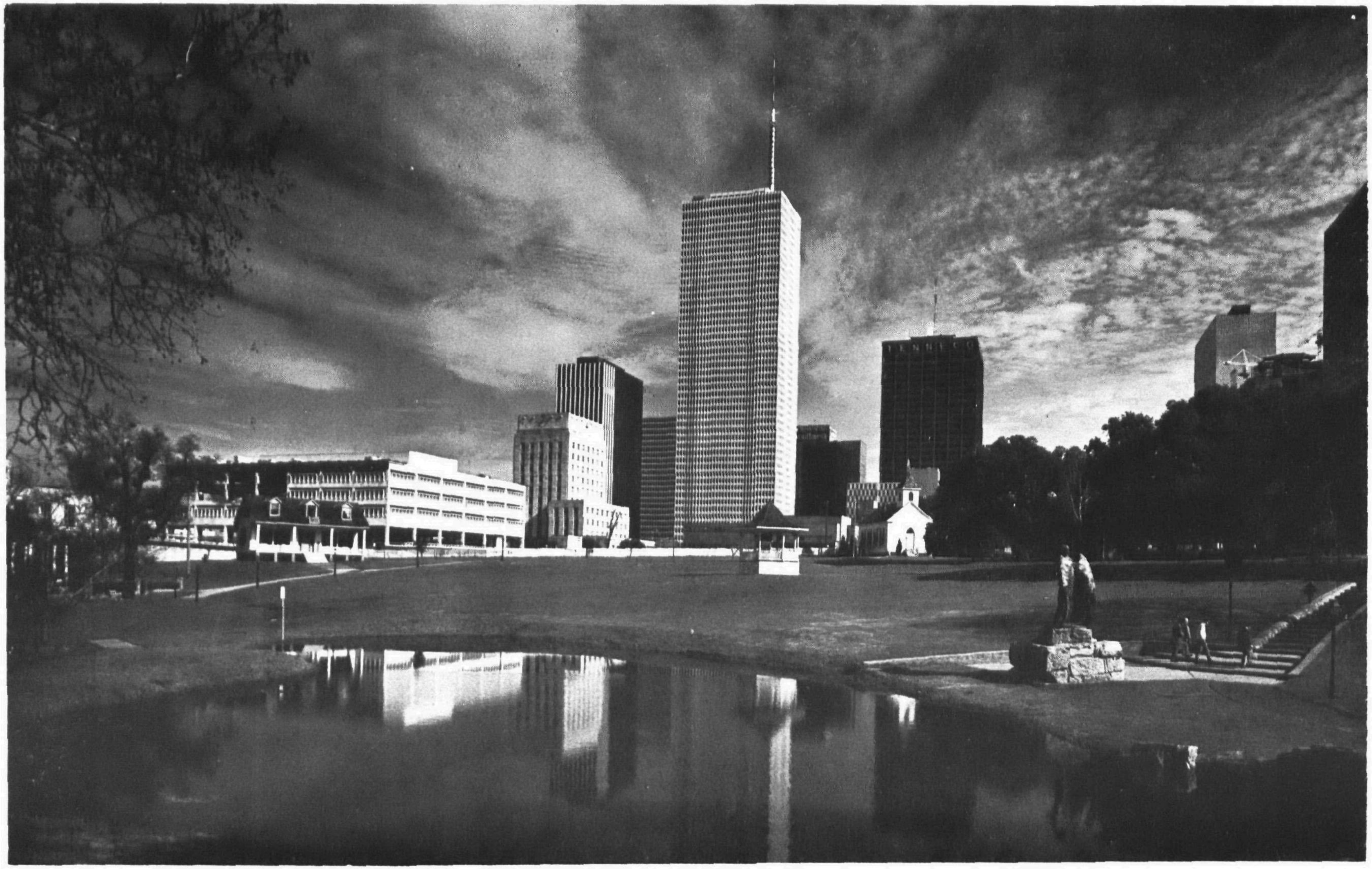
HOUSTON



SUMMARY

( ) Draft Impact Statement
(x) Final Impact Statement

Environmental Protection Agency
Region VI, Office of Grants Coordination
Dallas, Texas

1. Name of Action
   Administrative Action (X)
   Legislative Action ( )

2. The proposed action involves Federal grant assistance as authorized by the Federal Water Pollution Control Act Amendments of 1972 (Public Law 92-500).

The City of Houston has requested Federal funds in the amount of $4,594,912 to aid in its efforts to enlarge the wastewater treatment facilities at the Northwest Wastewater Treatment Facility Site. The expanded facility, located at Cole Creek and Randon Road has been designed to treat the wastewater generated in its service area through the year 1990. The service area is 18.6 square miles in area and has a current population of 47,000 persons. The 1990 population has been projected for 90,000 persons.

The proposed project calls for the expansion to a 12 Million Gallons per Day (mgd) treatment facility on the existing 4 mgd Northwest Facility Site. The enlarged plant will provide secondary biological treatment using the contact stabilization mode of the activated sludge treatment process. The additional capacity of 8.00 mgd will provide sufficient size to treat projected daily wastewater flows through the year 1990. The projected influent of 12 mgd will receive secondary treatment followed by chlorine disinfection prior to discharge into the Cole Creek approximately

1000' from its confluence with the White Oak Bayou.

Sludge from the facility will be conveyed through a combination force and gravity main to the Northside Regional Sludge Treatment Plant where it will be dewatered by vacuum-filtration at the plant and the fertilizer produced will be chemically conditioned and marketed to a Florida-based citrus production firm.

The total cost of the project is estimated at $6,126,549.

3. Summary of Environmental Impact and Adverse Environmental Effects

The proposed facilities are expected to reduce health hazards in the Northwest Treatment Plant's service area; enhance water quality in the Cole Creek, White Oak Bayou and Buffalo Bayou, and the Houston Ship Channel which represents the continuation of Buffalo Bayou; and aid in orderly physical development for the area to be served by this facility.

The minor adverse effects which cannot be avoided are those normally associated with the existence and operation of wastewater treatment facilities. The increased noise levels and possible occasional odors emanating from the facility will be kept at a minimum by employing an improved system of treatment process and efficient plant operation.

Some degree of disruption of the environment and inconvenience to citizens during construction is unavoidable but will be reduced in severity by proper construction scheduling and techniques.

The enlargement and operation of the proposed facility should cause no serious problems or adverse effects unless drastic unforeseen changes take place in the magnitude and character of anticipated future development. The adverse effects are expected to be minor compared to the beneficial effects of the proposed project.

4. Alternatives Considered

A number of alternatives including No Action Alternative have been considered both in the determination of plant location and in the evaluation of systems design with due consideration given to economic, social, technological and environmental factors. These alternatives are summarized below:

A. Non-Structural Alternatives

These include policy options available to the City of Houston for collection, treatment and disposal of wastewater and pollution control.

B. Structural Alternatives

Within the defined parameters of the non-structural alternatives, the structural alternatives were reviewed to determine:

a. Whether the service system should be centralized or decentralized.

b. Where the plant site should be located.

C. Treatment Subsystems Alternatives

A variety of options were evaluated for each subsystem in terms of:

a. Collection system
b. Treatment process
c. Disinfection
d. Effluent disposal
e. Sludge handling and disposal

D. No Action Alternative

The treatment system chosen for the proposed project located at the Cole Creek and Randon Road consists of biological treatment using the contact stabilization mode of treatment process, followed by disinfection of the effluent through chlorination with hypochlorite and discharge of the treated effluent into the Cole Creek. The chosen sludge handling and disposal system involves transporting sludge through a combination force and gravity main to the Northside Sludge Treatment Plant where the sludge will be chemically conditioned, vacuum filtered, flash-dried, and finally converted into fertilizer/soil conditioner for market absorption. The chosen system proved to be the best alternative when measured and tested against all economic, social, technological and environmental constraints.

5. List all Federal, State and Local Agencies from which Comments were sought

Federal Agencies

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6. The Draft Environmental Impact Statement was submitted to the Council on Environmental Quality in September, 1974. Submission of the Final Impact Statement has been scheduled for December, 1974.

CHAPTER I: INTRODUCTION

A. EPA AUTHORITY AND RESPONSIBILITY UNDER NEPA

B. PURPOSE AND SCOPE OF THIS REPORT

I. INTRODUCTION

The ever-increasing demand for housing, transportation, work places and public facilities created by a growing population has dominated the natural environment of our cities. While urbanization must continue, it is the obligation of this generation to preserve those environmental features which man cannot create. Policymakers at all levels of government and concerned citizens are facing the challenge of establishing a balance between the demands of urbanization and preservation and conservation of the natural environment.

The City of Houston shares this concern of environmental preservation with the rest of the nation and is trying to improve the quality of its environment through various public service programs.

One of Houston's critical problems is the collection and disposal of wastewater from areas of human settlement. The present sanitary sewer and treatment system is inadequate and allows the pollution of city waterways, which is hazardous to public health. Water quality is a well known problem for the Houston Ship Channel. Most of the waterways draining the City of Houston empty into the Ship Channel. Effluent discharge from the various sewage treatment plants in the Houston area are a major source of water flow in these water courses during dry weather periods. Improved water quality in these waterways will better the water quality of the Houston Ship Channel. Modernization and improvement of the city's sanitary sewer system can check the pollution problem of the Houston Ship Channel and its major tributaries and also improve Houston's urban environment by eliminating a public health hazard.

The water carrier system of waste removal outlined in this report is the most economically feasible and environmentally desirable solution to this critical water quality problem for an area in the northwest section of Houston. The objective of this project, and indeed the entire sewage treatment system of Houston, is to improve the public health and facilitate the overall enhancement of water quality within the Houston Metropolitan Area. This is a long established goal of Houston's people and its government. The proposed project represents a step toward the fulfillment of that goal in an area where a serious health problem exists at the present time.

The estimated cost of the proposed Northwest Sewage Treatment Plant is $6,126,549. The City of Houston has applied for a Federal grant of $4,594,912 to aid in the enlargement and expansion of the project.

A. EPA AUTHORITY AND RESPONSIBILITY UNDER NEPA

Under Title II of the Federal Water Pollution Control Act, Amendment of 1972, Public Law 92-500, the Environmental Protection Agency is given authority to fund 75% of the cost for construction of sewage treatment facilities in order to comply with Section 301 of the Act.

Section 102(c) of the National Environmental Policy Act of 1969, Public Law 91-190, charges all agencies of the Federal government, when funding a project, in part or in entirety, that will have a significant effect on the environment, to prepare a detailed statement taking into consideration:

1. The environmental impact of the proposed action;
2. Any adverse environmental effects which cannot be avoided should the proposal be implemented;
3. Alternatives to the proposed action;
4. The relationship between local short-term effects on man's environment and the maintenance and enhancement of long-term productivity; and
5. Any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented.

B. PURPOSE AND SCOPE OF THIS REPORT

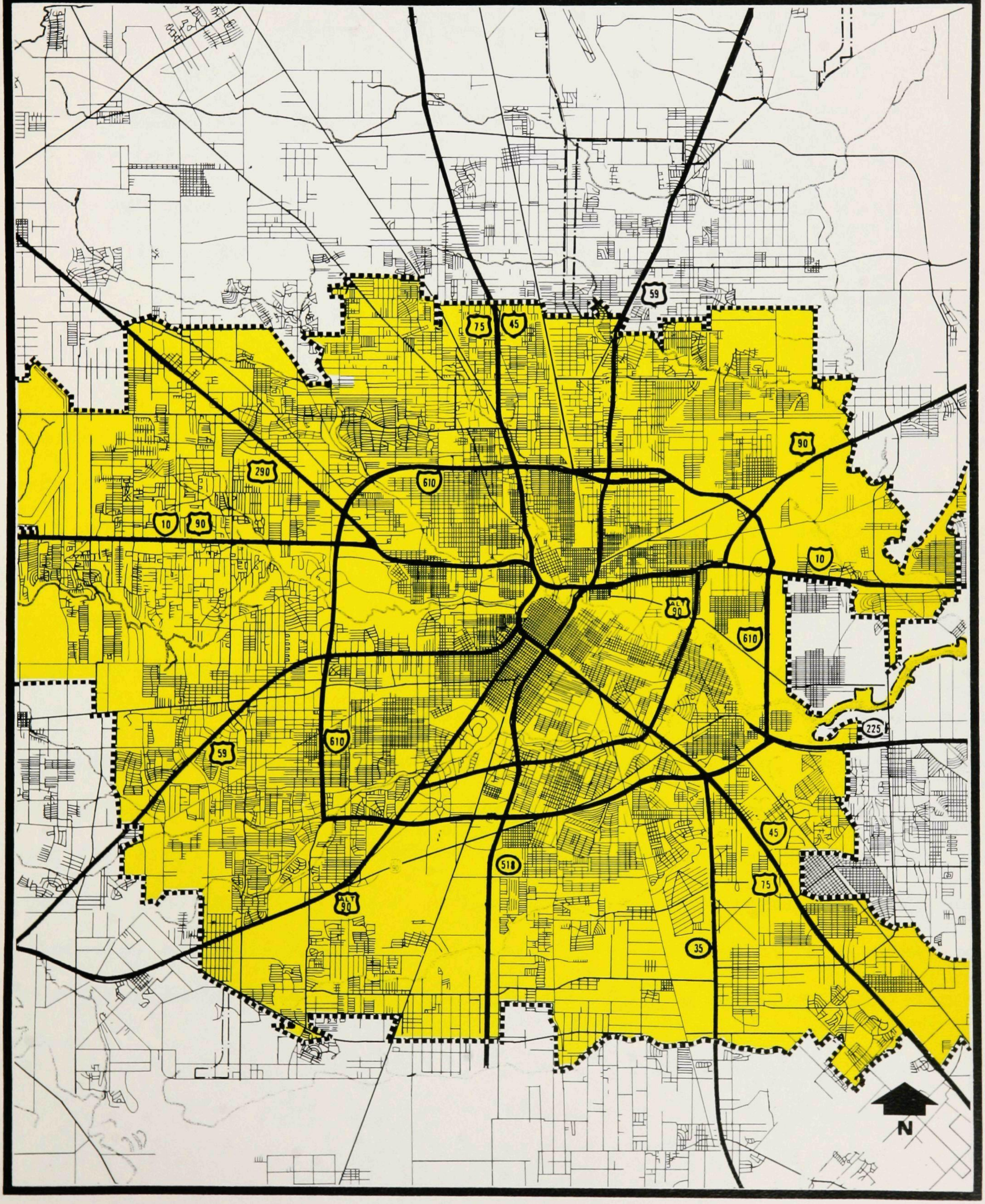
This report is a Final Environmental Impact Statement based on the environmental assessment submitted by the City of Houston, attendant to construction of an enlarged Northwest Regional Sewage Treatment Plant with a 1990 projected capacity of 12 mgd. Procedures set forth by the U.S. Environmental Protection Agency have guided the preparation of this Final Environmental Impact Statement. This report identifies the impact of the proposed action with respect to both adverse and beneficial terms and suggests how the adverse effects can be minimized.

CHAPTER II: BACKGROUND PERSPECTIVES

A. PERSPECTIVE: CITY OF HOUSTON, TEXAS

B. PROPOSED ACTION

HOUSTON, TEXAS



II. BACKGROUND PERSPECTIVES

A. PERSPECTIVE: THE CITY OF HOUSTON, TEXAS

The City of Houston grew from a log cabin village laid out by the Allen brothers in the 1830's to the nation's sixth largest city in 1970, with a population of 1,233,000 persons, encompassing a geographic territory of 506 square miles. Over 40% of the land inside the city limits is still available for urban development. Continuation of current trends of economic growth, transportation, recreation and entertainment is expected to make Houston a corporate city of nearly two and a half million persons by the year 1990.

Houston is the industrial, commercial and cultural capital of the Southwest United States. To continue its dominant position, the people of Houston and its government must face the challenge of developing and maintaining those urban facilities which are essential to assure a high-quality environment for all parts of the city. The provision of an adequate system of public health services, including sanitary sewage, must rank high in the order of development priorities for the city. This task must be carried out in a manner such that the natural environment will not fall prey to the structures of steel and concrete, and such programs must promote the quality of air, water and the man-made and biological environment of the Houston Metropolitan Area.

1. Existing Wastewater Treatment System

In response to the population increase and business and industrial development, the City of Houston has built a sanitary system over the years that consists of 42 wastewater treatment plants, two major sludge disposal plants, 179 pump stations and approximately 3600 miles of wastewater collection and conveyance lines. Much of the system was constructed by the city itself. The remainder was acquired through purchase or annexation of water district sewer systems.

The system has been characterized by piece-meal planning and construction of treatment plant facilities. The consequence of this practice has lead to a degree of decentralization that is unparalleled for an urban conglomerate the size of Houston. On the average, one treatment plant in Houston serves about 30,000 persons. The size of the plants varies from 0.5 mgd for treatment plants such as Easthaven and Clinton Park, to 100 mgd for the Northside Plant. This compares with one treatment plant that serves the entire City of Fort Worth and its suburbs, with a population of 800,000 persons. The City of Dallas is only served by three treatment plants, each serving about 300,000 persons.

Despite the highly decentralized form of Houston's wastewater treatment system, it processed an average volume of just over 172 mgd of wastewater in 1973. During the same year the city's two major sludge disposal plants produced approximately 120 tons of dried soil conditioner/fertilizer per day.

Table II-1 includes data for each treatment plant capacity, quality of influent sewage and effluent in terms of bio-chemical oxygen demand, suspended solids and chlorine residual. Many of these existing plants are beset with problems of insufficient capacity, treatment standards that do not meet established water quality criteria and odors associated with sludge disposal systems. A more elaborate description of each plant in terms of system components is attached in Appendix A. The geographic location of existing plants is presented in Figure II-1.

2. Proposed Treatment System for Houston

To address the problems of wastewater treatment and disposal associated with the current system, Houston has adopted a comprehensive policy of regionalization of its wastewater treatment system. The City of Houston Wastewater Management Plan developed in June of this year recommends the abandonment of a number of small plants in favor of regional treatment plants, which together will have an enlarged capacity of over 300 mgd, capable of serving a population of approximately 3 million persons. The city's Capital Improvements Program through 1977 provides for the regionalization of most of these plants. In addition to the complete abandonment of some plants, sewage from several others will be diverted to the regional plants for treatment and disposal. The proposed system also includes the development of four sludge treatment facilities designed to serve the sludge treatment need of the entire city through the year 1990. Figure II-2 shows the proposed Regionalization Sewage Treatment System for the City of Houston. The grouping of the various sewage treatment plants under each regional sludge disposal plant, the current status of all treatment plants, the abandonment and diversion summar-

TABLE II-1

INFLUENT AND EFFLUENT QUALITY OF HOUSTON'S EXISTING TREATMENT PLANTS

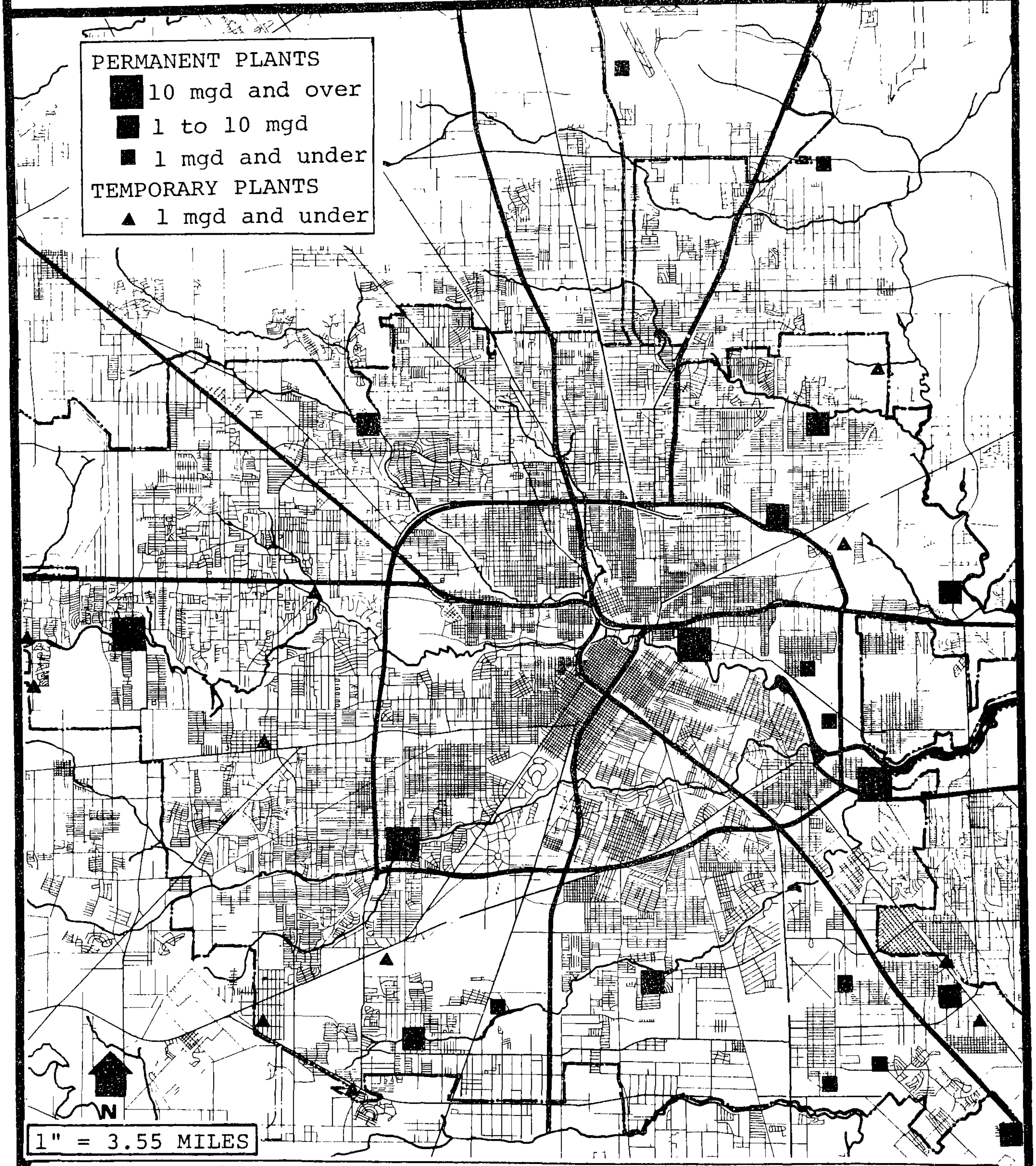
Sewage Treatment Plant	Suspended Solids mg/l		5-Day BOD mg/l		Residual Chlorine mg/l Effluent	Treated Flow Yearly Average mgd	Dry Weather Flow* mgd
	Raw	Effluent	Raw	Effluent			
Northside	385	141	304	79	0.7	89.69	100.5
Sims Bayou	243	61	181	23	0.6	39.64	43.3
Almeda Sims	232	27	118	9	1.3	0.819	0.42
Chadwick Manor		24		6	2.0	0.040	(E)
Chocolate Bayou	156	100	124	36	1.2	3.305	2.67
Clinton Park	134	80	145	35	1.9	0.754	0.31
CIWA	-	-	-	-	-	-	-
Eastex Oaks		49		24	2.0	0.183	0.16
Easthaven	197	48	175	25	1.3	0.476	0.25
Fontaine Place		45		39	1.9	0.275	(E)
FWSD 17	211	35	136	15	1.9	0.7	(E)
FWSD 23	118	45	99	12	1.4	2.154	1.48
FWSD 34	107	18	166	13	1.7	0.631	0.62
Gulf Meadows	133	8	113	3	2.1	0.999	0.75
Gulf Palms		49		25	1.3	0.283	0.23
Gulfway Terrace		39		25	1.3	0.231	0.14
Homestead	194	55	96	16	1.7	1.435	1.13
Intercontinental Airport	446	42	267	23	1.6	0.311	
Longwoods		25		17	1.7	0.075	(E)
Mayfair Park	161	38	148	15	1.7	0.39	0.18
Northeast	188	18	122	7	2.0	1.567	0.87
Northwest	407	24	136	7	1.5	6.135	
Red Gulley		34		9	2.0	0.367	0.13

TABLE II-1
(Con't)

Sewage Treatment Plant	Suspended Solids mg/l		5-Day BOD mg/l		Residual Chlorine mg/l Effluent	Treated Flow Yearly Average mgd	Dry Weather Flow* mgd
	Raw	Effluent	Raw	Effluent			
Sagemont	227	8	166	4	4.1	1.548	1.60
Sherwood Forest	-	-	-	-	-	-	-
Southeast	121	53	41	10	2.5	0.134	0.19
Southwest	188	8	147	4	1.7	25.37	20.9
Turkey Creek		81		20	1.6	0.263	0.14
WCID 20		116		52	2.0	0.244	0.097
WCID 32	169	77	146	26	2.0	0.860	0.69
WCID 34		38		25	1.8	0.300	(E)
WCID 39		49		43	1.9	0.500	(E)
WCID 42		78		55	1.9	0.645	0.33
WCID 44-1		85		52	1.4	0.444	
WCID 44-3		48		35	1.4	0.606	0.91
WCID 47	158	8	161	6	1.5	1.660	
WCID 51	125	14	136	8	1.3	2.441	(E)1.65
WCID 53	250	64	222	58	2.1	0.449	
WCID 62	140	41	155	35	2.3	0.196	
WCID 73		34		7	2.1	0.254	1.05
WCID 81	213	66	209	20	2.1	0.240	
WCID 82		26		4	5.0	0.034	
WCID 95		51		16	1.6	0.372	0.40
West District	171	53	170	19	1.3	11.4	11.0
Chatwood		66		78	1.5	0.250	(E) 3 mo.
Forest West		55		16	1.6	0.235	(E) 8 mo.
Lake Forest		36		18	2.2	0.180	(E) 3 mo.

FIGURE II-1

EXISTING TREATMENT SYSTEM FOR HOUSTON



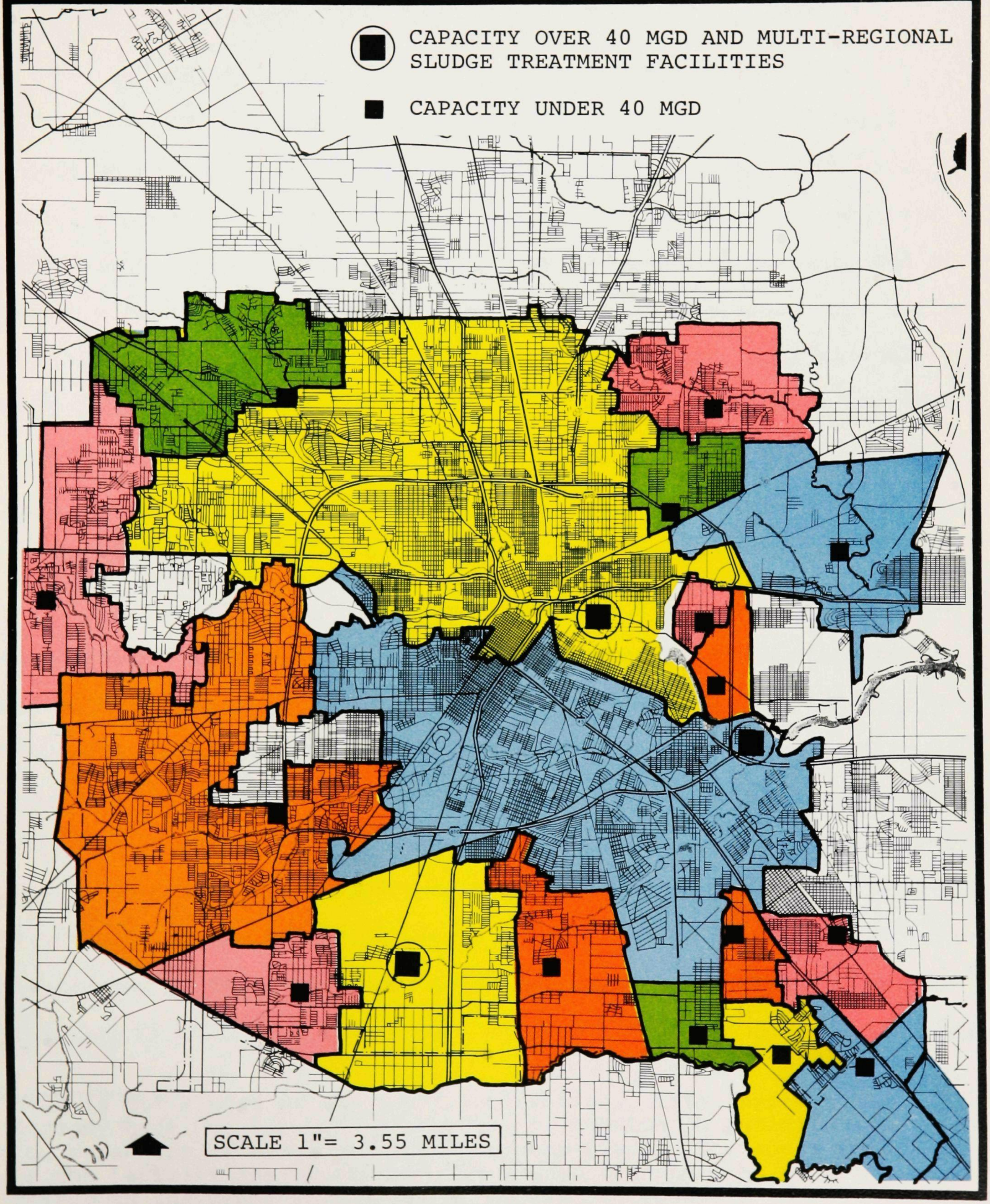
Note: Some of the temporary plants do not appear on this map since they have recently been phased out or are in the process of being phased out.

ies, the proposed expansion schedule for regional plants, and other related data are shown in Appendix B.

B. PROPOSED ACTION

The proposed project has been designed to meet the current and projected wastewater facilities need of the 11,900 acres in the Northwest Regional Plant Service Area. Much of the sewage currently generated in the service area does not receive adequate treatment and often does not meet the existing discharge requirements. The sludge currently generated in this plant is transported to the Northside Regional Sludge Treatment Plant for treatment and final disposal. Until recently, the inadequacy of the sludge line sending sludge to Northside used to result in periodic failures causing public health problems for the area. The problem has been corrected by constructing a new sludge line for transporting sludge to the Northside Multi-regional Sludge Treatment Plant.

FIGURE II-2 PROPOSED REGIONALIZATION PLAN FOR HOUSTON'S WASTEWATER TREATMENT SYSTEM



1. Project Elements

To address the problem associated with the existing plant, the City of Houston proposes to construct the following:

a. Northwest Regional Wastewater Treatment Plant

The proposed plant will provide secondary biological treatment by utilizing the contact stabilization mode of activated sludge process to ensure adequate treatment of influent sewage. The 1990 design capacity of 12 mgd will meet the sewage treatment need of the service area's projected population of 90,000 persons. The effluent from the plant will be discharged into the Cole Creek approximately 1000 feet from its confluence with the White Oak Bayou. The service area of the proposed project is shown in Figure II-3.

b. Sludge Line from the Proposed Plant to the Northside Regional Sludge Plant *

A 68,800 feet force main and gravity combination sludge line will be used to transport the sludge from the Northwest Plant to the Northside Regional Plant for sludge handling and disposal to produce soil conditioner/fertilizer for sale to a Florida-based citrus firm. An estimated 3800 feet of this line is an 8-inch force main connected to a gravity line varying in diameter from 24 to 48 inches. The gravity line covers a distance of 10.2 miles, or 65,000 feet, before termination at the Northside Sludge Plant. A lift station has been constructed at the 11th Street location. (See Figure II-3.) The proposed use of this sludge line will eliminate the need for on-site treat-

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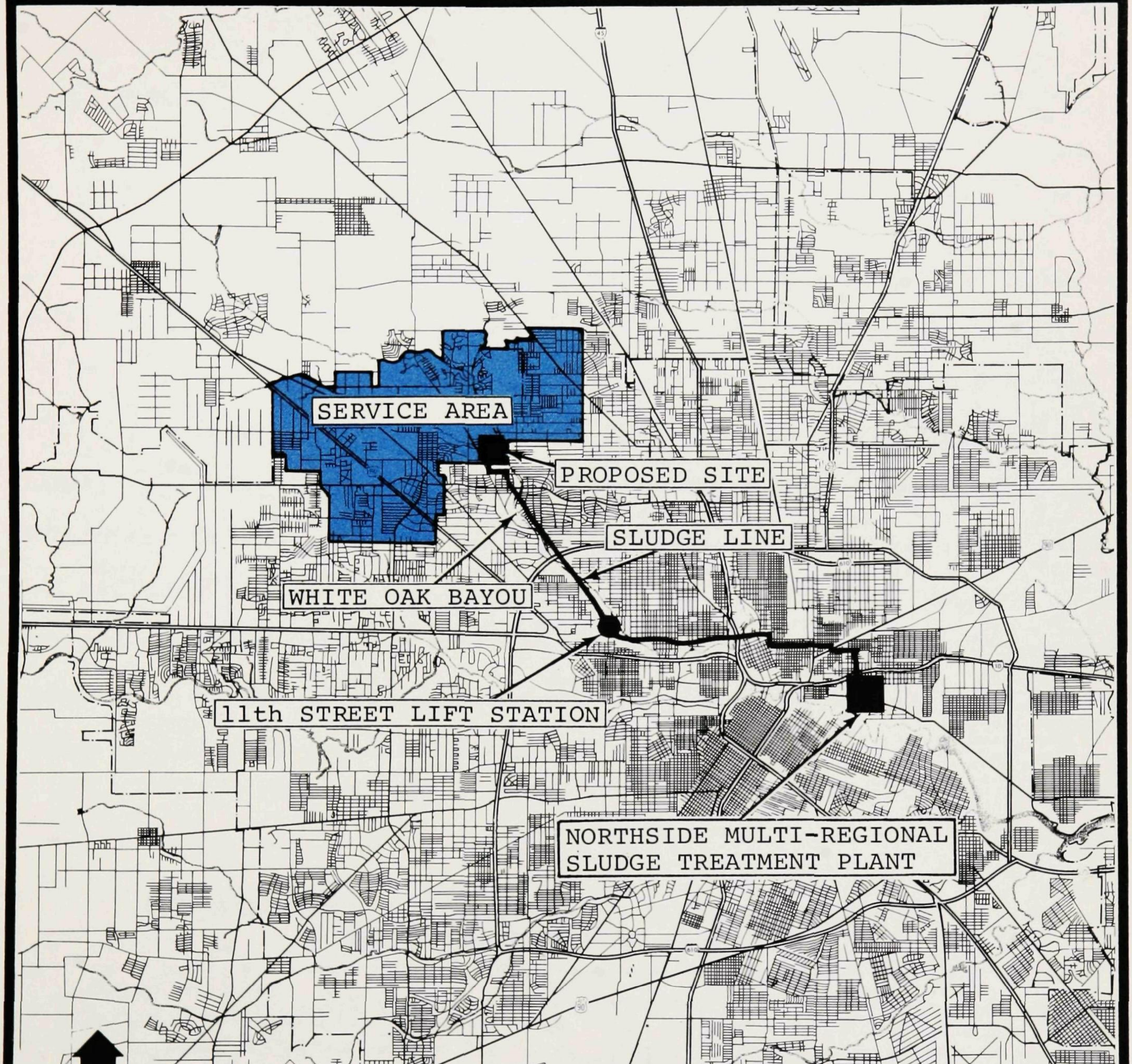
*This is not a part of the grant application. This facility has already been constructed by the City of Houston in anticipation of the expansion of the Northwest Treatment Plant. The construction of the facility has eliminated the sludge transporting problem stated in the Draft Environmental Impact Statement.

FIGURE II-3

PROPOSED PROJECT LOCATION AND SERVICE AREA



ment of sludge at the Northwest Plant, alleviating the air pollution, odor and related problems in the plant vicinity. However, this will exert some adverse effect on the surrounding environment of the Northside Plant. This is discussed in more detail in Chapter VI, Page 106.

2. Financial Status

The total cost of the project covered by grant application is estimated at $6,126,549, as shown in Table II-2. The funds required to finance the local share of the project have been acquired by the City of Houston through the sale of bonds by the Gulf Coast Waste Disposal Authority in November, 1973, under the terms of a contract between the City of Houston and that Authority. A copy of this contract is attached in Appendix C. In April, 1972, the City of Houston received a permit from the Texas Water Quality Board for the construction of a 12 mgd treatment plant at the proposed location. A copy of this permit is attached in Appendix D.

TABLE II-2

ESTIMATED COST OF IMPROVEMENTS: NORTHWEST REGIONAL WASTEWATER TREATMENT PLANT

Construction	$5,011,475
Engineering and Contingencnies	$1,115,074
Land, Structures, Right-of-way	$ -0-
PROJECT TOTAL	$6,126,549
Eligible Project-Grant Amount	$6,126,549
Grant Amount	$4,594,912
Local Matching Share	$1,531,637
Non-Recoverable (prior expenditures from private sources)	$ -0-

SOURCE: Turner, Collie and Braden, Inc., City of Houston, Department of Public Works, Sanitary Sewer Division, and Dannenbaum Engineering Corporation, Consulting Engineers

3. Site Plan

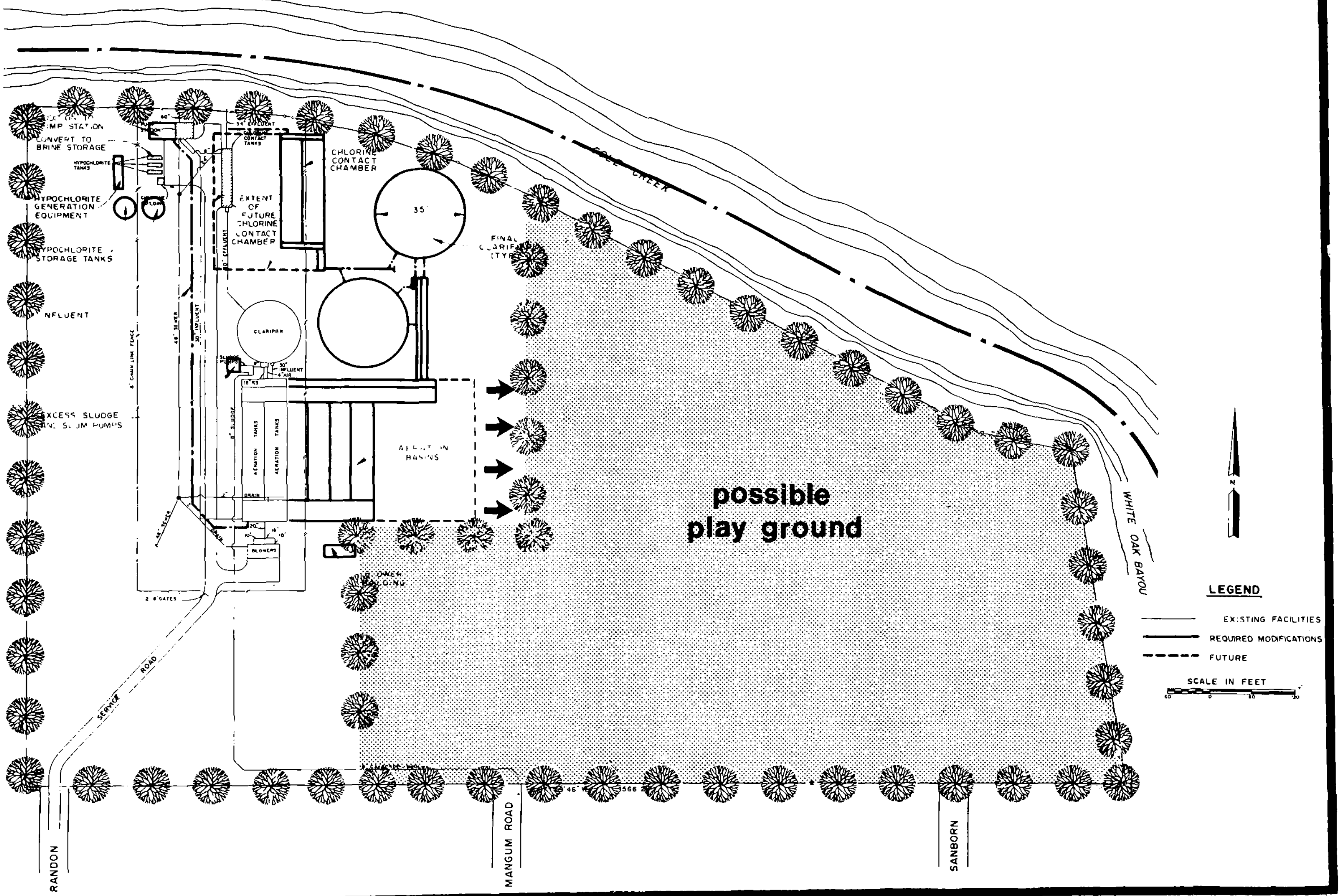
A total of 27 acres of land, including the existing treatment plant, is within the ownership of the City of Houston. Of this, only three acres are currently utilized for the operation of the existing plant. The expansion of the plant from its present 4 mgd to 12 mgd will require the addition of four extra aeration basins, two final clarifiers of 135 feet diameter, two chlorine contact chambers, two hypochlorite storage tanks, one hypochlorite generation set of equipment, expansion of the existing pump station and a new tower building. These activities will require another three to four acres of land for their use and operation. Even if the 12 mgd facility is further expanded to a 20 mgd facility after 1990, the total site requirement for the plant will still not exceed 12 or 13 acres. That would leave about 14 acres for open space and landscaped area. That much land will be adequate for the development of a neighborhood park.

Availability of this additional open space on the site gives the city an opportunity to make its Northwest Treatment Plant site more than just a site for treating wastewater liquids. Land around the plant site is remarkably suitable for creating a superior environment. There is an abundance of vegetation and tall trees, and Cole Creek flows through the area. It is naturally suited for park development. The need for a neighborhood playground utilizing the balance of the site area is accentuated by a residential subdivision across Cole Creek on the north and the Acres-Home area northeast of the site across the White Oak Bayou. Perhaps pedestrian bridges could be built over these streams, connecting these residential sections with the playground, which could be developed on the eastern half of the plant site.

The residential area to the immediate south is populated primarily by non-white persons, and there are no nearby neighborhood parks for this population. The city is in an ideal position to devote part of the plant site to such neighborhood recreation activities as tennis courts, basketball courts, baseball diamonds and related facilities for use by the people living north, south and east of the treatment plant. Since the proposed system does not call for sludge treatment at this site, the operation of the plant will be virtually odorless, making it entirely possible to develop a neighborhood park adjacent to the site. The proposed plant site thus can be a multi-functional facility by treating sewage and also providing neighborhood recreation for nearby residents. With appropriate landscape design, a park and treatment plant can exist side by side. (See Figure II-4.)

FIGURE II-4

SITE PLAN FOR THE NORTHWEST REGIONAL TREATMENT PLANT



CHAPTER III: SOCIAL AND ENVIRONMENTAL SETTING

NATURAL ENVIRONMENT

A. SURFACE AND SUBSURFACE SETTING

B. CLIMATIC AND ATMOSPHERIC CONDITIONS

C. BIOLOGICAL ENVIRONMENT

MAN-MADE ENVIRONMENT

D. HISTORICAL AND CULTURAL ENVIRONMENT

E. SOCIAL AND ECONOMIC ENVIRONMENT

F. LAND USE AND TRANSPORTATION SYSTEMS

III. SOCIAL AND ENVIRONMENTAL SETTING

The social and environmental setting as identified in this chapter is discussed in two parts: the natural environment and the man-made environment. The natural environment includes the physical features, their conditions and modifications from urban development. This includes surface and subsurface settings, climate and atmospheric conditions and biological environment. The man-made environment includes man's modifications of natural features in development of living, working, moving and recreation environments. This is discussed in terms of historical and cultural environment, social and economic environment and land use, transportation and related systems.

NATURAL ENVIRONMENT

A. SURFACE AND SUBSURFACE SETTING

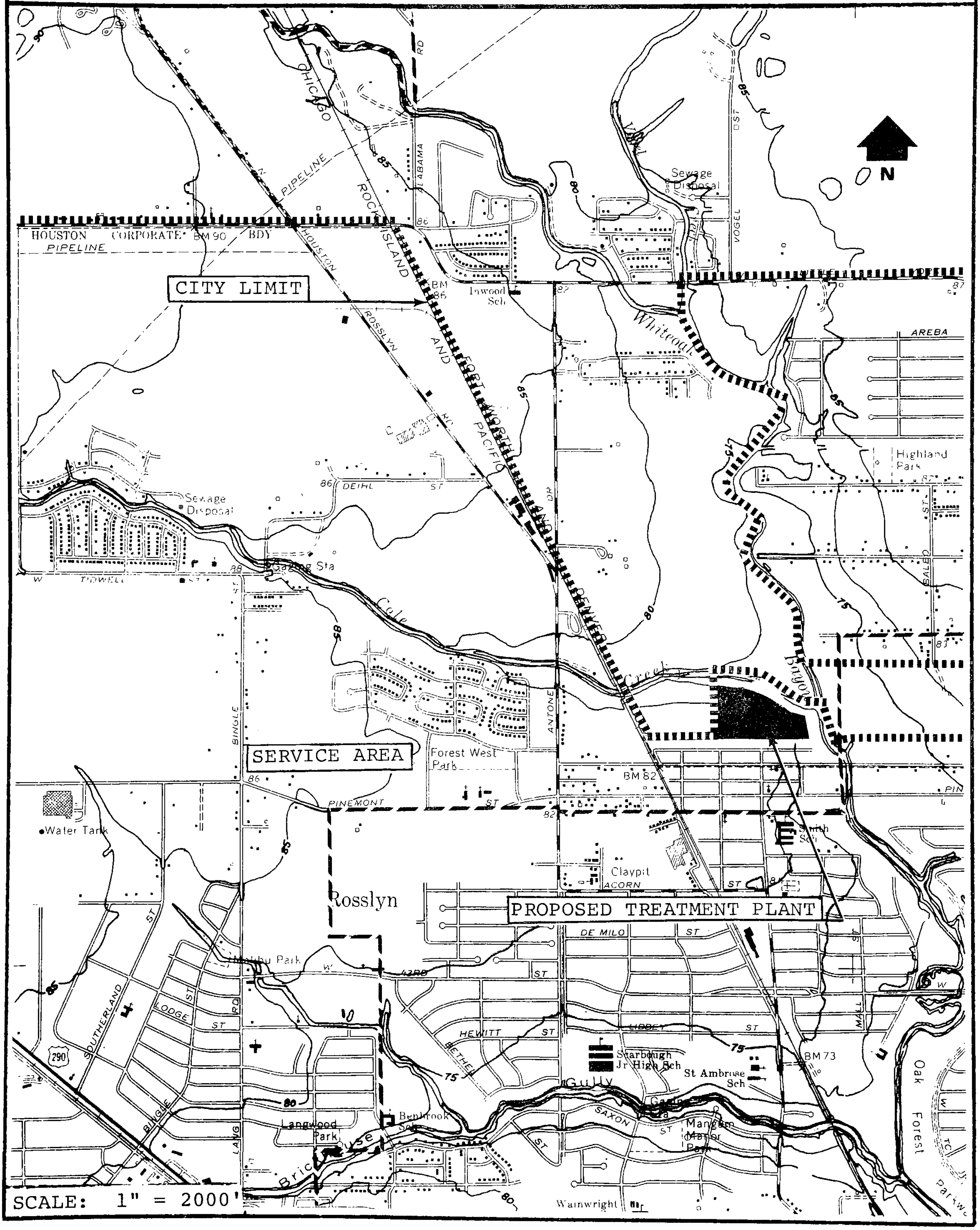
1. Topography

The City of Houston and its environs have been built on a gently sloping part of the Texas Coastal Plain. The elevation of the area varies only 65 feet. The low point is around 25′ above the mean sea level in the east and southeast, while the high point is about 90 feet in the northwestern part of Houston. The broad prairie presents an undulating pattern of long and gentle swells and depressions, ascending from the southern part of the city to Spring Creek near the northern part of the city. In the past the gentle slope allowed easy drainage of the undeveloped prairie land, but with the unprecedented urbanization which Houston experienced in the last 50 years, drainage is becoming increasingly difficult since much of the open land is rapidly being covered by concrete, asphalt, buildings and other man-made structures. Houston has no extreme topographic features such as mountains or valleys.

The service area of the proposed project lies in the Texas Coastal Prairies, which extend westward along the Gulf Coast, reaching inland 30 to 60 miles. The topography of the service area is one of very low relief with slopes in the area being generally less than 1% with the exception of the banks of Cole Creek and White Oak Bayou where, along the channels, the slopes exceed 25%. The elevation for the service area is between 45 feet to 90 feet above mean sea level. The topographic map included as Figure III-1 shows the topographic relief of the area. Low relief and slopes make runoff and internal drainage difficult and expensive.

The topographic features characterizing the service area have serious ramifications concerning the distribution and intensity of future land use development. Since about 50% of the service area is still vacant and available for urban development, the city can avoid some mistakes that have been made in the past. While living and working space must be provided for the people, this can be done through such land use policies as will prevent the continuation of low density development. Efforts should be made to concentrate land use in appropriate locations, permitting as much land to remain open as possible. This arrangement will ease the drainage of the area during periods of heavy rainfall, reducing costs for public works, engineering and

FIGURE III-1
TOPOGRAPHY OF PROJECT VICINITY



drainage projects. A very important by-product of such policies will be the preservation of the natural environment, and at the same time will allow development of open space with minimum of public funds.

2. Geology

Sand, gravel, silt and clay deposited along inland waterways or built up as deltaic, shoreline or lagoonal deposits along the coast are the dominant geologic features of the Houston area. The subsurface is mineral rich, containing sulphur, petroleum, gas and salt deposits. In addition, the surface deposits provide gypsum, limestone from shells, sand, gravel and brick clays.

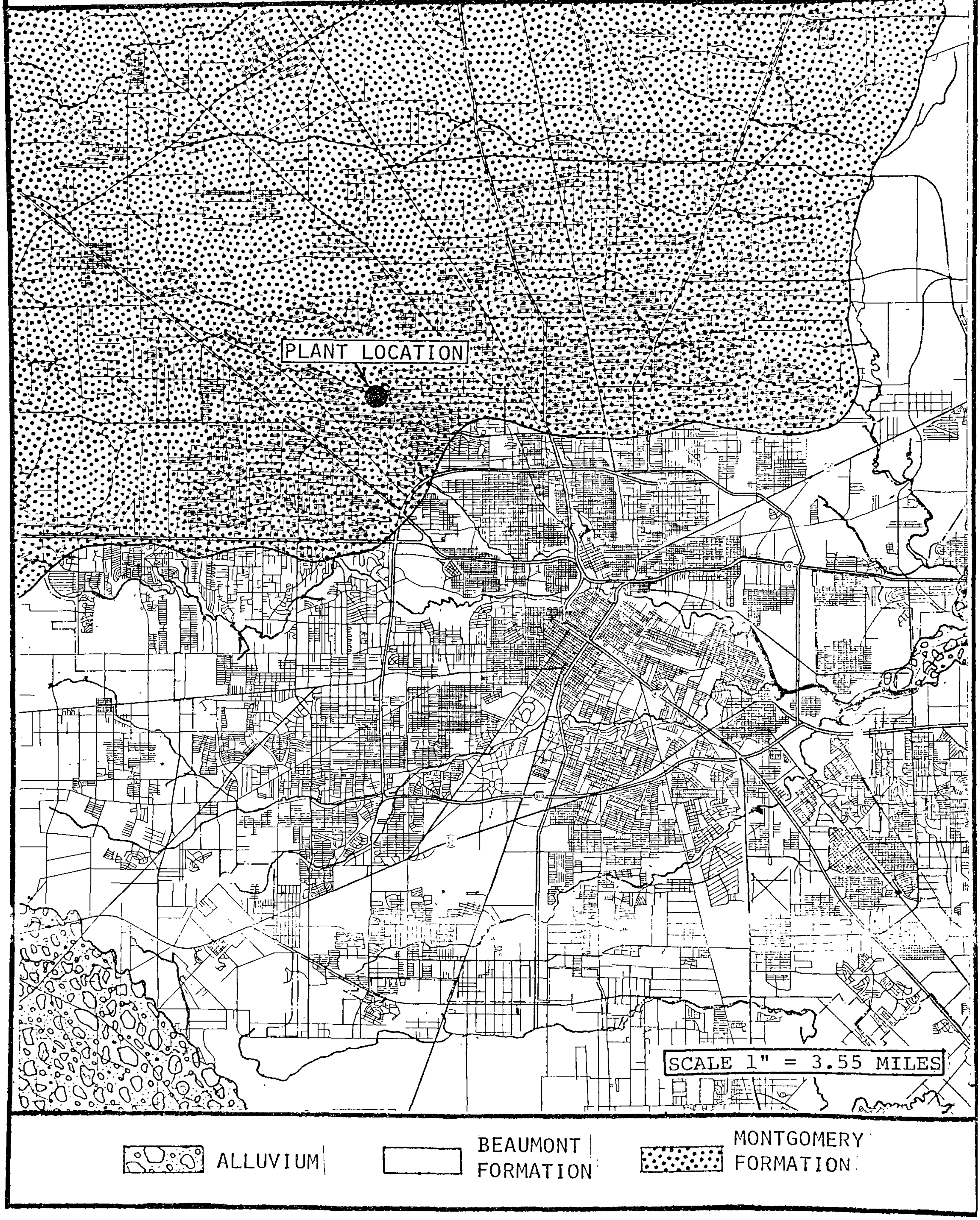
Most of the service area of the proposed project is underlaid by the Montgomery Formation, as shown in the Geologic Atlas of Texas, Houston Sheet (1968). The Montgomery or Lissie Formation, as previously mapped, is a fluviatile deposit. The makeup of this unit varies from granule pebble sized gravels to sand, silt and clay sized particles. These sediments were deposited by a Pleistocene river system and the unit tends to be coarser to the north. Figure III-2 is a geologic map of the service area of the proposed project as taken from the Geologic Atlas of Texas, Houston Sheet (1968).

3. Soils

There are two detailed soil maps available for Harris County. The oldest of these was prepared by the U.S. Department of Agriculture in 1922. More recently, the Soil Conservation Service of the U.S. Department of Agriculture has completed a new soil map for Harris County. A portion of this map, taken from the aerial photos used to

FIGURE III-2

GEOLOGICAL FORMATIONS FOR HOUSTON AREA



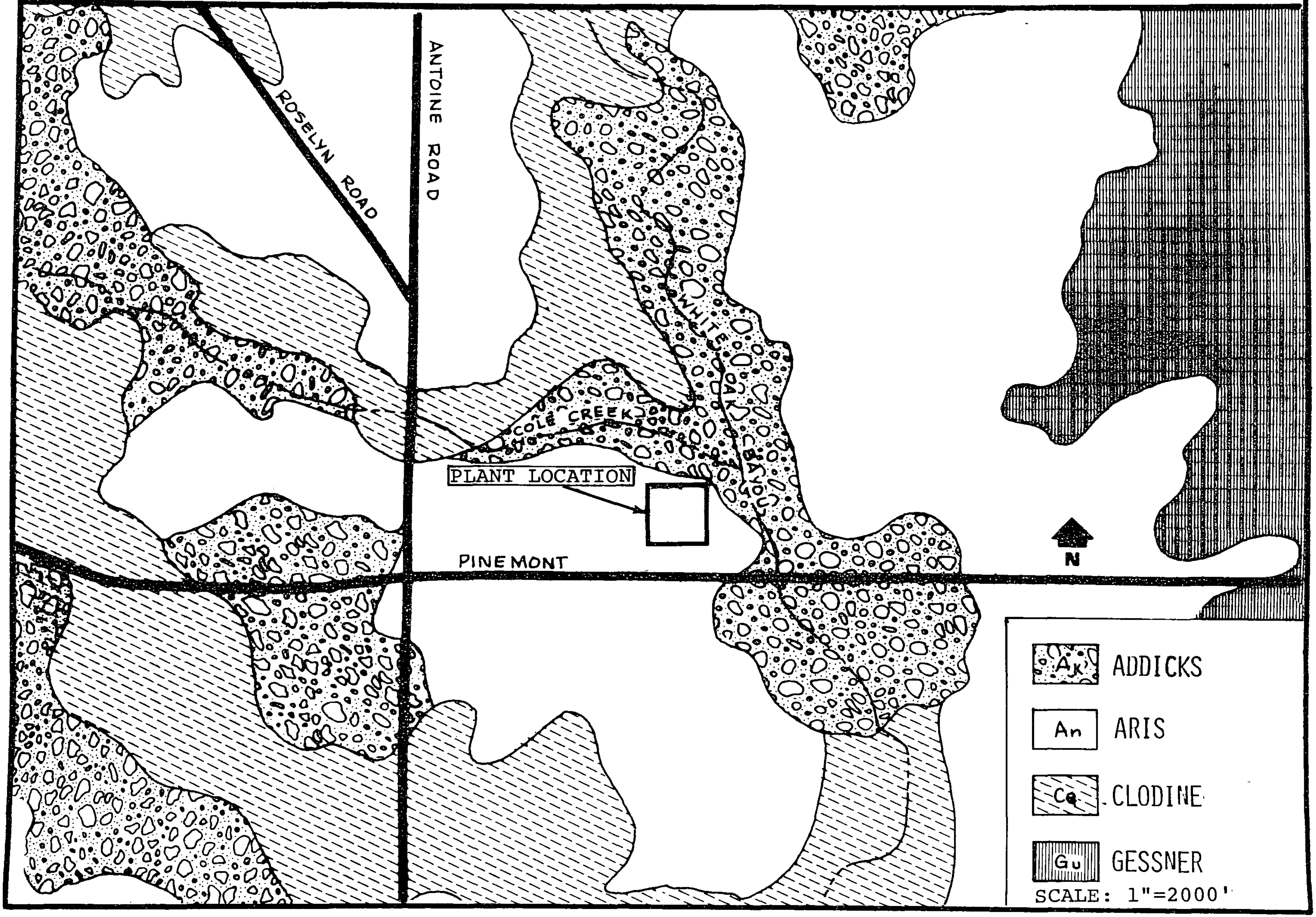
delineate the various soil series, is included as Figure III-3 of this report. It shows the four soil series that occur in the source area of the proposed project. Soil series descriptions and interpretations for these four series are presented in Appendix.

More than 50 specific types of soil are found in the Houston area. They are mostly clay, sandy loam and loam types. Clay types predominate in the area south of Buffalo Bayou, making the soil in this area dark, blocky, and hard when dry except for a thin granular surface layer a few inches thick and very high in clay content. On the margins of the prairie, especially where there are small clusters of pine trees, the soils tend to have a grayish, loamy surface with either blocky, clayey, very slowly permeable soils or loamy moderately permeable subsoils. In the bottomlands bordering the streams, creeks and bayous, deep grayish alluvial soil, some being mottled with other colors, are deposited in narrow flood plains with timber immediately adjacent to the water course. Houston's soils generally have poor drainage characteristics. They tend to hold water and swell during periods of heavy rainfall.

In the service area of the proposed project, the Beaumont and Montgomery formation soils predominate. They are composed mostly of clay, silt and sand. They support scattered grasses, weeks and small amounts of timber. The clay is heavy, black, and alluvial type, having low permeability, which virtually eliminates septic tanks as a method of wastewater treatment since the soil cannot satisfactorily absorb wastewater effluent. Their fine-grained texture and the high plastic, montmorillonitic clay contents make for high water holding capacity, high plasticity, shrink-swell potential and compressibility. These characteristics represent restrictions to heavy construction, road building

DETAILED SOILS MAP FOR NORTHWEST HARRIS COUNTY

FIGURE III-3



and other intense structural construction unless proper stabilization and adequate engineering precautions are taken before such construction.

4. Hydrology

a. Aquifer Systems

The Texas Water Development Board Report 178 (1974) lists three major aquifer systems in Harris County: the Chicot, which ranges in depth from 50 to 500 feet; the Evangeline, which ranges in depth from 500 to 1400 feet; and the Jasper, which varies in depth from 2000 to 2800 feet. These aquifers are located in the Lissie, Willis, Goliad and Lagart Formations, in order of increasing depth.

The recharge area for all these aquifer systems lies to the north of Harris County. Water quality is quite good, and the aquifers produce the major part of the water for residents of the Houston area. Detailed information on the aquifer system for Harris County can be found in the TWDB Report 178, Volume I, II and III, which describes well logs for various wells, the records of wells and chemical analysis of well water. Figure III-4 is a coutour map showing the depth to the base of the fresh to slightly saline water sands in the Harris County area. Figure III-5 is an Isopach (thickness) map for the fresh water sands in the same area. Figure III-6 shows the location of water wells in Harris County.

The continued use of water from underground sources in Houston bears major significance on the environmental problem of the city and its environs, including the Northwest Treatment Plant's service area.

FIGURE III-4
BASE OF THE FRESH TO SLIGHTLY SALINE WATER SANDS IN
SUBREGION II OF THE GULF COAST REGION

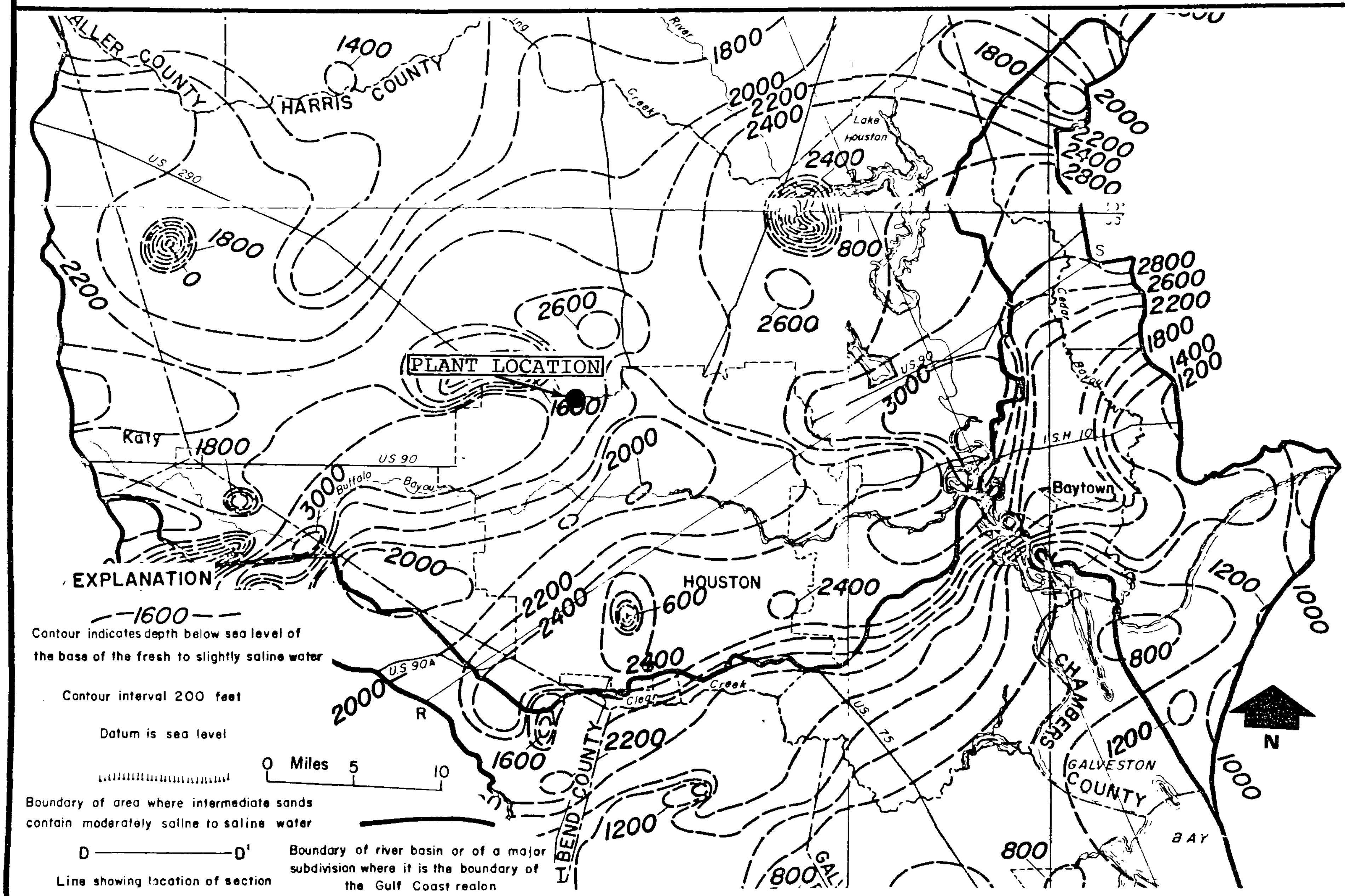


FIGURE III-5

ISOPACHOUS MAP OF THE FRESH TO SLIGHTLY SALINE WATER SANDS IN SUBREGION II OF THE GULF COAST REGION

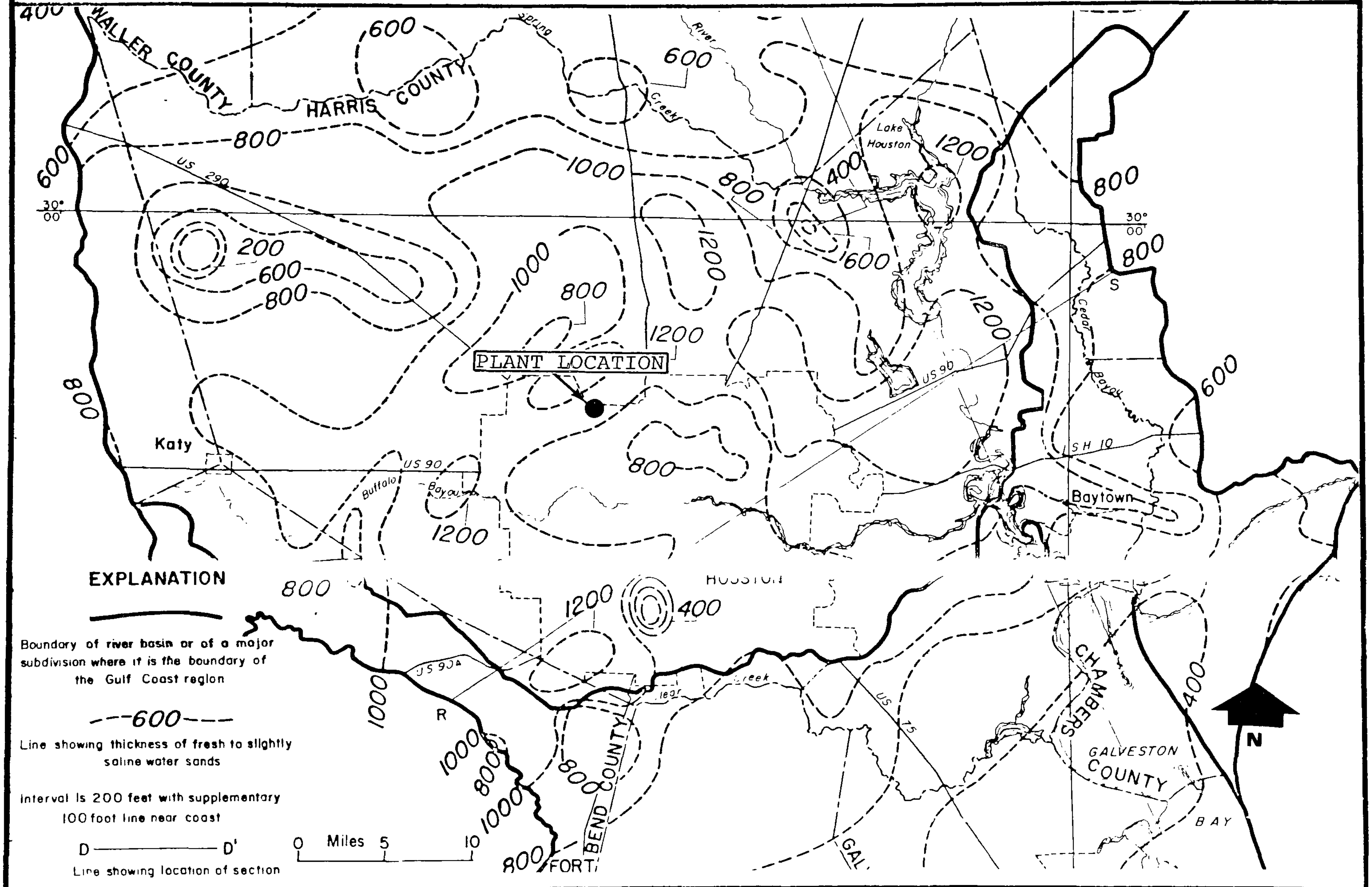
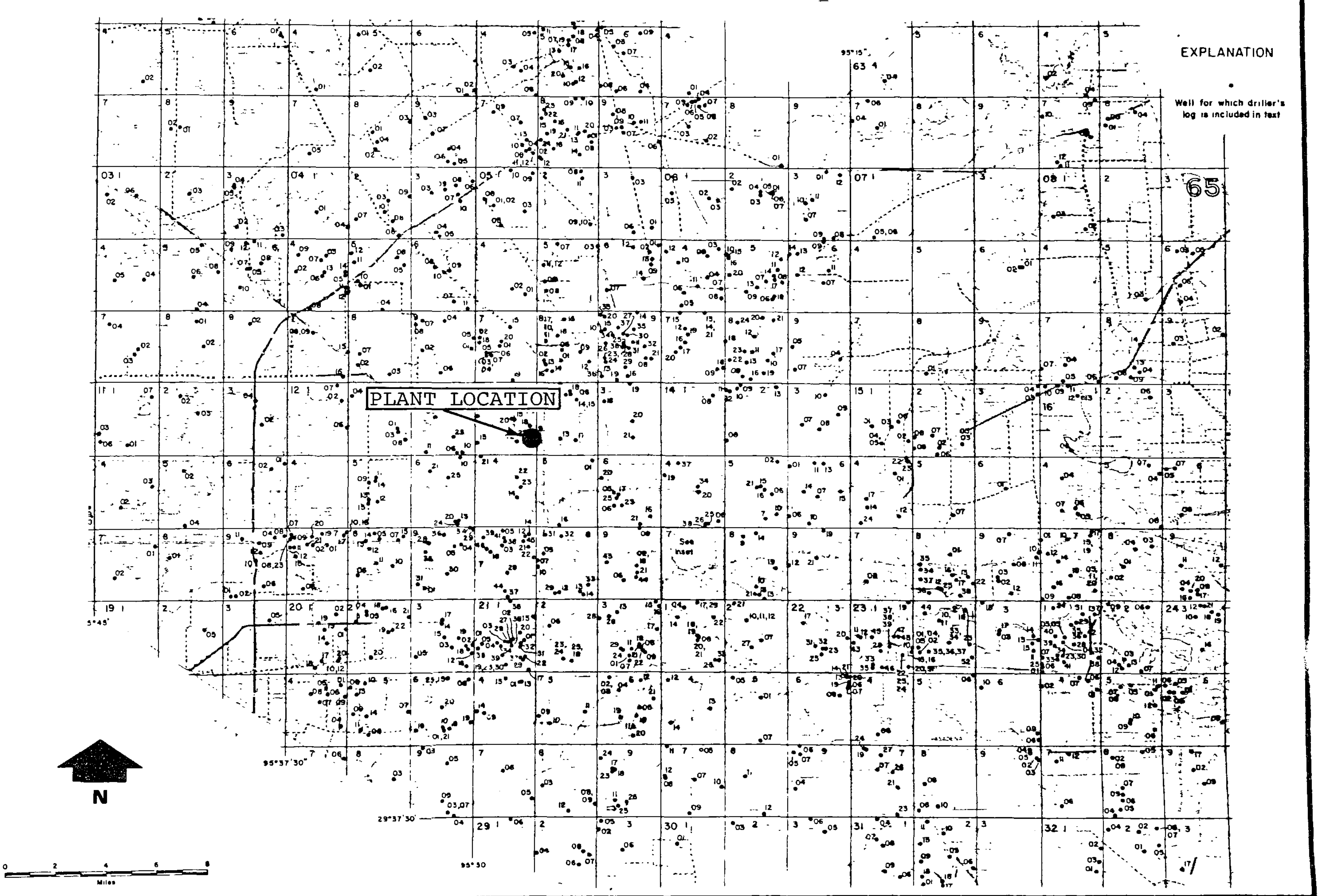


FIGURE III-6
LOCATION OF WELLS IN HOUSTON AND VICINITY



At present, according to the City of Houston Public Works Department, 70% of all water consumption per year is met by underground sources. A most recent study by the Bureau of Economic Geology of the University of Texas-Austin provides an alarming signal to the people of Houston and its government about the future of Houston as an urban environment:

> "The Houston area is slowly sinking....Some neighborhoods are sinking faster than others and this could create serious problems....The uneven subsidence is creating faults. These are breaks where slippage occurs between layers of earth. These findings provide warnings for future land use locations in the city.
>
> The study further confirms that the "sinking spells" accelerate during summer months when more underground water is pumped out for municipal and industrial needs. Only minor movements occur during the winter when pumping decreases sharply....More than a thousand square miles in the Houston-Galveston area have subsided at least one foot.
>
> More than two hundred square miles in the Pasadena-LaPorte area have dropped more than five feet as a result of the pumping of underground water....
>
> According to Dr. William L. Fisher, Director of the Bureau, future studies will be able...to predict where the faults will occur as the land sinks at uneven rates....This would permit businesses and industries to avoid selecting plant sites along the breaks, which could cause serious damage to foundations."
>
> Excerpted from Dallas Morning News
> August 10, 1974

The City of Houston is fully aware of the impact of the underground water use on the uneven settlement* of lands. It has abandoned the use of eastside wells because of the most critical subsidence problem in this part of the city, where industries rely heavily on underground water supply. While adequate surface water is available for domestic and commercial supply, surface water treatment facilities are limited at the present time. Plans for new facilities to treat

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*For impact of this on the installation of underground utility lines, see Chapter VI, Page 123 .

additional surface water are currently underway. When fully operational these facilities will reverse the present ratio of underground and surface water usage. It is projected that by the year 2000 surface water will supply 70% of the City of Houston's water needs.

b. Surface Water

Figure III-7, taken from the Regional Atlas 1972 of the Houston-Galveston Area Council, shows the location of all the water courses and reservoirs in the Houston-Galveston Planning Region. The waterways which will be directly or indirectly affected by the proposed project are the following:

(1) Cole Creek

The receiving stream for treated effluent from the Northwest Regional Wastewater Treatment Plant is Cole Creek. Cole Creek empties into White Oak Bayou several hundred feet east of the treatment plant. Cole Creek is not concrete-lined at the present.

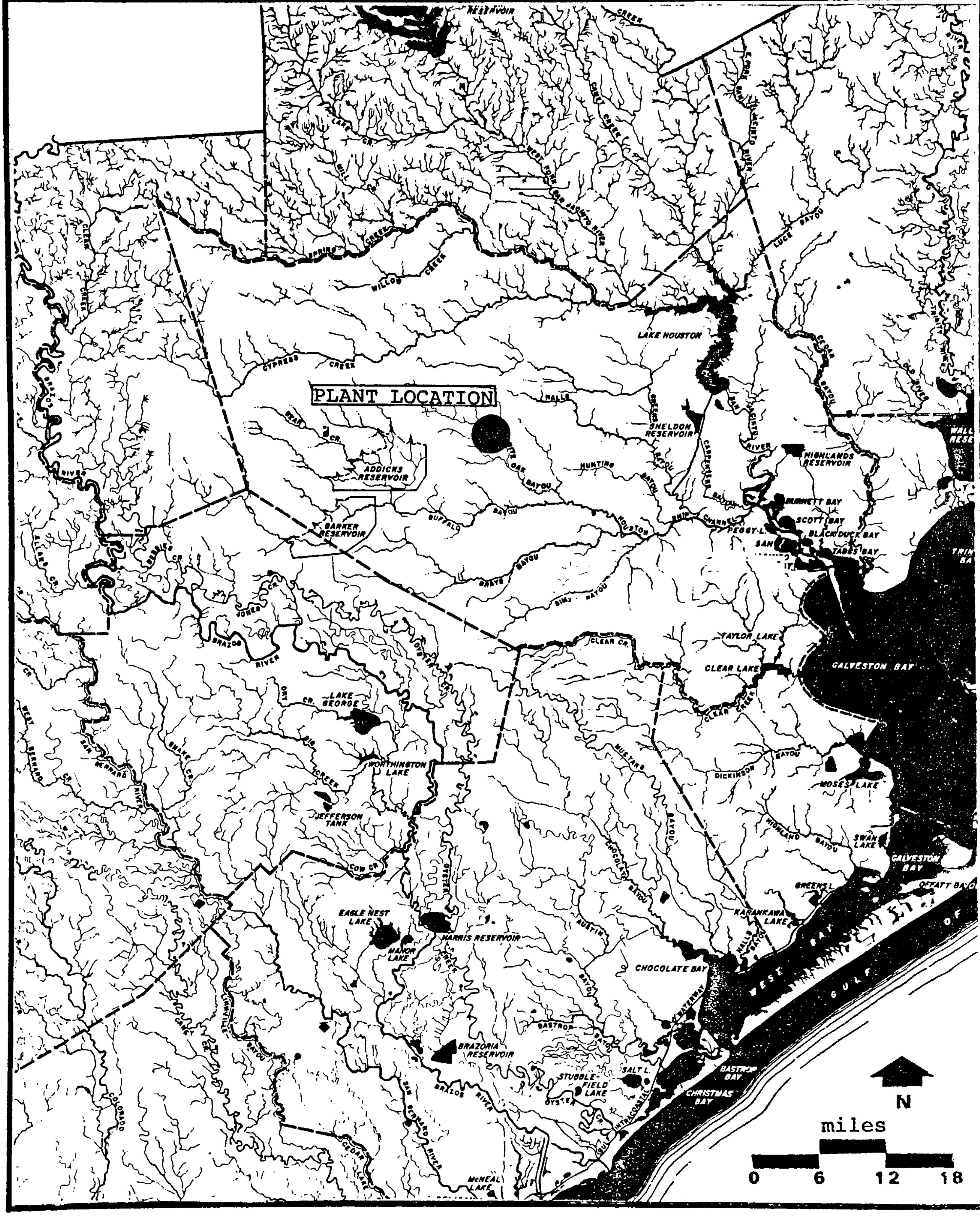
(2) White Oak Bayou

White Oak Bayou originates in the northwest area of Houston and travels through the north and northeast portions of the service area. It joins Buffalo Bayou north of the Houston Central Business District approximately nine miles southeast of the Northwest Treatment Plant. White Oak Bayou is mostly concrete-lined, beginning northeast of the treatment plant site.

(3) Buffalo Bayou

Buffalo Bayou originates in the western section of Houston. It travels in an easterly direction through the Memorial Park Area and empties into the Houston Ship Channel approximately 15

FIGURE III-7
WATER COURSES AND RESERVOIRS



miles southeast of the proposed project. Buffalo Bayou is a natural watercourse.

(4) Houston Ship Channel

The uppermost portion of the Houston Ship Channel is a nearly 25-mile section of Buffalo Bayou widened and dredged to accommodate ocean-going vessels, capped by a turning basin three and one-half miles east of Downtown Houston. Land use on both sides of this channel is heavily industrial, and the quality of water in the Houston Ship Channel currently does not meet governmental standards. This continues to be a major environmental problem for the Houston area.

The two bodies of water most directly affected by the proposed project are White Oak and Buffalo Bayous, neither of which supply water to residents of the project area or the City of Houston. The treated surface water supply to the area originates from the reservoirs at Lake Houston and Lake Conroe.

The proposed project will influence the water flow and quality in Cole Creek, White Oak Bayou and Buffalo Bayou. The flow of water will increase in all these waterways, and since the effluent from the plant will be a better quality water, the construction of the project will improve the water quality of the receiving bodies of water.

Since Buffalo Bayou enjoins the Houston Ship Channel, the proposed project will also improve water quality of the Ship Channel. The regionalization plan for the city, as stated earlier, calls for the expansion and modernization of a number of treatment plants over the next several years. The City of Houston intends to take full advantage of the opportunity presented by the implementation of the regional system to address the problem of water pollution of the Houston Ship Channel. Since the effluent from all treatment plants will be discharged into area water courses, most of which empty into the Ship Channel, improving their water quality with better treatment systems will reduce the pollutants in the Channel and even stimulate the water quality of the Galveston Bay. The objective of the city's wastewater management program is to improve and enhance the overall water quality of the entire Houston area. The proposed project represents a step in that direction.

Water flow and quality data collected at several points along Cole Creek, White Oak Bayou and Buffalo Bayou are presented in Appendix G of this report. (See Page G-1 in the Appendix for the exact location of these points.) The samples of water flow and quality taken at different sections are reasonably representative of the year-round flow condition and water quality of these bayous since the samples covered the periods of both low and high flow conditions. The sample also appears adequate from the standpoint of geographic coverage since data was collected at different sections encompassing up and downstream characteristics.

c. Flood Prone Areas

A special Flood Hazard Report prepared in June, 1972, by the U.S. Army Engineer District, Corps of Engineers, Galveston, Texas, for the Harris Soil and Water Conservation District and the Texas Water Development Board, provides flood hazard information for land use planning in the flood plains of White Oak Bayou, Cole Creek and Vogel Creek in the reaches above the confluence of Cole Creek and

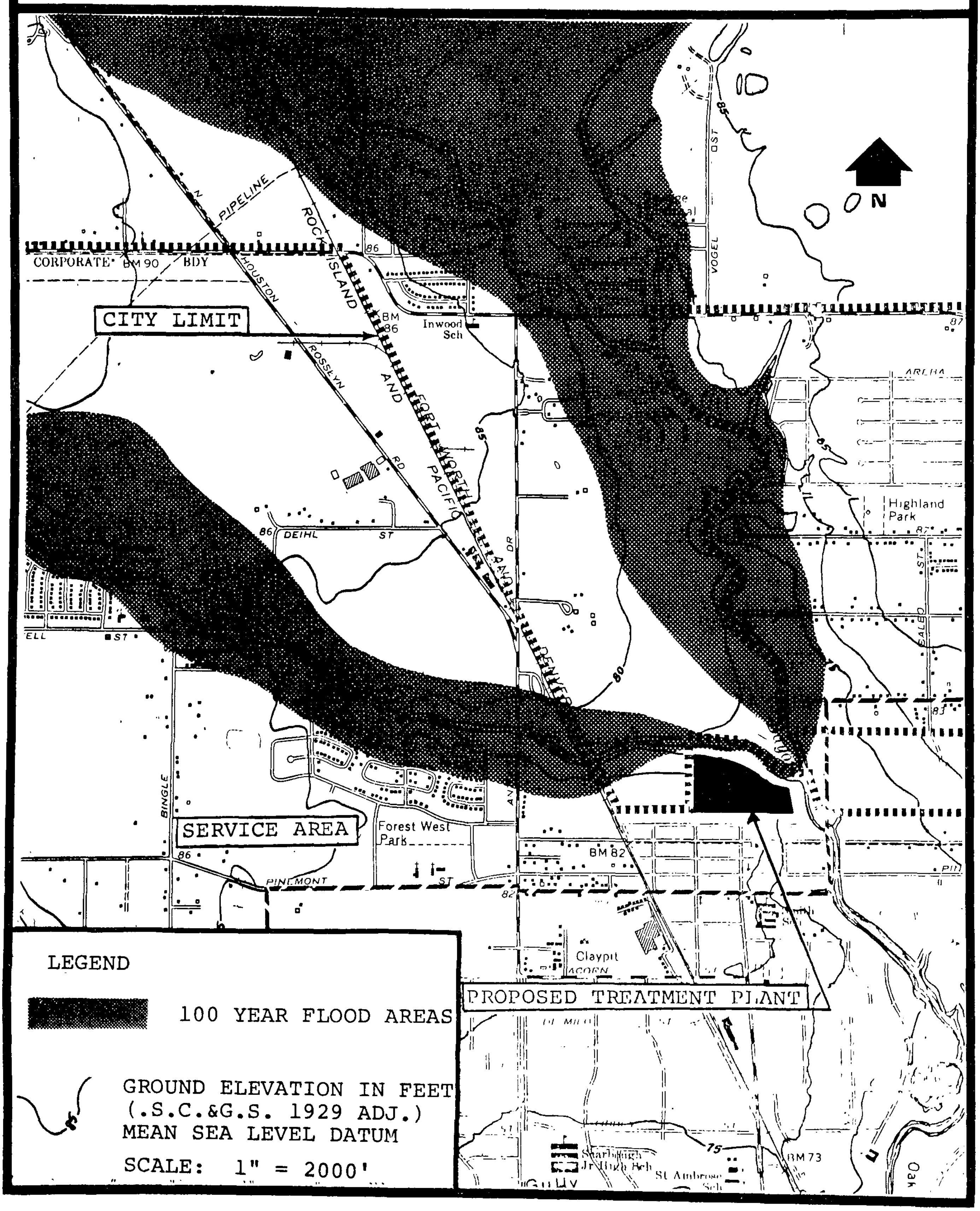
White Oak Bayou. The study covers about 14 miles of White Oak Bayou, six miles of Cole Creek and four miles of Vogel Creek. Flood plain areas delineated in this study for Intermediate Regional Flood (100 year flood level) are shown for the project vicinity in Figure III-8.

The proposed site is just outside the Cole Creek 100 year flood plain area. The plant site is also outside the Standard Project Flood which is defined by the Corps of Engineers in the same report as the flood that may be expected from the most severe combination of metrological and hydrological conditions considered reasonably characteristic of the geographic area in which the drainage basin is located. Peak discharges for these floods are generally about 40% to 60% of the probable maximum floods for a given basin.

The existing Northwest Plant is elevated and its expansion is proposed to be patterned after the existing design and layout. The requirements of the Executive Order No. 11296 regarding locating treatment plants on flood plain areas are therefore not applicable. Detail engineering plan for the site is now at the final stage of preparation by the Dannenbaum Engineering Corporation in Houston. The plant site is protected on the east side by a levy system built up just below the confluence of White Oak Bayou and Cole Creek. The elevation of the plant site is 75 feet above the mean sea level. The plant site is unusually flat, and elevation for all parts of the site is practically 75 feet above the mean sea level.

FIGURE III-8

AREAS SUBJECT TO 100 YEAR FLOOD LEVELS



B. CLIMATIC AND ATMOSPHERIC CONDITIONS

1. Climate

The Houston area is subject to frequent precipitation. The annual average rainfall from 1965 to 1973 was 49.47 inches. The monthly precipitation for this period is shown in Table III-1, averaging 4.12 inches per month. Houston experiences high intensity showers during the spring and late summer.

Temperatures range from as low as 32°F in winter, to as high as above 100°F in summer. The mean January temperature is 45°F, and the mean July temperature is 93°F. Below freezing temperatures occur only seven days a year. Snows are extremely infrequent.

Two principal wind regimes dominate the Houston area: persistent southeasterly winds from March through November and short-lived but strong northerly winds from December through February. More elaborate data on the climatic condition of Houston, including frequency of surface wind direction and hurricane tracks, are shown in Figure III-9.

Hurricane flooding is a potential problem in any coastal zone, although it occurs infrequently in the Houston-Galveston area. However, the storm surge tides that accompanied Hurricane Carla flooded large areas of Harris County. Flood elevations of up to 15.3 feet above normal were recorded on Buffalo Bayou to the northwest of Galena Park.

2. Air Quality

Like many other large metropolitan cities in the United States, air pollution is one of the most serious problems facing the City of Houston. This problem results from solids, liquids and gases in

TABLE III-1

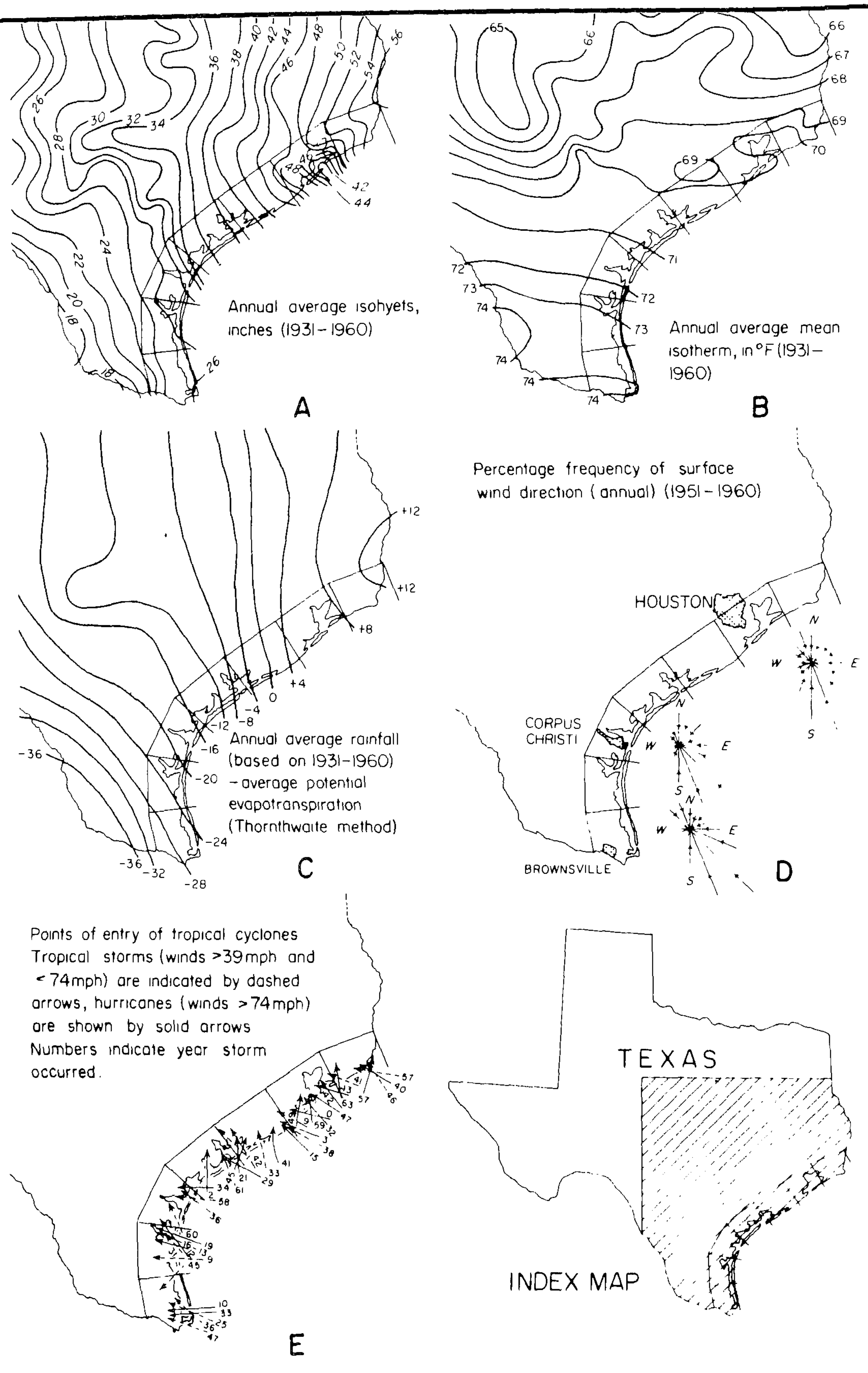
MONTHLY PRECIPITATION (MEASURED IN INCHES)
CITY OF HOUSTON 1965-1973

Month	1965	1966	1967	1968	1969	1970	1971	1972	1973
January	1.87	4.46	2.14	8.02	2.74	1.93	0.36	3.30	5.00
February	3.27	7.75	2.47	1.99	5.31	2.52	2.11	1.20	3.40
March	0.81	2.20	1.83	2.92	3.18	5.08	1.21	8.52	3.18
April	0.95	7.98	4.42	3.02	3.34	2.21	2.14	1.85	7.15
May	6.53	11.21	2.54	13.24	4.73	14.39	3.41	6.99	4.22
June	3.06	4.42	0.17	11.18	1.51	0.26	2.42	3.02	13.46
July	1.57	1.45	7.77	6.49	3.89	2.28	1.42	2.76	6.66
August	2.29	7.11	1.60	2.90	2.67	2.03	6.95	3.90	3.73
September	3.46	4.01	4.84	3.87	6.08	6.22	5.17	6.23	9.38
October	3.09	5.45	3.18	3.91	3.30	9.09	3.49	3.34	9.31
November	4.82	1.56	0.50	2.71	2.13	1.54	1.82	6.49	1.59
December	6.15	1.53	5.02	1.99	4.38	0.64	7.33	2.20	2.47
TOTAL YEAR	37.97	59.13	36.45	61.44	43.26	48.19	36.83	50.80	70.16

Average 1965-1973: 49.47 Inches

SOURCE: United States Department of Interior, Weather Bureau

FIGURE III-9
CLIMATE CONDITIONS



Annual average isohyets, inches (1931-1960)

Annual average mean isotherm, in °F (1931-1960)

Annual average rainfall (based on 1931-1960) - average potential evapotranspiration (Thornthwaite method)

Percentage frequency of surface wind direction (annual) (1951-1960)

Points of entry of tropical cyclones Tropical storms (winds >39mph and <74mph) are indicated by dashed arrows, hurricanes (winds >74mph) are shown by solid arrows Numbers indicate year storm occurred.

Regional climatic data, Texas Coastal Zone. A, Average annual precipitation (after J. T. Carr, 1967). B, Average annual temperature (after J. T. Carr, 1967). C, Precipitation deficiency (after Orton, 1969a). D, Frequency of surface wind direction (after Orton, 1964). E, Hurricane tracks across Texas coastline (after Hayes, 1967).

amounts that are injurious and detrimental to man, animals, plants and properties. Its interference with the comfortable enjoyment of life and the environment is undeniable. The principal sources of air pollution in Houston, as in other urban areas, are automobiles, aeroplanes, burning of fuels in industries and waste materials. The table below indicates the extent of the problem of air pollution that currently exists in the Houston and Harris County area.

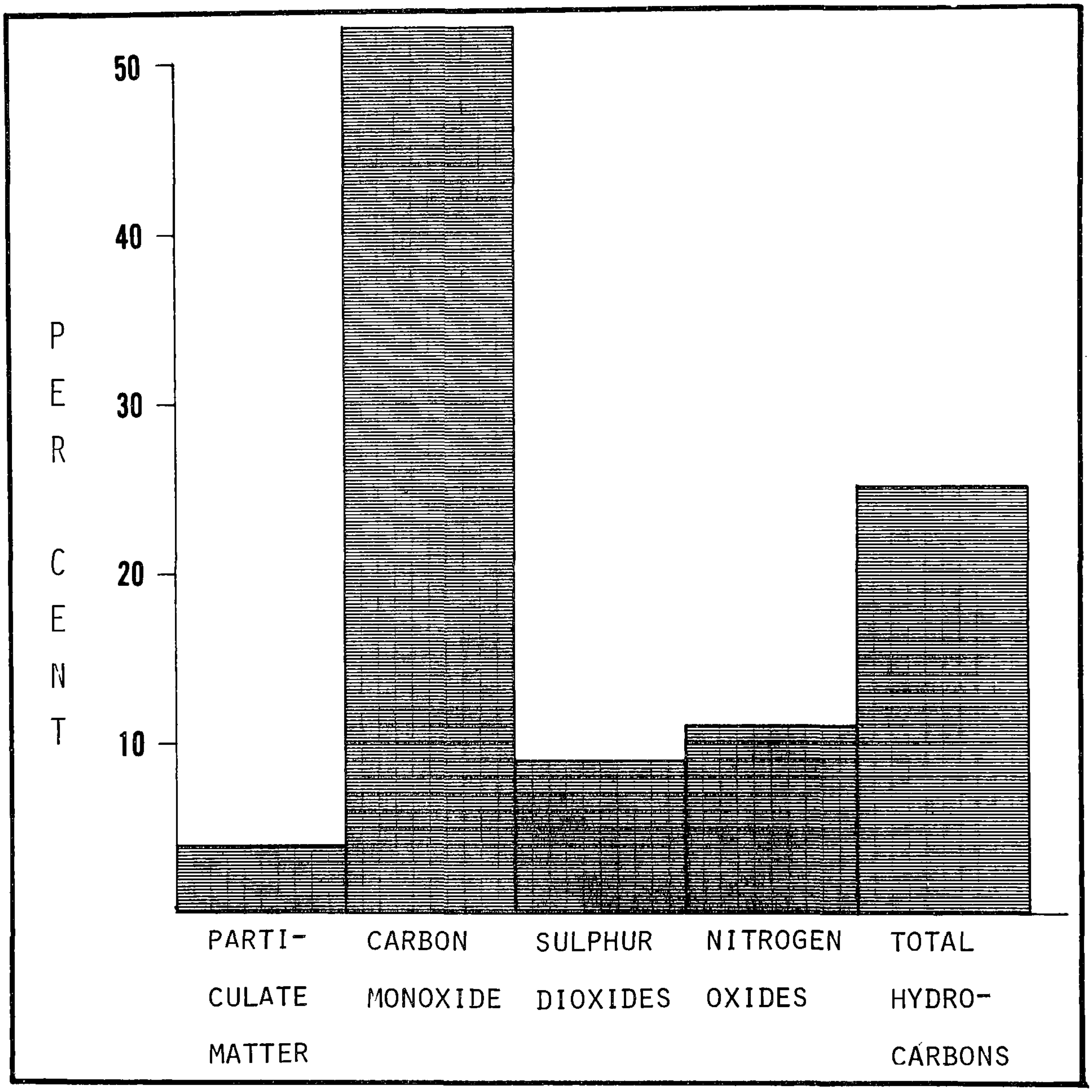
TABLE III-2

LEVEL OF AIR POLLUTION BY TYPE OF POLLUTANTS FOR HARRIS COUNTY, 1972

Pollutants	Air Contaminants Tons/Year	Harris County, 1972 Percent Distribution
Particulate Matter	69,300	4.20%
Carbon Monoxides (CO)	871,500	52.10%
Sulphur Dioxides (SO_2)	134,000	8.30%
Nitrogen Oxides (NO_2)	168,500	10.20%
Total Hydrocarbons	421,900	25.20%
TOTAL	1,665,200	100.00%

A graphic presentation of data in Table III-2 is furnished in Figure III-10.

FIGURE III-10: SOURCES AND LEVEL OF AIR POLLUTION IN HARRIS COUNTY, 1972



The air quality problem as it exists is highly critical. Houston already tops the list of cities with significant problems of air pollution in the State of Texas. The continued growth of the city and its environs will intensify this problem further if appropriate programs are not implemented to address the issue of air pollution. Over 50% of the total air contaminants in the city currently result from carbon monoxide, the major source of which is the automobile. Unless Houston explores alternative modes of transportation, the problem will continue to affect public health and welfare. The current efforts by the City of Houston Public Health Department are limited in their scope to fundamentally attack the problem, though some improvements in air quality have been made since 1972. The current programs and their effect on air quality in Houston are discussed below.

Current Air Quality Programs for Houston:

In 1967, Houston established the City's Air Pollution Control Program under the Health Department to monitor sources of air pollution and to control, regulate, and reduce pollutants. Since then, the Program has grown considerably and its scope has been expanded. Monitoring information is published annually and in 1974 the Program has started monthly reports. The City now has over 60 personnel working on pollution monitoring and control. The Program includes enforcement, engineering, technical services, and meteorology. Data is compiled and stored by a computer telementry system.

The number of monitoring stations has increased to 25, including the Houston Ship Channel Industrial District, where large concentrations of pollution sources exist. Two continuous monitoring mobile units have been assembled to sample Carbon Monoxide, Nitrogen Oxides, Sulfur Dioxides, and Total Oxidants on a continuing basis. Numerous surveys have been conducted for various parts of the city, particularly for industrial plants, to provide a basis for City Ordinances on incinerator permits and pollution control. In addition, stack sampling teams have been organized and trained to gather direct source data for industrial control and regulation. In 1973, the City has made over 1,100 inspections and 2,500 advisory visits. It has attended to 3,100 complaints, and 989 notices were served on 632 companies - 431 corrections have been made. A total of 633 incinerator operating permits have been issued and 750 incinerators have been removed from service. See Table GG-3 in Appendix GG.

In the seven years the Air Pollution Control Program has been in operation, the City has made good progress in the monitoring, analysis, and control of industrial and small source pollutants. However, the Program has not been able to adequately address the problem of air pollution caused by the automobile, other than to monitor some of the pollutants generated by the auto. A more detailed description of the City's air pollution control programs and related data are presented in Appendix GG.

C. BIOLOGICAL ENVIRONMENT

Common native plant life in the Houston area includes both tropical and temperate climate zone vegetation. Forest trees include ash, bays, cedar, cottonwood, cypress, dogwood, elm, hawthorne, honeysuckle, jasmine, laurel, magnolia, oak, pine, poplar and wild peach. There are narrow timberlines extending from main bodies of timber along the streams out onto the prairie and up the small water courses reaching out for miles. The trees line the bayou banks and bay shores up to the water's edge.

Wild flowers are abundant through spring and summer. The prairie is covered by such flowers as wild plox, evening primrose, Texas bluebonnets, orange milkweed and standing cypress. In the summer, Texas bluebells bloom. The green-leafed possumhaw or yaupon bears red berries in the autumn that provide winter bird food. Many varieties of fruits and vegetables are indigenous to the Houston area, including grapes, dew and blackberries. Houston has both coastal prairie tall-bunch and mid-bunch grasses, as well as true prairie grasses. Some salt and sand tolerant, short grass species are common in the Houston area.

Native wild animals include prairie chicken, partridge, deer, wild turkey and squirrel. Seasonal or migratory animals include geese, brant, sandhill, crane, curlew, snipe, plover and ducks of every variety. Fire, drought, floods and other natural disasters sometimes upset the balance of nature by destroying animals and their food, putting a strain on all wildlife struggling for survival. The process is further affected by continuing urbanization of the city and its environments. While man-made activities are needed to sustain civilization, a lasting balance must be found so that the man and the other species of nature can exist in harmony.

1. Botanical

Figure III-11 shows the distribution of various plant assemblages within areas in and around the City of Houston. Taken from Proctor and Hall (1974), this figure shows the typical vegetation of the area to the north and west of the city.

Vegetation in the service area of the proposed project is fairly typical of the Gulf Prairie and Coastal Plains. However, significant wooded areas exist, particularly along natural drainage ways such as Cole Creek and White Oak Bayou. Major woody plants include oak, pine, acacia, mesquite and elm. The principal native grasses are tall bunch grasses, including the big bluestem, little bluestem, seacoast bluestem, Indiangrass, eastern gamagrass, switchgrass and Gulf cordgrass. Other grasses include panicums, gulf muhly, bermuda grass and carpet grass. The forbes, or inferior grasses, in the region include western ragweek, tumble grass, broomsedge bluestem, smutgrass, threeawns, yankeeweed, ragweed, bitter sneezeweed and broomweed. Vegetation in residential areas is characterized by the planting of non-indigenous shade and fruit trees, shrubs and grasses.

2. Zoological

Major marine and wildlife habitats in the Greater Houston area are shown in Figures III-12, III-13 and III-14. This data was taken from the Regional Atlas 1972 prepared by the Houston-Galveston Area Council. Available studies indicate no significant evidence of the existence of any rare or endangered species within the project service area or the City of Houston. However, according to the Texas Department of Parks and Wildlife, there might be some rare and endangered species in the Southeast Texas Region which include Attwater's prairie chicken, red wolf, poregrine falcon, Eskimo cuslew, bald eagle, ocelot, American Alligator and Houston toad.

a. Wildlife Habitats

Wildlife in the area consists of small fur-bearing mammals such as cottontail and jack rabbits, squirrels, opossums, skunks and rodents (including mice, rats and moles). Small wolves or coyotes are seen on rare occasions to the south of the City of Houston in south Harris County.

b. Aquatic Fauna

The variety and abundance of aquatic fauna to be found in Buffalo Bayou is limited by the low flow and the poor water quality of the stream. Species of turtles, frogs, reptiles, mollusks and rough

FIGURE III-11

PLANT ASSEMBLAGES FOR THE GREATER HOUSTON AREA

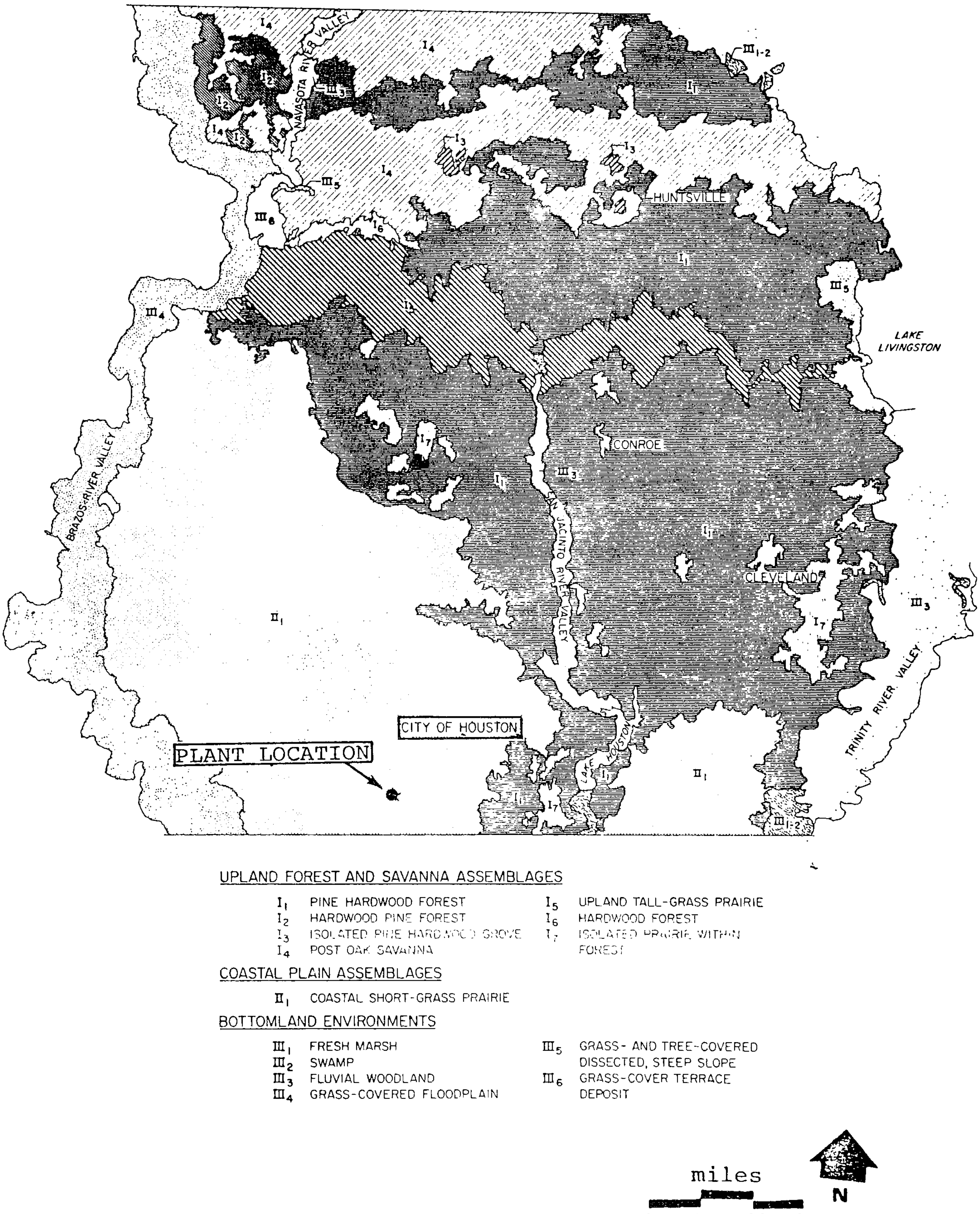
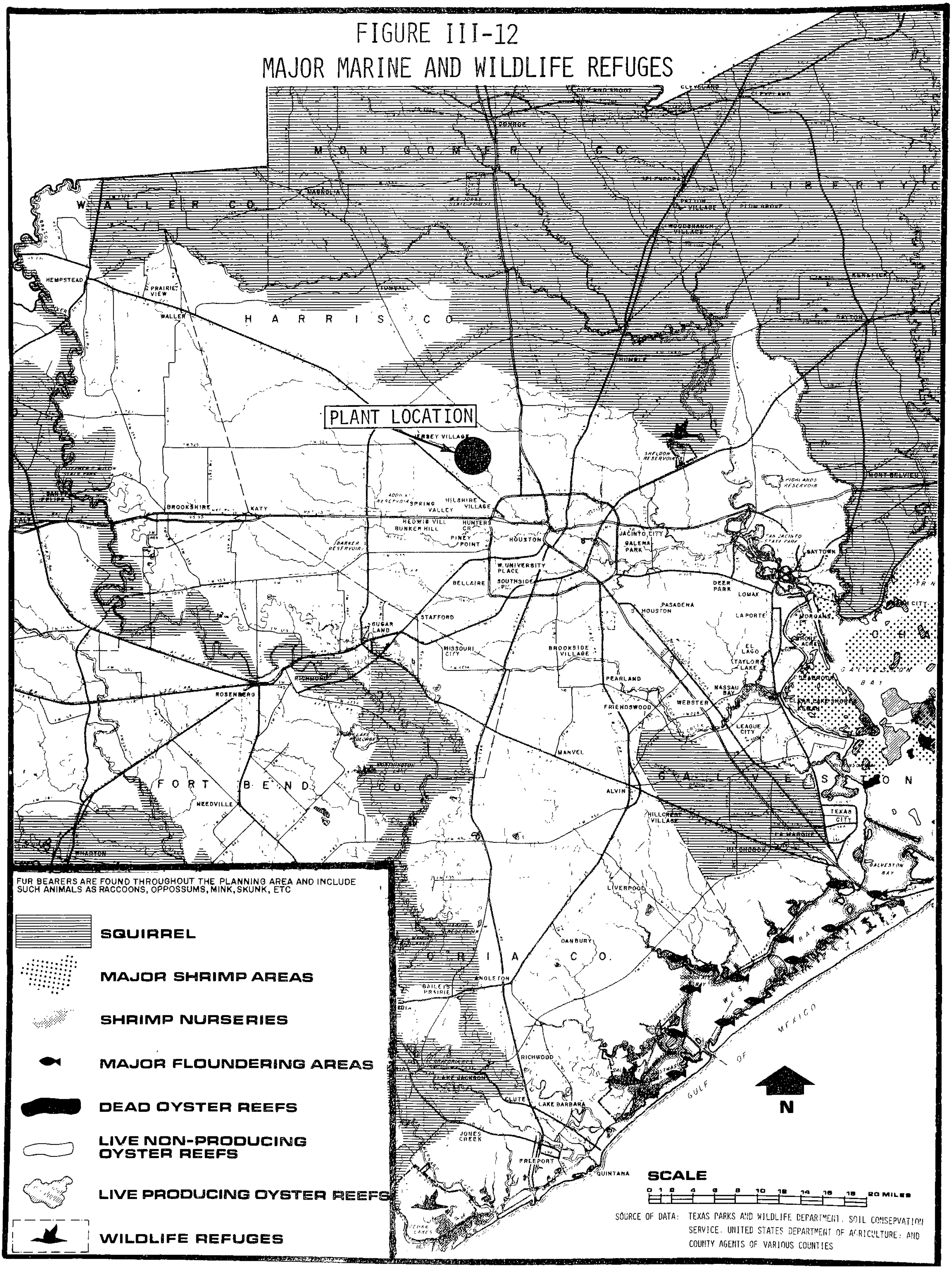
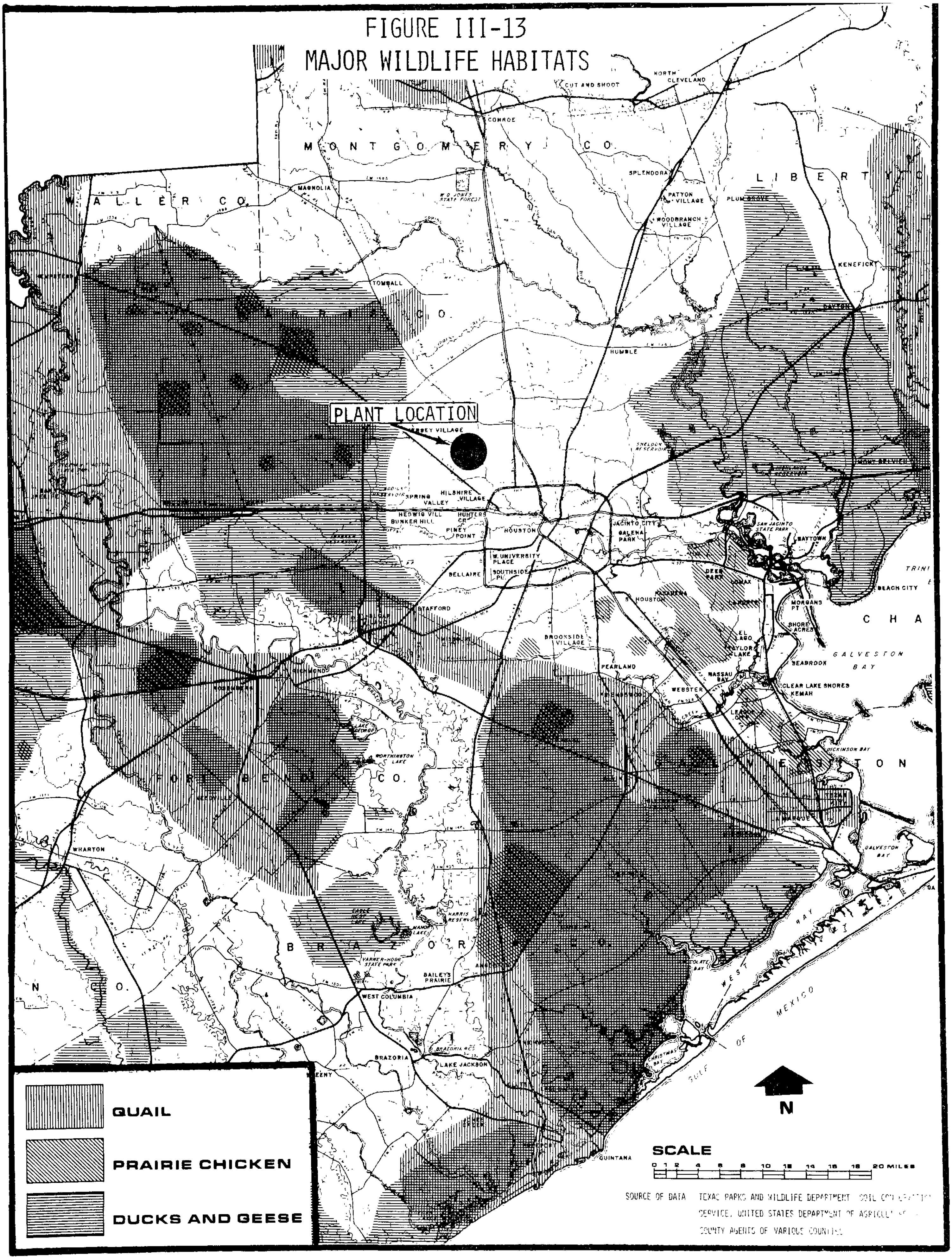


FIGURE III-12
MAJOR MARINE AND WILDLIFE REFUGES



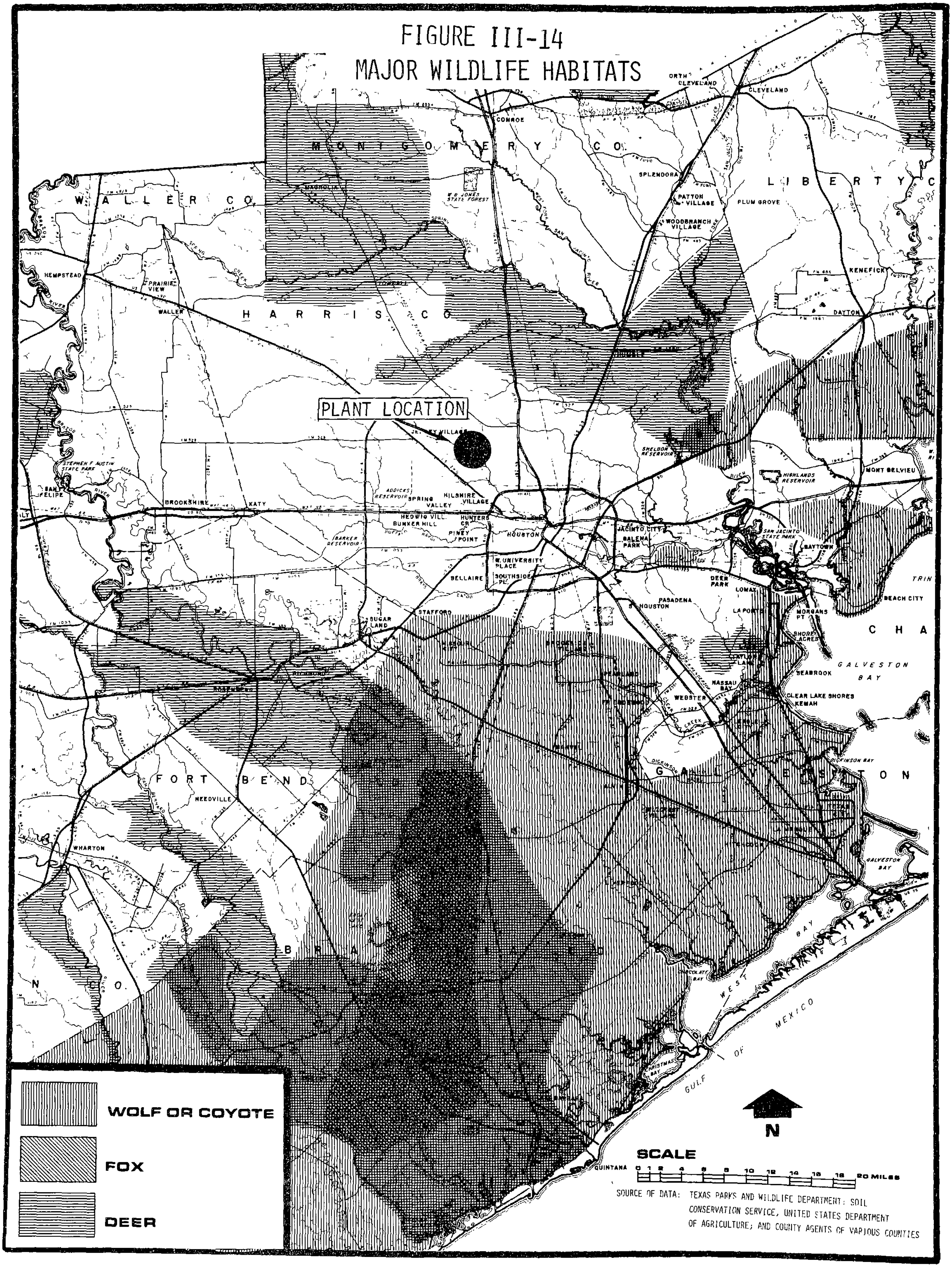
SOURCE OF DATA: TEXAS PARKS AND WILDLIFE DEPARTMENT, SOIL CONSERVATION SERVICE, UNITED STATES DEPARTMENT OF AGRICULTURE; AND COUNTY AGENTS OF VARIOUS COUNTIES

FIGURE III-13
MAJOR WILDLIFE HABITATS



SOURCE OF DATA TEXAS PARKS AND WILDLIFE DEPARTMENT, SOIL CONSERVATION SERVICE, UNITED STATES DEPARTMENT OF AGRICULTURE, COUNTY AGENTS OF VARIOUS COUNTIES

FIGURE III-14
MAJOR WILDLIFE HABITATS



- ▥ WOLF OR COYOTE
- ▧ FOX
- ▤ DEER

SOURCE OF DATA: TEXAS PARKS AND WILDLIFE DEPARTMENT; SOIL CONSERVATION SERVICE, UNITED STATES DEPARTMENT OF AGRICULTURE; AND COUNTY AGENTS OF VARIOUS COUNTIES fish such as buffalo, carp, gar, mosquito fish, killy, sheepshead minnows, crayfish and sunfish are found in the bayou. On occasion other species of fish enter the bayou at its confluence with the Houston Ship Channel. Aquatic fauna is essentially non-existent in White Oak Bayou, as this waterway is concrete-lined.

c. Birds

Varieties of small birds have been sighted in the service area. Cardinals, mockingbirds and house sparrows are found throughout the year in the residential areas. Brown thrashers appear in the winter. Seed-eating birds such as meadowlarks, mourning doves, redwinged blackbirds, grackles and short-eared owls are found in the weedy fields. Savannah sparrows, goldfinch, sparrow hawks, marsh hawks and other species of hawks are often seen. Such migratory birds as orioles and kingbirds are also occasionally seen in the area.

MAN-MADE ENVIRONMENT

D. HISTORICAL AND CULTURAL ENVIRONMENT

1. Paleontology

According to Dr. DeWitt Van Siclen of the Department of Geology, University of Houston, there are no known paleontological sites in the service area of the proposed project. The low relief of the area, humid climatic conditions and deep acid soil development would tend to destroy most fossil evidence at or near the surface. The rocks of the Montgomery Formation are deeply weathered and probably contained only limited fauna at the time of deposition. The non-marine deltaic sediments of this unit would not be conducive to fossil accumulation or preservation.

Significant paleontological finds are, however, possible during excavation of a site below the depth of soil development. Any fossil, if detected, should be carefully extracted and preserved by trained paleontologists.

2. Archaeological, Historical and Cultural Elements

There are six items listed in the National Register of Historic Places located in the Houston area. All are outside the service area of the project. The Cotton Exchange Building is located in Downtown Houston, and the San Jacinto Battleground is located northeast of Houston. Others are Pillot Building, 106 Congress Street; Sweeny, Coombs and Frederick Building, 301 Main Street; and the U. S. Custom's House, San Jacinto at Rusk Streets.

According to the Texas Historical Commission, most recent archaeological surveys were confined to one area of Houston. These surveys have recorded ten sites along White Oak Bayou in northwest Houston. This data, however, will not be available for public use until steps are taken to insure the preservation of these sites.

Areas south of the city were surveyed prior to construction of the Army Corps of Engineers projects and were successful in locating large numbers of sites of archaeological and historical value. Prior to the construction of the project, the proposed site should be subjected to a thorough archaeological survey. Such sites as are recognized in the survey at that time should be recorded and their significance appraised prior to their commitment to the project. Sites which can fulfill National Register criteria can then be included in the National Register of Historic Places.

The Houston Astrodome, Astrohall and Astroworld represent major attractions in the Southwestern United States. A more detailed description of historical, cultural and archaeological elements in Houston is included in Appendix H of this report.

E. SOCIAL AND ECONOMIC ENVIRONMENT

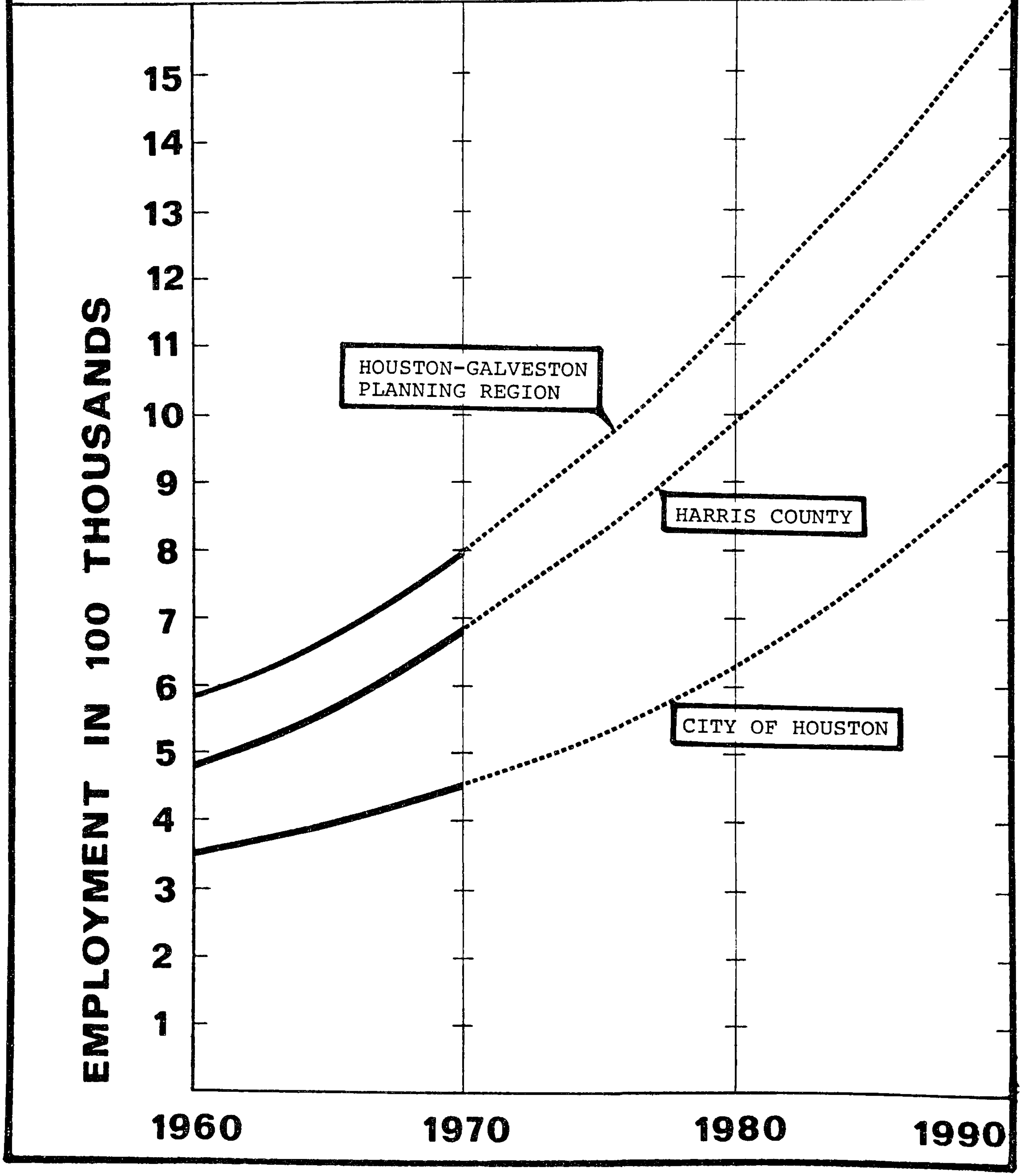
The demand for public facilities, including sewage treatment facilities, in any community is a function of population and economic growth. The future need for sewage treatment facilities in Houston will be determined by the type and intensity of growth in population, employment and land use.

1. Economic Development

Houston, during the 1960's, has been one of the fastest growing major cities in the United States. Major factors accounting for this growth have been the continued expansion of manufacturing, petrochemical and chemical production, educational facilities, the aerospace industry and medical research. From 1960 to 1969, 118 new industrial plants were located in the Houston area, and another 272 existing plants underwent major expansions. In 1970, Houston had almost 150,000 persons employed in manufacturing alone. Table III-3 shows the past, current and projected employment for the City of Houston, Harris County and the Houston-Galveston Planning Region.

These projections are expected to have a far-reaching impact on

PAST, PRESENT & PROJECTED ECONOMIC DEVELOPMENT, FIG. III-15



Houston in the planning and provision of adequate municipal facilities. If Houston continues to grow at its present rate through the year 1990, orderly physical development will depend greatly on the provision of an adequate infra-structure system, including transportation and utilities. How much of this additional growth could be allocated to various communities within the Houston area will be largely dictated by the quality and quantity of public services provided to those areas. The proposal for the expansion of the Northwest Treatment Plant is a recognition by the city that future development is inevitable in the service area where public health problems will intensify without this facility.

TABLE III-3

HOUSTON'S EMPLOYMENT OUTLOOK - 1960 THROUGH 1990

	Employment				
	Number		Per Cent Change	Projections Through	
	1960	1970	1960-1970	1980	1990
City of Houston*	363,636	515,599	42%	667,000	1,000,000
Harris County**	470,452	711,749	51%	1,064,050	1,400,000
Houston-Galveston Region***	587,698	797,421	33%	1,186,591	1,575,600

*Employment projection for the City of Houston is based on the continuation of its 1970 share of Harris County total employment.

**Volume 2, "Houston-Harris County Population Projection", Table 5, Page 15, Texas Highway Department, 1967.

***Projections by University of Texas at Austin and Texas A & M University for Economic Base Studies and Projections of the HGAC Region, Page 9, "A Summary Projection, Land Use and Population", December, 1969.

2. Population Characteristics, Trends and Projections

As of April, 1970, the service area of the proposed project had a population of 47,173 persons, including the annexed areas of the Acres Home Addition to the northeast of the plant. This is a gain of nearly 100% since 1960. Comparable population growth rates and projections for the City of Houston, Harris County and the Gulf Coast Planning Region are shown in Table III-4.

In 1980, the proposed project will be serving an estimated population of 63,500 persons. By 1990, about 90,000 people will require service, 43,000 more people than are being served today. The City of Houston must not only improve sewer and other services to meet existing needs and standards, but must also plan facilities that will serve the increasing population of the city. The population trends and projections for the areas affected by the Northwest Treatment Plant are graphically illustrated in Figure III-16. In 1960, the service area accounted for 2.4% of the City of Houston's population, but in 1970, its share jumped to 3.8%. While the service is rapidly increasing in population, its projected share for 1980 and 1990 is expected to stabilize at the 4% level since the City of Houston is also expected to grow rapidly during this period of time.

Figures III-17 and III-18 show the 1970 and 1990 geographic distribution of population for Harris County. Presently, the population is heavily confined within the Loop 610 and its immediate outer zone. But continuing dispersion of Houston's population appears almost inevitable. The projected distribution of net population change as shown in Figure III-18 indicates that there will be very little population increase inside the Loop 610 between now and 1990. A close

TABLE III-4

POPULATION TRENDS AND PROJECTIONS FOR THE PROJECT AREA, CITY OF HOUSTON, HARRIS COUNTY AND GULF-COAST PLANNING REGION - 1960 THROUGH 1990

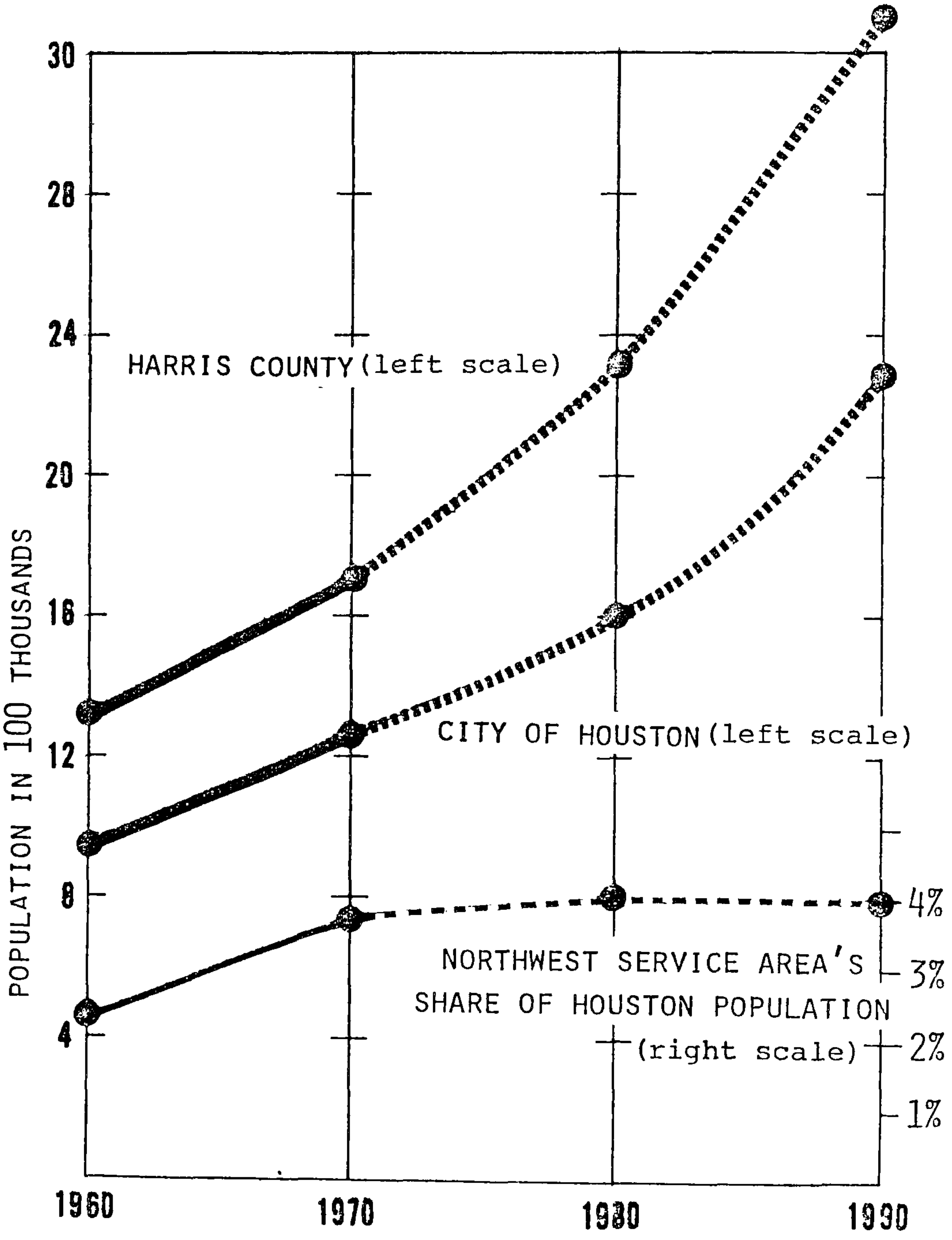
Area	Past and Present**				Future Projection*			
	1960	1970	Change 1960-70		1980	1990	Change 1970-90	
			Number	Percent			Number	Percent
Service Area of the Plant	23,862	47,173	+ 23,211	99.00%	63,460	90,140	+42,967	91.0%
City of Houston	938,219	1,232,802	+294,583	31.39%	1,600,000	2,300,000	+1,067,198	86.5%
Harris County	1,243,158	1,741,912	+498,754	40.11%	2,311,600	3,300,000	+1,558,088	89.4%
Gulf-Coast Planning Region (13-county)	1,698,748	2,305,196	+606,358	35.69%	3,293,500	5,157,100	+2,851,994	123.7%

*Projections by HGAC, "A Special Report on Population Projection, 1970-2020", November, 1972.

**1960 and 1970 Censuses of Population and Housing for the Houston, Texas, Standard Metropolitan Statistical Area

FIGURE III-16

PAST, PRESENT AND PROJECTED POPULATION



1970 POPULATION DISTRIBUTION HARRIS COUNTY, FIGURE III-17

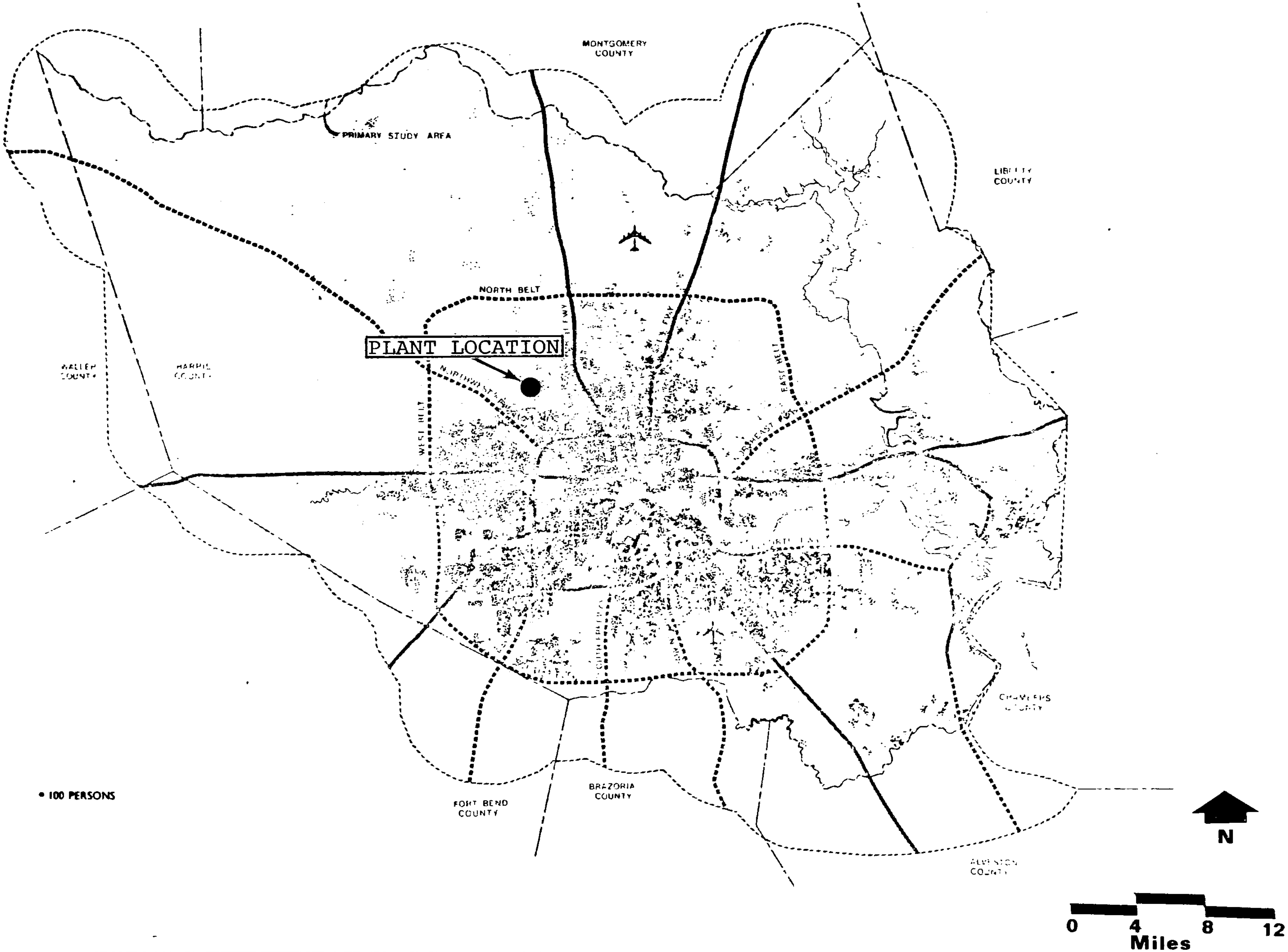
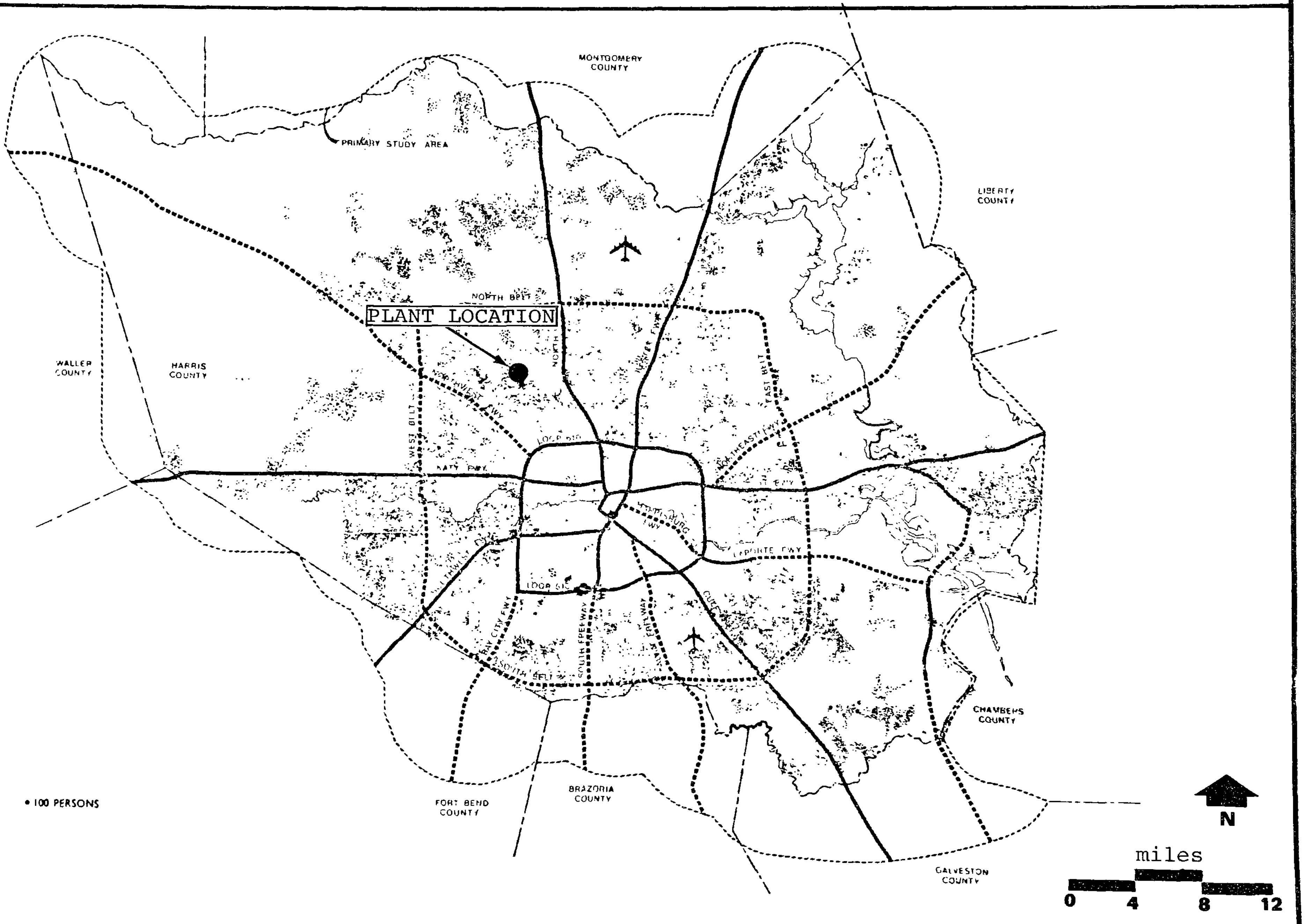


FIGURE III-18
1970-90 POPULATION DISTRIBUTION INCREMENT, HARRIS COUNTY



examination of the data presented in this map confirms a sizeable population increase expected for the service area of the proposed project through the year 1990 since the project area is located well outside the Loop 610 of the Houston Freeway System.

F. LAND USE AND TRANSPORTATION SYSTEMS

1. Existing and Projected Land Use

Figure III-19 shows the existing land use in the project area and shows the considerable amount of undeveloped land available for urbanization, especially in the northern portions of the study area along the Northwest Freeway, which is currently under construction. A portion of the population within the study area is apparently utilizing septic tanks and is not connected to the sanitary sewer system tributary to the Northwest Houston Wastewater Treatment Plant.

Land use along the Northwest Freeway is primarily commercial, and this is expected to continue as the freeway nears completion. More commercial development is also expected along Hempstead Highway. Much of the land along other major thoroughfares, such as Clay Road, Pinemont, West Tidwell and West Little York Road, will likely be used for nonresidential establishments. The following table indicates the existing land use distribution for the project area. (Page 59)

FIGURE III-19

EXISTING LAND USE

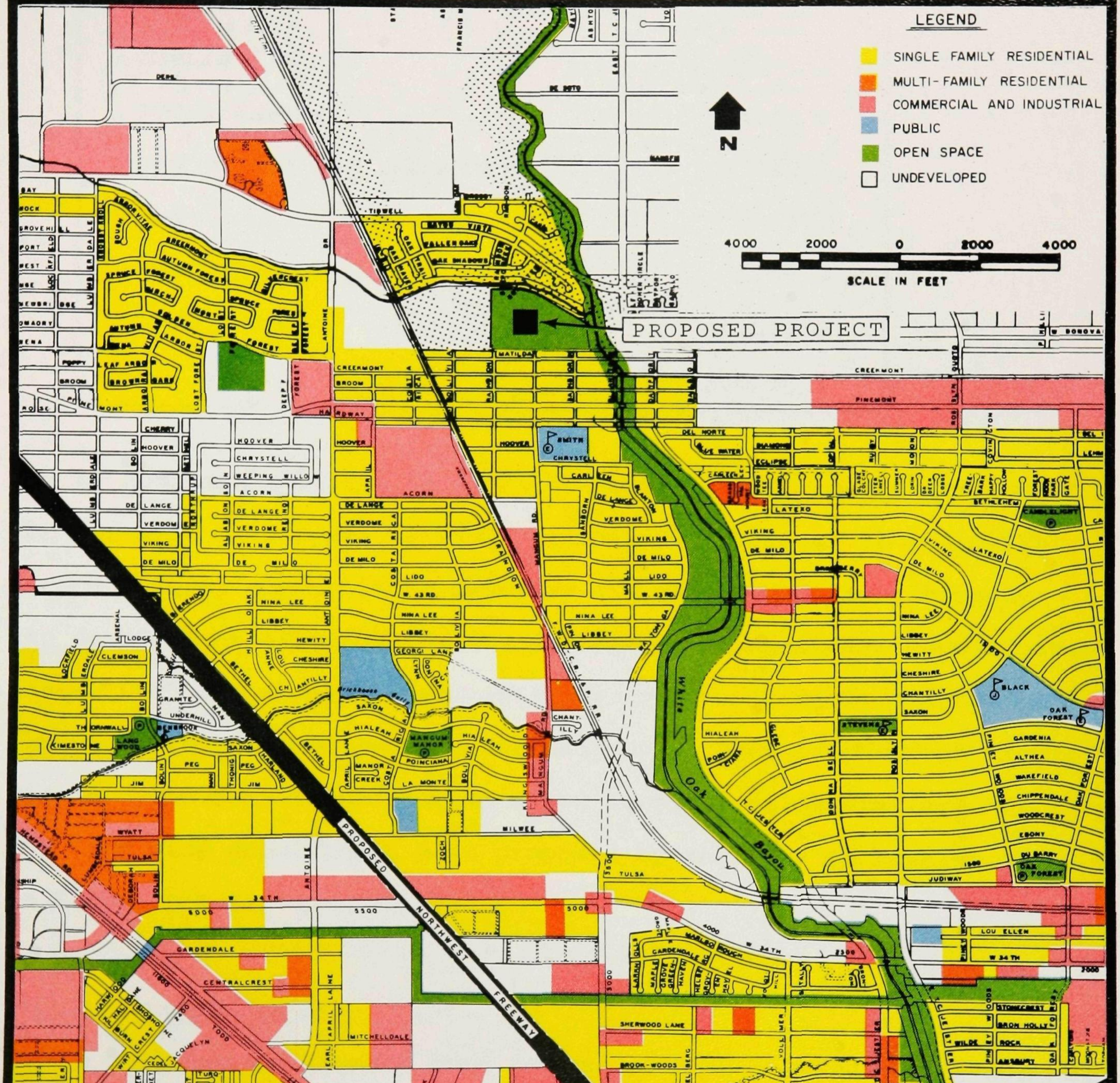


TABLE III-5

EXISTING LAND USE DISTRIBUTION FOR SERVICE AREA

Land Use	Percent
Single Family	29.00 %
Multi-Family	3.16 %
Commercial and Industrial	10.96 %
Public	0.58 %
Open Space	1.18 %
Undeveloped	55.12 %
TOTAL	100.00 %

As Houston continues to grow, the service area of the proposed project will be subject to urbanization. Development of commercial establishments and of light industry can be expected to accompany the development of single-family dwellings and apartment housing associated with the projected population increase. Projected land-use structure for the Northwest District Service Area is shown in Figure III-20. The area should become a low density residential area by 1990. The city wide development plan proposed by the City of Houston is shown in Figure III-21.

2. Transportation

The service area's road system consists mostly of all-weather surfaced roads that are passable all year round. The Northwest Freeway currently under construction passes through the middle of the service area diagonally bisecting the area in the southeast-northwest direction. The major north-south transportation arteries for the service

FIGURE III-20

PROJECTED LAND USE

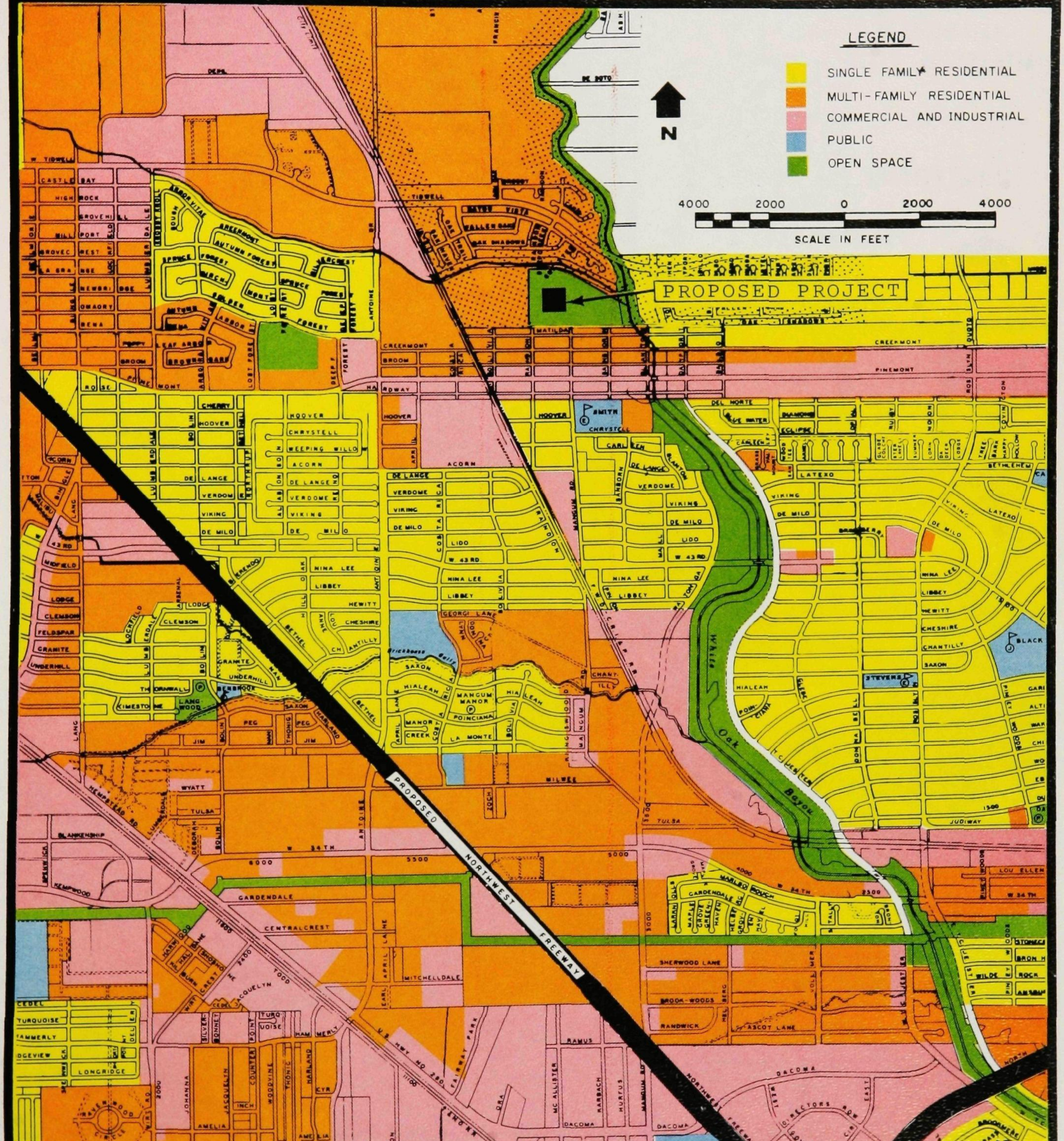
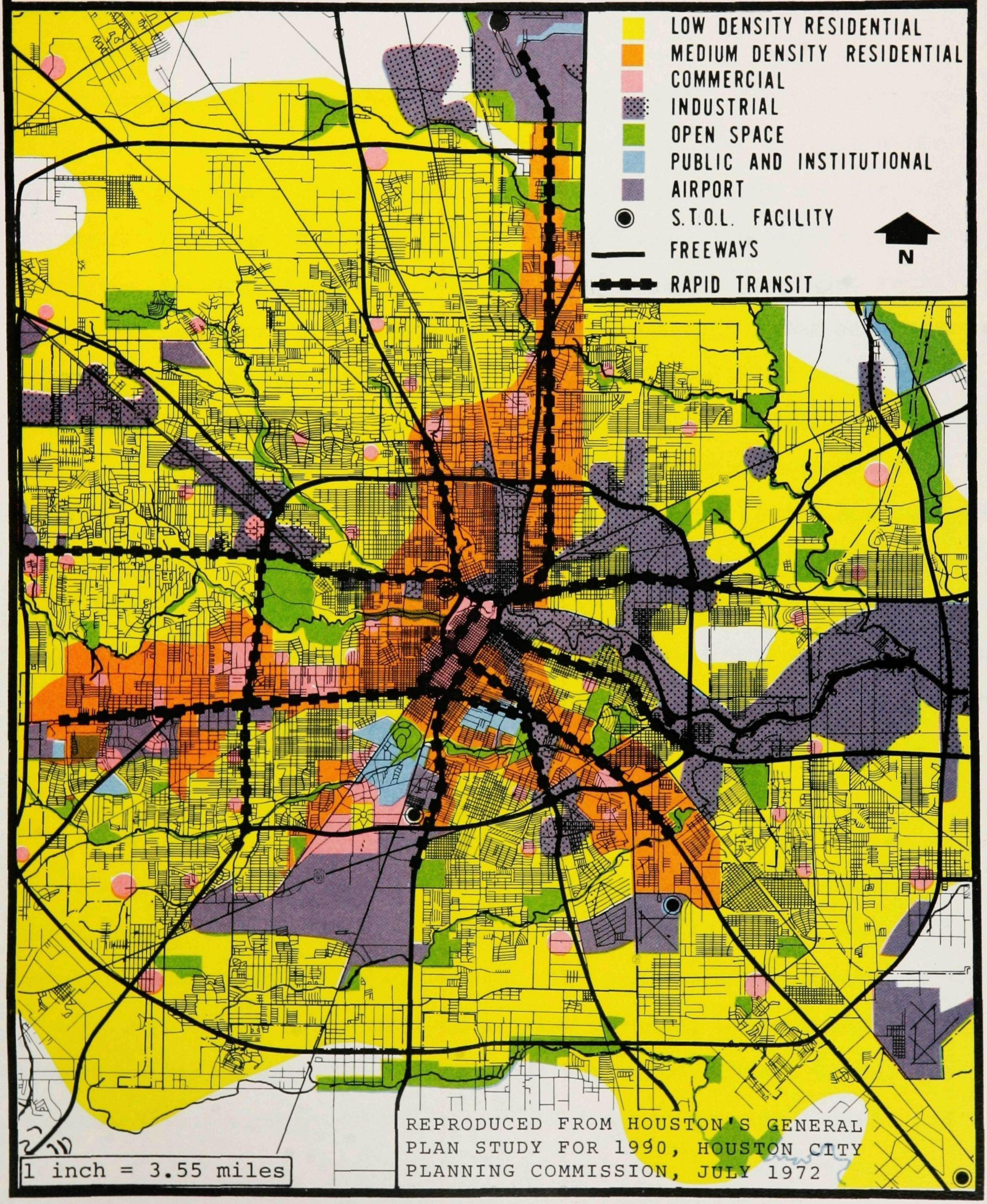


FIGURE III-21

CITYWIDE DEVELOPMENT PLAN FOR HOUSTON



REPRODUCED FROM HOUSTON'S GENERAL PLAN STUDY FOR 1990, HOUSTON CITY PLANNING COMMISSION, JULY 1972 area are Hempstead Road and North Houston-Rosslyn Road. The major east-west arteries are Pinemont and Little York Roads. The construction of Northwest Freeway, when completed, will facilitate accelerated development of the area.

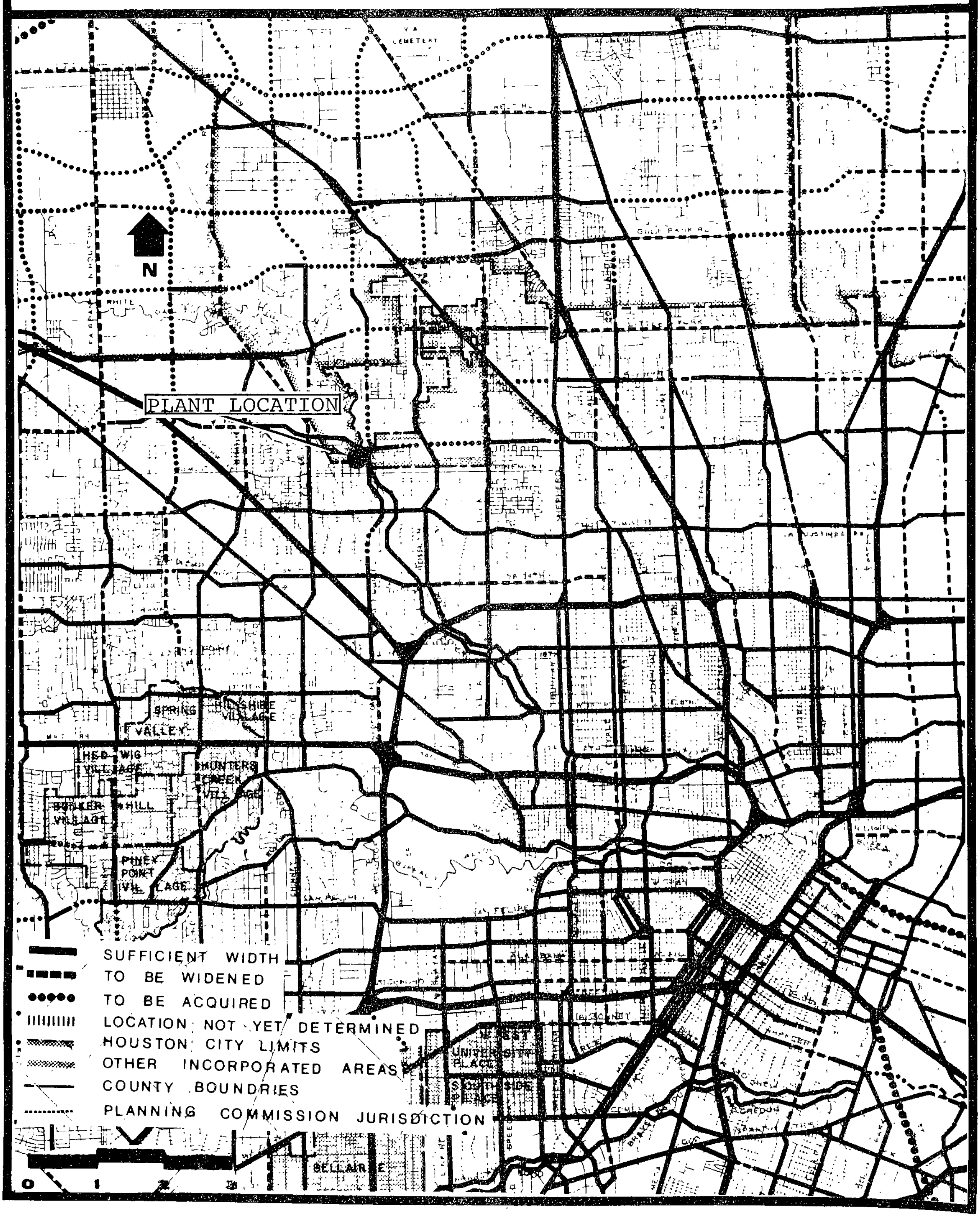
Figure III-22 shows the existing and proposed transportation network for the project area and surrounding vicinities, including the proposal on a rapid transit system recently prepared by the City of Houston. The transit system will have a far-reaching impact on the southeast section of the service area. The transit corridors radiating from the Central Business District along Katy Freeway and portions of Loop 610 will drastically alter the growth pattern of the service area projected for 1990. High density, concentrated development will inevitably take place, particularly around the transit stops. The energy crisis may well turn the transit development into a serious possibility. The actual 1990 population and employment will then far exceed the projections presented in this report. The need for an expanded system of wastewater treatment facilities will increase proportionately. The City of Houston should be prepared to respond to this situation.

3. Needs of the Service Area

A stimulating living and working environment must have public services, i.e., water, sewer, solid-waste disposal, parks, streets, schools, public safety and so forth. The project area urgently needs an adequate waste treatment system. The proposed project will improve water quality in Cole Creek, White Oak Bayou and Buffalo Bayou, the Houston Ship Channel, and will help the city to provide a clean and

FIGURE III-22

PROPOSED TRANSPORTATION NETWORK



safe environment for the citizens of the project area. The area is subject to substantial growth, and it is obvious that adequate sewage treatment is urgently needed if critical health problems are to be avoided.

As estimated, 4.70 mgd of wastewater is currently generated by the service area, which is served by the Northwest Plant. This is 0.7 mgd beyond its design capacity. The excess sewage is currently handled by septic tanks in some parts of the service area. Increased land use activities in the area will cause additional sewage generation in the future. The projected population of 90,000 persons for the service area will generate a total of 10 mgd of wastewater. The need for the expansion of the Northwest Plant to a design capacity of 12 mgd by 1990 is evident.

4. Other Projects in the Service Area

The only known major project occurring in the service area at the present time is the construction of the Northwest Freeway. The Army Corp of Engineers has proposed that Cole Creek be concrete-lined and that the lining of White Oak Bayou be extended. This project is expected to commence in 1978 and be completed within five years from that date. A number of private projects are currently underway for the service area, mostly apartment and townhouse housing complexes, further intensifying the need for the construction of the proposed Northwest Sewage Treatment Plant.

CHAPTER IV: ALTERNATIVES TO THE PROPOSED ACTION

A. GENERAL

B. MAJOR OBJECTIVES

C. CONSTRAINTS AND CONDITIONS

D. STRUCTURAL AND NON-STRUCTURAL ALTERNATIVES

E. TREATMENT SUBSYSTEMS ALTERNATIVES

F. CHOSEN TREATMENT SYSTEM
(SINGLE ALTERNATIVE REFLECTING SUBSYSTEM CHOICE)

G. No Action Alternative

IV. ALTERNATIVES TO THE PROPOSED ACTION

A. GENERAL

This section surveys various non-structural, structural, and treatment-system alternatives within the established framework of major objectives, conditions and constraints.

B. MAJOR OBJECTIVES

The major objectives of the proposed action are:

1. Regionalization of wastewater treatment facilities.
2. Accomodation of increased wastewater treatment demands resulting from new growth and development.
3. Reduction of water pollution levels in streams receiving inadequately treated effluent and maintenance of adequate water quality levels in the future.
4. Compliance with state and Federal Environmental Quality regulations.
5. Protection of public health and safety.
6. Improvement of aesthetic performance related to sewage collection, treatment and disposal.

C. CONSTRAINTS AND CONDITIONS

U.S. Environmental Protection Agency and Texas Water Quality Board requirements, regulations and standards relating to discharge of treated wastewater, including TWQB Waste Control Order No. 10495, must be satisfied.

1. Environmental Protection Agency Standards

The Federal Water Pollution Control Act Amendment of 1972 established a national system for preventing, reducing, and eventually elminiating water pollution. Under the National Pollutant Discharge Elimination System (NPDES), all point sources (including publicly owned treatment works) must obtain a permit for the discharge of wastewater to the navigable waters of the United States. For publicly owned treatment works, the initial objective is secondary treatment, followed by the best practicable treatment technology.

The minimum level of effluent quality attainable by secondary treatment as defined by EPA is summarized below:*

BOD_5 and Suspended Solids

1. The arithmetic mean of 30 consecutive days value not to exceed:	30 mg/l
2. The arithmetic mean of 7 consecutive days value not to exceed	45 mg/l
3. The overall removal efficiency based on 30 consecutive days of influent and effluent monitoring not to be less than	85%

Fecal Coliform Bacteria

1. The geometric mean in a period of 30 consecutive days shall not exceed	200 per 100 ml
2. The geometric mean in a period of 7 consecutive days shall not exceed	400 per 100 ml

pH

The effluent value for pH shall remain within the limits 6.0 to 9.0.

2. Texas Water Quality Board Standards

The Board prescribes a sewage treatment process capable of producing an effluent having an average monthly BOD_5 of 20 mg/l

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*Federal Register, Appendix D, EPA Water Programs Secondary Treatment Information, August 17, 1973, Vol. 38, No. 159, Washington, D. C.

or less, an average monthly TSS of 20 mg/l or less, and a chlorine residual of at least 1.0 mg/l.

Texas Water Quality Board Order No. 71-0819-1 and Addendum requires that the City of Houston abandon certain obsolete sewage treatment plants and divert wastes from these plants to regional and subregional wastewater treatment plants. This order also requires the City of Houston to eliminate a recurring overflow of untreated sewage into natural water systems.

Texas Water Quality Board Control Order No. 10495 specifies the effluent standards imposed upon discharges from all sewage treatment plants in Houston, including the Northwest Sewage Treatment Plant. The TWQB standards require effluent having the following quality:

Average monthly BOD_5	20 mg/l or less
Average monthly TSS	20 mg/l or less
Average daily TSS	25 mg/l or less
Individual sample BOD_5	30 mg/l or less
Individual sample TSS	30 mg/l or less
Residual chlorine after a contact time of 20 minutes at peak flow	1.0 mg/l or less

The Texas Water Quality Board Order No. 74-0122-2 directs the City of Houston to:

1. Initiate monitoring and evaluation procedures of load capacities at various treatment plants, lift stations, and sewers.
2. Develop a comprehensive plan to build additional facilities to satisfy future collection, treatment, and disposal demands.
3. Restrict wastewater loading at existing facilities until additional capacity can be provided.

The order also requests a waste load report, which the City of Houston first submitted in March, 1974, and will update at six months intervals.

3. Scope of the Proposed Project

The existing Northwest Regional Wastewater Treatment Plant was proposed in the 1960 Master Plan. The first increment of 4.0 mgd was put into operation in January, 1970. The second increment of 8 mgd, presently being designed, will expand the plant capacity to 12.0 mgd. The expanded plant will provide secondary biological treatment using completely mixed system with sludge reaeration. The waste sludge will be transported to the Northside Multi-Regional Sludge Disposal Plant for treatment and disposal. The scope of this project is limited to addition of an 8 mgd facility to the existing plant.

a. Physical Considerations

The area to be served by the proposed project is located in the northwest section of Houston. The area boundaries are quite irregular. The terrain is generally flat. The area slopes from an elevation of about 100 feet above mean sea level in the northwest to an elevation of 60 feet in the southwest. White Oak East Bayou and its tributaries, Cole Creek and Brickhouse Gully, provide drainage outlets for all of the study area except a small segment in the southwest corner, which is drained by Spring Branch. Portions of the service area lie within the 100-year flood prone areas.

b. Political Jurisdictions and Agencies Involved

Except for a portion of Acres Homes, the area to be served by the proposed project lies within the corporate limits of the City of Houston. Several other political jurisdictions and agencies involved are:

1. Harris County
2. The Gulf Coast Waste Disposal Authority
3. The Houston-Galveston Area Council of Governments
4. The Texas Water Quality Board
5. The U.S. Environmental Protection Agency.

c. Economic and Financial Considerations

The total cost of this project must lie within the financial capabilities of the government sponsoring agency or agencies as the case may be. The treatment and transporting facilities must be efficiently designed to meet the objectives of the proposed action and also to minimize capital costs and subsequent operation and maintenance costs.

D. STRUCTURAL AND NON-STRUCTURAL ALTERNATIVES

1. Non-Structural Alternatives

These include policy options available to the City of Houston for guiding growth and development in the service area, and for collection, treatment and disposal of wastewater and pollution control.

a. Control of Growth and Development

The City of Houston does not have a zoning ordinance or comprehensive plan for guiding and controlling the growth of the city. It has, therefore, attempted to influence growth through:

- Use of its authority to approve subdivision plats.
- Issuing and enforcing building permits.
- Construction and extension of streets, parks, sewer lines, water mains, drainage systems, and other public services.

The city will continue to exert some control over private development of the service area in this manner.

b. Control of Collection and Disposal of Wastewater

The city's statutory policy as defined in the code of ordinance imposes the following limits on the sanitary sewer system:

- Limitation of total wastewater quantity discharged into the sanitary sewer system. This is controlled by sewer line connection permits and applies to all sewer users.
- Limitation of wastewater quality discharged into the sanitary sewer system by industrial users.
- Imposition of sanitary sewer rates charged as a function of quantity.
- Imposition of sanitary sewer rates charged as a function of quality.
- Prohibition of certain types of harmful discharges into the system by the industrial users.
- Restriction on excessive discharges caused by storm or overflow conditions into the system.

The city will endeavor through use of these non-structural alternatives outlined above to keep growth of development in the service area in balance with wastewater collection, treatment, and disposal system capacities.

2. Structural Alternatives

These include evaluation of those system alternatives which govern:

- Treatment process selection
- Design and construction of treatment facilities, and
- Wastewater collection, transport and disposal systems.

These structural alternatives are examined in detail in Section F. However, the policies that guided the development of all structural alternatives are discussed below:

- Whether the service system should be centralized or decentralized.
- Where the plant should be located
- Where and how sewers should be routed.

It should be mentioned that the structural alternatives to the project elements would be applied in conjunction with the non-structural policies previously outlined. These structural alternatives must exist in a state of economic balance when non-structural policies are implemented.

a. Centralized vs. Decentralized Systems.

The general policy of the Texas Water Quality Board is to require elimination of small plants and encourage centralization of facilities wherever possible, as well as to prohibit construction of additional small plants.

The policy for regionalization of wastewater systems has been adopted to:

- Permit improved planning and coordination of wastewater collection and treatment activities.

- Facilitate application of new technology.
- Allow more efficient monitoring of effluent by regulatory agencies.
- Economize the construction and operating costs.
- Reduce the present inventory system by selecting equipment compatible with other regional plants.

Policies pursued by the Gulf Coast Waste Disposal Authority, the Houston-Galveston Area Council and the City of Houston are in complete agreement with the regional approach to wastewater collection and treatment systems for the Houston area. The proposed project represents action on the part of the city to implement this policy.

b. Plant Location Alternatives

Sewage treatment plant location should be sensitive to the constraints imposed by system design; land cost and availability; and the nature of surrounding development, both existing and planned. Plant location should be sensitive also to the environmental constraints defined by the characteristics of soil, geology, topography, drainage pattern and water courses, quality of water, air and related ecological factors.

Where wastewater collection can be accomplished through use of gravity flow systems, accompanying treatment plants are normally located in an area of low elevation, preferably adjacent to a natural watercourse which can serve as the receiving stream for the treated effluent. Such locational arrangements can minimize the cost of sewage collection by reducing the number and size of lift stations required to move wastewater to treatment plants. Since treatment plants often require a large amount of land, they should usually be located in areas where lands are available and costs are relatively low.

For the Northwest Treatment Plant, an optimum location will be that which will minimize cost of collection, treatment and disposal, and at the same time will cause minimum adverse effects on both the immediate vicinity of the plant and its service area. In addition, the treatment plant will be located with respect to the sludge treatment areas (Northside Plant) in such a manner that sludge conveyance costs will be minimum. Keeping these objectives in mind, the following alternative locations were analyzed and evaluated to determine the optimum location of the proposed facility.

<u>Location 1</u>: A new plant of 12 mgd will be located at the now abandoned Forest West Plant site at Cole Creek and Antoine Drive. The Northwest Plant will be closed.

<u>Location 2</u>: The location at the Northwest Plant as proposed in this report.

<u>Location 3</u>: The proposed location (Northwest) will be expanded by 2 mgd and another 6 mgd plant expansion will be at the West Forest Plant. This together with 4 mgd existing facility at the Northwest Plant will handle the projected 12 mgd need.

A more elaborate description of the above alternatives is presented in Appendix I. Under each alternative, sludge will be transported to the Northside Plant for treatment and disposal.

A detailed comparative evaluation of these alternative locations and the selection of the optimum site is also enclosed in that Appendix. The results of that analysis indicate that the plant location can be optimized by locating the plant on a suitable site already owned by the city. That site is located at the Cole Creek and Randon Street. Appendix I further indicates that the proposed location of the Northwest site is by far the best location among the three alternatives considered. This determination has been based on the evaluation of a total of 12 location factors, ranging from the objective of regionalization of the citywide treatment system to the aesthetic consideration for plant construction (See Table I-1 in Appendix I).

c. Routing of Sewers

Sewer routes should:

1. Minimize sewer length where practical to do so;
2. Utilize existing utility easements held by the City of Houston wherever possible to avoid the expense of acquiring new rights-of-way; and
3. Provide adequate service to the service area.

E. TREATMENT SUBSYSTEMS ALTERNATIVES

A wastewater treatment and disposal system, such as the proposed Northwest project, consists of several component subsystems. These subsystems include: treatment processes, disinfection, effluent disposal and sludge transport.

A variety of alternatives are available for each subsystem. These alternatives are listed below. Based on considerations of technology, cost, U.S. Environmental Protection Agency and Texas Water

Quality Board effluent requirements, and the nature of the city's existing sanitary sewer system, most optimal alternatives for each subsystem were selected and then combined and reviewed as a unified collection, treatment and disposal system. Technical details of these alternatives are given in Appendix J.

1. Treatment Processes

Treatment process alternatives are limited by effluent quality, reliability and operation under variable loading conditions, expansion opportunities and economies. The following alternatives were evaluated before the final selection was made:

a. Septic tanks

b. Primary treatment only

c. Secondary treatment
    (i) Oxidation Pond
    (ii) Trickling Filter
    (iii) Activated Sludge

d. Advanced treatment

A more elaborate description of each of these options is included in Appendix J. A critical evaluation of these processes is given in Table IV-1. In order to evaluate the systems, the ratings* Satisfactory (S), Questionable (Q), and Unsatisfactory (U) for different areas of environmental quality have been used. The scores S, Q, and U are added together to obtain the most desired system. The activated sludge process ranks highest and has been selected for proposed action.

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* These ratings were assigned to each alternative in the most objective manner possible based on the professional expertise and judgments of the required interdisciplinary team that was responsible for this study.

TABLE IV-1

WASTEWATER TREATMENT PROCESS EVALUATION

Treatment Process Options	Effluent Quality Compliance		Land Area Required	Improvement of Aesthetic Performance		Protection of Public Health and Safety	Reliability	Operation under Variable Loading Condition	Ease of Expansion or Process Addition	Economics	Total Rating			Remarks
	BOD	SS		Visual	Odor						S	Q	U	
Septic Tanks	U	U	U	Q	Q	U	Q	U	U	S	1	3	6	Rejected
Primary Treatment Only	U	U	S	S	S	S	S	U	S	S	7	0	3	Rejected
Secondary Treatment:														
Oxidation Pond	U	U	U	U	Q	Q	Q	U	U	S	1	3	6	Rejected
Sedimentation & Trickling Filter	Q	Q	Q	Q	S	Q	S	S	Q	S	4	6	0	Rejected
Activated Sludge	S	S	S	S	S	S	S	S	S	S	10	0	0	Selected
Advanced Waste Treatment	S	S	S	S	S	S	S	S	S	U	9	0	1	Rejected

KEY:

S = Satisfactory
Q = Questionable
U = Unsatisfactory

2. Disinfection Alternatives

Disinfection of treated effluents prior to final discharge into the receiving bodies of water is necessary to insure destruction of pathogenic organisms found in domestic wastewater, thereby avoiding hazards to public health. Disinfection is generally accomplished by (a) ozonation or (b) chlorination with gaseous chlorine or hypochlorite solution. The following options were investigated. Details of these options are discussed in Appendix J.

a. Ozonation
b. Chlorination using gaseous chlorine
c. Chlorination using hypochlorite solution (chosen).

3. Effluent Disposal Alternatives

The treated effluent must be discharged into the receiving waters without any adverse effect upon the public health and well-being. The following options were evaluated. A detailed discussion of these options is included in Appendix J.

a. Ocean outfall
b. Natural evaporation
c. Artificial evaporation
d. Irrigation
e. Industrial reuse
f. Ground water recharge
g. Diversion to distant inland waters
h. Discharge into adjacent water system (chosen)

4. Sludge Disposal Alternatives

Solids separated from the liquid portion of the wastewater during treatment generally require additional treatment before ultimate disposal. Sludge handling and disposal is relatively costly and is associated with environmental problems such as air and land pollution. Sludge treatment may consist of:

a. Stabilization to further reduce the organic fraction of sludge solids;

b. Conditioning by chemicals to enhance dewatering and handling;

c. Dewatering to reduce the volume of sludge requiring ultimate disposal.

Ultimate disposal operations may take the form of incineration or wet air oxidation or land disposal.

a. On-Site Treatment and Disposal (Rejected)

Satisfactory treatment and disposal of sludge normally require highly sophisticated installations and operations if environmental pollution is to be minimized. Such facilities and operations are relatively uneconomical when constructed and operated to treat only small volumes of sludge. At the Northwest Regional Wastewater Treatment Facility, approximately 9 tons of sludge will be produced per day. This is a relatively small quantity. Highly sophisticated installations requiring full-time skilled operators cannot be economically justified for such a small size operation.

b. Off-Site Treatment and Disposal (Chosen)

Since satisfactory treatment and disposal of sludge on-site is neither practical nor economical in view of the volume of sludge involved, the sludge is to be transported via force main to the existing Northside Multi-Regional Sludge Disposal Plant which provides a full range of treatment processes including ferric chloride chemical conditioning, vacuum filter dewatering, flash drying, and ultimate disposal by sale as a soil conditioner/fertilizer. By treating large quantities of sludge at one central location, the unit capital cost could be lowered due to the economy of scale. Furthermore, this alternative will maximize utilization of already existing equipment at the multi-regional sludge disposal facility. Operational labor requirements for incremental capacity will also be kept at a minimum by expanding the existing multi-regional sludge disposal facility. Therefore, in the interest of economy and environmental control, off-site sludge treatment has been chosen.

5. Summary of Subsystem Alternatives and Selected System

Table IV-2 lists the subsystem alternatives which have been discussed in this section and Appendix J. A summary of competing wastewater treatment, disinfection, effluent disposal and sludge handling systems and optimum alternatives are given in Figure IV-1.

F. TREATMENT SYSTEM (SINGLE ALTERNATIVE REFLECTING SUBSYSTEM CHOICE)

The treatment system chosen for the proposed project consists of secondary treatment using the activated sludge process, followed by disinfection of the effluent through chlorination with hypochlorite, and discharge of the treated effluent into Cole Creek at a point adjacent to the plant site. The sludge will be processed off-site

FIGURE IV-1

SUBSYSTEM AND SYSTEM ALTERNATIVES
PROPOSED NORTHWEST REGIONAL WASTEWATER FACILITIES

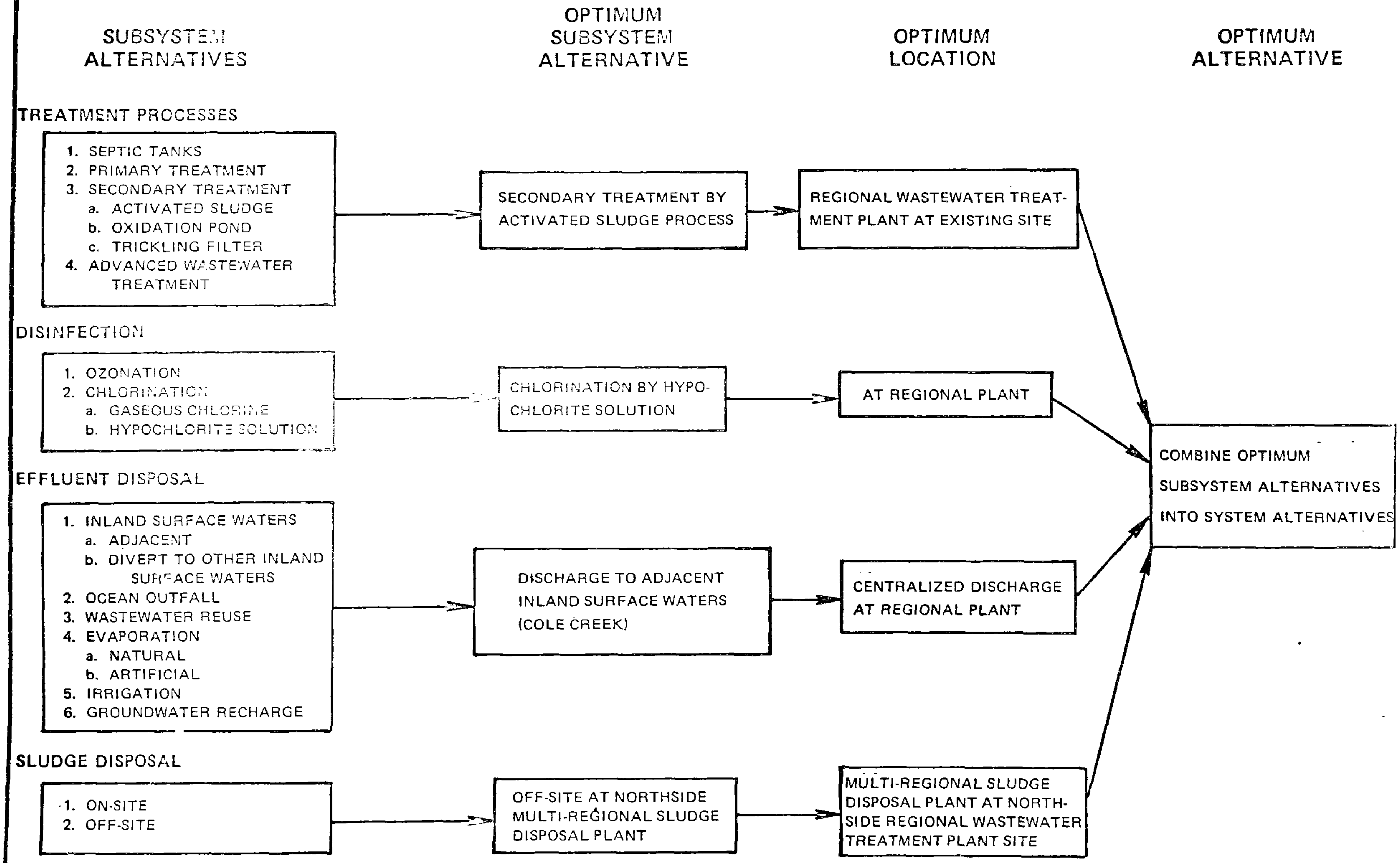

TABLE IV-2: WASTEWATER TREATMENT-DISPOSAL SUBSYSTEM ALTERNATIVES AND RELATED WASTEWATER FACILITIES

(R) Rejected (C) Chosen

Treatment Processes

1. Septic tanks (R)
2. Primary treatment only (R)
3. Secondary treatment
    a. Activated Sludge (C)
    b. Oxidation Pond (R)
    c. Trickling Filter (R)
4. Advanced treatment (R)

Disinfection

1. Ozonation (R)
2. Chlorination
    a. Gaseous chlorine (R)
    b. Hypochlorite solution (C)

Effluent Disposal

1. Discharge to adjacent inland waters (C)
2. Diversion to other inland waters (R)
3. Ocean outfall (R)
4. Re-use (R)
5. Natural evaporation (R)
6. Artificial evaporation (R)
7. Irrigation (R)
8. Groundwater recharge (R)

Sludge Disposal

1. On-site (R)
2. Off-site (C)

at the Northside Regional Sludge Disposal Plant by chemical conditioning (ferric chloride), dewatered by vacuum filtration, flash dried, and sold as a soil conditioner/fertilizer.

The treatment system chosen for this project has been judged to be the most cost-effective method for wastewater treatment and disposal within the service area. The system would conform to the U.S. Environmental Protection Agency and Texas Water Quality Board requirements and standards.

The primary advantage of the chosen system over other possible combinations of subsystems is its compatibility with other treatment plants and facilities operated by the City of Houston. The city operates 16 other large wastewater treatment plants using the activated sludge process and two major sludge disposal plants using the vacuum filtration, flash drying, bulk soil conditioner/fertilizer product process. Each of these plants and facilities uses standardized equipment and machinery, minimizing the need for a large inventory of spare parts and equipment within the citywide system. Being relatively standardized, the plants can be operated effectively by personnel familiar with the processes involved but not necessarily familiar with a specific plant.

The processes chosen are the most flexible of the choices available. Activated sludge units can be operated in several different modes depending on the influent flows and concentrations. Duplication of units allows shifting of loads in the event of equipment downtime due to failure, repair, or maintenance. The chosen sludge disposal process produces a marketable product, which reduces the cost of overall operation and maintenance.

G. NO ACTION ALTERNATIVE

If the proposed action were not to be implemented, the existing Northwest Regional Wastewater Treatment Plant will soon become overloaded. Also, wastewater in excess of 4.0 mgd will be bypassed at the existing Northwest Plant into the Cole Creek. The following adverse effects would result:

- Continuation of inadequate wastewater treatment and disposal in the service area of the project.
- Intensification of water pollution in Cole Creek, White Oak Bayou and other streams.
- Aggravation of public health hazards to residents of the service area.
- Loss of opportunities for orderly development and economic growth of the areas to be served.
- Failure of the City of Houston to fulfill the commitment it has made to the service area residents.

The "No Action" alternative does not meet any of the objectives established for the proposed action nor the goals and policies of the City of Houston, the Texas Water Quality Board, and the U.S. Environmental Protection Agency. The "No Action" alternative, therefore, should not be considered as a solution to the defined problem of inadequate sewage treatment facilities in this area of the city.

CHAPTER V: DESCRIPTION OF PROPOSED ACTION

A. GENERAL

B. DESCRIPTION OF EXISTING NORTHWEST PLANT

C. DESCRIPTION OF PROPOSED TREATMENT FACILITY

V. DESCRIPTION OF PROPOSED ACTION

A. GENERAL

The Northwest Regional Wastewater Treatment Project will affect two existing treatment facilities. The existing Northwest Plant will be enlarged to a total average design capacity of 12.0 mgd by 1977. The waste sludge generated at this plant will be transported to the Northside Multi-Regional Sludge Disposal Plant for treatment and disposal. The scope of the action is limited to the 8 mgd expansion of the existing Northwest Plant.

B. DESCRIPTION OF EXISTING NORTHWEST PLANT

The existing Northwest Treatment Facility began operation in January, 1970. It provides secondary treatment to an average design flow of 4.0 mgd. This flow includes approximately 0.2 mgd diverted flow from the Forest West plant, which has recently been phased out. Figure V-1 indicates the location of the Forest West and Northwest Plants. The treatment process "Diffused Air Activated Sludge"*, as defined by the City of Houston, is neither a true conventional activated sludge nor a contact stabilization process. However, the flow pattern would classify the process as contact stabilization. A general discussion of "Diffused Air Activated Sludge" as defined by the City of Houston and related design criteria

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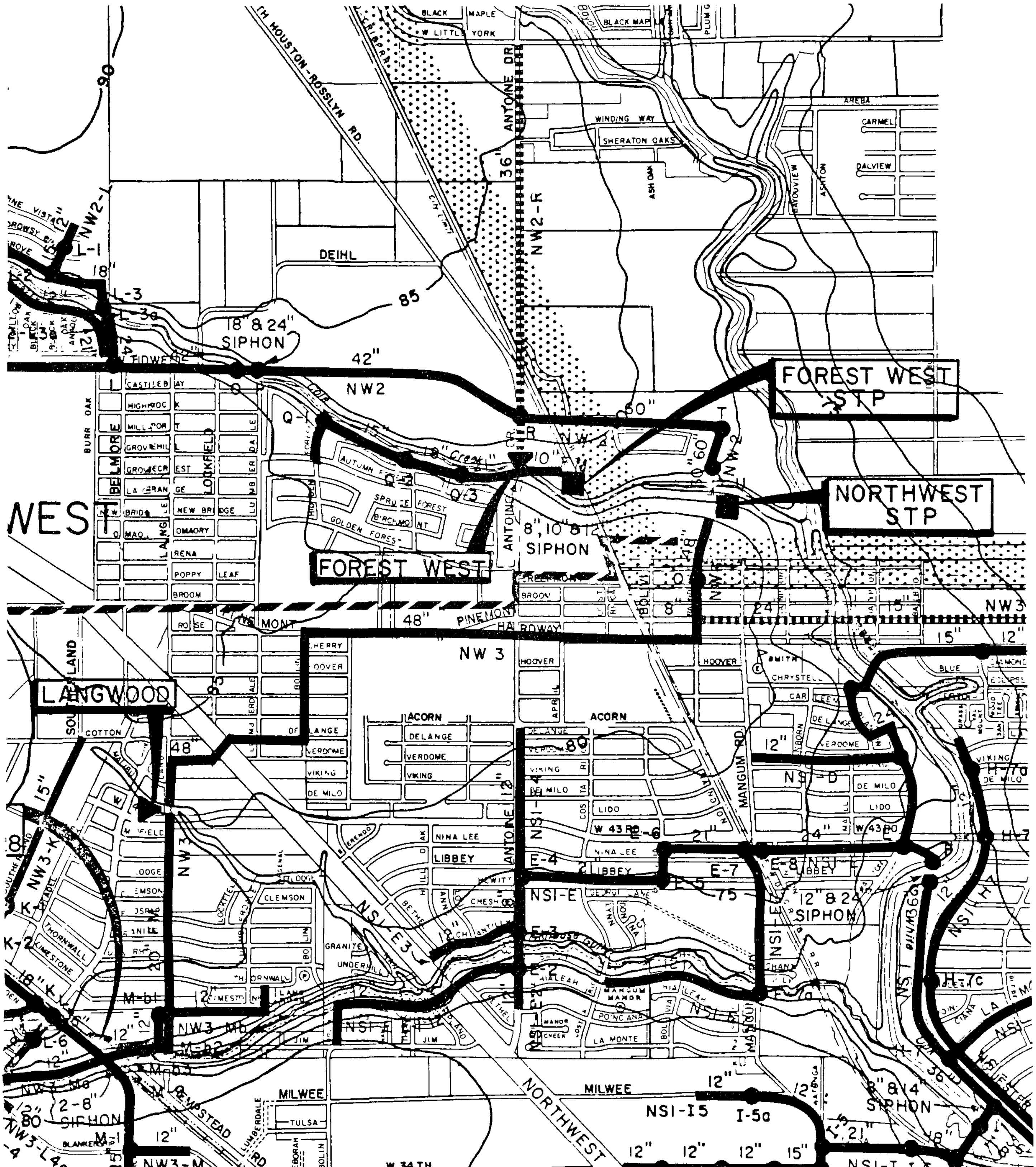
*"Analysis of Excess Flow Treatment Costs at Wastewater-Treatment Plants Not Receiving Transfer Sludge, 1974", City of Houston, the Department of Public Works, Job No. 347. Binkley and Holmes, Inc., Consulting Engineers, Houston, Texas.

PRESENT TREATMENT PLANT
PROPOSED PLANT EXPANSION
COLE CREEK
POSSIBLE PLAYGROUND
ANTOINE DRIVE
RANDON ROAD
PINEMONT
F.W. AND D. R.R.
WHITE OAK BAYOU
N
1 INCH = 525.0'

FIGURE V-1

EXISTING AND PROPOSED INTERCEPTOR SYSTEM FOR THE SERVICE AREA



are summarized in Appendix K. Also, a description of the contact stabilization process is provided in this Appendix for comparison purposes.

1. Process Description

Influent raw sewage is lifted into the plant from the lift station which passes through a bar screen for removal of gross solids. It then flows into the influent channel and then into an aerated basin where it is mixed with reaerated sludge. The organic matter and the nutrients are absorbed or adsorbed by the microbial cell. The flow then passes into the clarifier where the microbial cells are removed as sludge. The clarified effluent is chlorinated by sodium hypochlorite solution prior to discharge into Cole Creek.

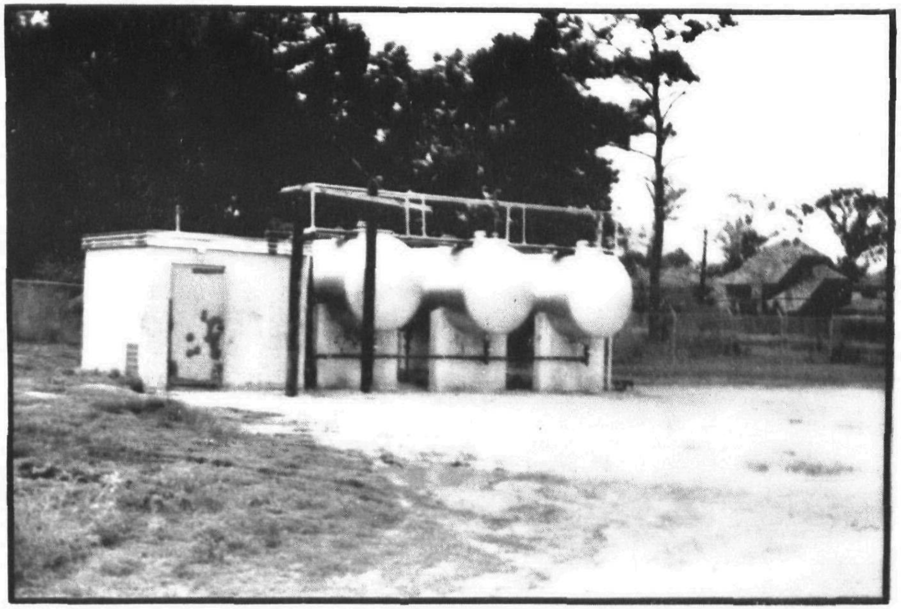
Most of the sludge from the clarifier is pumped into the reaeration channel for stabilization of assimilated food into the cell. This sludge is subsequently mixed with incoming waste. Excess sludge is wasted and pumped through an 8-inch force main to a 24-inch gravity trunk sewer, which is enlarged to a 48-inch line. This trunk sewer flows to the 11th Street Lift Station, where it is transported for treatment and eventual disposal at the Northside Multi-Regional Sludge Disposal Plant.

2. Plant Design Criteria

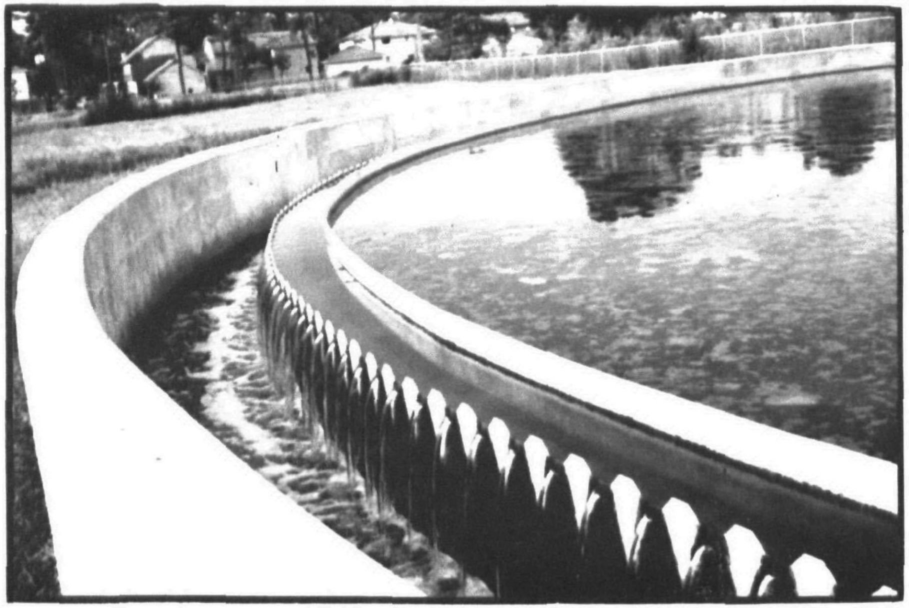
The basic design criteria used for this plant is summarized in Table V-1.

FIGURE V-2 PLANT DETAILS FOR EXISTING NORTHWEST TREATMENT PLANT

AERATION AND REAERATION TANKS



HYPOCHLORITE STORAGE FACILITIES



CLARIFIER

OUTFALL SEWER

TABLE V-1

DESIGN CRITERIA FOR EXISTING NORTHWEST TREATMENT PLANT

Item Description	Design Criteria Used
Year Completed	January, 1970
Influent Quality	
BOD_5	0.17 lb/capita
Suspended Solids	0.20 lb/capita
Industrial Loading	None
Design Capacity	
Average Design Flow (ADF)	4 mgd
Maximum Hydraulic Loading	12 mgd
Lift Station Capacity	8,400 gpm
Aeration System	
Aeration Period	
Aeration Basin	3.36 hrs (based on ADF)
Reaeration Basin	7.92 hrs (Based on ADF)
Solid Concentration	
Aeration Basin	2500-3000 mg/l
Reaeration Basin	8000 mg/l
Air Supply	
Aeration Basin	350 cft/lb of BOD
Reaeration Basin	750 cft/lb of BOD
Total Air Supply	7300 cfm
Clarifier	
Detention Time	2.88 hrs (based on ADF)
Overflow Rate	600 gpd/ft^2 (based on ADF)
Weir Loading	15,000 gpd/ft^2 (based on ADF)
Sludge	
Return Sludge	4 mgd maximum capacity
Waste Sludge	87 gpm at 8000 mg/l
Chlorination	
Contact Time	20 minutes
Chlorine Residual	1 mg/l
Power Requirement	5915 kw hrs per day

Source: Data supplied by Dannenbaum Engineering Corporation, Houston, Texas.

3. Plant Performance

The plant was designed for an average flow of 4 mgd. The average daily flow at the plant is 6.14 mgd*. The effluent quality of the plant is summarized in Table V-2.

TABLE V-2: INFLUENT AND EFFLUENT QUALITY FOR EXISTING NORTHWEST PLANT

Parameter	Value
Average Design Flow	4.00 mgd
Average Flow at the Plant	6.14 mgd
Permitted BOD_5 in Effluent	20.00 mg/l
Permitted Suspended Solids in Effluent	20.00 mg/l
Reported Influent BOD_5	130.00 mg/l
Reported Effluent BOD_5	5.00 mg/l
Reported Influent Total Suspended Solids	282.00 mg/l
Reported Effluent Total Suspended Solids*	14.00 mg/l
Reported BOD_5 Removal Efficiency	96.00%
Reported TSS Removal Efficiency	95.00%

*1973 Average Values based on TWQB Self Reporting Data.

4. Future Plans for Existing Plant

This plant will be enlarged by 1977 to a total average design capacity of 12.0 mgd. The existing plant will be incorporated completely in the expansion and will continue to operate during the construction of the expanded facility.

C. DESCRIPTION OF PROPOSED TREATMENT FACILITY

1. Proposed Plant Capacity

Many wastewater treatment plants bypass a portion of the influent flow during the time when infiltration/inflow is high. The reasons for bypassing raw sewage at a treatment plant include insufficient raw sewage pumping capacity, restricted plant hydraulics and problems associated with washout of biological solids.

Recent Federal regulations have banned the discharge of untreated sewage into receiving streams. Higher quality effluents now require that all the influent wastewater receive some degree of treatment. Therefore, wastewater treatment plants must be capable of treating the total flow expected at the plant. As existing plants are enlarged or upgraded, it will be necessary to include provisions for handling maximum-hour wet weather flows.

The relative quantity of wet weather flow to be treated by each individual plant must be determined from an infiltration/inflow analysis including a cost-effectiveness analysis as prescribed by EPA. Such a study for the Northwest Treatment Plant has been completed.* Based upon the recommendations of this study and the City of Houston design criteria, a wet weather flow of five times the average design flow has been used for this project.

The enlargement of the Northwest Plant will allow treatment of the projected average and daily peak flow from the Northwest service area through the year 1990. This plant should also treat the wet weather flows. The capacity of the proposed plant upon completion of construction in 1977 is presented in Table V-3.

2. Proposed Methods of Treatment

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*"Infiltration/Inflow Analysis Northwest Treatment Plant, City of Houston", WPC-TEX-1020. Dannenbaum Engineering Corporation, June, 1974.

TABLE V-3: DESIGN CAPACITY OF PROPOSED NORTHWEST REGIONAL WASTEWATER TREATMENT PLANT

Flow Condition	Design Capacity, 1990
Average Daily	12.0 mgd
Maximum Dry Weather	18.0 mgd
Maximum Wet Weather	60.0 mgd

a. Process Description

The proposed expansion of the Northwest Plant will have the same flow pattern as the existing plant discussed in Section B.1. above. Details of the process are also given in Appendix K. See Figure II-4, page 17, for a flow diagram of existing and proposed facilities.

The only change in the proposed facility is production of hypochlorite solution at the site. The facility will generate 75 lbs/hour of equivalent chlorine at an electric consumption of 2.0 kw/lb. The electrolyte cells will be arranged in 10.7 lbs/hr modules with each module hydraulically and electrically independent. Each module will require a minimum of 20 gpm of 3.5% salt solution.

b. Design Criteria and Conditions

The design criteria used for design of the expanded facility is summarized in Table V-4. This criteria has been used to meet TWQB Effluent Set 2 Standard (monthly average of 10 mg/l BOD and 15 mg/l suspended solids). As yet, no plant in Houston has been designed and built under this new design criteria for clarifier loading rate used in this design.

TABLE V-4

DESIGN CRITERIA FOR PROPOSED NORTHWEST TREATMENT PLANT

Item Description	Design Criteria Used
Year to be Completed	1977
Influent Quality	
BOD_5	225 mg/l
Suspended Solids	220 mg/l
Industrial Loading	None
Design Capacity	
Average Design Flow (ADF)	12 mgd
Peak Dry Weather Flow	18 mgd
Maximum Hydraulic Loading	60 mgd
Lift Station Capacity	44,800 gpm
Aeration System	
Aeration Period	
Aeration Basin	3.36 hrs (based on ADF)
Reaeration Basin	7.92 hrs (based on ADF)
Solid Concentration	
Aeration Basin	2500-3000 mg/l
Reaeration Basin	8000 mg/l
Air Supply	
Aeration Basin	750 cft/lb of BOD
Reaeration Basin	750 cft/lb of BOD
Total Air Supply	41,700 cfm
Clarifier	
Detention Time	5.52 hrs (based on ADF)
Overflow Rate	360 gpd/ft^2 (based on ADF)
Weir Loading	5,000 gpd/ft^2 (based on ADF)
Sludge	
Return Sludge	20 mgd
Waste Sludge	260 gpm at 8000 mg/l
Chlorination	
Contact Time	20 minutes
Chlorine Residual	1 mg/l
Power Requirement	56,613 kw hrs per day

Source: Data supplied by Dannenbaum Engineering Corporation, Houston, Texas.

c. Plant Performance

The effluent quality at the proposed facility will meet the criteria established by TWQB and the U.S. Environmental Protection Agency. The anticipated quality of incluent and effluent is summarized in Table V-5. Detailed calculations* for developing effluent quality are given in Appendix K.

TABLE V-5: INFLUENT AND EFFLUENT QUALITY FOR PROPOSED NORTHWEST PLANT

Parameter	Expected Value
Influent BOD_5	225 mg/l
Influent TSS	220 mg/l
*Effluent BOD_5	10 mg/l
*Effluent TSS	15 mg/l
Expected Removal Efficiency of BOD_5	96%
Expected Removal Efficiency of TSS	94%
Fecal Coliform	200/100 mg/l
Chlorine Residual	1 mg/l

d. Sludge Treatment Disposal

The excess sludge from the proposed facility will be pumped via an existing 8-inch force main to an existing 24-inch gravity trunk sewer, which enlarges to a 48-inch line, and will flow to the existing 11th Street Life Station, where it is transported to the Northside Multi-Regional Sludge Disposal Plant. At this facility the sludge will be given full-range chemical treatment, including chemical conditioning

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* These calculations which indicate total BOD of 6.2 mg/l and a TSS of 6.0 mg/l (See Page K-11 of Appendix K) are subject to some assumptions on flow variation and related factors. In the actual situation variations in these assumptions may result in a somewhat greater or smaller value of effluent quality than calculated here. In view of the more stringent regulations expected in the future requiring better effluent quality, the City of Houston should keep the option open for incorporating advance treatment for its treatment system, including the Northwest Plant. The inclusion of tertiary treatment such as mixed media or sand infiltration should be given consideration.

prior to vacuum filtration for dewaterizing. The dewatered solids will be flash-dried and then converted into soil conditioner/fertilizer for sale.

e. Land Requirement

The enlargement of the Northwest Wastewater Treatment Plant will be located entirely on the existing 27-acre plant site. It is expected that this site will also be sufficiently large for all anticipated future enlargements.

f. Relationship of this Action with Other Houston Wastewater Facilities Systems Studies

The construction of this treatment-disposal system under the proposed action is consistent with the Master Plan for the city's sanitary sewer system and the city's Wastewater Management Plan. These plans designate the Northwest system to be one of the regional wastewater collection-treatment-disposal systems for the City of Houston. The proposed action is one segment of the expansion of the city's existing sanitary sewer system through its 1973-1979 capital improvement program.

Other recently completed, in process or planned projects in the northwest section of Houston are as follows:

(i) Construction of the White Oak Bayou Regional Wastewater Treatment Plant

This project should be completed in late 1974 or early 1975. The White Oak Bayou Regional Plant is an 0.5 mgd plant located on the bank of the White Oak Bayou in the City of Jersey Village northwest of Houston.

(ii) Westway Utility District Wastewater Treatment Plant

Located northwest of Houston, an 0.1 mgd plant is now in place and plans for expansion from 1.5 to 2.5 mgd are underway. This plant serves a new unnamed residential development.

(iii) Harris County Municipal Utility District No. 6

A recently completed 0.914 mgd wastewater treatment plant is now in operation northwest of Houston, serving a new residential development.

(iv) Northside Multi-Regional Sludge Disposal Plant

The City of Houston is currently adding six additional vacuum filters to the Northside Plant. This will improve the efficiency and capacity of the Northside Plant enabling it to handle the additional sludge from the enlarged Northwest Regional Wastewater Treatment Plant.

(v) Acres Homes Collection System, Phase IV

The final phase of a collection system that provides sewer service to the minority inhabited Acres Homes area located adjacent to the Northwest Regional Wastewater Treatment Plant in northwest Houston. The project is scheduled for completion in early 1973.

(vi) Forest West Diversion

In late 1973, the Forest West Wastewater Treatment Plant (capacity 0.10 mgd) was diverted to the Northwest Regional Wastewater Treatment Plant.

g. Status of Project, April, 1974

(i) Preliminary Engineering Report

Report entitled "Preliminary Engineering Report, Northwest Houston Water Supply Corporation, Phase IV, Acres Homes Area-Harris County, Texas and Expansion of City of Houston Northwest District Sewage Treatment Plant" was completed and submitted to the City of Houston in March, 1973, by Dannenbaum Engineering Corporation, Consulting Engineers, Houston, Texas.

(ii) Plans and Specifications

It is anticipated that the plans and specifications for this project will be finished by the consulting engineers, Dannenbaum Engineering Corporation, by September, 1974.

(iii) Funding of Project

Funding for the City of Houston's portion of this project has been arranged by contract with the Gulf Coast Waste Disposal Authority, which sold the required bonds in November, 1973.

(iv) Timing

The following table presents the anticipated schedule of events related to this project:

Completion of plans and specifications	September, 1974
Beginning of construction	January, 1975
Completion of project	July, 1976

CHAPTER VI: ENVIRONMENTAL EFFECTS OF THE PROPOSED ACTION

A. ENVIRONMENTAL CONDITIONS SHOULD THE PROPOSED ACTION BE IMPLEMENTED

B. SECONDARY IMPACT OF THE PROPOSED ACTION

C. LONG-TERM SECONDARY ADVERSE IMPACT

VI. ENVIRONMENTAL EFFECTS OF THE PROPOSED ACTION

This section identifies the primary and secondary effect of the proposed project on the natural and man-made environment and suggests how the adverse effects could be avoided or minimized while accomodating the need for physical changes in the plant vicinity and the service area.

A. ENVIRONMENTAL CONDITIONS SHOULD THE PROPOSED ACTION BE IMPLEMENTED

1. Construction Impact (Short Term)

Construction activity associated with this project will consist of excavation at the plant site for the sewage treatment plant.

a. Alterations to Land Forms, Streams and Natural Drainage Patterns

There will be no permanent alterations to land forms, streams, or natural drainage patterns other than the installation of the outfall structure. Temporary alterations made during construction will be rectified prior to completion of the construction activity.

b. Erosion Control Measures

Because of the flat character of the area where construction will occur, erosion should not cause any significant problem. In those areas where erosion might occur, it will be controlled through the use of temporary settling ponds and dikes. The construction sites will be graded, seeded and restored to their original condition upon completion of work.

c. Effect of Siltation and Sedimentation on Area Watercourses

It is possible that even with erosion control, some sedimentation and turbidity will occur in the receiving waters of Cole Creek during the construction period. Every precaution will be taken to eliminate possible sources of siltation and sedimentation.

d. Protection for Cover Vegetation and Trees

Cover vegetation and trees will be protected, where possible, by means of fences and wooden slats. Only such growth will be removed from the plant site as is necessary for the construction and subsequent operation and maintenance of the treatment plant.

e. Clearing with Herbicides, Etc.

No herbicides would be used for clearing vegetation on the plant site.

f. Disposal of Soil and Vegetable Spoil

Top soil removed during construction will be stockpiled and subsequently placed on stripped or fill areas. Excess soil will be deposited in the plant site area. Vegetation spoil will be disposed of by burial.

g. Dust Control

Dust control measures, if necessary, will consist of frequent sprinkling with water.

h. Dredging, Tunneling and Trenching

Construction will not require any dredging. The problem of trenching and tunnelling would arise in the installation of a sludge line transporting sludge from the proposed project to the Northside Plant. This facility, however, has already been built and its capacity is adequate to carry the projected sludge volume.

i. Areas Affected by Construction Noise and Precautions

The proposed plant construction will take place at the site of an existing plant. Plant construction will be sufficiently distant from residences so that construction noise will not be a problem in the immediate vicinity. The nearest residential area is to the north of the project across the Cole Creek. There are no residential or commercial activities on the three other sides within 2,000 feet. All sides are well buffered by dense, tall trees and plants.

Construction of the proposed facility will require use of machinery and equipment that will increase ambient noise levels and produce high temporary noise levels. Equipment to be used will include backhoes, power shovels, trucks, and compressors and pumps. Such equipment will generate average noise levels ranging from 70 to 85 dBA. The contractor will be required to minimize the impact of equipment noises as much as possible. Special precautions required to minimize noise levels would be specified in the construction contract to be administered by the City of Houston Public Works Department. The contract will further specify that working hours for the construction crew will be generally limited to daylight hours. Noise impact on wildlife, including birds and insects, will be temporary.

j. Areas Affected by Blasting and Precautions

Due to the nature of the soils in the area, blasting will not be necessary. No precaution is required.

k. Measures to Minimize Vehicular and Pedestrian Traffic Disruption

Since enlargement of this plant will occur at the existing plant site, there will be no disruption of vehicular and pedestrian traffic.

l. Effects of Night Work

The contractor, as a rule, will be required to limit his activity to daylight hours. Night work will be permitted only for special tasks such as line tie-ins which are best performed at night to take advantage of low flow conditions characteristic of such hours. In such cases, the use of flood lights will be restricted to the work site only. No harm to wildlife or serious disturbance to area residents is anticipated as a result of night work.

m. Protection Against Construction Hazards

Construction will be isolated from the public. Provisions requiring the contractors to take all necessary precautions to protect the public and construction workers from such hazards will be included in contract specifications.

n. Land Acquisition and Impact on Land Values

Land has already been acquired for this project. The land at the project site is adequate not only for the construction of the proposed facility but also to accomodate its future expansion as and when that becomes necessary. Because of the availability of improved sewer service, land values are expected to rise for those parts of the service area which are currently served by septic tanks.

o. Relocation

The proposed project will require no relocation.

2. Long-Term Impact

a. Land Affected by Construction

The proposed expansion will be accomodated on vacant portions of the existing Northwest Treatment Plant Site. No additional land purchase will be necessary. The proposed site lies outside the 100-year flood plain. The elevation of the plant site is 75 feet above the mean sea level. The area around the plant is heavily vegetated and has potentials of parks and open space development of recognized aesthetic value within the immediate vicinity. The site plan for the project has been prepared accordingly (see page 17).

b. Beneficial Use of Land in Plant Vicinity

No beneficial use of land in the plant vicinity will be altered by construction of the proposed improvements. Available vacant lands in the immediate area will receive an added stimulus as a result of the multi-functional nature of the proposed project. The park and playground facility incorporated in the site plan will have a beneficial impact on the surrounding area in terms of subjecting lands to quality development.

c. Interference with Natural Views and Present Character of the Area

The proposed facilities will not alter the natural character of the area, nor will they interfere and obstruct natural views of the general area. The addition of the park facility on the site will strengthen the natural character of the project vicinity.

d. Architectural Techniques and Landscaping

Architecturally, the site will be designed to present a low profile for the project structures. Care will be taken to blend the proposed project with the surrounding natural environment. Trees and shrubs will be planted and fences erected where necessary in and around the project site. Grass planting and other landscaping activities will be undertaken to beautify the project environment and enhance its aesthetic values. Ample open lands are available within the designated plant site to provide a neighborhood playground to serve the recreation need of the immediate neighborhood.

e. Relationship of the Project with the Residences and Business, and Prevailing Wind Patterns

There is no commercial or industrial activity within the immediate vicinity of the project. Prevailing winds, for most of the year, originate from the south. There is a residential subdivision to the north of the proposed site across the Cole Creek. Remote possibility exists for occasional odor problems affecting the resident population in the surrounding area since sludge treatment and disposal will not be carried out at the site and odor from the existing treatment process has been virtually none.

f. Incineration

Plans for the proposed project do not include any sludge incineration.

g. Possible Odor Sources and Their Effects

The selection of the proposed treatment process was carefully made to avoid odor sources and their effects as much as possible. Since the plant will not do primary treatment and will utilize the activated sludge process (contact stabilization mode) odor emanating from the treatment site is expected to be minimal except on unusual occasions. Further, the proposed treatment process excludes any primary treatment that can cause odor problems at the plant site. Also, the sludge treatment and disposal which is a major source of odor associated with treatment plants will be handled in another location, reducing the odor sources from the site of the proposed project.

h. Assessment of Potential Odor Problems

The project has been designed to minimize odors. The wastewater treatment plant design requires all influent to be pumped. To prevent odors arising from raw sewage, pumps will discharge the sewage below the surface of the liquid in the aeration tanks. The aeration tank will maintain aerobic conditions in all parts of the tank, thus minimizing any odor problems associated with the treatment process.

No odor problems should arise from the sludge disposal plant since it will be transported to the Northside Plant.

i. Effects on Air Quality

There will be two sources of air pollution from the project activity. The ambient air will be affected by heat, smoke and thermal emissions from the use of construction equipment and machinery. Its effect will be temporary. For further discussion see items "l" and "m" on construction impacts (pgs. 101-102). The other source will include the operation of the plant itself and possible odor sources from the treatment processes. The effects of these have already been discussed in items "g" and "h" in this section (pages 104-105).

The effect of the project on the quality of ambient air will be negligible compared to other sources of air pollution in Houston. However, there will be some additional air pollution problems at the Northside Multi-Regional Sludge Treatment site as a result of the sludge transport from the Northwest Plant. It is estimated that only 1.92 tons per day of volatile gases will be incinerated by the afterburners in the sludge drying process at the Northside Plant as a result of the sludge transport.

A study by the World Health Organization* compared pollutants caused by the automobile with that of municipal incineration for American cities.

Type of Pollutants	Contaminants in lbs/ton	
	Automobile Gasoline	Municipal Incineration
Particulate	0.12	24.0
Carbon Monoxides (CO)	1000.00	Data not available
Sulphur Oxides (SO_2)	5.80	2.0
Nitrogen Oxides (NO_2)	9.00-18.00	2.0
Organic vapors including hydrocarbons	70.00-140.00	1.20

> "Based on the above data, it is estimated that the contaminants to be released from the afterburners as a result of sludge transport per day will be equivalent to the air contaminants generated from the combustion of approximately 270 gallons of automobile fuels per day. Considering contaminants from the ozone treatment for sludge drying, the net effect of the Northwest Plant on air pollution around the Northside Plant is estimated to be equivalent to the combus-

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*Air Pollution, World Health Organization, Columbia University Press 1961.

> tion of 430 gallons of automobile fuels per day. That level of air pollution is only 40% of the air pollution that would be caused per day from the use of automobiles by the number of families that could be accommodated on the Northwest Plant site were it devoted to single family residential homes instead of a wastewater treatment plant. (The total project site = 27 acres, density assumed is seven dwelling units per acre)."
>
> University of Texas at Arlington
> Arlington, Texas

j. Effects on Present Water Quality

The proposed action will comply with the effluent discharge requirements prescribed for the City of Houston by the Texas Water Quality Board and the Environmental Protection Agency. At no time is the quality of the effluent discharge expected to be below those currently required by the agencies. The final effluent from the proposed plant will contain a BOD_5 and TSS levels of 6.6 mg/l and 6 mg/l respectively.

At present, the low flow in the Cole Creek and White Oak Bayou consists mostly of treated wastewater effluent from the existing plant. The increased quantity of effluent to be discharged by the expanded plant should change the condition of Cole Creek and White Oak Bayou from one of periodic low torpid flow to one of steady flow, eliminating the stagnation which often arises during periods of low flow. Minimum flow rates in these streams are expected to increase by 12.0 mgd once the plant capacity reaches saturation in 1990. The corresponding net flow increase by 1980 is projected at 7.5 mgd. The reinforced concrete outfall structure on Cole Creek has been designed to facilitate low discharge velocities for the purpose of minimizing foaming and bank scour.

k. Effects on Aquatic Life

Construction of the proposed project should have, if any, a beneficial effect on the aquatic biota in Cole Creek and White Oak and Buffalo Bayous by reducing the pollutants in these streams. The dissolved oxygen level in the receiving streams will increase as a result of low BOD discharge from the plant effluent. Increased quantity of improved effluent discharged into the bayous will maintain uniform flow conditions even under low flow periods and eliminate stagnant pools which can cause odor problems. These new conditions of water flow will benefit the aquatic life of these streams.

l. Effects of Chlorine Residual on Aquatic Life

The adverse effects of the chlorine residual on normal aquatic life in the receiving streams will be only local since free residual chlorine is short-lived in the natural water system.

m. De-Chlorination

The plans for the proposed project do not include de-chlorination.

n. Effect on Municipal and Industrial Water Supplies and Ground Water

The water of Cole Creek and White Oak and Buffalo Bayous is not utilized for drinking, industrial, irrigational or recreational purposes. The effluent disposal is expected to have no effect upon groundwater since (1) the soil is impermeable and (2) groundwater flows into the bayous. The effluent discharged will not cause any groundwater infiltration. Surface water supplies start over 20 miles northeast of the proposed project and will not be affected. Recreation potentials of the areas along the Cole Creek and Buffalo Bayou will be enhanced as a result of the improved water flow and quality of these bayous.

o. Present and Potential Market for Wastewater Re-Use

Wastewater re-use by industries is a possibility, but no market for such a recycling now exists since an ample and relatively inexpensive supply of water is available in Houston. Water supply projections indicate that available sources will not be exhausted in the Houston Metropolitan Area before the year 2000. However, since the use of underground water for water supply has been proving detrimental to Houston by causing a much concerned subsidence problem, efforts should be directed to recycling of wastewater and re-use. The effluent quality can be improved by additional treatment to conform with the industrial water quality requirements and recycled at least for industrial re-use. A citywide policy will need to be implemented so that re-use of effluent will be possible from all treatment plants in the Houston area.

p. Effects of Re-Use on Receiving Water Quality

There will be no such effects since wastewater will not be re-used in the immediate future.

q. Groundwater Recharge

There is no need, nor is it economically feasible to recharge aquifers with treated wastewater in the forseeable future. The

Houston municipal water supply was formerly derived in full from groundwater and is presently augmented by surface water from three major reservoirs at Lake Houston, Lake Conroe and Lake Livingston. The heavy rainfall in Houston precludes the need for any groundwater recharge from treated wastewater. Further, the projected demand for water supply in Houston can be met by sources without wastewater recharge, provided the problem of subsidence can be addressed.

r. Spray Irrigation

There is no spray irrigation conducted in the service area at the present time, nor will there be any in the future.

s. Diversion of Flows Between Basins

There will be no such diversion under the proposed action.

t. Ultimate Disposal Methods for Grit, Ash and Sludge

Sludge generated by the proposed plant will be conveyed to the Northside Multi-Regional Sludge Disposal Facility by means of an existing sludge force main and gravity trunk sewers.

At the Northside Plant the sludge will be processed into soil conditioner/fertilizer by vacuum filtration and flash drying. The fertilizer will contain five percent nitrogen, three percent phosphoric acid and small amounts of potash. It will be sold in bulk form under the brand name Hou-Actinite to a Florida based citrus firm.

u. Effects on Historic Sites, Recreation Uses or Natural Preserves

The proposed project will not adversely affect any existing historic sites, areas or preserves. Depending on the goals and policies of the City of Houston, the impract of the proposed project on the parks and open space development could be highly beneficial. Implementation of the regionalization sewage system can improve the quality of water not only in Cole Creek and White Oak and Buffalo Bayous, but for other waterways in Houston as well. The cumulative effect of such an effort to increase water flow and quality in the area can enhance the recreation potential of flood plain areas. Pursuing an aggressive flood plain development policy, the city can restrict private development in flood plains and utilize them for recreation and open space development. The net effect of this on environmental conservation and beautification could be substantial.

The service area for the proposed project could develop linear parks and open space corridors along Cole Creek and White Oak and Buffalo Bayous. Scattered parks and open space spots along Cole Creek and White Oak Bayou can be connected in a linear fashion to form an integrated system. Flood plain areas along White Oak Bayou are predominantly vacant, presenting a unique opportunity for recreation corridor development. The improved water flow and quality in these bayous will aid in the achievement of parks and recreation goals for Houston.

v. Local Areas Designated for Use as Recreational Areas Or Natural Preserves

None of the existing parks and recreation areas in the service area have been designated as Natural Preserves. The beneficial impact of the proposed project on recreational areas has been discussed in item "u".

w. Potential Noise Levels and Protective Measures

Potential noise from the operation of pump motors, compressors, fans, and other equipment shall be below 85 dBA. All equipment used will comply with the noise level standards promulgated by the Occupational Safety and Health Act of 1970 and the Noise Control Act of 1972. Noise at the site will be muted by the use of equipment with low sound vibration levels. Noise and vibration cannot be completely eliminated from the plant site and will to some extent inconvenience the plant employees. This is not a significant problem.

x. Control of Access to Facilities

The entranceway to the plant site will be an extension of Randon Street. It will provide sole access to the plant. Cole Creek and the dense trees will bound the project site on the other three sides.

y. Effect on Insect Populations

The proposed project will have no detectable effect on the insect populations of the service area. The mosquito population of the Cole Creek and White Oak Bayou will be reduced. These insects carry germs affecting public health.

z. Insect Control Programs and Use of Insecticides

None will be required.

aa. Effect on Wildlife, Birdlife and Aquatic Habitats

Except for a minor disruption of animal habitats in and around the plant site during the construction period, no significant effect or protracted disturbances of natural habitats will result from the operation of the plant. Clearing of vegetation will be temporary, and ground cover and trees will be restored to the land immediately following construction of the plant. For the project's effect on aquatic habitats, see items "k" and "l".

bb. Project Relation to Flood Plains

The plant structures are to be built above the highest anticipated level of flood in the area. The proposed site is outside the 100 year flood plain area. Cole Creek, already channelized for purposes of flood control, has been excavated to promote sufficient drainage. Since groundwater is able to flow into the stream, it lowers the water table and thus helps increase the infiltration capacity of the soil to absorb rainwater. For detail discussion on the site elevation and federal and local regulations governing flood plain development and design, see Chapter III (Natural Environment), Section A, Subsection 4, Hydrology, (iii) c. Flood-prone areas, page 33.

cc. Operational Reliability

The proposed treatment facilities have been designed to ensure operational reliability and prevent adverse environmental effects stemming from plant operation. There should be no overload either organic or hydraulic of the proposed system. In the event high organic loadings occur or if slugs of toxic materials reach the plant, the treatment process will result in a temporary deterioration of effluent quality. However, any adverse effects resulting from such contamination are expected to be offset by the relatively large size of the plant.

Safety controls contained in the engineering design of the system will prevent operational failures. The City of Houston operates 16 other wastewater treatment plants closely similar to the proposed plant and has experienced mechanical and electrical personnel available to operate and maintain the plant. The proposed system provides for spare units so that while a basin or a pump is taken out for maintenance or repair, another unit will be available for use in its place.

B. SECONDARY IMPACT OF THE PROPOSED ACTION

If the term "secondary impact" implies effects of secondary significance, it will be an erroneous notion for an Environmental Impact Statement study, particularly for a project which involves the construction of infra-structure investments stimulating effects in the form of associated investments and corresponding changes in the pattern of social and economic activities for the service area.

Such secondary effects, by their abilities to induce new facilities and activities, can sometimes be more significant than the primary impact of a project. For instance, the effect of a proposed project on population, economic development and land use growth may be among the more significant secondary effects. The stimulated growth of this type as a result of the proposed Northwest Treatment Plant is highly significant for its service area. This is an area in the city which is experiencing rapid growth and where growth will continue to take place in the future.

1. The Degree to Which this Action will Ultimately Affect Residential or Industrial Development

The addition of sewer service to an area is a key factor in encouraging residential or industrial development in an area. This and other factors influence the intensity and type of growth that may occur. For instance, land values and the availability of suitable land, provisions for an adequate water supply, an efficient and convenient transportation system, availability of parks and recreation, and educational, cultural and entertainment facilities are all needed to attract development to an area. Aside from adequate sewer service, the project area has a favorable outlook for development. The provision of sewer service in collaboration with other elements of the infra-structure system should result in an accelerated rate of development which would probably cause most of the open land in the area to be developed within the next 20-year period.

Although the proposed project's impact on the development of the service area cannot be completely quantified, the secondary net impact on the residential, industrial and related developments through 1990 is shown in Appendix L of this report. A summary of the net numerical impact of the project on the area development activities is shown in Table VI-1.

TABLE VI-1: SECONDARY NET IMPACT OF THE PROPOSED ACTION

Net Impact On:	Magnitude of Net Impact	
	Number	Acres
Population	43,000 persons	-
Employment	22,000 jobs	-
Residential Development	16,780 housing units	2,380
Industrial Development	-	295
Commercial Development	-	215
Parks and Recreation	12	430
Schools	8	215
TOTAL	-	3535 acres

The Northwest Treatment Plant, when built to its proposed capacity, will occupy 27 acres of land which is a very small amount of land compared to the geographic area it is intended to serve. As Table VI-1 indicates, 3535 acres or 6 square miles could be urbanized in the service area as a secondary impact of the project.

The environmental implications of this urbanization are enormous. The ecology of the service area is likely to be vulnerable unless precautions are taken to protect the natural characteristics of the area.

The economic implications of the secondary growth are also substantial. Thousands of jobs can be created in the area as a result of the project and associated infra-structure improvements. The enormous real-estate investments anticipated as an impact of the project could be a great opportunity for the area residents and property owners. On the other hand, it could be a significant liability to the area if the quality of development is not insured through sound practice in environmental planning and urban development.

The city government cannot emphasize one or two major city services and ignore others. To guarantee quality development, other services and facilities must also be provided. For instance, the 1990 increase in population, employment and land use for the service area will create a solid waste disposal need of 90 tons per day. This service has also to be provided by the City of Houston along with the provision of water and sewer services.

In the past, the development in the service area has been characterized by the lack of coordinated public service facilities which have created a somewhat haphazard pattern of growth. This must be avoided in the future by following an integrated policy of infrastructure development if the full benefits from the investment in the proposed project are to be realized.

2. Ultimate Effect of the Project on the Character of the Area

As noted previously, a part of Houston's population growth is expected to take place in the service area of the project. Its construction will aid in coordinated occurance of that growth. Commercial and industrial development along the Northwest Freeway will grow. The rest of the service area, with the exception of commercial strips along the major thoroughfares, is likely to develop predominantly as low density residential use, though current trend of housing development is multi-family and townhouses.

Completion of this project will aid the development of a community in Houston that urban growth has somewhat bypassed in the past. This will aid Houston in experiencing a more balanced and uniform distribution of land use about the present city core. The recent development trends in the service area are expected to continue through the future. The proposed project will not reverse that trend in any adverse direction. The low density character of the area is expected to persist.

3. Extent to Which Undeveloped Areas Will Ultimately be Served

Service will be provided to presently underserviced areas to comply with "reserve capacity" requirements of the Federal Water Pollution Control Act Amendments of 1972, Section 204 (a) (5). Sewer policy in Houston has been for developers to construct the subsystems and connect and deliver sanitary sewage to interceptor lines. The City of Houston is empowered in the event of failure on the part of the private developers to levy front foot assessment and hook-up charges sufficient to underwrite the costs of line installation. The construction of the project will allow the city to sewer the area currently served by septic tanks. An estimated 6,000 persons are currently served by septic tanks in this part of Houston.

4. Relationship Between the Project's Effect on Growth and Type of Growth Desired by the Area Residents

The nature of anticipated development of the area seems to be compatible with the wishes of residents and property owners; however, should plans for future development prove incompatible with such wishes, a variety of administrative and judicial remedies are available to the citizens to reflect their goals on the type of growth desired.

Recently the City of Houston Planning Department has initiated a citizen participation planning program under which the city has been divided into a number of communities and neighborhoods for planning purposes (See Figure VI-1). The program calls for active citizen participation in the planning process. The major intent of this project is the development of neighborhood plans and dialogue with the people who live, work, own property or do business in a neighborhood. It offers the residents of the various parts of the city an opportunity, on a continuing basis, to voice their opinions on the type and intensity of growth they desire for their particular area. A detailed description of this program is included in Appendix M.

The residents of Northwest Houston can utilize the city's citizen participation program as a vehicle for reflecting their goals and objectives in shaping city policies on land use, transportation and public facilities for their area. Through this program, the citizens can prevent the type of growth they do not want. The effect of the proposed project on the type and level of growth therefore cannot be such as will be against the wishes of the area residents.

The citizens of Houston and their city government have made a commitment for the project. The citizens' commitment is reflected in their approval of the bond program through which the local share of the project costs will be funded. The City of Houston has entered a contract with the Gulf Coast Waste Disposal Authority for the sale of bonds for the construction of this facility.

5. How This Project is Being Used to Implement Land Use Planning

Unlike most cities in Texas and the nation, the City of Houston does not have any zoning to regulate and control land use in the city. It has attempted to influence growth through such available techniques as its authority to approve subdivision plats, issuing and enforcement of building permits and through the provision of various infra-structure elements such as transportation, sewer and water services, drainage systems, and so forth.

In view of the quality of environment achieved through regulatory practices of pro-zoning cities, Houston appears to have done relatively well without any zoning regulations.

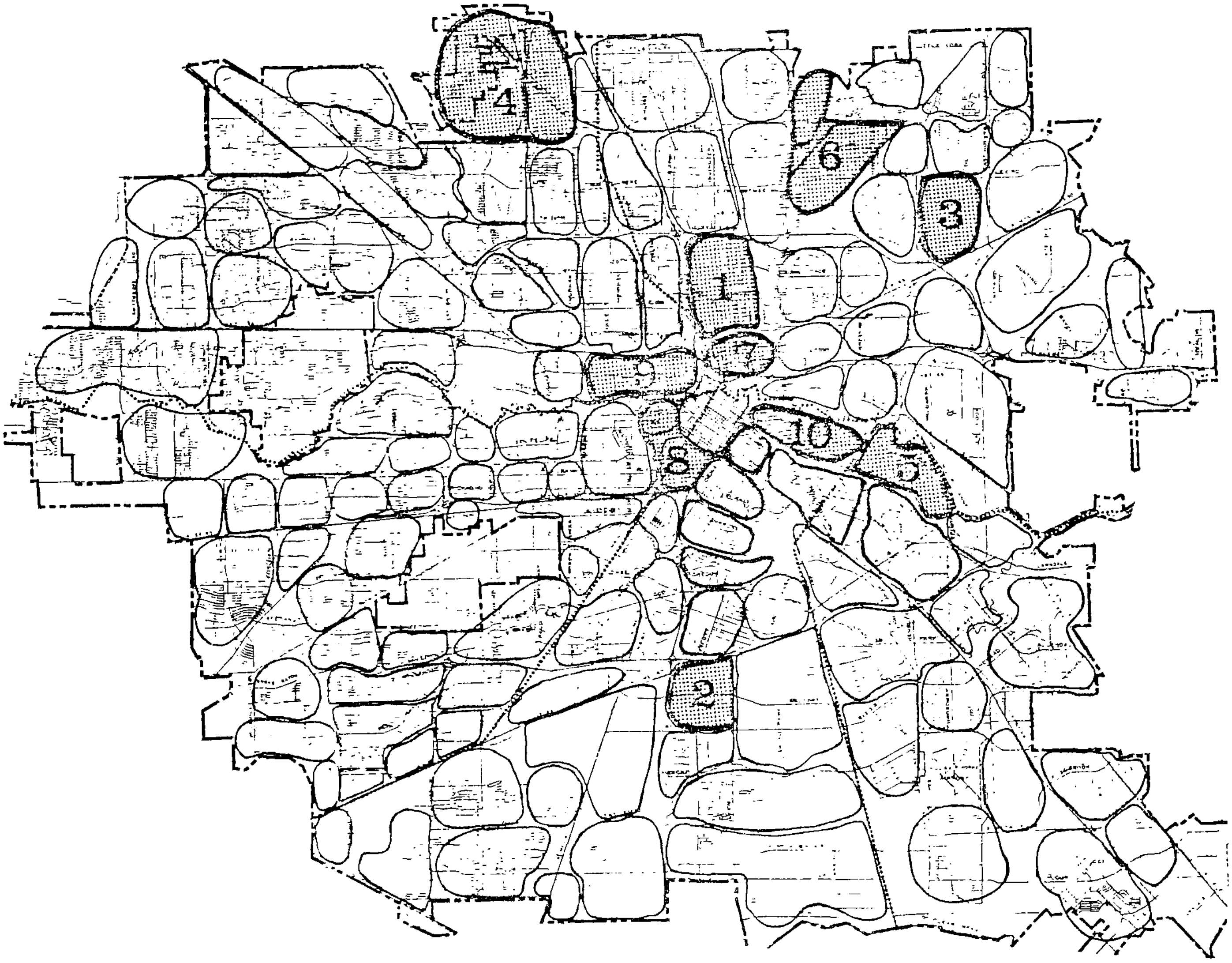
> "Houston is the only large city in the United States without zoning laws. Yet it is no more chaotic than other metropolitan areas of its size. In fact, though it has some drawbacks, marketplace determination of land use is working well indeed for the Space City."

Urban Dynamics of Non-Zoning
Joseph W. Santamaria, AIA
AIA Journel, April 1972
The American Institute of Architects

FIGURE VI-1

HOUSTON'S
NEIGHBORHOOD IMPROVEMENT PLANNING PROGRAM

FIRST TEN STUDY AREAS



1. Moody Park
2. Sunnyside
3. Settegast
4. Acres Homes
5. Magnolia Park
6. Dodson - Oak Park
7. Near North Side
8. Not Named
9. Washington
10. Navigation

HOUSTON CITY PLANNING DEPARTMENT March 1974

Absence of zoning has placed the City of Houston in a unique position to manage growth through "impact policies" which can be, if carefully applied, more effective than conventional zoning as a tool for controlling growth for large cities in America. From this standpoint, the proposed project is highly compatible with the current policy of the city in regulating land use growth and distribution.

C. SECONDARY ADVERSE IMPACT ON THE ENVIRONMENT

While the project's short-term adverse effects on the environment will not be significant compared to its benefits, its long-term adverse impact on the quality of the environment could be quite severe unless appropriate policy actions are taken to avoid detrimental effects. There are many secondary benefits to be derived from the project; however, its adverse effects associated with the change in the level of environmental quality resulting from the expanding urbanization for the service area must be carefully evaluated before beginning construction. The City of Houston must consider these potentially adverse effects and develop necessary policies with regard to land use location and intensity to mitigate such effects on the service area of the project.

1. Secondary Impact on Air Pollution

An additional 43,000 persons are projected to live in the service area of the project by 1990. These additional people will generate a total of 130,000 trips per day, which will call for an extensive road building program to accommodate the travel need. Statistics indicate that more than 50% of Houston's air pollution is caused by the automobile. Such a problem will affect not only the service area but also the city as a whole, since other parts of Houston will also be urbanized. By 1990 the air pollution index of the service area will increase as a result of this growth. The reduction in present air quality will be substantial if other sources of pollution are considered. For detail calculations of the impact of projected traffic volume on ambient air quality, see Appendix L, Section H, Pages L-7 through L-14.

2. Impact on Water Quality

On a short-term basis, the impact of the project on the water quality of the receiving waters will be beneficial; however, as vacant lands in the service area are urbanized, the water quality of the waterways will deteriorate. As the runoff increases in these water courses, with increased dust particles, grit and related spoils, the quality of water is expected to decline. Effect of this condition will be harmful to the aquatic life in these streams. Also, with expanded urbanization, drainage will become increasingly difficult, subjecting many areas to floods that will cause damaging effects on life, property and the environment.

3. Impact of Subsidence on Underground Utility Lines

One of the major environmental problems currently facing the City of Houston is the continuing subsidence of the Houston area caused by the pumping of underground water for domestic and commercial supplies. This subsidence, with its serious ramifications on the environment, will create a major problem for the underground utility lines. The city's expanding program for sewer extension should be carefully implemented so that the uneven settlement of lands will not cause sudden failures of the water, sewer or gas lines. The breakdown of these systems would prove to be greatly injurious to public health and the environment. A monitoring program should be instituted to identify where the problem is most serious now and where it may occur in the future. This effort should be supplemented by undertaking rehabilitation programs to correct breakdowns when they happen. All future utility lines should be carefully planned and aligned to avoid this problem.

4. Impact on Ecology

With the growth of the service area, some of the natural elements will inevitably be affected by the secondary impact of the proposed project. Man-made activities will invade the natural environment. Soils, geology, sub-surface hydrology and vegetation all will be affected by the continuing growth of the service area.

The goal of peaceful coexistence between man and nature will not be an easy task to achieve. Unless new and innovative policy programs are designed and implemented to create such a balance, long-term consequences of the proposed project and similar projects could be seriously adverse to the quality of air, water, land life and the environment. The City of Houston must balance its goals of urbanization against the need of protecting the environment which it took the forces of nature thousands of years to create.

CHAPTER VII: ADVERSE IMPACTS WHICH CANNOT BE AVOIDED SHOULD THE PROPOSAL BE IMPLEMENTED

A. GENERAL
B. SUMMARY OF ADVERSE EFFECTS

VII. ADVERSE IMPACTS WHICH CANNOT BE AVOIDED SHOULD THE PROPOSAL BE IMPLEMENTED

A. GENERAL

Careful planning and design and close supervision of construction and scheduling activities will minimize short term adverse effects resulting from project construction.

The project is the outgrowth of a commitment made to the service area property owners and residents. It has been designed to minimize harm to the environment while collecting and treating wastewater in the most efficient and economical manner possible.

B. SUMMARY OF ADVERSE EFFECTS

Adverse impacts which cannot be avoided are listed below:

1. Occasional minor odor associated with the wastewater treatment plant.
2. Minimal levels of machine and engine noise.
3. Construction noises.
4. Minimal levels of air pollutants and particulate matter in the air due to construction activities.
5. Some thermal emissions into ambient air due to the plant operation.
6. Some disruption of natural earth within the plant site during the construction period.

1. Disruption and Inconvenience During Construction

The construction of the project will be totally limited within the plant site. It will not cause any inconvenience to the residents of the project vicinity. The only inconvenience that will occur will be for the construction crew who will be subjected to some noise and heat during the construction period. With careful planning and proper scheduling, the inconveniences associated with project construction will be kept to a minimum. All contracting documents, plans, and specifications will include provisions for minimizing construction impacts. Upon the completion of the construction activity, ground surfaces will be restored as quickly as possible.

2. Noise

The construction process will require the use of machinery which will create a moderate but temporary noise nuisance. Proper equipment maintenance and noise reduction policies will be adhered to. Operation of the completed system will produce so little noise as to be inaudible. Noise levels experienced by operators will likewise be minimal.

3. Loss of Habitat

Loss of some habitats during project construction is possible. However, since the plant construction will occur on an existing plant site, loss of habitat is expected to be minimal.

4. Air Pollution

Construction activities will cause some temporary increases in particulate matter concentrations due to dust. Water sprinkling and minimizing equipment movements will keep this problem to a minimum level. Hydrocarbons, carbon monoxide and other byproducts from fuel combustion in construction equipment will be emitted in the construction area but will not significantly affect air quality.

Within the plant site, some minimal level of occasional odors will be unavoidable during the operation of the plant. To prevent odors arising from raw sewage, pumps will discharge the sewage below the surface of the liquid in the aeration tank. The aeration tank will maintain aerobic conditions in all parts of the tank, thus minimizing odor problems associated with the treatment process. Since sludge will be transported to the Northside Multi-Regional Sludge Treatment Plant, the project will affect the air quality around that site. This is not expected to be a major problem, however. For details, see Page 106 and 107.

5. Aesthetic Considerations

All equipment, with the exception of the plant site equipment, will be located below ground level. At the plant site, the buildings will be built in low profile, and the site will be well landscaped. Since the plant site is 1000 feet from the nearest street, there is no possibility that anyone will see the plant other than plant employees and the residential dwellers to the north, across Cole Creek. The natural setting of the plant vicinity with dense, tall trees on three sides will greatly aid the project from being visible from outside the site. The addition of the playground facilities on the site will remarkably enhance the visual and aesthetic image of the treatment site.

CHAPTER VIII: RELATIONSHIP BETWEEN LOCAL SHORT TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG TERM PRODUCTIVITY

VIII. RELATIONSHIP BETWEEN LOCAL SHORT TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG TERM PRODUCTIVITY

The improved sewage treatment system recommended for the proposed project will enhance the environment by reducing water pollution and public health problems caused by existing septic tank systems and overloaded treatment plant. Efficient and improved sewage treatment will increase long-term productivity by allowing more efficient use of land and related environmental resources in the service area.

The proposal does not and will not impose harmful cumulative effect and long-term alterations on the environment of the service area or surrounding community. Any inconveniences will be short-term and will be related to the initial construction of the proposed facilities.

If the proposed improvements are not made, then the degradation of water quality and public health conditions will continue. The people of Houston could suffer the effects of inadequate waste treatment over an indefinite period of time. Construction of the project would, therefore, control water pollution and improve the health and environment in the Houston area. This will be accomplished by providing adequate public services, including sewage collection and treatment facilities, while facilitating increased long-term productivity of land and the environment. Delay of the project construction may impose additional adverse short and long-term social, economic and environmental impacts on the area residents.

CHAPTER IX: IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES WHICH WOULD BE INVOLVED IN THE PROPOSED ACTION, SHOULD IT BE IMPLEMENTED

A. RESOURCES WHICH WILL BE IRRETRIEVABLY COMMITTED TO THE PROJECT

B. ALTERNATIVES

IX. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES WHICH WOULD BE INVOLVED IN THE PROPOSED ACTION, SHOULD IT BE IMPLEMENTED

Certain irreversible and irretrievable commitments of resources will be required for the construction, operation and maintenance of the proposed project. Resources such as steel, concrete and fuels are essentially nonrenewable, but the benefits gained by their short-term depletion will more than offset the cost of the project development and operation.

A. RESOURCES WHICH WILL BE IRRETRIEVABLY COMMITTED TO THE PROJECT

1. Energy

Based on data on historical energy requirements for plants of comparable size and equipment, it is estimated that energy consumption when the proposed facilities reach design capacity will be approximately 9,750,000 kilowatt hours of electrical energy per year. The annual estimated cost of this energy commitment in Houston will be approximately $86,000 or $235.00 per day at the rate of $19.60 per million gallons of treated sewage. (This figure does not include the energy costs for sludge processing and disposal.) However, one return from this energy consumption is $45.20 of marketable fertilizer per million gallons of treated sewage. Should the present energy shortage persist and rising energy costs render it impossible to use the present level of power, then the City of Houston, with the aid of available technology, should attempt to use anaerobic sludge digestion for methane generation from the residual sludge. This will be only possible for those treatment sites where sludge processing facilities are available. The poser generated from the methane gas will then provide an additional source of energy for those treatment plants with sludge treatment facilities.

2. Chemicals

The only chemical which will be used for the treatment operation of the plant is chlorine. It will be used for disinfection.

Chlorine is the least expensive disinfection agent available. It will be used in hypochlorite form in the treatment process. In its use, care will be taken to avoid health and safety hazards usually associated with the use of chlorine. An estimated 720 lbs of sodium hypochlorite will be used each day to produce 500 lbs of free chlorine to be used by the plant each day.

In the event that the nationwide shortage of chlorine supply becomes a limiting factor, the City of Houston has wisely decided to generate chlorine on the plant site for use by the plant operation. The program has great merit and should be applied to other plants in the city.

3. Manpower

Operation and routine maintenance of the expanded Northwest Regional Wastewater Treatment Plant will require a staff of approximately twelve equivalent full-time employees at an estimated labor cost of approximately $120,000 per year.

The additional load placed on the Northside Sludge Disposal

Plant where sludge from the proposed project will be transported for treatment and disposal will not require additional employees.

4. Money

Funds committed to this project will be retrieved through customer service charges. There will be no opportunity to commit the same funds to some alternative endeavor for the duration of the bonded indebtedness and are therefore irretrievable. Compensation for this irretrievability is reflected in the interest rendered. The estimated cost of this proposed project is $6,126,549.

5. Land

During the lifetime of these facilities, land designated for their use will in effect be unavailable for other uses. It is not anticipated that these facilities will be abandoned; however, if they are, then the land will be returned to its former condition and made available for other uses. The return of the land to park use will allow the proposed playground to expand into a community park. A portion of the land used for the proposed project is now used for the existing Northwest Treatment Plant. No additional land purchase will be necessary.

B. ALTERNATIVES

Several alternatives have been considered from economic, social and environmental viewpoints. The proposed project is considered to be the best possible alternative for meeting the objectives outlined in Section II.

CHAPTER X: COMMENTS, PUBLIC PARTICIPATION AND INFORMATION DISSEMINATION

A. SUMMARY OF PUBLIC HEARING, 21 JUNE 1973, CONCERNING PROPOSED NORTHWEST WASTEWATER FACILITIES

B. NEWSPAPER AND OTHER MEDIA ACCOUNTS

C. REVIEW OF THE DRAFT ENVIRONMENTAL IMPACT STATEMENT

D. COMMENTS AND RESPONSES

X. COMMENTS, PUBLIC PARTICIPATION AND INFORMATION DISSEMINATION

A. SUMMARY OF PUBLIC HEARING, 21 JUNE 1973, CONCERNING PROPOSED NORTHWEST WASTEWATER FACILITIES

Six Pollution Abatement Federal Grant Projects proposed by the City of Houston were discussed in a Public Hearing held in the Houston City Council Chambers--9:00 a.m., 21 June 1973, including the expansion of the Northwest Wastewater Treatment Plant (WPC-TEX-1020).

Plans for these projects had already been prepared and applications sent to the Environmental Protection Agency requesting federal participation in the amount of 75 percent of costs for each of the six projects. The consensus of persons attending the public hearing favored implementation of each project. No objections or complaints were raised at the hearing against any of the proposals. All were judged worthy and necessary by residents of the affected service areas.

Several attendees expressed dismay at the slowness of project schedules for extension of sewer lines to the areas concerned. Some service area property owners objected to paying ad valorem taxes while receiving inadequate sanitary sewer service. Questions were raised about the need for depending on federal funding when the city had already sold sanitary sewer bonds for extending sewer lines and making improvements to treatment and disposal facilities.

B. NEWSPAPER AND OTHER MEDIA ACCOUNTS

Samples of press coverage on wastewater treatment problems in Houston, including those to be affected by the implementation of the proposed project are included in Appendix N.

C. REVIEW OF THE DRAFT ENVIRONMENTAL IMPACT STATEMENT

The Draft Environmental Impact Statement for the proposed project prepared in July, 1974, was distributed in September, 1974, for comments and review by 25 agencies, 23 state agencies, and 46 local agencies and individuals including the representatives from the Houston area in the U. S. Congress and the State of Texas Legislature. The comments received from these agencies are enclosed following this chapter. Comments made or questions raised are answered following this section (Section D).

A public hearing was held on the proposed project by the U. S. Environmental Protection Agency, Region VI, on November 18, 1974. The hearing took place in the Rice Hotel in downtown Houston. Regional Hearing Officer, Mr. Jim Collins, presided at the hearing. There was no opposition voiced against the project. A complete record of this hearing is enclosed in Appendix O.

D. COMMENTS AND RESPONSES:

Of the agencies and individuals who responded to the Draft Environmental Impact Statement by returning formal responses, only four agencies made comments which call for additional clarification. The rest of the agencies had no comments to offer and were in complete agreement with the Draft. The comments sent by the three agencies are discussed below. EPA's response to each comment is made separately.

1) U.S. DEPARTMENT OF HEALTH, EDUCATION AND WELFARE
Office of the Secretary
Washington, D.C. 20201

COMMENTS: The comments made by this agency are primarily concerned with the proposed plant's effluent quality and its possible impact on public health. Specifically, the comments focused on (i) the type of industries served by the Northwest project, the possible chemicals they discharge in the city system; (ii) possible formation of toxic chemicals as the result of the chlorination of effluent prior to its discharge into Cole Creek; (iii) the potential of the effluent entering the food chain through aquatic species affecting public health; and (iv) the construction impact of the project on the safety of the children attending school.

RESPONSE: (i) The types of industrial activities added to Houston's industrial base during the 1960 decade have been discussed in the Draft in page 49. These activities oriented to petrochemical and chemical production, aerospace industry and medical research are virtually all located in South and Southeast Houston in and around the Houston Ship Channel

Industrial District. Reference is made to Figure III-21, Citywide Development Plan which shows the distribution of existing and proposed industrial areas in the city. This figure further shows that the Northwest Section of the city is generally free of industrial development. There are no existing or planned industrial parks in the service area of the Northwest Plant. The small scale, scattered industrial activities in Northwest are predominantly light manufacturing and warehousing oriented which do not use or produce chemicals from which strong industrial wastes are generated. This is indicative of the relatively good quality effluent currently produced from the Northwest Plant with BOD_5 and TSS values of 7mg/l and 24mg/l, respectively. See Table II-1, page 7.

Further reference is made to page 70 which discuses the City of Houston's statutory policy as defined in the Code of Ordinance imposing control on the quantity and quality of industrial wastes which could be discharged into the city's sanitary system. Prohibition of certain types of harmful discharges into the system by industrial users has resulted in most industries undertaking a pre-treatment process of their own before such wastes are discharged in the sanitary system. These measures are being taken to produce better effluent quality at the plant site to improve public health.

(ii) On the question of possible formation of toxic chemicals as a result of effluent chlorination, this may be a potential public health problem for a large treatment plant. For a facility the size proposed for the Northwest project (12mgd), the possibility of public health problems is remote. The EPA study team fails to see how the service area residents can be affected by the use of hypochlorite solution generated at the plant site for effluent purification prior to its discharge into Cole Creek. The nearest residence is 1000 feet from the plant site across Cole Creek. The only possibility that exists in this regard is the effect on the plant site employees. But the City of Houston has successfully applied this method for the past 23 years for 16 other treatment plants in the city. Besides, the on-site chlorine production from sodium hypochlorite is considered to be a good program. The program has a great merit and the on-site chlorine production should be applied to other plants in the city.

(iii) On the effect of effluent quality on aquatic species with potential for concentrating chemicals and thereby transmitting them to humans, reference is made to pages 108 (Effects on Aquatic Life, and Effects of Chlorine Residual on Aquatic Life) and K-7 through K-11 of Appendix K. The predicted effluent quality with BOD_5 and TSS values of 6.6 and 6.0 mg/l would have a beneficial impact on both the quality of receiving waters and the aquatic biota, and would not contribute to the concentration of chemicals by any aquatic species. The effect of chlorine residual on aquatic life is very insignificant since chlorine is short-lived in the natural water system.

The projected effluent quality will significantly increase the dissolved oxygen in the waters of Cole Creek and White Oak Bayou. While the data on the types of aquatic species with potential for concentrating chemicals are not available either for Cole Creek or White Oak Bayou, it is not believed that these streams have significant aquatic population to serve as a resource for fish production. White Oak Bayou is concrete-lined from below its confluance with Cole Creek and cannot have any significant aquatic population.

(iv) The project construction will have not effect on the traffic hazards for the area since the project site is well isolated from the areas of residential and commercial activity. The project construction will be confined within the plant site and will not interfere with the activities outside. The Smith School, which is referred to as being affected by construction activity on the project site, is approximately 4000 feet from the plant site, far beyond the walking distances. The safety problem for the school children as a possible adverse effect of the project construction is unfounded.

2) DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Regional Office
Dallas, TX 75202

COMMENTS: HUD does not oppose the proposed facility. It however makes some comments which are summarized as follow: (i) the identification of pollutant concentrations from projected traffic volume as a secondary impact of the project and their comparison against the allowable limits of air quality in Houston; (ii) a July 1974 study by the Texas Parks and Wildlife Department concluded that the secondary treatment plants are inadequate for the Houston-Galveston area; (iii) identification of impact of the effluent on aquatic food-systems; and (iv) EPA's apparent support for Houston's refusal to undertake a public land use management controls system (zoning).

RESPONSE: (i) The impact of 130,000 trips per day generated from the service area of the Northwest Plant on ambient air quality has been identified. Reference is made to Appendix L, Section H, Impact of Urbanization on Ambient Air Quality, pages L-7 through L-12. Page L-11 shows the pollutant concentration of CO, HC, and NO_x as being 3,200 tons/year, 340 tons/year, and 219 tons/year, respectively. Unfortunately this impact is not comparable against the NAAQS since data on existing ambient air quality for Northwest Houston are not available from the Houston Air Control Program office or from any other sources.

(ii) The EPA study team believes that secondary treatment for the Northwest Plant will be adequate and would meet the stringent effluent requirements should they be imposed in the future. An extensive analysis has been made in Appendix K (see page K-11, Appendix K) to determine the plant's effluent quality in terms of BOD_5 and TSS. These values have been calculated to be 6.2mg/l and 6.0mg/l, respectively, which would meet the requirement of stringent effluent criteria anticipated after 1979. There are treatment plants in Houston which would require tertiary treatment in order to satisfy the effluent requirements by 1979 but Northwest treatment plant would not be one of those. However, a statement has been added in this final EIS to the effect that that option should be kept open by the City of Houston to place tertiary treatment for the Northwest plant should that be necessary. Reference is made to the footnote in page 94 in relation to Section C, Plant Performance.

(iii) It is believed that adequate response has been made to this comment in a preceding section. See the second and third paragraphs, page 137.

(iv) HUD's comment that EPA seems to be taking a stand against public land use controls in Houston is unfounded. What was meant in the Draft EIS for the Northwest Treatment Plant was that many cities have exercised zoning as a land use control, yet they have not succeeded well in developing quality environment. Houston has done equally well without zoning. The EPA study team believes that zoning is an artificial land use control system, often manipulated to protect and enhance parochial interests of a few, ignoring the larger interest of the public at-large. Zoning as a tool raises land values sometimes without regard for the market and often without environmental considerations. The City of Houston has been attempting to control land use through intra-structure policies such as sewer and transportation systems. Reference is made to Appendix N, Newspaper Accounts, offering evidence that development in Houston would be contingent upon the ability of the sewer system to support land use activities.

3) U.S. DEPARTMENT OF AGRICULTURE
Soil Conservation Service
Temple, TX 76501

COMMENTS: Comments from this agency are essentially a two-part suggestion on the Soils Section in Chapter III: Social and Environmental Setting: (i) a few minor revisions, primarily editorial in nature, in the description of soil characteristics for the service area; and (ii) deletion of Appendix E on the description of soils from the 1922 soil survey in favor of placing new data on soil conditions available from the 1974 Soil Survey for Harris County.

RESPONSE: (i) Comments by this agency were constructive which have been duly reflected in this Final EIS. Reference is made to paragraphs 1, 2, and 3 of page 23. Corresponding changes have been made in Figure III-3, page 24.

(ii) Appendix E has been deleted. Appendix F, "Characteristics of Soil Series in Northwest Harris County," has been expanded to include the now available data on 1974 soil series furnished by this agency. This data was not available at the time the Draft EIS was prepared.

4) UNITED STATES DEPARTMENT OF THE INTERIOR
Office of the Secretary
Washington, D. C. 20240

COMMENTS: Major comments from the Department of the Interior are are the following: (i) Need for including in the Final EIS a more comprehensive, quantified land use analysis, projections and plan development particularly with regard to the parks and recreation facilities for the service area; (ii) need for including a list of rare and endangered species in the Final EIS report; (iii) updating the list of places which have been added to the National Register of Historic Places during 1974; and (iv) the need to make a statement whether the project site expansion and operation will be affected by the subsidence problem which presently characterizes the Houston area.

RESPONSE: (i) The EIS team for the Northwest Treatment Plant does not agree with the comments that the Draft Environmental Impact Statement does not adequately cover the land use analysis and forecasts for the project area. Reference is made to Figures III-19 and III-20, which indicate the existing and projected land use distribution for the service taken from the work of Binkley and Holms, Inc. (the consultant engaged by the City of Houston for the Northwest Project). The Houston quantified land use data is shown in Table III-5.

The proposed park and playground facilities shown as a part of the plant expansion is not a proposal by the City of Houston, rather it has been suggested by the EIS team out of its own initiative. It is a proposal which is feasible. Land is available to accommodate such a facility adjacent to the plant site, and residential developments within reasonable distances make such a facility desirable. Reference is made to the description of Site Plan given in Pages 15 and 16 of this report. Instances of an EIS team's boldness to propose such a facility in absence of any initiative from a city are rare and indicative of this EIS team's objective appraisal of the need for additional parks and recreational facilities for the service area population.

The Department of the Interior has entirely missed a section that deals with land use projection as a part of the secondary impact analysis for the service area. This is covered in Appendix L, Secondary Impact of the Proposed Action, Page L-1 through Page L-7. Forecasting open space is adequately covered in Pages L-5 and L-6 and in so reflected in the table provided in Page L-7 at the end of that Appendix which states that 430 acres of additional land will be needed to support the parks and recreation need of the 1990 population of the service area.

(ii) Its comment on the need to include a list of rare and endangered species in the greater Houston area is appropriate. The project's service area does not have any rare and endangered species. However, according to the Texas Department of Parks and Wildlife, endangered species which might be in the region are Attwater's prairie chicken, red wolf, peregrine falcon, Eskimo cuslew, bald eagle, ocelot, American alligator and Houston toad. This has been included in the final EIS. Reference is made to Page 42 of this Final EIS.

(iii) On the comment on the project area's relationship with the subsidence problem, the plant site and its immediate vicinity is not subject to any existing or potential surface subsidence problem. However, the sludge line which would transport sludge from the proposed project site to the Northeast Multi-Regional Sludge Treatment Plant, would cross a fault-line (reported by Mr. Martin Sheet - a local geologist and patroleum consultant) approximately 3 miles southeast of the plant location. That sludge line has already been constructed and is not a part of the construction grant funds requested by the City of Houston under the expansion program of the Northeast Plant.

COMMENTS RECEIVED ON DRAFT ENVIRONMENTAL IMPACT STATEMENT

Texas State Department of Health

JAMES E. PEAVY, M.D., M.P.H.
COMMISSIONER OF HEALTH

FRATIS L. DUFF, M.D., Dr. P.H.
DEPUTY COMMISSIONER

AUSTIN, TEXAS 78756

October 30, 1974

Mr. Arthur Busch
Environmental Protection Agency
Region VI, 1600 Patterson,
Suite 1100
Dallas, Texas 75201

RECEIVED
NOV 04 1974
Assistant for Congressional & Intergovernmental Relations

RE: City of Houston
Northwest Wastewater
Treatment Facility Site
WPC-Tex-1020

Dear Mr. Busch:

We appreciate receiving a copy of the Environmental Impact Statement for the Northwest Regional Wastewater Treatment Facilities to be installed by the City of Houston. Members of our staff have reviewed the document and found that it is in general agreement with the policies of the Texas State Department of Health. Our recommendations and comments are also being transmitted to the Division of Planning Coordination, Governor's Office, in keeping with usual review procedures.

Sincerely,

G. R. Herzik, Jr., P.E.
Deputy Commissioner
Environmental and Consumer
Health Protection

DMC/slm

ccs: City of Houston
ATTN: E. B. Cape, P.E., Director
Department of Public Works
Texas Water Quality Board
Region VIII

DEPARTMENT OF THE ARMY
GALVESTON DISTRICT, CORPS OF ENGINEERS
P. O. BOX 1229
GALVESTON, TEXAS 77550

SWGED-E

6 November 1974

Mr. Arthur Busch
Regional Administrator
Region VI, Environmental
  Protection Agency
1600 Patterson, Suite 1100
Dallas, Texas   75201

Dear Mr. Busch:

This is in response to your letter dated 7 October 1974, transmitting for our review and comments a draft environmental statement for the City of Houston's Northwest Wastewater Treatment Facility, WPC-TEX-1020, prepared by the Environmental Protection Agency.

The project will have beneficial effects on the water quality in White Oak Bayou and the lower reach of Cole Creek, and it does not appear to affect any present or proposed activities of the Galveston District, Corps of Engineers. The statement appears to adequately present the environmental effects of the project.

Sincerely yours,

MARTIN W. TEAGUE
LIEUTENANT COLONEL, CE
DEPUTY DISTRICT ENGINEER

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1974
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TEXAS FOREST SERVICE

File 5.7

College Station, Texas 77843
October 28, 1974

Mr. Brice H. Barnes
Executive Office
Division of Planning Coordination
P. O. Box 12428
Capitol Station
Austin, Texas 78711

Dear Brice:

I have your letter of October 23rd re the Draft Environmental Impact Statement for the City of Houston, WPC-Tex-1020.

This office has no constructive comments to offer on the proposed project.

Pages 99 and 113 cover adequately the measures necessary to protect cover vegetation and trees during the construction phases of the project as well as restoration of the site with suitable cover following construction of the plant.

Sincerely,

Mason C. Cloud

Mason C. Cloud
Head, Forest Environment Dept.

MC/jc

cc: Greg Edwards

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
REGION SIX
FORT WORTH, TEXAS 76102
819 Taylor Street

November 8, 1974

IN REPLY REFER TO
06-00.8

Mr. Arthur W. Busch
Regional Administrator
Environmental Protection Agency
1600 Patterson
Dallas, Texas 75201

Dear Mr. Busch:

We have reviewed your draft environmental impact statement for the Northwest Regional Wastewater Treatment Facilities at the City of Houston.

We have no comments to make.

Sincerely yours,

for J. W. White
Regional Administrator

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
Southeastern Area, State and Private Forestry
Atlanta, Georgia 30309

December 4, 1974

Mr. Arthur W. Busch
Regional Administrator
U. S. Environmental Protection Agency
Region VI
1600 Patterson
Dallas, Texas 75201

Re: Draft EIS for Northwest Regional Wastewater Treatment Facilities, City of Houston

REC
DEC 9 1974
Assistant for
Congressional &
Intergovernmental
Relations

Dear Mr. Busch:

We acknowledge receipt of the above named environmental impact statement.

Our review discloses that impacts on forest lands and forest resources are negligible. Therefore, we have no comments.

Thank you for the opportunity to review and comment on this environmental impact statement.

Sincerely,

Paul E. Buffam

PAUL E. BUFFAM
Area Environmental Coordinator

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
REGIONAL OFFICE
1114 COMMERCE STREET
DALLAS, TEXAS 75202

OFFICE OF
THE REGIONAL DIRECTOR

October 24, 1974

Our Reference: EI# 1074-429

Mr. Arthur W. Busch
Regional Administrator
U.S. Environmental Protection Agency
Region VI
1600 Patterson
Dallas, Texas 75201

RE: Northwest Regional Wastewater
Treatment Facilities
City of Houston
WPC-TEX-1020

Dear Mr. Busch:

Pursuant to your request, we have reviewed the Environmental Impact Statement for the abofe project proposal in accordance with Section 102(2) (C) of P. L. 91-190, and the Council on Environmental Quality Guidelines of April 23, 1971.

Environmental health program responsibilities and standards of the Department of Health, Education, and Welfare include those vested with the United States Public Health Service and the Facilities Engineering and Construction Agency. The U. S. Public Health Service has those programs of the Federal Food and Drug Administration, which include the National Institute of Occupalional Safety and Health and the Bureau of Community Environmental Management (housing, injury control, recreational health and insect and rodent control).

Accordingly, our review of the Draft Environmental Statement for the project discerns no adverse health effects that might be of significance where our program responsibilities and standards pertain, provided that appropriate guides are followed in concert with State, County, and local environmental health laws and regulations.

We therefore have no objection to the authorization of this project insofar as our interests and responsibilities are concerned.

Very truly yours,

Wm F Crawford
William F. Crawford
Environmental Impact Coordinator

ORD EI 1

DEPARTMENT OF HEALTH, EDUCATION AND WELFARE

Reaction Review and Comments on Environmental Impact Statement for Project Proposal:

Draft Environmental Impact Statement Reviewed With Objections ☐

Draft Environmental Impact Statement Reviewed With No Objections ☒

Date: 10/22/74

EI# 1074-429

Agency/Bureau: DHEW/PHS

Project Proposal: Northwest Regional Wastewater Treatment Facilities
City of Houston

Comments: Pursuant to Section 102(2)(f) of Public Law 91-190 we have reviewed this project proposal and find no indication of adverse environmental health impact where our program standards and responsibilities are concerned.

However, I would suggest consideration be given to possible traffic hazards which may exist in the three public school areas near the construction site due to increased early morning traffic on streets by or near these schools. I would recommend travel routes be established for utilization of construction employees which will provide minimum congestion and danger to children going to school in the mornings.

I also notice one school (Smith School) is very near the project area. Will the noise of construction become a problem with this school? Perhaps the Department of Education should determine size of expected labor force and this information could be used as a base for evaluation of the potential environmental impact upon school population.

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20201

DEC 6 1974

Mr. Arthur W. Busch
Regional Administrator
Environmental Protection Agency
1600 Patterson
Dallas, Texas 75201

Dear Mr. Busch:

We have reviewed the draft Environmental Impact Statement concerning the City of Houston's Northwest Wastewater Treatment Facility, WPC-TEX-1020. On the basis of our review, we have the following comments:

1. The statement indicates (p. 49) that industrial expansion in Houston has been considerable in the areas of manufacturing, petrochemical and chemical production, aerospace industry, and medical research: 118 new industrial plants between 1960-1969, and 272 major expansions of existing plants. However, we found no indication of the nature of the industrial plants whose waste will be treated by the Northwest Wastewater Treatment Facility and the chemicals which they discharge.

2. The figures on pp. 13, 17, 20, 31, 58, 60, 61 and 85 show present and proposed urban and industrial relationships. Since EPA has recently been considering the possibility of formation of toxic chemicals as the result of the chlorination step in water purification, this should also be considered in this proposed project. This plant plans to generate Cl_2 from NaOCl on-site and use the Cl_2 for disinfection of the water at the Northwest facility prior to release into Cole Creek and the White Oak Bayou. Sludge would be conveyed to the Northside Plant for further treatment and thus, this part would not be treated by the chlorination step.

3. Recent findings have identified chlorinated Hydrocarbons and other potential hazardous substances in water as a potential result of chlorination. It may be wise to identify the compounds found in the sludge, and hypothesize the chemicals which may be formed as a result of chlorination.

4. Despite the fact that the water is apparently not going to be used as a source of drinking water, one still must identify the potential of the effluent entering the food chain. Some aquatic species do have a potential for concentrating chemicals and thereby transmitting them back to humans. It is noted that Aldrin; DDD; DDE; DDT; Dieldrin; Endrin; Heptachlor; Lindane; Chlordane; Dioxane; Organo phosphurous; 2,4,D; 2,4,5,T; Silvex; Heavy metals; etc., have been found in the San Jacinto River Basin. These chemicals are a health hazard, for instance, 2,4,-D may be associated with the presence of dioxones. From the standpoint of Public Health and Safety, it would be cogent that positive steps be taken to prevent their entry into the food chain, and to assure that there will be no exposure to humans.

5. We suggest that consideration be given to the possible traffic hazards which may exist in the three public school areas located near the construction site. We recommend travel routes be established for utilization of construction employees which will provide minimum congestion and danger to children attending school.

   Also, will construction noise have an adverse impact on the Smith School which is located very near the project area? The size of the expected labor force should be determined and evaluated for the potential environmental impact upon school populations.

Thank you for the opportunity to review this statement.

Sincerely,

Charles Custard

Charles Custard
Director
Office of Environmental Affairs

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
REGIONAL OFFICE
1100 COMMERCE STREET
DALLAS, TEXAS 75202

December 2, 1974

REGION VI

IN REPLY REFER TO:
6ME

Mr. Arthur W. Busch
Regional Administrator, Region VI
United States Environmental Protection Agency
1600 Patterson
Dallas, Texas 75201

Dear Mr. Busch:

The Draft Environmental Impact Statement for the City of Houston's Northwest Wastewater Treatment Facility has been reviewed by environmental assessment personnel in the Department of Housing and Urban Development's Dallas Area Office. A summation of that Office's review comments on the subject Statement follows:

1. Cross Reference to Incoming Inquiry

   The proposed action is to expand the existing four-million gallons per day Northwest Wastewater Treatment Facility in Houston to a twelve-million gallons per day facility. The enlarged facility "will provide secondary biological treatment using the contact stabilization made of the activated sludge treatment process."

2. HUD Comment on the Statement

   a. There should be more detailed discussion of this proposed project's possible impacts on air quality. The expanded facility will generate additional urban development which, in turn, will generate additional automotive traffic with its accompanying pollutants. It would be helpful, therefore, to include quantified data regarding the total amount of automotive emissions that would result from the 130,000 trips per day generated. These totals should then be related to the air quality standards established for the Houston-Galveston Area.

   b. The Statement fails to discuss or set standards for thermal pollution of waterways by the expanded plant's effluent.

   c. The Texas Parks and Wildlife Department in its report, A Regional Environmental Analysis of the Houston-Galveston Region, July, 1974, indicates that secondary treatment plans are inadequate for the Houston Area and states that "Tertiary treatment should be required of all new residential developments." Yet the proposed facility would provide only secondary treatment.

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d. The statement should discuss the impact of the facility's effluent on aquatic food-systems and the impact of excess nutrients on estuarial waters and marine life.

e. It is felt to be unfortunate that EPA in this Statement appears to be taking a stand against the need for public land use management controls as evidenced by the fact that only Urban Dynamics of Non-Zoning by J. W. Santamaria is quoted in regard to this area of concern.

3. HUD Reservation about the Proposal

HUD does not oppose the proposed facility. Rather, HUD is concerned that the facility is proposed to provide only secondary rather than tertiary treatment.

Sincerely,

David W. Baker
Environmental Clearance Officer

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

P. O. Box 648
Temple, Texas 76501

November 22, 1974

Mr. Arthur W. Busch, Regional Administrator
United States Environmental Protection
Agency, Region VI
1600 Patterson
Dallas, Texas 75201

Dear Mr. Busch:

We have reviewed the draft environmental statement for the city of Houston's Northwest Wastewater Treatment Facility, WPC-TEX-1020.

We offer the following suggestions for section IIIA-3:

1. Page 23, First Paragraph

   The last two sentences should read:

   > "It shows the four soil series that occur in the service area of the proposed project. Soil series descriptions and interpretations for these four series are presented in Appendix F."

   Urban should be deleted from the legend in figure III-3 and Appendix F because it is not a soil series but only indicates disturbances of the soil by development. Also, we are enclosing series descriptions and interpretations for the four soils series. Appendix F would contain more factual information if this data were summarized for each soil series. The title for Appendix F would become, "Characteristics of Soil Series in Northwest Harris County."

2. Page 23, Second Paragraph

   It is difficult to relate information in this paragraph to the proposed project. What are the limits of the Houston area and the area south of Buffalo Bayou? If the purpose of this paragraph is background information, you may want to use Harris County as the evaluation unit. The second sentence of this paragraph should read:

   > "Clay types predominate in the area south of Buffalo Bayou making the soils in this area dark, blocky, and hard when dry except for a thin granular surface layer a few inches thick and very high in clay content."

The third sentence should read:

> ". . . the soils tend to have a grayish, loamy surface with either blocky, clayey, very slowly permeable subsoils or loamy, moderately permeable subsoils."

The fourth sentence should read:

> ". . . deep grayish alluvial soils, some being mottled with other colors, are deposited in narrow flood plains with timber immediately adjacent to the watercourse."

3. Pages 23 and 24, Third Paragraph

   This paragraph could be improved if information on texture, color, permeability, problems, etc. is abstracted from the enclosed soil series descriptions. A statement about dominant vegetative species found in the service area would be meaningful. The meaning of the fourth sentence is unclear. Septic tanks function poorly in most of the service area due to flat topography, perched water table and slow permeability. This condition is not confined to the small areas of alluvial soil along the streams. In the fifth sentence, correct the spelling of montmorillonitic. Also insert "high" before plasticity and shrink-swell.

4. One of the primary soil problems in this area is poor natural drainage of the loamy soils. The only soil series in the service area of the project which has high shrink-swell potential is the Aris and this occurs in the subsoil.

5. We believe the 1922 soils information should be deleted since you have information from a more recent survey.

We appreciate the opportunity to review this draft and make appropriate comments.

Sincerely,

Sam K. Haderlie

For Edward E. Thomas
State Conservationist

Enclosure

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

In Reply Refer To:
EGS
ER-74/1294

Dear Mr. Busch:

This Department has received and reviewed the draft environmental statement for Northwest Regional Wastewater Treatment Facilities, City of Houston, Texas, WPC-Tex-1020. The upgrading of wastewater treatment facilities will be a positive step in improving regional water quality through the reduction of overloading and bypassing, both of which are prevalent problems in Houston's wastewater treatment system. We offer the following comments to further improve the environmental statement.

Land Use

In general, we do not believe that the draft statement adequately addresses the concerns of this Department with regard to land use. We suggest that the final statement include a detailed, quantified discussion of existing and planned recreation facilities in the area and the proposed project's impact thereon.

It is indicated on page 103, "The park and playground facility incorporated in the site plan will have a beneficial impact on the surrounding area . . ." However, figure II-4, "Site Plan for the Northwest Region Plant," depicts only a "possible playground." Clarification is needed as to the city's specific plans relative to park and open-space development and their timing.

Very little difference is noted in green color areas, i.e., open space, between figure III-19, "Existing Land Use," and figure III-20, "Projected Land Use." This would indicate that few park and open-space developments are being planned to satisfy future growth and development. A table should be provided depicting projected land-use distribution for the service area.

It is stated on page 59, "The area in question should become a low density residential area by 1990." On page 118 it is stated, "The low density character of the area is expected to persist." However, on page 62, a somewhat different assumption is made: "The transit system will have a far-reaching impact on the southeast section of the service areas . . . High-density, concentrated development will inevitably take place . . ." Clarification is needed as to the projected population density of the area before any accurate planning assessments for land use can be projected.

On page 111 the report states, "Depending on the goals and policies of the City of Houston, the impact of the proposed project on the parks and open space development could be highly beneficial." A more definite statement as to the commitment for parks and open space by the city of Houston is necessary to adequately assess overall environmental impacts.

Biological Environment

We find that the statement generally represents an adequate assessment of the effects of the project on fish and wildlife.

The section entitled "Botanical" (p. 41) covers, in general terms, botanical aspects of the project area. A more specific discussion of plants within the project area, including rare or endangered species, could be included in this section. The Rare Plant Study Center of the University of Texas in Austin has released a listing of "Rare and Endangered Plants Native to Texas." Four species found within Harris County are listed. We suggest a study be conducted to determine if any rare or endangered plant species will be affected by the project and the results of the study should be included in the statement.

"Wildlife Habitats," page 42, describes the mammal species found in the project area rather than their habitat. We suggest that a separate section on mammals would further strengthen the "Biological Element" section of the impact statement.

A discussion of the Houston toad (Bufo houstonensis), listed as an endangered species, and the project's impact upon its future existence would be appropriate on page 42, under "Aquatic Fauna."

A section on national parks, historical areas, and national or State game preserves or refuges could be appropriately included in this section.

Figure III-6, page 28, would be enhanced by inclusion of information pertinent to each well shown. If this information is not immediately available, we suggest omission of the figure. Figures III-17 and III-18 are of little value to the reader without pertinent data such as tables and boundary indications and we suggest inclusion of such information on the figures.

Historical and Cultural Environment

The proposed wastewater facilities will not adversely affect any existing or proposed unit of the National Park System, nor any site eligible for registration as a National Historic, Natural, or Environmental Education Landmark. However, with reference to page 48, "Archeological, Historical and Cultural Elements," we wish to note that several additional properties in the Houston area were added to the National Register of Historic Places during 1974. All are apparently outside the service area of the project, as are the two currently mentioned in the draft statement. The additional listings are: Pillot Building, 106 Congress Street; Sweeney, Coombs and Frederick Building, 301 Main Street; and U. S. Custom House, San Jacinto at Rusk.

We agree with the second sentence, page 48, paragraph 3, that "Prior to the construction of the project, the proposed site should be subjected to a thorough archeological survey." We suggest information obtained from such a survey be included in the final statement, which should also include the name of the professional archeologist who surveys the project area, as well as information on the number and types of sites discovered, their significance, and the impact the project will have on the sites. If there will be an adverse effect, the final statement should detail the actions to be taken to mitigate such effects.

Environmental Effects of the Proposed Action

We wish to stress that any improvements in water quality and beneficial effects on aquatic biota will result from the increased assimilative capacity of the streams and not the reduction of pollutants per se, as stated in the first paragraph, page 108. Increasing the plant's net discharge rate from 4.0 mgd to 12.0 mgd may reduce the concentration of pollutants in the effluent, but the daily effluent loading (lbs/day) will undoubtedly increase, particularly with increased urbanization. In addition, the impact statement would benefit from a more critical evaluation of disinfection alternatives presented in Appendix J. Chlorination does not provide complete disinfection, nor is it more efficient than ozone in removing waterborne contaminants.

<u>Adverse Impacts Which Cannot Be Avoided</u>

Subsidence resulting from excessive withdrawal of ground water is recognized as a major problem in the Houston area (p. 123) but no indication is given as to whether the project area has suffered subsidence or is an area where subsidence is likely. This information and a discussion of any required safeguards should be included in the final environmental statement.

We thank you for the opportunity to review the subject document and hope that our comments will assist in the preparation of the final environmental impact statement.

Sincerely yours,

Stanley D Doremus

Deputy Assistant Secretary of the Interior

Mr. Arthur W. Busch
Regional Administrator
Region VI
Environmental Protection Agency
1600 Patterson
Dallas, Texas 75201

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APPENDIX

TEXT REFERENCE

CHAPTER II: BACKGROUND PERSPECTIVES (EXISTING WASTEWATER TREATMENT SYSTEM)

APPENDIX A: PRELIMINARY INVENTORY OF CITY OF HOUSTON WASTEWATER TREATMENT PLANTS

SOURCE:

CITY OF HOUSTON WASTEWATER MANAGEMENT PLAN
WASTE LOAD REPORT TO THE TEXAS WATER QUALITY
BOARD (REVISED)
APRIL 1, 1974

BY:

TURNER, COLLIE & BRADEN, INC.
CONSULTING ENGINEERS
HOUSTON, TEXAS

TABLE A-1
Preliminary Inventory
City of Houston
Wastewater Treatment Plants

Treatment Plant Name	Stated Design Capacity (mgd)	Treatment Unit Components Primary Treatment								Sedimentation			Trick. Filters		Activ. Sludge			Sludge Handling				Disinfection			
		FM	FR	PC	BS	MS	CO	GC	AG	IT	SC	FC	PF	SF	CB	SB	AB	AD	ND	DB	OTH	MC	CC	CD	OD
Almeda-Sims	1.00		X		X				X			X			X	X			X				X	X	
Chadwick Manor	0.08									X		X	X										X	X	
Chocolate Bayou	1.55		X		X			X				X												X	
Clinton Park	0.75	X			X			X				X			X	X			X				X	X	
Fastex Oaks	0.05									X		X	X										X	X	
Easthaven	0.40		X		X					X		X	X		X	X								X	
Fontaine Place	0.33									X		X	X											X	
FWSD No. 17	1.50				X							X			X	X							X	X	
FWSD No. 23	5.00		X									X			X	X						X	X	X	
FWSD No. 34	1.30											X			X	X		X					X	X	
Gulf Meadows	1.00		X		X							X			X	X		X				X	X	X	
Gulf Palms	0.20									X		X	X										X	X	
Gulfway Terrace	0.18									X		X	X										X	X	
Homestead	0.80		X		X							X			X	X							X	X	
Intercontinental Airport	0.60		X		X							X			X	X		X					X	X	
Longwoods	0.02			X							X	X							X				X	X	
Mayfair Park	0.40		X		X							X			X	X		X					X	X	
Northeast	2.00		X		X							X			X	X		X					X	X	
Northside	55.00		X		X			X				X			X							X	X	X	
Northwest	4.00		X		X							X			X	X						X	X	X	
Red Gulley	0.30		X		X							X			X	X							X	X	
Sagemont	2.00		X		X							X			X	X							X	X	
Sherwood Oaks	1.50		X		X							X			X	X							X	X	
Sims Bayou	48.0		X		X			X				X			X							X	X	X	
Southeast (Existing)	3.0	X		X	X							X			X	X		X					X	X	

*Contact Aeration (-Hays)

TABLE A-1 (Cont'd)
Preliminary Inventory
City of Houston
Wastewater Treatment Plants

Treatment Unit Components

Treatment Plant Name	Stated Design Capacity (mgd)	Primary Treatment								Sedimentation			Trick. Filters		Activ. Sludge			Sludge Handling				Disinfectio			
		FM	FR	PC	BS	MS	CO	GC	AG	IT	SC	FC	PF	SF	CB	SB	AB	AD	ND	DB	OTH	MC	CC	CD	OD
Southwest	30.0		X									X			X	X							X	X	
Turkey Creek	4.00		X		X							X			X	X		X					X	X	
WCID No. 20	0.25	X		X	X							X			X				X				X	X	
WCID No. 32	1.00		X	X	X							X			X				X				X	X	
WCID No. 34	0.16									X		X	X										X	X	
WCID No. 39	0.60	X		X	X							X	X						X				X	X	
WCID No. 42	0.25	X		X	X							X			X				X				X	X	
WCID No. 44-1	0.50	X		X	X							X			X				X				X	X	
WCID No. 44-3	0.10		X	X	X							X	X	X					X				X	X	
WCID No. 47	3.00		X		X							X			X	X							X	X	
WCID No. 51	5.00		X		X							X			X	X		X				X	X	X	
WCID No. 53	0.50									X		X	X										X	X	
WCID No. 62	0.40									X		X	X										X	X	
WCID No. 73	0.30	X			X							X			X	X		X					X	X	
WCID No. 81	0.25		X		X							X			X	X		X					X	X	
WCID No. 82	0.05	X			X							X			X	X		X					X	X	
WCID No. 95	0.20		X		X							X			X	X		X					X	X	
West District	14.0		X						X			X			X	X						X	X	X	

Inventory Codes

		Code
Primary Treatment:		
Flow Measurement:	Flow Meter	FM
	Flow Meter/Recorder	FR
Screening:	Bar Screen	BS
	Mesh Screen	MS
	Comminutor/Shredder	CO
Grit Removal:	Grit Channel/Chamber	GC
	Aerated Grit Chamber	AG
Primary Clarification:		PC
Clarification - Sedimentation:		
	Imhoff Tank	IT
	Secondary Clarifier	SC
	Final Clarifier	FC
Trickling Filters:		
	Primary Trickling Filter	PF
	Secondary Trickling Filter	SF
Activated Sludge Processes:		
Contact Stabilization:	Contact Basin	CB
	Stabilization Basin	SB
Activated Sludge, General:		
	Aeration Basin	AB
Sludge Handling:		
	Aerobic Digester	AD
	Anaerobic Digester	ND
	Drying Beds	DB
	Other:(Incineration, Vacuum Filtration)	OTH
Disinfection:	Mixing Chamber	MC
	Contact Chamber	CC
	Chlorine Disinfection	CD
	Other Disinfection Process	OD

TEXT REFERENCE:

CHAPTER II: BACKGROUND PERSPECTIVES (PROPOSED TREATMENT SYSTEM FOR HOUSTON)

APPENDIX B: PRELIMINARY RECOMMENDATIONS FOR REGIONAL SEWAGE TREATMENT IMPROVEMENTS AND EXPANSIONS

SOURCE:

CITY OF HOUSTON WASTEWATER MANAGEMENT PLAN
WASTE LOAD REPORT TO THE TEXAS WATER QUALITY
BOARD (REVISED)
APRIL 1, 1974

BY:

TURNER, COLLIE & BRADEN, INC.
CONSULTING ENGINEERS
HOUSTON, TEXAS

TABLE B-1

City of Houston
Wastewater Management Plan
Expansion Summary
(Revised 3-15-74)

Plant Name	WCO Number	Existing Capacity	Expansion Date	Nature of Expansion
Almeda-Sims	10495-03	1.00 MGD	1975-1977 1984-1985	Expansion proposed to 20 MGD (2) Expansion proposed to 40 MGD (1)
Chocolate Bayou	10495-09	1.55 MGD	1974-1976	Expansion proposed to 8 MGD (2)
Clinton Park	10495-10	0.75 MGD	1977-1979	Expansion proposed to 2 MGD (1)
Easthaven	10495-65	0.51 MGD	1975-1977	Expansion proposed to 2 MGD (3)
Homestead	10495-23	0.80 MGD	1977-1979	Expansion proposed to 5 MGD (1)
Intercontinental Airport	--	0.33 MGD	1974	Expansion under construction to C
Northeast	10495-77	2.00 MGD	1976-1978	Expansion proposed to 8 MGD (2) Expansion proposed to 12 MGD (1)
Northside	10495-01	55.00 MGD	1975-1977	Expansion under design to 155 MGD
Northwest	10495-76	4.00 MGD	1975-1977 1980-1981	Expansion under design to 12 MGD Expansion proposed to 16.0 MGD
Red Gulley	10495-71	0.30 MGD	1974-1975	Expansion proposed to 0.90 MGD (
Sagemont	--	2.00 MGD	1975-1976	Expansion proposed to 5 MGD (2)
Sherwood Oaks	--	1.50 MGD		(1)
Southeast	10495-79	3.00 MGD*		Expansion proposed to 6 MGD (1)
Turkey Creek	10495-85	0.75 MGD	1974-1975 1977-1978 1988	Expansion proposed to 2 MGD (inte Expansion proposed to 6 MGD (1) Expansion proposed to 12 MGD (1)
WCID [illegible]	10495-50	3.00 MGD	1977-1979	Expansion proposed to 6 MGD (1)
West District	10495-30	14.00 MGD	1980	Expansion proposed to 22 MGD (1)

TABLE B-1 (Cont'd)
City of Houston
Wastewater Management Plan
Expansion Summary

Plant Name	WCO Number	Existing Capacity	Expansion Date	Nature of Expansion
FWSD 17	10495-15	0.75 MGD	1975-1976	Expansion proposed to 1.50 (3)
Gulf Meadows	10495-20	1.00 MGD	1977-1979	Expansion proposed

*Enlargement completed 1974.

(1) Preliminary engineering in progress.
(2) Engineering plans being prepared.
(3) Engineering plans complete.
(4) Construction in progress.

TABLE B-2 (Cont'd)
CITY OF HOUSTON
WASTEWATER MANAGEMENT PLAN
DIVERSION SUMMARY
(REVISED 3-15-74)

Plant Name	Plant Flow Data		Diversion		Plant Receiving Diversion	
	Design Capacity (mgd)	Existing Load (mgd)	Quantity (mgd)	Date	Plant Name	Design Treatme Capacity (mgd)
Chadwick Manor	0.08	0.04	0.08	Dec. 1976(2)	Southwest	30.00
Eastex Oaks	0.05	0.20	0.20	July 1977(2)	Prop. GCWDA STP	----
Fontaine Place	0.33	0.28	0.33	June 1975(4)	FWSD 23	5.00
FWSD 34	1.30	0.67	1.30	(2)	WCID 51	5.00
Gulf Palms	0.20	0.36	0.36	1976(3)	WCID 47	3.00
Gulfway Terrace	0.18	0.28	0.28	1976(3)	WCID 47	3.00
Longwoods	0.02	0.08	0.08	July 1977(2)	Northside	90.00
Mayfair Park	0.40	0.28	0.40	June 1977	WCID 51	5.00
Sims Bayou	48.00	38.00	10.00 20.00 23.00	1977 1985 1990	Almeda-Sims(5) Almeda-Sims Almeda-Sims	20.00 20.00 40.00
WCID 20	0.25	0.20	0.25	(2)	Northeast	2.00
WCID 32	1.00	0.86	1.00	(2)	Northeast	2.00
WCID 34	0.16	0.30	0.30	(2)	Southwest	30.00
WCID 39	0.60	0.50	0.60	June 1975(4)	FWSD 23	5.00

TABLE B-2
CITY OF HOUSTON
WASTEWATER MANAGEMENT PLAN
DIVERSION SUMMARY
(continued)

lant Name	Plant Flow Data		Diversion		ant Receiving Diversion	
	Design Capacity (mgd)	Existing Load (mgd)	Quantity (mgd)	Date	Plant Nam	Design Treatment Capacity (mgd)[1]
CID 42	0.25	0.68	0.68	June 1975(4)	FWSD 23	5.00
CID 44-1	0.50	0.46	0.50	(4)	Almeda-Sims	20.00
CID 44-3	0.10	0.46	0.46	(4)	Almeda-Sims	20.00
CID 53	0.50	0.38	0.50	June 1974(4)	Southeast	3.00
CID 62	0.40	0.19	0.40	June 1974(4)	Southeast	3.00
CID 73	0.30	0.20	0.30	(1)	Prop. Cedar Bayou	0.26
CID 81	0.25	0.36	0.36	June 1974(4)	Southeast	3.00
WCID 82	0.05	0.051	0.051	(1)	Prop. Cedar Bayou	0.26
WCID 95	0.20	0.42	0.42	Dec. 1976(2)	West District	14.00

At time of diversion

1) Preliminary Engineering in Progress
2) Engineering Plans Being Prepared
3) Engineering Plans Complete
4) Construction in Progress
5) Diversion from Brays Bayou Watershed

TABLE B-3
City of Houston
Wastewater Management Plan
Abandonment Summary
(Revised 3-15-74)

Plant Name	WCO No.	Existing Design Capacity (mgd)	Anticipated Flow at Time of Abandonment	Anticipated Date of Plant Abandonment	Disposition of Flow
Chadwick Manor	10495-07	0.08	0.08	Dec. 1976 (2)	Diversion to Southwest STP
Eastex Oaks	10336-01	0.05	0.20	July 1977 (2)	Diversion to GCWDA Plant
Fontaine Place	10495-14	0.33	0.33	June 1975 (4)	Diversion to FWSD 23
FWSD 34	10495-69	1.30	1.30	(2)	Diversion to WCID 51
Gulf Palms	10495-21	0.20	0.36	1976 (3)	Diversion to WCID 47
alfway Terrace	10495-22	0.18	0.28	1976 (3)	Diversion to WCID 47
ongwoods	10495-29	0.02	0.08	July 1977 (2)	Diversion to Northside
ayfair Park	10495-81	0.40	0.47	June 1977	Diversion to WCID 51
WCID 20	10495-41	0.25	0.25	(2)	Diversion to Northeast
WCID 32	10495-43	1.00	1.00	(2)	Diversion to Northeast
CID 34	10495-44	0.16	0.30	(2)	Diversion to Southwest
CID 39	10495-45	0.60	0.60	June 1975 (4)	Diversion to FWSD 23
WCID 42	10495-46	0.25	0.68	June 1975 (4)	Diversion to FWSD 23
WCID 44-1	10495-47	0.50	0.46	(4)	Diversion to Almeda-Sims
WCID 44-3		0.10	0.46	(4)	Diversion to Almeda-Sims
WCID 53	10495-55	0.50	0.50	June 1974 (4)	Diversion to Southeast
WCID 62	10495-58	0.40	0.40	June 1974 (4)	Diversion to Southeast
WCID 73	10495-82	0.30	0.30	(1)	Diversion to Prop. Cedar B
WCID 81	10495-83	0.25	0.36	June 1974 (4)	Diversion to Southeast
WCID 82	10495-77	0.05	0.051	(1)	Diversion to Prop. Cedar
WCID 95	10495-84	0.20	0.42	Dec. 1976 (2)	Diversion to West District

(1) Preliminary engineering in progress.
(2) Engineering plans being prepared.
(3) Engineering plans complete.
(4) Construction in progress.

CITY OF HOUSTON
WASTEWATER MANAGEMENT PLAN
REGIONALIZATION SUMMARY
(Grouping of Sewage Treatment Plants under Sludge Disposal Plants)
(4-25-1974)

The sewage treatment districts within the city limits of Houston are proposed to be grouped under the three sludge disposal plants as follows:

1. North Side System:
   - (a) North Side Wastewater Treatment Plant
   - (b) Homestead Wastewater Treatment Plant
   - (c) District No. 23 Wastewater Treatment Plant
   - (d) District No. 17 Wastewater Treatment Plant
   - (e) Clinton Park Wastewater Treatment Plant
   - (f) Northeast Wastewater Treatment Plant
   - (g) Northwest Wastewater Treatment Plant
   - (h) West District Wastewater Treatment Plant
   - (i) Turkey Creek Wastewater Treatment Plant
2. South Side System:
   - (a) Sims Bayou Wastewater Treatment Plant
   - (b) District No. 47 Wastewater Treatment Plant
   - (c) East Haven Wastewater Treatment Plant
   - (d) Sagemont Wastewater Treatment Plant
   - (e) Southeast Wastewater Treatment Plant
   - (f) Gulf Meadows Wastewater Treatment Plant
   - (g) Chocolate Bayou Wastewater Treatment Plant
3. Almeda-Sims System:
   - (a) Almeda-Sims Wastewater Treatment Plant
   - (b) District No. 51 Wastewater Treatment Plant
   - (c) Southwest Wastewater Treatment Plant

In approximately four to five years, a new major system will be formed and the following districts will be grouped under this system:

4. Northwest System:
   - (a) Northwest Wastewater Treatment Plant
   - (b) West District Wastewater Treatment Plant
   - (c) Turkey Creek Wastewater Treatment Plant
   - (d) Western Portion of the North Side Wastewater Treatment Plant area

TEXT REFERENCE:

CHAPTER II: BACKGROUND PERSPECTIVES (THE PROPOSED ACTION)

APPENDIX C: IMPROVEMENT CONTRACTS FOR THE CONSTRUCTION OF NORTHWEST REGIONAL SEWAGE TREATMENT PLANT BETWEEN THE CITY OF HOUSTON AND THE GULF COAST WASTEWATER AUTHORITY

LEGAL CONTRACTS PLACED HERE HAVE BEEN RETYPED TO CONFORM TO STANDARD SIZE

GULF COAST WASTE DISPOSAL AUTHORITY - CITY OF HOUSTON SEWER SYSTEM CONTRACT

THE STATE OF TEXAS §

KNOW ALL MEN BY THESE PRESENTS:

COUNTY OF HARRIS

WHEREAS, the Gulf Coast Waste Disposal Authority (the "Authority") is a conservation and reclamation district created by Article 7621d-2, Vernon's Texas Civil Statutes, pursuant to Article 16, Section 59 of the Texas Constitution;

WHEREAS, the Authority is an agency of the State of Texas operating on a multiple county and regional basis;

WHEREAS, the City of Houston (the "City") is a city duly organized and existing pursuant to the Constitution and laws of the State of Texas;

WHEREAS, the Authority is willing and able, in order to carry out a purpose for which it was created, to acquire by purchase and construction, for the benefit of the City, parts of a sanitary sewer system to render sanitary sewage service to make certain improvements and additions to existing sanitary sewer facilities of the City (with such sanitary sewer system, together with said improvements and additions, being herein-after sometimes collectively called the "Project");

WHEREAS, the City has filed or will file applications for Federal grants for the Project with the Texas Water Quality Board and the Environmental Protection Agency of the United States of America and the City will seek such grants in the maximum amount available of the estimated reasonable costs of constructing the Project;

WHEREAS, the Texas Water Quality Board has granted and given the necessary permits in connection with the Project;

WHEREAS, the City and the Authority are authorized to make and enter into this Contract under Articles 7621d-2 and 1109j, Vernon's Texas Civil Statutes;

WHEREAS, the City and the Authority have determined that it is in the best interest of the parties to issue the Authority's bonds from time to time to acquire funds with which to carry out the purposes of this Contract, and that this Contract will facilitate the issuance of and provide security for such bonds.

IT IS THEREFORE CONTRACTED AND AGREED BETWEEN THE AUTHORITY AND THE CITY AS FOLLOWS:

Section 1. DEFINITIONS. The terms and expressions used in this Contract, unless the context shows clearly otherwise, shall have meanings as follows:

(a) "Project" means collectively and consists of all of the following described work bearing the City's job numbers designated by the Sewer Division of the Department of Public Works of the City and having Federal grant application numbers, to-wit:

Federal Grant Number	Job Number	Description
WPC-TEX-1009	3304-DT	Enlargement of Almeda-Sims Sewage Treatment Plant
WPC-TEX-1010	3372	Enlargement of North Side Sludge Plant
WPC-TEX-1008	3249	Trunk Sewer for Diversion of Gulf Pa and Gulfway Terrace Sewage Treatment Plants
WPC-TEX-1060	3292 and 3378	Almeda, Knight, Cambridge Trunk Sewer and Pump Station
WPC-TEX-1047	3348	Enlargement of East Haven Sewage Treatment Plant
WPC-TEX-1074	3304-DS	Almeda-Sims Sewage Sludge Disposal Plant
WPC-TEX-1020	3405	Northwest Sewage Treatment Plant Enlargement and Sanitary Sewer Line in Acres Home area

(b) "Board" and "Board of Directors" means the Board of Directors of the Authority.

(c) "Bond Resolution" means any resolution of the Board of Directors authorizing the issuance of Bonds and providing for their security and payment, as such resolution(s) may be amended from time to time as therein permitted.

(d) "Bonds" means any bonds to be issued by the Authority for acquiring, by purchase and construction, any Component of the Project, whether in one or more series or issues, any completion bonds, or any bonds issued to refund same.

(e) "Component" means any one or more of components of the Project designated by a Federal grant number in the above definition of Project.

Section 2. A OBLIGATION OF AUTHORITY TO ACQUIRE. The Authority agrees to pay, and will pay, pursuant to this Contract all of the actual costs of acquiring, by purchase and construction, any Component or all of

(g) This Contract shall be cumulative of and in addition to any other agreements heretofore or hereafter entered into by the parties hereto, and this Contract shall not affect the rights, duties, or obligations of either party hereto under any other agreement unless such agreement specifically provides that any of the rights, duties, or obligations contained in this Contract are affected by such subsequent agreement.

IN WITNESS WHEREOF, the Authority and the City, acting under authority of their respective governing bodies have caused this Contract to be duly executed in several counterparts, each of which shall constitute an original, all as of the _______ day of ______________________, 1973, which is the date of this Contract.

GULF COAST WASTE DISPOSAL AUTHORITY

By ____________________________
Chairman, Board of Directors

ATTEST:

____
Secretary, Board of Directors

(AUTHORITY'S SEAL)

CITY OF HOUSTON, TEXAS

By____________________________
Mayor

ATTEST:

____
(CITY'S SEAL)

COUNTERSIGNED:
LEONEL J. CASTILLO, City Controller

By ____________________________
City Controller

TEXT REFERENCE:

CHAPTER II: BACKGROUND PERSPECTIVES (THE PROPOSED ACTION)

APPENDIX D: PERMIT ISSUED BY THE TEXAS WATER QUALITY BOARD FOR THE ENLARGEMENT OF THE NORTHWEST REGIONAL SEWAGE TREATMENT PLANT

LEGAL CONTRACTS PLACED HERE HAVE BEEN RETYPED TO CONFORM TO STANDARD SIZE

PERMIT
NO. 10495

(Page 76 of 77. An Amendment
adding Page 76 to Permit)

TEXAS WATER QUALITY BOARD
1108 Lavaca Street
Austin, Texas 78701

PERMIT to dispose of wastes under provision of
Article 7621d-1, Vernon's Civil Statutes

I. Name of Permittee

1.	Name	City of Houston (Northwest Sewage Treatment Plant)
2.	Address	900 Brazos Street
3.	City	Houston, Texas

II. Type of Permit

Regular__________ Amended _____xxx_____

III. Nature of Business Producing Waste

IV. General Description and Location of Waste Disposal System

Description: Contact stabilization process

Location: Located at 5422 Randon Road in Samuel McClelland Survey, A-544, Harris County, Texas as shown on the map with the application.

V. Conditions of the Permit

1. Character, volume and disposal area(s) or point(s) or discharge authorized under this Permit. The conditions on the reverse side are a part of this Permit and apply for all purposes.

Character: Treated Municipal sewage effluent
Volume: Not to exceed an average of 2800 gallons per minute; not to exceed 5600 gallons per minute; not to exceed an average of 4,000,000 gallons per day.

	NOT TO EXCEED		
Item	Monthly Average	24 Hr. Daily Composite	Individual Sample
B.O.D.	20 ppm	25 ppm	30 ppm
Total Suspended Solids	20 ppm	25 ppm	30 ppm

A Chlorine residual of not less than 1.0 ppm shall be maintained after a 20 minute detention time.

Point of Discharge: At a point adjacent to the plant site that will abut Cole Creek, thence to White Oak Bayou, thence to Buffalo Bayou, thence to the Houston Ship Channel.

2. Special Provisions

SEE ATTACHMENT

3. This permit becomes effective February 29, 1968 and is valid until amended or revoked by the Board.

ISSUED this 1st day of March, 1968

(Signed)
Deputy Director

(Signed)
For the Board

Standard Provisions

(a) This permit is granted in accordance with the Texas Water Pollution Control Act (Article 7621d of V.T.C.S.) and the Rules, Regulations and Modes of Procedure adopted by the Board, and is granted subject to the rules and regulations of the Board, the laws of the State of Texas, and further orders of the Board issued in accordance with said rules and regulations.

(b) In the event the permittee discharges wastes which exceed the quantity or quality authorized by this Permit, the permittee shall give immediate notice to the office of the Board.

(c) Acceptance of this permit constitutes an acknowledgement and agreement that the permittee will comply with all the terms, provisions, conditions, limitations and restrictions embodied in this permit and with the rules, regulations, and orders of the Board. Such agreement is a condition precedent to the granting of this Permit.

(d) This permit cannot be transferred without prior notification to the Board.

(e) This permit is issued pursuant to the terms of section 5 of Article 7621d of V.T.C.S., which reads in part as follows:

> "Upon receipt of such application, the Executive Secretary of the Board is hereby authorized to, and he shall immediately, issue to such applicant a permit to continue the existing discharge covered by such application until further order of the Board. Thereafter, the permittee may be required for good cause, from time to time, after public hearing initiated by the Board, to conform to new or additional conditions and terms imposed by the Board....

> Such permit or amended permit shall never become a vested right in the permittee, and it may be revoked for good cause shown, after public hearing initiated by the Board, in the event of the permittee's failure to comply with the condition or conditions of such permit as issued or as amended."

(f) The application pursuant to which this permit has been issued is incorporated herein; provided, however, that in the event of a conflict between the provisions of this permit and the application, the provisions of the permit shall control.

(g) There may be substituted for the foregoing features of the plant other mechanisms, equipment, or treatment methods on prior approval of the State Health Department, provided such substitutions do not result in a reduction of the efficiency and operating safety of the plant nor result in the discharge of a lesser quality of effluent than that authorized under the permit issued previously.

PARAGRAPH (e) ABOVE DOES NOT APPLY AS WRITTEN AND IS REPLACED BY THE FOLLOWING PARAGRAPH (e):

(e) The permittee may be required, for good cause, from time to time, after public hearing initiated by the Board, to conform to new or additional conditions and terms imposed by the Board following such hearing. Such permit or amended permit shall never become a vested right in the permittee, and it may be revoked for good cause shown, after public hearing initiated by the Board, in the event of the permittee's failure to comply with the condition or conditions of such permit as issued or as amended.

Permit No. 10495
City of Houston

Attachment
Effective Date 2-29-68

SPECIAL PROVISIONS

Plant enlargement to be by stages. Plans and specifications for each state shall be reviewed and approved by the State Health Department prior to construction. The Permit shall issue in installments, following final approval of each installment by the Board, as plans and specifications for each successive stage are approved by the State Health Department. Each successive installment will include the pertinent portions of preceding installments, which preceding installments shall be superseded and cancelled.

The maximum average volume of discharge as approved by the Board is to be 40,000,000 gallons per day. Provided, however, that the authorized volume of discharge at any time shall not exceed the volume requirements shown above.

This permit is granted subject to the policy of the Board to encourage the development of area-wide waste collection, treatment and disposal systems. The Board reserves the right to amend this permit in accordance with applicable procedural requirements to require the system covered by this permit to be integrated into an area-wide system, should such be developed; to require the delivery of the wastes authorized to be collected in, treated by or discharged from said system, to such area-wide system; or to amend this permit in any other particular to effectuate the Board's policy. Such amendments may be made when, in the judgment of the Board, the changes required thereby are advisable for water quality control purposes and are feasible on the basis of waste treatment technology, engineering, financial and related considerations existing at the time the changes are required, exclusive of the loss of investment in or revenues from any then existing or proposed waste collection, treatment or disposal system.

These public sewage facilities shall be operated and maintained by a sewage plant operator holding a valid certificate of competency issued under the direction of the Texas State Health Department as required by Section 20 (a) of Article 4477-1, Vernon's Texas Civil Statutes.

TEXT REFERENCE:

CHAPTER III: SOCIAL AND ENVIRONMENTAL SETTING
(NATURAL ENVIRONMENT)

APPENDIX F: CHARACTERISTICS OF SOIL SERIES FOR NORTHWEST HOUSTON, HARRIS COUNTY, 1974

BY:

DR. CHARLES F. DODGE, CHAIRMAN
DEPARTMENT OF GEOLOGY

AND

REBECCA DODGE
DEPARTMENT OF GEOLOGY
UNIVERSITY OF TEXAS AT ARLINGTON

AUGUST, 1974

SUMMARY OF SOILS TYPES CHARACTERISTICS FOR NORTHWEST HARRIS COUNTY

1. The Addicks (Ad) Soil Series is found in limited areas to the south and west of the Houston Dome Stadium. Soil depth ranges up to 78 inches for the "C" horizon. The Addicks is a poorly drained upland soil with slopes of generally less than 1% and moderately slow permeability. Soil pH ranges from 6.1 to 8.4, with a high corrosivity to steel and a low corrosivity to concrete. The various soil zones have a Plasticity Index that ranges from 5 to 27, with a low to moderate Shrink-Swell potential.

2. The Aris (An) Soil Series: The Aris soils are poorly drained and have a very slow permeability. The soil is dark grayish brown, and is up to 78" thick. The PI ranges from 9 to 36 and the shrink-swell potential is low to high. pH ranges from 5.1 to 7.3 and the soils have a high corrosivity to steel and a moderate corrosivity to concrete.

3. Clodine (Cd) Soil Series: The soid depth ranges from 60 to 100 inches for the "C" horizon. The Clodine is a poorly drained, moderately permeable upland soil with slopes mainly less than 1%. Soil pH ranges from 6.1 to 8.4, with a high corrosivity to steel and a low corrosivity to concrete. The various soil zones have a Plasticity Index ranging from 4 to 20, with a low to moderate Shrink-Swell potential.

4. The Gessner (Ge) Soil Series has a limited extent in the services area, being restricted to the south-

central part of Harris County near its common corner with Fort Bend and Brazoria Counties. This soil extends to depths of 84 inches. It is poorly drained, with slopes that rarely exceed 1% and moderate permeability. The Plasticity Index ranges from 4 to 20; thus, the Shrink-Swell potential is low. The soil has a pH ranging from 6.1 to 8.4, with depth; corrosivity is high to steel and low to concrete.

5. The Midland (Md) Soil Series is found in the area east and north of the Dome Stadium. The soil is up to 60 inches thick. Slopes range up to 1%; it is poorly drained and has very slow permeability. The pH values range from 5.1 to 8.4, with depth, and cause a corrosivity that is high to steel and low to concrete. With a Plasticity Index of from 12 to 40, it has moderate to high Shrink-Swell potential.

6. Nahatche Soil Series (Na): Soil depth ranges up to 83 inches for the "C" horizon. The Nahatche is a poorly drained, moderately permeable, bottomland soil, with slopes mainly less than 1% but ranging up to about 2%. Soil pH ranges from 5.1 to 7.8, with a moderate to high corrosivity to steel and a moderate corrosivity to concrete. The various soil zones have a Plasticity Index ranging from 11 to 25, with a moderate Shrink-Swell potential.

As will be noted from these brief soils descriptions, almost all of the service area is covered by deep soils with high Shrink-Swell potentials and moderate to high Plasticity Indexes. Of all potential land uses from the point of view of a sanitary facility or community development, only a sewage lagoon rates slight in the problem classification. Septic tank absorption fields, sanitary landfills and cover, shallow excavations, dwellings with or without basements, small commercial buildings, and local streets and roads are all rated as severe on the Soils Survey Interpretations range.

Established Series
Rev. CMT:FFW
5/73

GESSNER SERIES

The Gessner series is a member of the coarse-loamy, siliceous (see remarks), thermic family of Typic Glossaqualfs. These loamy soils have dark grayish brown A1 horizons and grayish brown A2g horizons that tongue into dark gray upper Bg horizons that are slightly more clayey. The B2tg horizons are light brownish gray loam in the upper part and light gray loam in the lower part.

Typifying Pedon: Gessner loam - pasture.
(Colors are for moist soil unless otherwise stated.)

Ap -- 0-7" -- Dark grayish brown (10YR 4/2) loam, light brownish gray (10YR 6/2) dry; few fine faint yellowish brown stains around root channels; weak fine granular structure; hard, friable; many fine roots; common fine pores; common worm casts; few fine soft ferromanganese masses; few fine pockets and vertical streaks of uncoated fine sand grains; slightly acid; clear wavy boundary. (4 to 10 inches thick)

A2g -- 7-16" -- Grayish brown (10YR 5/2) loam, light brownish gray (10YR 6/2) dry; common fine faint brown stains mostly around root channels; weak fine granular structure; hard, friable; few fine roots; many fine pores; common worm casts; few fine soft ferromanganese masses; common crayfish krotovinas filled with concave stratas of loam and uncoated fine sand; few pockets of Btg material; slightly acid; clear irregular boundary. (4 to 20 inches thick)

Bg&Ag -- 16-34" -- Dark gray (10YR 4/1) loam, gray (10YR 5/1) dry; few fine faint mottles of yellowish brown and brown; weak coarse prismatic parting to weak fine subangular blocky structure; very hard, friable; common fine roots; few patchy clay films on some surfaces of peds; common ferromanganese concretions 2 to 10 mm. in diameter; prism faces surrounded with uncoated fine sand grains (1 cm. and less in thickness); about 30 percent grayish brown (10YR 5/2) A2g material; few tongues of silt loam and fine sand extend through this horizon; about 10 percent crayfish krotovinas; krotovina walls are coated with a layer of dark gray clay about 1 mm. thick; neutral; gradual irregular boundary. (12 to 30 inches thick)

B21tg -- 34-53" -- Light brownish gray (10YR 6/2) loam, light gray (10YR 7/2) dry; few fine faint mottles of yellowish brown; weak coarse prismatic parting to weak fine subangular blocky structure; very hard, friable; few fine roots; few fine pores; few patchy clay films; few soft ferromanganese masses; prism faces are covered with uncoated fine sand; few tongues less than 2 cm. wide and tapered at the bottom; about 8 percent crayfish krotovina filled with silt loam and uncoated fine sand; krotovina walls are coated with dark grayish brown clay about 1 mm. thick; bottoms of krotovinas have dark gray clay coatings about 10 mm. thick; moderately alkaline; gradual irregular boundary. (12 to30 inches thick)

B22tg -- 53-84" -- Light gray (10YR 7/2) loam, white (10YR 8/2) dry; common medium distinct mottles of yellowish brown (10YR 5/8) and brownish yellow (10YR 6/8); weak coarse prismatic parting to weak coarse subangular blocky structure; very hard; firm; few fine roots; few fine pores; few patchy clay films; few fine soft ferromanganese masses; gray (10YR 5/1) streaks mainly in root channels; uncoated fine sand grains on prism faces; 15 percent crayfish krotovinas filled with silt loam, loam, and fine sand; moderately alkaline.

Type Location: Harris County, Texas; in pasture 75 feet east of Interstate Highway 45, from a point about 2 miles south of the intersection of Interstate Highway 45 and Farm Road 1960, which is about 18.6 miles north of downtown Houston.

Range in Characteristics: Solum thickness is more than 80 inches. The A horizon is loam or horizon is dark gray (10YR 4/1), gray (10YR 5/1, 6/1), dark grayish brown (10YR 4/2), grayish brown (10YR 5/2; 2.5Y 5/2), or light brownish gray (10YR 6/2; 2.5Y 6/2) with brown or yellowish brown mottles in some pedons. The A2g horizon is gray (10YR 5/1, 6/1), light gray (10YR 7/1, 7/2;

2.5Y 7/2), grayish brown (10YR 5/2; 2.5Y 5/2), or light brownish gray (10YR 6/2; 2.5Y 6/2) with brown or yellowish brown mottles in some pedons. The A2g horizon has crayfish krotovinas and streaks of uncoated fine sand and silt that tongue into the Btg horizon. The tongues or streaks of A2g material extend through the Bg&Ag horizon, and become tapered with depth. The bottoms of crayfish krotovinas have gray or dark gray clay coatings 2 to 20 mm. in thickness. The Btg horizon is dark gray (10YR 4/1), gray (10YR 5/1, 6/1), light gray (10YR 7/1, 7/2; 2.5Y 7/2), grayish brown (10YR 5/2; 2.5Y 5/2), or light brownish gray (10YR 6/2; 2.5Y 6/2). Mottles in the Btg horizon are few or common, fine to coarse, faint or distinct brown, strong brown, yellowish brown, brownish yellow, or red. The Btg horizon is loam or fine sandy loam. The average texture is 12 to 18 percent silicate clay and more than 15 percent sand coarser than very fine sand. It is neutral through moderately alkaline.

Competing Series and their Differentiae: These are the Alikchi, Basile, Bissonnet, Caddo, Calhoun, Clodine, Fountain, Frost, Guyton, Mollville, Ozan, Sorter, Tuckerman, Waller, and Wrightsville series. The Alikchi, Basile, Bissonnet, Caddo, Calhoun, Fountain, Frost, and Guyton soils have fine-silty control sections. Sorter, Clodine, and Tuckerman soils lack tongues of A2 material penetrating the Bt horizon. Mollville soils have ped coatings of dark grayish brown or very dark grayish brown. Waller soils have more than 18 percent clay in the control section. Ozan soils are medium to very strongly acid in the upper Bt horizons. Wrightsville soils have fine textured control sections.

Setting: Gessner soils occupy nearly level to depressional areas in the Gulf Coast Prairies. Slopes are mainly less than 1 percent. Low sandier mounds are associated with these soils in some areas. Gessner soils formed in thick beds of unconsolidated loam, sandy clay loam, and clay loam sediments of Pleistocene age. The climate is humid with mean annual precipitation ranging from 40 to 52 inches. The mean annual temperature ranges from 68° to 70° F. The Thornthwaite annual P-E indices range from 62 to 82.

Principal Associated Soils: These are the Clodine, Sorter, Tuckerman, Waller, and Wrightsville soils of the competing series and the Acadia, Addicks, Boy, Crowley, Edna, Hockley, Katy, Kenney, Segno, Splendora, and Wockley soils. The Acadia, Crowley, and Edna soils have fine textured control sections. Addicks soils have mollic epipedons and have more than 15 percent calcium carbonate equivalent in the Bt horizon. Boy and Kenney soils have sandy A horizons more than 20 inches thick. Hockley, Segno, Splendora, and Wockley soils have more than 5 percent plinthite and in addition Splendora soils have fragipans. Katy soils are not dominated by gray colors and lack tongues of A2 material that penetrate the upper Bt horizon.

Drainage and Permeability: Poorly drained; surface runoff is very slow to ponded; moderately permeable. The soil is saturated with water during the winter and spring and for short periods following summer rains. Water stands on the surface for long periods in depressional areas.

Use and Vegetation: Used mainly for native pasture. Small areas are cultivated where they occur in fields used for rice production. A few areas are used for grain sorghum production. Native grasses are species of Andropogons, Paspalums, and Panicums. Timbered areas consist mostly of handwoods, such as water and willow oak, sweetgum, ash, and persimmon. Pine trees have encroached on some areas.

Distribution and Extent: Gulf Coast Prairies of Southeast Texas. The series is of moderate extent.

Series Established: Harris County, Texas; 1973.

Remarks: These soils were formerly classified in the Low Humic Gley great soil group. The mineralogy is changed to siliceous based on Lincoln Soil Survey Laboratory data on closely associated soils.

National Cooperative Soil Survey
U. S. A.

SOIL SURVEY INTERPRETATIONS

GESSNER SERIES

MLRA(S): 150
CMT:FWW, 5-73
TYPIC GLOSSAQUALFS, COARSE-LOAMY, SILICEOUS, THERMIC

THE GESSNER SERIES IS A POORLY DRAINED SOIL. IT HAS A DARK GRAYISH BROWN LOAM SURFACE HORIZON THAT TONGUES INTO A GRAYISH LOAM SUBSOIL. IT OCCUPIES NEARLY LEVEL TO DEPRESSIONAL AREAS. SLOPES ARE LESS THAN 1 PERCENT.

ESTIMATED SOIL PROPERTIES (A)

DEPTH (IN.)	USDA TEXTURE	UNIFIED	AASHO	FRACT >3 IN (PCT)	PERCENT OF MATERIAL LESS THAN 3" PASSING SIEVE NO. 4	10	40	200	LIQUID LIMIT	PLASTICITY INDEX
0-16	L, FSL	CL-ML, CL, SC, SM-SC	A-4	0	98-100	95-100	85-95	45-75	17-26	4-10
16-84	L, FSL	CL-ML, CL	A-4, A-6	0	98-100	95-100	85-95	51-70	20-40	5-20

DEPTH (IN.)	PERMEABILITY (IN/HR)	AVAILABLE WATER CAPACITY (IN/IN)	SOIL REACTION (PH)	SALINITY (MMHOS/CM)	SHRINK-SWELL POTENTIAL	CORROSIVITY STEEL	CORROSIVITY CONCRETE	EROSION FACTORS K	EROSION FACTORS T	WIND EROD. GROUP
0-16	0.6-2.0	.10-.15	6.1-7.8	-	LOW	HIGH	LOW	-	-	-
16-84	0.6-2.0	.15-.20	6.6-8.4		LOW	HIGH	LOW			

FLOODING FREQUENCY	FLOODING DURATION	FLOODING MONTHS	HIGH WATER TABLE DEPTH (FT)	HIGH WATER TABLE KIND	HIGH WATER TABLE MONTHS	CEMENTED PAN DEPTH (IN)	CEMENTED PAN HARDNESS	BEDROCK DEPTH (IN)	BEDROCK HARDNESS	SUBSIDENCE INIT. (IN)	SUBSIDENCE TOTAL (IN)	HYD GRP	POTENT'L FROST ACTION
NONE			0-2.0	APPARENT	NOV-MAY	-		>60		-		B/C	-

SANITARY FACILITIES (B)

SEPTIC TANK ABSORPTION FIELDS	SEVERE-WET
SEWAGE LAGOONS	SEVERE-WET
SANITARY LANDFILL (TRENCH)	SEVERE-WET
SANITARY LANDFILL (AREA)	SEVERE-WET
DAILY COVER FOR LANDFILL	POOR-WET

COMMUNITY DEVELOPMENT (B)

SHALLOW EXCAVATIONS	SEVERE-WET
DWELLINGS WITHOUT BASEMENTS	SEVERE-WET
DWELLINGS WITH BASEMENTS	SEVERE-WET
SMALL COMMERCIAL BUILDINGS	SEVERE-WET,CORROSIVE
LOCAL ROADS AND STREETS	SEVERE-WET,LOW STRENGTH

REGIONAL INTERPRETATIONS

SOURCE MATERIAL (B)

ROADFILL	POOR-WET,LOW STRENGTH
SAND	UNSUITED
GRAVEL	UNSUITED
TOPSOIL	POOR-WET

WATER MANAGEMENT

POND RESERVOIR AREA	SLIGHT
EMBANKMENTS DIKES AND LEVEES	MODERATE-UNSTABLE FILL,PIPING
EXCAVATED PONDS AQUIFIER FED	MODERATE-DEEP TO WATER
DRAINAGE	WET
IRRIGATION	WET
TERRACES AND DIVERSIONS	WET
GRASSED WATERWAYS	WET

RECREATION (C)

CAMP AREAS	SEVERE-WET	PLAYGROUNDS	SEVERE-WET
PICNIC AREAS	SEVERE-WET	PATHS AND TRAILS	SEVERE-WET

CAPABILITY AND PREDICTED YIELDS -- CROPS AND PASTURE (HIGH LEVEL MANAGEMENT)

CLASS-DETERMINING PHASE	CAPABILITY		RICE (BU)		GRAIN SORGHUM (BU)		BAHIAGRASS (AUM)		IMPROVED BERMUDAGR. (AUM)		CORN (BU)		COTTON LINT (LBS)			
	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.
ALL	4W	4W		100	55		6.0		8.0		50		250			

WOODLAND SUITABILITY

CLASS-DETERMINING PHASE	ORD SYM	MANAGEMENT PROBLEMS					POTENTIAL PRODUCTIVITY		TREES TO PLANT
		EROSION HAZARD	EQUIP. LIMIT	SEEDLING MORT'Y.	WINDTH. HAZARD	PLANT COMPET.	IMPORTANT TREES	SITE INDX	
ALL	3W	SLIGHT	SEVERE	SEVERE	SLIGHT	SEVERE	LOBLOLLY PINE WATER OAK SWEETGUM	80 80 80	LOBLOLLY PINE SLASH PINE

WINDBREAKS

CLASS-DETERMINING PHASE	SPECIES	HT	SPECIES	HT	SPECIES	HT	SPECIES	HT
	NONE							

WILDLIFE HABITAT SUITABILITY (D)

CLASS-DETERMINING PHASE	POTENTIAL FOR HABITAT ELEMENTS								POTENTIAL AS HABITAT FOR:			
	GRAIN & SEED	GRASS & LEGUME	WILD HERB.	HARDWD TREES	CONIFER PLANTS	SHRUBS	WETLAND PLANTS	SHALLOW WATER	OPENLD WILDLF	WOODLD WILDLF	WETLAND WILDLF	RANGELD WILDLF
ALL	POOR	FAIR	FAIR	GOOD	FAIR	-	GOOD	GOOD	FAIR	GOOD	GOOD	-

POTENTIAL NATIVE PLANT COMMUNITY (RANGELAND OR FOREST UNDERSTORY VEGETATION) (E)

COMMON PLANT NAME	PLANT SYMBOL (NLSPN)	PERCENTAGE COMPOSITION (DRY WEIGHT) BY CLASS DETERMINING PHASE				
		RANGELAND	WOODLAND			
SWITCHGRASS	PAVI2	20	-			
EASTERN GAMA	TRDA3	15				
LITTLE BLUESTEM	ANSC2	10	10			
INDIANGRASS	SCNU2	10	-			
CARPETGRASS	AXAF	-	5			
PASPALUM	PASPA2	10	5			
PANICUM	PANIC	5	10			
OTHER PERENNIAL GRASSLIKES	PPGL	-	15			
OTHER TREES	TTTT	10	15			
VIRGINIA WILDRYE	ELVI3		5			
BEAKED PANICUM	PAAN		15			
MAIDENCANE	PAHE2	20	-			
PINEHILL BLUESTEM	ANDI		10			
SWITCHCANE	ARGI		5			
PLUMEGRASS	ERIAN		5			
POTENTIAL PRODUCTION (LBS./AC. DRY WT):						
FAVORABLE YEARS		9000	2750			
NORMAL YEARS		8000	2000			
UNFAVORABLE YEARS		7000	1500			

FOOTNOTES

A ESTIMATES BASED ON ENGINEERING TEST DATA FROM [illegible] IN HARRIS COUNTY, TEXAS.
B RATINGS BASED ON GUIDE FOR INTERPRETING ENGINEERING USES OF SOILS, NOV. 1971.
C RECREATION RATINGS BASED ON SOILS MEMORANDUM-69, OCT. [illegible]
D WILDLIFE RATINGS BASED ON SOILS MEMORANDUM-74, JAN. 1972.
1 RATINGS BASED ON SRWPC COMMITTEE GUIDE DRAFT 4/70.
E LOWLAND RANGE SITE; FLATWOODS GRAZING GROUP.

Established Series
Rev. JDC:CMT
5/73

CLODINE SERIES

The Clodine series is a member of the coarse-loamy, siliceous, thermic family of Typic Ochraqualfs. These soils have dark gray loam A horizons and gray, light gray and light brownish gray loam Btg horizons that are slightly acid to moderately alkaline.

Typifying Pedon: Clodine loam - pasture.
(Colors are for moist soil unless otherwise stated.)

Ap -- 0-10" -- Dark gray (10YR 4/1) loam, gray (10YR 6/1) dry; weak coarse subangular blocky structure and fine granular structure; hard, friable; many fine roots; many fine pores; many wormcasts; few fine soft ferromanganese masses; neutral; gradual smooth boundary. (7 to 20 inches thick)

B21tg -- 10-24" -- Gray (10YR 5/1) loam, light gray (10YR 7/1) dry; weak medium subangular blocky structure; very hard, friable; common fine roots; many fine pores; many wormcasts; patchy clay films on faces of peds and on pore walls; many fine soft ferromanganese masses; slightly acid; gradual wavy boundary. (8 to 20 inches thick)

B22tg -- 24-35" -- Gray (10YR 6/1) loam; moderate medium and fine subangular blocky and blocky structure; very hard, friable; few fine pores; few wormcasts; patchy gray clay films on peds; 10 percent by volume of indurated, pitted $CaCO_3$ concretions less than 1 inch in size; few fine distinct brownish yellow mottles around $CaCO_3$ concretions; many fine soft ferromanganese masses; moderately alkaline; gradual irregular boundary. (6 to 20 inches thick)

B23tg -- 35-60" -- Light gray (5Y 7/2) loam, moderate medium and fine blocky and subangular blocky structure; very hard, friable; few fine pores; patchy gray clay films on peds; 10 percent by volume of indurated, pitted $CaCO_3$ concretions less than 1 inch in size; few fine distinct brownish yellow mottles around $CaCO_3$ concretions; many fine soft ferromanganese masses; moderately alkaline; gradual irregular boundary. (15 to 30 inches thick)

B3tg -- 60-85" -- Light brownish gray (2.5Y 6/2) loam; weak medium and fine subangular blocky and blocky structure; very hard, friable; few patchy clay films on peds; common, indurated, pitted $CaCO_3$ concretions; many fine soft ferromanganese masses; moderately alkaline; gradual irregular boundary. (15 to 35 inches thick)

Cg -- 85-105" -- Light brownish gray (2.5Y 6/2) clay loam; massive; very hard, friable; many medium and coarse soft masses of ferromanganese oxide; few lenses or pockets of very pale brown (10YR 7/3) loamy fine sand; moderately alkaline.

Type Location: Fort Bend County, Texas; 1 mile north of Farm Road 1093 from a point 4.1 miles west of Clodine, 1/2 mile north of ranch house, or 1/4 mile north of Buffalo Bayou.

Range in Characteristics: The solum ranges from 60 to 100 inches in thickness. The soil is nonsaline to moderately saline. The A horizon is dark gray (10YR 4/1; 2.5Y 4/1; 5Y 4/1), or gray (10YR 5/1; 2.5Y 5/1, 6/1, 6/0; 5Y 5/1, 6/1). It is loam or fine sandy loam and is slightly acid through mildly alkaline. The Btg is gray (10YR 5/1, 6/1; 2.5Y 5/1, 6/1, 6/0; 5Y 5/1, 6/1), or light gray (10YR 7/1, 7/2; 2.5Y 7/0, 7/1, 7/2; 5Y 7/1, 7/2). Most pedons contain few to common, fine to medium mottles of brown and yellow. Texture of the B2tg horizon is loam or fine sandy loam containing 12 to 18 percent silicate clay, 20 to 45 percent silt, and more than 15 percent sand coarser than very fine sand. Some part of the Btg horizon between 20 and 60 inches contains 2 to 15 percent by volume of indurated, pitted $CaCO_3$ concretions. The B21tg horizon ranges in reaction from slightly acid through moderately alkaline, and the remainder of the Btg horizon ranges neutral through moderately alkaline.

Competing Series and their Differentiae: These are the Adaton, Amagon, Fountain, Routon, Sorter, Tichnor, Tuckerman, Waller and Yonges series. Adaton, Amagon, Fountain, Routon and Tichnor soils are of a fine-silty family. Fountain and Waller soils have tongues of A2 material extending into the Bt horizon. Sorter soils are medium to very strongly acid in the upper Bt horizon. Tuckerman soils are fine loamy and decrease in clay content in the lower Btg horizon and lack carbonate concretions. Yonges soils have an abrupt boundary between the A and Bt horizons.

Setting: Clodine soils are on broad nearly level coastal prairies. Slopes are mainly less than 1 percent. Clodine soils formed in thick loamy unconsolidated sediments of Pleistocene age. The mean annual temperature ranges from about 63° to 70° F.; mean annual precipitation from 40 to 60 inches; and Thornthwaite annual P-E indices from 64 to 82.

Principal Associated Soils: These are the Waller soils of the competing series and the Bernard, Edna, Katy and Lake Charles series. Bernard and Edna soils are of a fine textured family. Katy soils are not dominated by chromas 2 or less in the Bt horizon. Lake Charles soils are clayey and have intersecting slickensides.

Drainage and Permeability: Poorly drained; very slow surface runoff; slow internal drainage; moderate permeability. The soil is saturated for periods of 3 to 6 months during winter and spring.

Use and Vegetation: Used mainly for native range and for growing rice. Native grasses are mainly species of Andropogon, Paspalum, and Panicum. Myrtle (Myrica cerifera) bushes are common. Mixed pine and oak forests have encroached on some areas.

Distribution and Extent: Coast Prairie of Texas, mainly east of the Brazos River. The series is extensive.

Series Established: Fort Bend County, Texas; 1956.

Remarks: This soil was formerly classified in the Low Humic Gley great soil group.

National Cooperative Soil Survey
U. S. A.

SOIL SURVEY INTERPRETATIONS

MLRA(S): 153
JDC:CPT, 5-73
TYPIC OCHRAQUALFS, COARSE-LOAMY, SILICEOUS, THERMIC

CLODINE SERIES

THE CLODINE SERIES IS A POORLY DRAINED, MODERATELY PERMEABLE UPLAND SOIL. IT HAS A DARK GRAY LOAM SURFACE AND A GRAY SLIGHTLY ACID TO MODERATELY ALKALINE CLAY LOAM SUBSOIL. SLOPES ARE MAINLY LESS THAN 1 PERCENT.

ESTIMATED SOIL PROPERTIES (A)

DEPTH (IN.)	USDA TEXTURE	UNIFIED	AASHO	FRACT >3 IN (PCT)	PERCENT OF MATERIAL LESS THAN 3" PASSING SIEVE NO.				LIQUID LIMIT	PLASTICITY INDEX
					4	10	40	200		
0-10	L, FSL	CL-ML, CL	A-4, A-6	0	95-100	95-100	85-100	60-75	18-30	4-15
10-24	L, FSL	CL, ML, CL-ML	A-6, A-4	0	90-100	88-100	80-90	60-75	25-40	5-20
24-85	L, FSL	CL-ML, CL	A-6, A-4	0	90-100	88-100	85-95	60-80	20-40	5-20

DEPTH (IN.)	PERMEABILITY (IN/HR)	AVAILABLE WATER CAPACITY (IN/IN)	SOIL REACTION (PH)	SALINITY (MMHOS/CM)	SHRINK-SWELL POTENTIAL	CORROSIVITY		EROSION FACTORS		WIND EROD. GROUP
						STEEL	CONCRETE	K	T	
0-10	0.6-2.0	.15-.20	6.1-7.8	1-3	LOW	HIGH	LOW	-	-	-
10-24	0.6-2.0	.15-.20	6.1-8.4	2-6	MODERATE	HIGH	LOW			
24-85	0.6-2.0	.12-.20	6.6-8.4	2-8	MODERATE	HIGH	LOW			

FLOODING			HIGH WATER TABLE			CEMENTED PAN		BEDROCK		SUBSIDENCE		HYD GRP	POTENT'L FROST ACTION
FREQUENCY	DURATION	MONTHS	DEPTH (FT)	KIND	MONTHS	DEPTH (IN)	HARDNESS	DEPTH (IN)	HARDNESS	INIT. (IN)	TOTAL (IN)		
NONE			0-2.5	APPARENT	DEC-MAR	-		>60		-		D	-

SANITARY FACILITIES (B)

SEPTIC TANK ABSORPTION FIELDS	SEVERE-WET, PERCS SLOWLY
SEWAGE LAGOONS	SEVERE-WET
SANITARY LANDFILL (TRENCH)	SEVERE-WET
SANITARY LANDFILL (AREA)	SEVERE-WET
DAILY COVER FOR LANDFILL	POOR-WET

COMMUNITY DEVELOPMENT (B)

SHALLOW EXCAVATIONS	SEVERE-WET
DWELLINGS WITHOUT BASEMENTS	SEVERE-WET
DWELLINGS WITH BASEMENTS	SEVERE-WET
SMALL COMMERCIAL BUILDINGS	SEVERE-WET, CORROSIVE
LOCAL ROADS AND STREETS	SEVERE-WET

REGIONAL INTERPRETATIONS

SOURCE MATERIAL (B)

ROADFILL	POOR-WET
SAND	UNSUITED
GRAVEL	UNSUITED
TOPSOIL	POOR-WET

WATER MANAGEMENT

POND RESERVOIR AREA	SLIGHT
EMBANKMENTS DIKES AND LEVEES	MODERATE-PIPING, COMPRESSIBLE
EXCAVATED PONDS AQUIFER FED	SEVERE-DEEP TO WATER
DRAINAGE	PERCS SLOWLY
IRRIGATION	WET, PERCS SLOWLY
TERRACES AND DIVERSIONS	WET, PERCS SLOWLY
GRASSED WATERWAYS	WET, PERCS SLOWLY

RECREATION (C)

CAMP AREAS	SEVERE-WET	PLAYGROUNDS C	SEVERE-WET
PICNIC AREAS C	SEVERE-WET	PATHS AND TRAILS C	SEVERE-WET

CAPABILITY AND PREDICTED YIELDS -- CROPS AND PASTURE (HIGH LEVEL MANAGEMENT)

CLASS-DETERMINING PHASE	CAPABILITY		RICE (BU)		COTTON LINT (LBS)		GRAIN SORGHUM (BU)		CORN (BU)		HAY CROPS, ANNUALS (TONS)		IMPROVED BERMUDAGR. (AUM)			
	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.
NON SALINE	3W	3W		110	400		60		65		3.5		8			
SALINE	6S			-	-		-		-		-		7			

WOODLAND SUITABILITY

CLASS-DETERMINING PHASE	ORD SYM	MANAGEMENT PROBLEMS					POTENTIAL PRODUCTIVITY		TREES TO PLANT
		EROSION HAZARD	EQUIP. LIMIT	SEEDLING MORT'Y.	WINDTH. HAZARD	PLANT COMPET.	IMPORTANT TREES	SITE INDX	
NON SALINE	2W	SLIGHT	SEVERE	SEVERE	SLIGHT	SEVERE	LOBLOLLY PINE SWEETGUM WATER OAK SOUTHERN RED OAK	90	LOBLOLLY PINE SLASH PINE

WINDBREAKS

CLASS-DETERMINING PHASE	SPECIES	HT	SPECIES	HT	SPECIES	HT	SPECIES	HT
	NONE							

WILDLIFE HABITAT SUITABILITY (D)

CLASS-DETERMINING PHASE	POTENTIAL FOR HABITAT ELEMENTS								POTENTIAL AS HABITAT FOR:			
	GRAIN & SEED	GRASS & LEGUME	WILD HERB.	HARDWD TREES	CONIFER PLANTS	SHRUBS	WETLAND PLANTS	SHALLOW WATER	OPENLD WILDLF	WOODLD WILDLF	WETLAND WILDLF	RANGELD WILDLF
ALL	FAIR	FAIR	FAIR	FAIR	FAIR	-	GOOD	FAIR	FAIR	FAIR	FAIR	-

POTENTIAL NATIVE PLANT COMMUNITY (RANGELAND OR FOREST UNDERSTORY VEGETATION)

COMMON PLANT NAME	PLANT SYMBOL (NLSPN)	PERCENTAGE COMPOSITION (DRY WEIGHT) BY CLASS DETERMINING PHASE				
		RANGE	WOODLAND			
LITTLE BLUESTEM	ANSC2	10	15			
INDIANGRASS	SONU2	5				
BIG BLUESTEM	ANGE	5				
EASTERN GAMA	TRDA3	15				
BROWNSEED PASPALUM	PAPL2		5			
SWITCHGRASS	PAVI2	20	-			
FLORIDA PASPALUM	PAFL4	10	10			
MAIDENCANE	PAHE2	15	-			
PANICUM	PANIC	10	10			
OTHER PERENNIAL GRASSLIKES	PPGL	10	15			
BEAKED PANICUM	PAAN		15			
VIRGINIA WILDRYE	ELVI3	-	10			
OTHER TREES	TTTT	-	20			
POTENTIAL PRODUCTION (LBS./AC. DRY WT):						
FAVORABLE YEARS		9,000	2,750			
NORMAL YEARS		8,000	2,000			
UNFAVORABLE YEARS		7,000	1,500			

FOOTNOTES

A ESTIMATES BASED ON ENGINEERING TEST DATA OF 1 PEDON FROM HARRIS COUNTY, TEXAS
B RATINGS BASED ON GUIDES FOR INTERPRETING ENGINEERING USES OF SOILS, NOV. 1971
C RECREATION RATINGS BASED ON SOILS MEMORANDUM-69, OCT. 1968
D WILDLIFE RATINGS BASED ON SOILS MEMORANDUM-74, JAN. 1972
1 RATINGS BASED ON SRWPC COMMITTEE IV GUIDE, DRAFT APR. 1970

Established Series
Rev. CMT:FFW
3/73

ARIS SERIES

The Aris series is a member of the fine, mixed, thermic family of Typic Glossaqualfs. These soils have dark grayish brown fine sandy loam Ap horizons and grayish brown fine sandy loam A2g horizons that tongue into B2tg horizons that are gray sandy clay loam in the upper part and dark gray clay with prominent red mottles in the lower part.

Typifying Pedon: Aris fine sandy loam pasture.
(Colors are for moist soil unless otherwise stated.)

Ap -- 0-7" -- Dark grayish brown (10YR 4/2) fine sandy loam, grayish brown (10YR 5/2) dry; common fine faint dark yellowish brown mottles; weak fine granular structure; hard, friable; many fine roots; few worm casts; few fine pockets of uncoated fine sand; neutral; clear wavy boundary. (4 to 10 inches thick)

A2g -- 7-21" -- Grayish brown (10YR 5/2) fine sandy loam, light brownish gray (10YR 6/2) dry; common fine faint dark yellowish brown mottles; few fine faint reddish yellow mottles; weak fine subangular blocky structure; hard, friable; common fine roots; common fine pores; common worm casts; common fine pockets of uncoated fine sand; few crayfish krotovina filled with very pale brown (10YR 7/3) uncoated fine sand and lined with dark grayish brown (10YR 4/2) clayey material; slightly acid; clear wavy boundary. (6 to 18 inches thick)

Bg&Ag -- 21-28" -- Gray (10YR 5/1) sandy clay loam, light gray (10YR 6/1) dry; common fine faint yellowish brown (10YR 5/4) mottles within the bodies of Bg material; moderate fine and medium subangular blocky structure; very hard, firm; grayish brown (10YR 5/2) A2g material occurs as tongues and interfingers and comprises about 20 percent by volume of this horizon; common 2-5 mm. pockets of uncoated fine sand; few black concretions 2-5 mm. in diamter; few fine pores; few worm casts; few crayfish krotovina filled with very pale brown (10YR 7/3) uncoated fine sand and lined with dark grayish brown (10YR 4/2) clayey material; medium acid; clear wavy boundary. (4 to 10 inches thick)

B21tg -- 28-46" -- Dark gray (10YR 4/1) clay, gray (10YR 5/1) dry; common fine and medium prominent red (2.5YR 4/8) mottles grading with depth to common fine distinct yellowish red (5YR 5/8) mottles; few fine strong brown mottles; moderate coarse prismatic parting to moderate fine and medium angular blocky structure; extremely hard, very firm; continuous clay films; few fine roots; few black concretions 2-5 mm. in diameter; few crayfish krotovina filled with very pale brown (10YR 7/3) uncoated fine sand; strongly acid; gradual irregular boundary. (12 to 24 inches thick)

B22tg -- 46-60" -- Gray (10YR 6/1) clay, light gray (10YR 7/1) dry; common medium distinct reddish yellow (7.5YR 6/8) mottles; few fine prominent red (2.5YR 4/8) mottles, mainly surrounded by reddish yellow mottles; moderate coarse prismatic parting to moderate medium subangular blocky structure; extremely hard, very firm; patchy clay films; common fine yellowish brown stains along root channels; few black concretions 2-5 mm. in diameter; grayish brown (10YR 5/2) fine sandy loam coatings 2-10 mm. thick on prism faces; few crayfish krotovina lined with grayish brown (10YR 4/2) clayey material and filled with loamy material and horizontal streaks of uncoated fine sand; medium acid; gradual irregular boundary. (10 to 18 inches thick)

B3g -- 60-78" -- Light gray (10YR 7/1) clay loam, white (10YR 8/1) dry; common fine reddish yellow (7.5YR 6/8) mottles and stains along fine root channels; moderate coarse prismatic parting to weak coarse subangular blocky structure; very hard, firm; grayish brown (10YR 5/2) fine sandy loam coatings 2-5 mm. thick on prism faces; slightly acid.

Type Location: Harris County, Texas; in pasture 75 feet west of center-line of Gertie Rice Road, from a point 0.7 mile north of its intersection with Clay Road, which is 1.8 miles west of its

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intersection with Texas Highway 6, which is 3.2 miles north of the intersection of Texas Highway 6 and Interstate Highway 10 in Addicks, Texas.

Range in Characteristics: Solum thickness is more than 78 inches. Thickness of the A horizon is 16 to 28 inches and it is medium acid through neutral. It is mainly fine sandy loam, but ranges to loam or silt loam. The Ap horizon is mainly dark gray (10YR 4/1), dark grayish brown (10YR 4/2), or grayish brown (10YR 5/2). In a few areas it is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2), but the thickness is less than 6 inches. Mottles are few or common, fine or medium faint or distinct yellowish red (5YR 4/6), yellowish brown (10YR 5/4, 5/6), strong brown (7.5YR 5/6), or dark yellowish brown (10YR 4/4). The A2g horizon is dark grayish brown (10YR 4/2) or grayish brown (10YR 5/2). Mottles are few or common, fine, faint or distinct dark yellowish brown (10YR 4/4), strong brown (7.5YR 5/6, 5/8), yellowish brown (10YR 5/6, 5/8), reddish yellow (7.5YR 6/6), or gray (10YR 5/1). The Bg&Ag horizon is dark gray (10YR 4/1) or gray (10YR 5/1). Mottles are few or common, fine or medium, faint or distinct yellowish brown (10YR 5/4, 5/6, 5/8), strong brown (7.5YR 5/6, 5/8), yellowish red (5YR 4/6, 5/6, 5/8), or gray (10YR 6/1). It is sandy clay loam, clay loam, or silty clay loam. Tongues and interfingers of A2g material comprise 15 to 35 percent of this horizon. The Bg&Ag horizon is strongly acid through slightly acid. The B2tg horizon is dark gray (10YR 4/1) or gray (10YR 5/1) in the upper part and gray (10YR 6/1) or light gray (10YR 7/1, 7/2) in the lower part. Mottles are few or common, fine or medium, prominent red (2.5YR 4/6, 4/8; 10R 4/6, 4/8) and few or common, fine or medium, faint or distinct yellowish brown (10YR 5/6, 5/8), strong brown (7.5YR 5/6, 5/8), reddish yellow (7.5YR 6/6, 6/8) or yellowish red (5YR 5/6, 5/8). In some pedons, surfaces of peds in the upper part of the B2tg horizon are very dark gray (10YR 3/1). The B2tg horizon is mainly clay, but ranges to clay loam or silty clay loam. Clay content of the control section averages 35 to 50 percent. The B2tg horizon is strongly acid through slightly acid. The B3g horizon is gray (10YR 6/1) or light gray (10YR 7/1, 7/2). Mottles are few or common, fine or medium, faint or distinct yellowish brown (10YR 5/6, 5/8), strong brown (7.5YR 5/6, 5/8), reddish yellow (7.5YR 6/6, 6/8), or yellowish red (5YR 5/6, 5/8). The B3g horizon is clay loam or silty clay loam. It is strongly acid through neutral, but in a few pedons it is mildly alkaline.

Competing Series and their Differentiae: These include the Basile, Calhoun, Crowley, Fountain, Frost, Gessner, Katy, Mollville, Mowata, Waller, and Wrightsville series. The Basile, Calhoun, Fountain, and Frost soils have fine-silty control sections. The Crowley and Katy soils lack tonguing of the A2 horizon into the B horizon. In addition the Crowley soils have montmorillonitic mineralogy and the Katy soils have fine-loamy control sections. The Gessner and Waller soils have fine-loamy control sections and siliceous mineralogy. Mollville soils have fine-loamy control sections and are less gray throughout. Mowata soils have montmorillonitic mineralogy. Wrightsville soils are more acid throughout and lack prominent red mottles in the B2tg horizon.

Setting: Aris soils occupy nearly level to gently sloping areas in the Gulf Coast Prairie. Slopes are mainly less than 1 percent, but a few areas have as much as 3 percent slopes. The soil formed in thick beds of unconsolidated loamy sediments of Pleistocene age. The climate is humid with mean precipitation of 40 to 52 inches. The mean annual temperature is 68° to 70° F. The annual Thornthwaite P-E indices are 62 to 82.

Principal Associated Soils: These are the Gessner, Katy and Waller soils of the competing series, as well as Bernard, Clodine, Edna, Hockley, and Wockley soils. Bernard soils have mollic epipedons. Clodine soils have fine-loamy control sections and lack tonguing of A2 material into the Bt horizon. Edna soils have montmorillonitic mineralogy. Hockley and Wockley soils have fine-loamy textured control sections and have more than 5 percent plinthite.

Drainage and Permeability: Poorly drained; slow runoff; slow internal drainage; very slow permeability. A perched water table occurs in the A2g horizon during the cool months or in periods of excess rainfall.

Use and Vegetation: Aris soils are used mainly for growing rice and for native pasture. Some areas are used for growing cotton, corn, grain sorghum, and vegetables. Native grasses are mainly indiangrass, little bluestem, big bluestem, switchgrass, Florida paspalum, and crinkleawn. Loblolly pine trees have encroached on some areas.

Distribution and Extent: Gulf Coast Prairies of Southeast Texas. The series is of moderate extent.

Series Established: Harris County, Texas; 1973.

Remarks: These soils were formerly classified in the Planosol great soil group. They were formerly included in the Crowley series.

Additional Data: Limited unpublished laboratory data is available for one pedon from the Texas Highway Department 1271L-261, 262, 263 and THD-71-Tex-101-11-1, 2, 3. Lincoln Soil Survey Laboratory data 71L1310 and S71Tex-101-2, and memo dated April 12, 1972, indicate family texture is fine, but close to the border between fine and fine-loamy. This same data indicates family mineralogy is mixed, but borderline to montmorillonitic.

National Cooperative Soil Survey
U. S. A.

TX0071 S O I L   S U R V E Y   I N T E R P R E T A T I O N S

MLRA(S): 150
CMT,FFW, 3-73
TYPIC GLOSSAQUALFS, FINE, MIXED, THERMIC

ARIS SERIES

THE ARIS SERIES CONSISTS OF POORLY DRAINED, VERY SLOWLY PERMEABLE SOILS. THEY HAVE A DARK GRAYISH BROWN FINE SANDY LOAM SURFACE AND A GRAY AND DARK GRAY CLAYEY SUBSOIL WITH PROMINENT RED MOTTLES. SLOPES ARE MAINLY LESS THAN 1 PERCENT BUT RANGE UP TO 3 PERCENT.

ESTIMATED SOIL PROPERTIES (A)

DEPTH (IN.)	USDA TEXTURE	UNIFIED	AASHO	FRACT >3 IN (PCT)	PERCENT OF MATERIAL LESS THAN 3" PASSING SIEVE NO.				LIQUID LIMIT	PLASTICITY INDEX
					4	10	40	200		
0-21	FSL, L, SIL	ML, CL, SC, SM	A-4	0	98-100	95-100	95-100	40-60	<25	NP-9
21-28	SCL, CL, SICL	CL	A-6, A-7	0	100	95-100	95-100	55-75	39-48	18-25
28-60	C, CL, SICL	CL, CH	A-7	0	100	95-100	95-100	60-80	42-62	21-36
60-78	CL, SICL	CL, CH	A-7	0	100	95-100	95-100	60-80	41-60	20-35

DEPTH (IN.)	PERMEABILITY (IN/HR)	AVAILABLE WATER CAPACITY (IN/IN)	SOIL REACTION (PH)	SALINITY (MMHOS/CM)	SHRINK-SWELL POTENTIAL	CORROSIVITY		EROSION FACTORS		WIND EROD. GROUP
						STEEL	CONCRETE	K	T	
0-21	0.6-2.0	.11-.15	5.6-7.3	-	LOW	HIGH	MODERATE	-	-	-
21-28	0.2-0.6	.12-.17	5.1-6.5	-	MODERATE	HIGH	MODERATE			
28-60	<0.06	.12-.18	5.1-6.5	-	HIGH	HIGH	MODERATE			
60-78	<0.06	.12-.18	5.1-7.3	-	HIGH	HIGH	MODERATE			

FLOODING			HIGH WATER TABLE			CEMENTED PAN		BEDROCK		SUBSIDENCE		HYD GRP	POTENT'L FROST ACTION
FREQUENCY	DURATION	MONTHS	DEPTH (FT)	KIND	MONTHS	DEPTH (IN)	HARDNESS	DEPTH (IN)	HARDNESS	INIT. (IN)	TOTAL (IN)		
NONE			0-2	PERCHED	NOV-MAR	-		60		-		D	-

SANITARY FACILITIES (B)

SEPTIC TANK ABSORPTION FIELDS	SEVERE-PERCS SLOWLY,WET
SEWAGE LAGOONS	SLIGHT
SANITARY LANDFILL (TRENCH)	SEVERE-WET
SANITARY LANDFILL (AREA)	SEVERE-WET
DAILY COVER FOR LANDFILL	POOR-WET

COMMUNITY DEVELOPMENT (B)

SHALLOW EXCAVATIONS	SEVERE-WET
DWELLINGS WITHOUT BASEMENTS	SEVERE-WET
DWELLINGS WITH BASEMENTS	SEVERE-WET
SMALL COMMERCIAL BUILDINGS	SEVERE-CORROSIVE,WET
LOCAL ROADS AND STREETS	SEVERE-WET,LOW STRENGTH

REGIONAL INTERPRETATIONS

SOURCE MATERIAL (B)

ROADFILL	POOR-WET,LOW STRENGTH
SAND	UNSUITED
GRAVEL	UNSUITED
TOPSOIL	POOR-WET

WATER MANAGEMENT

POND RESERVOIR AREA	SLIGHT
EMBANKMENTS DIKES AND LEVEES	MODERATE-LOW STRENGTH,COMPRESSIBLE
EXCAVATED PONDS AQUIFIER FED	SEVERE-DEEP TO WATER
DRAINAGE	WET,PERCS SLOWLY
IRRIGATION	WET,PERCS SLOWLY
TERRACES AND DIVERSIONS	WET,PERCS SLOWLY
GRASSED WATERWAYS	WET,PERCS SLOWLY

RECREATION (C)

CAMP AREAS	SEVERE-WET,PERCS SLOWLY	PLAYGROUNDS	SEVERE-WET,PERCS SLOWLY
PICNIC AREAS	SEVERE-WET	PATHS AND TRAILS	SEVERE-WET

CAPABILITY AND PREDICTED YIELDS -- CROPS AND PASTURE (HIGH LEVEL MANAGEMENT)

CLASS-DETERMINING PHASE	CAPA-BILITY		RICE (BU)		CORN (BU)		COTTON LINT (LBS)		GRAIN SORGHUM (BU)		IMPROVED BERMUDAGR. (AUM)					
	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.
ALL	3W	3W		130	70		500		60		10.0					

WOODLAND SUITABILITY

CLASS-DETERMINING PHASE	ORD SYM	MANAGEMENT PROBLEMS EROSION HAZARD	EQUIP. LIMIT	SEEDLING MORT'Y.	WINDTH. HAZARD	PLANT COMPET.	POTENTIAL PRODUCTIVITY IMPORTANT TREES	SITE INDX	TREES TO PLANT
ALL	2W	SLIGHT	MODERATE	SLIGHT	SLIGHT	MODERATE	LOBLOLLY PINE SOUTHERN RED OAK SWEETGUM	90	LOBLOLLY PINE SLASH PINE

WINDBREAKS

CLASS-DETERMIN'G PHASE	SPECIES	HT	SPECIES	HT	SPECIES	HT	SPECIES	HT
	NONE							

WILDLIFE HABITAT SUITABILITY (D)

CLASS-DETERMINING PHASE	POTENTIAL FOR HABITAT ELEMENTS GRAIN & SEED	GRASS & LEGUME	WILD HERB.	HARDWD TREES	CONIFER PLANTS	SHRUBS	WETLAND PLANTS	SHALLOW WATER	POTENTIAL AS HABITAT FOR: OPENLD WILDLF	WOODLD WILDLF	WETLAND WILDLF	RANGELD WILDLF
ALL	FAIR	FAIR	GOOD	FAIR	FAIR	-	GOOD	GOOD	FAIR	FAIR	GOOD	-

POTENTIAL NATIVE PLANT COMMUNITY (RANGELAND OR FOREST UNDERSTORY VEGETATION) (E)

COMMON PLANT NAME	PLANT SYMBOL (NLSPN)	PERCENTAGE COMPOSITION (DRY WEIGHT) BY CLASS DETERMINING PHASE RANGE	WOODLAND			
LITTLE BLUESTEM	ANSC2	45	-			
INDIANGRASS	SONU2	10				
BIG BLUESTEM	ANGE	5				
EASTERN GAMA	TRDA3	10				
BROWNSEED PASPALUM	PAPL3	5	-			
GIANT CANE	ARGI	-	5			
SWITCHGRASS	PAVI2	10	-			
CARPETGRASS	AXAF	-	10			
OTHER PERENNIAL FORBS	PPFF	5	-			
UNKNOWNS	UUUU	10	10			
BEAKED PANICUM	PAAN	-	15			
VIRGINIA WILDRYE	ELV13	-	15			
PINEHILL BLUESTEM	ANDI	-	15			
OTHER PERENNIAL GRASSLIKES	PPGL	-	15			
OTHER TREES	TTTT	-	15			
POTENTIAL PRODUCTION (LBS./AC. DRY WT):						
FAVORABLE YEARS		8500	2750			
NORMAL YEARS		6500	2000			
UNFAVORABLE YEARS		5000	1500			

FOOTNOTES

A ESTIMATES BASED CN ENGINEERING TEST DATA OF 1 PEDON FROM HARRIS COUNTY, TEXAS.
B RATINGS BASED ON GUIDE FOR INTERPRETING ENGINEERING USES OF SOILS, NOV. 1971.
1 RATINGS BASED ON SRWPC COMM. IV GUIDE DRAFT 4/70.
C RECREATION RATINGS BASED ON SOILS MEMORANDUM-69, OCT. 1968.
D WILDLIFE RATING BASED ON SOIL MEMORANDUM-74, JAN. 1972.
E RANGE SITE "LCAMY PRAIRIE", WOODLAND GRAZING GROUP "FLATWOODS".

Established Series
Rev. CMT:FFW:DTH
5/73

ADDICKS SERIES

The Addicks series is a member of the coarse-loamy, siliceous, thermic family of Typic Argiaquolls. These loamy soils have black A horizons, dark gray B21t horizons, and light gray B22tca horizons that contain more than 15 percent calcium carbonate equivalent.

Typifying Pedon: Addicks loam - pasture.
(Colors are for moist soil unless otherwise stated.)

Ap -- 0-11" -- Black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; hard, friable; many fine roots; common worm casts; many fine pores; neutral; gradual wavy boundary. (10 to 18 inches thick)

B21t -- 11-23" -- Dark gray (10YR 4/1) loam, gray (10YR 5/1) dry; few fine faint mottles of strong brown; weak fine and medium subangular blocky structure; hard, friable; common fine roots; common worm casts of very dark gray (10YR 3/1) material; common fine pores; few FeMn concretions up to 5 mm. in diameter; few patchy clay films slightly darker than matrix; few very fine $CaCO_3$ concretions in lower part of horizon; neutral; gradual wavy boundary. (6 to 19 inches thick)

B22tca -- 23-49" -- Light gray (10YR 7/1) loam, white (10YR 8/1) dry; 30 to 40 percent of matrix is light brownish gray (10YR 6/2); common fine faint pale yellow and few fine distinct yellow mottles; weak coarse subangular blocky parting to weak fine subangular blocky structure; very hard, friable; few fine roots; common fine pores; few patchy clay films; few black concretions; few worm casts; few crayfish krotovinas filled with dark gray (10YR 4/1) material; 20 percent by volume visible $CaCO_3$ in the form of soft masses and concretions less than 1 cm. in diameter; moderately alkaline; calcareous; clear wavy boundary. (15 to 30 inches thick)

B23t -- 49-78" -- Light gray (10YR 7/2) loam, white (10YR 8/2) dry; many fine and medium distinct mottles of yellow (2.5Y 7/6); common medium and coarse distinct mottles of yellowish brown (10YR 5/8); weak very coarse prismatic parting to weak medium and coarse subangular blocky structure; very hard, firm; few clay films; few black concretions; few crayfish krotovinas filled with very dark gray (10YR 3/1) and dark gray (10YR 4/1) loamy material; prism faces coated with light brownish gray loam 2 to 15 mm. in thickness; 5 percent irregular shaped, pitted $CaCO_3$ concretions 1 to 6 cm. in diameter; moderately alkaline; noncalcareous.

Type Location: Harris County, Texas; in pasture 75 feet south of Clay Road from a point 1.85 miles east of the intersection of Clay Road with Texas Highway 6, which is about 3.5 miles north of Addicks, Texas, on Texas Highway 6.

Range in Characteristics: Thickness of the solum is more than 72 inches. The mollic epipedon is 10 to 20 inches thick. The soil matrix becomes calcareous at 16 to 29 inches. The A horizon is black (10YR 2/1), very dark gray (10YR 3/1), or very dark grayish brown (10YR 3/2). It is typically loam but may be fine sandy loam or silt loam. It is slightly acid through moderately alkaline. The B2t horizon is dark gray (10YR 4/1), dark grayish brown (2.5Y 4/2), gray (10YR 5/1, 6/1), grayish brown (2.5Y 5/2), light gray (10YR 7/1, 7/2; 2.5Y 7/2), or light brownish gray (2.5Y 6/2) and contains few to common distinct brownish and yellowish mottles. It is loam or silt loam in the upper part but ranges to silty clay loam in the lower part. The average silicate clay content of the upper 20 inches is 12 to 18 percent and it is neutral through moderately alkaline. Some part of the B2t horizon contains 15 to 40 percent calcium carbonate equivalent that occurs in the form of few to common soft masses and concretions with pitted surfaces.

Competing Series and their Differentiae: These are the Bernard, Clodine, Jeanerette, Morey, and Stono series. Bernard soils contain more than 35 percent clay in the control section. Clodine soils lack mollic epipedons. Jeanerette and Morey soils have fine-silty control sections and have less than 15 percent calcium carbonate equivalent in the Bt horizon. Stono soils lack carbonates in the Bt horizon and have more than 18 percent clay in the control section.

USDA SCS-FORT WORTH, TEX 1974

Setting: Addicks soils occur on level to slightly depressional areas of the Gulf Coast Prairies. Slopes are mainly less than 1 percent. The soil formed in thick unconsolidated loamy sediments of Pleistocene age. The mean annual temperature ranges from about 68° to 70° F.; mean annual precipitation from 40 to 52 inches and Thornthwaite annual P-E indices range from 62 to 82.

Principal Associated Soils: These are the Bernard and Clodine soils of the competing series and the Aris, Gessner, and Midland soils. Aris soils have fine textured control sections and Gessner soils have Ochric epipedons fine-loamy control sections and lack calcic horizons. Midland soils have fine textured control sections and lack a mollic epipedon.

Drainage and Permeability: Poorly drained; slow surface runoff and internal drainage; moderate permeability. Water table is at 12 to 30 inches below the surface for 1 to 2 months during most years.

Use and Vegetation: Used mainly for pasture and growing rice. Native grasses are species of Andropogons, Paspalums, and Panicums. A few pine and hardwood trees have encroached on some areas.

Distribution and Extent: Gulf Coast Prairies of southeast Texas. The series is moderately extensive.

Series Established: Harris County, Texas; 1973.

Remarks: These soils were classified in the Humic Gley great soil group. They were formerly included in the Clodine and Morey series.

Additional Data: LSL 72L273-72L276 and thin sections on file in the Lincoln Soil Survey Laboratory.

National Cooperative Soil Survey
U. S. A.

TX0062

SOIL SURVEY INTERPRETATIONS

ADDICKS SERIES

MLRA(S): 150
CMT:FFW, 5-73
TYPIC ARGIAQUOLLS, COARSE-LOAMY, SILICEOUS, THERMIC

THE ADDICKS SERIES CONSISTS OF POORLY DRAINED, MODERATELY PERMEABLE UPLAND SOILS. TYPICALLY, THESE SOILS HAVE BLACK LOAM SURFACE LAYERS AND LOWER LAYERS OF GRAYISH, MODERATELY ALKALINE LOAM THAT CONTAIN MORE THAN 15 PERCENT CALCIUM CARBONATE EQUIVALENT IN SOME PART. SLOPES ARE MAINLY LESS THAN 1 PERCENT.

ESTIMATED SOIL PROPERTIES (A)

DEPTH (IN.)	USDA TEXTURE	UNIFIED	AASHO	FRACT >3 IN (PCT)	PERCENT OF MATERIAL LESS THAN 3" PASSING SIEVE NO. 4	10	40	200	LIQUID LIMIT	PLASTICITY INDEX
0-11	L, FSL, SIL	CL, CL-ML	A-4, A-6	0	100	95-100	95-100	51-75	20-30	5-14
11-49	L, SIL	CL, CL-ML	A-4, A-6	0	95-100	90-100	75-95	60-75	20-40	5-20
49-78	L, SIL, SICL	CL	A-6, A-7	0	95-100	90-100	90-100	60-80	25-45	11-27

DEPTH (IN.)	PERMEABILITY (IN/HR)	AVAILABLE WATER CAPACITY (IN/IN)	SOIL REACTION (PH)	SALINITY (MMHOS/CM)	SHRINK-SWELL POTENTIAL	CORROSIVITY STEEL	CORROSIVITY CONCRETE	EROSION FACTORS K	EROSION FACTORS T	WIND EROD. GROUP
0-11	0.6-2.0	.15-.24	6.1-8.4	-	LOW	HIGH	LOW	-	-	-
11-49	0.6-2.0	.15-.24	6.6-8.4	-	LOW	HIGH	LOW			
49-78	0.6-2.0	.15-.24	6.6-8.4	-	MODERATE	HIGH	LOW			

FLOODING			HIGH WATER TABLE			CEMENTED PAN		BEDROCK		SUBSIDENCE		HYD GRP	POTENT'L FROST ACTION
FREQUENCY	DURATION	MONTHS	DEPTH (FT)	KIND	MONTHS	DEPTH (IN)	HARDNESS	DEPTH (IN)	HARDNESS	INIT. (IN)	TOTAL (IN)		
NONE			1-2.5	APPARENT	JAN-FEB	-		-		-		C	-

SANITARY FACILITIES (B)

SEPTIC TANK ABSORPTION FIELDS	SEVERE-WET
SEWAGE LAGOONS	SEVERE-WET
SANITARY LANDFILL (TRENCH)	SEVERE-WET
SANITARY LANDFILL (AREA)	SEVERE-WET
DAILY COVER FOR LANDFILL	POOR-WET

COMMUNITY DEVELOPMENT (B)

SHALLOW EXCAVATIONS	SEVERE-WET
DWELLINGS WITHOUT BASEMENTS	SEVERE-WET
DWELLINGS WITH BASEMENTS	SEVERE-WET
SMALL COMMERCIAL BUILDINGS	SEVERE-WET,CORROSIVE
LOCAL ROADS AND STREETS	SEVERE-WET,LOW STRENGTH

REGIONAL INTERPRETATIONS

SOURCE MATERIAL (B)

ROADFILL	POOR-WET,LOW STRENGTH
SAND	UNSUITED
GRAVEL	UNSUITED
TOPSOIL	POOR-WET

WATER MANAGEMENT

POND RESERVOIR AREA	MODERATE-PERCS RAPIDLY
EMBANKMENTS DIKES AND LEVEES	MODERATE-LOW STRENGTH
EXCAVATED PONDS AQUIFIER FED	SEVERE-DEEP TO WATER
DRAINAGE	FAVORABLE
IRRIGATION	WET
TERRACES AND DIVERSIONS	WET
GRASSED WATERWAYS	WET

RECREATION (C)

CAMP AREAS	SEVERE-WET	PLAYGROUNDS	SEVERE-WET
PICNIC AREAS	SEVERE-WET	PATHS AND TRAILS	SEVERE-WET

CAPABILITY AND PREDICTED YIELDS -- CROPS AND PASTURE (HIGH LEVEL MANAGEMENT)

CLASS-DETERMINING PHASE	CAPABILITY		RICE (BU)		GRAIN SORGHUM (BU)		IMPROVED BERMUDAGR. (AUM)		COTTON LINT (LBS)		CORN (BU)					
	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.
ALL	2W			110	70		8.0		450		70					

WOODLAND SUITABILITY

CLASS-DETERMINING PHASE	ORD SYM	MANAGEMENT PROBLEMS					POTENTIAL PRODUCTIVITY		TREES TO PLANT
		EROSION HAZARD	EQUIP. LIMIT	SEEDLING MORT'Y.	WINDTH. HAZARD	PLANT COMPET.	IMPORTANT TREES	SITE INDX	
ALL	2W	SLIGHT	SEVERE	SEVERE	SLIGHT	SEVERE	LOBLOLLY PINE	90	LOBLOLLY PINE
							SWEETGUM	80	SLASH PINE
							WATER OAK		
							SOUTHERN RED OAK	80	

WINDBREAKS

CLASS-DETERMINING PHASE	SPECIES	HT	SPECIES	HT	SPECIES	HT	SPECIES	HT
	NONE							

WILDLIFE HABITAT SUITABILITY (D)

CLASS-DETERMINING PHASE	POTENTIAL FOR HABITAT ELEMENTS								POTENTIAL AS HABITAT FOR:			
	GRAIN & SEED	GRASS & LEGUME	WILD HERB.	HARDWD TREES	CONIFER PLANTS	SHRUBS	WETLAND PLANTS	SHALLOW WATER	OPENLD WILDLF	WOODLD WILDLF	WETLAND WILDLF	RANGELD WILDLF
ALL	FAIR	FAIR	FAIR	FAIR	FAIR	-	GOOD	FAIR	FAIR	FAIR	FAIR	-

POTENTIAL NATIVE PLANT COMMUNITY (RANGELAND OR FOREST UNDERSTORY VEGETATION) (E)

COMMON PLANT NAME	PLANT SYMBOL (NLSPN)	PERCENTAGE COMPOSITION (DRY WEIGHT) BY CLASS DETERMINING PHASE			
		RANGELAND			
LITTLE BLUESTEM	ANSC2	50			
INDIANGRASS	SONU2	10			
SWITCHGRASS	PAVI2	10			
EASTERN GAMA	TRDA3	10			
BIG BLUESTEM	ANGE	5			
OTHER PERENNIAL GRASSES	PPGG	10			
OTHER PERENNIAL FORBS	PPFF	5			
POTENTIAL PRODUCTION (LBS./AC. DRY WT):					
FAVORABLE YEARS		8500			
NORMAL YEARS		6500			
UNFAVORABLE YEARS		5000			

FOOTNOTES

A ESTIMATES BASED ON ENGINEERING TEST DATA OF 2 PEDONS FROM HARRIS COUNTY, TEXAS.
B RATINGS BASED ON GUIDE FOR INTERPRETING ENGINEERING USES OF SOILS, NOV. 1971.
C RECREATION RATINGS BASED ON SOILS MEMORANDUM-69, OCT. 1968.
D WILDLIFE RATINGS BASED ON SOILS MEMORANDUM-74, JAN. 1972.
E LOAMY PRAIRIE RANGE SITE
1 RATINGS BASED ON SRWPC COMMITTEE IV GUIDE, DRAFT 4/70.

TEXT REFERENCE:

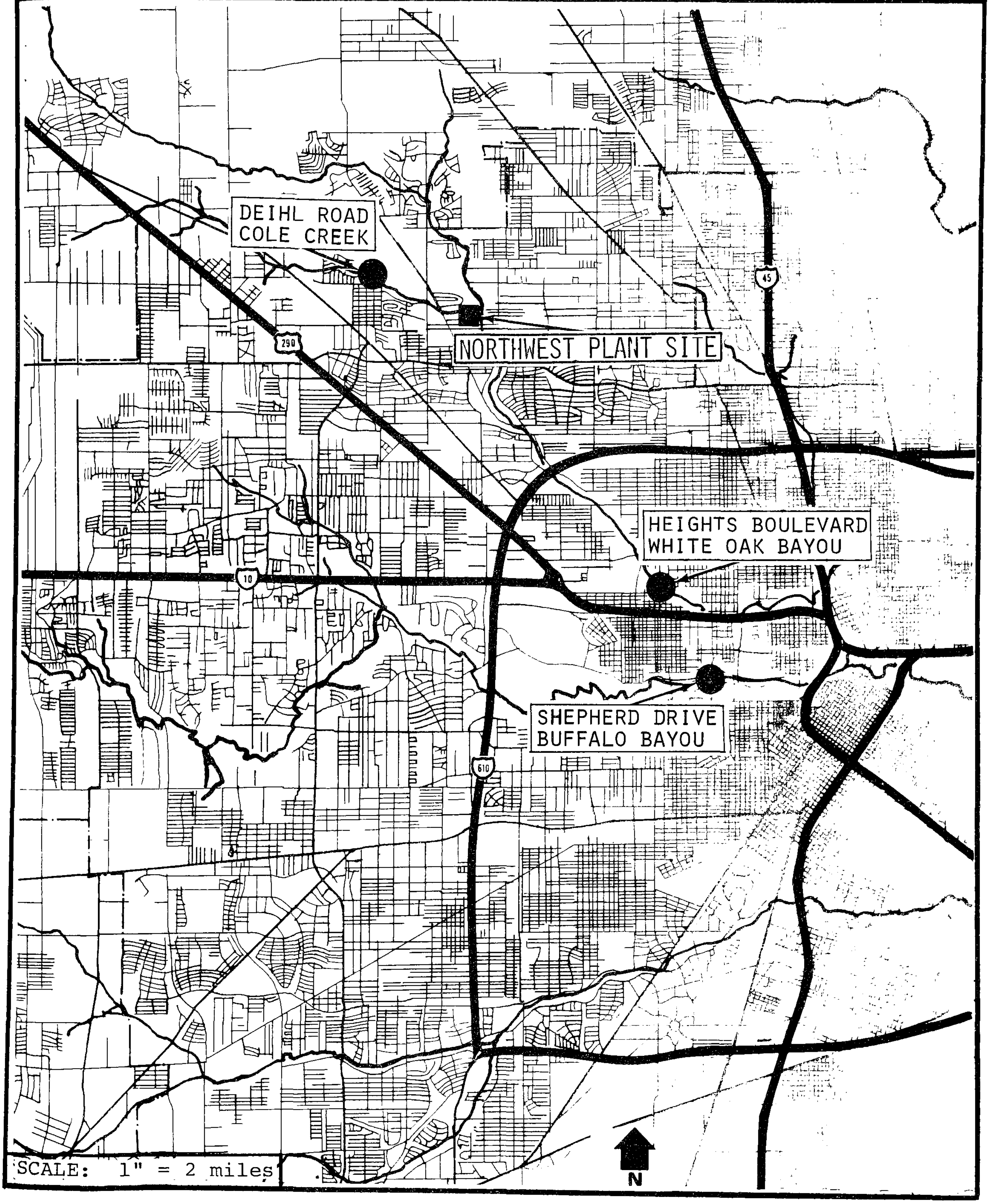
CHAPTER III: SOCIAL AND ENVIRONMENTAL SETTING (NATURAL ENVIRONMENT: SURFACE AND SUB-SURFACE SETTING)

APPENDIX G: STREAM FLOW AND WATER QUALITY DATA FOR COLE CREEK, WHITE OAK AND BUFFALO BAYOUS AT:

1) COLE CREEK AT DEIHL ROAD
2) WHITE OAK BAYOU AT HEIGHTS BOULEVARD
3) BUFFALO BAYOU AT SHEPHERD DRIVE

FIGURE G-1

LOCATION FOR WATER FLOW AND WATER QUALITY DATA



STREAM FLOW FOR COLE CREEK, WHITE OAK BAYOU AND BUFFALO BAYOU

Water discharge data for Cole Creek presented in Table G-1 were recorded at the Deihl Road, which lies above the plant site to the west. During the period October 1971 - September, 1972, the mean discharge was 7.35 cubic feet per second (cfs) ranging on a monthly basis from a minimum of 0 cfs to a maximum of 30.5 cfs. No data is available for Cole Creek at a place below the plant site. Similar data on the water discharge of White Oak Bayou recorded at Heights Boulevard to the southeast of the service area are presented in Table G-2. During the same period of time the mean discharge at this location was 84 cfs, the monthly variation of which was from a minimum of 5 cfs to a maximum of 4,150 cfs. Data on the stream flow of Buffalo Bayou recorded at Shepherd Drive are presented in Table G-3. The mean discharge during October 1971 - September, 1972, was 419 cfs, varying monthly from a minimum of 34 cfs to a maximum of 6,570 cfs.

WATER QUALITY FOR WHITE OAK BAYOU AND BUFFALO BAYOU

Water quality data for Cole Creek is not available. Table G-4 presents water quality data for White Oak Bayou taken at the Heights Boulevard during the period October, 1971 - September, 1972. The BOD at this location ranged from 3.3 mg/l to 18.0 mg/l. Table G-5 presents comparable data for Buffalo Bayou at the Shepherd Drive location. The BOD ranged from 2.1 mg/l to 12 mg/l during the same period of time.

TABLE G-1

WATER DISCHARGE DATA: COLE CREEK AT DEIHL ROAD

08074150 Cole Creek at Deihl Road, Houston, Tex.

LOCATION.--Lat 29°51'04", long 95°29'16", Harris County, on downstream side of bridge at Deihl Road in northwest Houston and 1.8 miles upstream from mouth.

DRAINAGE AREA.--8.81 sq mi. Prior to Apr. 1, 1965, 10.0 sq mi. Apr. 1 to May 17, 1965, 8.81 sq mi. At Antoine Drive, May 18 to Aug. 1, 1965, 9.94 sq mi; Aug. 2, 1965, to Sept. 1, 1966, 10.2 sq mi. Drainage area changes due to relocations and changes in storm sewers.

PERIOD OF RECORD.--April 1964 to current year. Gage at temporary location 1.0 mile downstream at Antoine Drive May 18, 1965, to Sept. 1, 1966, due to bridge construction and channel rectification.

GAGE.--Water-stage recorder. Datum of gage is at mean sea level, datum of 1929, adjustment of 1957; unadjusted for land-surface subsidence.

AVERAGE DISCHARGE.--8 years, 5.56 cfs (4,030 acre-ft per year).

EXTREMES.--Current year: Maximum discharge, 2,020 cfs Mar. 20 (elevation, 78.60 ft); no flow for many days.
Period of record: Maximum discharge, 2,020 cfs Mar. 20, 1972 (elevation, 78.60 ft); no flow at times.

REMARKS.--Records fair. No diversions above station. Low flow partly sustained by sewage effluent from Houston suburbs. Recording rain gage located at station.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1971 TO SEPTEMBER 1972

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	.08	.01	.10	2.8	14	2.0	.63	.17	.17	.03	.50	.04
2	.02	.01	188	1.9	6.6	1.9	.53	2.1	.18	0	.24	.04
3	.03	0	53	1.5	3.6	1.0	.49	.80	.18	.01	.22	.04
4	.82	.04	12	4.8	2.2	.91	2.6	.46	.18	.08	.06	.04
5	5.8	.01	87	4.4	1.7	.77	.82	.22	.17	.02	.03	.06
6	13	.03	119	2.5	2.0	.57	.50	.18	.14	0	.03	.03
7	3.9	.03	37	1.8	1.8	.61	.17	100	.11	0	2.9	.02
8	1.6	.01	14	1.3	1.4	.65	.14	27	.10	0	.90	.45
9	.87	0	11	1.5	1.0	.43	.10	4.9	.10	.01	.27	.63
10	.40	0	14	1.9	.91	.35	.10	27	2.2	.01	1.3	.73
11	.13	0	6.8	1.3	35	.34	.10	86	1.7	.28	13	.74
12	.11	0	4.1	.86	32	.37	.10	97	.31	.07	8.1	.87
13	.11	0	2.9	.65	11	.32	.17	41	.19	10	4.3	.92
14	.05	.01	2.4	.54	5.9	.26	.17	14	.24	4.2	6.0	.50
15	.34	.02	2.6	.40	4.3	.83	.20	6.2	5.2	.55	12	.15
16	.20	0	6.3	.33	3.5	.58	.10	2.9	7.7	.12	91	.04
17	1.2	0	6.2	.32	2.7	.35	.05	1.8	1.3	.51	2.6	.68
18	.78	.11	2.6	.62	1.9	.21	.04	1.2	.38	3.0	.91	3.9
19	.33	.01	2.0	1.4	1.3	.12	.04	1.0	.20	2.7	.44	5.6
20	8.6	0	1.5	5.0	1.0	442	.05	.73	.10	.60	.21	.70
21	8.8	0	1.2	2.5	.90	429	.28	.54	.05	1.2	.11	.18
22	2.8	0	.88	1.6	.88	37	.08	.43	.03	2.2	.11	3.6
23	1.1	2.9	.85	1.2	.87	9.3	.07	.34	.03	.88	1.1	1.6
24	.52	.74	.73	.96	.80	3.7	.03	.30	.02	.44	1.9	2.9
25	.43	.16	.46	.70	.73	3.0	.03	.29	.03	.21	1.3	3.4
26	.29	.04	.49	.62	.64	2.0	.02	.25	.05	.15	1.1	15
27	.18	.01	.45	.61	.52	1.6	1.1	.22	.04	.10	.22	14
28	.09	0	.37	.45	.48	1.7	1.5	.20	.02	.60	.10	1.5
29	.08	0	.49	.50	1.9	1.3	.67	.18	0	.36	.08	.88
30	.04	0	2.9	152	------	.89	.32	.18	0	.54	.07	37
31	.01	------	3.8	37	------	.74	------	.18	------	1.5	.04	------
TOTAL	52.71	4.14	585.12	233.96	141.53	944.80	11.20	417.77	21.12	30.37	151.14	96.24
MEAN	1.70	.14	18.9	7.55	4.88	30.5	.37	13.5	.70	.98	4.88	3.21
MAX	13	2.9	188	152	35	442	2.6	100	7.7	10	91	37
MIN	.01	0	.10	.32	.48	.12	.02	.17	0	0	.03	.02
AC-FT	105	8.2	1,160	464	281	1,870	22	829	42	60	300	191
(††)	3.00	.97	7.59	3.68	1.58	7.57	1.74	6.23	2.79	4.55	5.46	5.64

CAL YR 1971 TOTAL 1,651.59 MEAN 4.52 MAX 206 MIN 0 AC-FT 3,280 †† 40.56
WTR YR 1972 TOTAL 2,690.10 MEAN 7.35 MAX 442 MIN 0 AC-FT 5,340 †† 50.80

PEAK DISCHARGE (BASE, 250 CFS)

DATE	TIME	ELEV.	DISCHARGE	DATE	TIME	ELEV.	DISCHARGE
12- 2	0730	73.51	346	5- 7	1630	72.53	264
1-30	0915	72.52	250	8-16	0200	73.54	336
3-20	1830	78.60	2,020				

†† Weighted-mean rainfall, in inches, based on three rain gages.

Source: Water Resources Data for Texas, Part 1: Surface Water Records, 1972, United States Department of the Interior, Geological Survey, P. 257.

TABLE G-2

WATER DISCHARGE DATA: WHITEOAK BAYOU

SAN JACINTO RIVER BASIN

08074500 Whiteoak Bayou at Houston, Tex.

LOCATION.--Lat 29°46'30", long 95°23'49", Harris County, at downstream side of downstream bridge on Heights Boulevard in Houston, 560 ft downstream from Texas and New Orleans Railroad Co. bridge, 2.4 miles upstream from Little Whiteoak Bayou, and 4.0 miles upstream from mouth.

DRAINAGE AREA.--84.7 sq mi; unadjusted for basin boundary changes. During extreme floods when capacity of drainage ditches is exceeded, the drainage area is defined by natural ridges and is 92.0 sq mi.

PERIOD OF RECORD.--May 1936 to current year (October 1965 to September 1966, monthly discharge only).

GAGE.--Water-stage recorder. Datum of gage is 5.76 ft below mean sea level, datum of 1929, adjustments of 1957 and 1959; unadjusted for land-surface subsidence. Prior to June 17, 1936, nonrecording gage and June 17, 1936, to Apr. 28, 1965, water-stage recorder at site 480 ft upstream at same datum.

AVERAGE DISCHARGE.--36 years, 68.9 cfs (49,920 acre-ft per year).

EXTREMES.--Current year: Maximum discharge, 17,300 cfs Mar. 20 (gage height, 43.50 ft); minimum daily, 5.1 cfs Apr. 25.

Period of record: Maximum discharge, 17,300 cfs Mar. 20, 1972 (gage height, 43.50 ft); maximum gage height, 43.60 ft Nov. 13, 1961; no flow for many days during 1965 water year (result of construction dams).

Maximum stage since at least 1919, 51.5 ft Dec. 9, 1935, prior to channel rectification, present site and datum (discharge, 14,750 cfs, furnished by engineer for Harris County). Flood of May 31, 1929, reached a stage of 47.0 ± 0.5 ft, prior to channel rectification, present site and datum (discharge, 9,360 cfs), computed on basis of current-meter measurement at stage 1.0 ft below crest, furnished by city of Houston.

REMARKS.--Records fair. Low flow partly sustained by industrial waste. No diversion above station.

REVISIONS.--WSP 1732: Drainage area.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1971 TO SEPTEMBER 1972

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	11	13	14	42	134	21	18	13	12	12	34	16
2	11	12	1,340	30	72	22	21	105	15	10	36	15
3	13	10	561	31	42	22	23	38	16	10	27	15
4	31	11	173	67	26	20	36	22	15	12	18	14
5	179	11	957	52	23	19	18	16	15	12	14	14
6	102	12	909	31	30	17	16	16	13	12	13	19
7	52	12	368	23	30	17	17	928	14	20	16	21
8	26	10	186	20	27	16	17	324	14	15	33	17
9	21	12	140	23	28	16	16	86	13	14	15	16
10	16	12	154	27	30	15	20	413	179	13	31	15
11	16	12	101	23	372	14	20	716	31	43	79	14
12	16	13	89	18	259	13	22	1,090	24	33	143	25
13	19	9.6	49	18	110	13	23	525	20	56	256	19
14	21	12	46	19	57	13	25	286	24	99	140	30
15	32	12	54	19	42	13	26	125	42	42	93	43
16	67	14	148	18	41	13	23	67	215	33	270	20
17	80	14	213	17	42	13	19	41	21	106	53	26
18	25	74	48	29	44	13	21	29	12	49	38	30
19	28	14	34	49	42	13	21	33	12	82	21	50
20	41	9.6	30	74	41	2,710	19	19	12	39	14	15
21	199	9.0	30	25	38	4,150	25	15	12	68	13	14
22	104	9.0	29	19	34	333	11	12	12	72	14	33
23	50	103	29	17	31	110	7.4	11	12	51	95	23
24	31	16	27	14	26	43	5.7	11	12	19	33	123
25	21	10	28	14	20	36	5.1	10	12	15	24	85
26	17	10	28	14	18	30	5.3	8.7	10	15	21	110
27	16	9.3	29	10	18	25	260	7.0	10	49	13	119
28	16	10	25	10	17	28	76	8.3	12	46	12	61
29	13	10	22	14	18	24	22	8.9	12	35	12	39
30	14	12	44	1,640	------	20	15	12	12	24	13	270
31	14	------	52	345	------	20	------	11	------	35	14	------
TOTAL	1,302	497.5	5,957	2,752	1,712	7,832	853.5	5,006.9	835	1,141	1,608	1,311
MEAN	42.0	16.6	192	88.8	59.0	253	28.5	162	27.8	36.8	51.9	43.7
MAX	199	103	1,340	1,640	372	4,150	260	1,090	215	106	270	270
MIN	11	9.0	14	10	17	13	5.1	7.0	10	10	12	14
AC-FT	2,580	987	11,820	5,460	3,400	15,530	1,690	9,930	1,660	2,260	3,190	2,600

CAL YR 1971 TOTAL 21,903.1 MEAN 60.0 MAX 2,800 MIN 4.0 AC-FT 43,440
WTR YR 1972 TOTAL 30,807.9 MEAN 84.2 MAX 4,150 MIN 5.1 AC-FT 61,110

PEAK DISCHARGE (BASE, 2,000 CFS)

DATE	TIME	G.HT.	DISCHARGE	DATE	TIME	G.HT.	DISCHARGE
1-30	0400	26.70	3,420	5- 7	1100	25.53	2,720
3-20	2145	43.50	17,300	5-12	0730	24.37	2,180

Source: Water Resources Data for Texas, Part 1: Surface Water Records, 1972, United States Department of the Interior, Geological Survey, P. 259.

TABLE G-3

WATER DISCHARGE DATA: BUFFALO BAYOU
AT SHEPHERD DRIVE

SAN JACINTO RIVER BASIN

08074000 Buffalo Bayou at Houston, Tex.

LOCATION.--Lat 29°45'36", long 95°24'30", Harris County, at bridge on Shepherd Drive in Houston and 0.8 mile upstream from Waugh Drive.

DRAINAGE AREA.--358 sq mi, unadjusted for basin boundary changes

PERIOD OF RECORD.--May 1936 to September 1957, October 1957 to December 1961 (high-water records and discharge measurements), January 1962 to current year.

GAGE.--Water-stage recorder. Datum of gage is at mean sea level, adjustment of 1959. Prior to June 19, 1936, nonrecording gage and June 19, 1936, to Jan. 16, 1962, water-stage recorder at site 0.8 mile downstream at datum 4.08 ft below mean sea level. Since Jan. 17. 1962, auxilary water-stage recorder 0.8 mile downstream.

AVERAGE DISCHARGE.--8 years (1936-44) unregulated, 272 cfs (197,100 acre-ft per year); 23 years (1944-57, 1962-72) regulated, 243 cfs (176,100 acre-ft per year).

EXTREMES.--Current year: Maximum discharge, 9,200 cfs Mar. 21 (elevation, 20.39 ft); maximum elevation, 23.06 ft Mar. 21; minimum daily discharge, 34 cfs Nov. 13, 29.
Period of record: Maximum discharge, 10,900 cfs Aug. 30, 1945 (elevation, 28.82 ft), at site 0.8 mile downstream at present datum; minimum daily, 1.3 cfs May 24, 1939, Nov. 5, 1950.
All flood data at site 0.8 mile downstream at present datum. Maximum elevation since at least 1835, 49.0 ft Dec. 9, 1935 (discharge, 40,000 cfs; furnished by engineer for Harris County). Flood of May 31, 1929, reached an elevation of 43.5 ft (discharge, 19,000 cfs at bridge on Capitol Avenue 2.8 miles downstream, from rating curve extended above 15,300 cfs, stage-discharge relation materially affected by bridge; furnished by city of Houston).

REMARKS.--Records good. Floodflow regulated by Barker and Addicks Reservoirs (stations 08072500 and 08073000) 26.3 miles and 26.5 miles upstream, respectively. Flow affected by tides and backwater from Whiteoak Bayou. Low flow mostly maintained by sewage effluent from Houston suburbs.

REVISIONS.--WSP 1732: Drainage area (former site).

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1971 TO SEPTEMBER 1972

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	505	194	36	475	355	111	211	158	1,100	87	254	57
2	490	146	571	460	412	72	180	150	1,170	95	146	54
3	490	65	669	460	372	70	108	173	520	92	180	55
4	550	51	225	460	417	72	55	318	115	140	175	55
5	867	47	1,300	460	687	53	49	471	108	200	238	56
6	424	43	1,450	460	775	45	47	242	630	112	231	78
7	308	39	711	460	712	44	51	1,110	1,020	132	188	85
8	460	39	313	455	840	45	52	795	1,140	152	285	94
9	475	41	221	455	1,040	45	47	445	1,140	165	150	80
10	445	39	213	450	1,040	45	46	1,000	1,730	158	100	99
11	445	38	350	450	1,510	49	44	1,980	916	173	200	108
12	430	38	392	445	804	45	44	2,790	242	247	400	115
13	415	34	336	445	471	44	49	2,090	812	236	300	114
14	415	35	316	434	422	41	47	880	1,170	390	350	211
15	415	37	333	432	551	38	49	630	1,140	333	275	356
16	484	39	319	437	641	64	61	694	2,020	329	242	152
17	505	39	548	447	815	50	54	846	1,250	372	152	168
18	460	106	324	479	908	45	51	1,060	880	351	109	178
19	400	65	316	484	884	44	47	1,140	778	338	102	160
20	364	41	294	520	874	107	44	1,060	1,020	415	70	142
21	400	43	282	445	861	6,570	131	614	1,100	375	68	122
22	415	38	280	430	835	2,240	102	106	1,020	336	75	101
23	394	300	277	430	867	646	68	598	1,020	330	158	120
24	378	100	280	430	964	829	61	898	694	310	133	350
25	372	75	280	424	1,040	863	57	1,020	364	278	123	250
26	366	60	274	415	639	829	49	1,060	277	250	96	300
27	358	51	277	415	255	795	249	1,100	203	255	81	350
28	350	47	277	415	97	710	351	1,020	154	180	84	350
29	386	34	280	420	98	778	213	1,060	111	121	66	350
30	296	45	430	2,920	------	540	221	1,060	107	99	65	600
31	198	------	460	1,070	------	247	------	1,060	------	235	57	------
TOTAL	13,260	1,969	12,634	16,982	20,186	16,176	2,838	27,628	23,951	7,286	5,153	5,310
MEAN	428	65.6	408	548	696	522	94.6	891	798	235	166	177
MAX	867	300	1,450	2,920	1,510	6,570	351	2,790	2,020	415	400	600
MIN	198	34	36	415	97	38	44	106	107	87	57	54
AC-FT	26,300	3,910	25,060	33,680	40,040	32,090	5,630	54,800	47,510	14,450	10,220	10,530

CAL YR 1971 TOTAL 167,929 MEAN 460 MAX 5,390 MIN 25 AC-FT 333,100
WTR YR 1972 TOTAL 153,373 MEAN 419 MAX 6,570 MIN 34 AC-FT 304,200

Source: Water Resources Data for Texas, Part 1: Surface Water Records, 1972, United States Department of the Interior, Geological Survey, P. 256.

TABLE G-4

WATER QUALITY DATA: WHITEOAK BAYOU

SAN JACINTO RIVER BASIN

08074500 WHITEOAK BAYOU AT HOUSTON, TEX.

LOCATION.--Lat 29°46'30", long 95°23'49", Harris County, at gaging station on Heights Boulevard in Houston, 560 ft downstream from Texas and New Orleans Railroad Co. bridge, and 2.4 miles upstream from Little Whiteoak Bayou.

DRAINAGE AREA.--84.7 sq mi, unadjusted for basin boundary changes. During extreme floods when capacity of drainage ditches is exceeded, the drainage area is defined by natural ridges and is 92.0 sq mi.

PERIOD OF RECORD.--Chemical and biochemical analyses: October 1968 to September 1972.
Pesticides analyses: October 1968 to September 1972.

REMARKS.--See Part 1 of this report for remarks on diversions and return flows.

WATER QUALITY DATA, WATER YEAR OCTOBER 1971 TO SEPTEMBER 1972

DATE	TIME	DIS-CHARGE (CFS)	DIS-SOLVED SILICA (SIO2) (MG/L)	DIS-SOLVED CAL-CIUM (CA) (MG/L)	DIS-SOLVED MAG-NE-SIUM (MG) (MG/L)	DIS-SOLVED SODIUM PLUS POTAS-SIUM (MG/L)	BICAR-BONATE (HCO3) (MG/L)	CAR-BONATE (CO3) (MG/L)	DIS-SOLVED SULFATE (SO4) (MG/L)
OCT.									
26...	0930	13	30	66	15	85	256	0	57
NOV.									
17...	1100	14	21	62	18	130	327	0	31
18...	1145	45	4.3	33	5.3	25	90	0	35
DEC.									
02...	1215	1700	1.8	14	4.1	16	76	0	9.2
08...	1200	155	7.6	18	1.7	14	67	0	8.8
27...	1400	32	21	76	18	120	340	0	44
JAN.									
24...	1400	14	19	72	18	99	342	0	31
31...	1110	310	5.2	23	3.8	15	78	0	12
MAR.									
21...	1315	1500	3.8	22	2.0	6.1	64	0	14
APR.									
05...	1245	19	15	81	29	130	326	0	32
27...	1645	1150	4.7	24	2.9	12	75	0	14
MAY									
16...	1035	65	12	36	7.1	26	136	0	11
22...	1200	18	9.0	36	7.3	57	194	0	17
JULY									
26...	1115	10	21	70	17	110	304	0	32
AUG.									
08...	0900	30	12	38	6.6	40	138	0	20
14...	1045	45	6.6	33	6.2	26	123	0	18
28...	0945	11	24	64	17	100	302	0	28
SEP.									
12...	1130	6.0	--	--	--	--	--	--	--

DATE	DIS-SOLVED CHLO-RIDE (CL) (MG/L)	DIS-SOLVED FLUO-RIDE (F) (MG/L)	ORGANIC NITRO-GEN (N) (MG/L)	TOTAL NITRITE (N) (MG/L)	AMMONIA NITRO-GEN (N) (MG/L)	TOTAL NITRATE (N) (MG/L)	TOTAL PHOS-PHORUS (P) (MG/L)	DIS-SOLVED SOLIDS (SUM OF CONSTI-TUENTS) (MG/L)	TOTAL NON-FILT-RABLE RESIDUE (MG/L)	VOL. NON-SETTLE-ABLE RESIDUE (MG/L)
OCT.										
26...	100	.3	.43	.42	3.4	.9	2.2	494	--	--
NOV.										
17...	170	.4	.19	1.1	8.8	.7	4.1	610	--	--
18...	35	.2	.15	.28	1.7	1.1	1.2	190	--	--
DEC.										
02...	9.0	.2	.15	.012	.45	.5	.55	94	695	--
08...	14	.0	.21	.035	.34	.2	.40	99	--	--
27...	140	.5	.64	1.1	2.2	.8	1.1	595	--	--
JAN.										
24...	120	.4	.30	.50	4.2	.6	3.2	535	47	--
31...	20	.1	.25	.000	.28	.4	.49	119	--	--
MAR.										
21...	10	.1	.32	.038	1.7	.3	1.6	93	526	--
APR.										
05...	220	.4	.18	.18	2.0	.4	1.9	676	30	--
27...	16	.2	.46	.013	1.0	.8	1.0	116	1200	--
MAY										
16...	38	.2	.35	.13	.78	.5	.80	201	--	--
22...	48	.3	.39	1.0	1.9	.7	2.4	278	--	--
JULY										
26...	140	.4	.22	.86	.15	.7	3.1	546	19	--
AUG.										
08...	55	.4	.40	.15	1.3	.4	1.3	244	--	--
14...	34	.2	.27	.029	1.2	.3	1.1	187	--	--
28...	130	.6	.44	.44	3.6	.7	1.8	521	--	--
SEP.										
12...	--	--	.37	.50	4.5	.7	3.5	--	34	9

TABLE G-4 (Continued)

SAN JACINTO RIVER BASIN

08074800 WHITEOAK BAYOU AT HOUSTON, TEX.--Continued

WATER QUALITY DATA, WATER YEAR OCTOBER 1971 TO SEPTEMBER 1972

DATE	HARD-NESS (CA,MG) (MG/L)	NON-CAR-BONATE HARD-NESS (MG/L)	SODIUM AD-SORP-TION RATIO	SPE-CIFIC CON-DUCT-ANCE (MICRO-MHOS)	PH (UNITS)	TEMPER-ATURE (DEG C)	COLOR (PLAT-INUM-COBALT UNITS)	TUR-BID-ITY (JTU)	DIS-SOLVED OXYGEN (MG/L)	PER-CENT SATUR-ATION
OCT.										
26...	220	15	2.5	910	6.8	21.5	70	35	8.2	92
NOV.										
17...	230	0	3.8	1170	7.7	24.0	30	40	10.9	124
18...	100	30	1.1	388	6.6	20.0	40	110	8.3	96
DEC.										
02...	52	0	1.0	187	7.6	10.0	220	220	10.5	93
08...	52	0	.8	174	7.1	16.0	160	50	10.4	104
27...	260	0	3.2	1050	7.8	24.0	40	20	10.5	124
JAN.										
24...	250	0	2.7	975	7.8	24.0	160	30	11.6	134
31...	73	9	.8	226	7.5	5.5	120	80	11.0	87
MAR.										
21...	63	11	.3	186	6.7	19.0	70	150	6.6	70
APR.										
05...	320	53	3.2	1260	8.0	25.5	30	15	18.8	227
27...	72	11	.6	218	7.8	19.5	110	280	8.6	92
MAY										
16...	120	8	1.0	383	7.4	25.0	160	45	8.2	98
22...	120	0	2.3	499	7.2	28.5	50	20	9.7	124
JULY										
26...	240	0	3.1	985	7.5	31.0	15	15	13.2	176
AUG.										
08...	120	9	1.6	469	7.1	26.0	40	80	6.9	84
14...	110	7	1.1	368	6.9	26.0	65	80	6.7	82
28...	230	0	2.9	942	7.4	29.0	35	15	11.4	146
SEP.										
12...	--	--	--	1040	7.6	29.5	30	15	14.2	184

DATE	CHEM-ICAL OXYGEN DEMAND (LOW LEVEL) (MG/L)	BIO-CHEM-ICAL OXYGEN DEMAND (MG/L)	IMME-DIATE COLI-FORM (COL. PER 100 ML)	FECAL COLI-FORM (COL. PER 100 ML)	STREP-TOCOCCI (COL-ONIES PER 100 ML)	PHENOLS (UG/L)	METHY-LENE BLUE ACTIVE SUB-STANCE (MG/L)	OIL AND GREASE (MG/L)	DIS-SOLVED ARSENIC (AS) (UG/L)	DIS-SOLVED CAD-MIUM (CD) (UG/L)
OCT.										
26...	23	4.8	64000	18000	5600	2	.10	--	--	--
NOV.										
17...	15	9.6	1700000	54000	71000	19	.72	--	--	--
18...	45	18	660000	2300	66000	16	.00	10	0	0
DEC.										
02...	31	9.3	400000	7300	55000	4	.00	20	0	0
08...	33	3.1	300000	9000	4900	20	.00	--	--	--
27...	25	2.6	56000	2300	680	0	.10	--	--	--
JAN.										
24...	28	16	3800000	140000	9500	4	.72	20	10	0
31...	45	5.6	3600000	19000	8700	0	.00	0	0	0
MAR.										
21...	33	5.2	680000	48000	90000	2	.00	--	--	--
APR.										
05...	28	4.2	84000	1600	130	0	.16	--	--	--
27...	96	12	170000	100000	62000	13	.00	--	--	--
MAY										
16...	47	3.3	220000	16000	2200	21	.07	20	--	--
22...	28	7.5	96000	440	580	0	.26	--	--	--
JULY										
26...	22	5.1	1	1	1	10	.20	200	50	1
AUG.										
08...	29	9.9	300000	17000	2400	5	.07	120	30	0
14...	30	10	3000000	280000	33000	0	.04	--	--	--
28...	21	>9.3	280000	34000	2100	0	.23	20	30	0
SEP.										
12...	--	7.5	1400000	460000	14000	--	.22	--	--	--

SAN JACINTO RIVER BASIN

08074500 WHITEOAK BAYOU AT HOUSTON, TEX.--Continued

WATER QUALITY DATA, WATER YEAR OCTOBER 1971 TO SEPTEMBER 1972

DATE	DIS-SOLVED CHRO-MIUM (CR) (UG/L)	DIS-SOLVED COBALT (CO) (UG/L)	DIS-SOLVED COPPER (CU) (UG/L)	DIS-SOLVED IRON (FE) (UG/L)	DIS-SOLVED LEAD (PB) (UG/L)	DIS-SOLVED MAN-GANESE (MN) (UG/L)	DIS-SOLVED MERCURY (HG) (UG/L)	DIS-SOLVED NICKEL (NI) (UG/L)	DIS-SOLVED ZINC (ZN) (UG/L)
OCT.									
26...	--	--	--	--	--	--	--	--	--
NOV.									
17...	--	--	--	--	--	--	--	--	--
18...	0	0	10	320	18	100	.6	6	430
DEC.									
02...	0	0	5	380	0	0	.2	0	40
08...	--	--	--	--	--	--	--	--	--
27...	--	--	--	--	--	--	--	--	--
JAN.									
24...	0	0	8	40	0	170	<.2	1	60
31...	0	0	6	250	0	0	<.2	0	40
MAR.									
21...	--	--	--	--	--	--	--	--	--
APR.									
05...	--	--	--	--	--	--	--	--	--
27...	--	--	--	--	--	--	--	--	--
MAY									
16...	--	--	--	--	--	--	--	--	--
22...	--	--	--	--	--	--	--	--	--
JULY									
26...	0	0	3	10	0	110	2.6	0	80
AUG.									
08...	0	0	7	60	0	20	3.2	3	120
14...	--	--	--	--	--	--	--	--	--
28...	0	0	4	0	0	80	.2	5	90
SEP.									
12...	--	--	--	--	--	--	--	--	--

DATE	TIME	DIS-CHARGE (CFS)	ALDRIN (UG/L)	DDD (UG/L)	DDE (UG/L)	DDT (UG/L)	DI-ELDRIN (UG/L)	ENDRIN (UG/L)	HEPTA-CHLOR (UG/L)	HEPTA-CHLOR EPOXIDE (UG/L)
NOV.										
18...	1145	45	.00	.00	.01	.03	.02	.00	.00	.00
DEC.										
02...	1215	1700	.00	.00	.00	.01	.03	.00	.00	.00
JAN.										
24...	1400	14	.00	.00	.00	.00	.02	.00	.00	.00
APR.										
27...	1645	1150	.00	.00	.00	.10	.07	.00	.00	.00
MAY										
16...	1035	65	.00	.00	.00	.00	.01	.00	.00	.00
JULY										
26...	1115	10	.00	.00	.00	.00	.01	.00	.00	.00
AUG.										
08...	0900	30	.00	.00	.00	.02	.04	.00	.00	.00
28...	0945	11	.00	.00	.00	.00	.03	.00	.00	.00

DATE	LINDANE (UG/L)	CHLOR-DANE (UG/L)	DI-AZINON (UG/L)	MALA-THION (UG/L)	METHYL PARA-THION (UG/L)	PARA-THION (UG/L)	2,4-D (UG/L)	2,4,5-T (UG/L)	SILVEX (UG/L)
NOV.									
18...	.07	.2	.10	.08	.00	.00	.00	.00	.00
DEC.									
02...	.00	.1	.02	.00	.00	.00	.00	.05	.00
JAN.									
24...	.01	.1	.15	.00	.00	.00	.00	.00	.00
APR.									
27...	.00	.8	.63	.00	.00	.00	.00	.00	.00
MAY									
16...	.00	.1	.05	.00	.00	.00	.00	.06	.00
JULY									
26...	.00	.0	.24	.00	.00	.00	.00	.05	.00
AUG.									
08...	.01	.1	.24	.00	.00	.00	.15	.17	.00
28...	.02	.0	.36	.00	.00	.00	.00	.03	.00

Source: <u>Water Resources Data for Texas, Part 2: Water Quality Records, 1972,</u> United States Department of the Interior, Geological Survey, PP. 361-363.

TABLE G-5

WATER QUALITY DATA: BUFFALO BAYOU
AT SHEPHERD DRIVE

08074000 BUFFALO BAYOU AT HOUSTON, TEX.

LOCATION.--Lat 29°45'36", long 95°24'30", Harris County, at gaging station at bridge on Shepherd Drive in Houston and 0.8 mile upstream from Waugh Drive.

DRAINAGE AREA.--358 sq mi, unadjusted for basin boundary changes.

PERIOD OF RECORD.--Chemical and biochemical analyses: October 1968 to September 1972.
Pesticide analyses: October 1968 to September 1972.

REMARKS.--See Part 1 of this report for remarks on diversions and return flows.

WATER QUALITY DATA, WATER YEAR OCTOBER 1971 TO SEPTEMBER 1972

DATE	TIME	DIS-CHARGE (CFS)	DIS-SOLVED SILICA (SIO2) (MG/L)	DIS-SOLVED CAL-CIUM (CA) (MG/L)	DIS-SOLVED MAG-NE-SIUM (MG) (MG/L)	DIS-SOLVED SODIUM PLUS POTAS-SIUM (MG/L)	BICAR-BONATE (HCO3) (MG/L)	CAR-BONATE (CO3) (MG/L)	DIS-SOLVED SULFATE (SO4) (MG/L)	DIS-SOLVED CHLO-RIDE (CL) (MG/L)
OCT.										
26...	0850	350	19	17	3.8	17	74	0	2.4	20
NOV.										
17...	1140	43	21	56	11	96	279	0	28	100
DEC.										
03...	1100	675	4.2	20	1.7	15	71	0	13	12
08...	1230	260	9.1	19	3.5	15	68	0	9.2	18
JAN.										
24...	1320	420	5.5	16	2.2	15	62	0	8.6	15
FEB.										
02...	0835	445	5.4	21	4.8	14	79	0	10	20
MAR.										
21...	1215	6500	2.7	16	1.7	3.2	46	0	8.4	5.0
APR.										
05...	1320	55	17	54	7.7	69	257	0	18	68
MAY										
09...	1115	485	.0	20	2.9	14	65	0	9.4	17
24...	0920	900	2.6	15	2.1	8.4	52	0	7.6	10
JULY										
26...	1150	225	16	35	7.5	42	139	0	11	58
AUG.										
14...	0950	175	16	30	5.6	37	115	0	17	44
28...	0900	96	23	44	4.1	71	199	0	24	78

DATE	DIS-SOLVED FLUO-RIDE (F) (MG/L)	ORGANIC NITRO-GEN (N) (MG/L)	TOTAL NITRITE (N) (MG/L)	AMMONIA NITRO-GEN (N) (MG/L)	TOTAL NITRATE (N) (MG/L)	TOTAL PHOS-PHORUS (P) (MG/L)	DIS-SOLVED SOLIDS (RESI-DUE AT 180 C) (MG/L)	DIS-SOLVED SOLIDS (SUM OF CONSTI-TUENTS) (MG/L)	TOTAL NON-FILT-RABLE RESIDUE (MG/L)	HARD-NESS (CA,MG) (MG/L)
OCT.										
26...	.2	.53	.44	.37	.5	.88	--	119	--	58
NOV.										
17...	.5	.10	.63	5.0	1.1	3.7	--	468	--	180
DEC.										
03...	.2	.22	.083	.44	.5	.80	--	104	312	57
08...	.2	.28	.30	.45	.8	.55	--	112	--	62
JAN.										
24...	.2	.14	.15	.52	.6	.61	--	96	66	49
FEB.										
02...	.2	.30	.011	.70	.6	.53	--	118	--	72
MAR.										
21...	.2	.29	.060	.53	.4	.56	--	63	554	47
APR.										
05...	.4	.25	.34	4.0	.9	1.2	--	370	16	170
MAY										
09...	.2	.37	.036	.51	1.6	.75	--	103	342	62
24...	.2	.31	.060	.57	.3	.53	--	74	--	46
JULY										
26...	.3	.25	.25	.35	.8	.75	--	243	121	120
AUG.										
14...	.3	.23	.37	.33	1.1	.70	--	213	--	98
28...	.6	.37	.071	5.4	.0	1.1	--	353	--	130

TABLE G-5 (Continued)

SAN JACINTO RIVER BASIN

08074000 BUFFALO BAYOU AT HOUSTON, TEX.--Continued

WATER QUALITY DATA, WATER YEAR OCTOBER 1971 TO SEPTEMBER 1972

DATE	NON-CAR-BONATE HARD-NESS (MG/L)	SODIUM AD-SORP-TION RATIO	SPE-CIFIC CON-DUCT-ANCE (MICRO-MHOS)	PH (UNITS)	TEMPER-ATURE (DEG C)	COLOR (PLAT-INUM-COBALT UNITS)	TUR-BID-ITY (JTU)	DIS-SOLVED OXYGEN (MG/L)	PER-CENT SATUR-ATION	CHEM-ICAL OXYGEN DEMAND (LOW LEVEL) (MG/L)
OCT.										
26...	0	1.0	232	6.4	21.5	140	45	6.5	73	36
NOV.										
17...	0	3.1	889	7.3	22.0	30	45	4.2	48	11
DEC.										
03...	0	.9	201	7.3	9.5	190	150	9.4	82	41
08...	6	.8	223	7.0	14.5	160	65	9.3	90	31
JAN.										
24...	0	.9	210	7.2	19.5	160	40	8.5	91	21
FEB.										
02...	7	.7	239	7.3	10.0	120	70	9.0	80	32
MAR.										
21...	9	.2	125	7.0	19.0	50	200	10.5	112	32
APR.										
05...	0	2.3	660	6.9	23.0	40	10	4.2	48	19
MAY										
09...	9	.8	211	7.0	22.0	160	140	6.6	75	35
24...	0	.5	144	6.3	24.5	130	60	5.5	65	34
JULY										
26...	4	1.7	439	6.8	29.0	55	65	4.8	62	23
AUG.										
14...	4	1.6	376	6.7	25.0	55	60	4.2	50	24
28...	0	2.7	641	7.0	28.0	35	30	2.4	30	24

DATE	BIO-CHEM-ICAL OXYGEN DEMAND (MG/L)	IMME-DIATE COLI-FORM (COL. PER 100 ML)	FECAL COLI-FORM (COL. PER 100 ML)	STREP-TOCOCCI (COL-ONIES PER 100 ML)	PHENOLS (UG/L)	METHY-LENE BLUE ACTIVE SUB-STANCE (MG/L)	OIL AND GREASE (MG/L)	DIS-SOLVED ARSENIC (AS) (UG/L)	DIS-SOLVED CAD-MIUM (CD) (UG/L)	DIS-SOLVED CHRO-MIUM (CR) (UG/L)
OCT.										
26...	4.8	100000	61000	91000	1	.00	--	--	--	--
NOV.										
17...	2.1	80000	5300	150	21	.17	--	--	--	--
DEC.										
03...	12	--	--	--	17	.00	20	0	0	0
08...	4.7	1400000	23000	2000	23	.00	--	--	--	--
JAN.										
24...	2.5	300000	7300	700	3	.00	10	0	0	0
FEB.										
02...	4.5	1200000	7700	2100	1	.00	10	0	0	0
MAR.										
21...	4.6	240000	34000	46000	0	.00	--	--	--	--
APR.										
05...	3.2	9000	500	120	0	.13	--	--	--	--
MAY										
09...	10	560000	36000	2700	0	.00	10	0	0	0
24...	3.5	640000	56000	6500	5	.01	--	--	--	--
JULY										
26...	5.8	110000	10000	900	5	.02	20	0	0	0
AUG.										
14...	5.1	32000	16000	1900	0	.04	10	10	0	0
28...	>9.2	210000	41000	3500	10	.10	10	10	0	20

DATE	HEXA-VALENT CHRO-MIUM (CR6) (UG/L)	DIS-SOLVED COBALT (CO) (UG/L)	DIS-SOLVED COPPER (CU) (UG/L)	DIS-SOLVED IRON (FE) (UG/L)	DIS-SOLVED LEAD (PB) (UG/L)	DIS-SOLVED MAN-GANESE (MN) (UG/L)	DIS-SOLVED MERCURY (HG) (UG/L)	DIS-SOLVED NICKEL (NI) (UG/L)	DIS-SOLVED ZINC (ZN) (UG/L)
OCT.									
26...	--	--	--	--	--	--	--	--	--
NOV.									
17...	--	--	--	--	--	--	--	--	--
DEC.									
03...	--	0	9	120	0	90	<.2	0	30
08...	--	--	--	--	--	--	--	--	--
JAN.									
24...	--	0	16	410	2	0	<.2	5	40
FEB.									
02...	--	0	12	330	0	0	.2	0	20
MAR.									
21...	--	--	--	--	--	--	--	--	--
APR.									
05...	--	--	--	--	--	--	--	--	--
MAY									
09...	--	0	4	130	0	0	.2	7	30
24...	--	--	--	--	--	--	--	--	--
JULY									
26...	--	0	3	120	0	80	2.6	0	60
AUG.									
14...	--	0	3	160	0	0	2.1	0	50
28...	10	2	5	20	0	120	.2	0	80

TABLE G-5 (Continued)

SAN JACINTO RIVER BASIN

08074000 BUFFALO BAYOU AT HOUSTON, TEX.--Continued

WATER QUALITY DATA, WATER YEAR OCTOBER 1971 TO SEPTEMBER 1972

DATE	TIME	DIS-CHARGE (CFS)	ALDRIN (UG/L)	ALDRIN IN BOTTOM DE-POSITS (UG/KG)	DDD (UG/L)	DDD IN BOTTOM DE-POSITS (UG/KG)	DDE (UG/L)	DDE IN BOTTOM DE-POSITS (UG/KG)	DDT (UG/L)	DDT IN BOTTOM DE-POSITS (UG/KG)
DEC.										
03...	1100	675	.00	--	.02	--	.00	--	.03	--
JAN.										
24...	1320	420	.00	--	.00	--	.00	--	.00	--
MAR.										
21...	1215	6500	.00	--	.04	--	.01	--	.10	--
MAY										
09...	1115	485	.00	--	.00	--	.00	--	.00	--
24...	--	--	--	<.2	--	32	--	7.8	--	32
JULY										
26...	1150	225	.00	--	.00	--	.00	--	.00	--
AUG.										
14...	0950	175	.00	--	.00	--	.00	--	.15	--
28...	0900	96	.00	--	.02	--	.00	--	.01	--

DATE	DI-ELDRIN (UG/L)	DI-ELDRIN IN BOTTOM DE-POSITS (UG/KG)	ENDRIN (UG/L)	ENDRIN IN BOTTOM DE-POSITS (UG/KG)	HEPTA-CHLOR (UG/L)	HEPTA-CHLOR IN BOTTOM DE-POSITS (UG/KG)	HEPTA-CHLOR EPOXIDE (UG/L)	HEPTA-CHLOR EPOXIDE IN BOT-TOM DE-POSITS (UG/KG)	LINDANE (UG/L)	LINDANE IN BOTTOM DE-POSITS (UG/KG)
DEC.										
03...	.06	--	.00	--	.00	--	.00	--	.05	--
JAN.										
24...	.01	--	.00	--	.00	--	.00	--	.01	--
MAR.										
21...	.03	--	.00	--	.00	--	.00	--	.14	--
MAY										
09...	.02	--	.00	--	.00	--	.00	--	.00	--
24...	--	4.8	--	<.2	--	<.2	--	<.2	--	<.2
JULY										
26...	.02	--	.00	--	.00	--	.00	--	.00	--
AUG.										
14...	.07	--	.00	--	.00	--	.00	--	.00	--
28...	.04	--	.00	--	.00	--	.00	--	.17	--

DATE	CHLOR-DANE (UG/L)	CHLOR-DANE IN BOTTOM DE-POSITS (UG/KG)	DI-AZINON (UG/L)	MALA-THION (UG/L)	METHYL PARA-THION (UG/L)	PARA-THION (UG/L)	2,4-D (UG/L)	2,4,5-T (UG/L)	SILVEX (UG/L)
DEC.									
03...	.2	--	.07	.00	.00	.00	.00	.02	.00
JAN.									
24...	.0	--	.03	.00	.00	.00	.00	.00	.00
MAR.									
21...	.2	--	.26	.00	.00	.00	.18	.12	.05
MAY									
09...	.1	--	.10	.00	.00	.00	.00	.05	.04
24...	--	96	--	--	--	--	--	--	--
JULY									
26...	.1	--	.08	.00	.00	.00	.00	.06	.00
AUG.									
14...	.2	--	.15	.00	.00	.00	.04	.09	.00
28...	.1	--	.16	.00	.00	.00	.13	.07	.19

Source: Water Resources Data for Texas, Part 2:
Water Quality Records, 1972, United
States Department of the Interior,
Geological Survey, PP. 356-358.

TEXT REFERENCE:

CHAPTER III: SOCIAL AND ENVIRONMENTAL SETTING
(NATURAL ENVIRONMENT: CLIMATIC AND ATMOSPHERIC CONDITIONS)

APPENDIX GG: AIR POLLUTION CONTROL PROGRAM FOR THE HOUSTON AREA

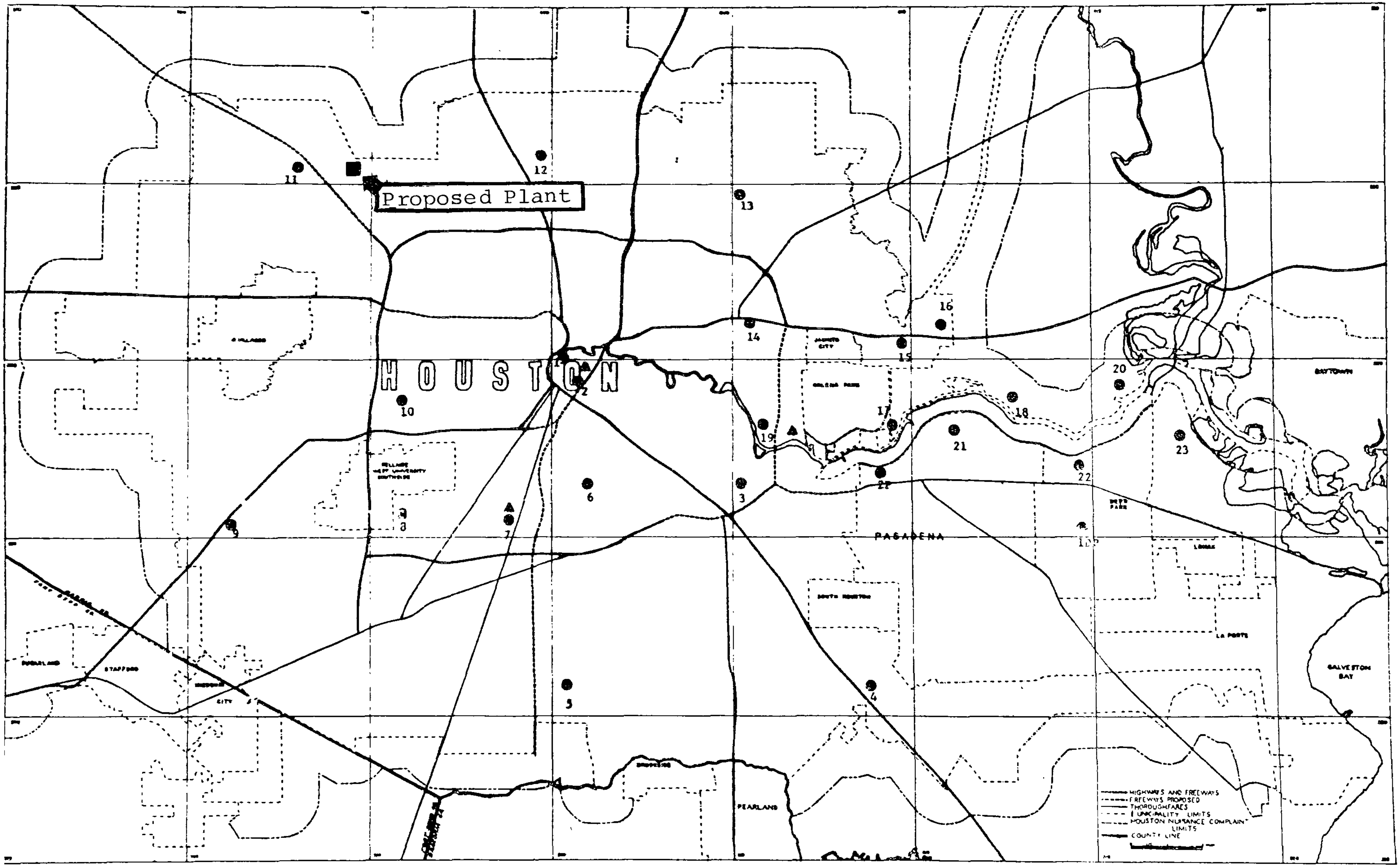
1. GEOGRAPHIC VARIATION OF AIR POLLUTION IN HOUSTON
2. COMPARISON OF HOUSTON'S AIR QUALITY AGAINST NATIONAL AND STATE AMBIENT AIR QUALITY STANDARDS
3. THE CURRENT PROGRAM OF THE CITY IN COMBATTING AIR POLLUTION PROBLEMS FOR HOUSTON

The Houston Air Pollution Control Program began in 1967 as a part of the City's Health Department. The purpose of the program was to monitor sources of air pollution and to control, regulate, and reduce these pollutants. The City assumed the responsibility of monitoring and enforcing the State and Federal Standards on air pollution. Their activities include the determination of where the standards are being violated and issuing citations to make improvements in the general air quality of Houston.

1. Geographic Variation of Air Pollution in Houston

Currently, the Houston area has 25 monitoring stations including the Houston Ship Channel Industrial District, where large concentrations of pollution sources exist. These monitoring stations are shown in Figure GG-1. In addition, two continuous monitoring mobile units have been put into operation to sample Carbon Monoxide, Nitrogen Oxides, Sulphur Dioxides, and Total Oxidants on a continuing basis. Of the 25 monitoring stations, only one is located in Northwest Houston in the vicinity of where Pinemont intersects with Northwest Freeway approximately three miles west of the proposed site of the Northwest Regional Treatment Plant. See location 11 in Figure GG-1.

FIGURE GG-1: AMBIENT AIR MONITORING NETWORK



● Permanent Air Sampling Sites

▲ Mobile Air Sampling Sites

Table GG-1 summarizes geographic mean data on suspended particulates (in micrograms per cubic meter) for the three month period of January to March, 1972 and 1973. Similar data on other pollutants are not available. Data in Table GG-1 indicates the relative pollutant concentrations at 25 locations. Location 11 provides a general indication of the level of pollution for the Northwest area of the City. This location ranks 14th in order of pollution concentration in 1972 and 16th in 1973. Thus, it could be concluded that the extent of pollution in this section of Houston is below the city average. The pollution concentration in 1972 ranged from 146mg/mt^3 for location 21 (Pasadena area, Houston Ship Channel) to 53mg/mt^3 for location 8 in the vicinity of the Houston Astrodome, with location 11 recorded at 66mg/mt^3. In 1973, the Northwest location ranked 16th with a concentration level of 59mg/mt^3 in a distribution curve that ranged from 274 for location 18 (again Ship Channel area) to 40 for location 23.

The City Air Pollution Control Program in cooperation with the University of Texas Health Science Center in Houston has prepared some computer maps showing the concentration of pollutants of suspended particulates, Sulphur Dioxides and Nitrogen Oxides and their geographic distribution. Figures GG-2 and GG-3 show the heaviest concentration of industrial

TABLE GG-1

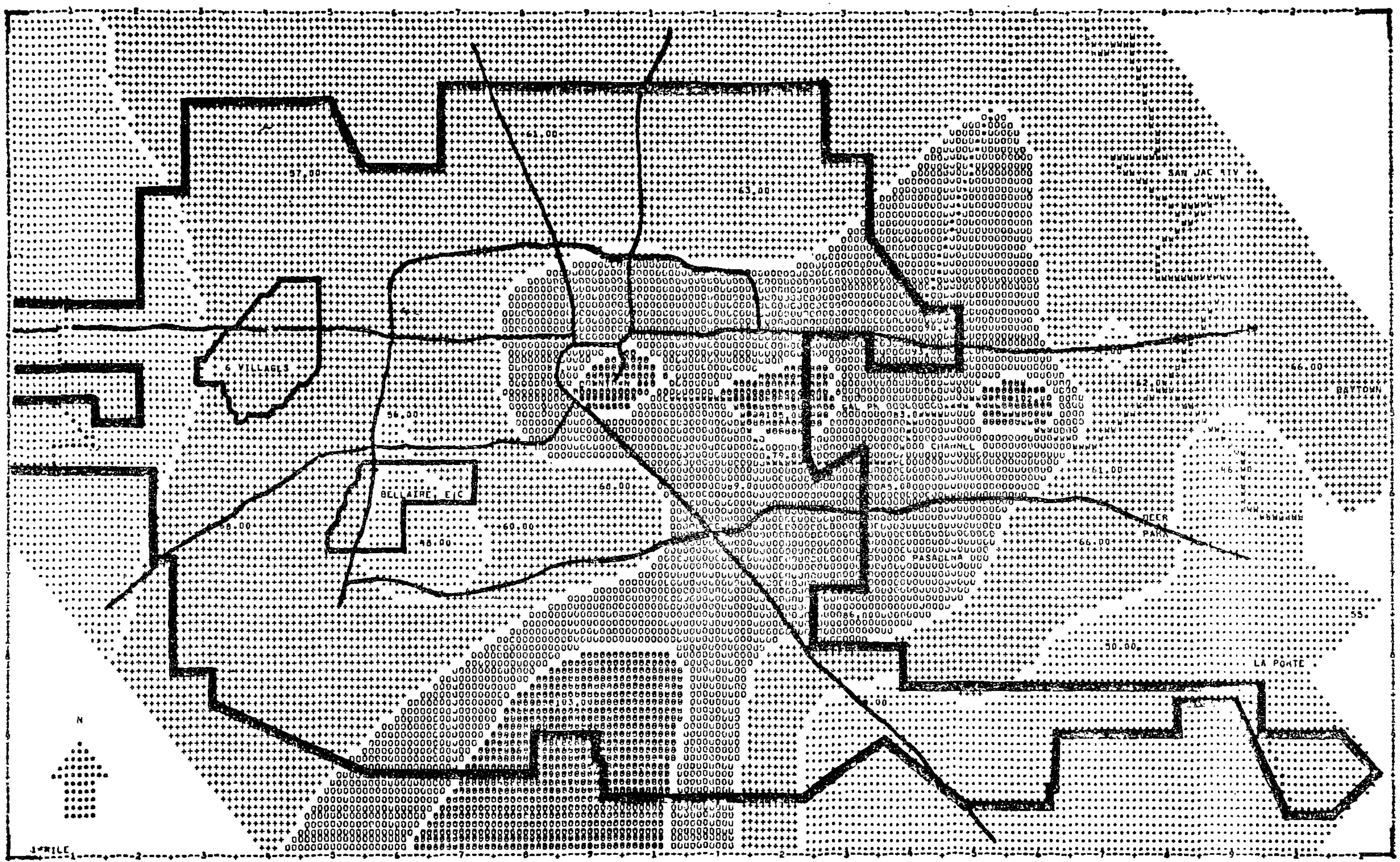
SUSPENDED PARTICULATE COMPARISONS

Geometric means [$\mu g/m^3$]: January through March

Site Location		1972	1973	% Change
Deer Park	1	66	74	+12.1
Pasadena	2	115	99	-13.9
Houston	2	91	102	+12.1
	3	76	97	+27.6
	4	59	47	-20.3
	5	69	68	- 1.4
	6	67	71	+ 5.9
	7	79	60	-24.1
	8	53	46	-13.2
	9	77	63	-18.2
	10	59	54	- 8.5
	11	66	59	-10.6
	12	62	57	- 8.1
	13	64	62	- 3.1
	14	87	93	+ 6.9
	15	80	78	- 2.5
	16	98	72	-26.5
	17	86	63	-26.7
	18	--	274	-
	19	99	123	+24.2
	20	64	55	-14.1
	21	146	79	-45.9
	22	57	66	+15.8
	23	54	40	-25.9

pollutants over the Ship Channel Industrial District, downtown Houston and other industrial areas. Figure GG-4 shows the heaviest concentration of Nitrogen Oxides in the downtown area. The Ship Channel area is high also, but so is much of the City. This concentration and distribution pattern is largely caused by the automobile.

FIGURE GG-2: SUSPENDED PARTICULATE MATTER ANNUAL GEOMETRIC MEAN



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       14   I..1..I     I++2++I
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TIME =     0.0

SUSPENDED PARTICULATES, UG/M3 - 1973:G.M.
HOUSTON AMBIENT AIR SAMPLING NETWORK DATA
BACKGROUND DATA SUPPLIED BY TEXAS NETWORK

                                   THIS TREND-SURFACE MAP WAS PREPARED AT THE UNIVERSITY OF TEXAS
                                   HEALTH SCIENCE CENTER IN HOUSTON, TEXAS AS A COOPERATIVE EFFORT
                                   WITH OTHER PUBLIC AGENCIES

DATA VALUE EXTREMES ARE          38.00       105.00

ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL
       (*MAXIMUM* INCLUDED IN HIGHEST LEVEL ONLY)

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PERCENTAGE OF TOTAL ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL

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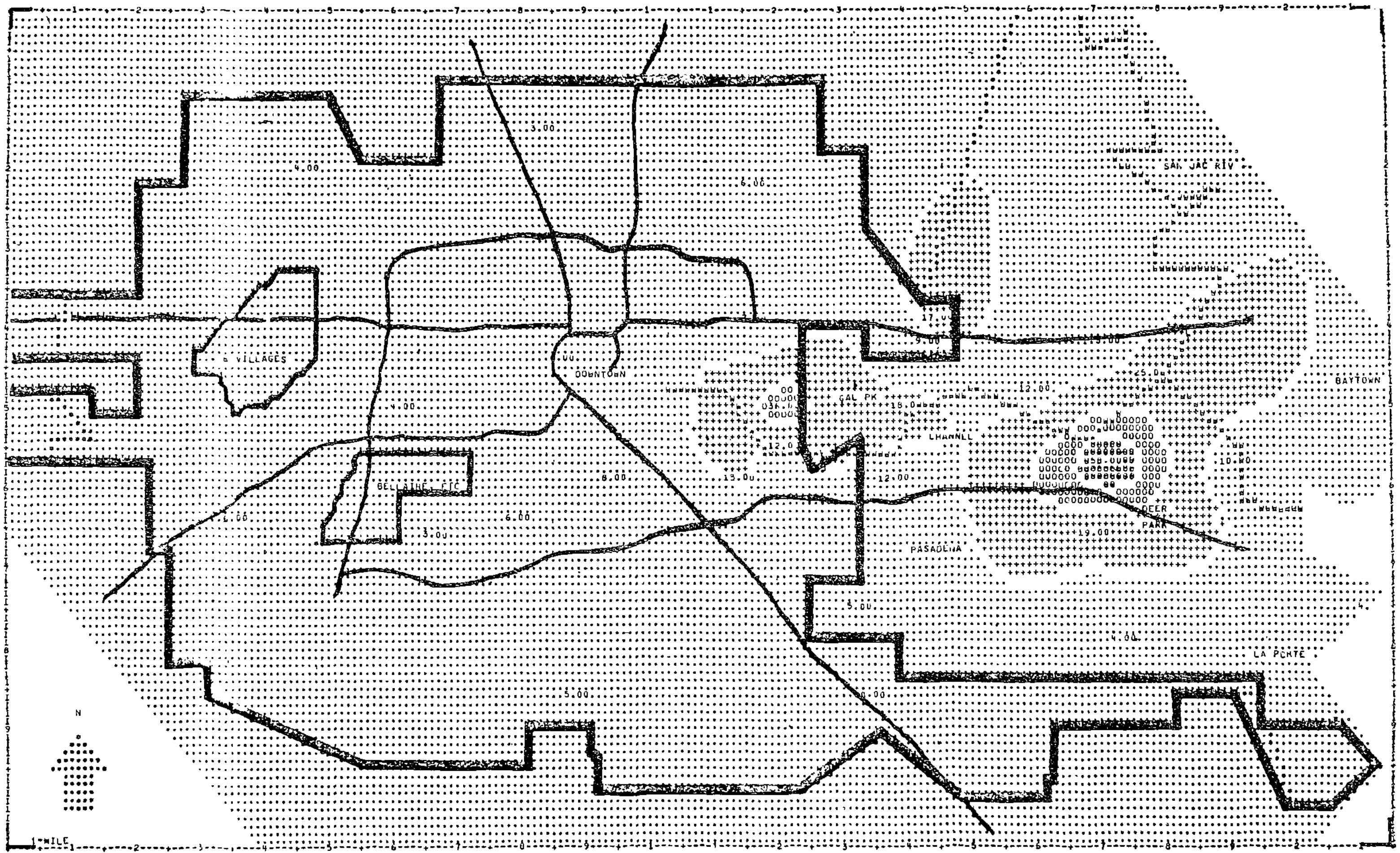
FIGURE GG-3: SULFUR DIOXIDE ANNUAL ARITHMETIC MEAN



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TIME =    0.0

SULFUR DIOXIDE, UG/M3 - 1973,A.M.
HOUSTON AMBIENT AIR SAMPLING NETWORK DATA
BACKGROUND DATA SUPPLIED BY TEXAS NETWORK

                                          THIS TREND-SURFACE MAP WAS PREPARED AT THE UNIVERSITY OF TEXAS
                                          HEALTH SCIENCE CENTER IN HOUSTON, TEXAS AS A COOPERATIVE EFFOR
                                          WITH OTHER PUBLIC AGENCIES

DATA VALUE EXTREMES ARE         3.00       58.00


ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL
        (*MAXIMUM* INCLUDED IN HIGHEST LEVEL ONLY)

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  MAXIMUM      15.00      30.00      45.00      60.00      75.00

PERCENTAGE OF TOTAL ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL

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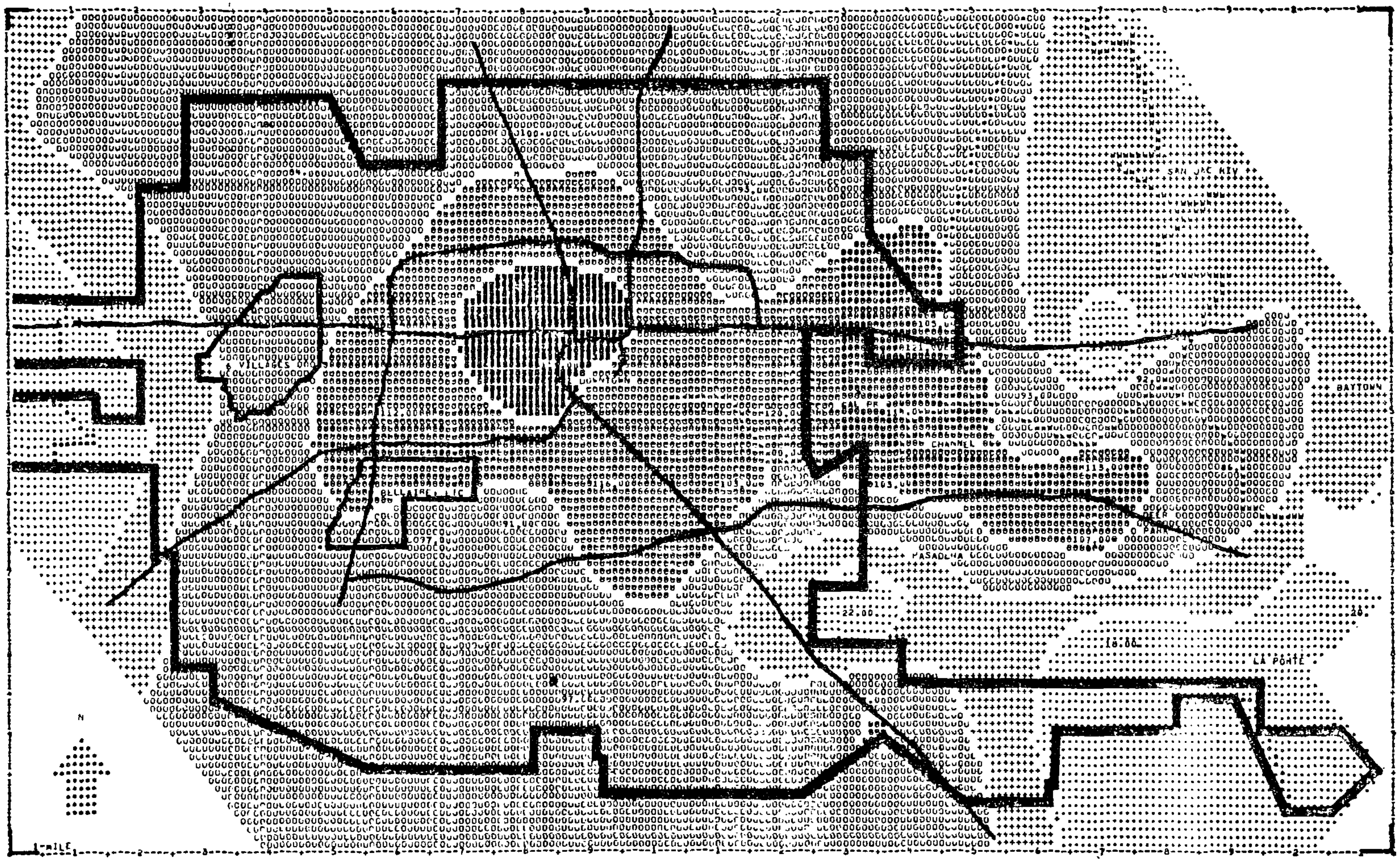
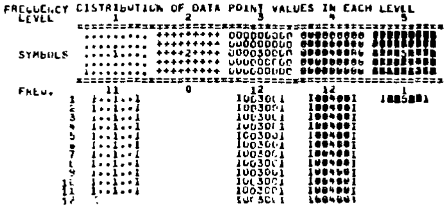
FIGURE GG-4: NITROGEN DIOXIDE ANNUAL ARITHMETIC MEAN





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NITROGEN OXIDES, 06/73 - 1973.A.M.
HOUSTON AMBIENT AIR SAMPLING NETWORK DATA
BACKGROUND DATA SUPPLIED BY TEXAS NETWORK

DATA VALUE EXTREMES ARE        16.00      159.00

ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL
      (MAXIMUM INCLUDED IN HIGHEST LEVEL ONLY)

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  MAXIMUM      44.00     73.00    102.00     131.00    160.00

PERCENTAGE OF TOTAL ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL
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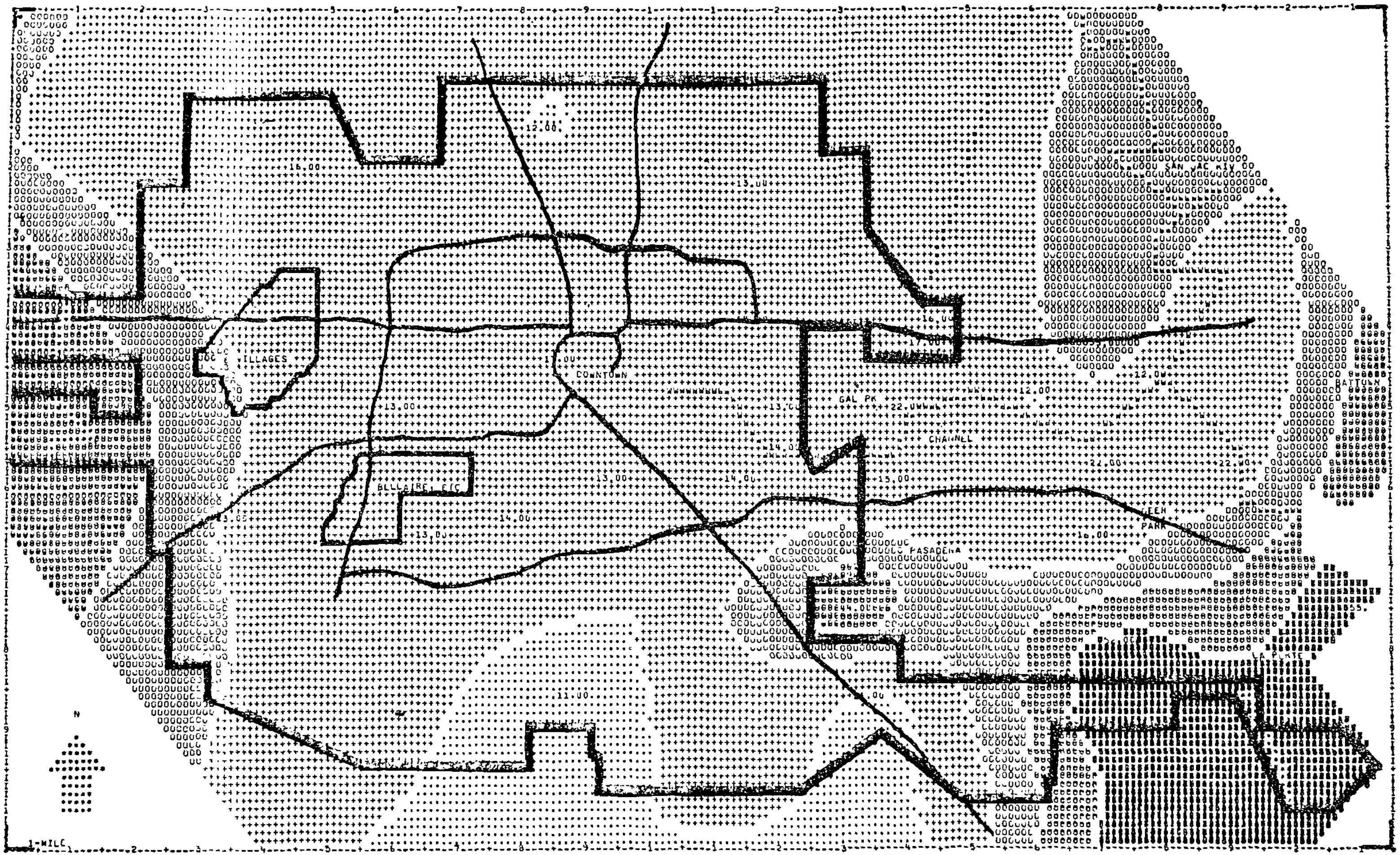
THIS TREND-SURFACE MAP WAS PREPARED AT THE UNIVERSITY OF TEXAS HEALTH SCIENCE CENTER IN HOUSTON, TEXAS AS A COOPERATIVE EFFORT WITH OTHER PUBLIC AGENCIES

FIGURE GG-5: TOTAL OXIDANTS ANNUAL ARITHMETIC MEAN



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TOTAL OXIDANT, UG/M3 - 1973,A.M.
HOUSTON AMBIENT AIR SAMPLING NETWORK DATA
BACKGROUND DATA SUPPLIED BY TEXAS NETWORK

                                                 THIS TREND-SURFACE MAP WAS PREPARED AT THE UNIVERSITY OF TEXAS
                                                 HEALTH SCIENCE CENTER IN HOUSTON, TEXAS AS A COOPERATIVE EFFORT
                                                 WITH OTHER PUBLIC AGENCIES

DATA VALUE EXTREMES ARE          11.00       58.00


ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL
     (*MAXIMUM* INCLUDED IN HIGHEST LEVEL ONLY)

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  MAXIMUM      12.00       24.00       36.00       48.00       60.00

PERCENTAGE OF TOTAL ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL

               20.00       20.00       20.00       20.00       20.00
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A comparison of these print-outs reveal the relative superior condition of Northwest's air quality compared to the rest of the city and other parts of Houston. In terms of both Suspended Particulates and Sulphur Dioxides, the Northwest area has relatively cleaner air but in terms of Nitrogen Dioxides, the problem is pronounced for most of Houston. Yet, the Northwest area falls within the lower concentration zone. Corresponding data on Carbon Monoxides are not available.

2. Comparison of Houston's Air Quality Against National and State Ambient Air Quality Standards

The Ambient Air Network established and monitored by the City of Houston Air Control Program of the Public Health Department measures pollutant concentrations at 25 random sampling sites and two continuous monitoring sites in the Houston area. The particulate data collected annually from 1969 through 1973 have been summarized in the following table. The table gives the percentage taken that exceeded the different 24 hour and annual standards established by the Environmental Protection Agency and the Texas Air Control Board. Comparable data for other pollutants (Carbon Monoxide, Sulphur Dioxides, Nitrogen Oxides) are not available.

TABLE GG-2

COMPARISON OF HOUSTON'S POLLUTANT CONCENTRATION WITH NATIONAL AND STATE STANDARDS

Federal and State Standards on Pollutant Concentrations for Particulate Matters	Percentages by Which Houston Exceeded National & State Standards on Particulate Matters				
	1969	1970	1971	1972	1973
TACB Standard 150 ug/m^3 24 hr/avg	10.2%	4.6%	4.8%	3.8%	7.7%
EPA Standard 260 ug/m^3 24 hr/avg	1.1%	0.2%	0.3%	0.0%	2.7%
TACB Standard 55 ug/m^3 Annual Geometric Mean	94.1%	70.6%	84.4%	88.0%	88.0%
EPA Standard 75 ug/m^3 Annual Geometric Mean	47.0%	29.4%	41.2%	35.2%	48.0%

SOURCE: City of Houston Department of Public Health, Air Control Program Division, Annual Report, 1973, p.20.

As Table GG-2 shows, Houston has consistently been in violation of both the Texas Air Control Board and Environmental Protection Agency standards for Particulate Matters in both the 24 hours average and Annual Geometric Mean. That the State standards are far more strict than Federal standards is evident from the above table. On 24 hour standards, Houston comes close to meeting the EPA standards but falls short by 5-10% to meet state standards. The situation is highly critical on the annual geometric mean standards since Houston is well over the allowable levels of concentration permitted by federal and state ambient air standards.

On the positive side, Houston's Air Pollution Control Program has been able to reduce the levels of pollution by controlling and limiting industrial polluters as shown by generally declining annual concentrations, but it has not been able to bring the City within State and Federal standards. This declining pollution concentration trend is also evident from data presented in Table GG-1. Most sampling locations experienced a reduction during the first quarter from 1972 to 1973. This is to say that the current programs are beginning to have some beneficial impact on pollutant concentrations of Particulate Matters. But the program needs to be expanded further to include control measures on other particulates, particularly Carbon Monoxides, the major source of which is the automobile.

3. The Current Program of the City in Combatting Air Pollution Problems for Houston

The people of Houston and their City Government are keenly aware of the pollution problems facing the nation's sixth largest city. Though the City has a long way ahead of it in cleaning its air and maintaining it that way, nonetheless, it has made a good beginning. The continuation of current trends of program expansion may enable the City in bringing the pollutant concentrations to allowable limits within the next 10 to 15 year period.

a) Program History:

The City of Houston Air Pollution Control Program has developed quite rapidly since its creation in 1967. Established with a goal to clean Houston's air of noxious and annoying pollutants, the growth of the control program has been significant. With an initial staff of less than twenty individuals with technical equipment for air monitoring and pollutant measurement. The following outline reviews the growth which the program realized during the past seven years.

1967 - 1968

(i) The Air Pollution Control Program was established as a section within the City of Houston Health Department.

(ii) Seventeen ambient air monitoring stations were established to monitor for both gaseous and particulate pollutants.

(iii) A survey of vegetation throughout Houston was conducted to determine if any air pollution damage could be verified. The survey indicated no visible damage to vegetation.

(iv) Several public meetings were held to convey to members of industry the information concerning the laws on air pollution.

(v) Much of the program's first year's activities involved the purchasing of necessary equipment and the survey of industrial polluters.

1969

(i) The agency began conducting three hour ambient air sampling to supplement the 24 hour sampling routine. The three hour samples provided a better understanding of pollution concentrations.

(ii) A comprehensive program to develop an emission inventory was undertaken by the program in cooperation with the Texas Air Control Board.

(iii) A second shift was initiated to provide complaint investigation and surveillance between 5 p.m. and midnight.

(iv) During 1969 forty-one positions were budgeted for personnel.

(v) A civil suit filed by the City of Houston against an industrial polluter resulted in a $17,000 fine and an injunction to prevent future violations of the air pollution laws.

1970

(i) A program titled "Survey of the Composition of Particulates in Air Samples from the City of Houston" was performed with the cooperation of the University of Texas School of Public Health. The work constituted a significant part in obtaining a more reliable picture of ambient air quality over the city.

(ii) A stack sampling team was organized and underwent training to familiarize themselves with procedural methods.

(iii) With an increase in available personnel, the enforcement section developed air sampling teams and assigned them to three air quality districts within the city.

(iv) The City of Houston filed five civil suits to enjoin industrial polluters from emitting contaminants in violation of the Regulations.

(v) During 1970 fortey-eight positions were budgeted for personnel.

1971

(i) An incinerator survey program was initiated to determine the impact on air pollution caused by incinerating waste at small business establishments. The survey established the number, type and location of the majority of incinerators within the city. This survey served as the basis for an ordinance which requires a permit to operate an incinerator within the City of Houston.

(ii) The Houston City Council adopted the incinerator ordinance in December 1971 thereby establishing the incinerator permit program.

(iii) The program expanded its manpower and established a permanent night shift to enable 24 hour coverage for air pollution investigation. Standby personnel were on call for weekend duty.

(iv) The Stack Sampling team established in 1970 became operational in 1971 and initiated sampling of emissions directly from the source.

(v) A stack sampling van was purchased to aid in the efficiency of the stack sampling team.

(vi) Two continuous monitoring trailers were assembled by staff members. The units became operational and began sampling for Carbon Monoxide, Nitrogen Oxides, Sulfur Dioxide and Total Oxidants on a continuous basis.

(vii) The Houston Polic Department joined the surveillance activities of the pollution program by reporting emissions sighted by the patrol helicopters.

(viii) The City of Houston filed nine civil suits to prohibit air pollution emission from industries in the city.

(ix) The monitoring technique for determining ambient levels of Sulfur Dioxide was improved by switching from the standard lead peroxide candles to Huey Sulfation plates.

(x) During 1971 fifty positions were budgeted for personnel.

1972

(i) The program began issuing suspended particulate forecasts in February 1972. The predictions currently reach about a million people daily since they are used by television and the Houston Post.

(ii) A program to analyze for heavy metals in the ambient air was established. Utilization of an atomic absorption unit to test the ambient air sampled and determine the background level of the following metals in the ambient air: Antimony, Arsenic, Beryllium, Cadmium, Chromium, Copper, Iron, Lead, Manganese, Nickel, Vanadium, Mercury, and Zinc.

(iii) The Emergency Employment Act allowed the program to place ten additional employees and thereby establish a rotating shift. Complete 7 day 24 hour coverage was established and replaced the standby weekend duty.

(iv) Expansion of program personnel permitted establishment of four separate sections for Enforcement, Engineering, Technical Services and Meteorology.

(v) The authority of the program was expanded to include the Ship Channel Industrial District. Through a city entered contract the program personnel were permitted to enter property for investigation and sampling of the industries located in this area.

(vi) The enforcement staff was expanded and the city divided into four sampling districts to permit coverage in the Houston Ship Channel District.

(vii) The ambient air monitoring sites were expanded from 17 to 25. Eight samplers were placed within the Houston Ship Channel Industrial District.

(viii) The Incinerator Permit Program began issuing operating permits in February 1972.

(ix) The Incinerator Program substantially reduced the number of polluting incinerators in Houston during 1972. Forty-six percent of the incinerators were taken out of service, thirtenn percent were permitted and the remainder were awaiting modification.

(x) The Program began issuing citations for incinerator violations. The violations were set for hearings in Municipal Courts.

(xi) Meetings were intiated with the City Planning Department to permit an exchange of information and assist in future city planning.

(xii) The Engineering Section began reviewing applications for Texas Air Control Board Construction Permits.

(xiii) A program to determine odor problems was established under contract to Copley International Corporation. The program conducted sixteen public attitude surveys and conducted training for odor evaluation.

(xiv) Scentometers, a device for determining concentrations of odor, were tested by the program and incorporated as one of the sampling techniques.

(xv) City Council amended the Houston fire prevention ordinance to authorize the air pollution control personnel to issue citations for outdoor burning.

(xvi) The City of Houston filed two civil cases to prohibit air pollution from industry in the area.

(xvii) In November 1972 the program began submitting air pollution violations to the District Attorney's Office for filing in Criminal District Court. Three criminal cases were filed during 1972.

(xviii) A total of 34 cases were filed in Civil, Criminal, and Municipal Courts.

(xix) During 1972 fifty positions were budgeted for personnel and an additional ten personnel were added through the Emergency Employment funds.

1973

(i) Preliminary work has been done on an ozone forecast for use in the summers when the ozone problem can be substantial. Part of the results of this work was used to show that industrial sources were the primary cause of the ozone problem and that radical transportation controls would be of small value in reducing ozone levels.

(ii) A hydrocarbon study was conducted in conjunction with the University of Houston to determine the background levels of hydrocarbon in the ambient air of Houston.

(iii) Field enforcement personnel began routine gaseous and metal sampling of industrial sources.

(iv) The program began publishing monthly reports of current air pollution data to supplement the annual report.

(v) A system seven computer was installed as part of the telemetry system for the continuous monitoring network.

(vi) A trial run of the telemetry system was successfully conducted with equipment supplied by contract companies. The program equipment was on order and being assembled as of March, 1974.

(vii) The Technical Services Section increased its monitoring personnel to four individuals in order to adequately service the continuous monitoring sites.

(viii) The Enforcement Section expanded its staff to include four individuals in each of the four sampling districts.

(ix) City Council approved the expansion of the engineering staff with one public health engineer and three engineering assistants. Seven investigator positions and two technician I positions have also been provided.

(x) Fifteen criminal cases were filed through the District Attorney's Office for air pollution violations.

(xi) Nine civil cases were completed with fines and permanent injunctions imposed.

(xii) A total of 108 cases were filed against air polluters in Civil, Criminal, and Municipal Courts.

(xiii) During 1973, 56 positions were budgeted for personnel and another ten additional positions were added to the program through the Emergency Employment Funds.

(xiv) A total of 633 incinerator operating permits have been issued and 750 incinerators have been removed from service.

b) Program Summary:

The chronological accounts of the various activities by the City of Houston presented in the preceding section explain the current level of involvement by the City in addressing the pollution problems. In summary it can only be said that the program has made a significant stride in reducing concentration of Particulate pollutants. Supplementary programs are needed to combat other pollutant concentrations. The automobile continues to remain the major source of Houston's air pollution problem. The various federal regulations controlling transportation activities under the State Implementation Plans for Transportation Control as well as through the Indirect Source Control will have some effect in the future. But these programs are primarily curative. What is needed is a Comprehensive Prevention Program. The City's current program should be expanded to incorporate federal regulations on local transportation control and more importantly, the City with the aid of the federal government (through the recently passed Mass Transit Bill) should make a shift in the basic pattern of its transportation system. An aggressive mass transit program is long over-due for Houston.

Table GG-2 shows that the progress made by the city in air control during 1973 is praiseworthy. Yet, much remains to be done. A major policy shift is needed and a greater priority place in the Air Pollution Control Program. Public funds are not unlimited in supply. Their wise allocation to various programs and projects according to a rational order of priority is essential. Air pollution as a program should received a high priority from the city government. The City has recognized the need for it but commensurate level of priority has not yet been given this program.

TABLE GG-3

HOUSTON AIR POLLUTION CONTROL PROGRAM ACTIVITIES

Activities	Total 1973
Hours on Air Pollution	85566
Conferences Attended	702
Instruments Calibrated	4207
Ambient Lab Samples	9403
Plans Reviewed	108
Inspections	1147
Advisory Visits	2591
Complaints Serviced	3120
Odor Evaluations	84
Visible Emission Evaluations	109
High Volume Samples	276
Gaseous Samples	34
Other Samples	216
Notices Issued	989
Violating Companies	632
Corrections Made	431
Cases Filed	108*
Cases Won	89*
Cases Lost or Dismissed	20

* The difference in case numbers results from a carry-over of cases filed in previous year.

TEXT REFERENCE:

CHAPTER III: SOCIAL AND ENVIRONMENTAL SETTING (MAN-MADE ENVIRONMENT)

APPENDIX H: HISTORICAL, ARCHAEOLOGICAL AND CULTURAL ELEMENTS

SOURCE:

THE TEXAS HIGHWAY DEPARTMENT
VOLUME II, HOUSTON-HARRIS COUNTY TRANSPORTATION PLAN
1967

HISTORICAL SITES:

In the 1820's, the settlement named Harrisburg sprang up on the banks of Buffalo Bayou at the confluence of Brays Bayou. In 1836, during the Texas rebellion with Mexico, Harrisburg was destroyed by fire. On April 21, 1836, General Sam Houston's small army captured the dictator Santa Anna and destroyed his army. Within months, the Allen brothers (real estate promoters) bought a 6,642-acre townsite for $1.42 per acre. The townsite was located on the banks of Buffalo Bayou at the confluence of White Oak Bayou; the town was given the name, Houston, after the founder of the Republic of Texas.

There remain today two outstanding historical sites near Houston: (1) San Jacinto Park Monument Museum located at the spot where Santa Anna was defeated which is fifteen miles east of the center of Houston and on Buffalo Bayou at the confluence of the San Jacinto River. This site includes a large State park, 570-foot concrete monument and a museum of Mexican-American relics. (2) Sam Houston Park located at the western fringe of the business core of the city and containing several century-old wood frame houses with antique furnishings.

The recent construction of Allen's Landing Memorial Park, located at the foot of Main Street and Buffalo Bayou, is intended to create a fitting memorial to the founders of Houston and to serve as a catalyst for the redevelopment of the city's original business area.

CULTURAL ELEMENTS:

Education. There are 14 institutions of higher learning within Harris County: (1) University of Houston--a State school, the largest in Houston, and second largest in the State, (2) Rice University--a privately endowed school of extra high standards, (3) Texas Southern University--a State school catering mainly to Black students, (4) South Texas College--a junior college and law school, (5) Baylor University of Medicine--a Baptist supported college, (6) University of Texas Dental Branch--a State school, (7) University of Texas Graduate School of Bio-Medical Science--a State school, (8) Texas Women's University College of Nursing, (9) Saint Thomas Academy--Catholic supported college, (10) Sacred Heart Dominican College--a Catholic school, (11) Saint Mary's Seminary--a Catholic school, (12) San Jacinto Junior College--a State supported technological school located southeast of Pasadena, (13) Lee Junior College--a State supported technological school in Baytown, and (14) Houston Baptist College--a new college located in southwest Houston. Numbers (5), (6), (7) and (8) are located in the world famed Texas Medical Center, a 150-acre medical park, which contains fifteen hospitals with a major Veteran's Administration Hospital nearby. There are 403 public schools and over 1,200 churches of various denominations in Harris County.

Libraries. A vital element in Houston's educational and cultural life is the Houston Public Library--an institution dedicated not just to the enjoyment of reading but specifically to the dissemination of information. The city also maintains bookmobiles and branch installations scattered throughout the city in locations convenient to all parts of Houston. There is also a County library system which operates to serve smaller towns throughout the County. Also, most public schools have libraries of varying size, and the universities and colleges have excellent collections.

Museums. There are several public museums: (1) The Museum of Fine Arts which is actually an art gallery of paintings and sculpture, (2) The Museum of Natural Science and Planetarium located in Hermann Park near the zoo, (3) The San Jacinto Monument Museum, which is housed in the enlarged base of the Monument and contains hundreds of relics of the Spanish and Mexican ownership of Texas, (4) Contemporary Arts Museum, and (5) Bayou Bend Museum. There are also many other privately owned galleries with extensive collections of artistic value. The National Aeronautics and Space Administration installation in southeast Harris County maintains a current exhibit of space hardware and relics of their explorations into space.

Public Arena. The Jesse H. Jones Hall for the Performing Arts is a structure of elegant architectural design which seats 3,000 persons in luxurious seats for such performances as symphony, ballet, and grand opera. The Music Hall is an auditorium of 3,044 seats used for a large variety of public entertainment. The Sam Houston Coliseum is an arena of 13,000 seats used for a great variety of entertaining shows. The Harris County Domed Stadium or Astrodome is the world's only enclosed, air conditioned stadium for sports events and conventions. The multi-purpose facility seats 46,000 for baseball, 53,000 for football, and 66,000 for boxing and conventions. Other events held at the Astrodome include soccer, rodeos, polo matches, bloodless bullfights, automobile destruction derbys, circuses, musical performances, and spiritual revivals. Rice Stadium (the Bluebonnet Bowl) has 73,000 seats. This outdoor stadium was built in the year 1950 and received awards for its outstanding beauty and utility of design.

Theatre. There are four "legitimate theatres" and four "little theatres" in the area. The former are the Alley Theatre, which is known nationwide and received a Ford grant to build a new building in the core of the city, Houston Theatre Center, Theatre Incorporated, and the Houston Music Theatre, which is housed in a domed structure of 288-foot diameter with 2,865 luxury seats. The little theatres are: Country Playhouse Incorporated, Pasadena Little Theatre, Theatre Suburbia Incorporated, and Southwest Theatre Guild.

Music Groups. The Houston Symphony Orchestra founded in 1913 has a total of 111 performances annually. This group has an annual budget of $900,000 and received a Ford grant of $2,500,000. The Symphony has been listed in an April 8, 1966, Time Magazine story as being among the "Elite Eleven" in the United States. The Houston Grand Opera Association performs five operas per season, and has an annual budget of over $300,000.

RECREATIONAL FACILITIES:

Recreational facilities in the Houston area consist of parks, swimming pools, golf courses, botanical gardens, horse trails, boating, camping, fishing, and bird-watching areas.

Harris County has 60 miles of salt water shoreline including the Houston Ship Channel and the lower reaches of the San Jacinto River. Nearby Galveston Bay and the Gulf of Mexico have 260 miles of salt water shoreline within seventy miles of the City of Houston. The northern part of Harris County together with nearby counties has 600 miles of planned fresh water shoreline within a distance of one hundred miles from the center of Houston.

TEXT REFERENCE:

CHAPTER IV: ALTERNATIVES TO THE PROPOSED ACTION (NON-STRUCTURAL ALTERNATIVES)

APPENDIX I: EVALUATION OF ALTERNATIVE LOCATIONS FOR A REGIONAL WASTEWATER TREATMENT PLANT SERVING COMMUNITIES IN NORTHWEST HOUSTON

LOCATION ALTERNATIVES

The purpose of optimizing location for a sewage treatment plant is manyfold. An optimum location will be that which will minimize cost of collection, treatment and disposal, and at the same time, cause minimum disruption of the environment in the immediate vicinity of the plant, its service area and the city as a whole. In addition, a treatment plant should be located in such a manner that the on-sit sludge handling and disposal costs will be minimum, or if the sludge is to be transported to another location, then the sludge conveyance costs will be minimum.

All three alternative locations were analyzed and evaluated under the constant assumption that the treatment process and disposal methods will remain the same at each of these alternative locations as proposed for the Northwest Plant Regional Sewage Treatment site. The following table (Table I-1) indicates the evaluation methods and the subsequent results.

The location analysis presented in Table I-1 clearly reveals that the proposed location at the Northwest Regional Wastewater Treatment Plant is the best location among the three alternatives considered. The evaluation is based on a total of 12 location factors, encompassing the objective of regionalization of the citywide treatment system to the aesthetic consideration for plant construction.

Column 17 of the evaluation table indicates that the least optimum location is the site of the now abandoned West Forest Treatment Plant. This means that a new treatment plant of 12 mgd cannot be located here to serve the service area.

An aggregate of all factors indicates that Northwest is the optimum location. The 12 mgd facility therefore can best meet the sewer needs of the project area if it is located at the existing Northwest Plant site which is proposed in this study.

TABLE I-1

EVALUATION OF ALTERNATIVE PLANT LOCATIONS AND SELECTION OF OPTIMUM LOCATION

Alternative Locations	Regionalization of city-wide system	Centrality of location with respect to total service area	Collection of sludge with respect to service area	Transporting sludge to Northside Plant	City-owned land	Land Availability		
						Available land	Land costs	Suitability of lands
ONE: New plant of 12 mgd at West Forest site	++	+	+	---	+++	-	--	-
TWO: Proposed location	++	-	-	-	+++	+++	+++	+++
THREE: Expand Northwest to 6 mgd, add 6 mgd to new plant at Forest West	--	0	0	--	+++	++	++	++

KEY FOR RATING SYSTEM:[*]

Favorable:
High = +++
Moderate = ++
Low = +

Neither favorable nor unfavorable = 0

Unfavorable:
Low = -
Moderate = --
High = ---

---

[*] Ibid, Page 75

TABLE I-1

(Continued)

Alternative locations	Future possible expansion	Impact on Water Quality			Effect on immediate vicinity; compatibility with land use		Aesthetic considerations	Total Score			Aggregate score (net)	Rank in order of optimality	Remarks
		Cole Creek	White Oak Bayou	Buffalo Bayou	Existing	Proposed		+	0	-			
I	--	+++	+++	++	---	---	+	17	0	15	+ 2	3	Rejected
II	+++	+	+++	++	++	++	++	29	0	3	+26	1	Selected
III	+++	++	+++	++	0	0	+	20	5	4	+16	2	Rejected

TEXT REFERENCE:

CHAPTER IV: ALTERNATIVES TO THE PROPOSED ACTION (STRUCTURAL ALTERNATIVES)

APPENDIX J: TECHNICAL DISCUSSION ON THE DESCRIPTION OF ALTERNATIVES TO THE PROPOSED ACTION

1. TREATMENT PROCESS ALTERNATIVES

The treatment process alternatives have been evaluated principally on the basis of ability to satisfy effluent quality, cost and intra-system compatibility requirements. The state of this art offers a variety of alternatives. These alternatives are discussed below.

a. Septic Tanks

Septic tank treatment for domestic wastewater is impractical and inefficient in the project area. The population density existing in the developed areas and projected for the now undeveloped areas would allow insufficient land for soil absorption. Furthermore, the soils in the project area are primarily clays, and as such, are unsuited for wastewater absorption. Septic tank treatment in the project area would lead to inadequate waste treatment and generation of nuisances and public health hazards.

b. Primary Treatment Only

Primary treatment employes physical operations such as screening and sedimentation to remove floating and settleable solids present in wastewater. Such processes seldom remove more than 35% to 65% of contaminants present in the wastewater. Primary treatment along would not be a viable alternative, since it would not produce an effluent of acceptable quality.

c. Secondary Treatment

Secondary treatment is generally used in conjunction with primary treatment. It employs various biological processes to remove most organic contaminants present in wastewater. The biological unit is followed by a clarification unit, in which solids and biological floc developed in biological unit are separated from the liquid fraction. Such processes usually remove 65% to 95% of contaminants present in wastewater. These removal efficiencies are capable of satisfying effluent quality standards prescribed for the proposed project.

(1) Oxidation Pond

One form of secondary treatment involves the use of oxidation ponds or lagoons. The biological processes in this form of treatment proceed at natural rates. This alternative is not considered viable because of the slowness of the degradation process involved and the large amounts of land area required to provide the desired holding time. Also, this process is associated with odor problems, insect and vector problems, and ground water pollution.

(2) Trickling Filter

Another form of secondary treatment involves the use of sedimentation basins followed by use of one of a series of trickling filters. The trickling filter process concentrates contaminating biological organisms on a fixed media by exposing wastewater to such media. This process has limitations and, generally, produces an effluent of marginal quality. Trickling filter units require large land areas for installation. The trickling filter process is not considered an acceptable alternative for this project.

(3) Activated Sludge

A third form of secondary treatment involves the use of activated-sludge process. In the activated-sludge process, the flocculated biological growths are continuously recirculated and contacted with organic waste in the presence of oxygen. The oxygen is supplied in the form of air bubbles or by mechanical turbulence. The process involves an aeration step followed by a solid-liquid separation step, from which a portion of separated sludge is recycled as microbial seed.

There are a number of activated-sludge variations. These variations differ basically from each other in the manner in which the micro-organisms are put to work and the manner in which the required hardware is assembled. Some of the process variations are: (1) conventional, (2) extended aeration, (3) Kraus process, (4) high rate aeration, (5) completely mixed, (6) contact stabilization, and (7) pure-oxygen systems.

These activated-sludge process variations differ within specific ranges of influent flow as to efficiency and economy. The activated sludge in each form generally produces an effluent of acceptable quality and requires less land area than the other processes.

d. Advanced Treatment

Advanced wastewater treatment is used in conjunction with primary and secondary treatment processes and employs various chemical and physical unit operations and processes to remove nutrients and dissolved salts not removed during primary and secondary treatment. These operations and processes generally produce an effluent of excellent quality. The production of an effluent of such a quality is not required at this time, nor is it economically justifiable. However, the treatment processes and facilities proposed for this project are designed in such a manner that advanced wastewater treatment facilities can be added in the future.

2. DISINFECTION

Disinfection of treated effluent prior to final discharge from treatment facilities is necessary to insure reduction of pathogenic organisms found in domestic wastewater for reasons of public health. Disinfection may be accomplished by ozonation or chlorination with gaseous chlorine or hypochlorite solution. These alternatives are summarized in Table J-1.

3. EFFLUENT DISPOSAL

A number of options for effluent disposal were investigated. A summary is given in Table J-2.

TABLE J-1

EVALUATION AND SELECTION OF EFFLUENT DISPOSAL ALTERNATIVES

Alternatives	Review	Remark
Ocean Outfall	Due to the extremely high costs of long distance piping construction, direct outfall to the ocean is not considered viable.	Rejected
Natural Evaporation	The alternative here is not feasible because the hydrologic cycle in the Houston area produces a negative net evaporation rate during several months of the year. Moreover, pre-evaporation effluent storage area requirements cannot be met economically.	Rejected
Artificial Evaporation	The option of effluent disposal by artificial evaporation processes is not considered desirable due to high capital and operating costs associated with artificial evaporation facilities and prevailing fuel costs.	Rejected
Irrigation	Irrigational use of the treated effluent is not considered practical inasmuch as (1) adequate water supplies are presently available for nearby areas now under cultivation, (2) total acreage under cultivation in the Houston area is declining and (3) distances involved in delivering effluent to cultivated acreages where demand exists are uneconomical.	Rejected
Industrial Reuse	The alternative of re-use of treated effluent is not considered feasible due to the increased costs of treatment necessary to produce water of satisfactory quality compared with the current low cost and abundance associated with existing water supply sources within the Houston area.	Rejected

TABLE J-1 (continued)

Alternatives	Review	Remark
Groundwater Recharge	Groundwater recharge as a method of disposal is not considered feasible due to (1) the high cost of treating the effluent to make it suitable for injection into deep aquifers and (2) the high cost of injection facilities themselves.	Rejected
Diversion to Distant Inland Waters	The alternative of diverting treated effluent to another natural drainage channel is not considered viable due to the great costs involved with long distance pipe construction.	Rejected
Discharge into Adjacent Inland Waters	Treated effluent from the proposed facilities will be of quality sufficient to permit its disposal through discharge into Sims Bayou (natural drainage channel running beside the proposed plant site) while respecting state and federal regulatory constraints. It is the least costly and most practical, environmentally acceptable effluent disposal alternative.	Chosen

TABLE J-2

DISINFECTION ALTERNATIVES EVALUATION AND SELECTION

Alternatives	Description	Remarks
Ozonation	Ozonation involves bubbling gaseous ozone (O_3) through the effluent. Although ozone possesses high disinfective power, it has high cost of generation and associated hardware, and does not maintain a residual concentration.	Rejected
Chlorination	Compared to ozonation, chlorination is relatively inexpensive. It also provides complete disinfection. Associated equipment and hardware are easy to install and operate. Two varieties of chlorination are used in wastewater disinfection.	
	Gaseous chlorine: is toxic and dangerous although it requires lower equipment and operating cost than ozone. In the interest of safety at the plant, gaseous disinfection is considered undesirable.	Rejected
	Hypochlorite solution: is safer to use than gaseous chlorine. Although hypochlorite solution is associated with higher equipment and operating cost, the correspondingly lower chemical cost and safety in its use makes it a desirable chemical for disinfection.	Chosen

TEXT REFERENCE:

CHAPTER V: DESCRIPTION OF THE PROPOSED ACTION

APPENDIX K: TREATMENT PROCESS DESCRIPTION

1. Diffused Air Activated Sludge*

Diffused air activated sludge is the method of wastewater treatment used by the City of Houston since 1916, when the first full-scale activated sludge plant in the nation was completed at the North Side Plant. There are presently 18 activated sludge plants of permanent construction in the City of Houston. Nine smaller package-type activated sludge plants are now operated and maintained by the City of Houston as a result of annexations of smaller communities and water districts.

Figure K-1 shows a flow diagram of a typical activated sludge plant in the City of Houston today. City of Houston policy is to minimize process steps involving exposure of raw wastewater to the atmosphere, thereby minimizing the potential for odor. Therefore, treatment plants not receiving transfer sludge do not have grit removal facilities or primary clarifiers. Raw wastewater received at a plant is pumped directly into the aeration basin, where it is mixed with aerated return sludge. After approximately 4.8 hours aeration (based on average daily flow only), the mixed liquid flows to the final clarifier for solids separation. Return sludge is pumped from the bottom of the clarifier to the reaeration channel where it is aerated for approximately 11 hours (based on return sludge flow only) before being mixed with the raw wastewater. Excess sludge is pumped off-site through a force main. The final clarifier effluent flows to the chlorine contact chamber for

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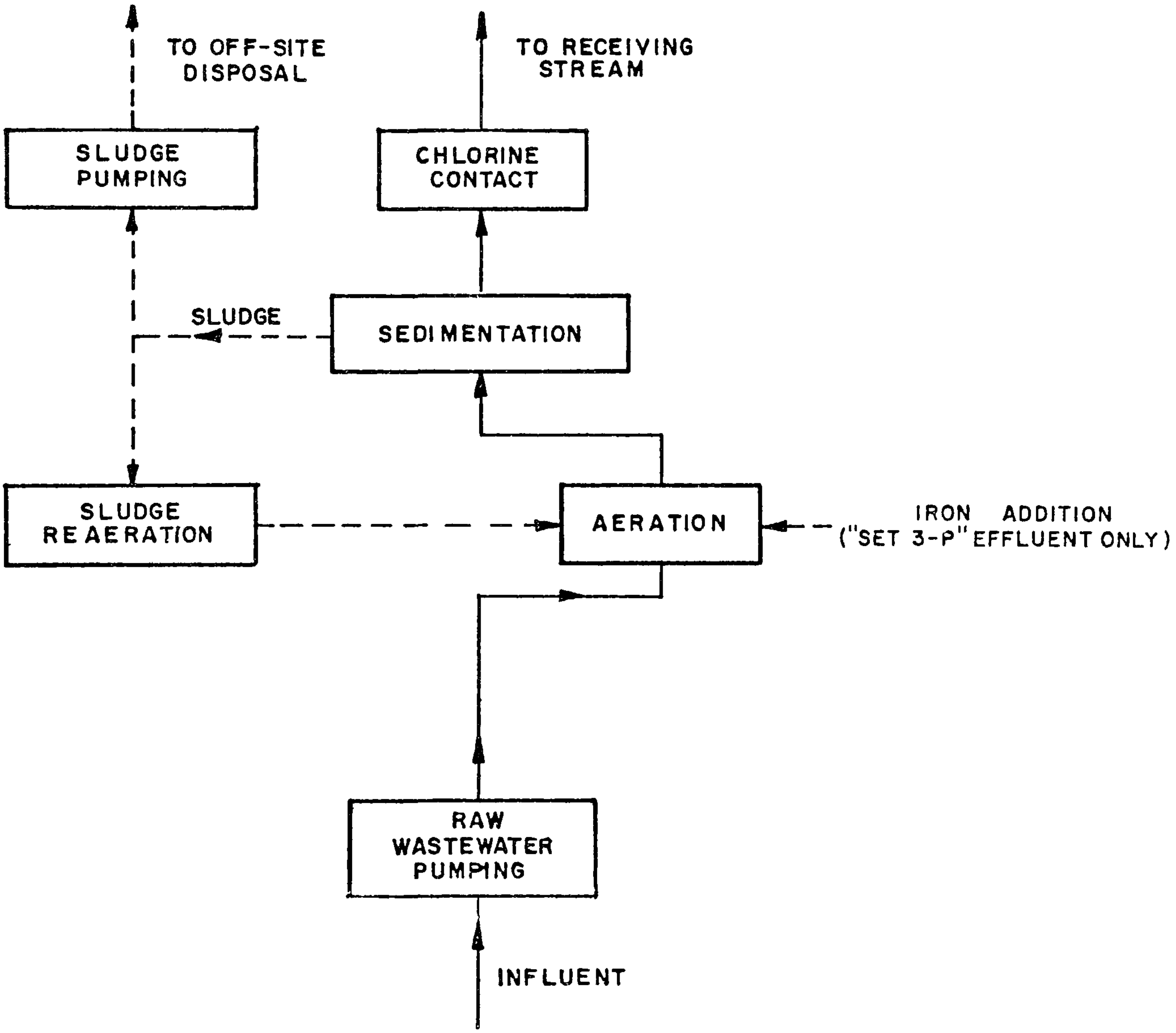
*Information has been extracted from "Analysis of Excess Flows Treatment Costs at Wastewater Treatment Plants Not Receiving Transfer Sludge", City of Houston, Department of Public Works, Job No. 347, 1974. Binkley & Holmes, Inc., Consulting Engineers, Houston, Texas.

FIGURE K-1 ACTIVATED SLUDGE PLANT FLOW DIAGRAM



a minimum detention of 20 minutes after hypochlorite addition, then is discharged to the receiving stream. Table K-1 shows the recommended design criteria for activated sludge plants. These criteria have been developed for the newly established TWQB effluent standards based on City of Houston operating data.

As yet, no plant has been designed and built under the new design criteria for clarifier loading rates. However, there are some plants, due to below-design loading, that are operating in the range of the new design criteria.

3. Contact Stabilization Process

In the contact stabilization process, the decomposition or digestion of organic waste by microorganisms is brought about in two steps, each in different process units. In the first step the microorganisms "eat" or "consume" the food. More rigorously, this corresponds to the diffusion of organic material and nutrients through the microbial cell wall. This step takes place very quickly in a "contact zone". The second step involves metabolic digestion or biochemical breakdown of the material consumed. This process is more complicated, involving a series of biochemical reactions, requires a longer period of time for its completion, and is achieved in a "reaeration tank". A flow diagram of a contact stabilization plant is shown in Figure A-2. Raw wastewater normally enters via a manually cleaned bar screen.

The screened waste flows to the "contact zone" where it is intimately and quickly mixed with a sludge consisting largely of microbial cells obtained from the "reaeration zone". The mixture of sludge (called activated sludge) and raw sewage is retained approximately 30

TABLE K-1

DESIGN CRITERIA FOR DIFFUSED AIR ACTIVATED SLUDGE PLANTS
(Q = Design Average Flow)

Raw Wastewater Pumping	
Firm capacity (with largest unit out of service) equal to maximum hour wet weather flow	
Aeration Basins	
Size/mgd (l x w x d - ft)	100 x 30 15
Volume/mgd (cu.ft.)	45,000
Detention (hr.)*	8
MLSS concentration (mg/l)**	2000
BOD loading (lb. BOD/lb. SS in Aeration)**	0.125
Firm air supply (Cf/lf. BOD)	1500
Ferric chloride dosage - Set 3-P Effluent only (mg/l as Fe)	32
Final Clarifier	
Overflow rate (gpd/sq.ft.)	
Avg. flow (Q) - Set 2 Effluent***	500
Avg. flow (Q) - Set 3-P Effluent	350
Maximum hour wet weather flow	1750
Underflow rate (gpd/sq.ft.)	
Average condition	150
Maximum capability	600
Solids loading @ Q (lb/sq. ft/day)**	7.6
Return sludge SS (mg/l)	8000
Chlorine Contact Basin	
Detention at maximum hour wet weather flow (min.)	20
Air mixing supply (cfm/1000 cu.ft.)	20
Hypochlorite dosage as equiv. Cl_2 (mg/l)	6
Hypochlorite generation capacity (lb/hr/mgd)	
Q _ 10 mgd	36
Q 10 mgd	24

* Total volume of aeration and reaeration based on Q only.

** Applies to Set 2 Effluent only. Addition of ferric chloride for Set 3 Effluent requires higher MLSS concentration, lower BOD loading and higher solids loading.

*** Applies up to 3.5Q, then maximum hour overflow rate governs.

Note: Set 2 Effluent Standard is defined as monthly average of 10 mg/l BOD and 15 mg/l SS.

Set 3-P Effluent Standard is defined as monthly average of 5 mg/l BOD, 10 mg/l SS and 2 mg/l phosphorous.

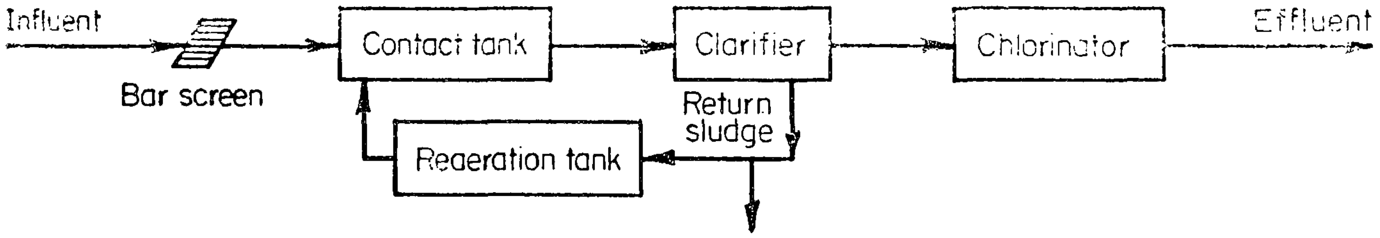
to 90 minutes in the "contact zone" during which period the first of the two above-mentioned processing steps occurs. (This retention time can be varied somewhat by adjusting the discharge rate of the return sludge pumps.)

Wastewater flows from the "contact zone" to the clarification compartment where the sludge or solids settle. A sludge collector then moves the sludge to a hopper, from which it is withdrawn and returned to the "reaeration zone". Here, the second of the two basic steps mentioned above occurs as organic material absorbed by the activated sludge in the "contact zone" is digested and assimilated for energy and production of new cells. At the outlet end of the compartment the reaeration activated sludge is ready to be mixed with a fresh load of raw sewage in the "contact zone". The reaeration period varies from 3 to 6 hours.

A portion of the activated sludge from the clarifier is wasted prior to recycle, to maintain a constant solid in the reaeration tank.

FIGURE K-2

FLOW DIAGRAM OF CONTACT STABILIZATION PLANT



Design criteria for contact stabilization plant is given in Table 1.-2.

TABLE K-2

DESIGN CRITERIA FOR CONTACT STABILIZATION PLANT

Contact-Stabilization (Reaeration): Basic Design Criteria:	
	Aeration: Detention Time:* 1 hour Air Aupply: 350 ft^3 min./lb raw BOD
	Sedimentation: Detention Time:* 2 hours Surface Loading:* 800 gpd/sf
	Reaeration: Detention Time:** 4 hours Air Supply: 750 ft^3/lb raw BOD applied
	Digestion: Detention Time: 15 days Volume (Aerobic): 1.5 ft^3/capita Air Supply: 20 ft^3 min/1,000 ft^3 volume

* Based on average daily design flow, Q, plus 50% return of 1.5 Q.

** Based on return flow of 0.5Q.

Blowers and compressors shall be capable of delivering the maximum air requirements considering the largest unit out of service.

Pumps and piping for return sludge shall be of such capacity as is capable of returning 100 per cent of the sludge and/or 50 per cent of the average design forward flow.

3. Plant Efficiency Calculation

The total suspended solids and BOD_5 removal calculations are given in this section.

a. Total Suspended Solids (TSS)

To illustrate the expected effluent quality criteria from plants designed under the new criteria, 1973 operating data have been compiled on several plants in Houston. Figure K-3 shows effluent suspended solids variation with varying clarifier overflow rates. For design overflow rate of 360 gpd/ft^2, the effluent TSS obtained from this Figure is approximately 6 mg/1. It is believed that under normal operational conditions, the suspended solids will remain below 15 mg/1 TSS criteria.

b. BOD_5 Removal

The following mathematical equations apply to completely mixed activated sludge systems operating in the declining growth phase. Fundamental microbiological relationships indicate that growth is controlled by the rate of addition of food in the declining growth phase.

$$K = \frac{Fi}{K_m\ t + 1}$$

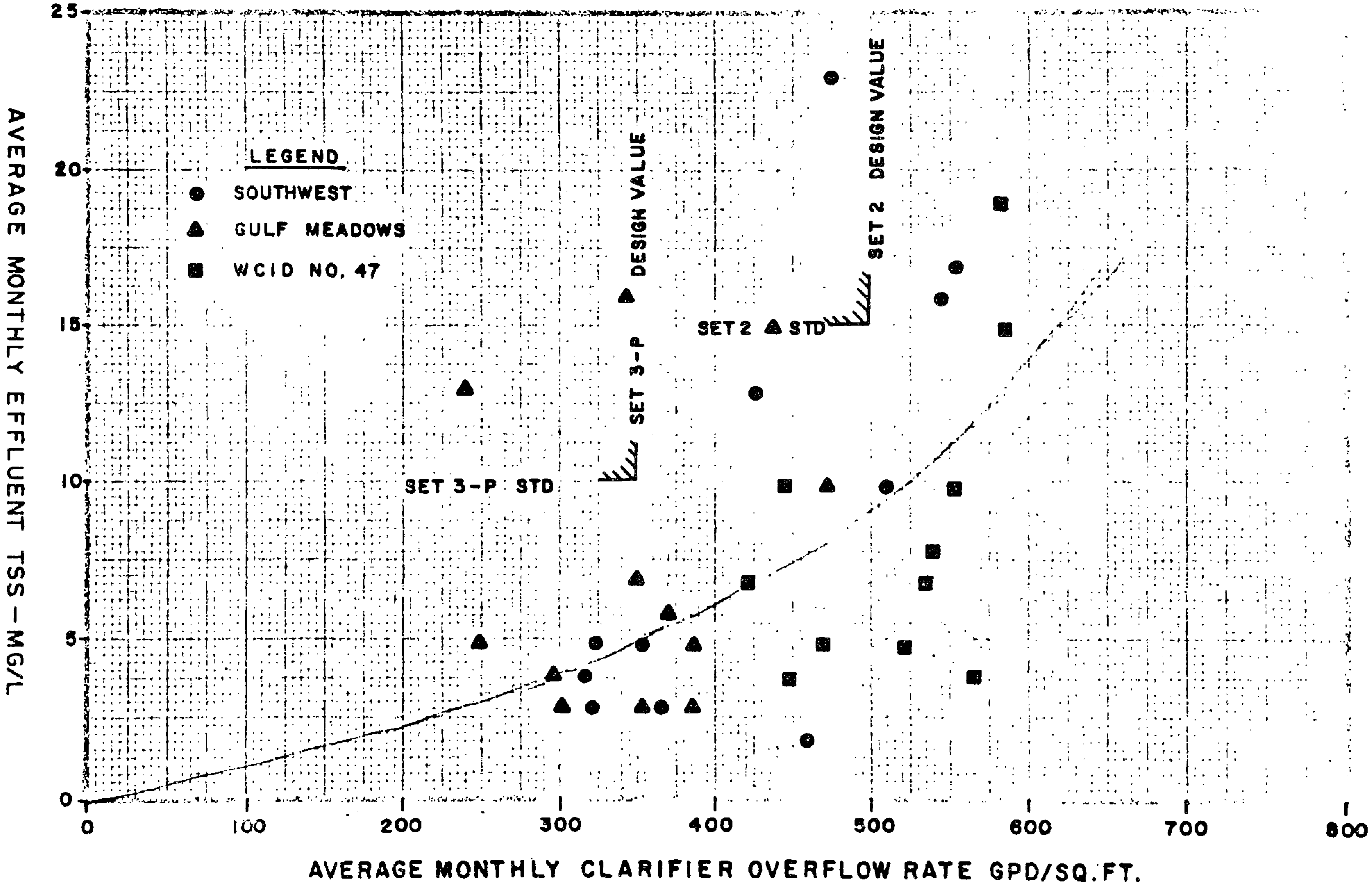
$$BOD_{eff} = F + K_b\ M_{aeff}$$

$$M_{aeff} = M_{Teff} \times \frac{M_a}{M_T}$$

$$M_T = M_a + M_e + M_i + M_{ii}$$

FIGURE K-3

1973 EFFLUENT SUSPENDED SOLIDS VARIATION AT CITY OF HOUSTON WASTEWATER TREATMENT PLANTS



K_T = K_m, K_s or K_e at temp T°C

K_{20} = K_m, K_s or K_e at temp 20°C

M_{iinf} = non-biodegradable organic suspended solids in influent, approximately 40% of the VSS in normal domestic sewage mg/l VSS

M_{iiinf} = inert SS in influent, mg/l nonvolatile SS

For the operation of the Northwest Plant, the average operational temperature in aeration tank is assumed to be 24°C.

$$K_m(24°C) = 7.2\ (1.072)^{24-20} = 9.5/hr$$

$$K_s(24°C) = 5.0\ (1.072)^{24-20} = 6.6/hr$$

$$K_e(24°C) = 0.02\ (1.072)^{24-20} = 0.026/hr$$

$$F = \frac{225}{9.5 \times 3.36 + 1} = \frac{225}{34} = 6.6 \text{ mg/l}$$

$$t_s = \frac{\text{lb of MLSS in aeration tank}}{\text{lb SS in effluent and waste sludge/day}} \begin{matrix} + \\ - \text{ neglect} \end{matrix}$$

Assume MLSS in aeration tank = 3000 mg/l. The volume of the tank is 1.68 million gallons.

Quantity of sludge wasted based upon 260 gpm at 8000 mg/l = 25,000 lbs/day.

Assume 48% solids constitute biological mass.

Biomass wasted per day = 25,000 x 0.48 = 12,000 lbs/day.

$$t_s = \frac{1.68 \times 3000 \times 8.34}{12 \times 6 \times 8.34 + 12,000} = \frac{42,000}{600 + 12,000} = 2.3 \text{ days}$$
$$= 56 \text{ hrs.}$$

$$M_a = \frac{6.6 \times 6.6}{0.026 + 1/56} = \frac{6.6 \times 6.6}{0.044} = 990 \text{ mg/l}$$

$$M_e = 0.2 \times 0.026 \times 990 \times 56 = 290$$

$$M_a = \frac{K_s F}{K_e + 1/t_s}$$

$$M_e = 0.2\ K_e\ M_a\ t_s$$

$$M_i = M_{iinf}\ \frac{ts}{t}$$

$$M_{ii} = M_{iiinf}\ \frac{ts}{t} + 0.1\ (M_a + M_e)$$

$$t_s = \frac{\text{lb MLSS in aeration tank}}{\text{lb SS in effluent and waste sludge}} \pm \text{lb SS change in ML per day}$$

$$K_T = K_{20}\ (1.072)^{T-20}$$

where F = unmetabolized BOD in the effluent, mg/l

F_i = influent BOD_5 = 225 mg/l

K_m = metabolism factor, 7.2/hr at 20°C

t = aeration time, 3.36 hrs

BOD_{eff} = BOD in effluent, mg/l

K_b = 0.8 (BOD factor)

M_{aeff} = active microbial mass in effluent, mg/l VSS

M_{Teff} = total suspended solids in effluent, mg/l

M_a = active microbial mass, mg/l VSS

M_T - mixed liquor suspended solids, mg/l

M_e = endogenous respiration mass, mg/l VSS

M_i = inert, nonbiodegradable organic SS, mg/l

M_{ii} = inert, inorganic SS, mg/l non volatile SS

K_s = synthesis factor 5.0/hr at 20°C

K_e = endogenous respiration factor, 0.02/hr at 20°C

t_s = sludge turnover time, hrs

$$M_i = 0.35 \times 0.9 \times 220 \times 56/3.36 = 1160$$

$$M_{ii} = 0.1 \times 220 \times 56/3.36 + 0.1\ (990 + 290) = 370 + 128 = 498$$

$M_T = 990 + 290 + 1160 + 498 = 2938$ within the operating range

$$M_{aeff} = 6.0 \times \frac{990}{2938} = 2 \text{ mg/l}$$

$$BOD_{eff} = F + K_b\ M_{aeff} = 6.6 + 0.8 \times 2 = 6.6 + 1.6 = 8.2 \text{ mg/l}$$

Effluent Quality

Active microbial mass	= 2.0 mg/l
Total suspended solids	= 6.0 mg/l
Soluble BOD_5	= 6.6 mg/l
Total BOD	= 8.2 mg/l

TEXT REFERENCE:

CHAPTER VI: ENVIRONMENTAL EFFECTS OF THE PROPOSED ACTION

APPENDIX L: SECONDARY IMPACT OF PROPOSED ACTION

THE DEGREE TO WHICH THIS ACTION WILL AFFECT POPULATION, ECONOMIC GROWTH, LAND USE AND RELATED DEVELOPMENTS

A. SOME BASIC ASSUMPTIONS ON THE INTERRELATIONSHIP OF THE INFRA-STRUCTURE AS AN INTEGRATED SYSTEM

The term infra-structure is defined as those elements of the urban environment which are conventionally provided by the public sector for stimulating private development of housing, commercial, industrial and other real-estate activities. These facilities are normally considered as transportation, water and sewer services. Other facilities, such as schools and parks, are also important determinants of private development, and as such are classified as infra-structure elements.

The interrelationships of these facilities are crucial. Since housing, industrial and commercial developments are often contingent on these facilities, the absence of any one type of facility can deter growth or at least can make the growth pattern haphazard and less than attractive. Paradoxically, the presence of the same factor alone may not be sufficient to bring about the desired growth. A balanced, complete policy of providing all elements of the infra-structure system for an area is vital.

In the context of the proposed Northwest Sewage Treatment Plant, most other public facilities are adequate for the service area except the sewer system. The proposed project will fill a vacuum that has long persisted in the area. Its construction is expected to complete the cycle of a full range of public services. The cumulative impact of these elements is projected to be substantial as noted earlier in this report on the section of population and economic base forecasts.

The secondary impact of the project on attracting population, employment, housing and land use growth as identified in this section reflects the integrated impact of all infra-structure elements as a system. But since a void exists in the area of sewer service, the impact of the rest of the service elements has not been fully felt in the past. The present level of population and land use for the project service area is testimony to that.

B. EFFECTIVE 1990 POPULATION AND EMPLOYMENT LEVELS FOR THE AREA TO BE SERVICED BY THE PROPOSED PROJECT

As noted elsewhere in this report, the project appears, in varying degrees, the areas which together make up the total service area for the proposed facility.

Population	Employment	Population	Employment
1970		1990	
47,173	22,200	90,140	44,000

C. IMPACT OF THE PROPOSED PROJECT ON POPULATION AND EMPLOYMENT GAIN BETWEEN 1970 AND 1990

	1970	1990	Net Change 1970-1990
Population	47,174	90,140	42,966
Employment	22,200	44,000	21,800

It could be approximately concluded that the construction and operation of the proposed project will cause a population gain of 43,000 persons and an additional gain of 22,000 employed people within its effective service area during the next 20-year period. Without the construction of the proposed project, these people and workers are not likely to select their residences or places of work in the service area.

D. NET IMPACT ON HOUSING DEVELOPMENT

1. Additional population increase by 1990 = 43,000 persons

2. Persons per household = $\frac{\text{Total Population}}{\text{Total No. of Households or Occupied Dwelling or Housing Units}}$

   Persons per household for:

   1960 = 3.28 (Source: 1960 Census of Population and Housing)

   1970 = 3.09 (Source: 1970 Census of Population and Housing)

   1990 (Projected) = 2.90 (Source: The University of Texas at Arlington

3. Total number of housing units required to house an additional

   population of 57,180 persons = $\frac{43,000}{2.90}$

   = 14,700 Dwelling Units (occupied)

4. Vacancy rate: 1960 = 7.1% (Source: 1960 Census of Population and Housing)

   1970 = 7.95% (Source: 1970 Census of Population and Housing)

   1980 (Projected) = 7.8% (Source: The University of Texas at Arlington

5. Total Housing Units = Occupied Housing Units + Vacant Housing Units

   $$H = 14,700 + .08\ H$$

   or $0.92\ H = 14,700$ units

   $$H = \frac{14,700}{0.92} = 16,000 \text{ units}$$

6. Anticipated displacement of existing housing as a result of delapidation, damage due to flood, incidence of fire, etc.

   = 5% of existing housing stock

   = .05 x 15,600

   = 780

7. Total additional dwelling units required through 1990:

= 16,000 + 780

= 16,780 units

8. Land Requirement: at a projected net density of 7.0 dwelling units per acre:

Residential land requirements through 1990 = $\frac{16,780}{7.0}$ = 2380 acres

The construction of a regional sewage treatment plant at the proposed Northwest location will, in conjunction with other infra-structure elements, attract by 1990 a population of 43,000 persons to its service areas, which will create the demand for 16,780 new housing units. At an average density of 7.0 dwelling units per acre, a total of 2380 acres of vacant land is expected to be urbanized in the service area for residential development.

E. NET IMPACT ON INDUSTRIAL DEVELOPMENT

Anticipated net increase of employment through the year 1990 is 22,000 workers. Proportion of manufacturing workers as a percent of total employment in Houston:

1960 = 21.6% (Source: 1960 Census of Population and Housing)

1970 = 20.4% (Source: 1970 Census of Population and Housing)

The service area of the proposed project is not as suitable for more intensive industrial development as several other communities in the city. As such, the proportion of manufacturing workers for the area is expected to be smaller than the corresponding city average. Further, the supply of suitable lands for industrial development is not as abundant in the service area as elsewhere in the city. Considering these factors, a 1990 projected figure of 16% for industrial workers as a percent of total area employment for the service area appears reasonable.

1990 manufacturing employment = 22,000 x .16

= 3520 workers

At a projected industrial density of 12 workers per acre of gross land, net industrial land demand is:

$$\frac{3520}{12} = 295 \text{ acres}$$

F. NET IMPACT ON RELATED DEVELOPMENTS

These will include commercial retail, office and service activities; parks and recreation; schools and related activities. Following is an estimate of lands to be developed for each of these categories:

1. Commercial Development

Total population = 43,000

At the rate of 5 acres of commercial land per 1,000 population,

$$\text{Total commercial land demand} = \frac{5 \times 43{,}000}{1000}$$

$$= 215 \text{ acres}$$

This may include the development of one new regional shopping center (75 acres), three community shopping centers (each 30 acres), and five neighborhood shopping centers (each 10 acres)

2. Parks and Open Spaces

Following the national standard of 10 acres of park land per 1,000 population, the total parks and recreation demand by the net increase of population = $\frac{43,000}{1000}$ x 10 = 430 acres

These park acreages could be allocated to various types of parks as follows:

Four community parks @ 75 acres = 300 acres

Eight neighborhood parks @ 15 acres = 120 acres

The ample lands available in the flood-plain areas along the Cole Creek and White Oak Bayou offer excellent opportunities for the development of these parks and open space facilities.

3. Schools:

Total Population - 43,000 persons

Five elementary schools, each serving a population of 7,000 to 10,000 persons

Two junior high schools, each serving a population of 18,000 to 25,000 persons

One senior high school, serving a population of 25,000 to 34,000 persons

The corresponding land area need is:

Five elementary schools @ 15 acres each = 75 acres

Two junior high schools @ 40 acres each = 80 acres

One senior high school @ 60 acres = 60 acres

Total 215 acres

G. SUMMARY CONCLUSION OF SECONDARY IMPACT OF THE PROPOSED PROJECT

The following table summarizes the net impact (secondary) of the proposed Northwest Sewage Treatment Project on the development of various land use activities under the assumptions stated earlier.

	Magnitude of Impact	
NET IMPACT ON:	Number	Acres
Population	43,000 persons	---
Employment	22,000 jobs	---
Residential Development	16,780 housing units	2,380
Industrial Development	---	295
Commercial Development	---	215
Parks and Recreation	12	430
Schools	8	215
TOTAL		3,535

H. IMPACT OF URBANIZATION ON AMBIENT AIR QUALITY

It appears that the people of Houston and their City Government desire additional growth. To attract urbanization, public facilities are needed such as sewage treatment facilities. The preceding sections have shown that the construction of the proposed facility will aid the city in bringing about an additional growth of 43,000 persons for its service area. This population will require the development of an estimated 3,535 acres of lands for various purposes such as housing, work places, schools, and related facilities. The expansion of the facility will also improve the existing public health conditions for those sections of the service area which are currently served by septic tanks. On a short term basis, the quality of water in Cole Creek, White Oak Bayou, Buffalo Bayou, and the Houston Ship Channel would also experience a beneficial impact from the project construction.

It is not disputed that growth and urbanization are in themselves harmful. But going a step further when one analyzes the possible consequences of urbanization on the quality of the environment, one faces the issue of deciding whether or not such urbanizations are desirable. There are options available for avoiding adverse ramifications of growth, though in some instances people are not aware of and are not willing to take necessary steps to make sure that only the beneficial impact of urbanization is wanted and not its adverse consequences. For example, unless the people of Houston are willing to undertake parallel programs to keep the problem of air pollution to a minimum, the additional growth of 43,000 persons would further deteriorate the quality of air in the northwest Houston. This section shows how this may occur.

1. Impact of Population Increase on Travel Demand:

Travel demand is defined here as the total number of vehicular miles driven per day by the service area population in the process of satisfying social and economic needs: work, shop, do business, etc. In 1960, the people of Harris County traveled a total vehicular miles of 9.6 million miles on an average day (Source: Houston-Harris County Transportation Study by the Texas Highway Department, November 1971, page XXIV). The average trip length was 2.6 vehicular miles and approximately 3 vehicular trips per day were generated on a per capita basis.

Total vehicular miles of travel by the net population increase of Northwest Treatment Plant Service Area:

Total net population increase by 1990 = 43,000 persons

No. of trips = 43,000 x 3 = 130,000 vehicular trips

Total vehicular miles to be traveled per day =

130,000 x 2.60 = 338,000 vehicular miles per day.

Alternately,

$Y = P(f_1)(f_2)(f_3)(f_4)$ where

Y = Vehicular miles per year

P = Population increase

f_1 = Total passenger miles per person

f_2 = The factor expressing the travel allocation to the motor vehicle after adjustment for mass transit

f_3 = Vehicular occupancy rate (no. of persons per vehicle)

f_4 = Allocation of total miles to urban and non-urban travel.

[f_1 = 7,000 miles/year, f_2 = 0.85, f_3 = 0.58 @1.72 persons per vehicle, and f_4 = .80. SOURCE: A Guide for Considering Air Quality in Urban Planning, PB-234 341, Prepared for the Environmental Protection Agency, Distributed by NTIS, U.S. Department of Commerce, March 1974, p. 71.]

The values of f_1, f_2, and f_3 as suggested by the above study appear to be appropriate for the Houston situation.

Y (for Northwest Service Area) = 43,000 X 7,000 X .85 X .58 X .8

= 108,000,000 miles per year

Total vehicle miles to be traveled per day by the 43,000 additional people in the service area = $\frac{108,000,000}{365}$

= 322,000 vehicle miles/day

$$\text{Average vehicle miles per day} = \frac{(338{,}000 + 322{,}000)}{2}$$

$$= 330{,}000 \text{ miles per day}$$

2. Vehicular Transportation Emission Rates:

Considerable research has been conducted through the auspices of the various federal agencies particularly the Environmental Protection Agency to determine the emission rates of transportation and motor vehicles. These emission rates would vary from one urban area to another, depending on the vehicular mix in terms of the proportion of automobiles as a percent of total vehicular distribution, vehicular age distribution, and related factors. Based on the results compiled by an EPA study, Compilation of Air Pollutant Emission Factors, Second Edition, AP-42, April 1973, Table 3.1.1-1, the following emission rates appear to apply to the Houston situation. Also see page 64, Table 8, A Guide for Considering Air Quality in Urban Planning, March 1974.

Pollutant	Emission Rates in Grams per Mile		
	1975	1980	1980 and later
CO	60	36.5	23.8
HC	7.66	4.1	2.5
NO_x	4.9	2.8	1.6

The declining emission rates from 1975 through 1990 are reflective of the projected impact of federal and state regulations on motor vehicles under the Transportation Control Programs of the 1970 Federal Clean Air Act Amendments.

3. Estimated Secondary Net Impact of the Proposed Northwest Treatment Facility on Ambient Air Quality:

Applying the emission rates in grams per mile to the projected vehicular miles of travel by the 43,000 persons, the pollutant concentration per day in 1990 is estimated as follows:

CO 330,000 X 23.8 = 7,850,000 grams/day
HC 330,000 X 2.5 = 825,000 grams/day
NO_x 330,000 X 1.6 = 528,000 grams/day

The corresponding pollution concentration in lbs/day is as follows:

CO 17,600 lbs/day = 8.8 tons/day = 3,200 tons/yr
HC 1,850 lbs/day = 0.93 tons/day = 340 tons/year
NO_x 1,190 lbs/day = 0.60 tons/day = 219 tons/year

4. Comparison Against National Ambient Air Quality Standards:

The preceding step shows the impact of the additional transportation development in the service area of the Northwest Treatment Plant on ambient air quality in terms of Carbon Monoxide, Hydrocarbons, and Nitrogen Oxides pollutants. In order for this data to be compared against the pollution concentration defined by the National Ambient Air Quality Standards, this net increase in pollutant concentration must be added to the level of existing air quality for the service area. The 25 monitoring stations established and used by the City Air Pollution Control Program, as discussed in detail in Appendix GG, have the ability to collecte and process air pollution information only for particulate matters. The Northwest Section has only one monitoring station (Station 11) approximately 3 miles due west from the proposed plant. Data on pollution concentration on Particulate Matters is of limited use in defining the projected impact of 1990 urbanization on the total air quality for the service area.

The transportation impact on air quality measured as 3,200 tons/year in Carbon Monoxides is certainly substantial in magnitude. This is the adverse effect which can only be avoided if the City of Houston undertakes an ambitious program of public transportation so that the travel need of the increased population can be met not through the conventional method of private automobile but through a mode that will not pollute the ambient air. This is an adjustment which the Houstonians will have to make in order for them to have both urbanization and clean air at the same time. This is a "trade-off" which should be given consideration. Appendix GG has shown the data that Houston as a whole is violating the national standards in every category of pollutants. Ways must be found to bring the pollution level within allowable limits.

TEXT REFERENCE:

CHAPTER VI: ENVIRONMENTAL EFFECTS OF THE PROPOSED ACTION

APPENDIX M: CITIZEN PARTICIPATION

HOUSTON'S NEIGHBORHOOD IMPROVEMENT PLANNING PROGRAM

HOUSTON'S NEIGHBORHOOD
IMPROVEMENT PLANNING PROGRAM

CITIZEN PARTICIPATION

A COMMUNITY RELATIONS HANDBOOK
PRELIMINARY

AUGUST, 1973

HOUSTON CITY PLANNING DEPARTMENT
ROSCOE H. JONES, DIRECTOR

The preparation of this report has been financed in part through a Grant in accordance with Section 701 of the 1954 Housing Act as amended.

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GENERAL NATURE OF CITIZEN INVOLVEMENT

REASONS FOR CITIZEN INVOLVEMENT

The Houston Neighborhood Improvement Program requires citizen-resident involvement. This draws together the resident, the planning team and the Community Relations Planner in an effort to bring about neighborhood improvement.

The resident knows his area better than observers living elsewhere. He, more than a passer-by, knows from daily experience the needs and blessings of where he lives. Field teams must, of course, check for a total picture of the area and for precise data relating to physical conditions. However, length of residency alone gives the citizen an advantage. He sees his neighborhood in all times of day and night, in all seasons of the year, in all kinds of weather.

An additional reason for calling on the residents for input and help is that improvements are made for the use of the residents; to some extent these same improvements come under the care of the residents. Residents are inclined to take better care of what they themselves help bring about. Hence the more involved a neighborhood becomes in its own improvement, the longer lasting the improvement and the further the tax-dollar will stretch.

Not infrequently features of an area are beloved to the residents,

NEIGHBORHOOD PLANNING METHOD

INFORMATION GATHERING

Working Base
In-House Info
Other Dept. Info
Working Maps
Presentation of Info

NEIGHBORHOOD CONTACT

Contact Civic,
Business and Church
Leaders

FIELD INFORMATION

Street Conditions
Natural Features
Historic Features
Housing Conditions

SKETCH PLAN

Overall Plan
Short and Long Range
Suggestions

NEIGHBORHOOD REVIEW

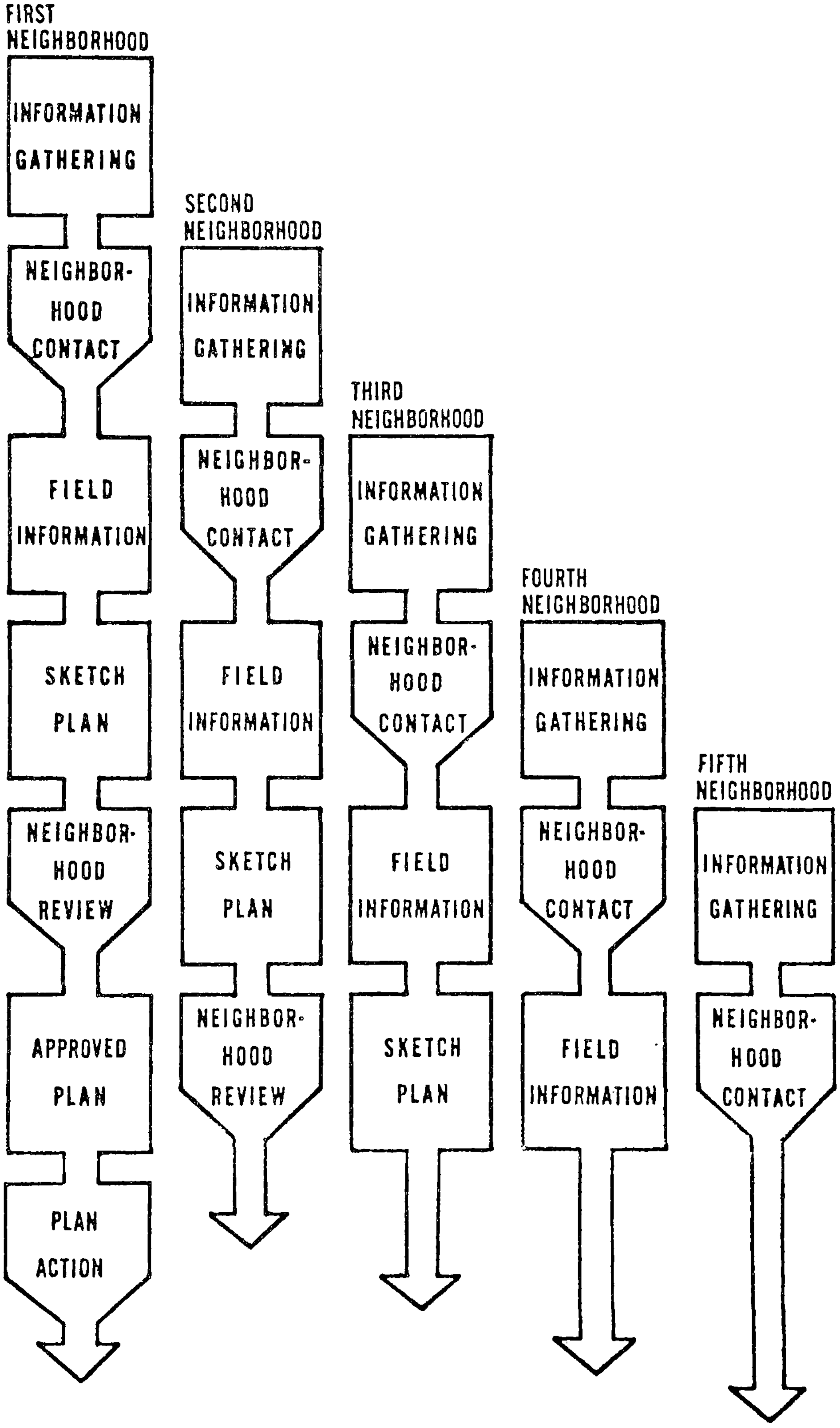
Presentation of
Sketch Plan
Revisions of Plan

APPROVED PLAN

Final Presentation
Final Layout,
Writing and Printing

PLAN ACTION

Implementation
Continuing Action
to Achieve Plan



MEETING WITH RESIDENT GROUPS

GROUPS SEEKING INFORMATION

A local civic club or church group, hearing of the Neighborhood Improvement Program may ask for more information about the Program. This is an opportunity for the Community Relations Planner to provide this information with the result that he will receive needed citizen input from the group and obtain more contacts with residents.

To do this he will need maps, relating to the program, that point up the work done city-wide and work done on this particular area. The number of maps and the type of information they contain will depend on what the in-house planning team has produced for his use.

A couple of points should be kept in mind. Minimally, it is requisite that his talk convey clearly that the City Planning Department is working on this particular area to develop a plan for it. Secondly, any added information of soon-to-be-added improvements should be mentioned to these listeners. The general thrust of the talk should be aimed at arousing local interest in self-betterment with the hope that initiative will come forward.

Questions will be asked about the area and about areas unfamiliar to the Community Relations Planner. These questions are to be answered honestly, admitting your limitations as to what is asked. If appropriate, offer to investigate a matter that is not known to you and yet is asked about.

TEXT REFERENCE:

CHAPTER X: COMMENTS, PUBLIC PARTICIPATION AND INFORMATION DISSEMINATION

APPENDIX N: NEWSPAPER ACCOUNTS

City limiting new buildings due to sewers

By MIMI CROSSLEY
Post Reporter

A partial citywide ban on new building permits has been placed on Houston by city officials because of the overloaded sewer system, pending an improvement plan to be submitted to state pollution authorities June 1.

City experts hope that the plan for revamping the system with $100 million in new sewer rates passed last month by Mayor Fred Hofheinz and the City Council will keep the Texas Water Quality Board from clamping a flat "No" on any further building.

But even if the board approves the plan, city officials say that future building in Houston -- the third fastest-growing city in the nation - will be tied directly to improvements in waste sewage treatment plants and new lines in each of the city's 43 treatment areas.

"We are in control of the situation here in the city," said Charles Williams, head of the city's sanitary sewer system. "We have actually had a floating system situation for some time, issuing permission for connections area by area as improvements go in."

Meanwhile, to limit connections to the overloaded system, no new construction permits are being issued in about one-third of the city, and restrictions have been placed on the type of construction in the rest of Houston, public works officials confirmed

Although all commitments previously issued for sewer connections are being honored, new permits are being generally held to a limit of five residential units per acre, or the equivalent of one two-story commercial building, with duplexes still being allowed on single lots in some areas.

The restrictions affect apartment construction, townhouses, high-rise residential and office buildings and large commercial development within the city limits.

Some relaxation of restrictions is being allowed in the southwest area where sections of a new relief trunk sewer line are being laid and an old water district treatment plant has been phased out.

Other permits in other sections are being allowed where improvements in the sewer lines paid for out of last year's bond election are going in.

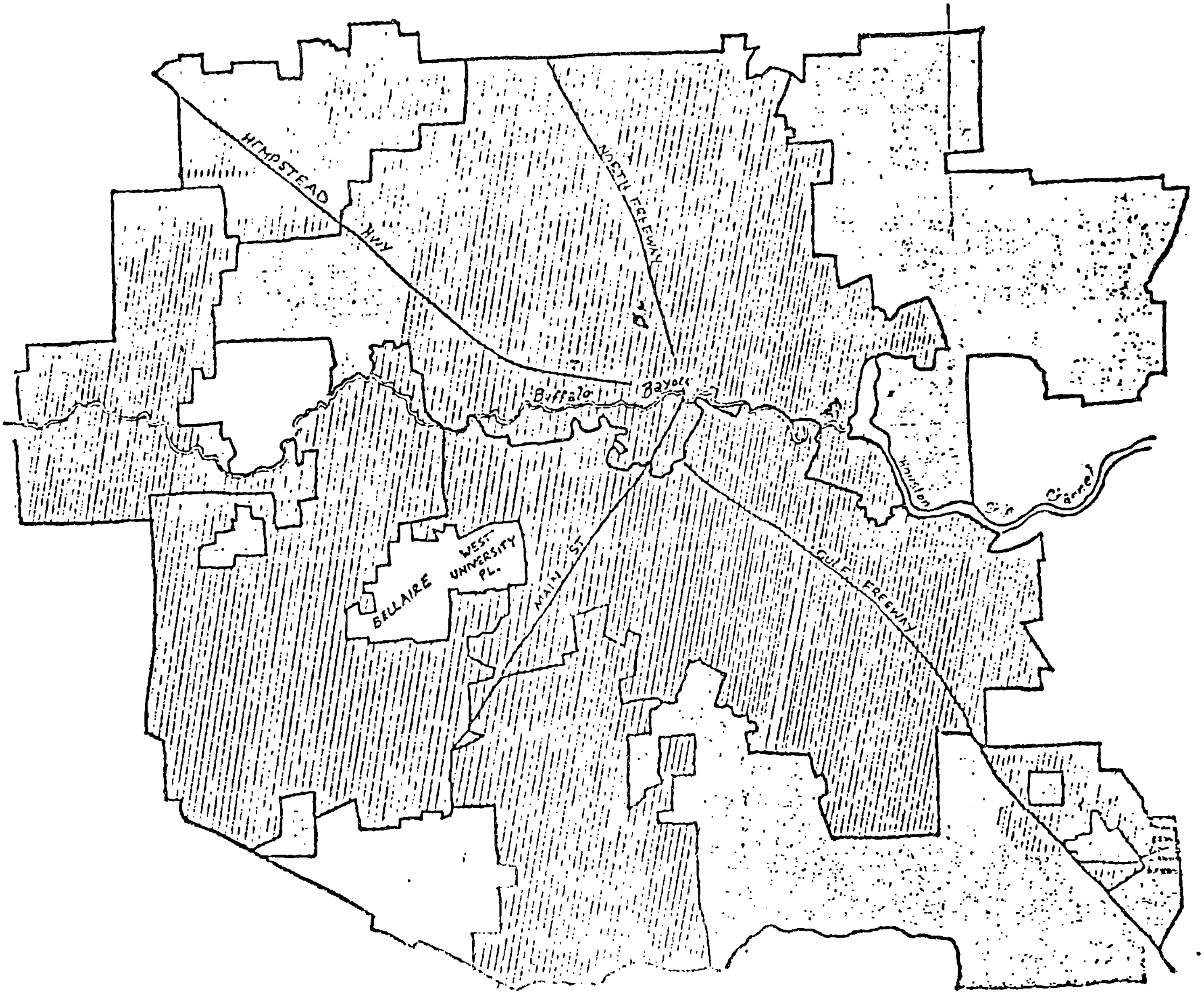
Restrictions on issuing permits in some areas of the city began last fall, after the TWQB warned Houston the majority of its 43 waste treatment plants were out of compliance with state and federal standards.

The ban at first affected the Chocolate Bayou and northeast sections, the first such limit put on building in Houston since the Montrose area was temporarily restricted in 1961-62 until new trunk lines were put in.

Issuing permits has gradually tightened, and new rules

Please see City/page 19

THE HOUSTON POST
March 12, 1974



Gray shows building ban, lines are restricted areas

—Post map by Bud Bentley

THE HOUSTON POST
March 12, 1974

City limits building permits due to overloaded sewers

From page 1

requiring landowners to file a letter with the City Public Works Department stating the number of units to be built for what use is likely to stay in effect.

The "letter only" qualification will hopefully stop instances where building has started without getting permission first for sewer hookups, a problem which has plagued city officials in the past, even from major building construction.

"This method should give us all better planning, and better development by helping us get improvements built without overloading the system in another area," said Williams.

Other problems in Houston include:

• Lack of compliance with state laws regulating the amount of sewage coming in and going out of each plant;

• Treatment plants and sewer lines unable to handle "infiltration" or rain water that floods the system in wet weather due to seepage or broken lines, backing sewage up through the lines into homes;

• Raw sewage dumped from the city's largest plant, the North Side, directly into Buffalo Bayou, and two points in the central section served by the Sims Bayou plant where lines do not go to the plant but dump raw sewage right into Brays Bayou, at Hermann Park and one at McGregor Parkway;

• Catching up with tripled growth in the past decade and redevelopment where high-rises and apartments have been built on sewer lines put in for single family residences;

• Abandonment of old water district plants and replacement of lines put in before city specifications were enforced, as in the case of Sharpstown;

• Deterioration of sewer lines because of hydrogen sulfide (that "rotten egg" smell) buildup in inadequate lines and treatment plants;

• Shifting guidelines for federal grants and standards pit put out by the Environmental Protection Agency that have sent city engineers back to the drawing board just before bids were ready to be let on several projects, with a holdup in federal funds.

The plan that will be presented to the TWQB June 1 will lay out a $175 million program, to be spent over five years to build some 15 new sewage treatment plants and upgrade or enlarge others, as well as plans for trunk and relief lines.

Of that sum, $100 million will come from the new sewer rates, boosted by 390 per cent, the first increase in 10 years.

The other $75 million is expected in federal grants. The total program will pump twice as much money per year for capital improvements over what was spent in the past decade.

The building ban may not have a drastic effect on construction in the area, since building has been somewhat off due to tighter money conditions, builders say.

"Its been more of an economic trend," said Allen Narmore, president of the Houston Apartment Builders Association. "In 1972, there were 24,000 apartment units under construction and some 14,000 in 1972. Financing and heavy rains were the important factors," he said.

While building permits declined inside the city limits in January by 66.4 per cent over the previous year, permits were also down in Harris County—not afflicted by sewer problems —some 65.5 per cent from the same month in 1973, the Houston Chamber of Commerce reported.

THE HOUSTON POST
March 12, 1974

N-4

THE HOUSTON POST
March 28, 1974

cited as threat to health

By HAROLD SCARLETT

Post Environment Writer

AUSTIN — The Houston sewage system may have as many as 200 points overflowing raw sewage, including some that are "a significant threat to public health."

So the Texas Water Quality Board was told Wednesday by its field operations director, John Latchford.

Latchford was summarizing an interim report from the city itself, required under a January order of the water board. The order directed the city by June 1 to pinpoint its present problems, work out solutions, and chart a long-range plan to keep the sewage system abreast of future city growth.

The city, in an interim report due March 1, said it had not yet completed a field investigation of overflow points. But Latchford said a check of records showed "some 200 historic overflow sites."

How [illegible] number [illegible] these [illegible] has been corrected [illegible] the field investigation [illegible] the finding [illegible].

Latchford said some of the overflow points were in sewage plants and could be easily corrected.

"Other overflow points may not appear to be major pollution threats to natural waters," he continued, "but are in fact a significant threat to public health."

Sewage hearing/page 4A

Latchford said the water board staff therefore had cautioned the city that public health "must be a major consideration in any priority system (for corrections), and priorities based on receiving stream impact alone will not be acceptable."

The field operations director, formerly stationed in Houston, later told a reporter that one thing disturbing him was the possibility of children catching diseases while playing in some parks and along sewage-contaminated drainage ditches.

Latchford said one of the overflows he had in mind is in MacGregor Park. There, he said, raw sewage is bypassed into Brays Bayou during overload periods.

The city report also listed two overflow points in the Hermann Park zoo.

Latchford also told the board that most of the overflows are "correctable with the city's own resources" and "we expect prompt and vigorous activity" to correct them.

The water board issued its January cleanup order as an alternative to a water pollution suit against the city, repeatedly urged by Atty. Gen. John Hill.

The order in effect gave the city a five-month grace peri-

Please see Sewage/page 23A

Sewage system cited as threat to city's health

From page 1

od to start getting its sewage sins under control.

Latchford said the city's March interim report was generally acceptable, although more work was needed in determining the true loadings and capacities of sewage plants rather than "nameplate" capacities.

The city report listed four basic causes for the raw sewage overflows: Insufficient pumping capacity; insufficient hydraulic capacity in collection systems; collection system blockages; and insufficient treatment capacity.

The report said that 19 of the city's 43 sewage plants were presently overloaded to varying degrees.

"However, the northside facility is the only major treatment plant that has been found to be in such a condition," the report said.

It said the northside plant, built to handle 55 million gallons of sewage a day, now has inflows averaging 87 million gallons. The plant is being expanded to handle 90 million gallons.

APPENDIX O: RECORDS OF PUBLIC HEARING

NOVEMBER 18, 1974

RICE HOTEL

HOUSTON, TEXAS

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION VI

***

DRAFT ENVIRONMENTAL IMPACT STATEMENT
HOUSTON NORTHWEST WASTEWATER TREATMENT FACILITY

***

November 18, 1974

Rice Hotel

Houston, Texas

MR. JIM COLLINS,

Regional Hearing Officer

MR. GREG EDWARDS

Environmental Scientist

MR. KHAN HUSAIN

Consulting Engineer

Reported by:

LINDA SCHMANKE

HEARING OFFICER: Goodmorning, Ladies and Gentlemen, and welcome to this public hearing on the draft environmental impact statement regarding the Houston Northwest Wastewater Treatment Facility, which I now call to order.

My name is Jim Collins, I am a licensed attorney and a Regional Hearing Officer for Region VI, of the Environmental Protection Agency. Mr. Arthur W. Busch, the Regional Administrator, to whom I directly report has designated me as the presiding officer of today's hearing.

Also, participating in today's proceeding is Mr. Greg Edwards, on my right, who is an environmental scientist from the Office of Grants Coordination of Region VI. On his right is Mr. Khan Husain from the University of Texas at Arlington. For the record, this hearing is being convened on November 18, 1974, in the Rice Hotel, Houston, Texas.

Now, I would like to give you a brief explanation of what this hearing is about, and the rules that will apply. This is a public administrative hearing, held by and through the authority of the Environmental Protection Agency under Public Law 91-190. Section 102 of the National Environmental Policy Act which is Public Law 91-190, also referred to as NEPA, requires that all agencies of the Federal government shall and I quote:

"A. Utilize a systematic interdisciplinary approach which will ensure the intregrated use of the natural and social sciences, and the environmental design arts in planning and in decision making, which may have an impact on man's environment;

B. Identify and develop methods and procedures, in consultation with the Counsel on Environmental Quality, established by Title II of this Act, which will ensure that presently unquantified environmental amenities and values may be given appropriate consideration in decision making along with economic and technical considerations;

C. Include in every recommendation or report on proposals for legislation and other major Federal actions significantly affecting the quality of the human environment, a detailed statement by the responsible official on the environmental impact of the proposed action, any adverse environmental effects which cannot be avoided should the proposal be implemented. Alternative to the proposed action, the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity. Also, any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented.

Prior to issuing the final statement, the responsible Federal official shall consult with and obtain the comments of any Federal agency which has jurisdiction by law, or special expertise with respect to any environmental impact involved. Copies of such statements and the comments and views of the appropriate Federal, state and local agencies, which are authorized to develop and enforce the environmental standards shall be made available to the President, the Counsel on Environmental Qualities, and to the public as provided by Section 552, Title V of the U.S. Code, and shall accompany the proposal through the existing agencies review processes."

To comply with the Act, the Office of Grants Coordination, Region VI in Dallas, has prepared a draft environmental impact statement for the proposed expansion of the Houston Northwest Wastewater Treatment Facility. This draft environmental impact statement was made available to Federal, state and local agencies, private organizations and certain individuals, earlier this year. I am certain that many of you have received a copy of that document, if not, there are a limited number available at the registration table.

The Counsel on Environmental Quality Guidelines, promulgated to implement NEPA, established the following policy:

"Federal agencies will, in consultation with other appropriate Federal, state and local agencies, assess in detail the potential environmental impact in order that adverse effects are avoided, and environmental quality is restored or enhanced, to the fullest extent practicable. In particular, alternative actions that will minimize adverse impact should be explored and both the long and short range implications to man, his physical and social surroundings, and to nature, should be evaluated in order to avoid to the fullest extent practicable undesirable consequences for the environment."

EPA policy is directed to fully comply with the National Environmental policy Act and Counsel on Environmental Quality Guidelines. Public participation is an integral part of the agencies planning and decision making process. The agency intends to keep the public fully informed about the status and progress of the studies and findings, and to actively solicit comments from all concerned groups and individuals. Approval of the proposed project here, the subject of this hearing, cannot be given until the environmental impact statement process is completed and until the project meets all state and Federal requirements.

Although this is not a court of law, what we are engaged upon here today, is a very serious business. In an effort to assure the fullest degree of public participation possible in all of its environmental programs, the Environmental Protection Agency, in addition to soliciting a written comment, holds public hearings on those issues where significant action is about to be taken, or when public interest is indicated. We encourage the citizens from all sectors of the public to make their views known.

Mr. Arthur W. Busch, Regional Administrator, has determined that the proposed Federal action here will have a significant impact on the environment, and that a public hearing might identify environmental issues that might otherwise be overlooked. This is why we are here today.

This hearing provides all interested persons an opportunity to express their opinions which will be pertinent to the proposed project and the draft impact statement. Please bear in mind that the draft statement serves only as a means of assessing the environmental impact of proposed agency actions and is not to be construed as justification for decisions already made. All relevant testimony presented today will be considered by EPA in arriving at a final decision and impact statement. That statement, inturn will relate to the question of whether or not, or under what conditions, Federal funds will be granted to further the project.

Since today's hearing is not a rule making hearing under the Administrative Procedure Act, nor a court of law, no formal procedures or rules of evidence will apply. Because this hearing is for the sole purpose of gathering all pertinent facts relating to the environemntal issues involved, our rules of evidence will be rather liberal; however, they will be kept as consistent as possible with orderly proceedings. Participants may present any information which they feel should be brought to the attention to the planning agencies. Also, participants in this hearing may question or discuss any issue or point which is brought up by any speaker, but only after the close of his or her presentation.

I do require that all formal testimony submitted today be under oath, that all testimony be relevant to the draft impact statement we are considering, and that it not be repetetive of previous testimony.

I may limit oral presentation if not pertinent or material to the relevant issues surrounding the draft impact statement, and I may ask that redundant or corroborative material be submitted rather than read. I also ask that all statements by anyone individual in excess of twenty minutes be summarized.

The procedure for today's hearing will be as follows. After my opening remarks, we will hear from Greg Edwards from the office of Grants Coordination of Region VI. He will present pertinent facts and comments concerning the application, investigation, and draft impact statement. Then we will hear from all those persons in the audience who have filled out a registration card indicating a desire to present formal testimony.

I would like to caution you now that this is not a forum for debate, nor argumentative conversation but rather, one for the gathering of facts and opinions regarding this draft environmental impact statement.

It is important that we have only one person at a time speaking. Therefore, I ask that you not engage in cross conversation, but rather, that you wait your turn and identify yourself prior to speaking in order that the reporter may make an accurate, permanent record of the testimony.

As you can see, a verbatim transcript is being made of today's proceeding, and it will be the sole official record. Persons desiring to purchase copies of the transcript should make arrangements with the court reporter at the conclusion of the hearing. Shortly a copy of the transcript will be made available to the public for inspection between the hours of 8:00 a.m. and 4:30 p.m., Monday through Friday, in the office of the Regional Hearing Clerk in Dallas, Texas. That's on the eleventh floor, 1600 Patterson Street. I am also in the habit of sending a copy to those localities concerned. In this case, we will send a copy of the transcript to the Houston Chamber of Commerce, probably to Mr. Welch's office.

The hearing record today will remain open for ten calendar days after adjournment of this hearing. If anyone has any additional comments or if you wish to modify any of the testimony you presented at this hearing, please, sent them to my attention at Region VI in Dallas, and it will become a part of the record.

In addition to the testimony at this hearing, written material which has been submitted directly here or to the Regional Administrator of Region VI, previously or within the ten day extension period that I announced will also be considered in reaching a final decision.

If there is anyone who wishes to testify but who has not filled out a registration card, I urge you to do so as soon as possiable in order that appropriate scheduling can be arranged.

If you have written material to be entered into the record as exhibits, make certain that you appear before me and have your exhibits marked prior to giving testimony. Also, if your oral presentation has been reduced to writing, I would appreciate copies being given to me and to the court reporter as an aid in transcribing today's proceedings.

Before anyone gives testimony in this preceeding, they must be sworn in. At this time, in order to expedite that aspect of the hearing, I would like to have the oath administered to everyone at one time. If those of you who feel you may participate by presenting formal testimony would please rise and raise you right hand.

Do you and each of you solemnly affirm that the testimony that you are about to present represents the truth, the whole truth, and nothing but the truth?

Answer, I do.

(Whereupon all witnesses were sworn.)

Please be seated.

As you come forward to testify, please identify yourself by name, title if within an organization, the actual organization and location, and if you are representing someone, the name of the person or organization you are representing. Also, please indicate at that time whether or not you have taken the oath.

Does anyone in the audience have any question now as to how the hearing is to be conducted?

No one so indicating, I will now call on Mr. Greg Edwards, of the Office of Grants Coordination, Region VI.

MR. EDWARDS: Thank you.

The draft environmental impact statement on Houston's Northwest Regional Wastewater Treatment Facility has been prepared and distributed in accordance with the Environmental Protection Agency Interim Regulations on Impact Statements, dated January 17, 1973, Counsel on Environmental Quality Guidelines, dated August 1, 1973, and the EPA Preliminary Draft Manual for Preparing Impact Statements, dated March 2, 1973.

This statement is intended to present EPA's analysis of the environmental impact of the proposed project.

In complying with this objective, Chapter 6 of the statement, entitled, "Environmental Effects of the Proposed Action", is organized to contain a discussion on short-term impacts, normally construction impacts such as noise and erosion, long-term impacts such as water quality and land use, and secondary impacts such as those resulting from additional growth. Discussions of short and long term impacts cover areas of environmental concern which are obvious, related to the project, and which for the most part, can be measured or understood.

Secondary or indirect impacts of the proposed project are not as easily understood or quantifiable.

This is a draft statement and no final conclusions or recommendations have been prepared.

The information presented in this draft statement together with all pertinent information presented at this hearing, will lay the ground work for our continued review, as the final impact statement is prepared. Following completion of our research, final conclusions and recommendations will be prepared and included as a separate section in the final impact statement.

Thank you.

HEARING OFFICER: Thank you, Greg.

I think at this time, according to how your time schedule is going, we might want to let Mr. Husain give his slide presentation. Is there any one of you who has indicated a desire to testify who would like to precede this and give your testimony now?

Well, we might get a little better idea of the project, Mr. Husain with your presentation.

MR. HUSAIN: Thank you. Would you please turn the lights off?
(At this time, a slide presentation was given by Mr. Husain accompanied by the following remarks.)

MR. HUSAIN: Actually, the purpose of this slide presentation is to summarize the materials that have been told in detail in the draft environmental impact statement document.

This is the Northwest Regional Treatment Plant, City of Houston.

In continuation of what Mr. Collins and Mr. Edwards has said, basically the purpose of the impact statement is to make sure that the environment is not adversely affected.

For instance, the kind of pollution that you see on these two slides, it is to be guaranteed that the proposed project will not create these conditions even of a lesser magnitude.

In terms of water quality, the quality of the water is detrimental to the extent that the aquatic life is seriously affected as you can see on these two slides.

The slide on the left of the Houston Ship Channel indicates the problems that exist there.

This is right in Downtown Houston and some of the areas surrounding it are not so good as you can see. These are the kind of conditions that must be avoided. EPA would like to make sure that the proposed project does not add to this problem but rather that they help minimize this kind of environmental problem. The purpose of the project is also, if possible, to enhance the conditions as you can see on these two slides.

Or even on these, where the man-made activities and the natural activities can coexist in harmonious relationship.

On the proposed project of the Northwest Treatment Plant, the slide on the left indicates the area that is going to be served by this particular project. It has 18.6 square miles and a population of 47,000 persons. The future projection of the population is 90,000 persons by the year of 1990. Obviously, this indicates the need for the facilities that have to be provided to meet the needs of the population as well as to provide efficient services.

A project cannot be planned by just taking a look at the project by itself. It has to be related to the entire city.

You can see from the chart on the left, the population projections for the service area itself, the City of Houston, the county and also the southwest planning regions. On the right side is the projected employment period. These two correlate extremely well. As you can see from the slide on the left both, the service area, the city and the county, are expected to continue to grow through the year 1990 and perhaps beyond. The City of Houston, on the left side, is the existing treatment system. That includes some forty two different treatment plants with a combined capacity of 172 to 175 million gallons per day. Obviously, there are too many plants and they are not very efficient. The City of Houston, therefore, has prepared a regional addition plan under which are combined a number of plants and the others are consolidated into a regional system. There are some nineteen that they are proposing which would be more efficient in delivering the treatment services, the waste water services, for the residents of Houston.

Under this plan -- again on the right side, you can see from the northwest regional area to the south by the proposed project and also our investigation includes the analysis of the comprehensive plan that the City of Houston has prepared. This shows the proposed land use consideration for the city and we have included the information from this plant into the regional treatment plant in terms of designing and so forth.

Lets take a few quick looks at the surface area, itself, and the conditions as they exist at the present time. Here the characteristics have been defined in terms of the natural environment and the man-made environment. Together they constitute what is known as the social and environmental setting as they exist at the present time.

The natural environment is on the right side, the map that shows the soil map for the area that is to be covered by this particular plan. It is our findings that the kinds of soil that exist at the present time there are not permeable. That eliminates that kind of treatment plant or facility for meeting the treatment needs.

These two slides on the left are the topographic maps and show the elevation of the area and the plant sites and the general area around it. On the right side is the area that is subject to hundred year floods. Also shown here is the plant location which is beyond.

The outside area is subject to floods. There is a lot of open space that is subject to flood and this could be created into parks and recreation areas if the City of Houston does so desire.

I think I am missing a slide on the left side here but on the right side is the climatic conditions, some of the inputs that we have considered from the wind directions and identifying the impact of the project on the area, -- the wildlife. These things are all explained in detail in the report itself.

Here are a couple of slides that indicate the project area itself is really not inhabited by wildlife or marinelife or related aspects. On the left side is a map that shows the subsidence problem for the City of Houston. On the right side is the air pollution -- as we all know, half the total pollution in the City of Houston is coming from automobiles, which indicates the kind of solution the city has to undertake sooner or later.

As far as the land surface subsidence, those of you here are very familiar with that problem. Up to 1973, parts of the City of Houston have subsided as far as ten feet in the northwest area, the subsidence has been two to three feet, as we have found out.

These are two land use maps and they show the existing land use and the proposed land use. A lot of land in the service area is vacant and available for urban development. On the right hand side is the projected land use and shows how the open land is going to be used and that would really create the demand for these kinds of facilities.

The proposed project is a four MGD facility at the present time with projected twelve MGD. The existing quality of the effluent for the treatment plant -- a couple of figures are misprinted here. The BOD_5 should read as 7 and the TSS should read as 24.

When you add this kind of system that they are proposing, under that the projected effluent quality according to our calculations would be 8.2 and 6.6 for a BOD_5 and suspended solids.

These projected standards when compared against the requirements of EPA as well as the Texas Water Quality Control Board are by far below the requirement level. So in this particular term, the project more than satisfies the environmental requirements as far as impact on water quality is concerned.

This is coming a little closer to the area where the project is located. On your right side is an aerial map and you can see the existing plant and its occupancy as well as the proposed expansion. We found out that there is a lot of land available to each side which could be used possibly as a neighborhood park and that is indicated on the left hand side slide. The reason that this suggestion has been made is because the areas on the east and north are good residential developments where a lot of people live who can use these facilities and it is a ideal location to meet the recreational needs, also. The idea here is to develop the multi-purpose use, if possible and if it is possible at this location, provided that the City of Houston does accept this position. It is not, however, a requirement.

The slides here show the plant itself, the aeration and the reaeration tank on the left side. The clarifier is on the right side. This is a pretty good plant as it operates at the present time.

Here is the Cole creek into which the effluent from the plant is discharged at the present time. On the left side you can see the plant itself and on the other side -- looking from the northwest to the southeast -- you can see the plant on this side and you can see the residential development on this side of the creek. This is a good residential quality development and, of course, this will detract somewhat but not to an extent that the project is not feasible.

The Northwest Freeway which is under construction in that area would start a lot of development in that area. On the right side is another residential area that is called Acres-Home. The EPA would like to make sure that this kind of character that does exist at the present time will not be affected.

There is a lot of open space here, trees, and some commercial development.

Now, the considerations on the alternative to the proposed action, a variety of alternatives have been considered, both of the treatment process as well as the location. I am not going to read all of these things in detail. They are all documented in the report.

The proposed system itself is the biological treatment and we have a slide to show you later on.

The alternative location here to the plant would be a one mile distance.

Greg, maybe you would like to go over there and show the location there. Do you mind?

(At this time, Mr. Edwards indicated the location on the map.)

That is the proposed location. About one mile west is a plant that has been abandoned. We did consider both as to which one would be more desirable. We considered three alternative ways; (1) the way it is now; (2) the other one is to have the complete plant located on the Forest location and (3) the third one is distributing half and half between the two plans. Of course, the detailed evaluations have been shown in the report and indicated that the proposed location is a better location.

The alternatives also include the no action alternative required by law. In many cases, this alternative is better than many other alternatives. In this particular instance, the no-action alternative should have no effect on the autos beyond the present level and no impact on the air quality. It will not help the water quality.

It will not help the water quality because the present water quality is not as good as the projected one. In terms of the water quality, the no-action alternative will not help at all. At the same time the correlated factors on the aquatic life -- there won't be any adverse effect on the wildlife but the no-action alternative will not address the problem of public health which is a major significant problem which must be addressed by this kind of public investment.

Here on the primary impact, there will be some effect on odors but it will not be significant. There will be very little impact on the air quality. You will have a very positive impact on water quality and a positive effect on aquatic life. There will be very significant impact on wildlife and plant life. Of course, it will not help the economic development, it will have a very beneficial impact on public health.

The secondary impact is not quantifiable. We did make an attempt to quantify this and the chart on the right indicates the amount of land that will be organized as a result of this project. Altogether over 3,500 acres could be served by this facility.

Of course, there will be some effects that can not be avoided. There are the parts of the project itself, the disruption, the inconvenience and some noise during construction, some loss of habitat, very little impact on air pollution and there will be some occasional odor problems. These are the things that have to be traded against the benefits derived from the facility. The secondary adverse impact -- I would like to make a qualification here -- as a result of the 43,000 population, there will be a lot of adverse impact -- on the air quality on the water quality, the drainage and subsidence and so forth. These problems could be avoided if the City of Houston does adopt some sort of environmental program.

EPA is not saying -- it is my understanding that since these problems do not exist as a result of the project, that is why there can not be any requirements that have to be imposed. That is simply because some of the problems will occur in the next sixteen-year period. During which time the agency of the city government will have the opportunity of undertaking programs to alleviate the problem. The purpose here is really to point out that unless appropriate programs are undertaken, some of these problems will be serious enough to the extent that they will jeopardize the environment. And that is a very big problem that could come from the secondary impact. It will not be adverse if these programs are undertaken.

Considering all these various social and economic and environmental needs, the preliminary finding is that there is a need for this project. Its also feasible. It also satisfies the requirements, the environmental requirements by the Environmental Protection Agency. That is a preliminary finding, it is not a recommendation. It is also believed that if the project is built, it will not give rise to the conditions as you see on these slides. It will also not alter the conditions which are desirable and which should be obtained from the project area. And it seems that some of these things could be enhanced, particularily the water quality, by the kind of construction you have in this project.

I think that is all I have.

HEARING OFFICER: Thank you, Mr. Husain.

Lets go ahead and proceed with the formal statements of those of you who have indicated a desire to speak and then we will allow some questions of Mr. Husain or Mr. Edwards.

Elaine Clark, would you like to make your presentation at this time?

MS. CLARK: I am Elaine Clark, a geologist with the Houston Geological Society and I have taken the oath.

The Houston Geological Society with a membership of over 2,000 in the metropolitain area of Houston is vitally interested in the captioned project with its attendant draft impact statement. Geologists are exposed to the environment and environment problems quite early in their educational and professional careers and as a consequence are very much aware of the importance of changes that occur to the surface and the subsurface of urban and suburban areas. The majority of our membership live within the confines of the City of Houston and as residents and concerned citizens are doubly interested in the proposed program.

We feel that improvement of water quality in our streams, bayous, Ship Channel, and subsequently Galveston Bay is a prime environmental consideration. We are in favor of the construction of additional wastewater facilities for the City of Houston to ensure a better water environment.

The proposed wastewater facilities may be affected by active geologic processes in the general area. These processes include possible surface faulting and land subsidence associated with subsurface fluid withdrawal. The gravity of these geologic problems is not fully known at this time. However, at this state we do not want to see the project delayed but do suggest that additional geological studies both surface and subsurface be made.

Thank you.

HEARING OFFICER: Thank you, Ms. Clark.

Mr. Martin Sheets.

MR. SHEETS: I am Martin Sheets, a Houston independent consultant, representing myself on geologic matters relating to the environment and our energy supply. The section on geology in the subject Environmental Statement is fine as far as it goes. However, it seems to fail to recognize the tectonic features of the area which could be very important and it seems to lack input by knowledgeable local geologists.

The proposed Eleventh Street Lift Station is located well within one of the best known and most active zones of surface faulting in the Houston area. The proposed sludge line crossed this same zone of active surface faults and other areas in which faults are suspected.

The entire project is located within the area affected by significant subsidence. All of these geologic factors deserve careful consideration if the facilities are to operate safely and efficiently.

Thank you.

HEARING OFFICER: Thank you, Mr. Sheets.

Does any one else have any comments they wish to make? Does anyone have any questions of any of the people who participated here?

Would you identify yourself?

MR. MILLER: I am Charles Miller with the Harris County Commission Control Department. I would just like some further clarification on what the existing BOD and total suspended solids values are and if this is a thirty-day average or what do the numbers represent?

HEARING OFFICER: That was the numbers you saw which were around four and projected to be eight later on for the BOD?
Do you know --

MR. HUSAIN: The existing BOD_5 value for this particular project is seven. That was a mis-print in the slide and the TSS -- twentyfour. The projected BOD_5 is 8.0 and the projected TSS is 6.6. These are in the report.

MR MILLER: OK. Are these three-day averages?

MR HUSAIN: No they are five days. Monthly BOD five-day averages.

MR. MILLER: Thank you.

MR. HUSAIN: Incidentally the projected values are much lower than what the standards by the Texas Water Quality Board and the EPA call for.

I would like to make one comment here while the meeting is still on and that is the proposed sludge line is not a part of the project. However, it is not a part of the grant application. The City of Houston has build a facility or is in the process of building it under their own funding. That doesn't mean that this particular thing would not be considered since we are covering the entire service area. Anything that happens within this service area will be considered.

Your comments are well taken.

Thank you.

HEARING OFFICER: Thank you. Are there any other questions or comments?

I have received one letter from a Mr. H. C. Clock, Associated Professor of Geology and it is to EPA. I am going to enter this as Exhibit 1 to this record.

I might remind you that the hearing record does remain open for ten calendar days from this date and we will accept any modifications for additional submissions that you would like to send in as exhibits to the record.

Hearing no further comments, I would like to thank you all for attending and participating and with that, call this hearing to a close.

CERTIFICATE

I, LINDA SCHMANKE, Certified Shorthand Reporter, do hereby certify that the facts as stated by me in the caption hereto are true;

that the foregoing proceedings were made before me by the indicated speakers hereinbefore named and were thereafter reduced to typewriting by me or under my direction.

Given under my hand this 15th day of January, 1975.

Linda Schmanke

Linda Schmanke, CSR

RICE UNIVERSITY

HOUSTON, TEXAS
77001

DEPARTMENT OF GEOLOGY
AREA CODE 713
528-4141

November 14, 1974

FILED
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EPA REGION VI
HEARING CLERK

Mr. James Collins
Regional Hearing Officer
Environmental Protection Agency
1600 Patterson Street, Suite 1100
Dallas, Texas 75201

Dear Mr. Patterson:

I have examined the draft EIS for the Northwest Regional Wastewater Treatment Plant, Houston, Texas (WPC-TEX-1020). I would like to make certain that you are aware of the active faulting in the 34th Street area. These faults are described in the literature and are under observation now by our group as part of an ongoing monitoring project.

This faulting does not affect the treatment plant itself but does apparently intersect the sludge line and interceptor system described on pages 13 and 86 in the vicinity of T. C. Jester and Sherwood Lane. There is active vertical displacement of the ground surface in the fault area which, over time, might have an effect on concrete work associated with the gathering system.

A reasonable solution to this conflict with the geologic environment might involve spot observations of this effect in the fault area and repairs as necessary. We would be happy to meet with the interested parties to pinpoint the fault area.

I will be at the Geological Society of America Meeting on November 18 and thus unable to attend the hearing. I would appreciate it very much if you would make certain that this letter is read into the record at that time.

Sincerely,

H C Clark

H. C. Clark
Associate Professor of Geology

HCC:bbh

cc: Mr. Charles Menut, Chairman, Environmental Co

ENVIRONMENTAL PROTECTION AGENCY
REGION VI
1600 PATTERSON, SUITE 1100
DALLAS, TEXAS 75201

February 5, 1975

OFFICE OF THE
REGIONAL ADMINISTRATOR

Re: ENVIRONMENTAL IMPACT
STATEMENT NUMBER 7413

TO ALL INTERESTED GOVERNMENT AGENCIES, AND PUBLIC GROUPS

IN ACCORDANCE WITH THE NATIONAL ENVIRONMENTAL POLICY ACT, WE ARE FORWARDING OUR FINAL ENVIRONMENTAL IMPACT STATEMENT TO THE PRESIDENT'S COUNCIL ON ENVIRONMENTAL QUALITY FOR THE 30-DAY REVIEW PERIOD. THE FINAL STATEMENT WAS MADE AVAILABLE TO THE COUNCIL AND THE PUBLIC ON FEBRUARY 10, 1975

THE FINAL STATEMENT HAS BEEN PREPARED TO FULLY CONSIDER THE SUGGESTIONS, CRITICISMS, AND COMMENTS RAISED THROUGH THE REVIEW PROCESS. WE APPRECIATE YOUR PARTICIPATION IN THE REVIEW PROCESS.

Regional Administrator

Enclosures