TABLE 33

APPROXIMATE NOISE LEVELS OF TYPICAL ACTIVITIES

INDOOR NOISE LEVELS	DECIBELS	OUTDOOR NOISE LEVELS
	140	THRESHOLD OF PAIN
	130	Pneumatic riveter
Oxygen torch	120	
	110	Elevated Train
		Jet flyover at 1000 feet
Rock and roll band	100	
		Farm tractor
		Lawn mower at 3 feet
Boiler Room	90	Motorcycle at 25 feet
Food blender at 3 feet		
		Diesel truck, 40 mph at 50 feet
Garbage disposal at 3 feet	80	
		Lawn mower at 100 feet
Shouting voice at 6 feet	70	
		Car, 50 mph at 50 feet
Normal speech at 3 feet		
	60	Heavy traffic at 300 feet
Average business office	50	
Average residence		Bird calls
	40	
Library		
	30	
		Quiet rural area at night
Broadcasting studio		
	20	Rustling leaves
	10	
	0	THRESHOLD OF HEARING

TABLE 34 CONSTRUCTION EQUIPMENT NOISE LEVELS

	Typical dBA level at 50 ft
Earth moving:	
Loader	78
Back hoe	82
Grader	86
Truck	88
Materials handling:	
Concrete mixer	82
Concrete pump	82
Crane	82
Stationary:	
Generator	77
Compressor	81
Impact equipment:	
Wrenches	85
Jack hammer/drill	89
Pile driver	100

Source: "Noise Impact Assessment Report, Pittston Refinery, Eastport, Maine," prepared for U. S. EPA, Region I, September 1976.

Studies in Mobile Bay with an oyster dredge indicate that the noise level on the dredge MALLARD was recorded in the range of 100 decibels in the engine room and 80 decibels on the upper decks. Noise levels of the operating dredge were 60 decibels at a distance of 2,000 feet. (U.S. Army Engineer District, Mobile, Alabama, Draft Environmental Statement on "Permit Application by Radcliff Materials, Inc., Dredging of dead-reef shells, Mobile Bay, Alabama, October 1972). Noise levels from pipeline dredges are not expected to differ significantly from those of a shell dredge, and, therefore, no significant adverse effects of noise levels are expected to occur from pipeline dredging. The temporary nature of the construction activity, together with the limited nighttime construction operations, tend to somewhat alleviate the impact of construction noise in the surrounding community.

4.117 Figure 38 presents the overview of the proposed Corpus Christi Port facility with the location of plants denoted by the letters Table 35. The concentric sound attenuation isolines are plotted with a range of attenuations from 30 to 60 dBA. These isolines connect points where the sound level produced by the plants would be as an example, 30 dBA below the individual plant boundary line sound level.

4.118 Comparison of the results of model use with the general guidelines for community noise and annoyance levels provides a means of probable impact assessment when information is available on specific source locations, sound levels, specific receptor locations, and existing ambient noise levels.

4.119 Because of the wide range of human hearing, sound levels are expressed by a logarithmic relative scale "in a ratio" to a standard intensity level. It is difficult for the average person to grasp the meaning of such a scale from abstract concepts. Because it is logarithmic, linear comparisons of decibel levels cannot be readily made. For example, a noise pressure level of 130 decibels is 10 times as great as one of 120 decibels and 100 times as great as a noise pressure level of 110 decibels. A better feeling for the measurement scale can be obtained from values relating to common experience. Based on published typical noise levels, and some prior measurements (SWRI 1975) in the area, typical current noise levels could be expected as shown in Table 34.

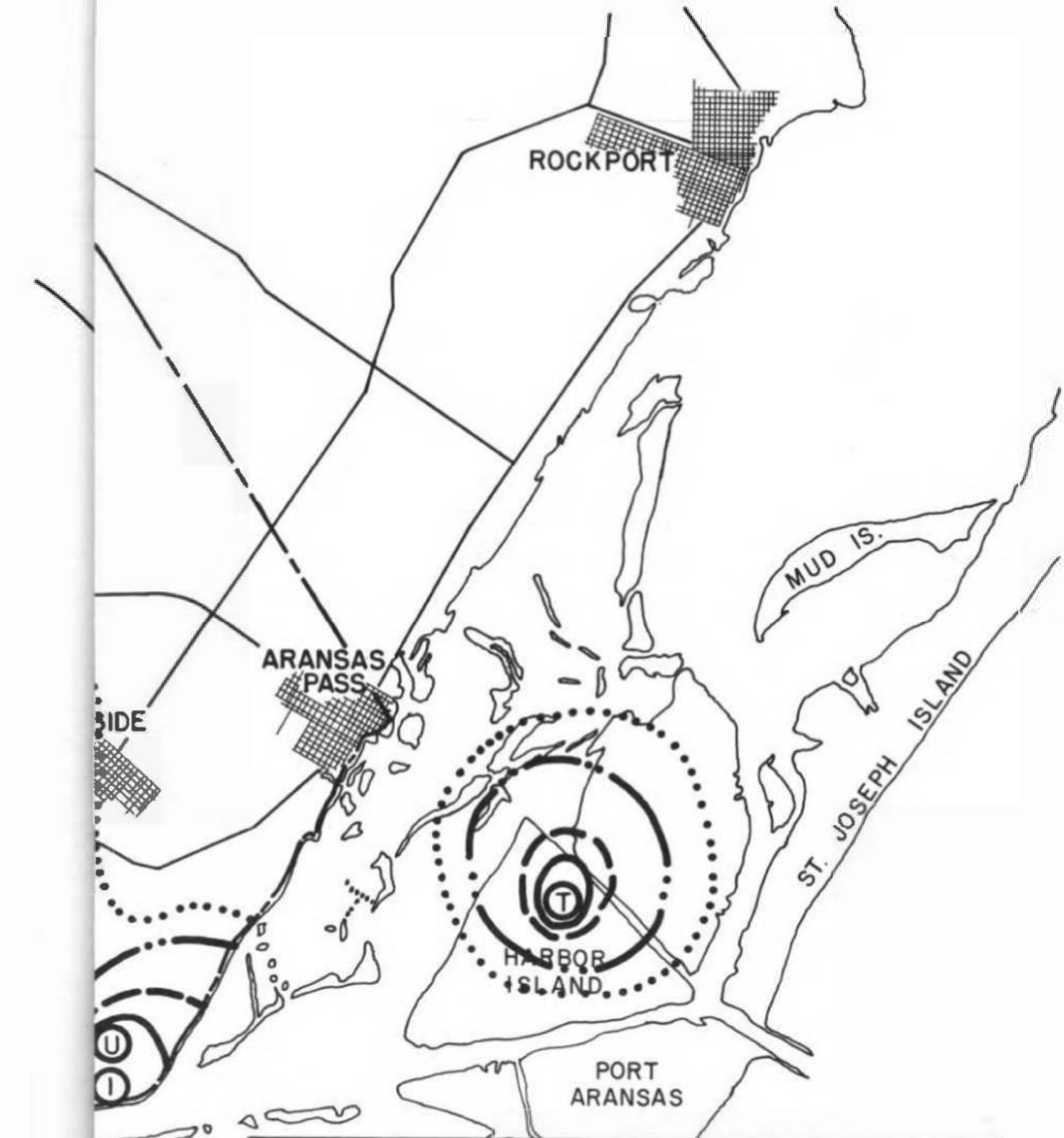


FIGURE 38

SOUND ATTENUATION CONTOURS

O INDUSTRIAL PLANTS-PROJECTED YEAR 2030

ATTENUATION CONTOURS (dBA)

30 dBA
40 dBA
50 dBA
60 dBA

TABLE 35

PROJECTED INDUSTRIAL GROWTH

(See figure 38)

Identification	Type	Capacities 1980	Without Project 2030	With Project 2030
A	Refinery1	70	150	200
B	"	185	300	300
C	"	41	100	100
D	"	119	180	200
E	"	65	100	100
F	"		200	300
G	"	50	180	180
H	"		180	240
I	"	10	60	60
J	"			320
K	"		160	200
L	"			200
M	"			200
N	"			200
O	"			100
P	"			100
Q	"			100
U	Blast Furnace or Sinter/ Scrap Furnace2		2	4
W	Bauxite/Alumina Plant2	5	11	41

1Thousands of barrels per day, 365 days per year.
2Millions of tons per year

4.120 The isolines shown in the noise attenuation map (Figure 38) are presented in terms of attenuation or noise reduction values. They are useful in any study of industrial noise in this area. In addition, because of the conservative nature of the mathematical calculations used to produce the contours, all values are "worst case" or conservative estimates of the problem and impact areas.

4.121 Since differing industrial developments will each have differing impacts, the map (Fig 38) is intended as a tool for interpretation of possible noise pollution given, specific industrial plant sites.

4.122 For assessment purposes, a simple situation can be based on assumed 2030 locations of industries as shown on Figure 38. To be unnoticeable to an average listener, noise from industrial sources would have to be attenuated to about 20-25 dBA for quiet rural receptor areas, to about 30-40 dBA for residential areas, and to 40-50 dBA for light commercial-city areas. If the hypothetical sources shown in Figure 38 all have boundary line noise levels of 80 dBA (high for refinery and petrochemical plants), there could be a slightly noticeable increase in noise levels in the rural areas between Ingleside and Gregory with little or no noticeable increases in the San Patricio County urban areas as presently located. For urban areas near plants located along the Corpus Christi Inner Harbor, noticeably increased noise levels would be expected only within a few blocks distance of the industrial sites. With any industry or traffic activity there are usually occasional sudden peaks above the average sound levels (due to horns, whistles, venting, machinery impacts) which can prove annoying to some who hear. These sounds are often amenable to control by modifying equipment or routine operation and maintenance practices.

4.123 Effects on Benthic Organisms. Dredging and disposal operations associated with construction of the project would have varied effects on bottom dwelling organisms. These effects include removal and destruction of the benthic organisms existing in the areas to be dredged, coverage of those organisms existing in the disposal areas, and disruption to organisms in areas adjacent to the dredged channel. Most of the areas to be dredged have previously been dredged and have few benthic organisms.

4.124 Maintenance dredging would probably be performed every year, a frequency which could prevent benthic recolonization of the dredged areas commensurate with the productivity of surrounding undisturbed areas. Numerous studies have been made in recent years on recolonization of dredged channels. Ten years after dredging of Boca Ciega Bay, invertebrate recolonization of canal sediments (92 percent silt and clay; 3.4 percent carbon) was negligible. None of 49 fish species caught in these canals (as compared to 80 species in undredged areas) was demersal, apparently because of the lack of benthic food organisms on or in the canal deposits (Taylor and Saloman, 1968). Rogers and Darnell (1973) have demonstrated that dredge cuts reduce the population of small benthic (meiobenthic) animals to about one-third of their former levels, and that recovery is only about 80 percent complete a decade later. This study further indicated that modifications of the particle structure of the sediments was probably the prime causative factor for the slow rate of recovery. Pfitzenmeyer (1970) also concluded from the dredging and disposal studies in Chesapeake Bay that because of the instability of bottom sediments, the benthic biomass in the channel may remain low, even though recovery from dredging began soon after dredging operations had ceased.

4.125 Materials deposited in the disposal areas during construction would cover approximately 7000 acres of Gulf bottom and 2910 acres of inshore wetland and bay bottom. Bottom dwelling organisms in these areas would be covered and perish. The Gulf areas should recolonize and be improved as habitat. Date from offshore disposal areas used for maintenance dredging of the Sabine Neches Waterway, Galveston Channel, and Freeport Harbor have shown no adverse impacts on biological communities. The inshore areas, however, would be removed from tidal influence and no longer support benthic life.

4.126 As discussed in Paragraph 4.03, some sediment suspended by the pipeline dredge may be carried by the tides and deposited on adjacent wetlands and bay bottoms, affecting benthic populations. Some organisms may be destroyed, but most would not be covered deeply enough to cause death.

4.127 <u>Effects on Shellfish.</u> The disposal of dredged material would result in the burial of all oyster reefs existing within the boundaries of the disposal areas. Except for a few scattered oysters, the largest concentration would be in disposal area C (Figure 4 & 39). However, scattered oysters extend south along the back side of Mustang Island, almost to Shamrock Island (Personal communication, Jim Nolke). All oysters within the disposal area would be permanently buried. A few small scattered oyster reefs also exist among the tidal areas of Harbor Island (Figure 39). Some reefs would be physically removed by the realignment of the Channel to Aransas Pass. Also, some reefs near the dredging activities could be affected by siltation. However, the siltation should not be significant enough to cause death. The other major oyster populations in the Corpus Christi Bay System are not close enough to the project to be directly affected by it.

4.128 Effects on Wetlands. Wetland habitat in the Harbor Island area is diversified, with sizable stands of several productive types of wetland plants such as Spartina anterniflora and Avicennia germinans (Black mangrove), and submerged grasses such as Halodule and Thalassia. Wetland areas both provide shelter and support a rich community of fish and wildlife, increase the stability of the soil, reduce shoreline erosion, and are important in the nutrient cycle.

4.129 Changes that would be brought about in wetland areas as a result of the Project are highly significant with respect to any evaluation of the environmental impact. A detailed analysis of habitat areas has been developed for this EIS of both those areas to be utilized by the project and the total areas in the immediate regional system in which the project is to be located. The presented analysis permits an evaluation of the impacts on habitat by type and location within the project area as compared to the habitat within the regional system in which the project is located.

4.130 Wetlands have been defined in the Federal Register, Department of the Army, Engineers Corps, Vol. 42, No. 138, Tuesday July 19, 1977, pages 37128 and 37129. In summary, wetlands are those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient enough to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Further, the "High Tide Line" (HTL) is considered the shoreward limit of wetlands in Coastal areas, such as Harbor Island. The HTL term has been defined as a line or mark left upon tide flats and beaches that indicates the

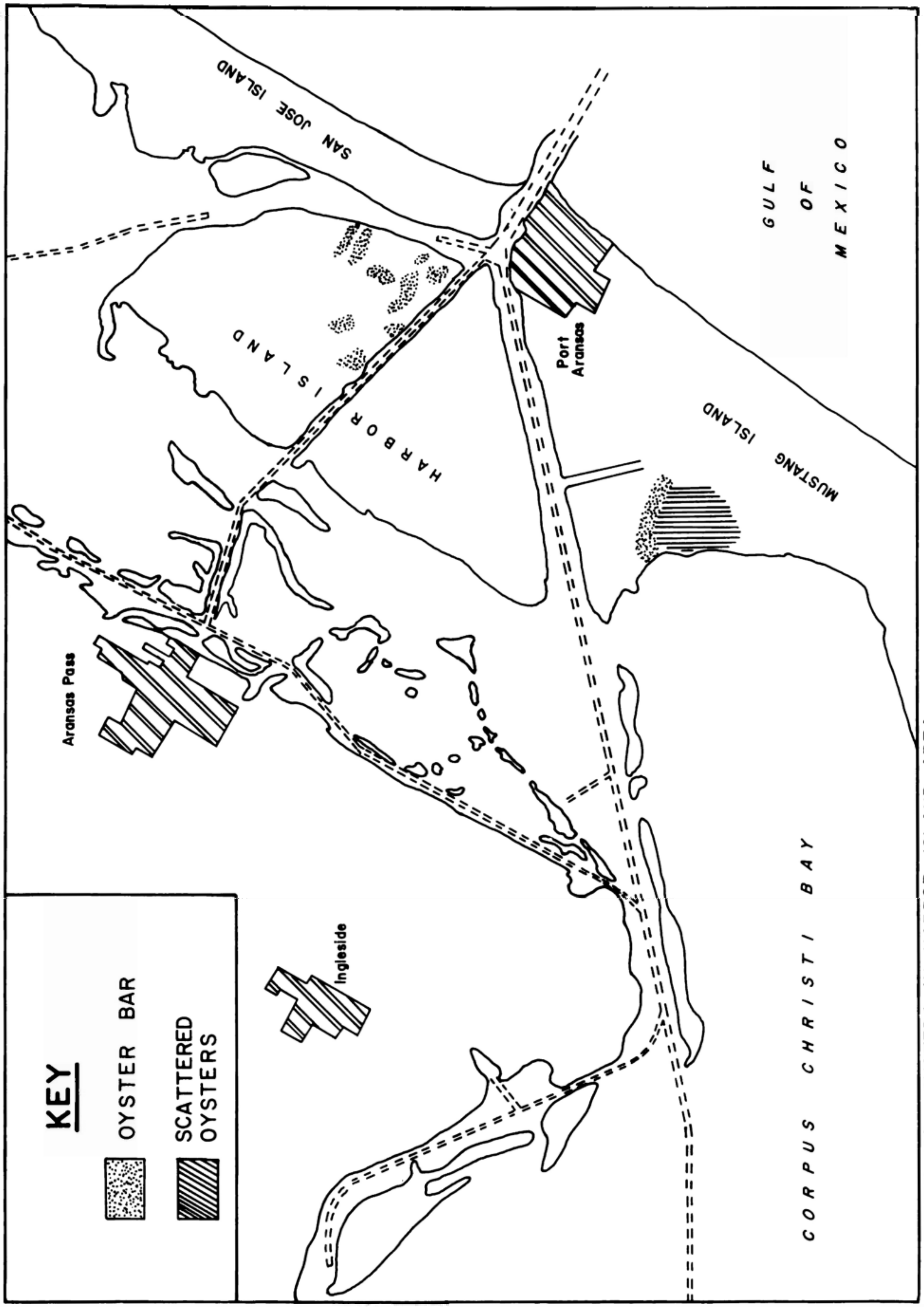


FIGURE 39 - OYSTERS IN HARBOR ISLAND AREA

intersection of the land with the water's surface at the maximum height reached by a rising tide. While wetlands are intended to include areas covered by spring high tides and other high tides that occur with periodic frequency, they do not include those areas that are covered by tidal waters resulting from storm surges, hurricanes, or other intense storms.

4.131 A study was conducted in late 1977 and early 1978 to confirm the wetland boundaries and vegetative characteristics of the Harbor Island Project area in conformance with the Federal Register definitions. The identification and summarization of habitat and Biotope areas was derived from a detailed descriptive survey of the Harbor Island area based on the preliminary aerial survey map produced by the Texas A&M University Remote Sensing Center (Benton et al., 1976), as well as a recently constructed detailed topographic map compiled by Tobin Aerial Surveys for the Harbor Island Project. The former map and its vegetation descriptions were verified by a series of ground traverses taken through representative areas of special importance to the Project. A summary of information derived from the foregoing data is presented in Figure 40.

4.132 As noted, the patterns of vegetation shown on Figure 40 were classified by Biotope, using the description in Oppenheimer and Gordon (1972). A Biotope is a region which is uniform in environmental conditions and in the populations of animals and plants for which it is the habitat (Webster). The Biotopes in the areas shown on Figure 40 list the species of plants or other characteristics of dominance; including minor types of organisms and characteristics labeled "others". These data were statistically validated and field checked during the development of the plant inventory map.

4.133 Tables 36 and 37 were also drawn from the same data as figure 40. Table 36 compares the various environmental zones in the Bay Complex served by the water exchange through the Aransas Pass Inlet (Figure 41) and those zones influenced by the Harbor Island Project. Table 36 also summarizes the various subdivisions of the wetlands and uplands, indicated their vertical limits, lists the habitat characteristics and Biotope units, and shows the acreages involved in each category. Specifically, these latter data were compiled from aerial photographs, charts, and ground

stachyum 14
cta 15
tonicifolium 16 equal abund.
mundii 17
ris 18

lomeratus
accharoides
yanus
rmedia
ri
tus
lata
lon
utum
littoralis
inosum
ceum
rniflora
tinae
per var. hookeri
ramidus
arpii
rginicus
skirrhobasis
uttallianus
ophaea
lata
tus
ata
onactis
oanoides
lchella
scens
e
lora
rophylla
silvanicum
rophyllus
niata
lia
da
ii

ra phyllocephala
a
atus
scens
eimeri
ana
ra
osa
ocumbens
dulosa
ncularis
ericana
gelovii
rginica
teatus
lii
ulacastrum
uriculata
eus
tosa
helvola
lieosperma

ilifolium

m draconeuloides
irrhiniflora
.
gae

Ground litter

Others
Chlorispetraea
Eragrostis oxylepis
Monanthochloe littoralis
Paspalum monostachyum
Schizacharium scoparius
Sporobolus pyramidus
Sporobolus virginicus
Ambrosia psilostachya
Avicennia germinans
Borrichia frutescens
Erigeron myrionactis
Eustoma exaltatum
Gaillardia pulchella
Gerardia heterophylla
Samolus ebracteatus
Sesuvium protulacastrum
Strophostyles helvola
Strophostyles lieosperma
Fimbristylis castanee
Scirpusamericanus

BIOTOPE 9

	Dom	
Bare ground	1	equal abund.
Heterotheca subaxillaris	2	
Eragrostis oxylepis	3	equal abund.
Schizacharium scoparius var. littoralis	4	
Sporobolus virginicus	5	
Suaeda linearis	6	

Others
Andropogon glomeratus
Andropogon virginicus
Uniola paniculata
Ambrosia psilostachya
Dalea emarginata
Erigeron myrionactis
Eupatorium betonicifolium
Gerardia heterophylla
Helianthus annus
Heliotropium currasivicum
Neptuniapubescens
Oenothera drummondii
Sabatia arenicola
Salicornia bigelovii
Sesbania macrocarpa
Sesuvium protulacastrum
Strophostyles helvola
Strophostyles lieosperma
Tidestroemia lanuginosa
Unknown composite
Fimbristylis castanee
Areal litter
Ground litter

Avicennia germinans
Areal litter
Ground litter

BIOTOPE 11

	Dom
Areal litter	1
Ground litter	2
Andropogon glomeratus	3

Others
Paspalum monostachyum
Schizacharium scoparius
var. littoralis
Spartina patens
Sporobolus virginicus
Ambrosia psilostachya
Heterotheca subaxillaris
Bare ground

BIOTOPE 12

	Dom
Halodule wrightii	1
Water	2
Bare ground	3
Dead oysters	4
Digenia simplex	5

Others
Ruppia maritima
Gracilaria verrucosum
Blue green algae
Live oysters
Areal litter
Ground litter

BIOTOPE 13

Open waters and dredged channels supporting no submerged angiosperms; with benthic algae

BIOTOPE 14

Thalassia testudinum
Halodule wrightii
Water
Bare ground

Others
Ruppia maritima
Benthic algae
Areal litter
Ground litter

Figure 40

NUECES COUNTY NAVIGATION DISTRICT NUMBER ONE

CORPUS CHRISTI SHIP CHANNEL

HARBOR ISLAND AND ADJACENT AREAS

Scale: 1" = 800'	VEGETATION MAP ON TOPOGRAPHIC BASE	Date: April 29, 1978
Sheet		Dwg. No. P-1-54(33)

TABLE 38

ACREAGES OF LOCAL COASTAL HABITAT ZONES

Zones	Habitat Characterized By	Corpus Christi Nueces	Aransas Copano	Total Acres	Harbor Island	San Jose Island	Mustang Island	Total Acres
		INFLUENCED BY WATER EXCHANGE THROUGH ARANSAS PASS INLET FROM KENNEDY CAUSEWAY TO CEDAR BAYOU* (Nueces-Corpus Christi-Redfish-Aransas-Copano-Mission and St. Charles Bay including bay margins)			ALTERED BY HARBOR ISLAND PERMIT APPLICATION NO. 9563 (Harbor Island-San Jose Island-Mustang Island and adjacent shores)			
Deep Water Zone More than 3.5' (Biotope 13**)	Water Plankton Shellfish Fish	83,330	105,943	189,273	23	0	32	55
Shallow Water Zone from 3.5' to MLT (Biotope 12	Water Bare Sand Halodule Thalassia	18,894	10,131	29,025	319	0	916	1,235
Tidal Zone from MLT to HLT (Biotope 1-2-14)	Shore Margin Spartina Avicennia	7,990	33,107	41,097	151	0	164***	315
Infrequently water covered zone from HTL to Plus 2 (Biotopes 8-10)	Sand, Mud, Blue green Algal Flats Distichlis	9,160	3,835	12,995	208	18	1,246	1,472
Highland Above Plus 2 HTL (Biotopes 3-5-7-7A-9)	Bare ground Woody-Vegetation Grasses	30,876	10,874	41,750	155	1,971	791	2,917
Total of Wetlands & Uplands				314,140				5,994

* See Index Map Figure 41
** See Vegetation Map Figure 36
*** Includes Fresh Water Marshes

MLT = Mean Low Tide
HLT = High Tide Line

TABLE 37

HABITATS INFLUENCED BY PERMIT APPLICATION NO. 9563*

(In Acres)

Zone	Deep Water More than 3.5'	Shallow Water 3.5' to MLT	Tidal Area MLT to HTL	Infrequently covered HTL to Plus 2	Highland Above Plus 2' HTL
Habitat Characterized by	Water Plankton Shellfish Fish	Water Bare Sand Halodule Thalassia	Shore Margin Spartina Avicennia	Sand, Mud, Blue-green Algal Flats Distichis	Bare Ground, Woody Vegetation, Grasses
Relative Aquatic Productivity	High*** (Net Productivity (1200 lbs,C/acre-yr.)	High*** (Net Productivity) (1800 lbs.C/acre-yr.)	High*** (Net Productivity) (1500 lbs.C/acre-yr.)	Low*** (Net Productivity) (300-600 lbs.C/acre-yr.)	None*** (Net Productivity) (1100-1700 lbs.C/acre yr.)
Biotypes**	13	12	1-2-14	8-10	3-5-7-7A-9
	Acres	Acres	Acres	Acres	Acres
Realigned Tributary Channel	0	15.4	34.7	15.6	6.6
Docking Basin	0	9.7	22.9	68.4	81.1
Disposal Areas					
A-1	22.9	23.4	32.1	9.8	3.7
A-2	0	23.5	7.4	11.6	17.4
A-3	0	0	4.2	32.8	26.7
A-4	0	114.9	49.6	69.3	19.6
A-5	0	132.5	0	0	0
C	0	906.7	41.1	405.5	376.7
D	31.5	8.8	123.1****	840.3	413.9
B	0	0	0	18.0	1971.0
Total Acres	54.4	1234.9	315.1	1471.3	2916.7

* Excluding 7000 acres of Gulf Bottom used for disposal of dredged material
** From vegetation map (Figure 36)
*** Productivity data taken from Kier and Fruh, 1977
**** Includes fresh water marshes

INDEX MAP OF AREA OF INFLUENCE BY WATER EXCHANGE THROUGH ARANSAS PASS INLET

FIGURE 41

observations in the Aransas-Copano Area and from the NSF-RANN report (1974) for the Nueces-Corpus Christi Area.

4.134 The five definitive environmental habitat zones of Table 36 may be described as follows:

(A) The deep water zone includes all water depths greater than 3.5 feet and is characterized by water, plankton, shellfish, fish, and benthic organisms. It is mapped as Biotope 13 on the vegetation map (Figure 40). The primary productivity from this zone is from the suspended phytoplankton.

(B) The next zone is the shallow water zone extending from the 3.5 foot water depth to mean low tide (MLT). Except during unusual drops in sea level, such as might be caused by severe storms in other areas of the Gulf or exceptionally strong "Northers" coincident with low tide level, this zone is continuously covered with water. This is a submerged grass community characterized by water, unvegetated (bare) sands, seagrass such as Halodule and Thalassia and is mapped as Biotope 12.

(C) The intertidal zone lies between mean low tide and the high tide line (HTL) as described in the Federal Register. It is regularly covered or saturated with surface or ground water and is characterized by Spartina alterniflora and Avicennia germinians (black mangrove) communities and associated plant species (Biotopes 1, 2, and 14).

(D) The next zone is characterized by extensive sand, mud, and blue-green algal flats that are at or above the high tide line and may be inundated or saturated with surface or ground water. Such plants as Distichlis, Salicornia, Batis, Spartina, etc., typically grow in depressed areas and on small mounds. In areas where fresh water may stand for a few days or weeks after a rain, the flats are covered with blue-green algae. During dry periods between rains or infrequent storm surges, the algae becomes dormant and the surface changes to curled-up patches of dry algal mat. This zone between the HTL and plus 2 feet has been mapped on figure 40 as Biotope 8 and 10.

(E) This uppermost habitat zone includes the highlands above plus 2 feet HTL and is characterized by bare ground, woody vegetation and upland grasses (Biotopes 3, 5, 7, 7A, and 9).

4.135 The influence area of the Aransas Pass Inlet extends from approximately the Kennedy Causeway at the south, northward to Cedar Bayou, the northeastern limits of Aransas Bay (Figure 41). The area includes Nueces, Corpus Christi, Redfish, Aransas, Copano, Mission, and St. Charles Bays and their shoreline margins. The total wetland acreage in the influence area has been calculated to be about 27,390 acres, as compared to a total of 3077 wetland acres in the total area to be occupied by the Harbor Island Project.

4.136 Table 37 presents a detailed breakdown of the wetland habitats to be altered by the Permit Application No. 9563 on Harbor Island itself - including both private and public lands, but excluding those lands presently utilized for transhipment facilities. The value of "productivity", in pounds of carbon/acre/year, has been shown for each of the habitat zones. All the areas are considered high in terms of aquatic habitat productivity. It is generally assumed that the variation in productivity is insignificant between the wetland zones, as the methods for determining such values are not precise. The uplands contribute little carbon to the surrounding aquatic habitat or wetlands. The sandy-silty soil absorbs the byproducts of microbial degradation and the carbon-nitrogen cycles take place in situ (Oppenheimer, 1977). Only during hurricane or major storm action is the carbon transported to the wetlands and made available to the aquatic food web. The productivity data are taken from a report of Kier and Fruh (1977).

4.137 A sea grant funded project is presently being conducted by the University of Texas Marine Laboratory at Port Aransas to identify the most appropriate plants and methods to enhance and reduce the time required for revegetation of dredged materials. The findings of this work are expected to be available and to be used for a vegetation/revegetation program as part of the Project.

4.138 Construction of this project would result in varied effects on wetlands of the project area including the physical removal by construction of the turning basin and realignment of the Tributary Channel to Aransas Pass, sedimentation in adjacent wetland areas associated with the actual dredging, and covering the wetlands in the proposed inshore disposal areas. Approximately 167 acres of wetlands would be physically removed from the project area by construction of the turning basin and realignment of the channel to Aransas Pass. The major wetland type affected by this aspect of the project is the black mangroves of the north Harbor Island area.

4.139 The Nueces County Navigation District has estimated construction of the inshore portion of the project would take approximately 2 years of continous dredging to complete the project and that pipeline dredges would be used. Pipeline cutter suction dredges are the least hazardous from an environmental standpoint, since the dredged material is taken up by pumps, producing limited turbidity. The turbidity that is produced, however, would be carried by the tides and currents and some may eventually be deposited on the adjacent wetlands. This effect could be significant if dredging is continuous in one location and could result in some damage to the wetlands. Turbidities would occur only as long as dredging is under way. Additionally, maintenance dredging would be accomplished annually.

4.140 One of the most significant effects on the wetlands as a result of the project would be from the proposed disposal operations. The use of disposal areas A, C and D, would result in a total loss of the wetlands in these areas (Figure 40). A breakdown of the habitat type in each disposal area is included in table 39. The loss of the higher productivity areas would result in lowered primary productivity, permanent loss of nursery grounds for marine species, and loss of wildlife habitat. However, new habitat would be created for terrestrial species. Wetlands play an important role in providing detrital material, a basic source of energy to the consumers of the estuarine system. Equally important to such first level consumers are the benthic organisms and epiphytic algae of this zone. Loss of the wetlands could result in a reduction in the numbers of sport and commercial fish, crustaceans, and mollusks, as well as larval, post larval, and juvenile fishes and crustaceans. With respect to wildlife, the dredged terrestrial uplands would reduce nesting and resting habitat for birds and other terrestrial wildlife. Establishment of terrestrial vegetation on the disposal areas could restore a part of the value to wildlife.

4.141 Enlargement of the entrance channel at Port Aransas would increase the cross sectional area and subsequently increase the tidal range in the project area. Changes in tidal range would be greatest at Harbor Island and decrease with distance away. By increasing tidal ranges, areas not previoulsy inundated by normal daily tides would now be periodically flooded, in effect creating additional wetland areas. The result of this would be a change in plant species from those which are only occasionally flooded by abnormally high tides to species able to tolerate daily tidal inundation. This could be expected to increase the extent of wetland vegetation in the project area, but, because of the many factors which affect plant growth, quantification of the increase in wetlands is not practicable.

4.142 To the greatest extent practical, offshore and upland disposal areas would be used to avoid loss of productive wetlands. New channels are aligned along existing channels and previously dredged waterways to minimize wetland loss. Wherever practical, land based equipment would be used to reduce the impact on wetlands. The locations of disposal areas were selected, in part, to displace areas of low productivity rather than the more valuable areas of high biological productivity.

4.143 During construction and maintenance dredging, state of the art equipment and procedures would be utilized to the greatest extent practical to minimize turbidity and siltation impacts on surrounding wetlands. To further reduce these turbidity and siltation impacts, the disposal areas would be diked and the effluent would be controlled by weirs draining into water areas of low sensitivity such as the naturally turbid surf zone of the Gulf or the docking basin or Corpus Christi Channel. Construction of the dike on San Jose Island and stabilization by vegetation would help protect the wetlands on the inshore side of the island from the continuing encroachment by blowing sand from the open beach.

4.144 Where practical, disposal areas would be contoured to provide proper terrain and saltwater circulation for establishing new desirable wetland habitat. Area D is a candidate for such a program. The displacement of wetlands by disposal areas would be partially offset by stabilization and revegetation programs to provide nesting and resting habitat for terrestrial species. In all cases, however, these area would be used as disposal areas until there use is no longer economically feasible.

4.145 Effects on Fishery Resources. Turbidities, excavation activities, and filling of wetlands, would have an effect on the fishery resources of the project area.

4.146 High concentrations of extremely fine particles, can cause asphyxiation of juvenile fish and shellfish by coating of their gill tissues. Turbidities, which would result from the dredging and disposal activities would have the effect of inhibiting phytoplankton activity in limited areas near the dredging operations. These turbidities would occur only while dredging is under way. Reduction of photosynthetic activity results in a corresponding reduction at the base of the aquatic food chain. This loss could be projected up the food chain. The loss which would occur may be in part compensated for by increases in productivity following resuspension of nutrients and aeration of sediments and organic matter. Increases in productivity have been reported immediately following dredging. (Odum and Wilson, 1962; Odum, 1973; Virginia Institute of Marine Science, 1967). Mackin (1961) reported that the distance to which materials are carried away from a dredge is a function of the current velocity, specific gravity of the solids, grain size and shape, and flocculation of the grains at the time of transport. His observations of turbidity drift showed that there is a decrease in suspended matter and diminution in turbidity due to a rapid deposition of suspended material and dilution. For example, Mackin observed that in waters having an average current velocity of 0.25 knots and dredging material discharge having a net weight specific gravity of 1.7, only 0.1 percent of the total material removed in the dredging operation remained in suspension outside a radius of 100 feet from the dredged material discharge point. Fine material was lost in the natural turbidities at distances over 1,000 feet and had the same effect on the environment as materials put into suspension by natural conditions, such as is observed in most Texas bays. He also noted that during his control study, turbidity in one secondary bay caused by shrimp trawlers on one day was greater than that produced at a distance of 300 feet from the dredge discharge. Cronin, Gunter, and Hopkins (1971) found when turbidity increase is of short duration and the amount of siltation is low, the effects are generally insignificant. Odum (1963), however, noted serious effects up to about 1300 feet (1/4 mile) east of a dredging site in Redfish Bay. Odum noted the Thalassia beds were covered with 12 inches of soft silt and that no plant growth occurred on that surface by the next year. Odum suggested that Redfish Bay was shallower than the bays reported on by Mackin and that this shallowness may have been part of the cause for the different effects in the two areas.

4.147 The Aransas Pass inlet is extremely important to the fishery resources of the entire coastal bend region.

Studies have documented the large numbers of invertebrate and vertebrate organisms that use the pass for movement in and out of the bay systems. Copeland (1965) estimated the biomass produced in the bay area served by the Aransas Pass inlet at 11.65 x 107 kg/year. Estimates indicate that one-third of the brown and pink shrimp, and over one-tenth of the white shrimp caught off the Texas coast are reared in estuaries that rely on the Aransas Pass inlet for a migration route to the Gulf. Marine fish of sport and commercial importance which use the inlet as a migration route include red drum, black drum, croaker, seatrout, flounder, sea catfish, and menhaden. The blue crab, the only readily marketable size crab found in Texas waters, mates in low salinity waters of the estuary, and the eggbearing females move into the Gulf for egg devalopment. The larvel stages develop into young crabs in the Gulf and the latter migrate through the pass into the upper reaches of the estuaries.

4.148 The migration of marine species in and out of the estuary is extremely important to their life cycles. Many of these migrations occur during very early and delicate stages of life. During construction of the channel these migrations could be affected. The magnitude of this effect would be dependent on the time of year, number, size, and location of dredges, and length of dredging time. The dredging should not preclude the passage of larval, juvenile, or adult marine organisms through the channel; however, those organisms approaching too close to the dredge suction pipe may be entrained in the pipe and pumped to the disposal area where they would be either buried in the sediment or consumed by birds.

4.149 Juvenile fish occur in the pass year round. However, the number of juvenile immigrations is greatest during November and March. The fewest juveniles occur during the month of May through July. The majority of gulf spawned blue crab juveniles immigrate from July through September. Brown shrimp post-larvae generally immigrate from mid-April to mid-June with a major peak during September and October. Some adult fish generally emigrate in the fall with decreasing temperatures as do the majority of adult white shrimp. The majority of adult brown shrimp emigrate from mid-June through mid-July.

4.150 Low levels of dissolved oxygen in the bottom waters of the inshore reaches of some deep channels may occur at times when mixing of tidal action is inadequate. Should such anoxic conditions develop, they probably would be limited to backwater areas of low current and would not be likely to affect migrating animals since they tend to move with tidal currents. The strength of the tidal movements and lack of stagnation near the pass is indicated by the bottom scour of some 15 feet below dredged depths in that area and favorable bottom measurements of dissolved oxygen made on numerous occasions by Southwest Research Institute.

4.151 Fishery resources in the area might also be enhanced by increasing the opening to the Gulf. Previous deepening of the entrance channel has decreased the extremes of both salinity and temperature which otherwise would occur in the bays. It is possible that channel enlargement could again improve biological productivity. Southwest Research Institute estimates the overall salinity change would increase less than 2 ppt. The salinity change would decrease with distance away from the pass. This change should not be significant enough to be noticed in sport and commercial catches in the area.

4.152 Impacts on fishery resources would be minimized as much as possible by utilization of existing disposal areas that are already disturbed and where new areas are necessary, selecting them to avoid biologically sensitive locations such as spawning areas, critical habitat, etc. Potential effects on migratory movements can be reduced by minimizing dredging in the jetty channel as much as practical during peak migratory movements. The utilization of state of the art equipment and procedures as much as practical to minimize turbidity and siltation impacts and diking disposal areas and controlling effluents to reduce project impacts as fishery resources.

4.153 Effects on Wildlife. Disposal of dredged materials would cover vegetation of value to wildlife, and excavation of the docking basin and realignment of the Channel to Aransas Pass would also eliminate wildlife habitat. However, new habitats could be established and, by employing revegetation, dredged material stabilization techniques would in part compensate for losses of existing vegetational cover. Sea Grant studies in several localities of the Corpus Christi area to determine appropriate plants to stabilize dredged material, improve productivity, and enhance the aesthetics of the area are now in the second year (Oppenheimer, 1978). Use of low productivity terrestrial habitat such as the unstable sandy areas on San Jose Island for disposal followed by a stabilization and revegetation program should increase the value of these areas for terrestrial wildlife. Other effects on wildlife which would result from construction of the project include increased development and human activity in the immediate area, and the possibility of secondary industrial development.

4.154 Use of disposal areas A, C, and D and realignment of the Channel to Aransas Pass would alter approximately 3077 acres of wetland areas (Table 39). These areas are used extensively by fish-eating birds and waterfowl. Texas Coastal Waterfowl surveys, conducted annually in January by the Texas Parks and Wildlife Department, indicate that 50,000 to 60,000 waterfowl use the Redfish Bay - Harbor Island complex each winter. These waterfowl feed on the shoalgrass and Widgeongrass of the Wetlands and on the benthic organisms associated with it. Also, large populations of shore and wading birds utilize the area extensively for nesting, feeding, and resting. The diversity and abundance of the specific foods now existing in the area Would be reduced. Select vegetational planting of productive foods for Wildlife could be established on the modified lands. This may alter the numbers and kinds of birds that populate the immediate area and would promote other bird populations and furnish different functionary uses for current wildlife populations.

4.155 Construction and operation of the proposed project Would also affect the wildlife resources of the area. Noise associated with dredging and facility construction would cause some forms of wildlife to temporarily leave the area for adjacent areas. Once construction ceased, some wildlife would return, and the vegetated disposal dikes would provide noise and visual shields around much of the tank farm and docking facilities.

4.156 The changes that would result from industrial and urban developments associated with the project activities would adversely affect wildlife populations. However, projected locations of new industrial and urban complexes indicate that the land that would be utilized for new development and expansion is of minimal value to wildlife populations or is currently being used agriculturally. The animals which periodically utilize this land, such as rabbit, deer, quail, dove and others, would be forced to reestablish their range, with a possible ultimate reduction in their total numbers.

4.157 Effects on Rare and Endangered Species. The proposed project should have no direct effect on any rare or endangered species, except possibly the brown pelican. Disposal of dredged material could disturb areas used for feeding by the brown pelican. No areas designated as critical habitat for endangered species are located in the areas to be affected by project construction.

4.158 Gulf Disposal Operations. Materials removed from the entrance and jetty channels by hopper dredge would be discharged in a designated open water disposal area in the Gulf of Mexico. This disposal operation is subject to the Ocean Dumping regulations (40 CFR 220-227) established by the Environmental Protection Agency pursuant to the Marine Protection, Research, and Sanctuaries Act of 1973. Section 227.13 b (1) of these regulations states that dredged material may be excluded from evaluative procedures and considered environmentally acceptable if it is composed essentially of sand and/or gravel, or of any other naturally occurring sedimentary materials with particle sizes larger than silts and clays. Table 38 shows that the materials dredged during previous maintenance dredging of the existing Federal project were essentially sands. Materials from the deepening are clays and sandy clays and cannot be considered acceptable on the basis of grain size analysis alone. However, results of tests on samples recovered from borings made along the entire length of the channel revealed no significant contaminants in the virgin sediments (Table 39). These materials are virgin sediments that have not previously been dredged and have never been exposed to any significant amounts of pollutants. Because of the lack of pollutant sources within a reasonable distance of the offshore dredging site and the relatively high quality of water and sediment throughout the channel, it is concluded that the materials to be disposed of in the Gulf are unpolluted and, therefore, acceptable for ocean disposal. Additional information on the sediments to be dredged is included in Appendix H.

4.159 Part 228 of the Ocean Dumping regulations establishes criteria for the initial selection of ocean disposal sites and for the management of the sites after designation. It also establishes the requirement to evaluate the total

TABLE 38

ARANSAS PASS OUTER BAR AND JETTY CHANNELS
MECHANICAL ANALYSIS OF MATERIALS TO BE
DEPOSITED IN OFFSHORE WATERS 1/

1970 - 1973

Station	% by Dry Weight Sand or Larger	MIL-STD-619B Classification		Date Sampled
180+00	33	Clay, sandy	(CL)	Aug 73
165+00	46	Clay, sandy	(CL)	Aug 73
165+00	41	Clay, sandy	(CL)	Aug 73
155+00	56	Sand, clayey	(SC)	Aug 70
145+00	83	Sand, silty	(SM)	Sep 72
145+00	88	Sand, silty	(SM-SP)	Jun 71
110+00	93	Sand	(SP-SM)	Jan 73
85+00	78	Sand, silty	(SM)	Sep 72
80+00	96	Sand	(SP)	Jan 73
75+00	92	Sand	(SP-SM)	Jun 71
72+50	73	Sand, clayey	(SC)	Aug 70
65+00	95	Sand	(SP-SM)	Jan 73
60+00	98	Sand	(SP)	May 71
56+00	99	Sand	(SP)	Sep 72
55+00	98	Sand	(SP)	Aug 70
50+0o	95	Sand	(SP-SM)	Apr 73
50+00	96	Sand	(SP)	Jun 71
45+00	99	Sand	(SP)	Sep 72
45+00	98	Sand	(SP)	May 71
40+00	96	Sand	(SP)	Apr 73
40+00	97	Sand	(SP)	Sep 72
40+00	99	Sand	(SP)	Sep 72
35+00	98	Sand	(SP)	May 71
35+00	97	Sand	(SP)	Jun 71
30+00	96	Sand	(SP)	Apr 73
28+00	96	Sand	(SP)	Apr 73
26+00	99	Sand	(SP)	Sep 72
25+00	96	Sand	(SP)	May 71
24+00	98	Sand	(SP)	Jan 73
16+00	94	Sand	(SP-SM)	Aug 70
10+00	96	Sand	(SP)	Sep 72

1/ Samples were taken directly from hopper dredge bins and are representative of the materials being dumped during maintenance dredging of existing project

CORPUS CHRISTI SHIP CHANNEL
RESULTS OF TESTS OF BOTTOM SEDIMENT

TABLE 39

Test Results for All Items Reported on Dry Basis, Milligrams per Kilogram

Boring No.	Date Sampled	Depth	Arsenic As	Cadmium Cd	Chromium (Total) Cr	Copper Cu	Lead Pb	Mercury Hg	Nickel Ni	Zinc Zn
76-106	30 Jun 76	3.8 - 20.0	1.4	0.52	3.7	4.2	3.7	< 0.1	4.2	8.1
76-106	30 Jun 76	26.0 - 37.5	1.4	0.24	4.8	16.0	8.6	<0.1	5.7	12.0
76-106	30 Jun 76	37.5 - 48.0	12.0*	0.38	4.4	5.5	5.7	< 0.1	6.1	13.0
76-106	30 Jun 76	48.0 - 68.0	4.1	0.22	4.9	5.6	6.7	< 0.1	4.9	9.6
76-107	15 Jun 76	30.0 - 36.0	5.1*	0.25	9.6	11.0	14.0	< 0.1	10.0	22.0
76-107	15 Jun 76	36.0 - 41.0	1.9	0.69	3.4	5.7	7.8	<0.1	6.4	7.3
76-107	15 Jun 76	45.0 - 62.0	1.1	0.22	5.2	3.8	4.9	<0.1	3.6	8.3
76-107	15 Jun 76	62.0 - 70.0	13.0*	0.47	13.0	5.9	16.0	<0.1	16.0	29.0
76-108	24 Jul 76	11.2 - 28.0	2.0	0.25	2.7	2.5	4.0	<0.1	3.5	9.0
76-108	24 Jul 76	28.0 - 37.5	2.5	1.1	4.4	6.2	8.4	<0.1	7.0	4.4
76-108	24 Jul 76	55.0 - 62.5	3.0	0.22	4.8	5.7	8.3	<0.1	5.3	10.0
76-108	24 Jul 76	62.5 - 75.0	2.9	0.25	9.2	7.5	6.5	<0.1	8.0	18.0
76-109	1 Jul 76	2.2 - 10.0	2.7	0.49	5.4	6.9	5.9	<0.1	6.9	13.0
76-109	1 Jul 76	10.0 - 31.0	1.2	0.21	4.2	4.2	4.2	<0.1	4.2	7.8
76-109	1 Jul 76	41.0 - 61.0	8.2*	1.1	7.6	6.7	12.0	<0.1	10.0	17.0
76-109	1 Jul 76	61.0 - 81.0	2.2	0.64	4.9	15.0	10.0	<0.1	7.3	11.0
76-172	25 Sep 76	48.5 - 49.0	<1.0	<0.5	3.0	2.0	<5.0	<0.1	6.0	19.0
76-172	25 Sep 76	54.0 - 57.0	3.5	<0.5	<3.0	3.0	<5.0	<0.1	5.0	20.0
76-172	25 Sep 76	65.0 - 67.0	6.4*	<0.5	14.0	15.0	15.0	<0.1	17.0	61.0
76-173	25 Sep 76	42.0 - 42.5	1.7	<0.5	10.0	4.0	5.0	<0.1	5.0	25.0
76-173	25 Sep 76	45.0 - 47.5	12.0*	<0.5	10.0	13.0	10.0	<0.1	20.0	53.0
76-173	25 Sep 76	52.5 - 56.0	<1.0	<0.5	<3.0	2.0	<5.0	<0.1	<2.0	6.0
76-173	25 Sep 76	82.0 - 84.0	3.1	<0.5	<3.0	3.0	<5.0	0.1	5.0	14.0
Environmental Protection Agency VI Guidelines for Determining the Acceptability of Dredged Sediments Disposal			5.0	2.0	100	50	50	1.0	50	75

Asterisk "*" indicates average of two or more results that exceed EPA Guidelines.

CORPUS CHRISTI SHIP CHANNEL
RESULTS OF TESTS OF BOTTOM SEDIMENT

TABLE 39

Test Results for All Items Reported on Dry Basis, Milligrams per Kilogram

Boring No.	Date Sampled	Depth	Arsenic As	Cadmium Cd	Chromium (Total) Cr	Copper Cu	Lead Pb	Mercury Hg	Nickel Ni	Zinc Zn
76-174	24 Sep 76	43.5 - 44.0	<1.0	<0.5	5.0	3.0	<5.0	0.1	6.0	21.0
76-174	24 Sep 76	55.0 - 59.0	<1.0	<0.5	10.0	8.0	11.0	0.1	14.0	40.0
76-174	24 Sep 76	70.0 - 72.0	3.1	<0.5	11.0	5.0	10.0	<0.1	10.0	27.0
76-174	24 Sep 76	76.5 - 79.0	<1.0	<0.5	<3.0	2.0	<5.0	<0.1	2.0	11.0
76-174	24 Sep 76	80.0 - 81.0	<1.0	<0.5	5.0	5.0	6.0	<0.1	5.0	11.0
76-175	23 Sep 76	52.5 - 53.0	2.6	<0.5	11.0	6.0	15.0	<0.1	12.0	43.0
76-175	23 Sep 76	55.0 - 65.0	5.2*	<0.5	11.0	10.0	10.0	<0.1	14.0	48.0
76-175	23 Sep 76	68.0 - 73.0	1.7	<0.5	10.0	12.0	10.0	<0.1	14.0	36.0
76-175	23 Sep 76	74.0 - 78.5	5.9*	<0.5	10.0	12.0	12.0	0.1	14.0	42.0
76-176	23 Sep 76	62.5 - 63.0	5.2*	<0.5	19.0	14.0	11.0	<0.1	19.0	64.0
76-176	23 Sep 76	67.5 - 82.5	4.5	<0.5	10.0	7.0	8.0	<0.1	13.0	34.0
Environmental Protection Agency VI Guidelines for Determining the Acceptability of Dredged Sediments Disposal			5.0	2.0	100	50	50	1.0	50	75

Asterisk "*" indicates average of two or more results that exceed EPA Guidelines.

CORPUS CHRISTI SHIP CHANNEL
RESULTS OF TESTS OF BOTTOM SEDIMENT

TABLE 39

Boring No.	Date Sampled	Depth	Moisture Content % Dry Wt	Total Solids % byWt	Total Volatile Solids % by Wt	Test Results for All Items Reported on Dry Basis, Milligrams per Kilogram: Total Kjeldahl Nitrogen	Ammonia Nitrogen	Total Organic Nitrogen	Total Organic Carbon	Oil & Grease	Chemical Oxygen Demand
76-106	30 Jun 76	3.8-20.5	32	76	1.1	120		110		230	3,660
76-106	30 Jun 76	26.0-37.0	22	82	2.0	75		65		< 100	1,910
76-106	30 Jun 76	37.5-48.0	25	80	2.3	50		40		< 100	1,640
76-107	30 Jun 76	48.0-68.0	22	82	2.2	135		50		< 100	2,020
76-107	15 Jun 76	30.0-36.0	33	75	3.1	370		310		< 100	11,800
76-107	15 Jun 76	36.0-41.0	27	79	1.1	90		70		< 100	1,330
76-107	15 Jun 76	45.0-62.0	19	84	1.6	100		90		< 100	1,500
76-108	15 Jun 76	62.0-70.0	25	80	4.9	320		310		< 100	1,390
76-108	24 Jul 76	11.2-28.5	32	76	0.9	970		935		930	1,860
76-108	24 Jul 76	28.0-37.5	27	79	0.7	< 15		< 5		410	1,090
76-108	24 Jul 76	55.0-62.0	22	82	2.0	50		15		450	2,360
76-108	24 Jul 76	62.5-75.0	43	70	2.0	80		70		320	2,070
76-109	1 Jul 76	2.2-10.0	39	72	1.5	300		290		730	10,900
76-109	1 Jul 76	10.0-31.0	32	76	1.1	180		155		620	4,700
76-109	1 Jul 76	41.0-61.0	28	78	4.3	470		445		340	2,420
76-109	1 Jul 76	61.0-81.0	25	80	2.9	110		100		610	1,410
76-172	25 Sep 76	48.5-49.0	24	76	1.6	259		246		205	4,180
Environmental Protection Agency VI Guidelines for Determining the Acceptability of Dredged Sediments Disposal					8.0	1,000					50,000

CORPUS CHRISTI SHIP CHANNEL

RESULTS OF TESTS OF BOTTOM SEDIMENT

TABLE 39

Boring No.	Date Sampled	Depth	Moisture Content %Dry Wt	Total Solids %by Wt	Total Volatile Solids % by Wt	Test Results for All Items Reported on Dry Basis, Milligrams per Kilogram					
						Total Kjeldahl Nitrogen	Ammonia Nitrogen	Total Organic Nitrogen	Total Organic Carbon	Oil & Grease	Chemical Oxygen Demand
76-172	25 Sep 76	54.0-57.0	21	79	4.5	65		62		130	408
76-172	25 Sep 76	65.0-67.0	26	74	6.6	227		222		195	1,880
76-173	25 Sep 76	42.0-42.5	28	72	2.1	374		354		235	8,780
76-173	25 Sep 76	45.0-47.5	26	74	4.3	195		190		115	960
76-173	25 Sep 76	52.5-56.0	21	79	0.5	34		32		270	160
76-173	25 Sep 76	82.0-84.0	18	82	0.8	24		22		250	1,210
76-174	24 Sep 76	43.5-44.0	24	76	1.9	256		244		270	2,810
76-174	24 Sep 76	55.0-59.0	32	68	3.8	474		465		260	14,300
76-174	24 Sep 76	70.0-72.0	31	69	2.9	221		214		400	9,000
76-174	24 Sep 76	76.5-79.0	21	79	1.5	34		33		210	1,630
76-174	24 Sep 76	80.0-81.0	17	83	1.4	188		180		155	568
76-175	23 Sep 76	52.5-53.0	39	61	3.4	750		740		370	12,700
76-175	23 Sep 76	55.0-65.0	37	63	4.6	365		358		95	22,200
76-175	23 Sep 76	68.0-73.0	25	75	1.9	217		213		250	8,580
76-175	23 Sep 76	74.0-78.5	24	76	3.9	257		252		30	9,910
76-176	23 Sep 76	62.5-63.0	53	47	6.6	709		687		85	22,100
76-176	23 Sep 76	67.5-82.5	29	71	1.3	237		226		210	9,190
Environmental Protection Agency VI Guidelines for Determining the Acceptability of Dredged Sediments Disposal					8.0	1,000					50,000

stress on the marine environment at the disposal site. The regulation states that disposal site selection will be based on historic uses of the site and on historic knowledge of the impact of disposal in areas similar in physical, chemical, and biological characteristics. The proposed Gulf disposal area F-G is fundamentally the same area used for maintenance of the existing Federal project except that it would have to be substantially enlarged. Disposal area H, however, has never previously been used for disposal. Data from offshore disposal areas used for maintenance dredging of the Sabine Neches Waterway, Galveston Channel, and Freeport Harbor have shown no significant adverse impacts on biological communities. The Chief, Marine Protection Branch, Environmental Protection Agency has been furnished information concerning ocean disposal site designation. Pertinent correspondence on the site designation request is included as Appendix H. Appendix H also includes an assessment of the proposed offshore disposal sites.

4.160 Effects on Population. Population estimates prepared by the Coastal Bend Council of Governments (CBCOG) show that growth will occur throughout the area but will center in Corpus Christi, the Rockport-Live Oak Penninsula, and in Portland. During the 34-month construction period about 4,134 construction related jobs would be required. Of these jobs about 1451 would be within the study area. Estimates of indirect and induced jobs due to construction are estimated to be as high as 4,642 jobs by the Texas Department of Water Resources.

4.161 Assuming an average household size of 3.0 the construction-related population would be 4,353 people. It is anticipated that about 60-80% of these families would already live in the study area and that 20-40% would move into the area from other cities.

4.162 Other secondary impacts during the construction phase would be in the area of housing and community services for the estimated 900-1800 families moving into the area.

4.163 Operation of the deep water port would generate long-term gains in employment at the marine facilities and at refineries both in and out of the study area. Gains in employment (jobs) were estimated to range from 2000-4000 for the study area based upon varying throughput schedules for refineries (Texas Department for Water Resources, Appendix I.) The population growth estimated for the Rockport-Live

Oak Peninsula and Corpus Christi areas is expected to be 33,181 people between 1977 and 1982 (CBCOG, 1977). Induced growth by the project is estimated to be between 15% and 30% of the estimated or manned growth and does not appear to be a significant effect.

4.164 Effects on the Economy of the Area. Development of port facilities at Harbor Island would stimulate economic activity in the study area due to construction expenditures (short-term) and contribute to an increase in petroleum refining activities. Cost savings would also be realized by refiners from shipping imported oil in larger vessels. The construction phase, lasting over 34 months, is expected to cost $430 million (Table 1.) The project would require 5,477 man years of labor at a direct annual gain of 1451 jobs. About $260 million would be spent in the study area, $92 million spent in other areas of Texas, $79 million spent in the rest of the nation during construction. Household incomes (direct, indirect and induced) are estimated at $107 million for the study area and $85 million for the rest of Texas. The primary and secondary impacts of a deepwater port development on Harbor Island would have a strong positive influence on the local economy and contribute to a diversified economy with a broad industrial base.

4.165 The impact resulting from actual construction of the facility is a short-run benefit to the economy of the region, state, and nation that occurs only during the estimated 34-month construction period. The long-term economic benefit would come from the ability of the refining industry to increase its production and assist in supplying national energy markets. To meet the anticipated demand over the next 15 years American refineries will necessarily process imported oil shipped in larger tankers to realize cost savings.

4.166 Approximately 166 million barrels of foreign oil at a value of $1.8 billion (1977 dollars) flows through the port of Corpus Christi.

4.167 Effects of varying throughput schedules without the project and with low, medium, and high throughputs was prepared by Exxon, Incorporated for the TWRD. Future imported crude throughputs in local refineries is estimated to be 200.75 million barrels annually in 1980 and to increase to 262.8 million barrels by 1990 without the proposed Harbor Island facility. Low range estimates with the proposed facility for 1980 and 1990 are 251.85 and 317.55 million barrels annually, respectively. High throughput estimates as a result of the project could be 438.0 and 912.5 million barrels annually in 1980 and 1990, respectively. Increases due to the project range from a low of 51.1 million barrels annually in 1980 (low estimate) to a high of 649.7 million barrels annually in 1990.

4.168 Increased refining production would mean an increase in the value of refinery output to about $2.2 million by 1980. The current capacity of area refiners is approximately 200 million barrels per year. The Harbor Island project would increase refinery expansion significantly above present expansions planned for completion in 1982. Value of refinery output is projected to reach $2.87 billion by 1990 without the project.

4.169 The low-case project-related refinery output is estimated at $2.8 billion by 1980 and $3.5 billion by 1990. There would be a net gain of 1119 additional project-related jobs and a total of 5,512 jobs generated in the region. This is the lowest effect the project would be expected to have.

4.170 If rapid expansion occurs in Harbor Island facilities, the throughput could reach an estimated 2.5 mb/day by 1990. Refining capacity could reach four times the present level, resulting in employment of over 10,000 in the refining sector and an additional 9,000 employees in other sectors of the regional economy. The total economic output would be $7.9 billion larger than the output without the facility.

4.171 Effects on Land Use. Projected land use was determined for each community (by CBCOG) in the "208 planning area" portion of the three county study area. Population changes and projections of the economic growth in the study area formed the foundation for predicting land use changes. Residential and commercial use is projected to expand through 1995 within the cities in the study area. Agricultural lands are expected to provide expansion capability for growing cities in the area. Industrial areas are projected to increase from 9,700 acres to 13,600 acres between 1977 and 1995. Growth in residential . commercial, and industrial lands are expected to occur around existing urban centers without the creation of new cities.

4.172 Industrial facilities (petroleum tank farm and marine facilities) exist on the southeast portion of Harbor Island across the Corpus Christi Ship Channel from Port Aransas. Project construction plans indicate a widening and deepening of the existing Aransas Pass Channel, relocation of the channel to the northeast. A 377 acre increase in industrial lands on the northeast edge of the Aransas Pass ship channel would present by the project. Related to projected changes in land use prepared by Coastal Bend COG in cooperation with cities in the 208 planning region, this represents approximately 10% of the increase in industrial land use predicted to occur by 1995. According to the Coastal Bend COG the majority of industrial development is anticipated to occur in the Corpus Christi area. Smaller increases are anticipated for Ingleside and Port Aransas.

4.173 Dredged material disposal is planned for San Jose Island and existing disposal areas along the Corpus Christi Ship Channel immediately west of Port Aransas. Secondary long-term effects of disposal are the creation of uplands which can be developed into residential, commercial, recreational or industrial sites. The extent or type of development on these disposal areas cannot be determined at this time. Project-related impacts by dredge material disposal areas, and docking basin and habitat type are shown in Table 39.

4.174 Effects on Recreation. The project area receives heavy recreational use thoroughout the year. Recreational activities in the area include fishing, swimming, surfing, picknicking, camping, and bird watching. Most of these activities should not be significantly affected by the project. Construction activities in the port area of Harbor Island could temporarily displace some mammals and birds. Dredge material disposal on inland areas could also displace temporarily some bird species. Bird watching would be affected to some degree by these construction activities. Fishing is heavy during seasonal runs of flounder, spotted sea trout, red and black drum. Annual channel maintenance as well as construction-related dredging and disposal which would increase turbidity could reduce the sport fish catch in the immediate vicinity of the dredge. Recreational boating in the project area may be affected during the 34 month construction phase. Boating may also be affected during those hours every 2-3 days when the VLCC is moving between the channel and the dock. During construction, dredge pipelines may interfere with recreational boating.

Maneuvering of the VLCC's in the channel may produce localized waves or currents hazardous to small boat operation.

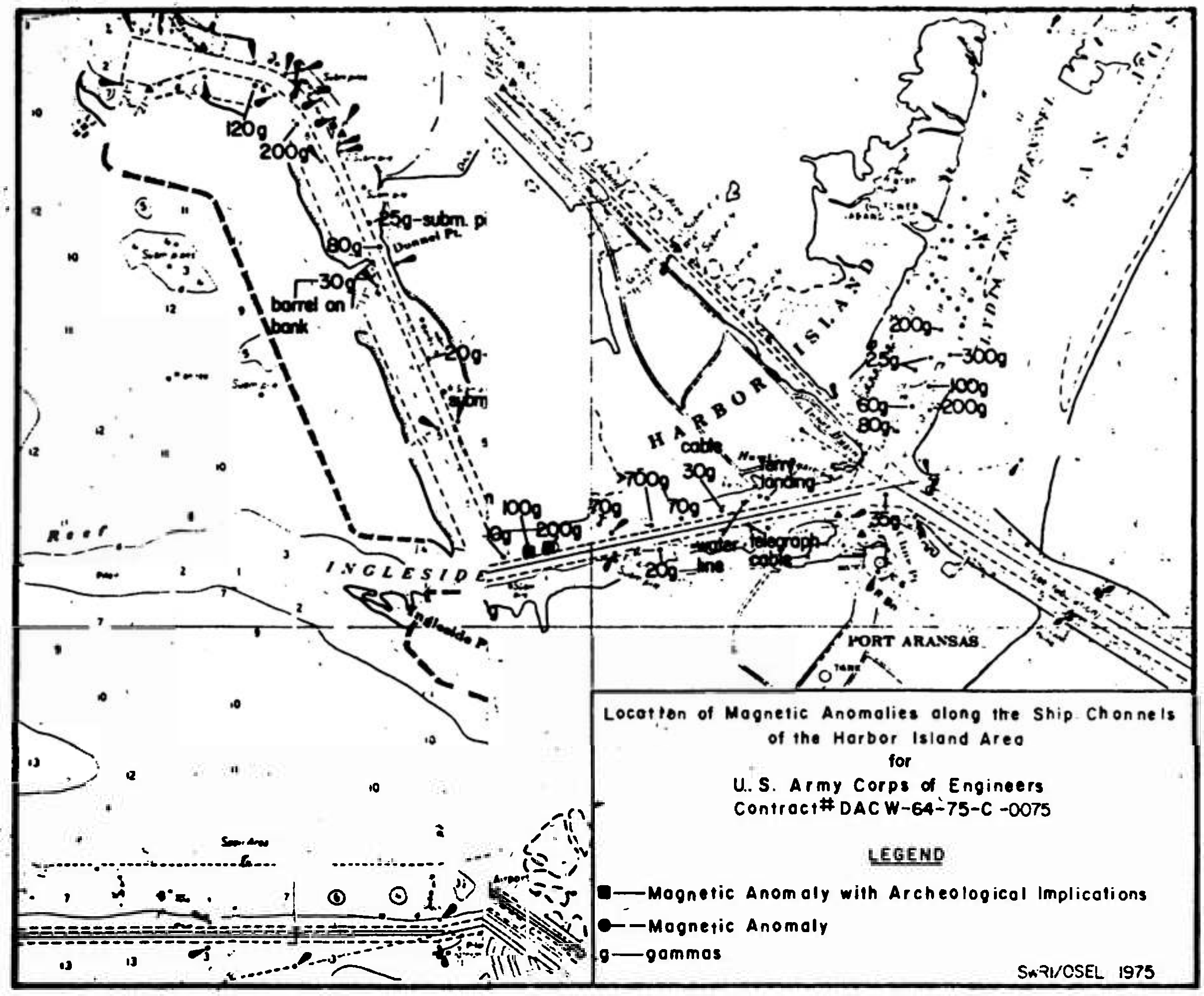
4.175 The proposed work should have no direct or indirect adverse effects on recreational use of the Federal or State recreational and wildlife management areas in the project vicinity. Demand for recreational activity is expected to increase over 1970 levels by 260% in Aransas County, 378% in Nueces County and 135% in San Patricio County.

4.176 Recreational use of shoreline areas may be affected by oil spills. Navigation and safety operations proposed as part of the project mitigation measures are aimed at reducing the potential for any oil spills. Equipment as well as a contingency plan required by the U.S. Coast Guard at the facility are geared to immediate response for any size leakage or spill. Project design also includes a control tower (similar to an airport control tower) for positive visual control of VLCC's.

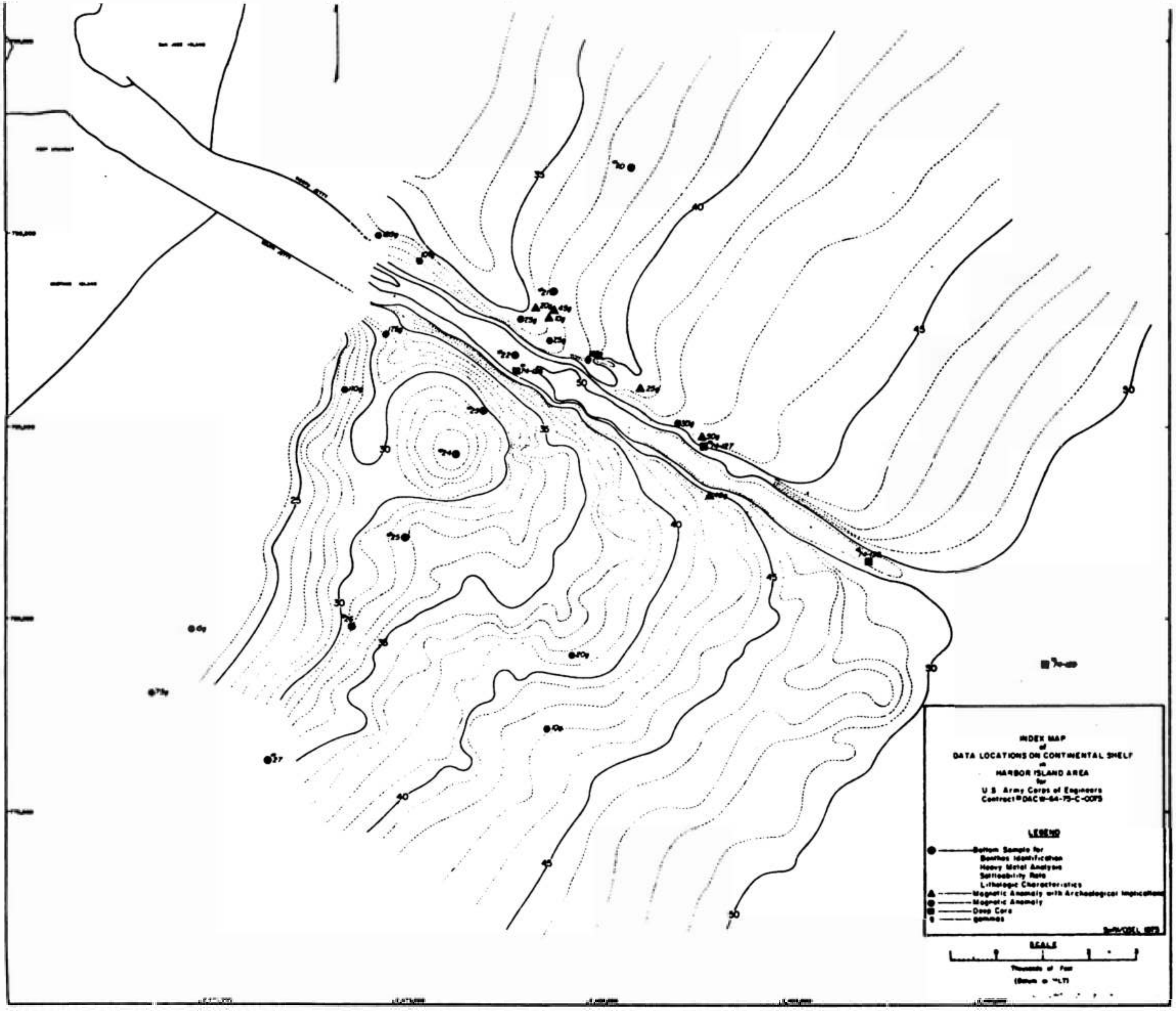
4.177 Effects on Archeological and Historical Resources. A search of the National Register of Historic Places indicates that there are three National Historic Places in the project area. They are the Mathis House in Rockport in Aransas County, the King Ranch in Nueces and Kennedy Counties, and McGloin Homestead in San Patricio County. These areas will not be affected by the project. In February 1977, Mr. F. R. Hollard Jr. nominated the Aransas Pass Light Station for inclusion in the National Register of Historic Places. The lighthouse is approximately one mile from the proposed project facility and should not be affected.

4.178 An evaluation of archeological resources in the area of the proposed project conducted by Thomas R. Hester was performed for Southwest Research Institute. Results of that evaluation showed that the proposed channel modifications would not have any direct impact on archeological resources the project areas. The report recommended that an archeologist be present whenever widening cuts are made into major islands or the mainland since it is possible that some buried and previously unknown resources could be discovered.

4.179 An archeological survey of the Tributary Channel to Aransas Pass, Texas conducted by Kenyon L. McDonald of the University of Texas at San Antonio, Center for Archeological Research, included an appraisal of archeological and



ATION OF MAGNETIC ANOMALIES ALONG THE CHANNELS OF THE HARBOR ISLAND AREA



DATA LOCATIONS ON CONTINENTAL SHELF IN HARBOR ISLAND AREA
Figure 43.

TABLE 40

COMPARISON OF PROJECTED AND SUPPORTABLE POPULATIONS WITH RESPECT TO AVAILABLE FRESHWATER

Year	Projected Total Population	Predicted* Supportable Population (thousands)
1980	308,000	520-780
1985	320,000	520-780
1990	355,000	500-750
2000	534,000	440-700
2010	671,000	430-690
2030	713,000	400-630

*Assuming percent population in manufacturing as shown, and completion of Choke Canyon Reservoir.

Source: SwRI 1976.

historical resources of the area to be affected by the proposed action. McDonald's report included a review of the archeology in the project area and six specific survey sites which are to be utilized as disposal areas for the tributary Channel to Aransas Pass. Results of the survey revealed no surficial evidence of aboriginal or historical remains. The report recommended that if during the course of channel modification, any articles that may be of archeological significance are seen in the dredged material, work should be stopped and qualified archeologists consulted. The report also noted that particular care should be taken in modifying North Harbor Island because this locality may be the least disturbed of all the survey areas and may possibly hold buried archeological resources.

4.180 Southwest Research Institute, under contract with the Corps of Engineers, conducted magnetometer surveys of the inshore area to be affected by the Harbor Island project. The survey results show no significant magnetic anomalies in the inshore area which could have archeological implications Figure 42. Several significant anomalies were located outside the area to be affected by construction of the project. SWRI also conducted magnetometer surveys in the offshore area and found no magnetic anomalies with archeological implications in the area to be affected by the project Figure 43.

4.181 Demands on Water Resources. Southwest Research Institute developed a water resource planning model for forecasting future water demands in the Corpus Christi area as a result of the proposed project. The results of the application of the water resource planning model showed a range of supportable populations of approximately 400,000 to 630,000. This is lower than the projected population of 713,000 in the year 2030. The chronology of growth was examined in order to determine when the water demand would exceed the planned water resource. Table 40 provides the total population, the manufacturing population, and the corresponding supportable populations. The incompatibility of water resource demand and supply observed could begin as early as the years between 1990 and 2000 if the worst demand/conservation situation occurs. Figure 44 provides a comparison of forecast water demands with existing governmental water plans for the Corpus Christi area. It can be concluded that the prediction of water demands is consistent with the projections of other governmental plans, that is, additional water supplies beyond the Choke Canyon Project will be required.