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MARINE AFFAIRS SEMINAR

MASTER OF MARINE AFFAIRS PROGRAM

UNIVERSITY OF RHODE ISLAND
KINGSTON, RHODE ISLAND

CHANNEL IMPROVEMENTS, NEW LONDON, CONNECTICUT

A CASE STUDY

by

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The contents of this paper reflect my own personal views and are not necessarily endorsed by the Naval War College or the Department of the Navy.

E. L. Gallup

10 May 1973

Even a casual glance through the daily newspaper will reveal at least one article on government expenditures to provide some service or facility to the general public. Many of these expenditures provide improved transportation services, since transportation is one function that serves the entire community and the costs associated with these services generally exceed the capability of the private sector. Large expenditures for highways, airfields and harbors have become accepted areas for government initiative. However, as dollars become scarce and the demands for limited resources increase, the average citizen has shown an ever increasing awareness and interest in the manner his tax dollar is spent. The sheer number, intensity and tone of concern contained in these newspaper articles is an indication of this interest.

The recent threat of a shortage of heating fuel and gasoline has precipitated debate and discussion on the so-called approaching "energy crisis." This problem strikes close to the heart and pocketbook of the average citizen. The solution of this problem can be greatly effected by the expenditure of government funds, particularly in the field of transportation. Ironically the leisure and security provided by the abundance of cheap energy, has allowed the average citizen greater time to study and debate the desirability of these expenditures. Therefore, an examination of the workings of the decision process of a typical Federal public works project is both timely and pertinent.

The U.S. Army Corps of Engineers is one of the largest single Federal agencies involved in the planning, design and construction of public waterborne transportation facilities. A critical review of a

typical Corps of Engineers survey report on the improvements to a harbor should provide an insight to the means of allocating the costs and benefits resulting from government expenditures. The purpose of this paper is to review this process using as a vehicle the proposed improvements to the navigation channel at New London, Connecticut.

It surprises many foreigners to learn of the extent to which the U.S. Army is involved in public works of a non-military nature. In fact there was considerable debate and hesitation on the use of the Federal government undertaking internal improvements. However, since its first year the national government has undertaken various public works. The Corps of Engineers involvement is problematical, but there is evidence that they did participate in these early works. The Army engineers were specifically mentioned in occasional laws, but the enactment of the 1824 Rivers and Harbors Act clearly connected the Corps with the prosecution of internal improvements as an agent of the Federal government. (1,2)

Starting in 1830 the Corps has periodically reported to Congress on improvements recommended for the harbor at New London and along the navigable reaches of the Thames River. These improvements have ranged from the simple removal of a few boulders in 1878 to the extensive channel deepening during the 1930's. Federal expenditures for improvements, maintenance and operation of the waterway through June 1969 have totaled \$809,501 in New London harbor and \$2,563,313 in the Thames River. These amounts do not include those funds spent by the Navy and others to improve portions of the waterway for their specific needs.

The initiative for a project such as the one at New London can come from a variety of sources. Generally some local group of private individuals, businessmen or commercial interests will start the ball rolling. For new projects the local interests will normally channel their request for improvements thru their political representatives, either governor, mayor or congressional delegates. They may consult directly with the Division Engineer, the senior representative of the Corps of Engineers for their locality, to obtain his advice and assistance. If the project appears to have sufficient merit the political representatives may request the Public Works Committee in Congress to authorize the Corps of Engineers to investigate and report on the feasibility of the project.

If a previous report has been made for the area the Committee may adopt a resolution authorizing the Board of Engineers for Rivers and Harbors to review and update the report to reflect the effects of the requested improvements. If a previous report has not been made and the Committee is convinced of the need for an original report, the authorization for the Corps investigation will be included in a bill for consideration by Congress. When passed, the bill becomes a directive for the study. In addition to specific directives for survey reports, the Congress has given the Chief of Engineers funds and authority for general investigations.

In the New London harbor the original report was authorized by the Rivers and Harbors Appropriation Act of August 11, 1888, which allowed the Secretary of the Army (then the Secretary of War) ". . .at his

discretion to cause examination or surveys and the cost of estimated improvements. . .be made at. . .New London, Connecticut. . ." (3) For these civil functions the chain of authority extends directly from the President to the Secretary of the Army, usually through the General Council in the Office of the Secretary of the Army, to the Chief of Engineers. Bypassed are the Secretary of Defense and Chief of Staff of the Army.

Later resolutions of Congress continued and expanded the authority to report on the New London harbor. The latest was adopted on 2 December 1963. Accordingly, the Chief of Engineers assigned the review of these previous reports to the New England Division on 11 December 1963.

In any analysis of a problem the first and probably most important step is to determine the objective. In this study the objective is well defined by Federal legislation and common practice developed over one hundred and fifty years of similar projects. The objective is to determine the economic justification of modifying the existing Federal navigation project for the New London harbor and the Thames River channel.

To obtain data for the report the Corps made detailed hydrographic surveys, soundings, and probings; studied maps, charts and aerial photographs, commercial statistics and other data pertaining to waterways; and held public hearings at New London on February 24, 1964 and April 12, 1972. Survey officers contacted local commercial interested and affected governmental agencies to gather additional data on the proposed project.

The criteria established for the selection of which improvements to recommend is based upon the dollar value of benefits to the general public exceeding the cost to the Federal government. In some cases local contribution to the project includes funds, as well as easements, rights-of-way, relocations of utilities and highways, and other similar actions. Local cooperation in this project did not require any funds, but was limited to the standard assurances. These included to provide without cost all lands, easements and rights-of-way required for the construction and maintenance of aids to navigation; to hold and save the United States free from damages due to construction; to make necessary alterations of underwater utilities; and to improve berth facilities and access channels commensurate with project depth.

This criteria provides the basis of the Chief of Engineer's recommendation to the Public Works Committee. Other considerations that cannot be quantified are included in the report, such as environmental impacts, general or long-term social benefits and other important unquantifiables.

The Public Works Committee considers all of these factors plus political realities in reaching a decision on a specific project. It is not unusual for projects with excellent economic justification to be disapproved or unfunded, while seemingly less deserving projects are completed. The decision is undoubtedly based on the unquantifiable factors, some of which, but certainly not all are included in the report.

In this study the Division Engineer first considers the validity of the need for the improvements based upon a broad economic survey

of the overall situation in the area and consideration of the economic trends for the future. Custom has established the standard economic life for this type of improvement at fifty years. However, in this study many of the projections were considered only thru the year 2000. The accuracy of the projections beyond this point are of questionable value. When in doubt the Corps has generally tended to take a conservative approach.

The selection of a fifty year life for navigation projects can be criticized on the basis that not every project will have an equal life. However, the use of a standard project life does provide a method for comparing projects. It also removes the difficult and politically controversial necessity of determining the individual life of each project.

This study focuses upon three aspects of the harbor in this preliminary estimate. These aspects are the terminals and transfer facilities, existing and prospective commerce and vessel traffic.

For a relatively small port, New London has a wide variety of terminal facilities currently in use. A total of 53 piers are available, the greatest number (17) are operated by the U.S. Naval Submarine Base; nine are involved in marine repair and construction, of which the largest single interest is the Electric Boat Division of the General Dynamics Corporation; eight handle a variety of petroleum products and the remainder are used to handle chemicals; seafood; molasses; general cargo; fuel oil for power generation; scrap metal; passenger and vehicle ferries; and mooring and storage, of

which the U.S. Coast Guard is the largest single user. A survey of these terminals became the starting point for the determination of those commercial activities which would be the most likely beneficiaries of the proposed improvements.

The commerce in terms of cargo tonnage was analyzed for the preceeding five year period. In the period 1965-1970 the New London harbor registered a 300% increase for a 1970 total of 3.9 million short tons. In 1970 over 90% of this tonnage represented petroleum and petroleum products. (See Chart 1). This single commodity accounted for the sharp increase in harbor tonnages in the years 1968 thru 1970. One of the primary causes of this spectacular rise was the conversion of several coal fired electric generating stations to oil fired units. The remaining tonnage has remained relatively stable and is made up of ship hull sections, synthetic chemical products, insulating materials, molasses, textiles, lumber and miscellaneous products.

By contrast the tonnage of commerce using the Thames River channel has actually declined during the same period. (See Chart 2). However, construction of a new 400 megawatt electric power plant and the conversion of a coal fired electric power plant in Montville will require 900,000 tons of residual fuel annually. This should substantially increase the tonnage of commerce in the river, which totaled only 677,000 tons in 1970.

Overall the waterborne commerce in this area has not kept pace with the general population trends in Southeastern Connecticut during the past twenty years. However, the recent increase in waterborne

commerce in the last three years would indicate that the area is experiencing increased activity.

The Connecticut State Development Commission is promoting a program to develop industrial sites along the Thames River. Presently there are eleven industrial sites available for firms that would require channel depths of 30 feet or more. This is the only undeveloped industrial land available with access to direct waterborne shipping in the southeastern part of the state. Although this potential industrial development is a direct benefit, it is difficult to quantify and consequently was not used to raise the cost benefit ratio. The ground rules for excluding these benefits are clearly set forth by Congress and the Bureau of the Budget. There has been some discussion and study within the Corps to establish a means of including regional development in the economic analysis. Implementation of this is not expected in the immediate future.

Next an analysis of the shipping traffic into the New London harbor revealed that the port was used by 5,378 vessels in 1970, excluding U.S. Navy and Coast Guard vessels. As expected the majority of the deep draft traffic consisted of petroleum tankers. This traffic is consistent with the trend toward larger capacity vessels, where economics of scale can be realized. The average tanker has increased in size from 16,000 dwt in 1949 to 27,100 dwt in 1965. By 1970 over 65% of the world tanker fleet exceeded 30,000 dwt.

Since the majority of the deep draft traffic consisted of tankers the projection of petroleum usage was evaluated. The U.S. Department

of Commerce predicts that the tonnage of petroleum products received in east coast ports will increase 350% in the period 1966-2000. It is not unreasonable to expect that New London will share in this increase. Therefore, this initial review of past trends in harbor tonnage, known and anticipated industrial development, overall economic expectations for the area, and trends in ship traffic, particularly as they involve petroleum products, indicates that improvements in waterborne navigation will produce future economic benefits. The exact amount and the distribution of these benefits would require a more detailed and comprehensive study.

Once a general assessment revealed that the proposed project would produce future benefits, it became necessary to pin down the exact improvements desired by the local interests. In order to accomplish this the first public hearing was held in New London on February 24, 1965. The 72 persons in attendance represented Federal, State and municipal government, shipping interests, terminal operators and other individuals concerned with the improvements to the waterway. As a result of this public hearing eleven specific improvements were identified.

Generally the problems of navigation in the waterway could be resolved into three major categories. The first is the present 33 foot depth, at mean low water, in the harbor is insufficient for the larger vessels now coming into prominent service. Second the channel in the Thames River has numerous bends and other obstructions which

CHART 1

COMMERCE IN NEW LONDON HARBOR

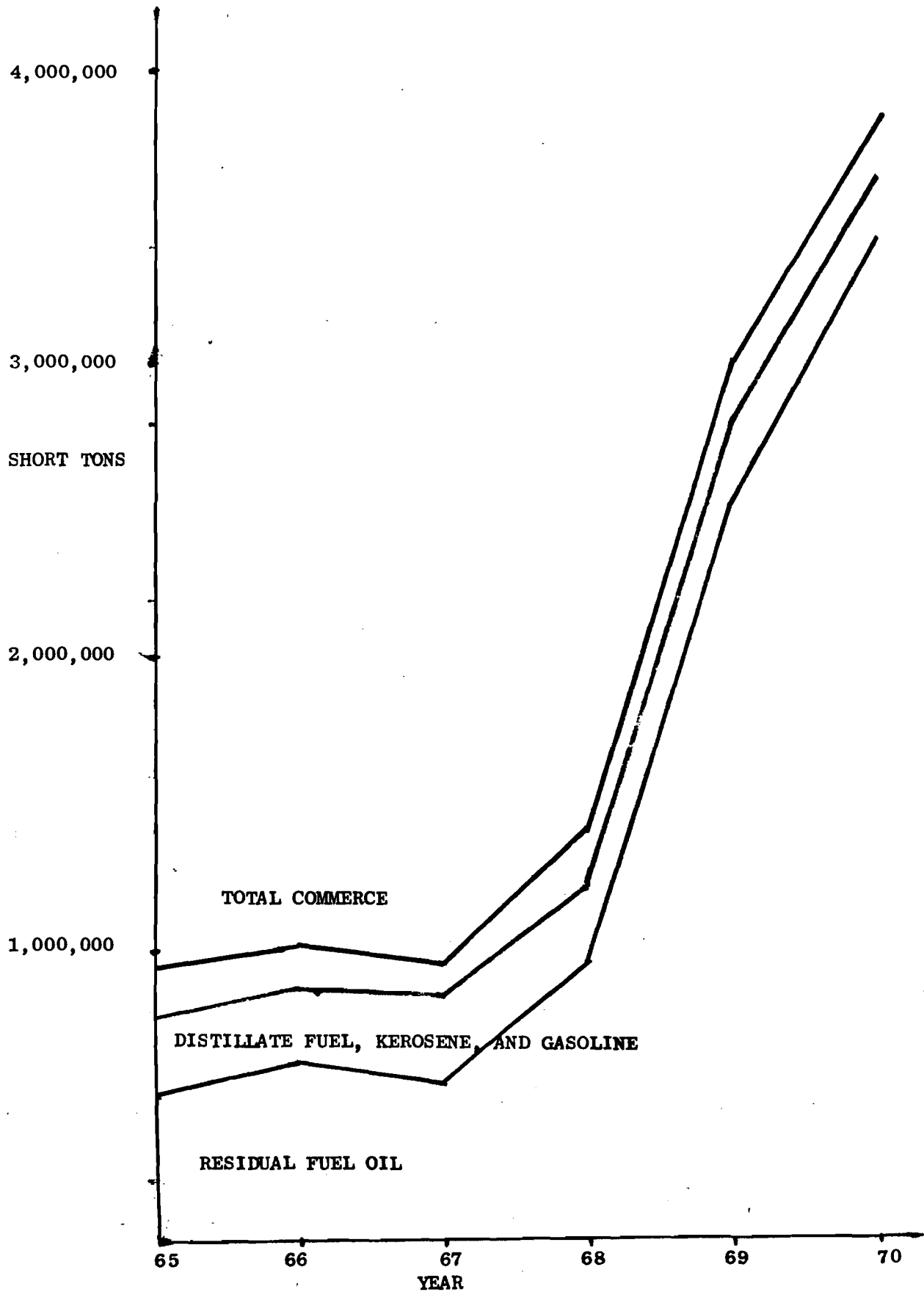
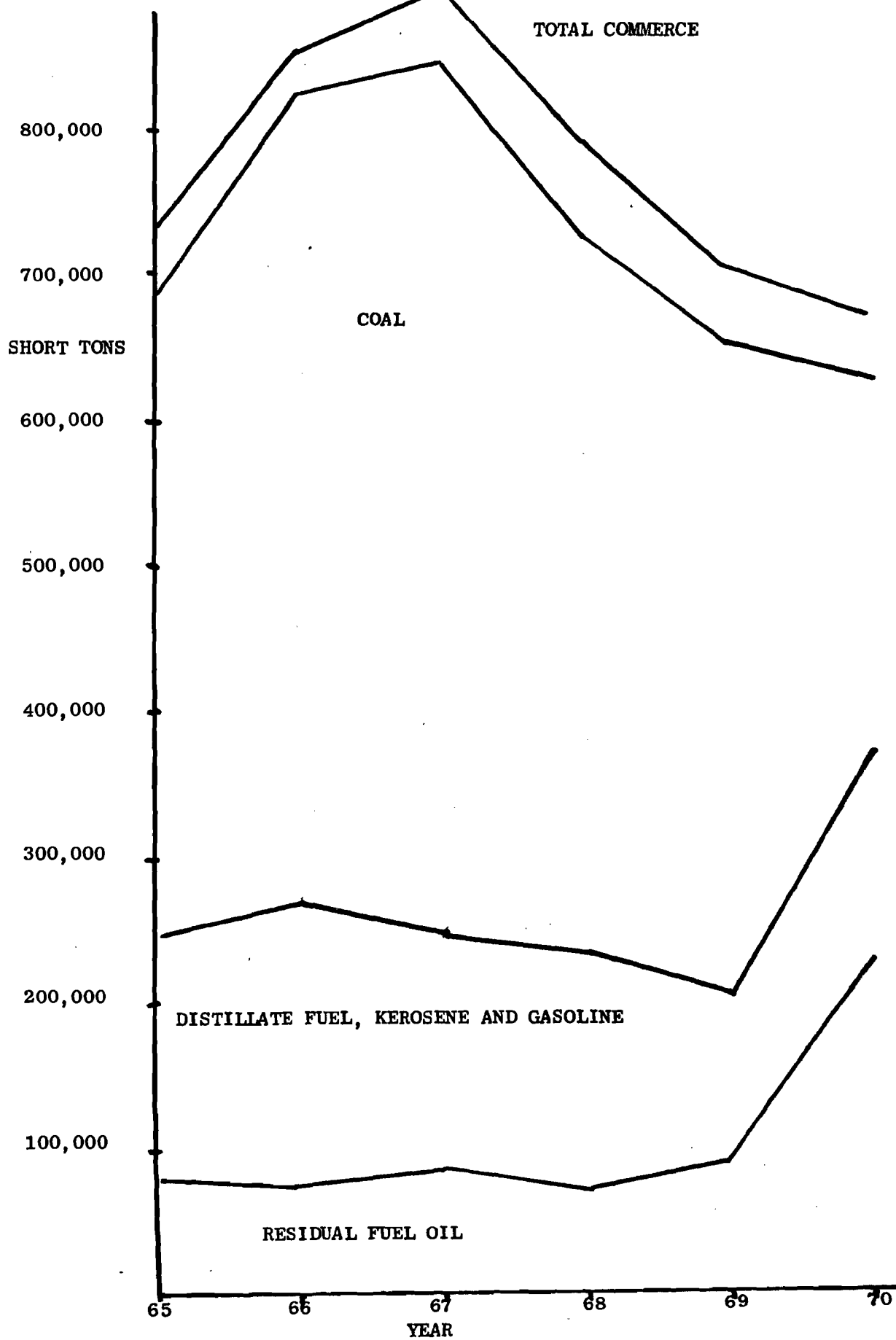


CHART 2
COMMERCE ON THE THAMES RIVER



make navigation in the river hazardous. Third the maneuver area in the approaches to the State Pier is limited and has resulted in damage to both shipping and the pier.

Subsequent to this public hearing all industries and commercial interests in the area known to have an existing or possible future interest in the waterway improvements were contacted and asked to respond to questionnaires. These questionnaires would provide more detailed and specific data upon which to base the analysis of the benefits. Follow-up visits by survey officers insured that all possible benefits were considered.

Interestingly the Dow Chemical Company initially indicated little interest in the proposed improvements, but upon learning the results of the initial survey which did not recommend the channel deepening to the company facilities, Dow Chemical requested and was granted reconsideration. The additional economic information provided by Dow Chemical was considered, analyzed and integrated into the final report.

Although there are nine major terminal facilities that might derive benefits from the improvements, only four were actually seriously considered in the quantitative analysis. All of the possible beneficiaries were studied in detail during this initial screening, but only those that could clearly demonstrate a direct and calculable economic benefit attributable to the waterway improvements were able to survive the screening.

For example, even though the Charles Pfizer and Company, Inc. indicated that larger ships might be used in the future delivery of

molasses, this possibility could not be established with sufficient certainty to justify inclusion as a benefit. Similarly, the requirements of the U.S. Naval Submarine Base and the General Dynamics Corporation for deeper channels to accommodate the new model submarines to be constructed and stationed in the area, were not included in the study. This is based upon two fundamental principles. First the deeper channel depths would provide a benefit to the national defense establishment. This is not within the charter of public works projects. The funding for defense projects must be charged against the military program that it supports. Secondly the Navy requirement is an immediate one, and could reasonably be expected to be completed prior to the approval of the Corps project. Therefore, the Corps study could not include these benefits in their analysis of the project.

The Corps study did evaluate the savings in dredging costs if the Navy project were completed first. The Navy channel would also reduce the transportation savings that would be realized by the improved channel. Both of these economic impacts were evaluated and included in the study, but they were not used as the justification of the project. The impact of the Navy dredging will be discussed in greater detail later in this paper.

The initial screening concluded with four major waterway users, who would directly benefit from the project. These were: the Connecticut Light and Power Company, Dow Chemical Company, Hess Oil Company and the State Pier.

For the Connecticut Light and Power Company the benefits consisted of lower transportation costs for the residual fuel delivered to its Montville electric power generating plant. This facility was estimated to require 900,000 short tons of residual fuel annually. To establish the lowest possible delivery cost with the existing channel, several alternatives were considered. These included the transfer of the fuel by barge or pipeline from New London harbor, the use of offshore terminals, direct delivery to the plant by smaller or partially loaded ships, and delivery to a terminal facility located near the plant. In each of the beneficiaries it was necessary to establish a lowest possible cost before improvements to the waterway, in order to have a point of comparison to calculate the benefits after the improvements were completed.

Similarly the Dow Chemical Company would benefit by reduced transportation charges on the liquid chemicals delivered to its plant at Allyn Point. Since this plant is only 1000 yards north of the Montville electric power plant the two benefits could be combined when the various incremental sections of the channel were studied. Dow Chemical indicated that it planned to expand its facilities and projected annual increases in receipts of liquid chemicals from 150,000 tons in 1975 to 450,000 tons by 1985. Further increases were expected to require the use of deep-draft tankers by 1994.

As anticipated from the preliminary estimates of commerce in the harbor the greatest beneficiary appeared to be the Hess Oil Company. The benefits that would accrue would be through the lower transportation

charges for the delivery of bulk petroleum products. Currently these products are delivered from the company's refinery in the Virgin Islands by tankers, which, because of the channel depth are only partially loaded and must often wait for high tide to complete their deliveries. Since this particular activity was to be the major economic factor in the decision process, it will be covered in greater detail.

The final beneficiary was the State Pier and the shipping using that facility to deliver general cargo. Due to a restricted maneuver area, in the past seven year period, 1964-1971, two ships have been involved in accidents while attempting to berth at the pier. The resulting damages to the pier and the ships amounted to \$200,000. The economic benefit for improving the approaches was readily determined. This amounted to an annual benefit of \$29,000 when projected and discounted over the 50 year project life.

The determination of the benefits that would accrue from the navigation improvements to each of these four activities was deliberately conservative. The only benefits that were considered were those that could be measured with a high degree of reliability. If the achievement of the benefit required a company to change its modus operandi, then the company had to demonstrate that if the waterway improvements were completed, it would make the necessary changes to take advantage of the improvements.

In order to establish the marginal benefit from the improvements, several alternatives were considered. In keeping with a conservative approach, the industry need not demonstrate that it would use the least

cost alternative, but the Corps assumption was that if a least cost alternative were available the industry would use that alternative. However, as will be discussed later the study considered the possibility of the industry using a certain size tanker that would provide the lowest delivery cost of petroleum. This alternative was rejected, because when the tanker industry as a whole was considered this would not provide the optimum use of the tanker fleet.

In order to analyze the method of arriving at the dollar value of the future benefits, the transportation savings for the petroleum products delivered to Hess Oil Company will be examined in greater detail. This procedure is representative of that followed in obtaining the benefits to other activities.

From the general study of commerce in the harbor, it was obvious that the benefit to the Hess Oil Company would result from reduced unit transportation costs achieved by the economies of scale from the use of deep-draft tankers. A marginal analysis was used to calculate the savings resulting from various improvements, above the cost of the best alternative means of delivery.

Currently petroleum products are received in the harbor via 30-36,000 dwt foreign flag tankers arriving from the company refinery in the Virgin Islands. In order to arrive at the least cost alternative means of delivery using the present waterway, three methods were considered.

The first delivery method was to deliver the petroleum directly to the New London terminal. Since the analysis was conducted on the

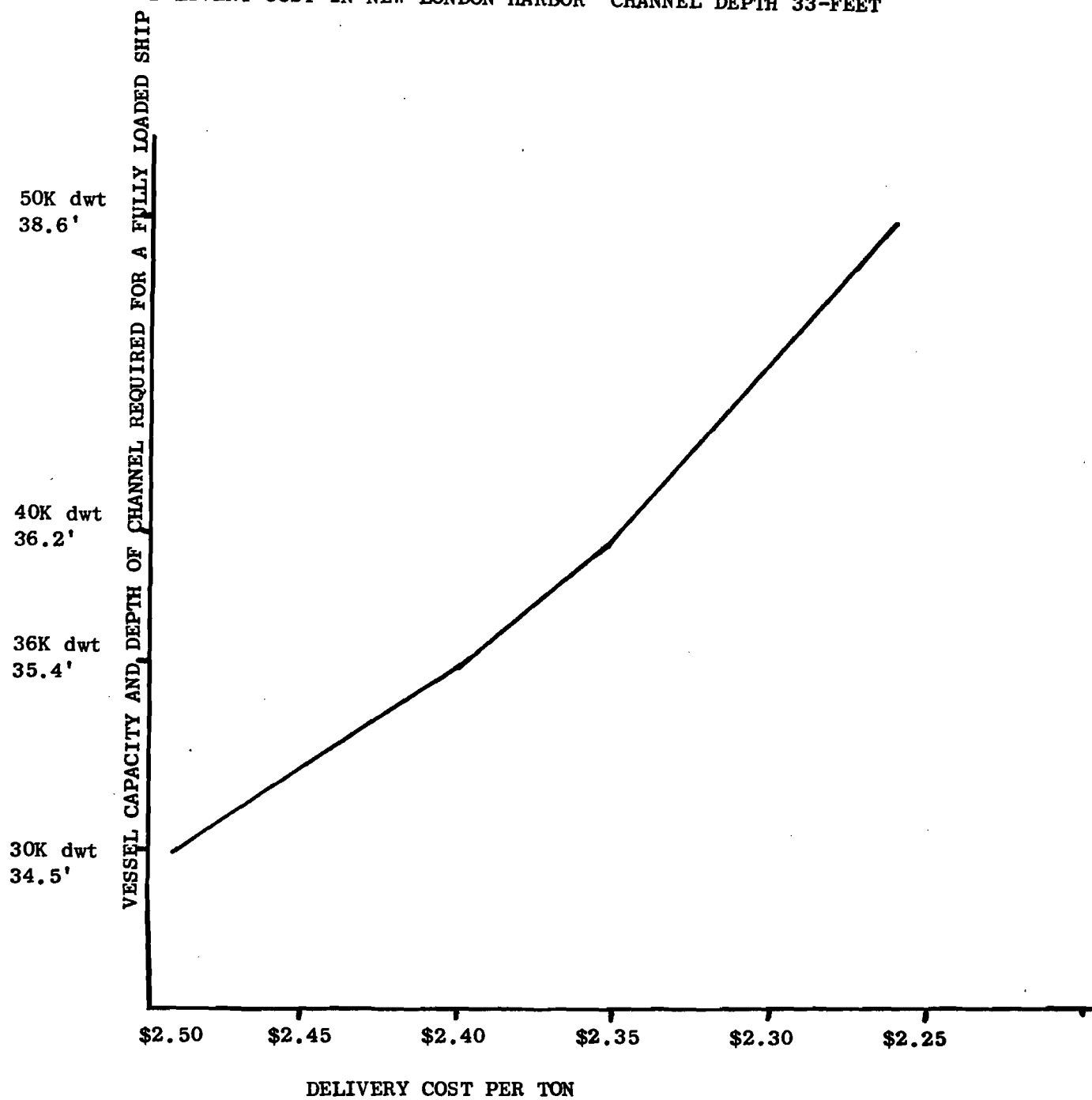
margin, overhead, profit, agent fees and other fixed costs were excluded. The calculations considered the distance, speed, hourly costs of ship operation, and loading and unloading time for the average round trip between New London and the Virgin Islands for tanker sizes varying between 30,000 and 50,000 dwt. For a given channel depth the delivery cost is smaller for the larger vessels, even though they must be partially loaded to not exceed 31.6 feet draft. (See chart 3). However, it was assumed that the 40-50,000 dwt tankers would be more economically employed serving deep-draft harbors where their full carrying capacity could be efficiently utilized, and that 36,000 dwt tankers now being used, would be available for the foreseeable future. This analysis resulted in an estimated delivery cost of \$2.40 per short ton.

The next alternative delivery method considered the trans-shipment by barge or pipeline from the deep-draft harbor under construction at Providence, Rhode Island. Since nearly 85% of the petroleum delivered is residual oil, which has a high viscosity and requires a heated pipeline to keep it flowing during winter months, this method would be obviously impractical. The cost of trans-shipment by barge was determined to be \$3.18 per ton, or \$.78 more expensive than direct shipment.

The last alternative considered an offshore terminal with pipeline distribution to land-based terminals. Rough cost estimates by private firms indicate that the cost of this facility would be about \$35 million. Other factors to be considered include availability of a

CHART 3

DELIVERY COST IN NEW LONDON HARBOR CHANNEL DEPTH 33-FEET



suitable site, the use of existing facilities, the attitude of local interests, the willingness of the oil companies to install this facility and the environmental impact of offshore oil transfers. While it is obvious that this alternative has the potential to greatly reduce the unit delivery cost by utilizing even larger tankers, the problems of site selection and investment cost are substantial. It would appear that the quantity of petroleum demanded by the area would not justify these expenditures by private industry. Therefore the least competitive delivery cost was established at \$2.40 per short ton.

Once the cost of delivery has been determined for the present waterway, the next step was to evaluate the savings that could be achieved by incremental improvements. The savings were calculated for incremental increases in depth at two foot intervals between 34 to 42 feet. For each depth the delivery cost was determined, using the most economical size tanker. (See Chart 4). Once more the probable tanker fleet operations were considered. For depths greater than 36 feet a 50,000 dwt tanker was considered both economical and reasonable. At 36 foot depths the 40,000 dwt tanker, and for lesser depths the 36,000 dwt tanker, were selected based upon the assumptions of tanker fleet operations discussed above.

The difference in the values determined for various improved channel depths and \$2.40 from the least cost use of the present channel determined the savings achieved. (Chart 5). It would appear that the 40 foot channel would be the most beneficial, however, before the analysis of annual benefits is complete the project tonnage of petroleum must be considered.

CHART 4

DELIVERY COST FOR VARIOUS TANKERS USING A 34-FOOT CHANNEL

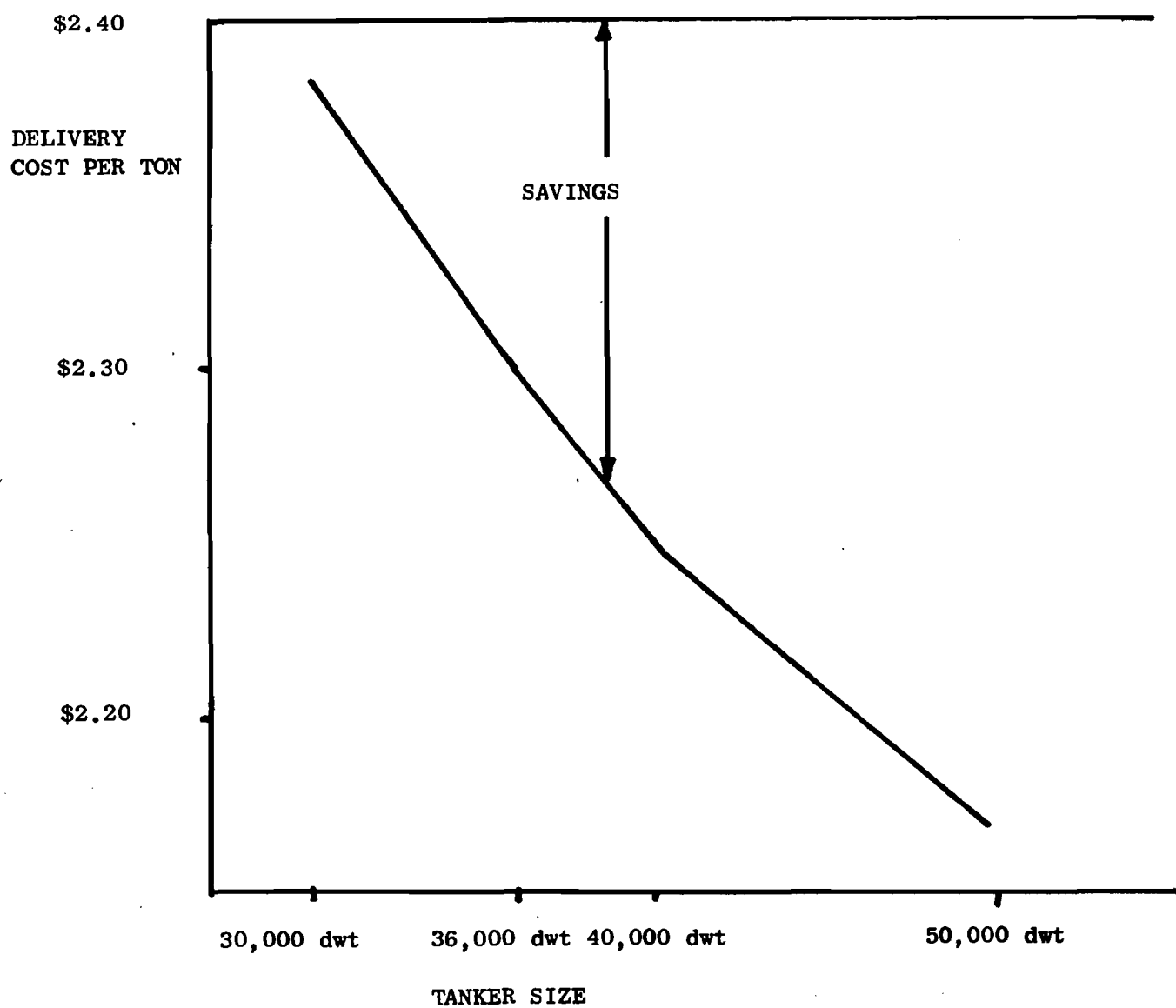
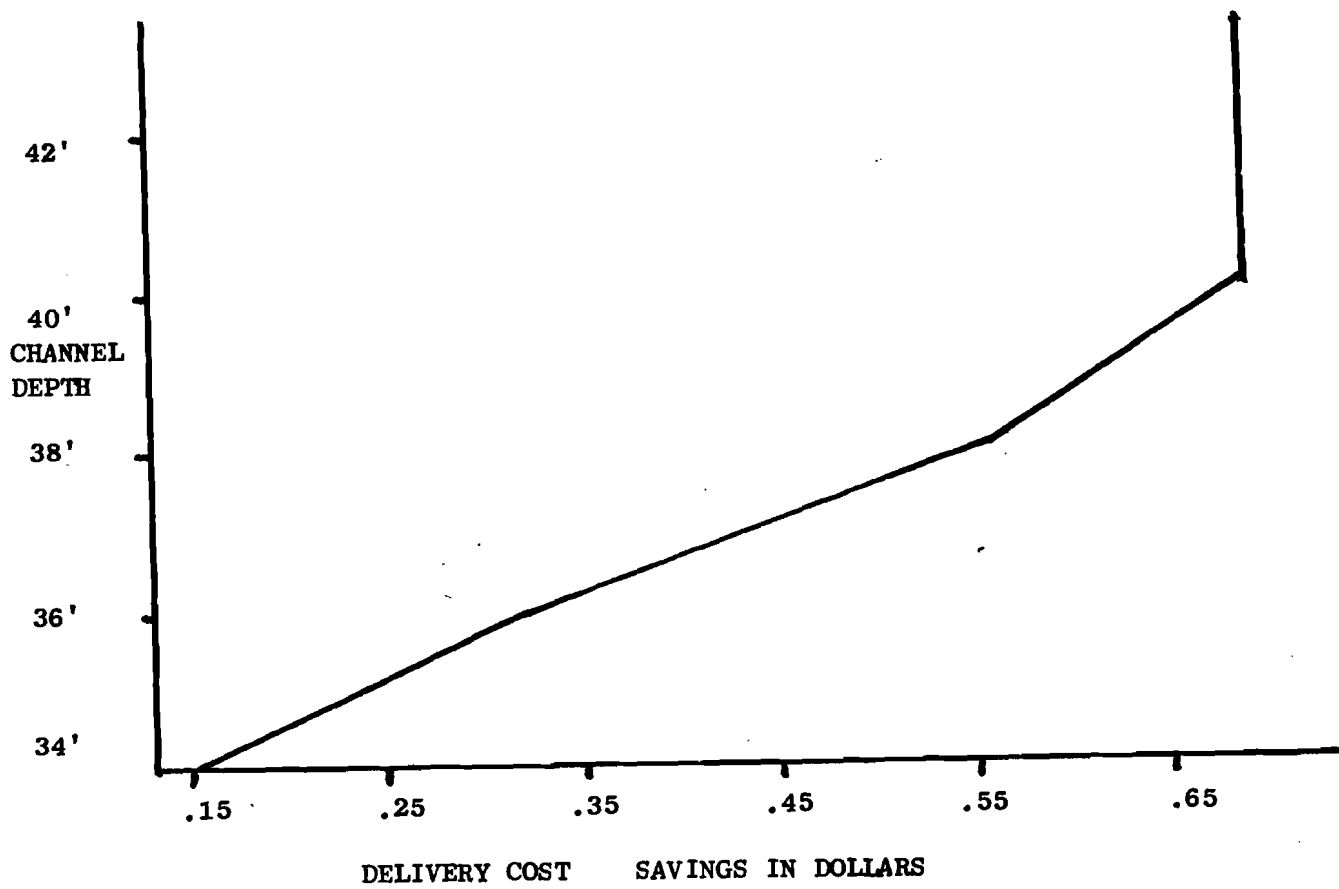


CHART 5

NEW LONDON HARBOR UNIT SAVINGS PER TON FOREIGN FLAG TANKERS
FROM THE VIRGIN ISLANDS



To determine the tonnage of petroleum that would be delivered to the harbor over the 50 year life of the project, two approaches were used. The first was an empirical investigation into the relationship between population growth and shipments of petroleum. The second approach utilized a recently completed study by Robert Nathan Associates for the Institute for Water Resources which analyzed the future delivery of petroleum on the east coast.

In the first approach the population growth and petroleum shipments on a national level were compared. If a high degree of correlation existed between these two factors, then the local population trends could be used to determine the future petroleum commerce in the area. The comparison on the national level was found to have large short-term fluctuations due to the Korean conflict, recessions, tax cuts and other transient economic factors. However, once these factors were accounted for the correlation was sufficiently close to provide long-term trends.

The analysis of the population and petroleum activity in the New London area showed even greater fluctuations than the national averages. In addition to the factors affecting the national averages, a variety of local conditions caused major changes in the shipment of petroleum. The largest single factor was the conversion of coal fired electric power plants to oil fired units. Other factors included an increasing concern about air pollution and the trend toward expanded uses of nuclear power. Consequently the 1962 to 1967 growth rate of 4% per year was considered to reflect short term conditions and was revised to a lower figure of 3%.

This figure was compared to the rate obtained from Robert Nathan's "U.S. Deepwater Port Study" which indicated a long-term growth rate for the Northeast at just over 2%. Since this rate included all of New England it would seem reasonable to adjust the value upward to 3% for the harbor. This growth rate was used to project the deep-draft petroleum deliveries for the year 1978 at 1.9 million tons, which would increase to 4.8 million tons by 2028.

These quantities of future petroleum deliveries thus derived agreed with projections of energy growth made by the Department of the Interior, Federal Power Commission, National Petroleum Institute, and other agencies. It was determined that the optimum size oil tanker that would be used to meet this level of demand would be 50,000 dwt. This is the reason that the unit savings shown in Chart 5 do not increase once the 40 foot channel depth is achieved. However, knowledgeable Corps representatives indicate that the optimum tanker may have already increased to 60,000 dwt or greater.

Now the total benefit could be calculated. Similar calculations would provide the benefits for each of the four activities and for a range of incremental improvements.

This total benefit was then converted into an annual benefit. The immediate benefits were calculated by projecting the number of tons received in the first year after completion of the project, i.e. 1978, and multiplying by the unit savings. The savings from future growth were discounted at 5-3/8% to obtain an annual value in current dollars. These estimates were made as follows:

" Immediate Benefits (1978)	\$ 1,325,000
1,920,000 tons @ \$0.69 per ton	
b. Future Growth (average from 1978-2028)	622,000
2,880,000 tons @ \$0.69 x 0.3134	
Total Average Annual Benefits to Deep-Draft Petroleum Commerce in the Harbor"	<u>\$ 1,947,000</u>

The discount rate used for these calculations is determined by Congress. It is possible to criticize this value as being too low, however, the use of one standard value does allow the Public Works Committee to judge the relative merits of competing projects without having to constantly be concerned with a variety of discount rate calculations.

Once the benefits have been determined, the remainder of the quantitative analysis should be relatively simple. Unlike many government programs, the cost estimates on this type of project are easy to determine with a fair degree of accuracy. The Corps has ample experience with similar projects, so that once the composition and topography of the bottom are known the costs of dredging are readily determined. However, as shall be seen, there are costs associated with this type of project that are not easy to identify and quantify.

The criteria for determining the amount of and extent of the channel improvements is based upon the accommodation of two large vessels in an overtaking or passing situation. Based on experience in other waterways and results of model basin experiments a recommended range of lane widths has been established. The total width of the channels is determined by consideration of volume of traffic, vessel speed and maneuverability, prevailing weather conditions, current, yawing factors

and bottom material. Where the heaviest traffic density could be expected in the harbor the width was 600 feet. In the Thames River channel a single ship lane was determined to be satisfactory. Using this criteria the channel would be 380 feet wide. However, this width would have required excessive dredging in shallow areas and it was found to be more economical to provide additional depth but a smaller (350 feet) channel.

With the width of channel selected it was a simple matter to arrive at the amount and cost of dredging. Added to the cost of dredging is the cost of disposal of the dredge spoil. Several methods were considered but the most economical means was disposal through the use of barges and nearby ocean disposal areas.

Additional costs were involved in the relocation of a railroad bridge and for aids to navigation in the new channel.

The Penn Central Railroad bridge was constructed in 1917 and the clearance between the piers was no longer sufficient for the larger ships that would be using the improved channel. The cost to replace the bridge was estimated to be \$6,000,000, however, not all of this could be charged against the project. Assuming a normal life span for the bridge of 80 years, it would require replacement in 1997, or 20 years after the beginning of the project life. Based on the present worth of the reconstruction in 1997 the portion of the cost chargeable to the waterway improvements was reduced to \$4,000,000.

The reduction in dredging costs as a result of the U.S. Navy channel improvements was considered but not used to justify the project.

At the same time costs were reduced, so were the benefits. The least unit transportation cost for the existing channel would be reduced by the Navy dredging. Therefore, the savings realized by the Corps channel must be reduced accordingly.

Next, estimates were made to determine the cost of annual maintenance for the completed project. For each section of the channel and each increment of depth these costs were added to the adjusted first costs to determine the annual cost for the project.

The total cost of the project was adjusted to an annual basis over the 50-year project life and using an interest rate of 5.375% for all investments.

The following example shows how these costs were calculated:

"Project Cost Estimates

Dredging 3,260,000 c.y. @ \$3.00	\$ 9,780,000
Contingencies 15%	1,470,000
	<u>\$ 11,250,000</u>
Engineering and Design	480,000
Supervision and Administration	770,000
Total Corps of Engineers Cost	<u>\$ 12,500,000</u>
U.S. Coast Guard Aids to Navigation	10,000
Total Project Cost	<u>\$ 12,510,000</u>

Annual Charges

Interest and Amortization	\$ 723,000
\$12,510,000 x 0.0580	
Added Annual Maintenance	34,000
Dredging	
Aids to Navigation	1,000
Total Annual Charges	<u>\$ 758,000" 4</u>

With the total benefits and costs identified for incremental portions of the project and reduced to annual amounts, the final stage of the quantitative analysis can be concluded. This consists of a

comparison of the costs and benefits and a selection of those improvements that will yield the optimum benefit to cost ratio.

From the analysis to this point, it can be readily seen that the project can be divided into three distinct regions. The first is the maneuver area at the State Pier. The annual cost of this portion of the project was estimated at \$11,000 and the annual benefits at \$29,000, which provides a benefit/cost ratio of 2.64.

The second area consists of the improvements from deep water to the Hess Oil Company terminal. The optimum depth was determined to be 40 feet by comparing the benefit/cost ratios for the incremental depths of channel. (See Chart 6). In this case this depth would also yield the maximum net benefits (See Chart 7).

The third area consists of the Thames River channel to the vicinity of the Dow Chemical Company and the Montville power plant. A comparison of the benefit/cost ratios for various depths discloses that the costs are greater than the benefits and this portion of the project was not recommended to the Public Works Committee. (See Chart 8).

In the analysis the Navy dredging was considered but not used as the justification for rejection or acceptance.

The result of this analysis was the recommendation from the Army to Congress as follows:

- "a. A 40-foot deep and 600-foot wide navigation channel from deep water in Long Island Sound along the line of the existing 33-foot deep channel, about 15,500 feet upstream to the Hess Oil and Chemical Division dock;
- b. A 40-acre turning basin, 30-feet deep, just north of the 40-foot channel;
- c. A 4.9-acre maneuver area, 32 feet deep, just south of the Connecticut State Pier."

CHART 6

NEW LONDON HARBOR BENEFIT/COST RATIO FOR VARIOUS CHANNEL DEPTHS

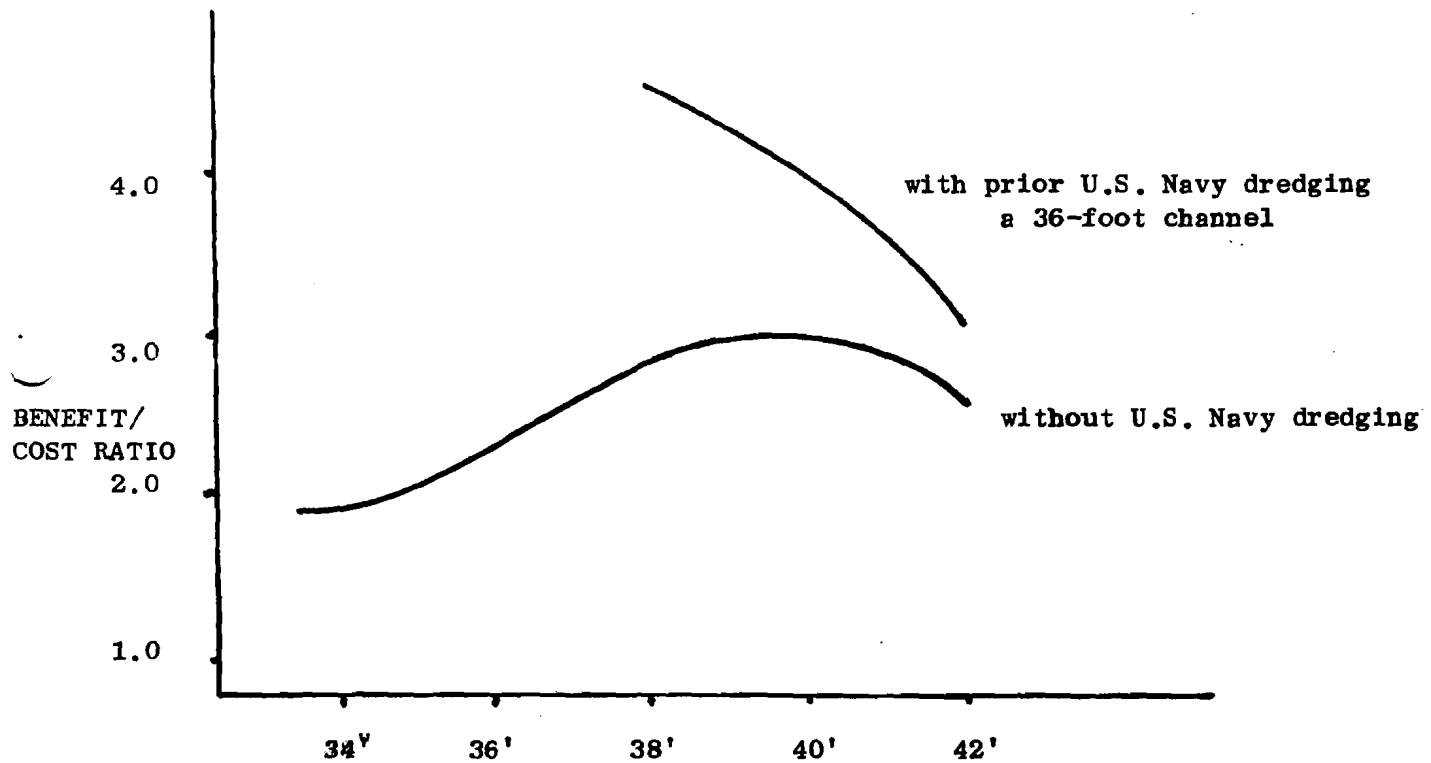


CHART 7

COMPARISON OF COSTS AND BENEFITS FOR HARBOR CHANNEL OF VARIOUS DEPTHS

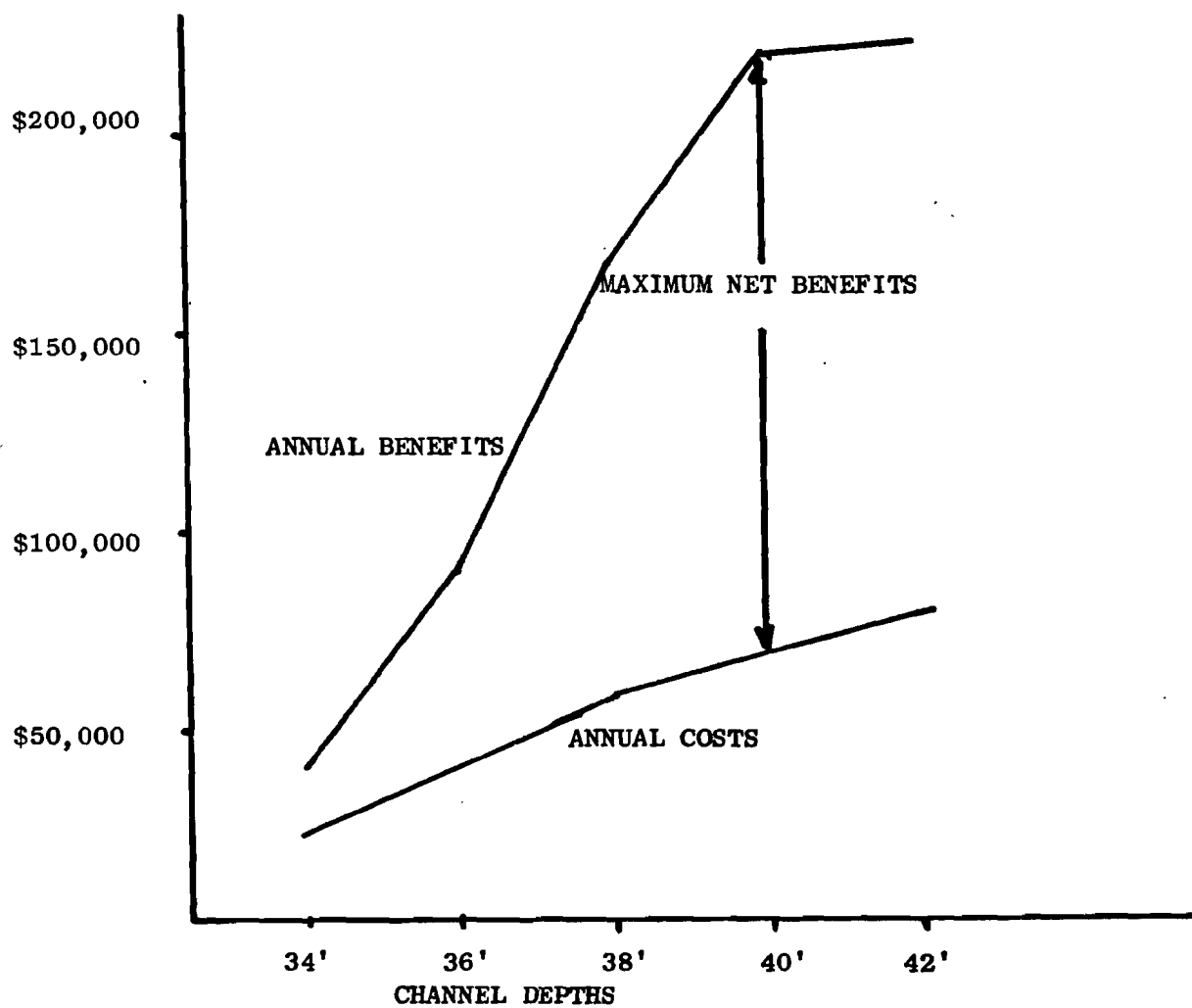
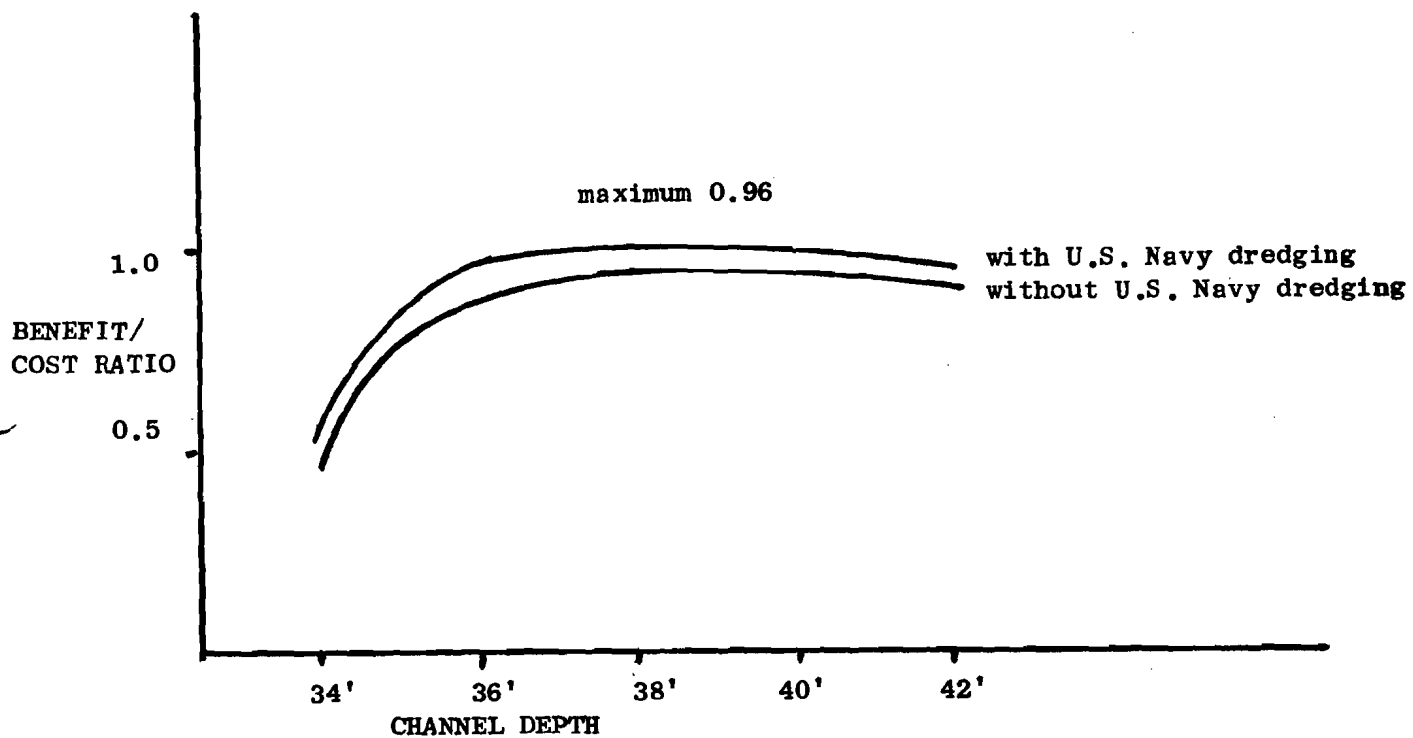


CHART 8
THAMES RIVER CHANNEL BENEFIT/COST RATIO FOR VARIOUS CHANNEL DEPTHS



The total first cost of the recommended project was estimated at \$12,500,000 for construction and \$10,000 for aids to navigation, resulting in annual costs of \$758,000. The estimated benefits were \$2,264,000 annually, resulting in a benefit/cost ratio of 2.98.

During the course of the study, the environmental impact of the project was considered concurrently. A cursory analysis indicated that the ecological damage would be minimal within the channel and harbor, with only the disposal of dredge materials presenting any significant problems. However, public law now requires that an Environmental Impact Statement accompany any major construction project. A preliminary draft of this statement was prepared and issued on 12 June 1972.

The summary sheet attached to the draft statement identified seven potentially adverse environmental impacts:

- "1. Localized alteration of habitat(s)
2. Destruction and redistribution of benthic biota
3. Temporary and localized increases in turbidity and siltation
4. Release of offensive gases such as hydrogen sulfide
5. Resuspension of non-biodegradable chemical pollutants and organics
6. Temporary increase in BOD and COD
7. Synergistic effects of heavy metals, organics, temperature and salinity on zooplankton, fin fish and benthic invertebrates."

Furthermore the environmental study considered five alternative methods of completing the project:

- "a. Variations in channel design
- b. Dredging Methods: Hydraulic versus Bucket
- c. Dredge Spoil Disposal
 1. Onshore
 2. Creation of Islands
 3. Dredge Spoil Forming
 4. Incineration
 5. Pipeline Systems

- 6. Ocean Disposal
- d. Reduction or Elimination of Dredging
- e. No action." 7

Finally the environmental study was forwarded to twelve government and private agencies and associations for comment.

Many of the environmental impacts discussed in this study depart drastically from the approach followed in the initial survey report. Where the survey report could be specific and quantitative, the environmental study was general and vague. Where the survey report could clearly identify the unknowns and assumptions the environmental study could only plead a lack of knowledge. This apparent dichotomy of approaches to this problem is understandable. Many of the adverse effects of the project on the local ecology are secondary or tertiary conditions; they are difficult to define with accuracy and almost impossible to quantify in terms of dollar costs.

Furthermore, to obtain the data and knowledge required to refine the ecological estimates requires time and money. Often the cost of these studies exceeds the potential economic benefits from the project and occasionally the cost of the project itself. Even more troublesome is the time required to make these ecological studies. Many of the effects of the project are long-term and to properly evaluate these effects requires years.

Some projects are of sufficient magnitude and duration to include in the cost of construction a research program to evaluate environmental impacts. Occasionally the only practical method of evaluating the environmental impact is to complete the project and then observe the damage produced on the local ecology.

In spite of these inherent difficulties, the Corps did conduct studies of the composition of the sediments, alternate methods, and researched all available data pertaining to the marine life in the area.

An analysis of the sediments in the areas to be dredged showed that the average values of the amounts of harmful materials were within the EPA guidelines, with the exception of zinc, which exceeded the guidelines by only 1.53%. These analyses compared favorably with similar studies conducted by the U.S. Navy.

Information on the marine life in the area is meager, however, the Corps did research the available literature produced by the Navy Underwater Sound Laboratory, the Naval Underwater Systems Center, the Universities of Rhode Island and Connecticut, Connecticut College, and the Environmental Protection Agency. The conclusion derived from these sources was that there was little marine life in the dredging area that would suffer damage. At this point only general comments could be made concerning the spoil disposal sites, since at the time several were being considered.

Once the meager ecological data had been analyzed, several alternative methods of construction were considered in order to minimize the environmental impact.

Several channel design variations were considered, but each of these variations were found to have the same environmental impact. Of course the design producing the greatest amount of dredge spoil would do the most environmental damage.

The type of dredge was considered. Of the two common methods, bucket or hydraulic, the bucket dredge would create the least damage in the harbor area. However, bucket dredges generally require ocean dumping sites with the attendant damage at the dump site. Therefore, container disposal in conjunction with hydraulic dredging was evaluated, but determined to be too expensive. Estimates for the container structure ranged between 8 to 10 million dollars. In addition, suitable container locations that would avoid pollution or become a hazard to navigation, were not readily available.

Incineration of the dredge spoil was determined to be excessively expensive and undesirable from the standpoint of air pollution.

Other spoil disposal methods were considered and rejected due to expense or local geography. Included were spoil farming, creation of islands and onshore disposal.

Offshore pipelines and terminals would completely eliminate dredging requirements. These had been previously considered and rejected in the economic analysis. Furthermore, the danger of massive oil spills and the difficulty of containment in open water would add to the potential environmental hazards.

The only method of spoil disposal considered feasible was ocean dumping. Three sites were proposed and each met with some opposition by either Federal, State or local interests. Two additional sites have been considered but their use would add to the cost of the project, reducing the benefit/cost ratio from 5.12 to 1.97.

Finally the environmental impact of no action, i.e., continued use of the present waterway, was considered. In addition to the obvious loss of economic benefits, it is possible that the increased number of vessels and the additional handling and transfer of petroleum and chemical products within the harbor could result in a greater danger of accidental oil and chemical spills.

The conclusion of the environmental impact statement was that there would be little, if any, long-term damage to the local ecology, with the possible exception of the immediate area of the spoil disposal site. These conclusions have since been borne out by the objections of environmentalists to the selection of the disposal sites.

This draft environmental statement was forwarded to all interested Federal, State and private interests, with any involvement in the environmental problems. A survey conducted by the author of this paper, confirms that most of the key individuals and organizations were informed of the proposed Corps actions prior to the final public hearing on the project. While many expressed general misgivings on the harmful environmental effects, none had specific knowledge or data to refute the environmental study conclusions.

The Connecticut Department of Environmental Protection has objected to this impact statement because it did not adequately consider these environmental effects. Representatives of the Department insisted that additional environmental data was available and had not been used. The individuals from the Corps responsible for the impact statement claimed that repeated efforts to obtain this data, or even information relating to the location of the data, had been unsuccessful.

An apparent lack of communication and understanding between these agencies was readily apparent. This is partially a result of a recent reorganization of the Department of Environmental Protection and the problems implementing this new requirement in Corps operations. These communication problems will probably be resolved in conferences scheduled between these two agencies in the near future. It is interesting to note that similar problems with other New England States were much more rapidly resolved.

On April 12, 1972, a final stage public hearing was held at New London. The purpose of this hearing was to present the draft findings of the survey report and environmental statement. The New England Division of the Corps maintains computer printouts to insure all interested parties are supplied with these reports.

At the final public hearing Dow Chemical asked for and was granted additional time to present data that might change the unfavorable recommendation on the Thames River channel improvements. A thirty day period was granted, but no substantially different data was forthcoming. Also at this hearing the Navy representatives proposed coordinating the dredging of their respective portions of the project to obtain lower unit dredging costs. This proved to be infeasible due to the urgency of the Navy project and the earliest commencement of the Corps work would be in FY 1976.

At this point, the New England Division portion of the report was complete and the recommendations were forwarded to the Chief of Engineers. The report is reviewed in the Office of the Chief of Engineers by the

Directorate of Civil Works. If the report is complete it is submitted to the Board of Engineers for Rivers and Harbors. The purpose of this independent review is to finalize the recommendations on the project to the Public Works Committee. Since the benefits exceed the costs the decision of the Board will be favorable.

The favorable report is circulated for comments to the Governor of Connecticut and to other Federal agencies. At this stage, the final formal coordination is generally automatic, since close and continuous coordination is maintained throughout the course of the study and, where possible, conflicts resolved prior to the final submission.

Once the coordination has been completed, the Chief of Engineers transmits the report to the Secretary of the Army. After a cursory review in the Secretary's office the report is cleared through the Office of Management and Budget to insure that it fits into the President's program. If there is no objection by the Office of Management and Budget the Secretary submits the report to the Public Works Committee.

If the Committee concurs with the favorable recommendation, the report will be printed as a public document and included in the next Rivers and Harbors Bill. The project is authorized for construction once the bill has been passed by Congress and signed into law by the President.

To obtain the funds for construction, the Chief of Engineers clears the request for funds through the Office of Management and Budget and transmits it back to Congress. Once the project has been included in an appropriations bill, and passed by both the House of Representatives

and the Senate, then signed by the President the construction may proceed.

Next the Division Engineer is directed to prepare plans, specifications and an estimate of costs. Invitations for bids are made public and mailed to prospective bidders. The successful bidder, generally the lowest, is selected and construction initiated.

It can be readily seen that this entire process is lengthy and a time-consuming operation. Several years elapse from the inspection to the completion of the project. At many levels of government there are technical, fiscal and political reviews to insure that the public funds are properly utilized.

How effective is this decision process? In the many years since the first boulders and snags were removed from the Thames River the Corps of Engineers has probably spent over a billion dollars in these types of activities. Most, but certainly not all of these projects have equalled or exceeded the economic predictions, but in the fast pace of modern technology and rapidly changing national values, is this still a viable means of constructing public works?

The answers to these questions must be a qualified affirmative. While there are many areas that could be improved, the basic procedure appears to be valid.

The study approach, particularly the computation of benefits, is conservative. Only those items that could be clearly identified and quantified are included in the benefit/cost ratio. Even in this area there are procedures that could be questioned by both engineers and economists.

The fifty year project life is standard for navigation projects, but a one hundred year life is not uncommon for flood control projects. It would appear that this standard project life could be more flexible and better relate to each particular situation. In this project a thirty year project life would be more compatible with the majority of the economic projections used in the study.

The interest rate and discount rate are somewhat lower than is customarily used in Department of Defense analyses. However, the method of determining this rate has been established by Congress and can not be changed by more than 1/4 percent each year.

The benefits are reduced to an annual basis by averaging and discounting them over the life of the project. Perhaps a more accurate method would project and then discount each individual annual benefit. This would be particularly important if a known major change were to occur during the project life. For example, the conversion of a large power plant from coal to oil, resulting in a sudden increase in petroleum tonnage. In this particular case the use of the annual average would not affect the results since the projected use of petroleum is based upon average values. However, the assumption that the benefits will always accrue at a uniform rate will not always be true.

The advantages of following standard procedures or methodologies are obvious. Standardization assists Congress and the Office of Management and Budget to compare projects with one another. Constant changes of basic parameters would undoubtedly lead to charges of Corps

manipulation of the facts and result in intense political pressure to revise these standards in order to achieve a favorable report on a project.

The Corps has a responsibility to remain as objective as possible and the maintenance of standard procedures can enhance achieving this goal.

In this study there are obvious economic benefits that were considered but did not become a factor in the benefit/cost ratio. For example, industrial land along the improved waterway would attract new commercial ventures and the lowering of petroleum transportation rates could cause inland users to shift their source of supply. There are numerous secondary benefits that would naturally follow in the wake of this project. These additional benefits are difficult to measure and should be excluded from the quantitative analysis. They should be included in the report so that they may be considered and evaluated. In this report some of the secondary benefits were included, but they could have been discussed in greater detail.

Representatives of the Corps indicated that the Office of Management and Budget was the toughest critic of their reports. Here the quantitative factors are carefully scrutinized and, therefore, they are emphasized in the report perhaps more than they should be.

Another criticism that has been leveled at this report by environmentalists, is the apparent lack of consideration of alternative means of accomplishing the objective. There is the suspicion that the Corps has overlooked or down-played any alternative that would not include

Corps participation. The construction of pipelines or off-shore terminals would be accomplished by private industry and were readily dismissed as viable alternatives.

This feeling may have been reinforced by the lack of depth of the discussion that these alternatives received in the report. However, the author of the report insists that this was not indicative of the effort spent upon these alternatives, and is contrary to Corps policy. Rather, the details of the consideration of these alternatives were deliberately omitted from the report for simplicity because the quantity of petroleum involved, the optimum size tanker and the lack of area in which to expand oil storage facilities, rendered these alternatives obviously uneconomical.

The environmental impact of this type of project is probably the most critical aspect. Many Corps projects have been halted or delayed by the recent assaults of environmental interests. At the worst these attacks have resulted in court orders and law suits, at best a delay in completing the survey report.

In this project the greatest objection arose from the proposal to dump the dredge spoil in the waters immediately offshore of the harbor. Although neither side to this dispute could present a factual case based on hard data, this single objection could drive the decision on the project. As the proponent for the new work, the burden of proof lies with the Federal government. As difficult as it may be to quantify these environmental costs, the Corps has the responsibility to do so wherever possible. For example, it appears that some attempt could

have been made to estimate the impact of these disposal sites on sport and commercial fishing. The amount of sea floor that would be affected could have been calculated. The recovery time for the area to regain its original conditions could have been estimated. Even if these facts were presented in gross terms or in best/worst case terms it would provide the decision makers a better basis for judgment.

The Corps agreed that this proposal appeared to be feasible, but expressed doubts as to its practicality. Vague numbers can be very dangerous and are subject to being misquoted and misunderstood. The general feeling of the Corps was that only those numerical values that were clearly established should be included in the report. This is obviously the safest course, but may not adequately present all sides of the problem.

One aspect that everyone interviewed agreed upon was the responsibility of the Corps to make value judgments on the social, political and environmental conditions. Although this area is fraught with problems, the Corps is probably best equipped with the technical capabilities to properly evaluate these conditions. It appears that the Corps is moving reluctantly into these controversial areas in the reports on several recent projects. An honest attempt to quantify as much of the environmental impact as possible will help in placing these conditions in perspective and reduce some of the less responsible opposition from environmental sources.

Governmental agencies at state and federal levels are undergoing some growing pains as they reorganize to meet the environmental

demands of recent legislation. This has resulted in a lack of communication and understanding between the Corps and, in this project, the Connecticut Department of Environmental Protection.

The Corps, throughout this study, has made a vigorous attempt to inform the public of their plans and intentions. Although occasional criticism, particularly from other governmental agencies, is directed at the lack of information, some of the individuals contacted indicated that they were engulfed by too much data. The vast majority of the public were aware of the proposed project, but few really understood the factors involved. The Corps representatives admitted that the public hearings instead of producing discussion on the project, generally resulted in an explanation of the proposed project.

This problem can be resolved by a better public information program. Perhaps a simpler, and more readable, presentation of the report would suffice to keep the majority of the public informed.

The Connecticut Department of Environmental Protection felt that the environmental impact statement and survey report should be combined into a single document. The Corps representatives agreed that this might be advantageous, but the present policy required that these documents stand by themselves. Since the requirement to submit an environmental impact statement was instituted after the survey report had been completed, there was a delay of several months between their respective completion dates. This situation should improve in future projects, but the difficulty of obtaining environmental data will probably continue to cause delays in the finalization of environmental impact statements.

Finally, underlying many comments by private individuals and some governmental agencies, was the feeling of being overpowered by the Corps of Engineers and the Federal bureaucracy. This is a natural reaction when confronting a large governmental agency whose concern is more national than regional. Under these circumstances individual projects may not receive the degree of concern that local interests might consider to be reasonable.

On the other hand, the Corps is accused of pushing some projects harder than others, particularly if the project is in another state or is especially harmful to the environment. However, the Corps is closely attuned to the President's policies, the priorities and programs of the Office of Management and Budget, and the wishes of Congress, and these realistic constraints must be considered if a project is to have any chance of approval. The Corps does make an effort to remain objective and only to recommend those projects that are beneficial to the general welfare of the public but some parochial interest can creep into the report. Hopefully, the approval procedures that require review at several levels of the organization should eliminate those projects that would benefit only small sectors of the country.

Some individuals indicated that the benefits appeared to accrue to special interests (such as the petroleum industry in this project). There was some concern that these benefits might not be passed on to the consumers and the general public. Furthermore, no post project studies had been conducted to insure that in the past benefits were received by the public. This could be a valid complaint, but involves arguments

on the role of the Federal government in the private sector that began with the first public works in the eighteenth century. Such a radical philosophical change in governmental activities is beyond the scope of this paper.

Recommendations that would improve this decision process fall into three general areas: the survey report, the environmental impact and the general public understanding of the Corps position.

First the quantitative portion of the survey report is adequate. It provides a standard for comparison between competing projects that is straightforward and reasonable. The qualitative and unquantifiable aspects could be more clearly presented and gross estimates of costs or benefits included wherever possible. Alternatives should be rigorously explored and clearly explained when rejected.

Second, the environmental impact statement should attempt to quantify the environmental costs wherever possible. The cost of studies to obtain data to evaluate environmental impact should be included in the report. Every effort should be made to alleviate any feelings that these factors were not given full consideration. While progress has been made in this regard, the general credibility gap must be reduced.

Finally, the public and other governmental agencies must be better informed of the operations, goals and particularly the limitations of the Corps of Engineers in the conduct of these projects. The Corps has silently borne criticism that may not be within their power to correct. Communications between the Corps and environmental interests must be improved.