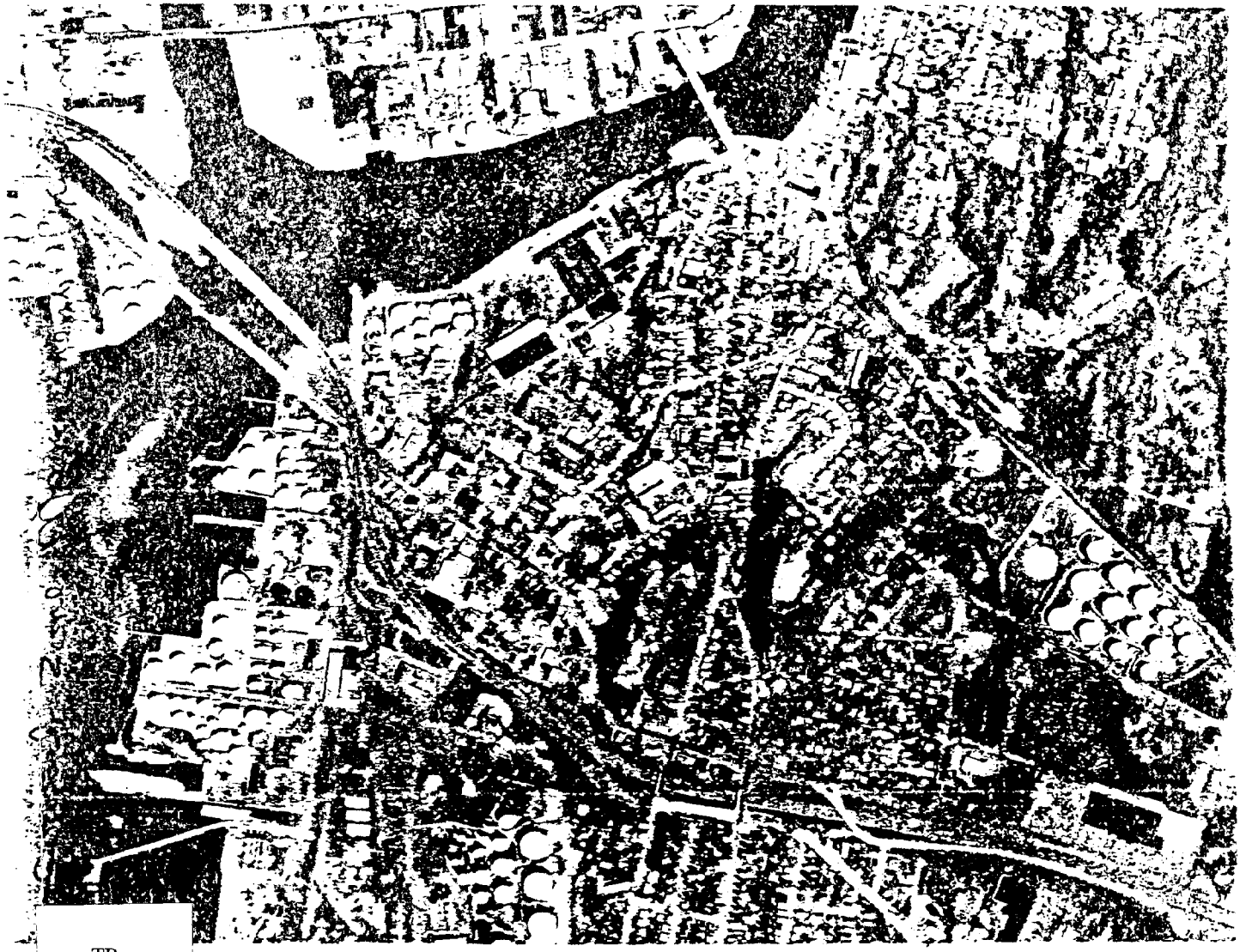
PETROLEUM STORAGE FOR NEW HAVEN HARBOR: WATERFRONT VS. INLAND



UDY OF THE FEASIBILTY OF LOCATING NEW
OLEUM STORAGE CAPACITY OR RELOCATING
EXISTING TANK FARMS AT INLAND SITES

NEW HAVEN CITY PLAN DEPARTMENT

JUNE, 1980

PETROLEUM STORAGE IN NEW HAVEN HARBOR: WATERFRONT VS. INLAND

New Haven City Plan Department
June, 1980

This document was financed in part by a Coastal Energy Impact Planning Grant received through the Office of Coastal Zone Management, National Oceanic and Atmospheric Administraton of the U.S. Department of Commerce under Section 308 of the Coastal Zone Management Act of 1972 and was prepared in cooperation with the Connecticut Office of Policy and Management.

Executive Summary

Under a Coastal Energy Impact Planning Grant, the New Haven City Plan Department studied the feasibility of locating new petroleum tank farms or relocating existing waterfront tank farms to inland sites to free up valuable waterfront land for more intensive uses. While adequate petroleum storage is essential to the local and regional economy, tank farms do not require waterfront sites and in many places including New Haven, are located inland.

Alternative uses of scarce, attractive waterfront land are more productive in terms of tax revenues (the average assessment per acre for tank farms was $134,500 in 1978, compared to $170,000-$212,000 in two City industrial areas and $1.6 million for a proposed waterfront condominium development); employment (tank farms employ an average of only 2.7 people per acre, compared to over 17 in an older industrial area); and amenities to the City and region. An inactive use occupying 80 acres of prime waterfront land with unattractive structures, tank farms not only preclude use of their sites for more active and/or water dependent uses, but detract from the overall appearance of the harbor, reducing its desirability for non-industrial and recreational boating use, especially in the Quinnipiac River area.

The idea of inland tank farm development is not new. In New Haven, 26% of the storage capacity is located at inland sites through private action, and the Long Island Sound Study recommended in 1975 that New Haven's remaining waterfront storage be relocated inland to the extent feasible. The Connecticut Coastal Management Act (P.A. 79-535), passed by the General Assembly in 1979, contains a policy specifically discouraging the siting of new tank farms in the coastal zone, giving localities the power to deny approval for such uses.

New Haven Harbor is a major petroleum port playing a vital role in supplying a large market area covering Connecticut, Western Massachusetts, Southern Vermont and Long Island. New Haven is the second largest New England port in terms of petroleum product (as opposed to crude oil) handled, receiving an estimated 64 million barrels in 1979 at 11 ship and barge terminals. Of 60 million barrels received in 1977, the last year for which a breakdown by product is available, 12.9 million (22%) were heavy residual oil, 19.8 million (33%) were distillate oil (diesel and #2-#4), and 24.6 million (41%) were gasoline.

On their way to end users, these products were stored in 209 tanks with a total storage capacity of 10.4 million barrels. Of these, approximately 4.8 million barrels (46%) are located on prime waterfront land in three areas: the East Shore industrial area on both sides of Interstate 95 (2.8 million bbls; 49 acres), the Belle Dock area on the West Shore (1.5 million bbls.; 17 acres), and in Fair Haven on both sides of the Quinnipiac River (545,000 bbls.; 14 acres).

This study projects a leveling of petroleum throughput volumes over the next twenty years based on a review of several government petroleum demand projections and discussion with industry sources and government officials. Although many authorities feel that demand will actually fall due to price increases, fuel switching and conservation efforts, the leveling trend was used in this study to provide a margin of safety in estimating future facility requirements. State and Federal policy encourage maintaining and expanding reserve storage capacity.

Future petroleum storage capacity needs depend on desired reserve capacity and intensity of facility use as well as on end use demand for petroleum products. It is clear from both historical experience and industry interviews that the present storage capacity could handle considerably more product or conversely, the same product receipts could be handled with less storage capacity used more efficiently (in 1973, 9% more product was handled with a storage capacity at least 7% lower than at present).

Relocation alternatives ranging from 170,000 to 4.8 million barrels are explored in Sections V-IX. A maximum program to relocate all 4.8 million barrels of waterfront storage capacity occupying 80 acres of prime waterfront land to an inland site or sites, whether by private, public, or joint action, would be extremely costly, somewhere in the neighborhood of $55-60 million including land, construction, and a pipeline to a waterfront terminal. Relocation of just those tanks not in the east shore port area would cost $27-30 million and free up 31 acres of waterfront land. The least ambitious relocation programs would not require any new construction because the throughput of these smaller facilities in less industrialized areas could be handled easily by other terminals.

The cost of a relocation program would be offset by several factors. On the private side these include the lower operating cost associated with a larger, centralized,

modern facility; the gain from using less valuable inland land and selling waterfront acreage; the lower property tax burden if located in outlying towns; and the tax advantages associated with new business investment, particularly depreciation deductions and investment tax credits. On the public side, these include the possibility of increased tax revenues; more active and water dependent use of the harborfront and the spillover effects of increased land values and development potential in the vicinity of the tank farm sites and throughout the harbor; and lower risk of large oil spills or catastrophic fires from the old tank facilities.

Relocation of waterfront storage capacity could be accomplished through private action, direct public intervention (public or quasi-public development of new facilities, public acquisition), or regulatory approaches such as zoning or coastal site plan review.

Many professionals with an interest in the harbor and even several terminal operators felt that eventually modern, consolidated, inland tank farms would be the most efficient method of petroleum storage and distribution. However, given the high cost of new tank farm development, wholesale relocation of waterfront petroleum storage capacity appears to be unattainable at the present time.

The lesser scale relocation programs, however, have a better chance of success. The smaller facilities up the Quinnipiac River are located in areas which are ripe for conversion into more intensive, compatible, and people-oriented uses. These facilities have the lowest tax yield of all the tank farms, averaging $95,000 in assessed value per acre compared to $134,000 overall.

In light of these findings the study concludes that:

1. Although technically feasible and operationally advantageous, Large scale relocation of waterfront tank farms through public intervention would not be economically feasible or cost effective at this time. Over the long term as existing waterfront tank farms deteriorate and the combined cost of operating numerous smaller terminals increases, inland development would gain in relative attractiveness and become more feasible. The City should encourage the State to create a quasi-public petroleum storage development entity to create inland storage areas if and when the economics of the proposition improve.

2. The City should, however, develop a long-term policy for inclusion in its Municipal Coastal Program which specifically prohibits development of any new storage capacity or expansion of existing terminals on the waterfront except under extreme circumstances. This policy could be implemented through the City's powers under state zoning enabling legislation and the Coastal Management Act.

3. The policies of the Municipal Coastal Program should guide the private market in appropriate reuse of waterfront parcels now occupied by tank farms should those facilities be phased out.

4. The City should seriously consider the acquisition and phase-out of smaller tank farms on the Quinnipiac River in or adjacent to the Quinnipiac River Historic District. Reuse of this land would not only provide for higher tax-yielding development, potential public access areas, and other people-oriented uses, but would also greatly enhance the land values and ambience of the entire area.

5. As long as New Haven remains a regional petroleum storage center, the City should seek some means of compensation for the burden of low tax-yielding tank farm uses. This could be accomplished by an inventory tax on the oil stored.

PETROLEUM STORAGE IN NEW HAVEN HARBOR: WATERFRONT VS. INLAND

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Preface

The City of New Haven is in the process of developing a plan for its coastal area under the provisions of the recently enacted Connecticut Coastal Management Act (P.A. 79-535). This report deals with one of the major uses of waterfront land in the harbor area: petroleum receiving and storage facilities, also known as tank farms.

Throughout this study, the tank farm issues have been explored in the overall context of the City's harbor planning program. Present and potential land uses have been evaluated for consistency with the planning objectives which guide the overall planning effort and the formulation of alternatives in this report. These objectives include:

1. To stimulate and plan for the maximum possible use and reuse of the waterfront. New uses should be developed within the context of a coordinated plan which designates particular waterfront areas for particular uses;

2. To expand and enhance public access to the waterfront throughout the harbor, whether through public open space or through private commercial development;

3. In waterfront industrial areas, to reserve scarce land to the fullest extent possible for water-dependent or water-related industrial uses. Uses with the highest employment per acre and tax assessments per acre should be sought, and measures should be taken to promote more intensive use of underutilized parcels of land in the furtherance of these objectives; and

4. To protect natural coastal resources by ensuring sound development practices through the coastal site plan review process.

An ancillary objective of this report is to provide information on the operation of the petroleum distribution system in this region which will assist policymakers and the public in evaluating energy policy options.

I. Introduction

The New Haven City Plan Department sought and received a Coastal Energy Impact Planning Grant under Section 307 of the Federal Coastal Zone Management Act of 1972 to determine the feasibility and desireability of locating new or relocating existing petroleum tank farms on inland sites. The goal of such a project would be to free up scarce, valuable waterfront land for more intensive and/or people-oriented uses while simultanteously increasing the overall desireability of the harbor by removing visually unattractive structures. In the process of looking at New Haven's tank farm operations, this study re-examines the recommendations in the 1975 Long Island Sound Regional Study of the New England River Basins Commission that waterfront tank farms be relocated to inland sites wherever possible and evaluates the feasibility and economic impact of the State coastal policy of discouraging coastal siting of new tank farms (Connecticut Coastal Management Act, P.A. 79-535, Sec. 2(b)(1)(E)).

Several coastal planning efforts in Long Island Sound and elsewhere as well as extensive private sector experience now suggest that present day pipeline technology obviates the need for waterfront tank farms. The presence of two major inland tank farms receiving petroleum products through New Haven Harbor, representing 26% of the storage capacity associated with the Harbor, demonstrates that inland storage is not only operationally feasible but is considered economically feasible by petroleum marketing companies. In fact, numerous examples of private development of inland tank farms can be found along the Hudson River, on Long Island, and at ports such as Port Everglades, Florida.

The coastal management literature discusses the many conflicting demands being placed on waterfront land, and considerable public attention has been focused on urban waterfront revitalization recently, both nationally and in New Haven. Port-related, commercial, and residential reuse projects in Boston, Seattle, San Francisco, and Baltimore have demonstrated that tremendous public benefits and private profits can flow from ambitious harbor redevelopment plans which create unique people-oriented environments, taking full advantage of waterfront amenities and siting. In some instances, these projects have been combined with port and industrial developments as well.

In carrying out the study objectives, this planning report explores:

1. The demand for petroleum storage capacity in the New Haven market area now and over the next 20 years;

2. The employment and tax revenues associated with the tank farm uses compared to those generated by alternative uses;

3. Alternatives to the present practice of locating and expanding petroleum storage facilities at the water's edge; and

4. The practicality of providing incentives for the relocation of existing storage capacity to or the provision of expanded capacity at inland locations, including possible operational changes and institutional forms which might be needed to accomplish this.

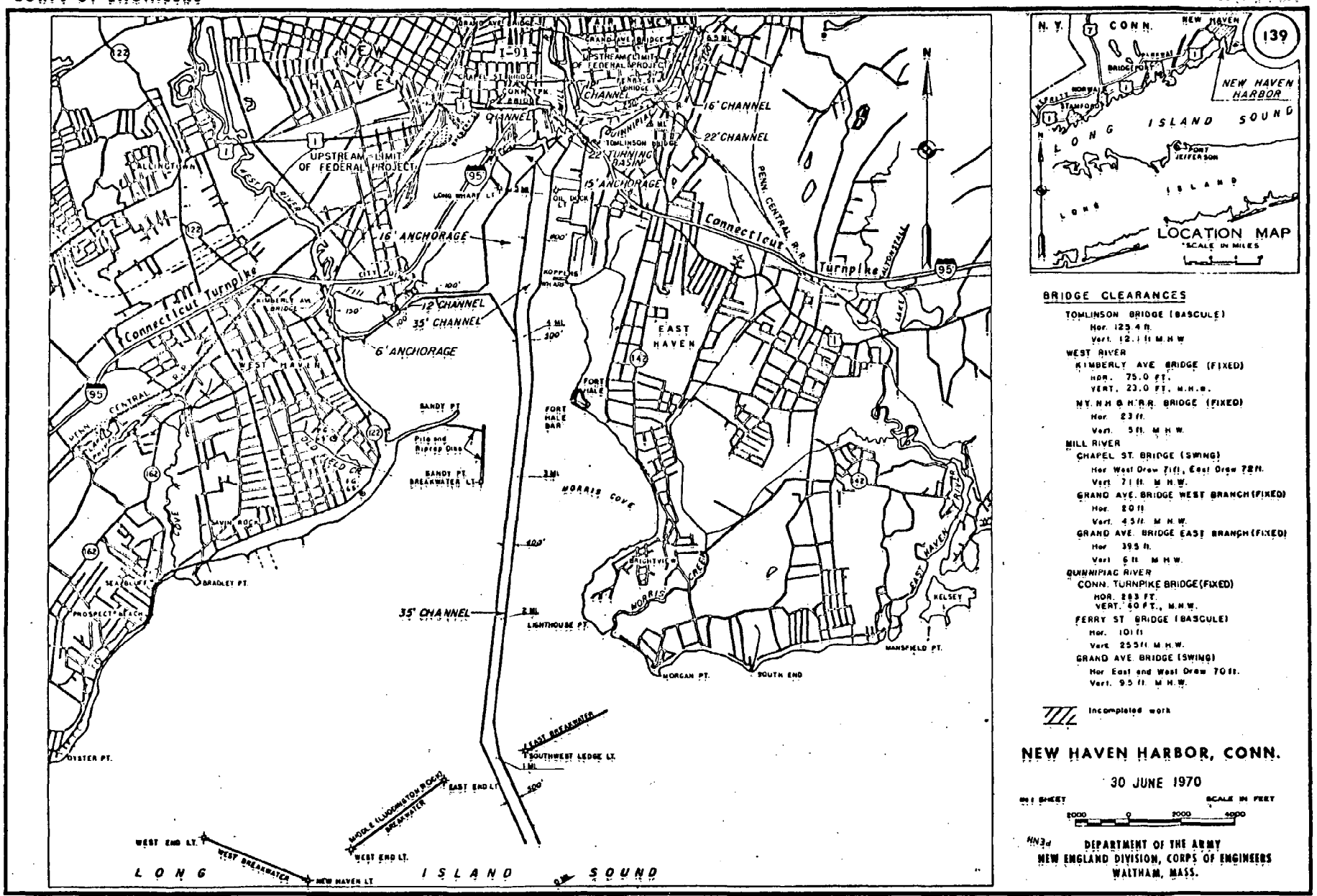
The study is based on detailed personal interviews with each terminal operator; interviews with others in the petroleum industry; assembly of data from a variety of local, state and federal sources; and review of the literature on petroleum company operations and coastal siting of energy facilities.

The feasibility of tank farm relocation depends to some extent on its impact on the operating profits of the companies which own and manage the tanks. While some of the terminal operators were helpful in a general way, most were understandably reluctant to provide information which would allow detailed asssessment of the impact of various tank farm relocation schemes on either profitability or prices. Several of the multi-national oil companies refused to provide any information about their operations whatsoever. To the extent estimates of impacts on price or profit were attempted, they are based on hypothetical situations.

This report will not consider the question of chemical storage facilities in any detail. New Haven Terminal (NHT) has chemical storage tanks with a capacity of 431,000 barrels at its waterfront site, and DuPont has two small sulfuric acid tanks at its barge terminal on the Quinnipiac River. NHT, the largest chemical terminal in New England, handles at least nine different chemicals for four principal and several other firms and each chemical has its associated hazards and storage requirements. Relocation of these facilities would require a number of dedicated pipelines which do not appear to be economically feasible given the volumes received.

CORPS OF ENGINEERS

U.S. ARMY



BRIDGE CLEARANCES

TOMLINSON BRIDGE (BASCULE)
Hor. 123.4 ft.
Vert. 12.1 ft M.H.W.

WEST RIVER
KIMBERLY AVE BRIDGE (FIXED)
HOR. 75.0 FT.
VERT. 23.0 FT. M.H.W.

NY. N.H & H.R.R. BRIDGE (FIXED)
Hor 23 ft.
Vert. 5 ft. M.H.W.

MILL RIVER
CHAPEL ST. BRIDGE (SWING)
Hor West Draw 71 ft., East Draw 78 ft.
Vert 7.1 ft. M.H.W.
GRAND AVE. BRIDGE WEST BRANCH (FIXED)
Hor. 80 ft
Vert. 45 ft. M.H.W.
GRAND AVE. BRIDGE EAST BRANCH (FIXED)
Hor 39.5 ft.
Vert 6 ft. M.H.W.

QUINNIPIAC RIVER
CONN. TURNPIKE BRIDGE (FIXED)
HOR. 883 FT.
VERT. 60 FT., M.H.W.
FERRY ST BRIDGE (BASCULE)
Hor. 101 ft
Vert. 25.5 ft. M.H.W.
GRAND AVE. BRIDGE (SWING)
Hor East and West Draw 70 ft.
Vert. 9.5 ft. M.H.W.

Incompleted work

NEW HAVEN HARBOR, CONN.

30 JUNE 1970

INDEX SHEET

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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

MAP I-1 NEW HAVEN HARBOR CHANNELS

COASTAL ENERGY IMPACT PLANNING GRANT
New Haven City Plan Department June. 1980

II. The Petroleum Industry in New Haven Harbor

A. Overview

New Haven Harbor, a major petroleum port in New England handles about 15% of New England petroleum product receipts and 50% of Connecticut receipts (Table II-1). In 1977, New Haven handled more petroleum products (as opposed to crude oil) than any New England port other than Boston and was the fifth biggest handler of clean products on the eastern seaboard.

With about half the petroleum storage capacity of the state (Table II-2) New Haven is the major petroleum storage and distribution point for a market area extending throughout Connecticut, western Massachusetts, and southern Vermont and New Hampshire (Map II-3). An extensive network of facilities and supporting services has grown over the last 50 years to serve this market which until recently had been expanding rapidly.

Table II-1

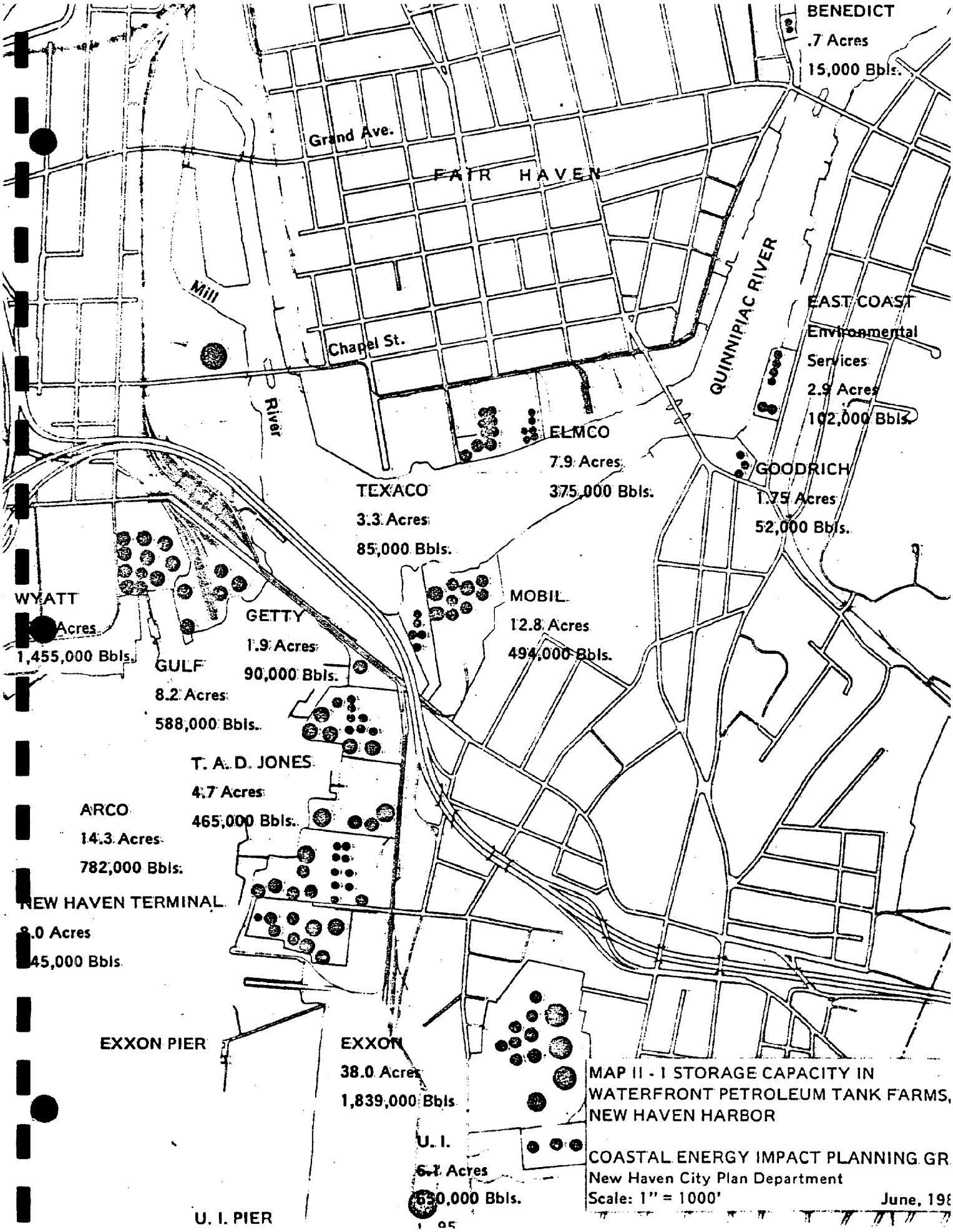
Petroleum Receipts and Shipments
in Major New England Ports and New York, 1977
(in thousands of short tons)

Port	Foreign		Domestic		Total
	Imports	Exports	Receipts[1]	Shipments	
Portland, ME	13,272[2]	--	4,351	646	18,269[2]
Boston, MA	6,119	1	15,017	2,427	23,564
Providence, RI	797	--	6,350	352	7,498
New London, CT	58	--	1,226	1,044	2,328
New Haven, CT	1,661	33	7,405	1,009	10,108
Bridgeport, CT	690	--	2,085	88	2,863
New York, NY	25,303	107	63,320	32,749	121,480

1. Includes "local" receipts.

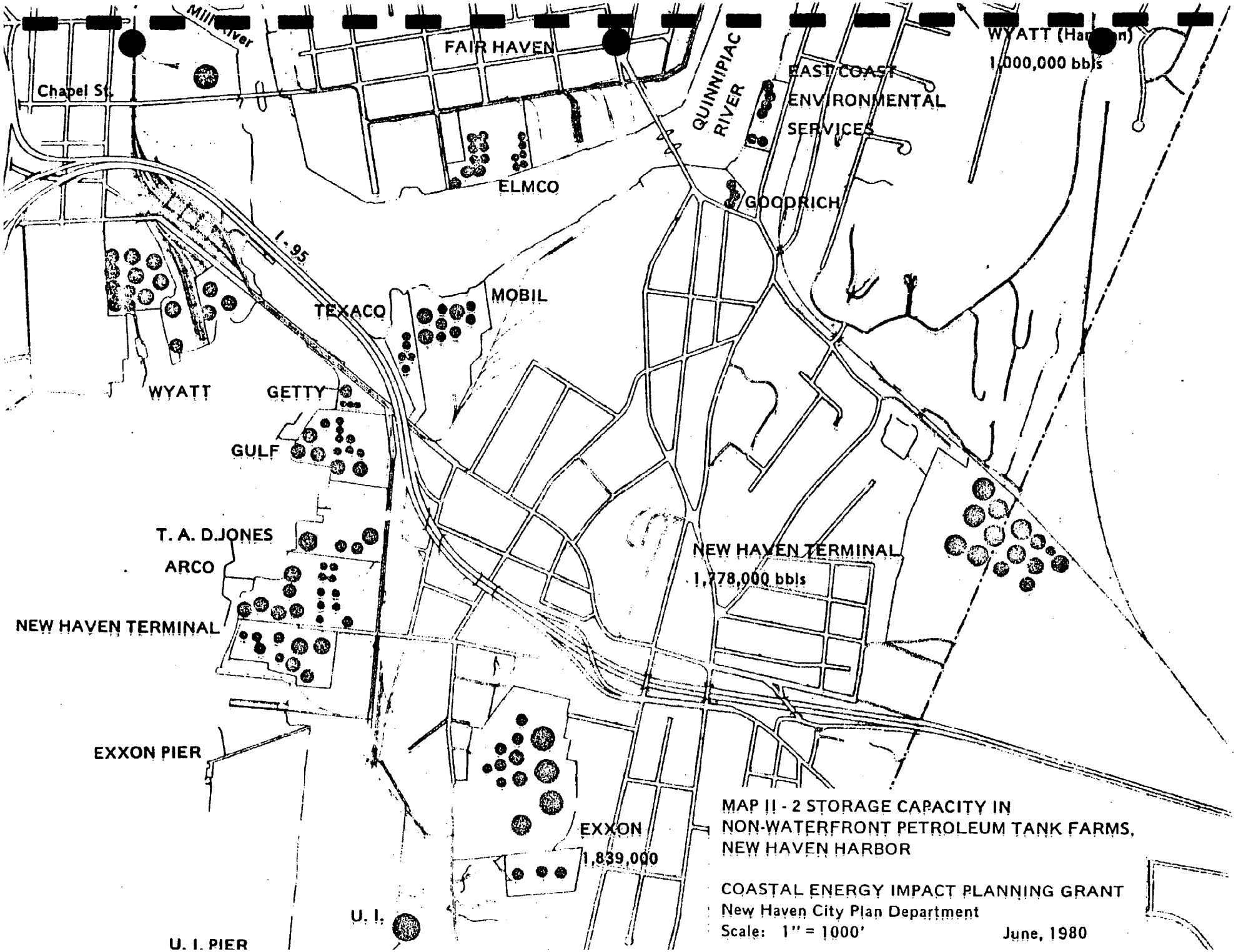
2. 67% of petroleum receipts and 92% of petroleum imports at Portland are crude petroleum destined for Canadian refineries via pipeline. This trade has decline considerably since 1977.

Source: U.S. Army Corpos of Engineers, Waterborne Commerce of the United States, 1977.



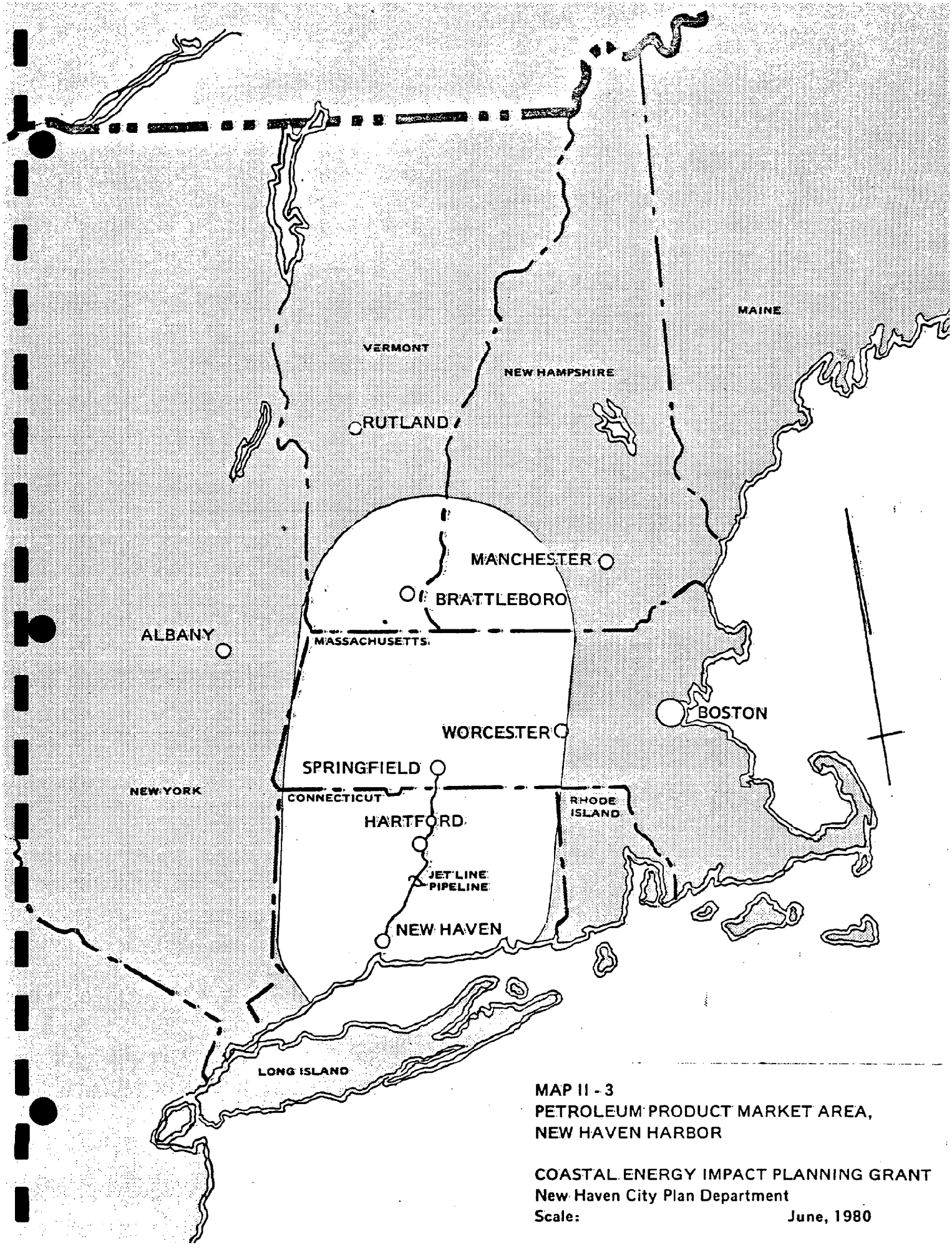
MAP II - 1 STORAGE CAPACITY IN WATERFRONT PETROLEUM TANK FARMS, NEW HAVEN HARBOR

COASTAL ENERGY IMPACT PLANNING GR
New Haven City Plan Department
Scale: 1" = 1000' June, 19



MAP II - 2 STORAGE CAPACITY IN NON-WATERFRONT PETROLEUM TANK FARMS, NEW HAVEN HARBOR

COASTAL ENERGY IMPACT PLANNING GRANT
New Haven City Plan Department
Scale: 1" = 1000' June, 1980



MAP II - 3
PETROLEUM PRODUCT MARKET AREA,
NEW HAVEN HARBOR

COASTAL ENERGY IMPACT PLANNING GRANT
New Haven City Plan Department
Scale: June, 1980

Table II-2

Estimated Petroleum Storage
Capacity in Connecticut, 1975
(barrels x 1000)

Product	New Haven		Conn. River		State		New Haven as Percent of State Total
	Total	%	Total	%	Total	%	
Gasoline	2,388	23	679	18	4,320	20	55.3
Kerosene	701	7	90	2	1,057	5	66.3
Distillates	5,339	51	1,719	47	10,588	50	50.4
Residual	2,000	19	1,194	32	5,384	25	37.1
	10,428	100	3,682	100	21,349	100	48.8

Source: Connecticut Energy Advisory Board, 1975.

The dominance of the local petroleum business by a small number of majors (even Wyatt, an independent, buys most of its products from Exxon) is an important factor in any local or state planning for the harbor area. With vast capital resources, and extensive control over all phases of production and marketing, the majors are not constrained by the same market financing forces which govern local businesses. Agreements among majors doing business in New Haven may reflect corporate deals involving numerous facilities throughout the nation would rather than objective market conditions in New Haven.

B. Operations and Throughput

1. General

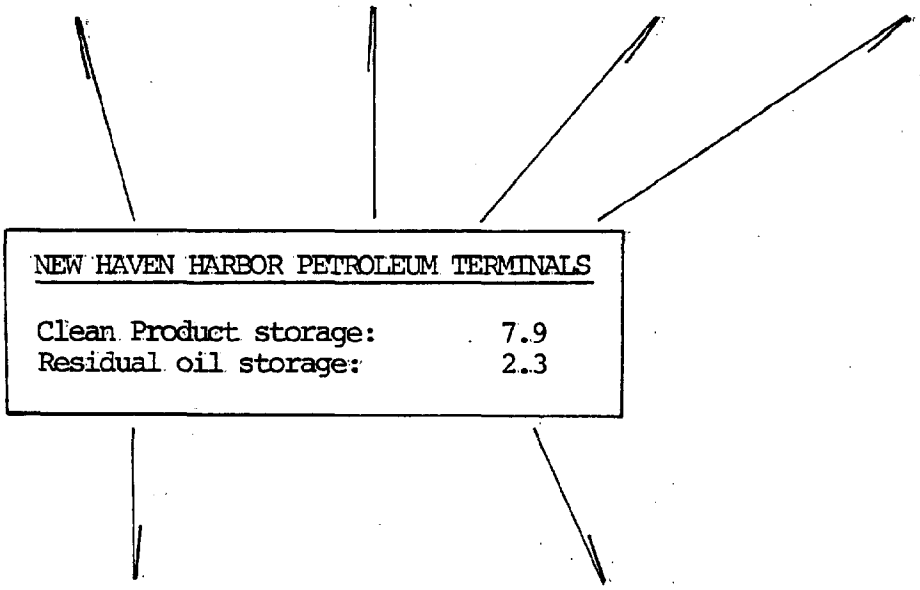
In 1977, the last year for which informaton on receipt by product are available, petroleum terminals in New Haven received 60.1 million barrels of petroleum products primarily from the Gulf area and Carribean refineries by ship and from New Jersey and mid-Atlantic refineries by barge.

The major products were motor gasoline (24.6 million barrels) distillates for heating oil and transportation (19.8 million barrels) and heavy residual oil primarily for utility and industrial uses (12.9 million barrels). Lesser quantities of jet fuel, kerosene, naptha and asphalt were also received (Table II-3). Figure II-1 provides a schematic presentation of the flow of petroleum products through the regional distribution system.

FIGURE II - 1

FLOW OF PETROLEUM PRODUCTS THROUGH NEW HAVEN HARBOR
1977
(millions of barrels)

	Rail	Pipeline	Truck	UI*
Clean Products	0	14.0	28.0	0
Residual Oil	2.0	0	4.0	3.4



	RECEIVED BY WATER	SHIPPED BY WATER
Clean Products	46.4	4.4
Residual Oil	12.9	3.5

* Residual oil burned by United Illuminating at their Harbor Station

Source: U. S. Army Corps of Engineers, Waterborne Commerce of the U. S.; New Haven City Plan Department survey.

Table II-3

Receipts and Shipments of Petroleum Products,
New Haven Harbor, 1977
(barrels x 1000)

	RECEIVED		SHIPPED		
Product	Barrels	% of all Receipts	Barrels	% of Product Received	Total
Gasoline	24,551	40.9	1,794	7.3	26,345
Jet Fuel	1,549	2.6	170	11.0	1,719
Kerosene	553	.1	47	8.9	578
Naphtha	533	.1	9	1.7	542
Distillates	19,833	33.0	3,000	15.1	22,833
Residual	12,858	21.4	3,523	27.4	16,381
Asphalt	203	.3	24	11.8	227
Total	60,058	100.0	8,567	14.3	68,625

Source: U. S. Army Corps of Engineers, Waterborne Commerce of the United States, 1977.

After discharge into tankage on the waterfront or inland, the products are either shipped out by barge to other coastal or river terminals (8.0 million barrels), shipped north on the Jet Line pipeline (about 13 million barrels of clean fuels), shipped north by railroad tank car (about 2.0 million barrels of residual oil), or distributed directly from tankage to retailers and end-use customers throughout the market area by truck (37.1 million barrels).

Approximately 64 million barrels of petroleum products were received in 1979, having a total estimated value of over $1.63 billion at late 1979 prices, assuming that roughly the same proportion of each product was received in 1979 as in 1977 (Table II-4).

Product throughput statistics show a leveling off of receipts in recent years after nearly continuous growth for the last 20 years (Table II-5). After growing at an average annual rate of 5.0% per year from 1961 to 1973, receipts dropped by 12% from 1973 to 1977. The exception to this trend was motor gasoline. This leveling is attributable to increases in price, which have spurred conservation and fuel switching and to a slowing of population and economic growth rather than to a drop in the harbor's share of the regional petroleum market.

Table II-4
Estimated Value of Petroleum
Products Received in New Haven Harbor

Product	1977 Receipts (bblsx1000)	1977 Average Price ($1/bbl)	1977 Value ($x10)	1979 Estimated Receipts (bblsx1000)	1979 Average Price ($/bbl)	1979 Value ($x10)
Gasoline	24,551	16.13	$366.0	26,288	30.66	805.0
Jet Fuel	1,549			1,660	N.A.	
Kerosene	531	16.13	8.6	569	29.40	16.7
Naptha	533	N.A.			N.A.	
Distillate Oil	19,833	15.41	305.6	21,270	29.40	625.3
Residual Oil	12,858	6.40	8.23	13,767	13.44	185.0
Asphalt	203	N.A.			N.A.	
	60,058		$	63,554		1,633.1

Source: U.S. Department of Energy (prices); U.S. Army Corps of Engineers (1977 receipts); U.S. Coast Guard and New Haven City Plan Department (1979 estimated receipts).

Table II-5
New Haven Harbor Petroleum Receipts
Selected Years, 1961-1977
(in thousands of short tons)

Product	1961	1963	1965	1968	1973	1975	1977
Gasoline	1425	1633	1899	1857	2717	2864	3336
Distillates	2257	2210	2545	3251	3775	3220	2998
Other Clean Fuels	338	229	381	256	174	352	384
Residual	1543	1937	2236	2673	3408	2124	2160
Asphalt	37	73	113	79	22	44	35
Other	3	34	1	4	5	8	-
Total	5603	6116	7175	8120	10101	8612	8913

Source: U.S. Army Corps of Engineers, Waterborne Commerce of the U.S.

Each product has different handling requirements, demand characteristics (seasonality, location), and economics of distribution, all of which affect storage requirements. The products range in gravity and viscosity from gasoline, which is highly volatile (7.44 bbls/ton); to home heating oil and deisel fuel (6.61 bbls/ton), also known as middle

distillates; to residual or #6 fuel oil (5.95 bbls/ton), which must be heated to be pumped (See Appendix A).

The sections below discuss handling, demand, and distribution characteristics of each major product. Data on throughput by product and on distribution has been derived and cross-checked by using several sources: Waterborne Commerce of the United States, U.S. Army Corps of Engineers (1977 is latest available); U.S. Coast Guard, Captain of the Port, Quarterly Statistics; State of Connecticut, Office of Policy and Management (OPM); and company data when available.

2. Residual Oil and Asphalt

Of the 12.9 million barrels of residual oil received in 1977, approximately 2 million were shipped north by rail tank car to Springfield, Massachusetts, and 3.3 million (25.7%) were shipped out by barge. As much as 30% of the total receipts were consumed locally to generate electricity at the United Illuminating Harbor Station. The rest (3.6 million barrels) was distributed by tank truck to regional industries except for a small amount delivered by insulated pipeline to the Simkins Company on East Street and the U. I. English Station on the Mill River.

Residual oil, which is used primarily for electric power generation and industrial heating and process boilers, must be stored at a temperature of at least 130°F to keep it liquid enough for pumping. This not only raises handling costs due to requirements for tank and pipeline insulation and heating plant operation, but limits locational flexibility due to the high cost of insulated or heated pipelines required to pipe it. Wyatt, one of the four handlers of #6 oil in the harbor, requires rail access for product distribution.

The demand for residual oil peaks in the winter when the demand for industrial space heating and electric power also peaks, though this peak is less extreme than that for home heating oil (#2).

Asphalt arriving by ship or barge must also be heated for storage, piping and handling. Wyatt is the only asphalt receiver in the harbor, bringing in 203,700 barrels in 1977. About 12% of that was shipped out by barge and the rest by truck.

3. Distillates

Distillate receipts in 1977 were 19.8 million barrels. Distillates, over 90% of which is #2 fuel oil, are distributed mainly through the Jet Line Pipeline or by truck, about 45% through each. Diesel, #3 and #4 fuel oil account for about 7-8% of the distillate demand in the state. A small volume

of the distillate oil, about 10%, leaves the harbor area on barges bound for Long Island and several Connecticut harbors. About 60% of the distillate going north by pipeline is destined for terminals in the Springfield, Massachusetts area while 40% goes to Connecticut terminals, primarily in the Hartford area. These figures mean that New Haven Harbor supplied from 50% to 60% of the Connecticut middle distillate demand of 23.7 million barrels in 1977, with the exact percentage depending on the destination of oil leaving New Haven by barge.

Distillate demand peaks during the heating season from December through March when 47% of sales are made and sales are twice what they are in June through September. Terminals in New Haven attempt to smooth out these peaks in their receipts and to avoid running low during cold spells by maintaining a large storage capacity. The objective is to have product on hand when demand is high, but to avoid having full tanks at the end of the heating season.

With refining output of distillates varying seasonally by only 4-5%, the excess production in summer must be stored at some point in the distribution system for sale during peak demand period. The major oil companies store the product at the refinery, at regional centers, and at distribution terminals such as New Haven. In the past, oil suppliers have had summer fill programs which offer fuel dealers either a discount on oil delivered during the summer months or an interest-free deferral of payment on summer deliveries until October 1st. The latter program which helped smooth out the peaks in deliveries has been hampered by price increases which have reduced the amount of oil that can be purchased under old credit limits by half.

4. Motor Gasoline

The 24.6 million barrels of gasoline coming into New Haven supplied about 70-75% of state demand in 1977. It is distributed mainly by tank trucks that carry about 170 barrels per load (about 125,000 truck loads annually), with about 7% going out by pipeline and 7% out by barge. New Haven terminals of most major oil companies serve the entire state and parts of New York and Massachusetts by truck. Of the approximately 1.6 million barrels going up the Jet Line, most goes to Hartford area terminals and none leaves the state.

Gasoline handling is complicated by its high volatility making it highly explosive and easily vaporized. Elaborate safety systems and procedures are required at gasoline storage tanks and truck loading racks under fire safety and air quality regulations. Air pollution regulations require

floating tops on gasoline tanks and expensive vapor recovery systems on truck loading bays. These measures have led to dramatic reductions in the emissions of hydrocarbons, a major ingredient of photochemical smog. Eventually, each terminal and truck loading bay will also have elaborate automatic foam fire suppression systems.

5. Jet Fuel, Kerosene, and Naptha

Lesser volumes of jet fuel (1,548,846 bbls), kerosene (531,107 bbls) and naptha (532,705 bbls) were received in New Haven in 1977. Of the jet fuel received 11% went out by barge and almost all the rest (1.38 million barrels) went north to Bradley International Airport in Windsor Locks and the Pratt and Whitney Aircraft factory in East Hartford via the Jet Line pipeline.

Kerosene is used primarily for residential space heating (43%) and by industry (57%) according to State OPM data. About 25% is shipped via Jet Line pipeline, a small percentage by barge, and the remainder by truck.

Naptha is combined with motor gasoline in local tanks and handled as gasoline from that point forward.

C. Receiving and Storage Facilities

1. Receiving Facilities and Usage

At present, the harbor has six berths for petroleum tankers drawing approximately 35-38 feet at five facilities, which also receive barges, and nine berths for receiving petroleum products exclusively by barge (Map II-1). This port is considered a major distribution center by the major multi-nationals, Mobil, Exxon, ARCO and Gulf, all of which maintain substantial facilities in the harbor, including the ability to receive deep draft ships (with Mobil using ARCO's pier). Getty and Texaco maintain smaller facilities, and the remaining large oil companies using the harbor have throughput arrangements with other terminals (AMOCO with Mobil, Tenneco and HESS with New Haven Terminal).

The largest independent, Wyatt Oil Company, operates a deepwater terminal, the only one on the west shore of the harbor. Several other independents receive products through New Haven Terminal Company, which does not take title to any products; two independents receive products by barge at their own terminals on the Quinnipiac River (Elmso) and in West Haven on the West River Channel (Connecticut Refining). Two small tank farms on the Quinnipiac River operated by small independents, Goodrich and Benedict, do not receive products by water. Two oil spill clean-up contractors

operate out of the smaller tank farms in West Haven (Farnham Environmental Control) and on the Quinnipiac River (East Coast Environmental Services), both of which store some products as well.

A range of vessels from small barges to deep draft oceangoing ships serve the harbor. According to Coast Guard data, approximately 1,314 barges (average 33,930 bbls.) and 234 ships (average 120,690 bbls.) used the receiving facilities to deliver or pick up petroleum products in a recent one year period (September, 1978 - August, 1979, Table II-7). The average quarterly vessel trips for the five busiest barge and ship terminals in their busiest quarters was 60 barges and 18 ships, or a barge about every 36 hours and a ship about every five days. The total vessel trips in the harbor in that overall busiest quarter (January-March) were 395 barges and 54 ships, or 4-5 barges per day and a ship about every other day (Tables II-6 and II-7). A noticeable shift from barges to ships in the second quarter of 1979 was presumably due to a tugboat strike during that period.

Vessel unloading rates determine both the time required in port and either the surge storage requirements at dock side or the pipeline and pumping capacity needed to move the product inland. A typical standard load barge of 32-37,000 barrels takes 6-10 hours to unload at a rate of about 3-6,000 barrels per hour. A typical ship carrying 125-140,000 barrels can unload in 7-14 hours at a rate of 10-18,000 barrels per hour.

While care must be taken in interpreting this vessel trip data, it appears that few of the terminals are used near capacity at the moment. Company interviews revealed, however, that each company prefers to maintain an exclusive pier facility to guarantee berth availability when needed even though common berths could be used more intensively.

If 70% of the berth-days were used, beyond which scheduling problems might occur, New Haven Harbor could handle 3,066 vessels per year, some mix of ships and barges, at existing pier and wharf facilities compared to a recent total of 1,548, an increase of 98%. In the busiest quarter, using the same factors, 40% more vessels could be accommodated.

These capacities could be increased with more efficient scheduling, but any major increases in usage or any reduction in the number of terminals through higher use of remaining terminals would require both physical improvements to the offloading and storage systems and increased cooperation among harbor users.

Table II-6
Petroleum Receipts and Shipments
New Haven Harbor 1977-1979

Period	Ships No.	Ships Barrels	Barges No.	Barges Barrels	All Vessels No.	All Vessels Barrels
1977						
Total, 1977						68,012.673
1978						
1st Quarter						20,167,356
2nd Quarter						15,067,356
3rd Quarter						15,961,460
4th Quarter	45	6,929,125	372	12,898,231	417	19,827,356
Total, 1978						71,017,804
1979						
1st Quarter	54	7,420,424	395	13,248,932	449	20,669,356
2nd Quarter	87	8,769,033	205	7,733,255	292	16,502,288
3rd Quarter	48	5,122,113	342	10,704,792	390	15,826,905
Total Year	234*	18,240,695*	1,314*	44,585,210*	1,548*	72,825,905*

*Includes 4th Quarter, 1978

Source: U.S. Army Corps of Engineers, Waterborne Commerce of the U.S, 1977. U.S. Coast Guard, Group Long Inland Sound (1978-79 data).

Table II-7
Ranking of Five Terminals Serving Highest
Number of Ships and Barges
September, 1978 - August, 1979

Terminal Rank	SHIPS Year Total	SHIPS Busiest Quarter	Terminal Rank	BARGES Year Total	BARGES Busiest Quarter
1+	90	37	1*	234	77
2	53	19	2*	225	88
3	45	12	3	224	60
4	28	13	4	124	45
5	17	11	5	115	31
Average	47	18	Average	184	60

\+ two ship berths
* capacity for two barges simultaneously

Source: U. S. Coast Guard

2. Storage Facilities and Usage

Petroleum storage facilities around the harbor have grown with the rising volumes of petroleum received in New Haven. In 1979, 209 tanks, varying in size from under 10,000 barrels to 300,000 barrels, with a total capacity of about 10.4 million barrels, were used to store these products. Capacity managed by waterfront and inland tank farm operators ranges from 2.8 million barrels to 85,000 barrels (Maps II-1 and II-2, Table II-8) and these facilities occupy a total of approximately 170 acres of land, about 80 of them within 1,600 feet of the waterfront.

Table II-9 breaks down storage capacity by product. For planning purposes, the tanks can be divided between clean fuel and residual oil facilities, each of which have special locational requirements and construction characteristics. While tanks can be switched among the clean fuels, primarily gasoline and #2 fuel oil, with some modifications, residual oil requires insulated and heated tanks.

Although there is little data available on the condition of the tanks, conversations with regulatory agencies, maintenance contractors, and industry sources suggest that most of the existing tanks, with a few notable exceptions, are in good condition. The actual life-span of a well-maintained oil tank is well over 40 years. Some of the old riveted tanks still in service on the East Shore were erected as early as 1917. Almost all the tanks, including all the largest ones, are welded steel rather than riveted, an indication of post-World War II vintage.

Of the 15 tank facilities on the waterfront, 11 receive products by ship or barge. Two are owned by oil spill clean up contractors, one of which uses its pier, and two are owned by local oil dealers who receive products by pipeline or truck.

Different companies use different storage strategies. While a major can use a regional terminal to store heating oil during the summer that would otherwise have to be stored somewhere else in its production and distribution system, the independent cannot afford to tie up the capital in inventory. The intensity of tank use is measured by the ratio of annual product throughput to the total storage capacity. This throughput-storage ratio, also known as the number of times the contents of a tank are "turned over", varies by company and product. While most companies would not reveal throughput figures, approximations can be derived from Coast Guard and State of Connecticut Office of Policy and Management data.

Table II-8
Ranking of Companies by Storage Capacity,
With Estimated Receipts and Shipments, 1978-1979

	Company	Total Capacity (barrels x 1000)	Estimated Receipts and Shipments, 1978-79[1] (barrels x 1000)
1.	Wyatt Oil	2,455	16,360
2.	New Haven Terminal	2,123	16,382
3.	Exxon	1,839	5,719
4.	Gulf[2]	1,054	11,126
5.	ARCO	782	6,891
6.	United Illuminating[3]	650	4,037
7.	Mobil	494	7,534
8.	Elmco	375	1,776
9.	Conn. Refining (West Haven)	151	273
10.	Getty	90	1,187
11.	Texaco	85	1,541
	TOTAL	10,098[4]	72,826

1 This data from the U.S. Coast Guard cannot be used to calculate actual throughput/storage ratios because it includes both receipts and shipments. In 1977, approximately 10% of all petroleum trade represented shipments out of harbor.

2 Includes facility of subsidiary, TAD Jones, Inc.

3 United Illuminating maintains this storage capacity to supply its Harbor Station generating facility.

4 Does not include 193,000 barrels of storage at four facilities which do not receive products by water.

Source: City of New Haven, Assessor's Office; U. S. Army Corps of Engineers; U. S. Coast Guard; private oil companies.

Table II-9

Petroleum Storage Capacity, by Product
New Haven Harbor, 1979
(Barrels in Thousands)

	Waterfront		Non-Waterfront*		Total	
	Tanks	Capacity	Tanks	Capacity	Tanks	Capacity*
Gasoline	34	965.5	15	1161.4	49	2126.9
Kerosene	7	101.1	2	110.3	9	211.4
Jet Fuel	1	80.0	3	290.0	4	370.0
#2 Fuel Oil	82	1982.5	25	3034.4	107	5016.9
Sub Total, Clean Fuels	124	3129.1	45	4596.1	169	7725.2
#4 Fuel Oil	6	383.8		-0-	6	383.8
#5 & 6 Fuel Oil	13	1172.3	2+	650	15	1822.3
Asphalt	4	139.0	-	-0-	4	139.0
Sub Total Residuals	23	1695.1	2	650	25	2345.1
TOTAL	147	4824.2++	47	5246.1	194	10070.3++

* Includes Exxon facility which is located 1,600 feet from the waterfront but is within the coastal flood hazard area and the coastal management area.
\+ Storage tanks for United Illuminating Harbor Station.
++ Waterfront storage capacity at two terminals in West Haven not included in this study is 173,700 barrels of #2 fuel.

Source: City of New Haven, Assessor's Office; New Haven City Plan Department; U.S. Army Corps of Engineers; private oil companies.

A higher throughput-storage ratio means a corresponding lower per barrel cost of operating a terminal, so there is an incentive to increase turnover rates. Estimated turnover rates for New Haven facilities range from a low of about 3.1 times per year to a high of 23 times per year, with the overall rate for clean fuels coming through the harbor of 6.65. The throughput-storage ratio for gasoline tends to be considerably higher than for #2 fuel oil because the annual pattern of demand is more even, resulting in lower peak storage capacity needs. Within the several terminals handling both #2 and gasoline for which data are available, this phenomenon is clear.

This data clearly shows that on the whole the storage facilities are not being used to capacity at present. Almost every terminal operator felt he or she could increase throughput without building any new tanks. Conversely, the same or reduced throughput could be handled by fewer facilities than operate now with an overall savings in handling costs due to more efficient facility use. The principle constraint on more efficient facility use will be institutional -- potential savings will have to be high before companies will agree to share receiving and storage facilities.

3. Tax and Employment Productivity

A major argument which has been raised against new tank farm development in other coastal areas and in favor of tank farm relocation to inland sites is the low tax and especially employment productivity of these facilites compared to alternative uses which could be made of the same prime waterfront site (Morell and Singer, 1979).

The average employment per acre in New Haven waterfront tank farms is about 2.7, including operators, drivers, clerical, and management employees. For comparison, average employment per acre in an older industrial area of the City is 17, and rises to 23 when two large underutilized parcels in that area are not counted.

In terms of real estate taxes, the returns from tank farms are closer to but still less than other industrial uses and considerably less than certain other uses. Whereas the average assessment per acre for New Haven tank farms is approximately $134,500/acre (not counting mercantile inventory taxes which apply to only two facilities and are being phased out), the average assessment per acre in our two sample industrial areas was $170,000/acre (older) and $212,000/acre (redeveloped). For comparison, a typical acre of residential land with improvements in a stable Westville area is assessed at about $235-305,000 per acre, and a new condominium development proposed for a 9.3 acre site at City

Point will have a projected assessment of about $1,617,000 per acre.

The assessment of the tanks does vary considerably by area, however. For instance, the average assessment for the smaller facilities on the Quinnipiac River is about $95,300/ acre while the average for four majors in the East Shore deepwater area is $173,500 approaching the level of other industrial areas.

Even though an estimated $1.6 billion in products passed through the tanks in 1979, the City will soon be deriving no revenues from these activities. The contents of the tanks in all but two facilities are considered manufacturer's inventory and are not subject to property taxes. The inventory in the remaining two facilities is subject to mercantile inventory taxes which will be totally phased out by 1983.

D. Institutional Forces

The major oil companies control seven of the eleven petroleum receiving terminals in the harbor and 4.34 million barrels of storage, or 43% of the total (Table II-8). Any discussion of public or private action to bring about the relocation of waterfront tank farms must consider the prevailing institutional forces in the petroleum industry locally and internationally. There are reasons why nine oil companies, six multi-nationals and three local independents each operate their own receiving and storage terminals in the harbor despite the apparent duplication of effort -- they each seek security of access to the channel and control of storage capacity, supplies, and operations at reasonable cost. Any alternative arrangement must accommodate these desires if it is to succeed.

Oil companies consider both cost and non-cost factors in deciding optimal terminal and storage facility location and configuration, both physical and operational. Fee simple ownership of facilities provides security of access, which is more difficult to obtain through lease arrangements or throughputting arrangements at facilities the company does not own. Control of a pier facility ensures that it will be available when needed, even in peak receiving periods, providing flexibility of scheduling.

Control over storage also increases flexibility and independence which makes up for higher operating costs associated with older or less efficient facilities. This is especially true with smaller independents who maintain storage facilities to ensure a reserve supply, to enable speculation as oil prices increase, and to preserve independence from the majors or large terminaling company.

For some majors which promote strong brand identification, the comingling of products of several companies which sometime takes place at multi-company terminals is unacceptable. In some places, these concerns are addressed by having injectors put company additives into the product at the loading rack. Most industry people admit privately that there is now very little difference among brands of a product. Comingling is hence increasingly accepted, especially when it leads to lower handling costs.

Alternatives to individual facilities have been accepted and used in numerous locations, including locally at New Haven Terminal where several oil companies lease tank space and/or purchase handling services, and on Long Island where Northville Industries provides a similar service. In sparsely populated areas of the mid-west several companies often share terminals, usually comingling product, to reduce total travel time required to serve all retailers and customers. These examples demonstrate that joint or "union" tank farms and comingled product are accepted where circumstances favor such arrangements.

Perhaps the major impetus toward such an arrangement is the cost savings to be gained. Operating a marine terminal is expensive, and at some point as the expense rises a company will choose to lease space and hire services of a terminaling company rather than continue operating a terminal. An aggressive development and marketing effort by Northville Industries combined with rising operating costs led several companies to close small barge terminals, one in Patchogue, and serve their markets through Northville terminals and tanks. In the case of Patchogue, and many other coastal areas, the high price offered for their waterfront land was an added inducement to sell out. Both these forces -- increases in both operating cost and land values at older waterfront facilities -- reinforce the trend toward more efficient, centralized facilities and make less expensive inland sites more attractive.

At what point this trend will apply to New Haven operators, and which ones, remains to be seen. New inland tank farms will have to offer substantial savings to both undercut the cost of operating and overcome the non-cost advantages of keeping an individual company terminal. Most of the data which could allow evaluation of these phenomena are proprietery and unavailable.

Several terminal operators agreed that in principle tank farms are best located inland, understood why New Haven's harbor planning aspirations might include relocating storage tanks away from the water's edge, and even felt that larger, consolidated terminals with lower per unit handling

costs are the way of the future. Yet each stressed that an advantageous resolution of the cost and security of access issues must come before their companies would consider moving -- several volunteered that if the City or State were to make it worth their while they would move immediately. Yet most believed the cost situation is not right and that sufficient government incentives were not in the cards.

E. Regulatory Programs Affecting Tank Farms

Due primarily to the hazardous nature of the product, the activities involved in the storage and handling of petroleum products are strictly regulated at all levels of government (Appendix B). Laws and regulations cover such activities as the transfer of oil from vessels (Coast Guard), the provision of air quality control equipment for storage tanks (DEP), the transfer of petroleum products by pipeline (DOT) and minimum areas required for diked areas around storage tanks (Municipal Fire Code).

Where inspections by public agencies are required by law, New Haven's petroleum bulk storage facilities are reportedly in compliance with applicable conditions. Tank farms are inspected by the Coast Guard on a semi-annual basis. According to the Office of the Captain of the Port at the New Haven Coast Guard station, the longest period of time that a violation could be outstanding at a particular terminal would be six months. If a violation is found a company has that much time to submit to the Coast Guard the results of tests which prove compliance has been achieved.

The New Haven Fire Department conducts comprehensive monthly inspections and routine weekly inspections of the tank farms to check for condition of containment dikes, loading racks, and on-site fire suppression equipment. The Fire Marshal's Office in New Haven reports strict adherence to fire safety standards.

The only land use regulations affecting tank farms are the City Zoning Ordinance, which requires a special exception from the Board of Zoning Appeals before a tank farm can be built and restricts tanks to areas zoned for heavy industry, and the recently mandated Coastal Site Plan Review. The State requires the City to review all developments in the coastal area for this consistency with the goals and policies of the Connecticut Coastal Management Act (See Sections IV and IX below).

The table in Appendix B outlines the various laws and regulations as they apply to the receipt, storage and handling of liquid petroleum products.

III. Projected Demand for Petroleum Storage Facilities to Serve New Haven Harbor Market Area

A. Petroleum Product Throughput Projections

1. Overview

Barring any major shift in the petroleum product distribution system for the region served by New Haven Harbor, the future level of petroleum receipts in the harbor will be a function of regional demand for these products. Demand in turn is related to price, changes in regional population and economic activity, weather, the success of conservation efforts, and fuel switching. Projecting demand for petroleum products is extremely problematic due both to uncertainties about price, supply, and taxes and to the fact that historic patterns of consumption and rates of change in consumption can not be used for projection in this period of dramatic, non-linear shifts in price and of stringent government programs aimed at conservation.

Some of the evolving replacements for petroleum, such as liquified coal, liquified natural gas, or pulverized coal-oil mixtures, share some of the physical characteristics and storage requirements of petroleum. These requirements must be anticipated to the extent possible in considering the overall storage capacity picture. For the purposes of this report these products are viewed as possible substitutions for petroleum which will have little impact on the total demand for petroleum-like liquid fuels and their storage requirements. It is assumed that the high cost of these alternative technologies will ensure continued and increasing incentives to conservation. Coal or other non-liquid forms of energy will impose other storage requirements which will have to be considered in harbor area land use management decisions, but will not be considered in this report.

Several recent attempts to project energy demand in Connecticut or New Haven Harbor petroleum throughput have produced results which diverge sharply (see Table III-1).

Table III-1
Petroleum Throughput Projects for
New Haven Harbor
Derived from Available Sources
(Millions of Barrels)

Study	Actual 1977	Proj. 1990	Annual Growth Rate from 1977	Proj. 2000	Annual Growth Rate from 1990
		GASOLINE			
Long Island Sound Study (1975)	24.6	33.4	2.4	-	2.6
U.S. Army Corps (1976)	24.6	30.5	1.7	39.5	2.6
Ct. Office of Pol. and Mgmt. (1978)	24.6	19.1	-2.5	17.1	-0.8
U.S. Army Corps (1979)	24.6	20.9	-1.2	26.4	2.4
		DISTILLATE			
LISS	19.8	32.2	3.8	-	-
ACOE (1976)	19.8	55.2	8.2	73.1	2.8
OPM	19.8	20.3	0.2	20.7	0.2
ACOE (1979)	19.8	30.6	3.4	32.0	0.4
		RESIDUAL			
LISS	12.9	26.1	5.6	-	-
ACOE (1976)	12.9	35.7	8.1	42.6	1.8
OPM	12.9	15.0	1.5	14.0	-0.7
ACOE (1979)	12.9	9.9	-2.0	13.3	3.0

Sources: New England River Basins Commission, Long Island Sound Study, People and the Sound: Marine Transportation, 1975; U.S. Army Corps of Engineers, Draft Feasibility Study for Improvements to the New Haven Navigation Project (1976 preliminary findings; 1979 Draft Report); Connecticut Energy Advisory Board, Connecticut Energy Outlook, 1977-1979 (prepared by the Office of Policy and Management), 1978.

2. Long Island Sound Study

The projections in the earliest of these studies, the Marine Transportation Report of the Long Island Sound Study (1975), prepared by the U.S. Army Corps of Engineers, were made in the midst of the 1973-1974 oil crisis using data from the period up to 1971. Population projections for the market area at that time were considerably higher then present official projections, and the values of other variables used in projection, such as furnace efficiency and per household heating oil consumption, led to high projections of demand.

The LISS cited data showing that regional demand for the three principal commodities -- gasoline, distillate, and residual -- grew by more then 7% a year, compound rate, from 1958 to 1970. Even though the planners dampened this rate to 4.4% annual growth to 1990, they still had Sound-wide port receipts rising from 171 million barrels in 1971 to 321 million barrels in 1990, an 88% increase. They felt, however, that after 1990 depletion of world oil resources would raise prices, lead to development of alternative energy sources, and cause a leveling off of petroleum demand. New Haven receipts were projected to grow from 48 million barrels in 1971 to 91.7 million in 1990 (3.4% per annum), with an additional 44 million barrels of Connecticut River shipments also diverted to New Haven. Actual average annual increase in receipts from 1971 to 1977 was 3.0% per annum.

These high projections to 1990 form the basis of extensive LISS recommendations regarding product distribution, including the construction of an off-shore unloading pier off New Haven, channeling of all Connecticut River shipments through New Haven to eliminate the need for extensive river channel maintenance, the construction of new pipelines from New Haven to Hartford (clean fuels) and Middletown (residual fuel), and the development of the new inland tank farm sites along the pipelines to accomodate 8.6 million barrels of relocated and expanded storage capacity. The economic feasibility of most of these facilities is very sensitive to the product receipt projections because project benefits are positively related to volumes of throughput as project costs must be spread over the number of barrels received.

3. U.S. Army Corps of Engineers Feasibility Report, 1979

The Army Corps recently released a new set of petroleum throughput projections for the harbor in a draft Feasibility Report on deepening the main shipping channel. The feasibility analysis is based on the transportation costs savings to be gained from transporting products in larger capacity ships

which a deeper channel can accommodate. The projected transportation cost savings are thus sensitive to assumptions about product origin, percentage carried by barge versus deep draft ship, and projected receipts.

The new Army Corps throughput projections are based on a model of energy demand in New England formulated by A. D. Little, a computer simulation of energy demand from the MIT Energy Labs, and documents of the Federal Energy Administration. These models disaggregate demand into sectors (residential, commercial, industrial, transportation, etc.) and project demand based on the projected changes in activity levels in each sector and assumptions about energy usage in these activities. The overall increase in petroleum product demand of 2.3% per annum between 1980 and 2000 obtained in this way was dampened by the Corp by adding the following assumptions for New England. For residual, six additional nuclear power plants would replace 65.4 million barrels per year, coal conversion of old electric plants and the construction of new coal-fired plants would replace a total of 19.5 million barrels, and a conservation effort would save 34 million barrels. For distillate and gasoline, conservation efforts would result in a demand figure 25% lower than the model. These changes bring the average annual rate of increase in demand between 1980 and 2000 to .37%.

The demands projections for New Haven assume that the harbor will receive the same percentage of New England receipts in the three main products as it received in 1971 through 1975 (on average). Table III-1 illustrates the resulting trends. The Army Corps says that movement of petroleum products "in New Haven Harbor" will continue the decline of 1974-76 up to 1990. A look at the breakdown by product reveals that this decline is caused by a drop in residual projections while gasoline and distillate demand continues to rise. Some error may be introduced in these figures by a mistake of double counting products that are received and shipped out via water. The figures used repeatedly by the Army Corp report are total tonnage which includes both receipts and shipments which amounted to 13% of receipts in 1976 (compare Table B-11, p. B-45 in report to Table B-7, p. B-34).

For some unexplained reason, these adjusted projections then show increases in the rate of growth after 2000 despite statements as early as the 1975 LISS Report referring to the leveling of demand after 2000 due to petroleum resource limitations. New Haven tonnage is projected to more than double between 2000 and 2030, rising at a rate of 2.38% per annum. Dampening of these assumptions to bring them into line with the 1980 to 2000 period would have consequences for the total benefits to be gained from harbor deepening.

Although benefits discounted back 20 to 50 years from that time period are less significant than earlier benefits, the low discount rate of 6-5/8% the Army Corp was mandated to use in their analysis most likely overstates the distant future benefits to be gained from deepening.

4. Connecticut Energy Advisory Board

The latest published set of comprehensive petroleum demand projections for this region are those of the 1978 Annual Report of the Connecticut Energy Advisory Board. These projections, undergoing possible downward revisions at present, are only available for the State of Connecticut, which is not coterminus with the market area of the port. As detailed in Section II, as much as 15% of the residual oil and 25 to 30% of the distillate coming into New Haven is not destined for in-State use. However, the trends and rates of change established after careful analysis of the State-wide energy demand can serve as fairly good guidelines for what to expect in New Haven Harbor receipts. The major out of State area served by the port is Western Massachusetts, an area displaying trends quite similar to Connecticut and subject to similar market forces and regulatory structures.

Energy Board projections are based on a model assembled by consultants in 1975, and later refined, which analyzes energy usage by sector -- residential, commercial, industrial, and transportation. Using techniques similar to the A. D. Little model discussed above, energy usage is related to indicators for which information is more readily available -- for instance, employment for commercial uses and number of housing units and type of heating systems for residential space heating. Energy consuming activities were projected using various methods including analysis of historical data, consideration of future trends, and relationships among activities. For the period 1980 to 1997, the Board projections show a drop in gasoline demand of 27%, resulting from mandated efficiency standards in new cars, increased price, and a variety of public conservation programs; a slight increase in distillate demand of 3%, less than the rate of increase in the number of households, a decline in use attributable to conservation and fuel switching; and a drop in residual demand of 6%, linked to industrial conservation efforts and increased reliance on nuclear power plants already scheduled for construction.

The percent of State gross energy demand served by petroleum products is expected to drop from 74% in 1977 to 66% in 1997 due in part to more efficient cars and conservation. The contribution of nuclear power is expected to increase from 16% to 24% over the same period.

If these OPM projection trends are applied to New Haven receipts between 1977 and 1997 the prospect is for a reduction in gasoline receipts from 26.3 million barrels to 19.2 million barrels; a slight increase in distillate receipts from 22.2 to 22.9 million barrels; and a drop in residual receipts from 16.4 to 15.4 million barrels.

5. Conclusion

Discussions with industry sources and state energy planners and review of recent literature all suggest that of the available projections the OPM figures most accurately reflect the probable levels of petroleum receipts in New Haven. If anything, the figures will probably be revised downward as prices continue to rise and efforts to develop and market conservation and alternative energy technologies are intensified.

For the purposes of analysis of storage needs in this report, the 1978 OPM trends will be adopted as guidelines even though further declines in receipts are likely.

One specific project is not accounted for in any of these demand projections. Discussions with Jet Lines pipeline managers and Massachusetts officials revealed plans to construct a new electric generating plant at Westover Air Force Base in Chicopee which would burn distillate oil brought in by pipeline from New Haven Harbor. The seasonal peaks in oil demand experienced by the plant would be smoothed out through the installation of a large storage capacity in both New Haven (300,000 barrels) and Chicopee (3-400,000 barrels). The demand on the Jet Lines pipeline would be constant at approximately 5,000 barrels per day. This new demand of 1.8-2.0 million barrels per year is taken into account in estimations of future demand for storage capacity.

B. Storage Capacity Needed to Meet Future Demands

In estimating the total petroleum product storage capacity required over the next 20 years to serve the harbor's market area, factors such as security of supply and reserve level goals must be considered along with the day-to-day operational needs of the oil companies.

Clearly, judging by past experience and experience in other areas, the present and projected throughput levels could be accommodated by a reduced storage capacity, especially in distillate and residual fuel oils. While distillate receipts declined 11% from 1973 to 1977, storage capacity increased at least 8%, decreasing the ratio of throughput to storage from about 5 to 4.1. Over the same period, residual receipts declined 19.3% while capacity increased 56%, de-

creasing the throughput/storage ratio from about 17 to 9. Gasoline storage capacity has increased less over this period and the throughput/storage ratio has increased.

Industry sources and state energy planners caution that the state's storage capacity, especially for heating oil, should be maintained or increased to ensure adequate supply in the case of a severe winter, interruption of navigation in the harbor, a reduction or cutoff in supply, or some combination of these natural and geopolitical events. Given a probable decline in demand for heating oil, however, maintenance of the current storage capacity for heating oil will mean an increasing level of reserve capacity without new additions.

In the area of motor gasoline, the state Energy Division is predicting a more significant decline in demand over the next 20 years, approaching 28%. This would allow for reductions in present gasoline storage capacity while still increasing reserve storage. Gasoline tanks could also be converted to store #2 fuel oil.

These predictions mean that for the purposes of this analysis, any change in the location or configuration of the harbor storage capacity should accommodate approximately the existing storage capacity in order to increase reserve capacity as demand declines and to ensure adequate capacity in the event that demand does not decline at the rates projected.

Viewing the total petroleum receiving and storage system, the storage capacity projected to be sufficient and which will be used for planning purposes is:

Gasoline	2,130,000 barrels
Distillate	5,020,000 barrels
Kerosene and Jet Fuel	580,000 barrels
Residual	2,340,000 barrels

These numbers should be considered capacity goals rather than absolute requirements, however. If necessary and/or desirable, some of the present capacity could be phased out without serious consequences for reserves.

IV. Waterfront Revitalization -- Potential Alternative Uses for Waterfront Land Occupied by Tank Farms

A. Context

The only reason to consider a concerted program to discourage coastal siting of tank farms or to relocate existing waterfront tank farms would be to reserve or free up valuable urban waterfront land for other uses which yield higher employment, taxes, amenity values or all three. Tank farms are essential to the local and regional economy, but they do not require waterfront locations, they provide low levels of employment and taxes, and they can detract from the amenity values of the harbor area, especially when located in areas undergoing revitalization. The City of New Haven has already acquired and phased out one small waterfront tank farm on the Quinnipiac River to make way for a waterfront park as part of the Fair Haven Redevelopment and Renewal Plan.

Several other waterfront communities, including Burlington, Vermont, Port Jefferson, Long Island, and Patchogue, Long Island, have witnessed the phasing out of tanks for other uses, usually new housing and open space, which conform to an overall waterfront plan of development. None of these terminals were of the scale of those in New Haven, however, and only in the case of Port Jefferson was the storage capacity replaced by an inland tank farm linked to a receiving terminal at the waterfront. In other communities, such as those along the Hudson River, tank farm development took place inland initially.

A number of areas along the New Haven Harbor waterfront are undergoing significant revitalization through a combination of public initiative and private investment. Other areas have been identified as opportunity areas for future redevelopment for industrial, commercial, residential and recreational uses. The City of New Haven's municipal coastal program will seek to reinforce these positive revitalization efforts through amendments to the zoning ordinance, creation of a comprehensive plan of development for the coastal area, and coordinated public development initiatives. This coastal program will also provide the context for future development of opportunity areas.

The overarching goals of the coastal program effort will be to bring the harbor back into the life of the City by bringing people to the water's edge for living, working, shopping and play. One rationale for this emphasis is that the economic development and fiscal health of the City will depend on the enhancement of the quality of life for all its residents, and the reclaiming of the waterfront for people-oriented activities can increase the livibility of the City.

While a discussion of possible new uses must look ahead over the five to 40 year time-frame used in talking about relocation of tank farms, prediction of markets for specific re-uses of waterfront land is risky at best. Re-use plans must be geared to market realities while striving for an optimal arrangement and mix of land uses. Looking at experience in a number of large and small waterfront cities, one sees that the most successful urban waterfront projects are those of a scale large enough to be a destination in themselves.

The rediscovery of the urban waterfront as an attractive environment for living, working, shopping and play in many East Coast cities is related to a number of other trends which support potential re-use initiatives discussed here: a dwindling supply of non-urban coastal land combined with the presence of large underutilized acres on urban waterfronts; stricter regulation of remaining natural coastal areas, which may divert development toward the urban coast; the increasing price and uncertain availability of petroleum products. which over the long term will encourage centralization in living and working places and a renewed emphasis on nearby shopping and recreational opportunities; and the improvement in harbor water quality, which will accelerate with the planned provision of secondary wastewater treatment by the mid-1980's.

The question of appropriate waterfront uses was considered at length in the development of the State's Coastal Area Management Program. The State policies enacted in the CCMA encourage the reservation of developed waterfront land for marine related uses to the fullest extent possible, "including but not limited to commercial and recreational fishing, boating and other water dependent commercial, industrial and recreational uses" (Sec. 2(b)(2)(G), P.A. 79-535). "Water dependent uses" are defined as:

> "Those uses and facilities which require direct access to, or location in, marine or tidal waters and which therefore cannot be located inland, including but not limited to: marinas, recreational and commercial fishing and boating facilities, finfish and shellfish processing plants, waterfront dock and port facilities, shipyards and boat building facilities, water based recreational uses, navigation aides, basins and channels, industrial uses dependent upon waterborne transportation or requiring large volumes of cooling or process water which cannot reasonably be located or operated at an inland site and uses which provide general public acces to marine ot tidal waters." (Sec. (3)(16), P.A. 79-535.)

Table IV-1 lists possible waterfront uses for developed shorefront areas and provides an evaluation of their con-

sistency with CCMA policies and goals of the City's coastal planning efforts. Such a table should be interpreted with caution as uses which alone would be inappropriate might be acceptable or highly desireable as part of a larger planned development. Surrounding land uses are also an important factor. The table is useful, however, in structuring thinking about waterfront development in a preliminary way.

An examination of land uses surrounding the waterfront tank farm facilities (Map IV-1), suggests more intensive or more directly water dependent alternative uses to which the land occupied by the tanks could be put. Below, each area of the harbor is discussed in this context.

B. Potential Alternative Uses, by Area

1. Quinnipiac River Area

Some of the most exciting waterfront revitalization in the City is underway in the area along the Quinnipiac River, which has recently been designated a local historic district (Map IV-2). Under the Fair Haven Redevelopment and Renewal Plan, the New Haven Redevelopment Agency acquired a scrap metal depot, a small tank farm, and other industries along the Front Street waterfront to create a park along the river with sites for new housing behind it. The old Quinnipiac Brewery to the south is in the process of being rehabilitated for residential, commercial and office uses. Along East Pearl Street, just west of the waterfront, North Front Street, and in the immediate area private homeowners are rehabilitating historic houses, sometimes with the assistance of Neighborhood Preservation Program grants and loans. Considerable private housing investment is also occuring outside the renewal area, north of Grand Avenue and across the river in Fair Haven Heights.

Three small tank farm facilities with a capacity of 170,000 barrels are located on this area of the Quinnipiac north of Ferry Street Bridge, none of them receiving product by barge (see Table V-1 below). Also located here, at 400 Quinnipiac Avenue, is the pumping station of the Jet Lines pipeline. Significantly, the average total tax assessment per acre in these facilities, $86,500, is very low compared to the East Shore tank farms or alternative uses. All the tanks lie on land that could be redeveloped in ways which compliment public and private non-industrial renewal efforts in the area.

Table IV-1
Possible Waterfront Land Uses
for Developed Shorefront Areas (A)

Waterfront Land Use	Relative Water Dependency	Consistency with CCMA Policies	Employment Density	Tax Yield
Port Facilities	very high	very high	low	moderate
Storage Tanks (Chemicals)	high	low	very low	moderate
Storage Tanks (Resid. Oil)	moderate	low	very low	moderate
Storage Tanks (Clean Fuels)	low	low	very low	moderate
Commercial Fishing	very high	very high	high	moderate
General Manufacturing	none	low (B)	high	high
Warehousing	none	low	low	moderate
Electric Utilities	high	high	moderate	very high
Marina	very high	very high	moderate-low	moderate
Park	moderate	high (C)	very low	none
Housing	low	low (C)	very low	high
General Commercial	moderate	high (C)	moderate-high	high

(A) This table provides only a general indication of suitability of land uses for waterfront siting. Compatibility with surrounding land uses, zoning, and particular details of a land use and a proposed site must be considered in any case by case analysis.

(B) The exception to this would be those industries which require large volumes of process water or receive or ship products by water.

(C) The consistency of uses which provide general public access is high, so residential uses could be consistent if access is provided.

Table IV-2

Comparison of Estimated Tax and Employment Benefits of Alternative Land Uses

Use	Tax Assessment Per Acre (1979)	Employment Per Acre (1979)
Petroleum Tank Farms	136,400	2.7
Manufacturing Firms, East Shore South of I-95	317,853	56
River Street Industrial Area	170,000	19
Redeveloped Industrial Area	212,000	N.A.
New Waterfront Condominium Project	1,600,000	--
Older Sable Residential Area	300,000 est.	--
Marinas	57,500+	2.5
Park	---	.1

+ not including personal property tax assessment on pleasure boats.

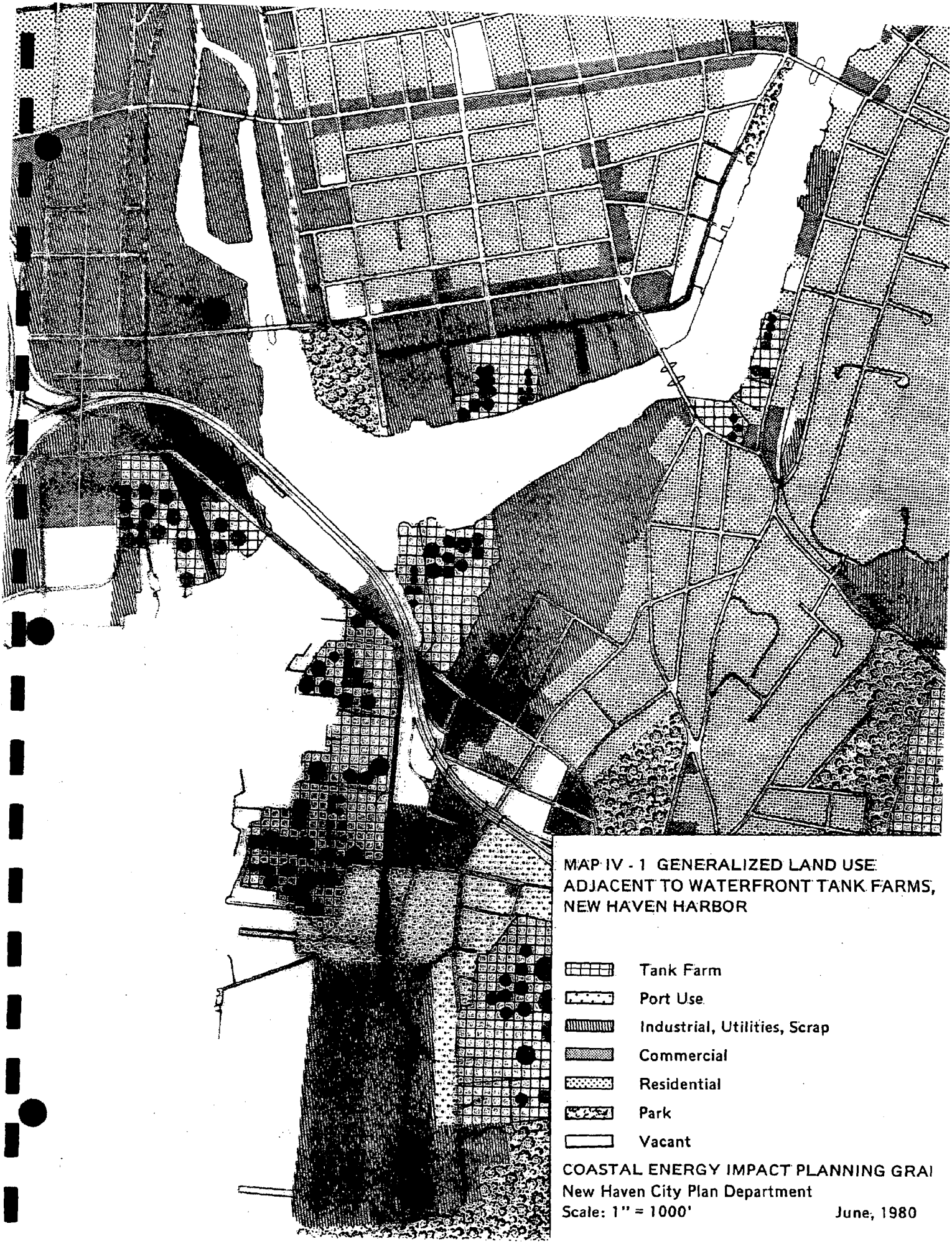
Source: New Haven City Plan Department based on City Property Tax Records.

Possible complimentary re-uses of these 5.3 acres of waterfront include marinas, commercial fisheries, commercial uses such as shops or restaurants, complimented by public access areas, and residential uses.

2. Inner Harbor

a. Present Character

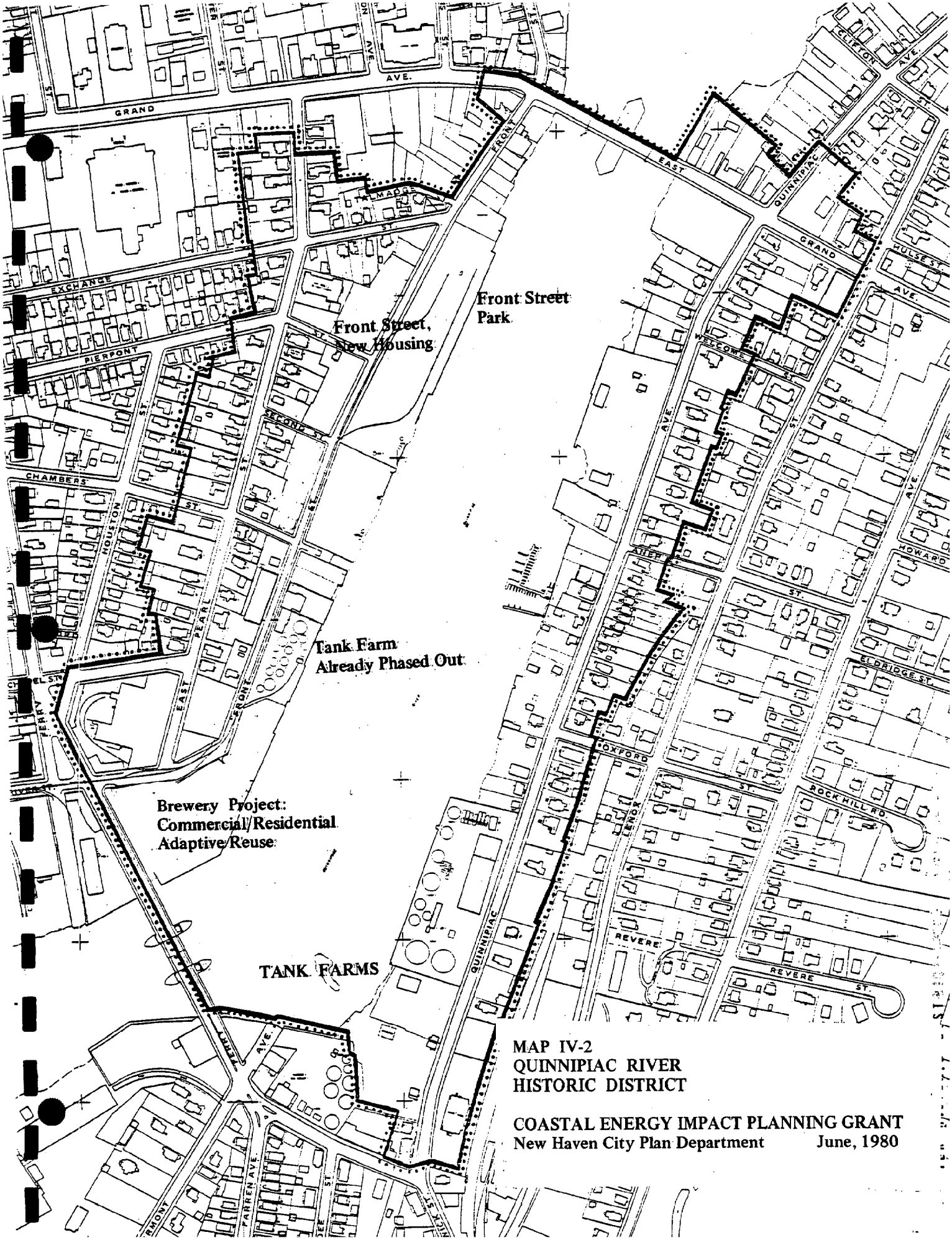
The inner harbor is the water area bounded by the Tomlinson, Chapel Street, and Ferry Street bridges and its adjacent land area, most of which is zoned and used for industry with the exception of Quinnipiac Park at the con-



MAP IV - 1 GENERALIZED LAND USE ADJACENT TO WATERFRONT TANK FARMS, NEW HAVEN HARBOR

- Tank Farm
- Port Use
- Industrial, Utilities, Scrap
- Commercial
- Residential
- Park
- Vacant

COASTAL ENERGY IMPACT PLANNING GRAI
New Haven City Plan Department
Scale: 1" = 1000' June, 1980



MAP IV-2
QUINNIPIAC RIVER
HISTORIC DISTRICT

COASTAL ENERGY IMPACT PLANNING GRANT
New Haven City Plan Department June, 1980

fluence of the Mill and Quinnipiac Rivers. This area has a 16-foot deep federal channel and the lowest water quality of the entire harbor, leading to intense odors in summertime at low tide. Barge access has been hampered in recent years by mechanical problems with the Tomlinson Bridge and rapid siltation of berths.

The three major areas of the inner harbor are the western shore between Chapel Street and Forbes Avenue, location of a Suzio concrete plant and vacant land; the River Street industrial area on the northern shore, which is the southern port of penninsular Fair Haven, an area of older buildings and firms employing about 550-600 people; and the southern shore, dominated by the recently vacated 34 acre U.S. Steel wire rope plant. The west shore being totally silted in, has no marine facilities. The north shore has two active barge terminals, Elmco receiving four petroleum products into 18 tanks (total capacity 291,400 barrels) and DuPont receiving sulphuric acid into two small storage tanks. The south shore has a broken down dock with good water on the northern part, the abandoned U.S. Steel barge dock, and two overlapping petroleum receiving piers operated by Mobil and Texaco. Mobil has made major investments in its 12-acre terminal (494,300 barrel capacity) recently, including extensive air and water quality control equipment, a new office and service building, and a new foam fire suppression system. Texaco operates a considerably smaller facility (3.3 acres, capacity 85,100 barrels).

b. Non-Industrial Use

In 1978, Charles G. Hilgenhurst Associates of Boston, an architecture and planning firm with considerable experience in urban waterfront redevelopment, proposed in a draft report to the City that the inner harbor area be transformed into a commercial and residential area taking full advantage of the waterfront environment. Hilgenhurst saw the River Street area as a natural link along Chapel Street between downtown and Wooster Square to the west and the Brewery project and Quinnipiac River Historic District to the east. Further, they suggested that should U.S. Steel close its plant directly across the river, that site and its old buildings should be converted for residential, office, commercial, and recreational uses as well.

The theory behind these proposals was that the strength and future of New Haven lies in its expanding service economy and its regional commercial and residential role rather than in its declining industrial sector which is having difficulty competing with suburban industrial parks and other regions of the country. In this view, the old industrial areas of the inner harbor, with their waterfront location and charac-

teristic brick structures, offer the opportunity to create a unique environment which would attract private investment and people to the waterfront.

Factors arguing against the Hilgenhurst proposal are: the shortage of industrial land and buildings in the City for both large industries and smaller, new firms to which urban locations are especially suited; the uncertainty of a market for non-industrial use of such a large area, which raises the possibility of conflict between downtown and waterfront renewal goals; and the existence in the River Street area of over 500 jobs, many of which would be put in jeopardy by any large scale change in use.

c. Industrial Use

Some business people and members of the Port Development Council of the Greater New Haven Chamber of Commerce see the inner harbor area as a major opportunity area for marine-related industrial development. With a limited amount of industrial land adjacent to Federally-maintained channels in the state, some of these people view the inner harbor industrial land as a unique resource for local economic development which should be restricted to water related industrial use only. The problem with such a policy is that most water-related industrial uses, like bulk oil storage, involve mechanized transfer and storage of bulk commodities, uses which generate little employment or capital investment compared to many other industrial or even non-industrial uses.

Another category of water-dependent use is large primary industries such as petroleum refining, wood pulp mills, and chemical refining. Although some are fairly job intensive, they also require large sites, produce myriad environmental impacts, and are not economically feasible in New Haven.

The City now has the discretionary power under the coastal site plan review provisions of the CCMA to deny permits for waterfront proposals which are not water dependent. This allows evaluation of uses on a case-by-case basis which would not be possible with an outright prohibition of non-water dependent uses. In response to low intensity uses of industrial land, the City is attempting to develop amendments to the Zoning Ordinance which would allow discretion in permitting industrial uses based on employment and tax productivity.

In balance, the most job and tax intensive industrial uses are probably non-water-dependent. From data compiled on industrial location criteria by the Fantus Company (subsidiary of Dunn and Bradstreet) for the Port of New York,

specific operations were identified which might be attracted to New Haven's waterfront industrial areas (Fantus Co., New York, March, 1979). The industries identified by Fantus were screened for the particular characteristics of the New Haven Labor Market Area both to single out strong candidates for New Haven and to eliminate industrial operations which might prove totally unsuitable.

The industrial categories identified with potential for the New Haven waterfront industrial areas are:

1. Telephone, television, and cable television (CATV) hardware manufacturing and distribution.

2. Fabricated wire products (closely related to #1).

3. Specialized and ornamental metal work.

4. Office computing and business machinery -- manufacture and distribution.

5. Single-use hospital procedure kits -- manufacture and distribution.

6. Electrical testing and measuring instruments (as for automobiles, other machinery).

7. Scientific and precision instruments for use in research and development or medical activities.

8. Flavoring extracts and syrups manufacture.

9. Contract private brand food packaging.

10. Converted and recycled paper products.

Each of these industrial sectors has potential strengths in this area by virtue of its labor market characteristics or linkages with strong industries in the regional economy. None, however, are necessarily water-dependent.

d. Balancing Conflicting Visions

In sum, the potential re-uses of waterfront land in the inner harbor area may be either industrial, if this area is maintained and upgraded as an industrial area, whether water related or not, or non-industrial in line with the recommendations of the draft Hilgenhurst Report. If the industrial route is chosen, the 8.7 acre Elmco facility on River Street, supporting about 50 jobs (5.7 per acre), could form the centerpiece of a River Street Industrial Park in which public infrastructure is improved for manufacturing firms in

the area and several additional underutilized parcels are also made available for new development.

In a non-industrial scenario, this parcel occupies an equally pivotal position in the River Street area. Relocation of the storage capacity would not only make a prime development site available, but would also make a giant step toward improving public perceptions of the area -- the large, rusting, turquoise Elmco tanks are a prominent landmark greeting people entering New Haven over the Quinnipiac Bridge.

If the storage capacity of Mobil and Texaco were relocated, the combined 15.2 acre site could be incorporated in the re-use plan for the extensive U.S. Steel property. Under a non-industrial scenario, continuous public access from the Quinnipiac Bridge northeast to Ferry Street could be provided, with excellent opportunity for protected marina development with ready access to the harbor channel. Even under an industrial scenario, a large part of the waterfront not required for shipping could be reserved for a public open space for employees and neighborhood residents.

3. West Shore

The only New Haven tank farm on the west shore is Wyatt Oil's 17 acre facility which includes two deepwater berths, 22 tanks with a combined capacity of about 1.17 million barrels, and loading bays for trucks and rail tank cars (see Map II-1). It has about 1,500 feet of water frontage on the south and east sides and is bounded by Forbes Avenue to the north.

This site is adjacent to the Gateway Landing site, for which an ambitious $25 million commercial-office-hotel reuse project has been proposed, and the Teletrack, a 2,200 seat closed-circuit TV theatre offering live broadcasts of horse races and paramutuel betting. Immediately west of the Wyatt site lies the East Street Sewage Treatment Plant which will be phased out under a new plan for secondary treatment of all municipal wastes. This would free up a key waterfront parcel.

To the southwest is the site of the relocated Leon's Restaurant and the mile long expanse of open waterfront land along Interstate 95. This area, zoned for park and marine commercial, will eventually be developed for recreational and commercial uses which will provide continuous, people-oriented waterfront development from Gateway Landing south to City Point.

Arguments for retaining the Wyatt site in port-related

use are its deepwater channel access and the availability of reliable rail freight service. The other deepwater port areas on the East Shore are hampered by the unreliability and limitations of the rail link across the Tomlinson Bridge. Use of this site for port uses other than oil storage would be more appropriate from the standpoint of water-dependency even if these uses did not provide the employment and tax benefits of other uses. The U.S. Maritime Administration has shown that general cargo and container operations are far more labor-intensive than bulk operations (U.S. Maritime Administration, Economic Impact of the U.S. Port Industry, August, 1978).

If, however, it became feasible to reduce the waterfront storage capacity, this prime site adjacent to non-industrial uses and reasonably close to downtown, Long Wharf, the proposed Union Station Transportation Center, and the intersection of I-91 and I-95 would make an ideal site for extension of the mixed use (commercial, office, residential, and public open space) waterfront development planned for the rest of the west shore. With a major revamping of the Tomlinson Bridge, the East Shore industrial area (described below) could be developed as the working port district of the harbor, separated from the very different uses of the west shore.

4. East Shore Port and Industrial Area

The East Shore Port and Industrial Area is bounded by Interstate 95 on the north, residential areas on the east, East Shore Park on the south, and the main harbor channel to the west. With excellent access to the interstate highways, this area contains the largest concentration of petroleum storage tanks in the harbor, 4.8 million barrels (3.65 million barrels of clean fuels, 1.1 million barrels residual oil), located in seven facilities with 64 tanks. Beyond this, New Haven Terminal has 431,000 barrels of chemical storage capacity in 22 tanks. The NHT finger pier is also linked to 1.75 million barrels of clean fuels storage capacity on the New Haven/East Haven line by two 16" pipelines which allow direct pumping from ship to tank.

This 255 acre area contains the harbor's only general cargo terminal facilities, at New Haven Terminal; six deep-water ship berths; three fairly deep barge berths; about 25 acres of open storage area for lumber and steel; and 180,000 square feet of cargo warehouse space. The United Illuminating Company Harbor Station occupies a 106 acre site, with 650,000 barrels of residual oil storage, on the southern end of the area. Exxon operates about 1.84 million barrels of clean fuel storage on a 38 acre site about 1,600 feet east of the waterfront and connected to its pier by 14 pipelines varying

in diameter from 6" to 18". Getty, Gulf, TAD Jones (owned by Gulf), ARCO, and NHT operate receiving, storage, and truck loading facilities at the water's edge, occupying approximately 34 acres of land with a combined storage capacity of 1.6 million barrels for clean fuels and 685,000 barrels for residual fuel (at TAD Jones only) and #4 fuel oil (at NHT). Non-petroleum or port related businesses and one residence occupy only 3.1 acres of the area, but two manufacturing firms employ an average of 52 employees per acre.

Significantly, the four tank farm facilities operated by majors on the waterfront in the East Shore area south of I-95 show considerably higher tax assessments per acre than the smaller facilities up the Quinnipiac River, offering $173,500 as opposed to $95,300 for the latter. This higher assessment is attributable primarily to the higher value of land adjacent to the deep water channel. The value of the docking facilities, the higher density of storage facilities, and the condition of the tanks. While these four facilities yield 27% more tax revenue per acre than the average tank farm, they still yield 46% less than the manufacturing uses in their immediate area and 78% less than the uses in a redeveloped industrial area.

Any discussion of alternative uses of land occupied by tank farms in this area logically turns toward expanded port or port-related industrial use. Possible re-uses include additional general cargo storage areas, a Foreign Trade Zone encompassing warehouses and/or manufacturing plants, and industries which either import or export in large volumes or rely on proximity to the water for other reasons (ship-building, barge building, or industries using large volumes of water for cooling and processes). While most forms of cargo storage are not particularly intensive uses, they are more water dependent than oil storage in that transporting general cargo to inland sites would be prohibitively expensive. As a regional facility, a larger port would be an economic development incentive for the region even if the City did not benefit from large infusions of taxes or employment directly. This suggests that some form of regional or State support for such a facility would be appropriate.

The discussion of non-water-dependent industrial prospects for the inner harbor area could apply equally in the East Shore as well except that the access to the main ship channel in this area makes it even more attractive for more water-dependent uses. The large public investment in the channel and the limited industrial land area are factors weighing against general industrial uses.

C. Benefits of Alternative Uses

Many land uses yield tax or employment benefits equal to or exceeding those from tank farm uses and would represent a considerable aesthetic improvement over tank farms. Table IV-2 compares the tax and employment benefits of a sample of alternative uses discussed above with those of tank farm uses.

V. Alternative Petroleum Receiving and Storage Scenarios for the New Haven Harbor Market Area

A. Policy Framework

In light of the conclusions about projected storage capacity needs, several alternative scenarios can be developed for meeting petroleum facility needs in the harbor while achieving or working toward urban waterfront revitalization goals over the next 20 years.

While ideally the entire waterfront storage capacity could be relocated in the near future to an inland site making 80 acres of prime waterfront land available for more intensive development, and thus transforming the face of the harbor, realities of cost and institutional impediments make such a scale of relocation unrealistic.

Clearly, some City and State policy and program on the issue of tank farm location is appropriate, however. The Connecticut Coastal Management Act of 1979 and the 1975 Long Island Sound Regional Study both recognized that tank farms are an inappropriate use of prime waterfront land, especially with the development of pipeline technology. The CCMA contains a policy which specifically discourages siting of new tanks in the coastal area (P.A. 79-535, Sec. 2(b)(1)(E)). The Massachusetts and New York State Coastal Zone Management Programs have adopted similar or stronger policies.

Over the last 40 years, in the absence of any clear City policy on appropriate waterfront development in New Haven, tank farms have proliferated in several waterfront industrial areas. With the passage of the CCMA, the City now has the clear opportunity to develop a binding, area-specific policy on coastal tank farm development. This policy can become part of the adopted municipal coastal program which the City is encouraged to draw up under the CCMA. Once adopted, this program will guide all public and private development in the coastal area. A City policy and program addressing tank farms could include a mix of regulatory measures, incentives, and public acquisition and/or development activities.

While aimed primarily at more active use of waterfront land, the City's coastal program must also ensure the smooth functioning of the petroleum receiving and distribution system on which the region will continue to depend heavily for the next 20 years and beyond. If a City policy were to impose costs on private oil companies which they might pass directly on to consumers, the City must be careful to weigh the public benefits such measures would reap in return.

This section of the report considers a range of possible tank farm relocation programs, progressing from minimal to total, and looks at the operational implications, advantages and disadvantages associated with each.

The discussion focuses on storage capacity rather than pier facilities. It is assumed that consolidation of petroleum receiving piers would be possible where necessary through more efficient use of fewer piers. Several companies have joint use arrangements at present. If solid gurantees of access to joint piers could be worked out, such an arrangement would be optimal from both a waterfront land use and operating and maintenance cost point of view.

The institutional mechanisms which could be employed to achieve the operational alternatives will be considered in Section VIII. As the scale of relocation will in turn determine the operational and institutional requirements, this question is explored first.

B. Scale of Proposed Relocation

Several scales of projects can be considered, beginning with minimal relocation from strategic areas, which would advance ongoing redevelopment plans, to complete harbor-wide relocation which would free-up land for major new development initiatives. For the purposes of this analysis, the tank farms have been divided into areal groupings as listed in Table V-1 and displayed on Map V-1. The 383,800 barrels of #4 fuel oil storage have been grouped with residual oil tanks because #4 oil cannot be shipped via a clean fuel pipeline even though heating is not required to pump it.

The range of relocation efforts could include:

1. Total relocation of waterfront tank farms (areas 1, 2 and 3; 79.9 acres).

   Clean fuels: 11 operators, 3,129,000 barrels.

   Residual fuels: 4 operators, 1,695,000 barrels.

   (This excludes tanks owned by Exxon which are located about 1,600 feet back from the waterfront and residual oil tanks owned and operated by the United Illuminating Company as an integral part of their harbor generating station).

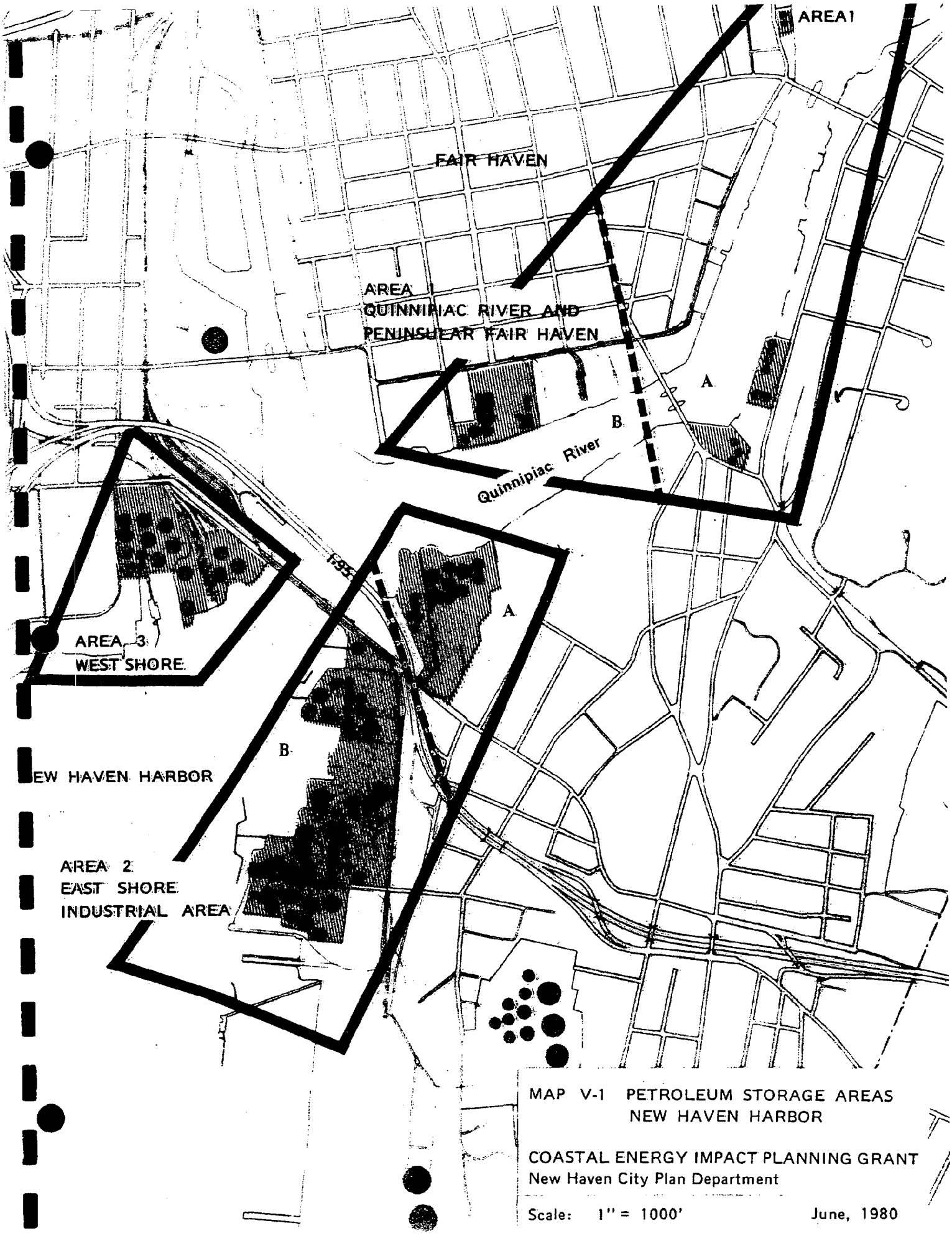
Table V

Petroleum Storage Capacity by Area
New Haven Harbor, 1979*
(barrels x 1000)

Waterfront Area	Acres	CLEAN FUELS Operators	CLEAN FUELS Capacity	#4 AND RESIDUAL FUELS Operators	#4 AND RESIDUAL FUELS Capacity	TOTAL Operators	TOTAL Capacity
1. Quinnipiac River							
a. Above Ferry St. Bridge	5.2	3	170	--	--	3	170
b. Peninsular Fair Haven	8.7	1	244	1	131	1	375
c. Total	13.9	4	414	1	131	4	545
2. East Shore Industrial Area							
a. North of I-95	15.2	2	579	--	--	2	579
b. South of I-95	33.7	4	1,560	2	685	4	2,245
c. Total	48.9	6	2,139	2	685	6	2,824
3. West Shore	17.1	1	576	1	879	1	1,455
4. Total Waterfront (1c, 2c & 3)	79.9	11	3,129	4	1,695	11	4,824
Non-Waterfront							
1. Inland	N/A	2	2,757	--	--	2	2,757
2. East Shore, Off Waterfront		1	1,839	1	650	4	2,489
3. Total		3	4,596	1	650	4	5,246
West Haven							
West River Channel	N/A	2	174	--	--	2	174
Total, New Haven Harbor		14	7,899	5	2,345	15	10,244

* #4 fuel oil tanks are grouped with residual oil tanks because #4 oil cannot be shipped via a clean fuel pipeline even though heating is not required to pump it. Four of the five operators handling #4 or residual oil also handle clean fuels. The fifth, United Illuminating, receives residual oil for its own consumption.

Sources: Assessor's Office, City of New Haven; U.S. Army Corps of Engineers; New Haven City Plan Department Survey.



MAP V-1 PETROLEUM STORAGE AREAS
NEW HAVEN HARBOR

COASTAL ENERGY IMPACT PLANNING GRANT
New Haven City Plan Department

Scale: 1" = 1000' June, 1980

2. Relocation of all storage located along the Quinnipiac River and the East Shore (areas 1 and 2; 62.8 acres).

   Clean fuels: 10 operators, 2,553,000 barrels.

   Residual fuels: 3 operators, 816,000 barrels.

3. Relocation of the East Shore tanks (area 2; 48.9 acres).

   Clean fuels: 6 operators, 2,139,000 barrels.

   Residual fuels: 2 operators, 685,000 barrels.

4. Relocation of Quinnipiac River and West Shore Tanks (areas 1 and 3; 31 acres).

   Clean fuels: 5 operators, 990,000 barrels.

   Residual fuels: 2 operators, 1,010,000 barrels.

5. Relocation of Quinnipiac River tankage, down to the Quinnipiac Bridge (areas 1 and 2a; 29.2 acres).

   Clean fuels: 6 operators, 993,000 barrels.

   Residual fuels: 1 operator, 131,000 barrels.

6. Relocation of the Quinnipiac River tanks above the Ferry Street Bridge, and the facility in peninsular Fair Haven (area 1; 13.9 acres).

   Clean fuels: 4 operators, 414,000 barrels.

   Residual fuels: 1 operator, 131,000 barrels.

7. Relocation of only those Quinnipiac River tanks above the Ferry Street bridge (area 1a; 5.2 acres).

   Clean fuels: 3 operators, 170,000 barrels.

C. Operational Alternatives

One or a combination of the following broad operational alternative could be used to limit expansion of waterfront tank farms or to accomplish relocation without serious disruption to the petroleum distribution system:

1. Leave the storage system as is, letting private market forces determine the fate of waterfront tank farms;

2. Prohibit expansion of any waterfront storage areas;

3. Consolidate as much of the harbor's storage facilities as possible in the East Shore industrial area and the existing inland tank farms areas;

4. Relocate waterfront storage capacity to a single site within the City;

5. Relocate storage capacity to a site which, though not within the City, is close enough to receive products directly from a barge or ship (this distance is limited by the cost of the pipeline and can increase with the scale of the facility and the throughput/storage ratio); and

6. Relocate storage capacity to sites to the north along the Jet Lines pipeline to Springfield.

A discussion of these operational alternatives follows.

1. Leave As Is

This could also be called the "no action" alternative, one which may possibly lead to reduction in waterfront tankage through market forces. But this would not necessarily contribute to more active uses of waterfront land, nor would it remedy the temporal inefficiencies in the land market which delay adjustments in use to those uses which reflect current market forces. Furthermore, if contraction in storage capacity were to occur in response to lowered demand, it would not necessarily occur in the areas of highest priority from a waterfront planning standpoint.

2. Prohibit Expansion of Storage Areas

Given the petroleum throughput projections discussed above, the existing tank capacity on the harbor will be adequate to serve its market area for the foreseeable future. Discussions with terminal operators on the waterfront reveal that for most facilities existing tankage is adequate for current and moderately expanded throughput. A City policy disallowing any net increase in storage capacity or land used for tanks would thus be operationally feasible and guarantee that no additional waterfront land will be committed to tank farms.

The main disadvantage of this approach would again be its general, non-site-specific effect. A complication would be the interpretation of how such a regulation would apply to chemical tanks, which have many of the economic and

aesthetic characteristics of oil tanks but are not as easily relocated to inland sites.

This course of action could be implemented immediately through the local coastal site plan review process of the Connecticut Coastal Management Act (see below, Section VIII, Institutional Alternatives).

3. Consolidate Storage Functions in East Shore Industrial Area and Existing Inland Sites

2,824,000 of the 4,824,000 million barrels of waterfront petroleum storage (58.5%) are located in the East Shore industrial area at present (see Table VI, Map II-1). Under this operational alternative, the petroleum tanks located outside this area would be phased out either through regulatory means or by acquisition and the current users serviced by existing tankage and/or additions to existing tank farms on the East Shore and inland.

Operationally, much of the throughput from the Quinnipiac River tank farms (capacity 545,000; recent annual receipts of 1,776,000 barrels) could be handled by existing facilities in the East Shore industrial area if management arrangements could be worked out. As all four operators currently either purchase from or have throughput arrangements with deepwater terminal operators, much of the product in the Quinnipiac tanks originates at the harborside now. An increase in the throughput/storage ratio in the East Shore facilities from roughly 7.8 to 8.1 (less than 4%) would accommodate all the Quinnipiac River volume. This consolidation would free up the lowest tax yielding tank farm land which also happens to be in some prime sites for more intensive uses, as discussed in Section IV.

Phasing out the older terminals on the Quinnipiac River including Elmco would represent less of a problem than phasing out the residual oil part of the Wyatt operation on the west shore (involving 879,000 barrels of storage for #4 and #6 oils and asphalt) which requires good rail access for product distribution, a boiler house to heat the oil, and insulated tanks. If Wyatt were included in such a scenario, the Tomlinson Bridge and East Shore rail system would have to be totally revamped or new rail access provided at existing inland tank farms. This would involve considerable new investment.

4. Relocate Storage Capacity to a Site Within the City

While operationally and institutionally relocation of storage capacity within New Haven would be most desirable,

only one site has been located which is suitable for tank farm development (see Section VI). This site, approximately 18 acres adjacent to New Haven Terminal's tank farm on the East Haven town line, could accommodate 1.3 million barrels of storage, assuming a ratio of 75,000 barrels per acre. The few other vacant sites of sufficient scale were eliminated because of soil conditions or because tank farms would not be an appropriate use in their locations.

Thus, new inland tank farm development within the City limits could accommodate about 41% of the existing waterfront clean fuels storage capacity, or 55% if Wyatt is not included. It could accommodate 27% of total waterfront storage capacity.

5. Relocate Storage Capacity to a Site Outside the City which is Close Enough to Receive Product Directly from a Ship or Barge

Considering the dearth of City sites, this is the best approach to realizing the goal of large-scale relocation from an operational standpoint. Two major terminals, Wyatt and New Haven Terminal, have already located a total of 2.8 million barrels of storage capacity at two inland locations in Hamden and on the New Haven/East Haven town line, respectively. New Haven Terminal currently has a capacity to pump directly off vessels to their inland tanks, a distance of 6,500 feet, at a rate of 10,000 barrels per hour. This eliminates the need for waterfront tanks to accommodate the surge of product as it is pumped from the vessel. The cost of pipeline construction will increase with the distance from the waterfront.

While operationally appealing, this approach may face difficulties in gaining acceptance from surrounding towns, especially if a public or quasi-public entity is involved in developing an inland facility. Although most towns do not reject tanks farms outright, they may have reservations about them or they may wish to reserve industrial land for more intensive uses. The abundance of industrially zoned land in the inland portions of this region means a ready supply for both tank farm and more intensive uses, however.

6. Relocate Storage Capacity to Sites to the North along the Jet Line Pipeline to Springfield

This is a major recommendation of the Long Island Sound Regional Study of 1975. Consolidating storage at inland sites in the Meriden or Hartford vicinities could replace coastal storage areas in New Haven, eliminate the need for petroleum barge traffic on the Connecticut River, and reduce the total distance which petroleum products must be trucked.

Operationally, this would prove an excellent opportunity if the Jet Line capacity were increased through the installation of additonal pumping capacity and the delivery of products to the pumping station at higher pressures. The Jet Line, which carried approximately 13.8 million barrels northward from New Haven in 1978, is committed to expanding their capacity to 27.4 million barrels per year by 1982 and has the capacity to handle 90,000 barrels per day or 32.8 million barrels per year, a 240% increase over the present rate, using the same pipeline. More significantly, this capacity could accommodate a winter monthly peak of 2.7 million barrels, compared to a peak monthly volume of approximately 1.8 million barrels in January, 1978.

At this rate of pumping the Jet Line could transport up to 65% of New Haven Harbor clean product receipts as opposed to the 27% it handles now.

The impact of this arrangement on the efficiency of products distribution would depend on the exact location of the inland tank farms. While New Haven is a fairly central distribution point, communities along Interstate 91 from Meriden to Hartford are closer to the large Hartford area market.

Various sites in the vicinity of the Jet Line have been identified (see Section VI).

VI. Alternative Inland Sites for Tank Farm Development

A. Locational and Site Requirements of Tank Farms

1. General Site Requirements

Petroleum tanks farms have a number of general site requirements applicable to both coastal or inland situations. Additional criteria should be included when examining potential inland sites for the relocation of tank farms presently situated on the waterfront.

According to industry sources, a potential petroleum storage facility site is assessed primarily from an operational point of view. A terminal optimization study is the common method of determining the most economical method of receipt and distribution. A dealer's cost is the sum of several factors, of which transportation of the product is at once the most critical and variable. The total cost includes the "laydown cost", or price of getting the product to the tank; storage and handling, including tank maintenance, labor, insurance, etc.; and the transportation cost to the dealer's market, which depends upon the location of the market and highway and secondary road access to it. This last factor is especially important in Connecticut where 75% of the total petroleum receipts are redistributed from primary marketing terminals by truck. Rail access is a requirement for some terminals which handle and distribute residual oil.

From interviews with operators in New Haven, it is clear that most companies find their present waterfront locations more advantageous than inland sites from a development and operating cost perspective. Waterfront storage eliminates the need for long pipelines and allows easier control over receiving and distribution from a central office. The New Haven terminals have excellent highway access, excellent rail access for the one terminal which uses rail (Wyatt), and existing tie-ins with the Jet Lines pipeline.

The strongest argument of many terminal operators in favor of their waterfront locations is the existence of facilities which are in most cases paid for. Replacement of old storage capacity at currently inflated steel, assembly, and site preparation costs is extremely expensive (see Section VII). As most of the waterfront tanks are welded steel, built since 1950, they have a long life expectency if properly maintained even though on paper they may have been totally written off.

The nature of the product handled at a tank farm requires that the facility be located in an area zoned for heavy

industry. Some municipalities impose additional requirements for the location of bulk storage such as buffer zones between storage areas and residential areas. In New Haven, for instance, a special exception must be obtained for this use from the Board of Zoning Appeals (BZA). The BZA takes into account the following factors when considering a particular location: the nature of the proposed site, including its size and shape; the proposed size, shape and arrangement of structures; the resulting traffic patterns and adequacy of proposed off-street parking and loading; the nature of the surrounding area and the extent to which the proposed use or feature might impair its present and future development; and the proximity of dwellings, churches, schools, public buildings and other places of public gathering. Recently, under intense pressure from neighboring residents, the BZA denied a permit to build a large tank in an IH zone which already contains a number of tanks.

With the current escalating value of petroleum products and the controversy often surrounding the major oil companies, security has become an important consideration in site assessment. Proximity to a high crime area of a town would be considered a negative feature of a proposed site.

While community acceptance is a factor in the site selection of most any type of business, it is especially important in the case of bulk storage of petroleum facilities because of the hazardous nature of the product, the large scale of the structures, and the increased heavy truck traffic generated by a terminal's delivery system. The climate for tank farm development business in a town might also hinge on or take into account the ratio of tax benefits received from this use to the cost of providing comprehensive fire and police protection as well as maintenance to heavily travelled roads.

2. Environmental Criteria

Environmental criteria must be evaluated in terms of impact upon the physical landscape, the social well-being of the community, and the financial burdens associated with mitigating environmental impacts.

Petroleum bulk storage facilities should not be located in an area which is subject to coastal or riverine flooding. Ideally, the topography of the site should be relatively flat. Although the effects of slope can be reduced by techniques such as terracing this increases development costs. Adjacent uses which are incompatible with a tank farm, such as residential, recreational or commercial development should be screened to minimize adverse aesthetic impacts.

Good soil properties were sited by terminal operators as a crucial site requirement. Stable, load-bearing soils are desirable both to prevent settlement problems and to hold down the cost of site preparation. According to industry spokesmen, a site with unsuitable soil conditions can be stabilized by piling or surcharging, but often at a cost equal to or greater than the construction of the storage facilities themselves.

3. Access to Marine Terminal and Jet Lines Pipeline

An important criteria mentioned by industry sources was convenient access to incoming and outgoing waterborne transportaion. While pipeline technology obviates the necessity of locating storage facilities on the waterfront, terminal operators maintain that shoreside storage is needed to accommodate off-loading ships whose cargo discharge rate is higher than the pumping rate of existing pipeline facilities. These are sometimes referred to as surge storage tanks. Operators must pay a demurrage cost for ships that are delayed at the terminal longer than 36 hours by other than natural causes. The alternative to surge storage tanks at the waterfront is a pipeline to an inland site which is capable of handling peak unloading rates from ships, about 10,000 barrels per hour.

Reasonable proximity to the Jet Line pump station located at 400 Quinnipiac Avenue, is another requirement for an inland tank farm which serves areas up the pipeline. Products using the pipeline must be delivered to the suction side of the pumping station unless a new pump station were built, a project that might prove prohibitively expensive. A right of way to connect a storage terminal to the Jet Line should follow the most direct route while altering the landscape as little as possible. A long right-of-way which must go through heavily built-up urban streets or very hilly topography could be prohibitively expensive.

4. Land Requirements

There are no hard and fast requirements for the amount of acreage needed to store and handle a given amount of product. Various sources have reported different acreage requirements:

- Petroleum Development in New England, a study by A. D. Little of potential development related to exploitation of outer continental shelf oil resources, recommends a ratio of 1 million barrels per 17 acres or approximately 60,000 barrels per acre.

- A port development report for New Haven Harbor prepared in 1968 by the consulting firm of Knight and Gladieux, Inc., recommends a petroleum storage ratio of 50,000 barrels per acre.

- A representative of Northville Industries on Long Island suggested that one acre is needed per 33,000 barrels of #2 heating oil and gasoline.

- The developed portion of New Haven Terminal, Inc.'s, inland tank farm on Peat Meadow Road, stores about 75,000 barrels per acre, including dicked area, access roads and loading racks.

Various State regulations require minimum distances for setbacks from property lines and public buildings, diked areas around tanks, and minimum distances between tanks. The dedication of individual tanks to specific products and/or companies may require a certain tank size, with the appropriate corresponding minimum distance requirements. Otherwise, the geometry of the site itself is a major determinant of the arrangement of facilites on the site and hence the amount of land needed. One industry source reported that given these regulatory parameters and a regularly shaped site, the use of large 300,000 barrel tanks result in the maximum number of barrels per acre.

Different options for relocation would carry differing land requirements. To provide an inland storage facility to accommodate the clean fuels storage presently on the waterfront (3,129,000 barrels) would require 42 acres assuming a ratio of 75,000 barrels per acre. The acreage requirements and development costs associated with each of the relocation scenarios of Section V are explored more fully below in Section VII.A.

B. Potential Inland Tank Farm Sites in the New Haven Market Area

1. South Central Connecticut Region

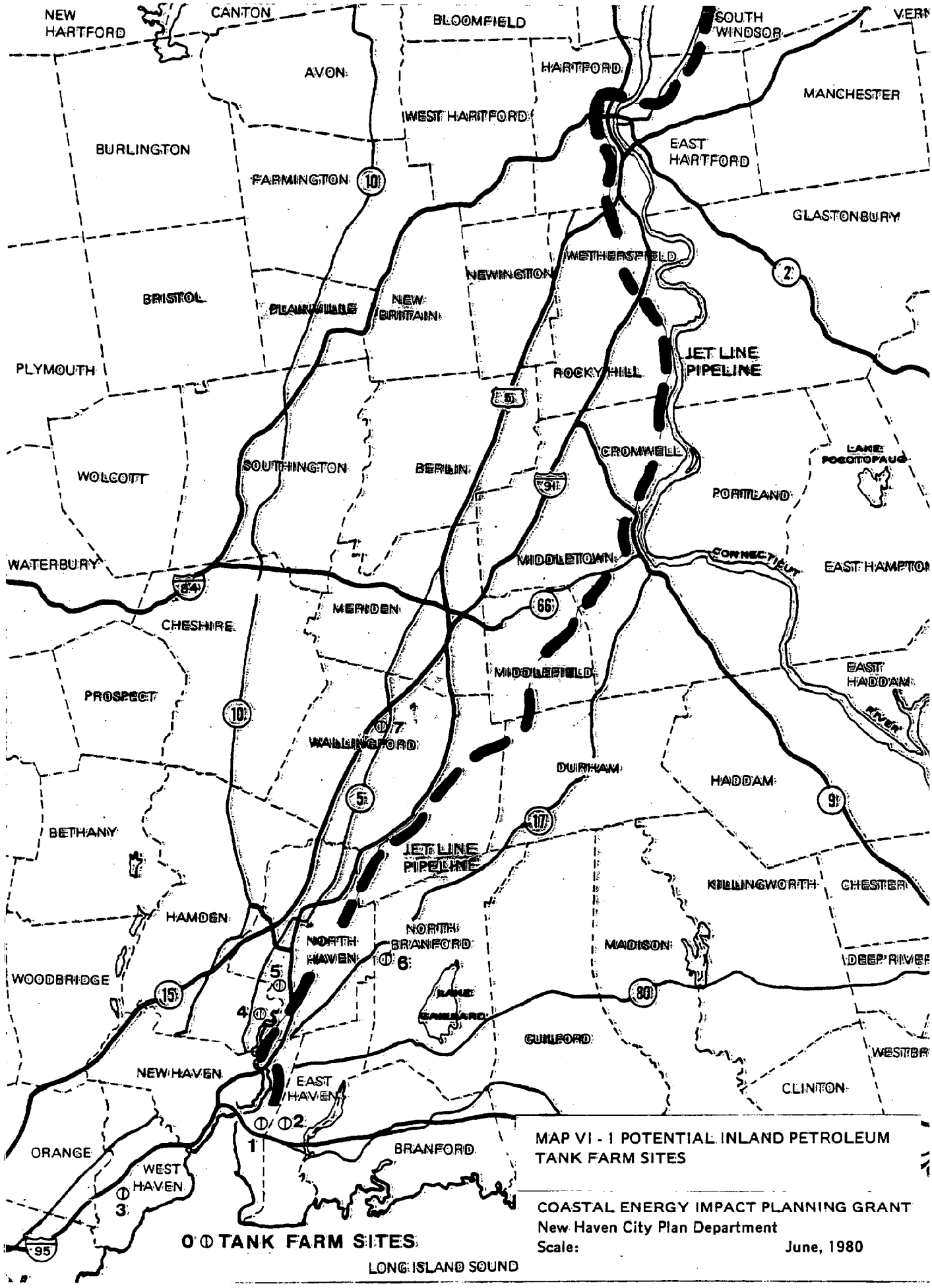
As one element of this feasibility analysis, potential inland petroleum storage sites in the region were screened. As site location and characteristics have a direct bearing on development costs and desireability from a marketing standpoint, site analysis was an integral part of the study. The sites examined in some detail are listed on Table VI-1 (see also Map V1-1).

Based on criteria discussed in Section VI.A., the ideal site would be at least 30 acres, have stable soil conditions, have good access to the interstate highway system and preferably

Table VI-1
Potential Inland Petroleum Tank Farm Sites

No. on Map VI-1	Municipality	Location	Area (acres)	Zone	Rail	Highway Access	Proximity to Jet Line Pipeline	Soil Conditions	Comments
1	New Haven/ East Haven	Adjacent to NHT Tank Farm on North and East	26.6	Heavy Industrial	Yes	I-95 via Frontage Rd.	Pipeline from NHT Tank Farm to pump station in place	Part fair; part very poor	Good highway access; adjacent to large tank farm; connection to Jet Line in place; possible community resistance; part is wetlands.
	New Haven	Between Russell St. and Amtrak mainline	17	Light Industrial	Yes	I-95 via local streets or new railroad crossing	via NHT pipeline to pump station	Fair	Adjacent to existing tanks; flat topography; screened from neighborhood by ridge; community resistance possible. Zone change needed.
2	East Haven	West of Bradley St. and East of Amtrak main	52	Heavy Industrial	Yes	I-95 via Bradley St. or new rail overpass	via NHT pipeline to pump station	Poor	Adjacent to existing tanks; area designated bulk storage in East Haven Plan of Development; poor soils; ravine.
3	West Haven	Morgan Lane	90	Industrial	Yes	I-95, good	Far		Far from harbor and Jet Line
4	Hamden	East of State St., adjacent to existing Wyatt tanks	5	Industrial	Yes	I-91 via Rt. 5	Connected via Wyatt pipeline*	Variable,	Some room on Wyatt site; some adjacent; tidal wetlands restrict expansion.
5	North Haven	Railroad property south of Sackett Pt. Rd.	150 (est.)	Industrial	Yes	I-91 via Sackett Pt. Rd. or Montowese Ave.	.3 mi. to line, 3.9 to pump station		Difficult to acquire land; possible community resistance.
6	North Branford	Intersection of Rt 17 and N.Branford/N. Haven town line	25	Industrial (part residential)	No	5.7 mi. to I-91 on Rt. 17	1.4 mi. for tie-in†	Good	Poor highway access; part of site would need zone change.
7	Wallingford	North Plains Industrial Park	187	Industrial	Yes	2.8 mi. from I-91 via Rt 68	3.8 mi. for tie-in†	Good	Possible community resistance; incompatible with adjacent uses.
8	Rocky Hill	Adjacent to existing storage of F.L.Roberts and	7 (est.)	Manufacturing	Yes	2 mi. to I-91 via Rt. 99	Adjacent terminals are connected	Good	Availability and exact size unknown; in flood plain.
9	Portland	End of Brownstone Ave. Extension	25	Industrial	Yes	2 mi. to I-91 via Rt. 66	Terminal 1.5 mi. south is connected	Good	Flat topography on site; needs access road to Rt. 66.

*New pipeline would have to be constructed to receive products at this site from vessels. Direct connection to Jet Line pipeline would be desireable.
†This distance is for tie-in to receive products. Distance to Jet Line pump station for shipment of stored product to north is considerably farther.



MAP VI - 1 POTENTIAL INLAND PETROLEUM TANK FARM SITES

COASTAL ENERGY IMPACT PLANNING GRANT
New Haven City Plan Department
Scale: June, 1980

rail access as well, and be in an industrially zoned area screened from adjacent non-industrial uses. Unfortunately, these same criteria apply to almost any industrial development which means that most such sites have already been developed. In New Haven, for example, the City went to great trouble and expense to prepare poorly drained industrial site for the G & O Company because no alternative sites within the City existed. Public subsidies were required to develop this site because a private company would locate elsewhere before footing the site preparation bill.

The distance a new tank farm facility can be located away from the harbor is limited by the expense of constructing a pipeline and pumping system large enough to receive product directly off a ship. If sufficient tank capacity were maintained at the waterfront for surge storage, the pipeline requirements would be reduced.

The first possibility examined was the expansion of storage capacity at the two inland storage areas. Currently, additional capacity to store 250,000 barrels of petroleum products exists at Wyatt's inland tank farm on Benton Street in Hamden. New Haven Terminal owns land adjacent to their inland tanks on the East Haven town line upon which they could expand their storage capacity by 900,000 barrels. The remaining 2.0 million barrels of clean fuels storage on the waterfront would require approximately 37 acres, assuming a ratio of 75,000 barrels per acre.

After looking for available relocation sites within the borders of the City of New Haven, where little vacant industrial land can be found, it quickly became evident that sites outside the City would have to be considered. Only one City parcel, land adjacent to existing storage tanks of New Haven Terminal near Peat Meadow Road, was considered even remotely feasible. Large open areas exist in the vicinity of the City landfill, off Middletown Avenue, but releases of explosive methane gas from the decomposing solid waste in the landfill would pose hazards and the soil conditions are very poor. A nearby major tract, known as the "Warner Property", bounded by Route 80, Quinnipiac Avenue, the Amtrak main line and Interstate 91, is zoned commercial, has poor soil conditions, and is being actively considered for more job intensive uses at present. All other New Haven sites examined were too small for a feasible scale of development.

The South Central Connecticut region has a great deal of vacant industrial land in its over 3,000 acres of industrial parks and zones, although a limited amount would be suitable for tank farm development. The site search focused on areas along the Jet Lines Pipeline for access to the pipeline and proximity to product markets which these sites could offer.

After surveying all the towns bordering on New Haven and several along the Jet Lines Pipeline to the north, a list of ten potential sites for new tank farms was developed. This list is for illustrative purposes in the cost analysis only. It does not constitute specific proposals nor have all the ramifications of tank farm development on the sites in question been explored. While a tank farm development in any location may face some opposition on economic and environmental grounds, the site survey and analysis does suggest that appropriate alternatives to waterfront sites do exist within the region.

The sites include the one in New Haven already mentioned, one in Hamden, two in North Haven, two in East Haven, two in West Haven, one in Wallingford, and one in North Branford.

2. Hartford Area

Another option would be to increase storage capacity near the pipeline in the Hartford area to serve a wider market from that point. Storage development costs would be comparable to those to the south with some variance in land costs.

Operationally, this option may become more attractive as the cost of trucking products increases.

While tanks that far inland would still have to be served by surge storage tanks closer to the harbor, their presence would reduce reserve storage capacity needs in New Haven and hence have the potential to increase local throughput/storage ratios and thus replace New Haven storage.

Potential sites were identified in Rocky Hill and the Hartford vicinity though none were examined in detail within the scope of this study.

VII. Costs of New Tank Farm Development or Relocation

A. Capital Costs

1. Relocation

Most industry sources felt that the physical relocation of existing tanks would not prove economically advantageous at this time. With labor and material costs involved in cutting apart the old tank, transporting it, and reassembling it on a new foundation, the total cost would approach 60%-70% of that of a new tank. The end result, for that price, is still an old tank with its associated risks and stresses of age, particularly in the original welds which are not guaranteed by the moving contractor (the tank is cut in new places to make the move easier).

New Haven Terminal did actually relocate three large tanks from the waterfront to their inland site in East Haven in the late 1960's, but construction costs and condition have changed since that time. Recently NHT also purchased two smaller tanks from the City and moved then in one piece from another waterfront site to their own. In this case, the size of the tanks and the proximate waterfront locations made it feasible to move them.

Therefore, if major new inland facilities were constructed or an existing one expanded, the likelihood is that new tanks would be used. Thus cost analysis will be limited to new development. Discussions of relocation refer to the storage capacity of tanks rather than the tanks themselves.

2. New Development

Beyond the cost of the tanks themselves, a new tank farm development must include: concrete tank foundations; diked areas around the tanks capable of containing the volume of the largest tank plus 10% of the volume of each additional tank within the diked area; service roads and truck or rail loading tracks; pipeline connections from the tank to the product source and to the truck or rail loading racks; and associated pumps and fittings required for moving the product. If #6 oil or asphalt is to be stored, a steam boiler house and tank and pipe insulation will be required.

The tanks themselves are either floating roof, required for gasoline, or fixed roof in the case of heating oil. Table VII-1 gives a cost breakdown in 1979 dollars of individual tank farm components.

The total cost of developing a new inland tank farm is the sum of site acquisition, construction, and pipeline costs. The cost figures developed in this study are rough

estimates for purposes of general feasibility analysis. While more detailed engineering and operational feasibility analysis would obviously be required to refine these concepts, the level of analysis and accuracy here is sufficient for preliminary evaluation.

The cost of acquiring waterfront tank farms was not calculated here. It was assumed that if relocation were accomplished privately, sale of the land would more than cover tank demolition costs plus new site acquisition. If waterfront sites were acquired by a public entity, resale or future lease revenues would offset these costs.

Depending on the area under consideration, the spill-over benefits of tank farm removal, measured by increases in property values and hence tax assessments on adjacent land and structures, could be considerable. In the Quinnipiac River Historic District vicinity in particular, the presence of aging tank facilities on the east bank reduces the value of land with a high residential and commercial potential on both sides of the river.

Analysis of the component costs of the new tank farm development results in a figure very close to the industry rule of thumb of $10 per barrel of storage capacity which will thus serve for analytical purposes in this report. Tot this must be added off-site pipeline costs and new site acquisition costs.

Table VII-2 details a range of development costs involved in accomplishing the levels of waterfront tank farm relocation outlined in Section V.B. These highly generalized capital costs are provided to give an idea of the magnitude of the project. The cost of the major relocation scenarious range from $25-60 million. More refined estimates would require more detailed site and pipeline right-of-way investigations.

The inclusion of residual oil capacity in any relocation scenario increases the costs because the specifically designed dedicated pipelines required are more than double the cost of clean fuel lines. Any of the first four scenarios could be accomplished for considerably less cost if only clean fuels were included.

Table VII-1
Estimated Cost of Tank Farm Components

1. Basic Tanks

	50,000 bbls	80,000 bbls	150,000bbls	300,000 bbls
Cone roof (fixed)	$235,000	$335,000	$557,000	$1,025,000
Floating roof	$294,000	$422,000	$680,000	$1,250,000

2. Site preparation (including floors and dikes) $200,000 - $500,000 (depending on site conditions)

3.	Pipeline from waterfront (16")	$85 - 120/ft.
4.	Pumps (2-4 needed depending on routes)	$1,000 - $5,000 each
5.	Basic valves, interior piping	$25/ft.
6.	Regulatory valves, fittings (2 per tank)	$5,000 each
7.	Old tank demolition and purging	$19 - 24,000/tank
8.	Truck loading racks (4-6 per site)	$250,000 each
9.	Vapor recovery units (1 per site)	$30,000 each
10.	Boilerhouse (if No. 6 oil or asphalt are involved)	$140,000
11.	Pumphouse and small office	$ 50,000
12.	Parking area and turnarounds	$ 5,000
13.	Tank insulation for No. 6 oil and asphalt (150,000 barrels)	$ 22,000

B. Operating Costs

The replacement of numerous, aging waterfront tank farms and terminals with a consolidated inland terminal would reduce total labor and operating costs for petroleum handling. Depending on the inland location, the transportation costs associated with distribution from more centralized locations may be reduced as well.

Of interest here is the extent to which the savings in operating costs would offset the high cost of financing new tank farm construction. While the derivation of these figures is difficult due to the proprietary nature of the information, there is probably a large gap between operational savings and the additional funds needed to support the new capital debt.

TABLE VII-2
ESTIMATED COST OF DEVELOPING NEW INLAND PETROLEUM STORAGE FACILITIES

Alternative	Areas on Map V-1	Storage Capacity (bbls x 1000) Clean Fuels Capacity	Clean Fuels New Acres Required(A)	Residual Fuels Capacity	Residual Fuels New Acres Required(A)	Total Acreage Required	Waterfront Land Made Available	Estimated Development Cost ($ x 1,000,000) New Tank Farm (@$10/bbl)	Land	Pipeline	Total
1. All Waterfront Tanks	1,2,3	3129	42-52	1695	23-28	65-80	80	48.2	1.6-2.8	4.4-9.2	54.2-60.2
2. Quinnipiac River and East Shore	1,2	2553	34-43	816	11-14	45-57	63	33.7	1.1-2.0	4.4-9.2	39.2-44.9
3. East Shore	2	2139	29-36	685	9-11	38-47	49	28.2	1.0-1.6	4.4-9.2	33.6-39.0
4. Quinnipiac River and West Shore	1,3	990	13-17	1010	13-17	26-34	31	20.0	.6-1.2	4.4-9.2	25.0-30.4
5. Quinnipiac River Down to I-95	1,2a	993	13-17	131	2	15-19	29	11.2	.4-.7	1.2-2.6	12.8-14.5
6. Quinnipiac River above Ferry St. and peninsular Fair Haven	1	414	6-7	131	2	8-9	14	(B)	---	---	-----
7. Quinnipiac River above Ferry St.	1a	170	2-3	---	---	2-3	5	(B)	---	---	-----

(A) Range based on 60,000-75,000 barrels per acre.

(B) These facilities could either be phased out without adverse impact on the storage system or could be replaced by additional tanks at existing inland tank farms at lower cost than new tank farm development.

(C) Range based on range of acreage requirements and range of inland industrial land costs of $25-35,000 per acre.

(D) Alternatives 1-4 would require separate pipelines for clean and residual fuels. Pipeline costs are based on $75-100/foot for clean fuels pipeline and $200-250/foot for specially designed residual oil pipeline for a distance of 3-5 miles.

VIII. Institutional Alternatives

A. General Considerations

The relocation of petroleum tank farms could be accomplished through a range of institutional and legal mechanisms depending on the level of relocation attempted and legislative preferences for one form over another.

The less ambitious relocation scenarios discussed above could be accomplished without major new inland tank farm development. Estimates of future throughput demands and analysis of current tank farm operations have shown that the present facilities could accommodate the moderate increases in throughput which would accompany the phasing out of a small percentage of the harbor's storage capacity. This points to public acquisition as the most direct method of accomplishing the less ambitious relocation scenarios such as 6 or 7. Users of these smaller facilities would then have to negotiate direct throughput contracts with other terminals to meet their supply needs.

The more ambitious the relocation program, the more complex are the institutional mechanisms required. Basic approaches involve either regulatory or direct intervention or a combination of the two.

Whatever approach is employed, its impact on the structure of the industry and consequently on prices must be assessed. Constriction of the supply of storage facilities through public action could lead to artifically increased terminaling charges, increased prices, or other related business practices which may be possible due to the concentration of ownership and market power in fewer, larger companies. Unless tied to some guarantee of access to alternative facilities, elimination of the storage capacity of independent operators on the Quinnipiac River would limit the options for smaller fuel oil dealers and marginally reduce competitive pressures on the majors and larger dealers.

B. Regulatory Approach

1. Zoning

The City has the power to control the type and intensity of land uses through zoning, including the power to prohibit certain uses altogether and to implement a program for long term elimination of uses which do not conform to the Zoning Ordinance. The zoning regulations must have a clearly stated purpose of protecting public health, safety and welfare. Zoning regulations and their enforcement or supervision must show some evidence of conformance with a comprehensive plan for the municipality or district involved.

Petroleum storage tanks are now permitted in New Haven by special exception in areas zoned for heavy industry. The City could act to phase these uses out over time by amending the zoning ordinance to declare such storage tanks in one district or throughout a large area a non-conforming use. This would limit expansion of the use.

The next level of regulation would be to require eventual phase out of the tanks, giving the owners of the facilities a specified period of time, such as 20 years, to amortize their investment in the facilities and remove the tanks.

This approach to tank relocation has been adopted by the City of Burlington, Vermont, to further the redevelopment of its lakefront area. A similar approach has been used to phase out non-conforming uses in other cities and states, and is specifically allowed by Connecticut law (Title 8, Connecticut General Statutes). The state courts, however, have held in most cases that a non-conforming use constitutes a property right which cannot be taken without compensation, even if a sufficient amortization period is allowed in the phase-out ordinance. This interpretation might be challenged successfully.

This long range policy would be the least expensive approach to relocation in terms of public resources and appreciates the need for companies to derive the benefits of their investments and to make long range plans for developing alternatives to waterfront storage capacity. Simple declaration of tanks as a non-conforming use without the phase-out provision would prohibit expansion of these uses and engender less industry opposition.

2. Connecticut Coastal Management Act (CCMA)

As mentioned above, the CCMA specifically directs local governments:

> "To disallow the siting within the coastal boundary of new tank farms and other new fuel and chemical storage facilities which can reasonably be located inland and to require any new storage tanks which must be located within the coastal boundary to abut existing storage tanks or to be located in urban industrial areas and to be adequately protected against floods and spills." [Sec. 2(b)(1)(E)].

The City must follow the detailed policies in the CCMA when considering applications for special exceptions or building permits for projects in the coastal area. The mechanism for this process, called Coastal Site Plan Review, would put the burden of proof on the person proposing to building a tank farm to demonstrate why their facility must be located within the coastal area.

This mechanism is specific to the coastal area, a specificity harder to achieve through amendment to the industrial section of the zoning ordinance without creating new districts. It allows some discretion on the part of the board or commission conducting the review. The task of regulating coastal tank development will be made easier if the question of new tank development is specifically addressed in the City's municipal coastal program. This program constitutes a plan of development for the coastal area, designating allowable uses and establishing local coastal policies to supplement state policies as they apply to New Haven.

C. Direct Public Intervention

Direct public intervention to accomplish tank farm relocation could take a number of forms depending on the scale of relocation proposed. Possibilities include simple public acquisition and preparation for reuse for less extreme programs; development of inland storage areas by a public or quasi-public entity as an inducement to relocation (or in conjunction with a regulatory or acquisition program); and a public-private partnership in which the City joined with a private firm or firms in buying out waterfront tank farms for reuse and/or in acquiring or developing common pier, pipeline, and storage facilities.

If relocation of waterfront tank farms is embraced as an important public initiative, it would have to be determined through more in-depth study what level of public action or investment would be required to induce private participation in the scheme. With access to lower cost financing and potential help in simplification of permit processes, the public sector could make an otherwise unworkable scheme financially feasible. Public initiatives could also provide the impetus for overcoming institutional barriers which are presently resulting in underutilized facilities, waterfront siting, and perhaps higher product costs for consumers.

IX. Conclusions and Recommendations

New Haven is a vital petroleum port for Connecticut, supplying 50-60% of all state heating oil, and a large part of Southern New England. The port is the fifth largest receiver of petroleum products on the east coast and the second largest in New England. While petroleum tank farms are essential regional support facilities, they do not require a waterfront location, as demonstrated by two New Haven terminals and numerous terminals around the country.

Current and historical data on storage capacity and throughput indicate that in general New Haven's petroleum receiving and storage facilities could be used more intensively by increasing the low annual turnover rates of the tanks. Petroleum throughput is expected to level and possibly decline over the next 20 years. This means that either reserve capacity can be increased or that storage capacity can be reduced as receipts level and/or decline.

New Haven, like many urban coastal cities, is just beginning to realize the potential of its extensive waterfront area. Ambitious waterfront revitalization projects and plans are underway in a number of areas, and other areas offer excellent opportunities for new construction or adaptive reuse.

If waterfront tank farms in strategic areas could be phased out, alternative uses of prime waterfront land could generate considerably more benefits to the people of the region in terms of jobs, taxes, public access, and a higher quality of life. While active citizen groups in several urban waterfront areas of New Jersey have banded together to halt construction of major new waterfront tank farms because they would preempt these opportunities, there are few precedents for actual removal of tank farms with more than minimal capacities.

Numerous people consulted in the course of this study felt that relocation of waterfront storage capacity is desirable as a long-term objective. While this report has demonstrated that a range of alternative uses for waterfront sites are more desireable from a societal perspective, there is serious question whether major tank farm relocation, costing $25-60 million would be economically feasible, although the data on operations which would allow a full analysis was not available for this study. A less ambitious level of relocation in areas where the tanks are non-conforming uses impeding non-industrial waterfront renewal may be worthwhile. The least extensive waterfront tank farm phase-out scenarios discussed would not require any new capacity development, would free up land in the upper Quinnipiac

River adjacent to areas with extensive new development and rehabilitation underway, and would involve the facilities yielding the lowest average tax assessment per acre.

Any public action to encourage or force extensive relocation of petroleum tank farms away from the waterfront may be resisted by private oil companies, especially if their operating costs are increased. However, even these companies stand to gain in some respects if some of the approaches suggested in this report are adopted. For instance, development of inland storage facilities by a quasi-public corporation or joint public-private action to serve a number of companies now located on the waterfront could have the effect of increasing the efficiency and safety of storage operations. The project could be structured so that the oil companies derived investment tax credits and depreciation reductions as well.

While oil companies developing new facilities might be willing to invest considerable additional capital to use inland sites if permit delays would be reduced (Singer and Morrell, 1979), the question in New Haven is one of relocation, not new development. As there is no pressing need or incentive for private development of inland storage areas to replace waterfront capacity, the public incentive to bring about relocation would have to go beyond simply expediting permit procedures to include net operating cost reduction or other operational advantages.

Inland tank farm development is technically and operationally feasible, as illustrated by the independent terminalling operation of New Haven Terminal and by inland terminals in other areas. Numerous sites in the greater New Haven area, some of which were analyzed in this report, would meet the requirements of inland tank farms.

Management of an inland tank farm which serves a number of companies would be modeled on jointly owned terminals in the midwest or on private independent terminals in this area such as Northville on Long Island or New Haven Terminal in New Haven. Oil companies are increasingly willing to accept comingling of product at such facilities in the interest of operational efficiency.

Based on extensive research of petroleum handling systems and technology in New Haven and elsewhere and on discussions with terminal operators and oil company executives, this report concludes:

1. While technically feasible and operationally advantageous, large-scale relocation of waterfront petroleum storage capacity is not economically feasible at the present

time due to the high capital cost of new inland facilities and the balance of labor costs and other operating costs. Over the long term as existing waterfront tank farms deteriorate and the combined cost of operating numerous smaller terminals increases, inland development of a combined storage facility would gain in relative attractiveness and become more feasible. The City should encourage the State to create a quasi-public petroleum storage development entity to create inland storage areas if and when the economics of the proposition improve.

2. Even though large scale relocation is not feasible, the City should develop a long-term policy for inclusion in its Municipal Coastal Program which specifically prohibits development of any new storage capacity or expansion of existing terminals on the waterfront except under extreme circumstances. Such a policy would recognize the non-waterdependent nature of petroleum storage facilities, support City objectives in harbor development and be consistent with the State Coastal Management Act. It could be implemented through local powers granted under the state zoning enabling legislation and coastal management laws.

3. While prohibiting expansion of existing or construction of new waterfront tank farms, the policies of the Municipal Coastal Program should guide the private market in appropriate uses of all waterfront land, especially land now occupied by tank farms should those facilities be phased out.

4. The City should seriously consider the near-town acquisition and phase-out of smaller tank farms on the Quinnipiac River in or adjacent to the Quinnipiac River Historic District. Reuse of this land would not only provide for higher tax-yielding development, potential public access areas, and other people-oriented uses, but would also greatly enhance the land values and ambience of the entire area. Acquisition of the facilities above the Ferry Street Bridge, none of which receive product by barge, would free up 5.2 acres of land and probably cost on the order of $.8-1.0 million including land and tanks. A more complete investigation of the costs and benefits of this acquisition should be conducted.

5. As long as New Haven remains a regional petroleum storage center, the City should seek some means of compensation for the burden of low tax-yielding tank farm uses requiring large public service costs which it shoulders for the region. While $1.8 billion worth of product may pass through the tanks around New Haven

Harbor in a year, the City derives less jobs and taxes per acre from tank farms than from other uses and must support and maintain specialized fire fighting capacity to serve the tank farm area. On top of this New Haven forgoes more intensive and water related harbor development on the 80 acres occupied by tank farms.

Alternative means of achieving this compensation which merit further investigation are: inclusion of the average inventory of all petroleum terminaling companies on the grand list of the city or town in which the facility is located; adoption of a state-wide formula similar to that applying to tax-exempt property to compensate those municipalities who bear a disproportinate burden of regional petroleum storage facilities.

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Appendix A
Petroleum Conversion Factors

Table 1
Gravity and Volume-to-Weight Conversion Factors for Petroleum Products and Water

Product	Pounds per Gallon	API Gravity	Pounds per Barrel	Barrels per Ton
Gasoline	6.4	52.5	268.8	7.440
Kerosene	7.0	36.8	294.0	6.803
#2 Fuel Oil	7.2	32.1	302.4	6.614
#4 Fuel Oil	7.7	21.5	323.4	6.184
#6 Fuel Oil	8.0	15.8	336.0	5.952
Water	8.33			

Law or Regulation	Authority	Activity Governed
Federal		
33 CFR Part 126		
Handling of Explosives or Other Dangerous Cargoes Within or Contiguous to Waterfront Facilities	U. S. Coast Guard Dept. of Transportation	Specifies conditions of designation as licensed waterfront facility; regulates requirements to maintain status as designated facility.
33 CFR Part 154	U. S. Coast Guard, Dept of Transportation	
Subpart A - General		Applies to each onshore and offshore facility, when it transfers oil in bulk to or from any vessel that has a capacity of 250 or more barrels of that oil.
Sec. 154.120		Mandates C. G. inspections of the facility to insure compliance with the Federal Water Pollution Control Act.
Subpart B - Operations Manuals		Requires manual of operations of facility and specifies contents for transfer facilities.
Subpart C - Equipment Requirements		
33 CFR Part 156 - Oil Transfer Operations	U. S. Coast Guard, Dept. of Transportation	Applies to the transfer of oil to or from any vessel with a capacity of 250 or more barrels for that oil on the navigable waters of the United States or contiguous zone thereof.
Section 156.120		Specifies requirements for oil transfer.
Section 156.130		Specifies connections.
Section 156.150		Requires declaration of inspection of transfer facilities and specifies contents of declaration.
40 CFR Part 60 Subpart K - Standard of Performance for Storage Vessels for Petroleum Liquids (New Source Performance Standards)	Environmental Protection Agency	
Section 60.110 (1)		Applies to each storage vessel for petroleum liquids (as defined in Section 60.111) with capacity greater than 40,000 gallons and commences construction or modification after 3/8/74.

APPENDIX B - Regulatory Programs Affecting Tank Farms

Law or Regulation	Authority	Activity Governed
(2)		Has a capacity greater than 65,000 gallons and commences construction or modification after 6/11/73.
Section 60.112 (1)		If true vapor pressure of liquid, as stored, is equal or greater than 1.5 psia but not greater than 11.1 psia requires floating roof, vapor recovery system or theirequivalents.
(2)		If true vapor pressure is greater than 11.1 psia, requires vapor recovery system or its equivalent.
Section 60.113		Regulates monitoring of operations: type of liquid stored, Reid vapor pressure, dates of storage, dates on which storage vessel is empty.
40 CFR Part 112 - Oil Pollution Prevention, Non-Transportation Related Onshore and Offshore Facilities	Environmental Protection Agency. Pursuant to Federal Water Pollution Control Act.	Applies to owners or operators of facilities (as described in Section 112.1 (b) which due to location could reasonably be expected to discharge oil in harmful quantities into or upon navigable waters or adjoining shorelines.
Section 112.3		Specifies requirements and guidelines for preparation and implementation of Spill Prevention Control and Countermeasure Plans. Mandates periodic integrity testing of tanks.
Section 112.7 (3)		Specifies conditions of facility transfer operations, pumping and in-plant process (on-shore.)
Section 112.7 (4)		Mandates compliance with Dept. of Transportation regulations for tank car and tank truck loading/unloading procedures.
49CFR Part 195 Regulations for the Transportation of Liquids By Pipeline	Department of Transportation Materials Transportation Bureau Office of Pipeline Safety	Prescribes rules governing the transportation by pipeline in interstate commerce of hazardous materials, petroleum and petroleum products.
Subpart B		Accident reporting
Subpart C		Design Requirements
Subpart D		Construction
Subpart E		Hydrostatic Testing
Subpart F		Operation and Maintenance
Amendment 195-15 Docket PS-51 Transportation of Liquids by Pipeline; Procedures for Operations, Maintenance and Emergencies	Department of Transportation Materials Transportation Bureau	Establishes precise and comprehensive requirements for written procedures to be prepared and followed by operators of hazardous liquid pipelines for conducting pipeline operations and maintenance, and for handling emergencies.

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Law or Regulation	Authority	Activity Governed
49 CFR Park 1300 Freight Tariffs Subject to Interstate Commerce Act.	Federal Energy Regulatory Commission U.S.Dept. of Energy	Governs the construction and filing of tariffs naming through routes and joint rates over the lines of common carriers by pipeline.
Section 1300.61 Demurrage on interstate shipments		Requires carriers to file tariffs containing terminal charges, including demurrage charges.
State		
Connecticut Occupational Safety and Health Standards Vol I. General Industry Standards	Promulgated by the Secretary of Labor, U. S. Dept. of Labor; adopted by the Connecticut Labor Commissioner	
Section 1910.106 Flammable and Combustible Liquids (b) (1)		Specification for design, construction and materials for storage tanks.
vi		Provisions for internal corrosion.
(2)		Installation of outside above-ground tanks - regulates location with respect to property lines and public ways, spacing between tanks, normal venting, emergency relief venting, drainage ditches and walls.
(5)		Regulates supports, foundations and anchorage for all tank locations.
(7)		Regulates standards for strength testing; materials for piping, valves and fittings.
General Statutes - Section 16-1	Connecticut General Assembly	Provides that a pipeline company is a public service company within the jurisdiction of the Public Utilities Commission.
Docket No. 10026 - Code of Standards for Petroleum Pipeline	Public Utilities Commission (Division of Public Utilities Control, Dept. of Business Regulation)	Requires pipeline companies within jurisdiction of the Commission to comply with the Code of Standards for Petroleum Pipelines as published Code addresses Design,Construction, Testing, Operation and Maintenance and complaints and Service Interruptions for purposes of insuring the health, safety and welfare of the public.
Docket No. 780633 - Decision on Application for Approval of Merger of Jet Lines, Inc.With and Into New Jet Lines, Inc.	Public Utilities Control Authority (Division of Public Utilities Control, Dept. of Business Regulation)	Decision to allow merger of Jet Lines, Inc. (a Connecticut Corporation) with and into New Jet Lines, Inc. (a Delaware Corporation) a wholly owned subsidiary of Buckeye Pipeline Co. (an Ohio Corporation). Merger is intended to accomplish a liquidation for tax purposes under Section 332 of the Internal Revenue Code and to obtain the benefits of Section 334 (b)(2) of that Code.

APPENDIX B - Regulatory P rams Affecting Tank Farms

Law or Regulation	Authority	Activity Governed
Regulations of Connecticut State Agencies Title 16 - Public Utility Environment Standards Act. Sec. 16-50g.	Connecticut General Assembly	Identifies legislative finding and purpose.
Sec. 16-50; Definitions (2)		"Facility" includes a fuel transmission facility extending a distance of 1,000 ft. or more except a gas transmission line having a design capability of less than 200 lbs./sq. in.
Sec. 16-50;		Establishes a Power Facility Evaluation Council, prescribes duties.
Sec. 16-50 c - Certificate of Environmental Compatibility and Public Need		Requires petition for declaratory ruling to decide whether Council has jurisdiction and whether application should be filed. Applies to facilities constructed after 4/1/72.
Sec. 16-50 w		Delineates jurisdiction of Council; Municipal regulation of proposed action.
Sec. 16-50 z		Acquisition of real property for transmission facility. Regulations.
Regulations of Connecticut State Agencies, Abatement of Air Pollution Title 19 - Control of organic compound emissions	Department of Environmental Protection	
Sec. 19-508-20 (a)		For storage of volatile organic compounds in containers more than 40,000 gallons capacity, requires floating roof (for vapor pressure less than 11 psia) vapor recovery system or equipment of equivalent efficiency.
(b) Volatile Organic compounds loading facilities.		Requires vapor collection and disposal system or equivalent for loading of liquid into tank truck, trailer or railroad car with capacity in excess of 200 gallons. Also requires vapor-tight seal between loading arm adaptor and hatch. (DEP also has enforcement authority over requirements of EPA Regulations (40 CFR Part 60 Subpart K) which were in effect 11/6/75.
General Statutes - Title 25 - Pollution of Water of State by Oil	Department of Environmental Protection Water Resources Commission	
Section 25-54cc		Empowers Commissioner of DEP to license all terminals in the State for loading or discharge of petroleum & chemical liquids or products from vessels and issue regulations for preventing discharge or spilling of oil, petroleum or chemical liquids or products into the waters of the state.

APPENDIX B - Regulat[illegible] Programs Affecting Tank Farms

Law or Regulation	Authority	Activity Governed
Section 25-54 cc - 1 through 7 - Regulations for Terminals for Loading or Discharge of Petroleum or Chemical Liquids or Products from vessels		Requires licensed terminal operators to file with the Commission current drawings of existing facilities; current operating rules including procedures for cargo transfers to or from vessels; a plan of action to contain and remove any oils from spilling including list of available equipment; a statement on method of handling and disposal of miscellaneous waste oils.
General Statutes - Title 29 - The Storage Use and Transportation of Flammable Liquids	Commissioner of State Police	Regulations provide for the abatement of fire and casualty hazards, damage to adjoining property where flammable liquids are stored, to the hazards incident to the transportation, storage and use of such liquids, and to the design, selection of materials, fabrication, inspection, testing and installation of pipeline systems for transmission of flammable liquids within the state.
"State Set-aside Program"	Connecticut State Energy office. Pursuant to Emergency Petroleum Allocation Act of 1973	Requires terminal companies to file with Energy Office a monthly estimate of volume of Petroleum fuel expected to enter the state through such terminals; 3% of estimated volume designated as "set-aside" for cases of emergency or hardship.
Municipal		
Code of the City of New Haven Title VI, Vol. III - Zoning Ordinance	New Haven Board of Aldermen	
Section 42 - Use Regulations for Business and Industrial Districts		Permits outdoor storage of fuels, chemicals or building materials (whether in tanks or other containers), except as incidental to other activities in IH District; Qualified by SE (Permitted only by special exception under subsection 63D.
Section 46 - Activities and storage in outdoor areas in Business and Industrial Districts		Subject to Use Regulations in Section 42 and Performance Standards in Section 48.
Section 48 - Performance Standards for business and industrial uses		Establish maximum levels for various nuisance factors.
Section 63 Board of Zoning Appeals D. Special Exceptions		Specifies conditions taken into account in granting special exceptions
Regulations of the Department of Fire Service of the City of New Haven		Conform to Fire Safety Code of the State of Connecticut