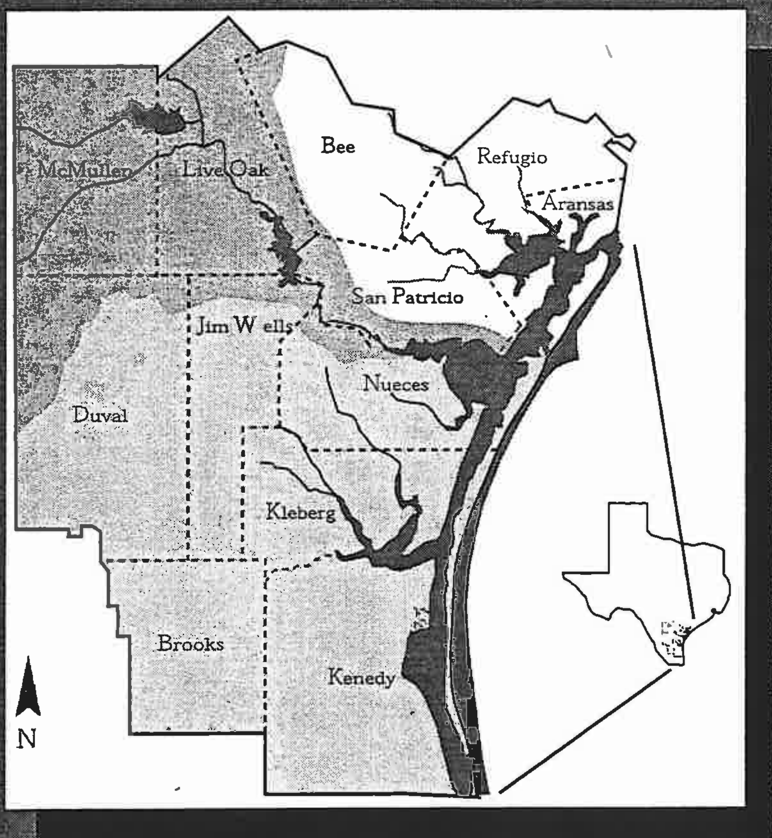
Ambient Water, Sediment, and Tissue Quality of the Corpus Christi Bay Study Area: Present Status and Historical Trends



Corpus Christi Bay National Estuary Program

CCBNEP-23 • November 1997

Ambient Water, Sediment, and Tissue Quality of the Corpus Christi Bay Study Area

Present Status and Historical Trends

Principal Investigators:

George H. Ward, Ph.D.
Neal E. Armstrong, Ph.D., P.E.. DEE

Center for Research in Water Resources
The University of Texas at Austin

Publication CCBNEP - 23
November 1997

Policy Committee

Commissioner John Baker
Policy Committee Chair
Texas Natural Resource Conservation Commission

Mr. Jerry Clifford
Policy Committee Vice-Chair
Acting Regional Administrator, EPA Region 6

The Honorable Vilma Luna
State Representative

Commissioner Ray Clymer
Texas Parks and Wildlife Department

The Honorable Carlos Truan
Texas Senator

Commissioner Garry Mauro
Texas General Land Office

The Honorable Josephine Miller
County Judge, San Patricio County

Commissioner Noe Fernandez
Texas Water Development Board

The Honorable Loyd Neal
Mayor, City of Corpus Christi

Mr. Ray Allen
Coastal Citizen

Mr. Bernard Paulson
Coastal Citizen

Management Committee

Mr. Ray Allen, Co-Chair
Mr. Bob Wallace, Co-Chair

Local Governments Advisory Committee

Commissioner Gordon Porter, Chair
Mr. James Dodson, Vice-Chair

Scientific/Technical Advisory Committee

Dr. Terry Whitledge, Chair
Dr. Wes Tunnell, Vice-Chair

Citizens Advisory Committee

Mr. Robert Corrigan, Chair
Mr. Jay Reining, Vice-Chair

Financial Planning Advisory Committee

Dr. Joe Moseley, Chair

Program Director

Mr. Richard Volk

Natural Resources Center, Suite 3300, TAMU-CC • 6300 Ocean Drive • Corpus Christi, TX 78412
512/980-3420 • FAX 512/980-3437 • CCBNEP home page: //www.sci.tamucc.edu/ccbnep

TNRCC

Published and distributed
by the
Texas Natural Resource Conservation Commission
Post Office Box 13087
Austin, Texas 78711-3087

CORPUS CHRISTI BAY NATIONAL ESTUARY PROGRAM

The Corpus Christi Bay National Estuary Program (CCBNEP) is a four-year, community based effort to identify the problems facing the bays and estuaries of the Coastal Bend, and to develop a long-range, Comprehensive Conservation and Management Plan. The Program's fundamental purpose is to protect, restore, or enhance the quality of water, sediments, and living resources found within the 600 square mile estuarine portion of the study area.

The Coastal Bend bay system is one of 28 estuaries that have been designated as an **Estuary of National Significance** under a program established by the United States Congress through the Water Quality Act of 1987. This bay system was so designated in 1992 because of its benefits to Texas and the nation. For example:

- Corpus Christi Bay is the gateway to the nation's sixth largest port, and home to the third largest refinery and petrochemical complex. The Port generates over $1 billion of revenue for related businesses, more than $60 million in state and local taxes, and more than 31,000 jobs for Coastal Bend residents.
- The bays and estuaries are famous for their recreational and commercial fisheries production. A study by Texas Agricultural Experiment Station in 1987 found that these industries, along with other recreational activities, contributed nearly $760 million to the local economy, with a statewide impact of $1.3 billion, that year.
- Of the approximately 100 estuaries around the nation, the Coastal Bend ranks fourth in agricultural acreage. Row crops -- cotton, sorghum, and corn -- and livestock generated $480 million in 1994 with a statewide economic impact of $1.6 billion.
- There are over 2600 documented species of plants and animals in the Coastal Bend, including several species that are classified as endangered or threatened. Over 400 bird species live in or pass through the region every year, making the Coastal Bend one of the premier bird watching spots in the world.

The CCBNEP is gathering new and historical data to understand environmental status and trends in the bay ecosystem, determine sources of pollution, causes of habitat declines and risks to human health, and to identify specific management actions to be implemented over the course of several years. The 'priority issues' under investigation include:

- altered freshwater inflow
- declines in living resources
- loss of wetlands and other habitats
- bay debris
- degradation of water quality
- altered estuarine circulation
- selected public health issues

The **COASTAL BEND BAYS PLAN** that will result from these efforts will be the beginning of a well-coordinated and goal-directed future for this regional resource.

STUDY AREA DESCRIPTION

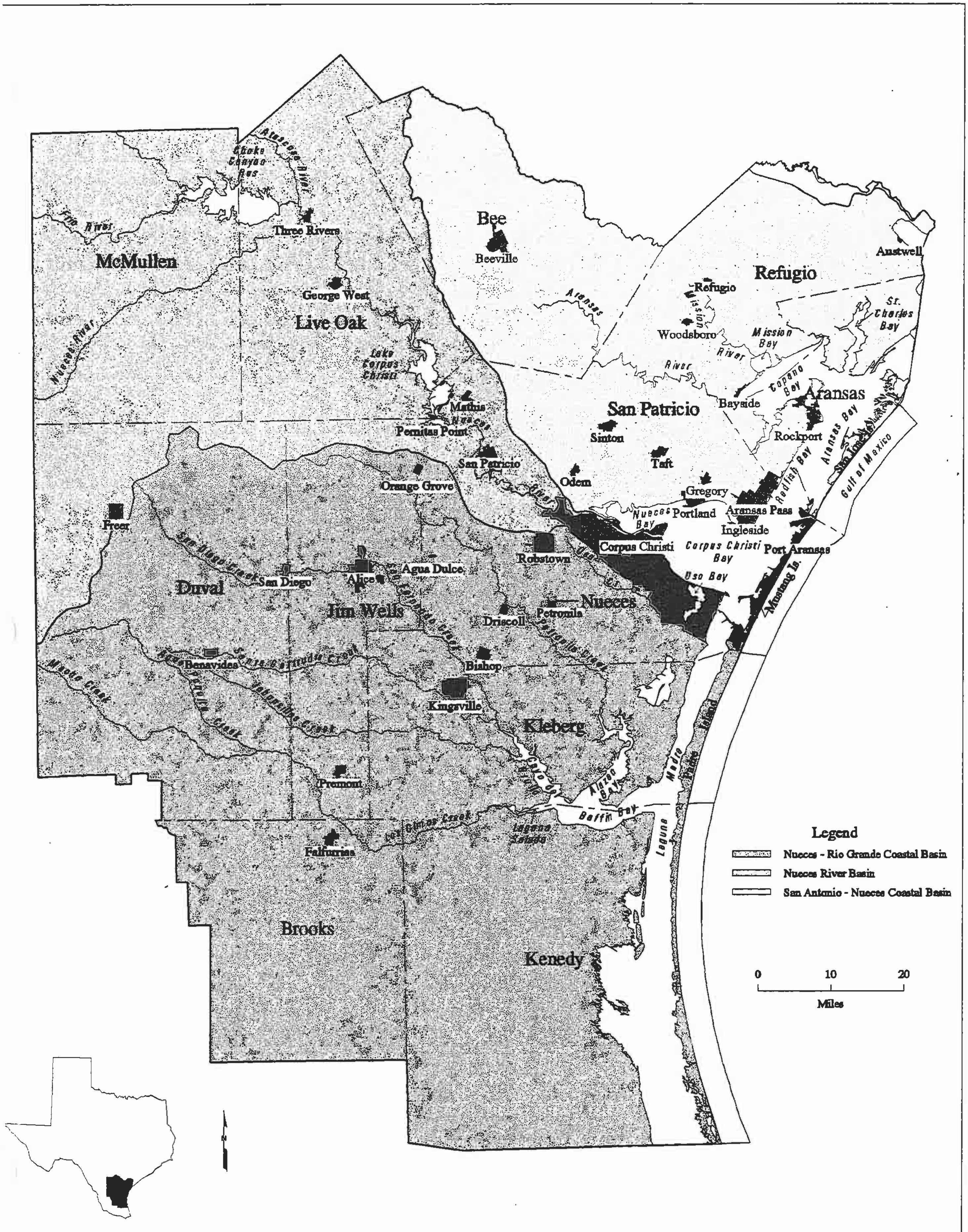
The CCBNEP study area includes three of the seven major estuary systems of the Texas Gulf Coast. These estuaries, the Aransas, Corpus Christi, and Upper Laguna Madre are shallow and biologically productive. Although connected, the estuaries are biogeographically distinct and increase in salinity from north to south. The Laguna Madre is unusual in being only one of three hypersaline lagoon systems in the world. The study area is bounded on its eastern edge by a series of barrier islands, including the world's longest -- Padre Island.

Recognizing that successful management of coastal waters requires an ecosystems approach and careful consideration of all sources of pollutants, the CCBNEP study area includes the 12 counties of the Coastal Bend: Refugio, Aransas, Nueces, San Patricio, Kleberg, Kenedy, Bee, Live Oak, McMullen, Duval, Jim Wells, and Brooks.

This region is part of the Gulf Coast and South Texas Plain, which are characterized by gently sloping plains. Soils are generally clay to sandy loams. There are three major rivers (Aransas, Mission, and Nueces), few natural lakes, and two reservoirs (Lake Corpus Christi and Choke Canyon Reservoir) in the region. The natural vegetation is a mixture of coastal prairie and mesquite chaparral savanna. Land use is largely devoted to rangeland (61%), with cropland and pastureland (27%) and other mixed uses (12%).

The region is semi-arid with a subtropical climate (average annual rainfall varies from 25 to 38 inches, and is highly variable from year to year). Summers are hot and humid, while winters are generally mild with occasional freezes. Hurricanes and tropical storms periodically affect the region.

On the following page is a regional map showing the three bay systems that comprise the CCBNEP study area.



Corpus Christi Bay National Estuary Program Study Area

WATER, SEDIMENT & TISSUE DATA BASES FOR THE CORPUS CHRISTI BAY NATIONAL ESTUARY PROGRAM

Data Report

Principal Investigators:

George H. Ward
Neal E. Armstrong

Center for Research in Water Resources
The University of Texas at Austin

Compiled as part of the Status & Trends in Water & Sediment Quality project, see:
Current status and historical trends of ambient water, sediment, fish and shellfish tissue quality in the CCBNEP study area, by
George H. Ward and Neal E. Armstrong, Report CCBNEP-13,
Texas Natural Resource Conservation Commission, March 1997.

Corpus Christi Bay National Estuary Program
CCBNEP-23A
January 1998

DATA BASES FOR CORPUS CHRISTI BAY

Principal Investigators:

George H. Ward
Neal E. Armstrong
Center for Research in Water Resources
The University of Texas at Austin

EXECUTIVE SUMMARY

For many years, data on the physico-chemical quality of water and sediment have been collected in the Corpus Christi Bay system by a variety of organizations and individuals. The purpose of this project was to compile these data, and to perform a quantitative assessment of water and sediment quality of Corpus Christi Bay and its evolution over time. Tissue quality was included as well in the project scope. The technical results of the project have been presented in the project final report, Ward and Armstrong (1997). The purpose of this report is to document the various sources of data that were acquired and compiled for the study, and to serve as a user's guide to the data base itself (which is transmitted in digital format to the CCBNEP office for further dissemination),

The digital data base compiled in this project is composed of water-quality, sediment-quality and tissue-quality data from 30 data collection programs performed in the Corpus Christi Bay system. This compilation included data from the three most important ongoing monitoring programs in Corpus Christi Bay: the Texas Natural Resource Conservation Commission (TNRCC) Statewide Monitoring Network, the Texas Parks and Wildlife Department (TPWD) hydrographic observations from its Coastal Fisheries program, and the hydrographic and biochemical data of the Texas Department of Health Seafood Safety Division program. The important surveys and research projects sponsored by the Texas Water Development Board (TWDB) and maintained in its digitized Coastal Data System are included. Several recent federal data-collection projects are represented, namely those of the U.S. Corps of Engineers (USCE) Galveston District, Environmental Protection Agency (EPA), National Ocean Service, and U.S. Fish & Wildlife Service. Each data source is described independently, including agency information and citations. Any problems encountered with the data, and how those problems were reconciled for addition of the data to the data base are detailed.

This compilation also entailed keyboarding of other major data sets, many of which exist in limited hardcopy and are virtually unobtainable, including the U.S. Corps of Engineers Galveston District water and sediment surveys of the 1970's, data of the Texas Game Fish & Oyster Commission from the 1960's, the Reynolds-sponsored "baseline" surveys of the early 1950's, the Submerged Lands Project of the Bureau of Economic Geology, and the data collections by the now-defunct Ocean Science and Engineering Laboratory of Southwest Research

Institute. Other entries in this compilation include research projects whose data are published only in limited technical reports or academic theses, all of which were keyboarded. A major data compilation effort of the project was devoted to determination of latitude/longitude coordinates based upon historical sampling station location information, so that all of the data could be unambiguously georeferenced. In addition to supporting the spatial-distribution analyses of this study, this georeferencing data will facilitate future incorporation of the data base into geographical information systems.

All told, the digital compilation is the most extensive and detailed long-term record of water and sediment quality ever assembled for Corpus Christi Bay. The study area for this compilation and analysis extends from the landbridge of the Laguna Madre to the southern limit of San Antonio Bay, and includes Baffin Bay, Corpus Christi Bay proper, the Aransas-Copano system, and Mesquite/Ayres Bay. We refer to Aransas, Copano and their secondary systems (including Mesquite) as the upper bays, and to Baffin Bay and the Upper Laguna Madre as the lower bays. The entire CCBNEP study area is referred to as the Costal Bend bays, or as the Corpus Christi Bay "system," to differentiate it from Corpus Christi Bay proper, unless it is clear in context that the CCBNEP study area is intended (such as the first sentence of this paragraph).

The complete data base approaches half a million independent records of which water:sediment:tissue are in the approximate ratios 100:10:2, and about 43% of the water-phase data are the "field" parameters temperature/salinity/pH/dissolved oxygen. Each measurement record includes the date, sample depth, latitude and longitude of the sample station, measured variable, estimated uncertainty of measurement expressed as a standard deviation, and a project code identifying the origin of the data. (For tissue data, the sample depth field is replaced by a code identifying the organism.)

The extant period of record for Corpus Christi Bay, with adequate continuity for trends analysis, extends back only to about 1965, except for some traditional parameters and for certain areas of the bay, for which the record can be extended back to the 1950's. As salinity and temperature are the most easily measured variables, they represent the densest and longest data record. For metals and for complex organics, the period of record may extend back only a decade or so. Many of these measurements are below detection limits. For sediment, the data base is even more limited, amounting to one sample per 50 square miles per year, and extending back in time at most to the 1970's.

Considering the effort required to obtain, digitize and compile the tissue data for the CCBNEP study area, this component of the data base is disappointing, and probably was not worth the effort. Pooling and analysis of the data are hampered by the noncomparable attributes of organism sampled, portion of organism analyzed (whole versus edible portions), and reporting convention (wet-weight versus dry-weight), in addition to the usual discriminants of analyte and geographical position. The most-sampled organism is the American oyster, with most samples from Nueces and Aransas Bays, followed by the blue crab, speckled trout, red drum and black drum. There is one sample each of brown shrimp and white shrimp. By far, the greatest quantity of analyses have been performed for the metals. The data base of *detected* PAH's and related hydrocarbons is negligible. For only a few, such as pyrene, have there been detects logged in the data.

TABLE OF CONTENTS

(continued)

TABLE OF CONTENTS
(continued)

LIST OF TABLES

(continued)

LIST OF TABLES
(continued)

LIST OF FIGURES

1. INTRODUCTION

For many years, data relating to the quality of water and sediment have been collected in the Coastal Bend Bays by a variety of organizations and individuals. The objectives of data collection have been equally varied, including the movement and properties of water, the biology of the bay, waste discharges and their impacts, navigation, geology and coastal processes, and fisheries. Some of this information dates back more than a century. While the specific purposes of the individual data collection projects have limited each project in time and space, the data have great potential value to the Corpus Christi Bay National Estuary Program (CCBNEP) if they can be combined into a comprehensive data base yielding a historical depiction of the quality of the bay environment.

This project, Status and Trends in Water, Sediment, and Tissue Quality, was undertaken to compile and evaluate these data, and to employ these data in a quantitative assessment of water and sediment quality of Corpus Christi Bay and its evolution over time. The key objectives for the project were threefold, *viz.*:

(1) compilation of a comprehensive data base in machine-manipulable format,

(2) analysis of time and space variation (including "trends") in quality parameters,

(3) identification of causal mechanisms to explicate the observed variations.

The purpose of the present report is to document the first objective, the compilation of a machine-readable data base of water/sediment quality measurements from the Coastal Bend Bays. Reference is made to the project final report, Ward and Armstrong (1997), for details concerning the overall project prosecution and the analysis of the data.

The present report is intended as formal documentation of the source and format of the different data sets. In the course of this project, several major data sets which had been heretofore lost have now been recovered. For practical purposes, the digital data base accompanying this report represents the only remaining record of many major historical surveys. ("Practical" in the sense that it is unlikely that such a data recovery effort will be repeated in the near future, and when—or if—it is, many of the primary data sources will have forever vanished.)

This document addresses the data base itself, documenting the sources for the data, formatting of the data, field methodology where relevant, and quality of the data. This report should function as a Users Guide to the data base, to form the foundation for use of the data base by other researchers. While frequent reference is made to details in the project report, and the extended report and its appendices (Ward and Armstrong, 1997) and to source documents for the various data sets, this report is designed to be self-contained insofar as the use and interpretation of the data are concerned.

2. PARAMETERS

Specific variables addressed in this study are summarized by class in Table 2-1. Several of these, e.g., "priority pollutants," in fact are classes of variables. The project report (Ward and Armstrong, 1997) includes maps of sample density by parameter for the Coastal Bend Bay system. It is immediately apparent that the extent of data available is highly variable from parameter to parameter, and from one bay to another. Many parameters sought in this study are absent from the present data compilation because no data exist for Corpus Christi Bay. Very few measurements have been made in the Corpus Christi Bay system of most of the EPA priority pollutants. In some instances, there may be a scattering of measurements, but not enough to use in any meaningful way in a status-and-trends analysis. For example, most of the individual polycyclic aromatic hydrocarbons (PAH) were represented only by a handful of data. Even for those parameters for which there is at least a minimum analyzable data base, and which are therefore included in the data base, most of those measurements prove to be below detection limits.

TABLE 2-1
Water/sediment quality parameters addressed in project

Nutrients (organic and inorganic carbon, phosphorus and nitrogen)
Heavy metals (total and dissolved)
Pesticides, herbicides and priority pollutants
Chlorophyll-a and pheophytin
pH
Salinity/Conductivity/TDS
Turbidity/TSS
Dissolved oxygen
Fecal coliforms
Temperature
Biochemical Oxygen Demand
Oil & Grease
Volatile Solids
Grain size (for sediments)
Secchi depth
Chlorides
Total coliforms

2.1 Proxy Variables

In estuarine water quality, there are several classes of parameters that measure (or can be interpreted to measure) the same essential property. For example, salinity can be estimated from measurements of: chlorides concentration, total dissolved solids, density, conductivity, and light refraction. Different data collection programs in the CCBNEP system may employ different measures, depending upon objective, convenience and tradition.

From an analytical viewpoint, the use of one parameter may have conceptual advantages over another, e.g. DO deficit may be more indicative of oxygen conditions than the concentration of dissolved oxygen itself. More importantly, while related parameters are technically distinct, the fact that they can be associated and may be converted from one to another means that a much denser and longer-duration data set can be compiled by converting these to a common parameter. These are referred to as "proxy" relationships. The project report (Ward and Armstrong, 1997) discusses whether such relations are justified for given classes of parameters and the basis (or lack of) for the formulation of such a relationship. Here we note the proxy relationships actually employed in the data base compilation, particularly for the parameters salinity, DO, DDT, and total suspended solids.

2.1.1 Salinity

Salinity originally measured the dissolved solids in seawater, which are dominated by halogen salts. A simpler measure was to determine the salts of a single halogen, *viz.* chlorine, and employ the empirical law of constant proportions (Forchhammer's Law). The relation between salinity and chlorinity is approximately

$$S = 1.807 \bullet Cl$$

for S and C in ‰. Certainly to the accuracy necessary for estuarine work, this is a satisfactory means of interconverting. One of the most common methods of salinity measurement is via conductivity. (In fact, in oceanography, the new practical salinity scale *defines* salinity in terms of conductivity.) A regression based upon the data of USNHO (1956) is

$$S = 0.000588 \bullet C \qquad \text{for } C < 17{,}000\ \mu\text{mhos}$$

$$S = 0.000679 \bullet C - 1.543 \qquad \text{for } C > 17{,}000\ \mu\text{mhos}$$

where C is conductivity at 25°C and S is salinity in ‰.

In the present context we regard density (and specific gravity) as an alternative measure of salinity and use a relationship by which salinity can be expressed as a function of density. Again, the oceanic relation is basic. The equation of state for seawater is empirical, and has most recently (UNESCO, 1981) been expressed as a best-fit multinomial with 15 coefficients. For present purposes, we retain only the higher-order terms, to obtain the approximate relation:

$$S = \frac{\rho - (a_1 + b_1 T + a_2 T^2)}{(a_4 + b_4 T + a_5 T^2)}$$

where

$a_1 = 999.8426$	$b_1 = 6.794 \times 10^{-2}$
$a_2 = -9.0953 \times 10^{-3}$	$a_4 = 8.245 \times 10^{-1}$
$a_5 = 7.644 \times 10^{-5}$	$b_4 = -4.090 \times 10^{-3}$

for salinity S in parts per thousand, temperature T in degrees Celsius, and density ρ in kg/m^3. This approximation is more than adequate for the accuracy necessary in estuary work, as shown in Ward and Armstrong (1997).

One additional measure of salinity is the refractive index of water. The field instrument used for this purpose is a portable refractometer that is calibrated for a direct read-out of salinity (the Goldberg refractometer). For present purposes, therefore, the conversion is unnecessary, but note is made of when this methodology is employed, for establishing a level of uncertainty in the data. Unfortunately, most researchers and monitoring programs (e.g., Texas Parks and Wildlife) do not note when salinity is determined by refractometer versus other methods.

2.1.2 Dissolved oxygen

Dissolved oxygen (DO) is one of the fundamental indicators of aquatic health, since it determines the ability of aerobic organisms to survive. One of the key controls on the concentration of DO is its solubility, which is a strong function of temperature and salinity. In this study several regression forms were evaluated, and the functional form of the Fair-Geyer expression proved to be simplest and most accurate:

$$C_S = 5\,(100 - Cl) / (T + 35)$$

where C_S is DO saturation in mg/L, Cl is chlorinity in parts per thousand and T is temperature in degrees Celsius. (The coefficients were re-evaluated using the data in APHA, 1985.) The functional dependence of solubility on temperature and salinity illustrates that saturation--and hence DO concentration--will vary substantially over the year, perhaps from 5 to 15 mg/L. This high range of natural variability can mask variations in DO of importance in diagnosing water-quality problems. Accordingly, the associated parameter of dissolved oxygen *deficit* is defined

$$D = C_S - C$$

where C is DO concentration and D is DO deficit, both in mg/L. The use of DO deficit effectively removes the influence of varying temperature and salinity, and allows a more direct interpretation of the (transformed) DO measurements in terms of water quality. That is, the total temperature and salinity variation is absorbed in the solubility, so the corresponding DO deficit has no temperature/salinity dependency. Deficit, by itself, however, cannot be interpreted biologically: a deficit of a given magnitude may be biologically limiting in summer and biologically unimportant in winter. Analysis of the DO "climate" requires both DO and deficit.

2.1.3 Suspended solids

Turbidity refers to the interference with the passage of light by suspended matter in the water, and is therefore an indirect indicator of the concentration of such suspended matter. While turbidity has value in itself as a water-quality indicator, our present interest is in its use as a surrogate measure of suspended solids. From scattering theory, T is roughly proportional to suspended solids (SS).

Turbidity is primarily a laboratory determination. The traditional method of viewing a candle flame through a vertical tube containing the water sample motivated the definition of the Jackson Turbidity Unit (JTU). Modern electrometric optics offers alternatives. Nephelometers measure light scattering at 90° and the measurement is reported in Nephelometric Turbidity Units (NTU's). These are defined to be numerically about the same as JTU's. Unfortunately, this numerical equivalence holds only for the calibration compound. For different types and distributions of suspended matter, NTU's and JTU's may depart. Further, each is an index and does not *per se* correspond to a physical property of the water. When the reference suspension in the nephelometric procedure is the formazin polymer, the results are often reported as FTU; for present purposes, we regard these as equivalent to NTU.

The depth of the Secchi disc has for many years been the limnologist's and oceanographer's standard means for field measurement of turbidity. Ward and Armstrong (1997) briefly review the empirical relations between Secchi depths and turbidity. For nephelometric turbidity T the approximate relation becomes:

$$SD = N'' / T$$

where N" ranges about 5-10 for SD in meters and T in NTU's, depending on other optical properties of the water. SD becomes decreasingly sensitive to T as T becomes large.

In summary, there is reason to expect an inverse relation between suspended solids and Secchi depth, SS = B/SD, and a direct proportional relation between suspended solids and turbidity, SS = A·T. Ward and Armstrong (1997) evaluated these constants A and B based upon literature values and data from Galveston Bay (which also served to verify the functional form), and the same relationship was applied to Corpus Christi Bay. Based upon these evaluations, the following forms are adopted to serve as proxy relations giving TSS in terms of turbidity measurement:

$$SS = 0.9\,T$$

$$SS = 13 / SD$$

where SS is suspended solids in mg/L, T is turbidity in JTU, NTU or FTU, and SD is Secchi depth in meters.

2.1.4 DDT

Analysis of chlorinated organic pesticides, and trace organic chemicals in general, is a relative newcomer to water and sediment quality monitoring. Protocols and procedures are still evolving, and this is reflected in a confusion of data acquisition. Some of the problem originates in the multiple forms a specific organic can assume: various isomers, analogs and metabolites. Dichlorodiphenyltrichloroethane (DDT) as a technical product is comprised of as many as 14 analogs and isomers. By far the most important are p,p'-DDT and o,p'-DDT. The relative proportion of the two is a function of the proportion in the initial source and of the relative kinetics and metabolism in the receiving water. Neither of these is particularly well-defined, though the former is probably better established than the latter, to be about 70% p,p'-DDT and 20% o,p'-DDT in technical grade DDT, which is roughly consistent with the rule-of-thumb of a 3:1 ratio of p,p'-DDT to o,p'-DDT that seems to be current now. Accordingly, the relation between total DDT and p,p'-DDT is taken to be:

$$\text{Total DDT} = 1.4 \bullet (\text{p,p'-DDT})$$

While this appears to be a workable proxy relation, we have no reported paired measurements by which we can test it, therefore data bases are provided for total DDT data (as reported), specific isomers, and the proxied (extended) data set using the above relation.

2.2 Biochemical Oxygen Demand

Treatment of biochemical oxygen demand (BOD) data in the data compilation involves selecting which of a variety of measurements, all labeled "BOD," should in fact be employed. Since the classical work of Phelps and Streeter the BOD has become one of the fundamental parameters for estimating the presence of oxygen-demanding organics in a water sample (either from a sewage effluent or from a natural watercourse) and is one of the central parameters in the mathematical modeling of dissolved oxygen in the watercourse. Despite this long history of use, the BOD test is in many respects still controversial.

Basically, the BOD is the amount of dissolved oxygen (DO) consumed in a sample of water during some period of time. The BOD concept has evolved in two separate directions. The first is the oxygen consumed within the watercourse by the degradation of organic wasteloads. The second is the evolution of the BOD bottle test as a measure of the organic wasteload of an effluent, and therefore a key design parameter for treatment processes. Generally, analytical procedures fall into three classes: manometric, including the classical Warburg device, multiple

BOD bottles analyzed sequentially, and electrometric-probe-monitored BOD. For the latter two, a modification of the technique is to reaerate the sample during the course of the "BOD" progression.

The amount of oxygen consumed is directly dependent upon:

(1) Types and concentrations of bacteria present in the water (the "seed");
(2) Chemical characteristics of the oxidizable organic constituents within the water;
(3) The concentration of the oxidizable constituents;
(4) Constituents which act as an inhibitor or a stimulant for bacterial metabolism;
(5) Environmental parameters, notably pH and temperature;
(6) Other aerobic organisms in the water, notably phytoplankton.

With respect to (4), because of the desirability of unequivocally separating the carbonaceous and nitrogenous stages, much has been made of the use of nitrification "inhibitor" constituents, and these have become an optional step in the laboratory procedure. Any such substance should, of course, be employed with great care to be certain that nitrification is in fact inhibited, not simply retarded, and that inadvertent effects upon the heterotrophic organisms do not occur. There is considerable debate in the literature as to the specificity of various nitrogen suppressors. Given this, it should be no surprise that there is a variety of data from Corpus Christi Bay, all labeled "BOD". Further, there is no means of reliably interconverting from one to the other.

The choice of which of these to employ therefore is based upon two criteria: (1) the parameter most utilitarian for the purposes of the study, (2) the parameter affording the greatest data record. With respect to the latter, the greatest amount of data, both in spatial coverage and period of record, is for dilution-series 5-day BOD. Most of the N-suppressed BOD data has been obtained by TNRCC. Further, with respect to criterion (1), the 5-day BOD was judged to serve as a suitable index to organic pollution. For consistency, it would be preferable to limit this to BOD_5 without nitrification suppression, since most of the historical data is of this type. However, this would exclude much of the more recent TNRCC SMN data. We therefore assume that for a 5-day duration the two will generally be equivalent, since nitrification rarely kicks in early enough in the BOD series to affect the consumption at five days, and we use both in the BOD data base.

Several studies have unsuccessfully attempted to correlate BOD and TOC in Galveston Bay, where there is a relatively rich data base for both parameters. We believe there to be too much uncertainty in the relation for TOC to serve as a suitable proxy for BOD, or *vice versa*. Further, there is very little TOC data from Corpus Christi Bay which could be used as a basis to test a proxy relationship.

2.3 Parameter Identification and Coding

Complete tabulations of the water quality and sediment quality parameters of this study are given in Table 2-2. Some of the more important classes of parameters are discussed briefly in the following sections. Table 2-2 lists the units of measurement employed in this study for each of these parameters, and an abbreviation of up-to-eight characters uniquely identifying the parameter in all of the data presentations in this report, as well as in the digital data files.

This abbreviation is decoded as follows. The first series of 2-3 characters indicates whether the analyte was determined from a water-phase or sediment-phase sample, "WQ" designating the former, and "SED" or "SD" designating the latter. For conventional parameters, the remainder of the abbreviation is a (hopefully) transparent abbreviation for the compound, e.g. WQDO for dissolved oxygen in water, WQFCOLI for fecal coliforms in water, SEDO&G for oil and grease in sediment, etc. For elemental analyses, primarily metals, the compound abbreviation is made up of the prefix "MET" followed by the (1-2 character) chemical abbreviation for the element. In the case of water samples, the sample may have been filtered, in which case the analysis is presumed to represent the dissolved metal; or the sample may not have been filtered, in which case the analysis is presumed to represent both the dissolved and suspended portions of the metal. The former is indicated by the letter "D" for "dissolved", and the latter by the letter "T" for "total." For example, WQMETASD refers to the arsenic in a filtered water sample, WQMETSET to the selenium in an unfiltered water sample, and SEDMETPB to lead in a sediment sample. Finally, all volatile organics are flagged by a hyphen in the abbreviation after the water/sediment phase designation. For example, WQ-ACEN refers to acenapthene in a water sample, and SED-LIND to the lindane in a sediment sample.

Data files created by application of the proxy relations in Section 2-1, to create an extended data base for the basic parameters, TSS and DDT, are indicated by the suffix "X." For salinity, the originating variable is converted directly to salinity to create the file variate WQSAL.

To include the acquisition and analysis of tissue data as a part of the present investigation had a certain logical appeal, in that most of the agencies engaged in the collection of tissue chemistry data are also those from which water/sediment chemistry data were sought, and in that some association might be expected of elevated body burdens in an organism with ambient sediment and water concentrations in the habitat of that organism. One might expect therefore that incorporating compilation and analysis of tissue data into the present project could potentially yield additional insight into the ambient environment of Corpus Christi Bay without substantially increasing or diverting the project effort. Unfortunately, both of these expectations proved false.

First, for all of the agencies that routinely acquire tissue data, that data is managed differently from the water and sediment chemistry data. Therefore, these data sets required special handling different from that of the water or

Table 2-2
Abbreviations and units for CCBNEP water and sediment parameters

abbreviation	*definition*	*units*
	— water analytes —	
WQALK	total alkalinity (as CaCO3)	mg/L
WQAMMN	ammonia nitrogen	mg/L
WQBOD5	5-day BOD	mg/L
WQCHLA	chlorophyll-a	µg/L
WQCHLB	chlorophyll-b	µg/L
WQCYAN	cyanide	µg/L
WQDO	dissolved oxygen	mg/L
WQFCOLI	fecal coliforms	MPN or colonies/200ml
WQKJLN	total Kjeldahl nitrogen	mg/L
WQNO2N	nitrite nitrogen	mg/L
WQNO3N	nitrate nitrogen	mg/L
WQO&G	oil & grease	mg/L
WQOPD	dissolved orthophosphate (as P)	mg/L
WQOPO4	total orthophosphate (as PO4)	mg/L
WQORGN	total organic nitrogen	mg/L
WQPH	pH	
WQPHEO	pheophytin-a	µg/L
WQSAL	salinity converted from proxy measures	ppt (‰)
WQSECCHI	Secchi depth of water	m
WQSIO2	dissolved silica (as SIO2)	mg/L
WQSO4	total sulfate (as SO4)	mg/L
WQTCOLI	total coliforms	MPN or colonies/200ml
WQTEMP	temperature	degrees C
WQTOC	total organic carbon	mg/L
WQTOTP	total phosphorus (as P)	mg/L
WQTPO4	total phosphate (as PO4)	mg/L
WQTRANS	transmissivity, over 100 cm path	% (1 m)
WQTSS	total suspended solids	mg/L
WQTURBJ	turbidity of water, JTU	JTU
WQTURBN	turbidity of water, NTU	NTU
WQXTSS	TSS converted from proxy relations	mg/L
WQVOLS	total volatile solids	mg/L
WQVSS	volatile suspended solids	mg/L
WQmetagd	dissolved silver	µg/L
WQmetagt	total silver	µg/L
WQmetasd	dissolved arsenic	µg/L
WQmetast	total arsenic	µg/L
WQmetbt	total boron	µg/L

(continued)

Table 2-2
(continued)

abbreviation	*definition*	*units*
	— water analytes continued—	
WQmetbd	dissolved boron	µg/L
WQmetbad	dissolved barium	µg/L
WQmetbat	total barium	µg/L
WQmetcdd	dissolved cadmium	µg/L
WQmetcdt	total cadmium	µg/L
WQmetcod	dissolved cobalt	µg/L
WQmetcot	total cobalt	µg/L
WQmetcrd	dissolved chromium	µg/L
WQmetcrt	total chromium	µg/L
WQmetcud	dissolved copper	µg/L
WQmetcut	total copper	µg/L
WQmetfed	dissolved iron	µg/L
WQmetfet	total iron	µg/L
WQmethgd	dissolved mercury	µg/L
WQmethgt	total mercury	µg/L
WQmetmnd	dissolved manganese	µg/L
WQmetmnt	total manganese	µg/L
WQmetnid	dissolved nickel	µg/L
WQmetnit	total nickel	µg/L
WQmetpbd	dissolved lead	µg/L
WQmetpbt	total lead	µg/L
WQmetsed	dissolved selenium	µg/L
WQmetset	total selenium	µg/L
WQmetsrd	dissolved strontium	µg/L
WQmetznd	dissolved zinc	µg/L
WQmetznt	total zinc	µg/L
WQ-245T	2,4,5 T	µg/L
WQ-24D	2,4 D	µg/L
WQ-ABHC	alpha-BHC	µg/L
WQ-ACEN	acenapthene	µg/L
WQ-ACENA	acenaphthylene	µg/L
WQ-ALDR	Aldrin	µg/L
WQ-ANTHR	anthracene	µg/L
WQ-BNZA	benzo(a)pyrene	µg/L
WQ-BNZE	benzo(e)pyrene	µg/L
WQ-BNZAA	benzo(a)anthracene	µg/L
WQ-BNZB	benzo(b) fluoranthene	µg/L
WQ-BNZGP	benzo(ghi)perylene	µg/L
WQ-BNZK	benzo(k) fluoranthene	µg/L

(continued)

Table 2-2
(continued)

abbreviation	*definition*	*units*
	— water analytes continued—	
WQ-CHLR	total Chlordane	µg/L
WQ-CHLRC	Chlordane cis isomer	µg/L
WQ-CHRYS	chrysene	µg/L
WQ-DBANE	dibenz(a,h)anthracene	µg/L
WQ-DDD	total DDD	µg/L
WQ-DDE	total DDE	µg/L
WQ-DDT	total DDT	µg/L
WQ-DIAZ	Diazinon	µg/L
WQ-DIEL	Dieldrin	µg/L
WQ-ENDO	Endosulfan I	µg/L
WQ-ENDR	Endrin	µg/L
WQ-FLRA	fluoranthene	µg/L
WQ-FLRN	fluorene	µg/L
WQ-HEPT	heptachlor	µg/L
WQ-HEPX	heptachlor epoxide	µg/L
WQ-HEXA	hexachlorabenzene	µg/L
WQ-I123P	indeno(1,2,3-cd)pyrene	µg/L
WQ-LIND	Lindane (gamma-BHC)	µg/L
WQ-MALA	Malathion	µg/L
WQ-MTHP	methyl parathion	µg/L
WQ-MTHX	methoxychlor	µg/L
WQ-NAPT	napthalene	µg/L
WQ-PAH	total PAH's	µg/L
WQ-PARA	Parathion	µg/L
WQ-PCB	total PCB's	µg/L
WQ-PCP	pentachlorophenol	µg/L
WQ-ODDT	o,p'-DDT	µg/L
WQ-PDDD	p,p'-DDD	µg/L
WQ-PDDE	p,p'-DDE	µg/L
WQ-PDDT	p,p'-DDT	µg/L
WQ-PHNAN	phenanthrene	µg/L
WQ-PYRN	pyrene	µg/L
WQ-SLVX	Silvex	µg/L
WQ-TOXA	Toxaphene	µg/L
WQ-XDDT	Total DDT converted from proxy relations	µg/L

(continued)

Table 2-2
(continued)

abbreviation	*definition*	*units*
	— sediment analytes (dry weight)—	
sedcyan	cyanide	mg/kg
sedkjln	total Kjeldahl nitrogen	mg/kg
sedo&g	oil & grease	mg/kg
sedammn	ammonia nitrogen	mg/kg
sedorgn	total organic nitrogen	mg/kg
sedtoc	total organic carbon	g/kg
SEDtotp	total phosphorus (as P)	mg/kg
sedvols	volatile solids (loss on ingnition)	mg/kg
sedmetag	silver	mg/kg
sedmetal	aluminum	mg/kg
sedmetas	arsenic	mg/kg
sedmetb	boron	mg/kg
sedmetba	barium	mg/kg
sedmetcd	cadmium	mg/kg
sedmetco	cobalt	mg/kg
sedmetcr	chromium	mg/kg
sedmetcu	copper	mg/kg
sedmetfe	iron	mg/kg
sedmethg	mercury	mg/kg
sedmetmn	manganese	mg/kg
sedmetni	nickel	mg/kg
sedmetpb	lead	mg/kg
sedmetse	selenium	mg/kg
sedmetsr	strontium	mg/kg
sedmetzn	zinc	mg/kg
sed-245t	2,4,5 T	µg/kg
sed-24d	2,4 D	µg/kg
sed-abhc	alpha-BHC	µg/kg
sed-acen	acenapthene	µg/kg
sed-acyn	acenaphthylene	µg/kg
sed-aldr	Aldrin	µg/kg
sed-anth	anthracene	µg/kg
sed-bnza	benzo(a)pyrene	µg/kg
sed-bnze	benzo(e)pyrene	µg/kg
SD-bnzaa	benzo(a)anthracene	µg/kg
SD-bnzb	benzo(b) fluoranthene	µg/kg
SD-bnzk	benzo(k) fluoranthene	µg/kg
SD-bnzgp	benzo(ghi)perylene	µg/kg

(continued)

Table 2-2
(continued)

abbreviation	*definition*	*units*
	— sediment analytes continued—	
sed-chlr	total Chlordane	µg/kg
sd-chlrc	Chlordane cis isomer	µg/kg
sed-chry	chrysene	µg/kg
sed-ddd	total DDD	µg/kg
sed-dde	total DDE	µg/kg
sed-ddt	total DDT	µg/kg
sed-diaz	Diazinon	µg/kg
SD-dbane	dibenz(a,h)anthracene	µg/kg
sed-diel	Dieldrin	µg/kg
sed-endo	Endosulfan I	µg/kg
sed-endr	Endrin	µg/kg
sed-flra	fluoranthene	µg/kg
SD-flrn	fluorene	µg/kg
sed-hept	heptachloride	µg/kg
sed-hepx	heptachloride epoxide	µg/kg
sed-hexa	hexachlorobenzene	µg/kg
SD-I123p	indeno(1,2,3-cd)pyrene	µg/kg
sed-lind	Lindane (gamma-BHC)	µg/kg
sed-mala	Malathion	µg/kg
sed-mthp	methyl parathion	µg/kg
sed-mthx	methoxychlor	µg/kg
sed-napt	napthalene	µg/kg
sed-pah	total PAH's	µg/kg
sed-para	Parathion	µg/kg
sed-pcb	total PCB's	µg/kg
sed-pcp	pentachlorophenol	µg/kg
sed-pddd	p,p'-DDD	µg/kg
sed-pdde	p,p'-DDE	µg/kg
sed-pddt	p,p'-DDT	µg/kg
sed-oddt	o,p'-DDT	µg/kg
sed-oddd	o,p'-DDD	µg/kg
sed-odde	o,p'-DDE	µg/kg
sed-pery	perylene	µg/kg
SD-phnan	phenanthrene	µg/kg
SD-pyrn	pyrene	µg/kg
SED-slvx	Silvex	µg/kg
sed-toxa	Toxaphene	µg/kg
sed-tbt	tributyltin	µg/kg
sed-xddt	DDT converted from proxy relations	µg/kg

sediment data. Second, for a specific chemical parameter, there is a greater range in what is measured and how it is reported in the tissue phase compared to water or sediment, and there is a corresponding lack of consistency among agencies (and sometimes within the same agency). This aggravated the compilation problems, and led to lack of intercomparability from data source to data source, and therefore a reduction in statistical inference power.

Tissue body burden of a specific chemical or element is determined by first acquiring an organism from the estuary, excising a portion of that organism, mechanically homogenizing the excised portion, and performing a chemical analysis using generally the same protocols and analytical methodologies (see Section 2.6) as employed in a sediment or solids sample. The ultimate purpose of such analyses may be either (1) to determine flux of specific compounds or elements through the food chain; (2) to establish whether there is a public health risk entailed by consumption of that organism. Which objective is intending informs the entire procedure, from the initial organism to be sampled to the compounds chosen for analysis and how the results are presented. All of this entails a great range of variation in the nature of the data. Options are:

- element or chemical compound for analysis

- selection of organism:
  - one individual
  - multiple individuals
    - same species
    - various species

- organism portion to be analyzed:
  - whole organism
  - specific organ
  - edible portions ("filet")

- reporting convention:
  - wet-weight concentration
  - dry-weight concentration

There were no instances encountered in this compilation of analyses performed on specific organs, such as livers. Our data fell into the categories of either whole-organism or edible-portions ("filet"). For oysters, the two are equivalent: there was no instance encountered in which analyses was reported on an entire oyster, shell and all. There were a few instances (in the TNRCC SMN data base) in which tissue data were reported based upon a composite (probably a purée) of individuals of more than one species (the names of which were not noted). These data were not used in the present compilation. However, a scattering of analyses of more than one individual of the same species were reported, and were included in the compilation.

A wide range of chemical parameters were encountered. At the outset, we retained data for all of the chemical parameters in the data compilation, though it was clear that for most of them, the data resource was going to be too small to permit any reliable statistical analysis, particularly when further stratified in space and time. At a later stage, data sets that were simply too small to treat (i.e. one isolated measurement) were deleted. The exception was PCB's, in that we did not retain the individual PCB analyses, because there were too many that were non-interconvertible (reported by congenor number in some cases, Aroclor identifiers in others, and level of chlorination in yet other cases), instead retaining only the total-PCB determination. Table 2-3 presents the complete list of chemical parameters retained in the tissue compilation.

For each chemical analyte, it is necessary to differentiate the organism sampled, whether the analysis was carried for the whole organism or filets, and whether the data is reported on a dry- or wet-weight basis. It should be noted that data from different organisms is fundamentally noncomparable. Accumulation of a compound in organism tissue is dependent upon the metabolism of the species, internal chemical transformation of the compound, activity of the species in a region of contamination, its activity in regions of noncontamination, its food sources and their respective exposures. Similarly, the concentration in the whole organism is fundamentally noncomparable to that in only the edible portion. The only two categories offering, in principle, a possibility of comparability are the wet-weight versus dry-weight reporting. These can be interconverted only if separate reporting is made of the moisture content of the tissue sample. Incredibly, most of the agencies providing tissue data do not report (and apparently do not analyze) tissue moisture content.

The same basic data structure was employed in the master data base compilation of tissue data as used for water and sediment quality, as described in Section 4.1 above, and the processing steps were basically the same as presented in Section 4.2. As with water and sediment parameters, the parameter is given a unique abbreviation used in tabular output and in the naming of data files. These are given in Table A-3 in the Appendix. We differentiated between dry-weight and wet-weight data, and between whole-organism and filet analyses by the leading characters in the parameter name. The general format for tissue parameter abbreviations is:

TXparam

All tissue data parameters begin with the letter "T." The second character X is one of:

S	-	whole-organism, wet weight
F	-	filet (edible portions only), wet weight
D	-	filet, dry weight

The remainder of the name "param" is either made up of the prefix "MET" followed by the (1-2 character) chemical abbreviation for the element, in the case of elemental analyses, or a hyphen followed by the compound abbreviation, in the case of volatile organic compounds. For example, TF-DDT represents the wet-weight concentration of total DDT in the edible tissue of an organism. No data were encountered of whole organism concentrations in dry weight so no separate identifier was necessary. (Actually, the USF&WS did report such data, but also provided proportion of moisture, so the results could be converted to wet-weight.)

Table 2-3
Abbreviations and definitions for CCBNEP tissue parameters
(all units mg/kg)

abbreviation	*definition*
TX-124TC	1,2,4-TRICHLOROBENZENE
TX-12DCB	1,2-DICHLOROBENZENE
TX-12DPH	1,2-DIPHENYLHYDRAZINE
TX-13DCB	1,3-DICHLOROBENZENE
TX-14DCB	1,4-DICHLOROBENZENE
TX-246TC	2,4,6-TRICHLOROPHENOL
TX-24DCP	2,4-DICHLOROPHENOL
TX-24DMP	2,4-DIMETHYLPHENOL
TX-24DNT	2,4-DINITROTOLUENE
TX-24DNH	2,4-DINITROPHENOL
TX-26DNC	2,6-DINITRO-2-CRESOL
TX-26DNT	2,6-DINITROTOLUENE
TX-2CLNP	2-CHLORONAPHTHALENE
TX-2NIPH	2-NITROPHENOL
TX-33DCB	3,3'-DICHLOROBENZIDINE
TX-3PCM	3-PYRIDINE CARBOXAMIDE
TX-4BRPE	4-BROMOPHENYL PHENYL ETHER
TX-4C3C	4-CHLORO-3-CRESOL
TX-4CLPE	4-CHLOROPHENYL PHENYL ETHER
TX-4NITP	4-NITROPHENOL
TX-abhc	BHC-alpha isomer
TX-acen	ACENAPHTHENE
TX-ACENA	ACENAPHTHYLENE
TX-ACENY	ACENAPHTHYLENE
TX-aldr	ALDRIN
TX-ANTHR	ANTHRACENE
TX-B2CE	BIS (2-CHLOROETHYL) ETHER
TX-B2CM	BIS (2-CHLOROETHOXY) METHANE
TX-B2CEN	BIS (2-CHLOROISOPROPYL) ETHER
TX-B2EPH	BIS(2-ETHYLHEXYL)PHTHALATE
TX-BBHC	B-BHC-BETA
TX-bnza	BENZO-A-PYRENE
TX-BNZAA	BENZO(A)ANTHRACENE1,2-BENZANTHRACEN
TX-BNZDE	BENZIDINE
TX-BNZGP	BENZO(GHI)PERYLENE
TX-BNZJ	BENZO(J)FLUORANTHENE
TX-BNZK	BENZO(K)FLUORANTHENE,
TX-BUBZP	BUTYLBENZYL PHTHALATE,
	CHLORDANE(TECH MIX & METABS)
TX-CHLRC	CHLORDANE-CIS ISOMER

(continued)

Table 2-3
(continued)

abbreviation	*definition*
TX-CHLRN	CHLORDANE-NONACHLOR,TRANS ISO
TX-CHLRT	CHLORDANE-TRANS ISOMER
TX-CHRY	CHRYSENE
TX-CHRYS	CHRYSENE
TX-CLPN	CHLOROPHENOL,
TX-DBANE	DIBENZ(A,H)ANTHRACENE
TX-DBHC	DELTA BENZENE HEXACHLORIDE,
TX-DDD	DDD TOTAL
TX-DDE	DDE TOTAL
TX-ddt	DDT SUM ANALOGS
TX-oDDD	O,P DDD
TX-oDDE	O,P DDE
TX-oDDT	O,P DDT
TX-pDDD	P,P'-DDD
TX-pDDE	P,P'-DDE
TX-pDDT	P,P'-DDT
TX-diaz	diazinon
TX-DIBUP	DI-N-BUTYL PHTHALATE
TX-diel	DIELDRIN
TX-DIETP	DIETHYL PHTHALATE
TX-DIMET	DIMETHYL PHTHALATE
TX-DIN8	DI-N-OCTYL PHTHALATE
TX-DIPH	DIPHENYLAMINE
TX-ENDO	Endosulfan I
TX-ENDOS	ENDOSULFAN SULFATE
TX-ENDR	ENDRIN
TX-ENDRA	ENDRIN ALDEHYDE,
	FLUORANTHENE
TX-FLRN	FLUORENE
TX-HEPT	HEPTACHLOR
TX-hepx	HEPTACHLOR EPOXIDE
TX-HXCBU	HEXACHLOROBUTADIENE
TX-HXCCP	HEXACHLOROCYCLOPENTADIENE
TX-HEXA	HEXACHLOROBENZENE
TX-HXCLE	HEXACHLOROETHANE
TX-I123P	INDENO(1,2,3-CD) PYRENE
TX-ISPHR	ISOPHORONE,
TX-lind	Lindane (BHC-GAMMA ISOMER),
TSMETAS	ARSENIC TOTAL
TSMETSE	SELENIUM, TOTAL
TX-MTHX	METHOXYCHLOR

(continued)

Table 2-3
(continued)

abbreviation	*definition*
TX-NAPT	NAPHTHALENE
TX-NITRB	NITROBENZENE
TX-NNNPR	N-NITROSODI-N-PROPYLAMINE,
TX-NNSM	N-NITROSODIMETHYLAMINE,
TX-NNSP	N-NITROSODIPHENYLAMINE,
TX-PAH	Total PAH's
	PCBS (MG/KG)
TX-PCP	Pentachlorophenol (PCP)
TX-pddd	P,P' DDD
TX-pddE	P,P' DDE
TX-pddT	P,P' DDT
TX-PHEN	PHENOLICS
TX-PHNAN	PHENANTHRENE
TX-PYRN	PYRENE,
TX-PHRN	
TX-TOXA	TOXAPHENE
TX-TYPHEN	PHENOLICS
TXMETCD	CADMIUM
TXMETCR	CHROMIUM,TOT
TXMETCU	COPPER,TOTAL
TXMETHG	MERCURY,Total
TXMETPB	LEAD,TOTAL
TXMETAG	Silver, total
TXMETNI	Nickel
TXMETZN	Zinc
TXMETAS	Arsenic

3. DATA MANIPULATION & PROCESSING

The goal of this data compilation, simply put, is to create a digital record of time/space/concentration for each water/sediment-quality variable of concern. That is, each data entry must identify a point in space-time at which the measurement was performed and the associated parameter magnitude. In designing the formats for this data compilation, emphasis was placed on data structure that is transferrable and manipulable via microcomputers (especially), i.e. compact ASCII files. The formatting of the data files is described further in the final section of this report.

The data compiled in this project were drawn from numerous past programs in the Coastal Bend Bays. These programs are summarized in Section 4 below. Each of these involved measurement of some of the water, sediment or tissue quality variables within a part of the Corpus Bay system for some definite sampling interval and period. Apart from this general statement, the programs differ in objectives and procedures.

Extremely important to the present project are the provisions in the original program for presentation and dissemination of the basic data. Large-scale semi-permanent monitoring programs generally have provision for data storage and dissemination, nowadays digital. Surveys usually have some form of hard-copy presentation, and research programs may not publish or even preserve the basic measurements, but rather present analyzed or reduced data in a professional publication. Since this project seeks to compile and analyze a combined data set, machine processing is indispensable, and we therefore require all data to be ultimately in a machine-readable format. Where digital databases existed we sought copies from the managing agencies. In some instances, the digital record has been lost or destroyed. Where hard copy or field notes existed, the data were keyboarded.

The limits of resolution of measurements and the associated imprecision, and the extent of infection of a data set with errors contribute a degree of uncertainty to each entry in the data record. The obverse concept is the reliability of that data set for scientific analysis. The need for determining the reliability of historical data and discounting measurements that are judged to be "unreliable" is clearly important. This is recognized by EPA and general methods for accomplishing this are outlined by Tetra Tech (1987). Further, this need was identified specifically in the CCBNEP draft Scope of Work for this project. It is the PI's conviction that such judgements must be formulated carefully, and the rejection of data be given close consideration. In data compilation and processing in this study, a major concern was the detection of errors capable of elimination and the quantification of the residual uncertainty in the data. This includes, but is not restricted to, the procedures commonly referred to as Quality Assurance/Quality Control, and is described in Sections 3.2 and 3.3, below.

3.1 Data-base files

One of the principles observed in the construction of the Coastal Bend Bays data base was the maintenance of integrity of the individual surveys. That is, in the compilation of data for a given parameter, say nitrogen series, the coded information included identification of the data source, say TNRCC Statewide Monitoring Program versus Corps of Engineers versus TWDB Coastal Data System, and was input without any modification, including retention of the original units of measurements. While the various data sources were later combined in various ways as a part of different analyses, it is mandatory that the data compilation be capable of separating and identifying, say, nitrogen data from various agencies, as they may differ in accuracy, methodology and procedure, differences which could become crucial in interpreting apparent trends or in more specialized analyses.

This is one aspect of differentiating the *source* data base from *derivative* data bases. The source data base codifies (in machine format) the original measurements as reported by the originating agency. This data base therefore contains exactly the information in the original: nothing is lost or added. Even an apparently innocuous conversion of measurement units can introduce a distortion. For example, many units carry an implicit level of precision that is modified when converted to another system, such as converting depths in feet to depths in meters.

Of course, in adapting the data file to the needs of the project, the source data file may be re-formatted. This might entail re-ordering of the variables, removing unneeded or redundant fields, or re-writing in a more compact format. An excellent example is use of data from the TNRCC Statewide Monitoring Network (SMN) data file. This data was provided as a special downloaded ftp files. In a previous National Estuary Program (for Galveston Bay) the same agency provided magnetic tape copy of a printed-page report, therefore containing headers, pagination and blank line fills (a file which contained about 40 million characters!). We were equipped from the previous experience with codes and techniques to process data in this format. The new format, of course, required completely new processing codes. However, the data themselves were not modified in any way in the transfer: they were re-ordered and re-formatted, but the numerical information was not altered.

For various analytical purposes, these data must be modified, for instance converted to common units, averaged in the vertical, aggregated, or screened out according to some criterion. The data set so processed is a *derivative* data base. Any number of derivative data bases can be created according to the needs of a scientific investigation; it is our opinion, however, that the source data base, once established, should remain inviolate and sacrosanct. Thus the basic approach in this project was to first create the source data base for a given parameter through the data compilation effort. Then various derivative bases were formed to selectively include certain subsets and to subject these to specific processing. For many researchers, the derivative data base will be more than adequate for their analytical uses.

Almost all of the data sets include the time of sampling, at least to some resolution (usually to the day). The point in space is more problematic. Most sampling programs express position by an alphanumeric station name. In order to be able to process the data spatially, this point must be expressed quantitatively. In this project, latitude/longitude coordinates were used to locate the horizontal position of the sample, and depth (i.e., distance below the water surface) to locate the vertical position. The former required precisely plotting the sampling stations from descriptions or from project maps and determining by manual measurement the coordinate positions, which were then keyboarded into a digital data base. In a minority of instances, the data-collecting agency includes latitude/longitude coordinates for the sampling stations (although, as described elsewhere, we have encountered numerous errors, and were forced to plot and re-measure many of these). This station location data is entered into a separate file, and the horizontal coordinates merged with the measurements at a later stage of the processing into the derivative files.

3.2 Measurement Uncertainty

There is a residual error in any set of measurements, deriving from the omnipresent sources of imprecision, inaccuracy and mistakes (including data-entry errors). In this project, data bases for specific variables were created by the combination of data sets from different sources, with differing analytical methodologies, different agency objectives, and differences in field procedures. In order to be able to attach a degree of uncertainty (or its complement, a level of confidence) to such a data set, it is necessary to assess the uncertainty in each of the component data sets, and devise a means of transferring this information to the composite data set. A data user then has the basic information to further determine how the uncertainty is affected by whatever processing of aggregation, units-conversion and proxy transformations to which the data are subjected.

The project final report (Ward and Armstrong, 1997) addresses the definition and formulation of uncertainty. In the present context, this uncertainty is taken as

$$v \pm e,$$

where e the error in the measured value v, defined to be the magnitude of the population standard deviation about a fixed value of the variate. We usually have to estimate e by the standard deviation about the mean of the measurements under the same idealized conditions, estimated in practice by a finite set of measurements. The uncertainty may vary with the magnitude of the measurement, and the dependency may be generalized as

$$e = a + mv$$

An at-most-linear variation is sufficient for present purposes because the limited data usually available on precision of water and sediment quality measures will not support the assignment of a nonlinear variation. For a specific parameter, often the constant term a or the linear variation mv will dominate the dependency of error e on variate value v, and the other can be neglected. In the case of the former, the precision is constant over the range of applicability, and may be expressed simply as a constant value with the units of v. In the case of the latter, e may be conveniently stated as a fraction (a percentage) of v.

In addition to the error term, specification of uncertainty includes the threshold value which v must exceed for the analysis to be meaningful. Such a threshold value always exists, due perhaps to mechanical friction in a gauge or the limits of resolution of a probe, but it may be much smaller than the lowest value of v encountered, or be much smaller than e for $v \approx 0$, and thus be practically negligible. For trace concentration determinations based upon gas chromatography and mass spectrometry, however, the threshold is a singularly important element of the procedure, establishing the detection limits of the analysis.

In order to completely characterize a measurement in the data base, we must include an estimate of the uncertainty, including any limiting values, such as the detection limit. Determination of these was approached in this study in several ways depending upon the extent of documentation for the data set, in decreasing order of preference:

(a) review of QA/QC procedures observed by the collecting agency, as reflected in practices memos, manuals and directives,

(b) identification of the specific methodologies used and their established accuracy,

(c) statistical variation of the measurements themselves, relative to some external standard, e.g. a more accurate proxy relation or data from a contemporary, independent source.

(d) judgement, based upon experience with the method or equipment, and upon the practice of workers in the field using that methodology, as inferred from their explicit or implicit uncertainty statements.

This first task was to document the different agency procedures and their implications for precision and accuracy. For recent data with well-established procedures and QA/QC protocols, this was generally straightforward, though many agencies have no written descriptions and our information had to be obtained from personal communications. For older data, the methodologies and probable care of the observers must be judged (following the above procedures). Where possible, measurements of related parameters from the same program or measurements of the same (or related) parameter by more than one agency were cross-correlated to detect systematic differences. Unfortunately, the general sparsity of data in space and time frequently prohibited this kind of test, but for some variables such as salinity, the data were sufficiently dense to allow it. In some instances, we were forced to judge fairly low levels of accuracy (i.e., broad confidence limits).

The technical report, Ward and Armstrong (1997), summarizes the measures of uncertainty assigned in this study. These uncertainty criteria were based upon available information on precision of various methodologies and procedures for different parameters.

Generally, there is more information--and more quantitative scope--on precision in the later literature than the earlier, which raises a dilemma: when precision information changes, should we utilize the data contemporaneous with the measurements, i.e. assumed to be reflective of the technology and procedures of the time, or should we presume that the more recent data derives from a larger base of measurements, and represents an improved estimate of precision applicable to the older techniques as well? Considering that the reported precision for many trace metals and organics is *lower* (i.e., greater standard deviations) in more recent publications than in the older, this is not a merely pedantic concern. No doubt there are elements of truth in either alternative, but we have elected the former. This is not an irreversible decision, as any later user of the data base has the option of employing a different measure of precision, and consequently a different data rejection procedure. (Of course, if one does not use the standard deviation as a basis for data rejection, then the issue of the source of precision information becomes irrelevant to the analysis.)

Also, we note that the precision data available is generally much more complete and accurate for the water-phase analytes than the sediment. Indeed, in the USGS manuals (Wershaw et al, 1987, Fishman and Friedman, 1989), for each of the bottom-material analyses there is simply the statement: "It is estimated that the percent relative standard deviation for [parameter name] in bottom material will be greater than that reported for dissolved [parameter name]." When precision data are presented for water-suspended sediment mixtures, we have used that preferentially over the dissolved data to estimate uncertainty for the sediment analysis.

3.3 Quality Assurance

The CCBNEP source data bases were compiled from various original data sources, some digitally and some manually, and because a transfer of information is involved, there is the possibility of error. Therefore, specific measures were introduced to minimize the occurrence of error, and maximize its detection, as follows:

(1) All data available in machine-readable form from an originating agency were obtained, manipulated and entered in that form. Further, intermedia transfers were minimized, i.e., copies were sought as ASCII or LOTUS files on floppy discs.

(2) Data entry by hand employed standardized formats that mimicked the hard-copy sources, and the data entry methods employed standard, simple software, viz. EXCEL™, MS WORD™, or LOTUS™. Following the entry and verification steps, the data were scanned and spot-checked personally by one of the PI's.

(3) Each new data set that involved a large file of information (and hence especially prone to errors of fatigue or oversight) was subjected to machine screening to verify that the variables lie within expected ranges and exhibit "natural" variability. When aberrancies were detected, the entries were verified against the original source. In many instances this screening detected apparent blunders in the source file itself. These are discussed below and separately in Section 4. Further, additional steps in the data processing process included various error traps and cross checks, which serve as further error-checking.

Particular note should be given the term "mimicked" in (2) above. This is a significant departure of the procedure of this project from that recommended by Tetra Tech (1987), who require that re-formatting into a uniform format, as well as conversion and/or mathematical transformation, be carried out as part of the data entry process. We believe this strategy is seriously flawed. The entry of thousands of numbers by keyboarding personnel demands maximizing efficiency and accuracy. Any differences between the keyboard format and the hard copy are an invitation to misinterpretation and transcription mistakes. Further, since keyboarding personnel are rarely equipped to interpret the numbers they are entering, they should not be expected to carry out calculations of any kind, but to simply input what they see. The Tetra Tech procedure, we believe, reduces efficiency and requires an additional level of oversight that could be totally replaced by machine screening. Moreover, we take exception to the philosophy of altering the source data, even by units conversion or rounding, as discussed above, and this is precisely what Tetra Tech recommends.

The errors introduced by the data transfer procedures of this project were the simplest to deal with, because their existence (i.e., that they were in fact errors of entry) could be confirmed by comparison with the original source, and corrections could be expediently implemented. The same screening process, i.e. testing for values within "reasonable" bounds (discussed below), spatial continuity (as reflected by simultaneous data from different depths or nearby stations) and temporal continuity (comparison with measurements at the same station before and after the sampling time), occasionally detected aberrant values in the source data files themselves. When possible, we contacted the agency source to verify the reported information. For most of the data files, however, there is no longer an authoritative source with which to compare the reported data: the original field sheets are discarded, or the principal investigator or originating agency is not accessible (or even extant). This forced us to make probability judgements. Consonant with our philosophy of leaving the source data files sacrosanct, "corrections" were introduced into these data files only when the typographical error was "patently obvious." Errors such as obviously misplaced (or omitted) decimal points, ppm entered instead of ppt (or vice versa), dropped or inverted digits in a date where there are other data from the same sampling run to confirm the date, are regarded as "patently obvious," and represent the limit to which we entered corrections into the source data files. If there is any reasonable possibility that the source data could be entered correctly, or if it is probably wrong but we have no logical, near-certain means of supplying the correct value, then the entry was allowed to stand. Most apparently aberrant values fell into this category. In the process of creating the derivative data bases later, and certainly in data analysis, there is the opportunity to reject apparently aberrant data, so leaving such values in the source files causes no harm to the analyst and preserves the integrity of the source data base.

Latitude and longitude coordinates were also subjected to screening. This employed a "range of limits" screen to verify that the positions fell within the latitude-longitude range of the study area (which helped in identifying wildly incorrect points) and a comparison of station descriptions to where the station plotted. In a few instances, enough information was given on the boat tracks during sampling to allow some judgement as to the likelihood of error. Generally, finer corrections were reserved for the derivative data-base screening unless some independent information was available. Errors in the positions determined in this project, due to the procedures of cross-checking and proofing used during these projects. However, the latitude/longitude coordinates provided by some of the agencies exhibited problems, as noted in Section 4 below.

A separate concern in data processing is the handling of anomalous values lying well beyond the expected range of the variate. Most of these are the result of human error at some point in the process from laboratory or field measurement to entry into the data base. A frequent manifestation is a decimal point mislocation, resulting in multiplying the true value by one or several orders-of-magnitude. A screening rule can be formulated to reject such points. The problem is how to assign a rejection trigger so as to exclude points certainly in error, but not to exclude points that happen to deviate widely from "normal" values, since such deviations may in fact be real and therefore significant. It must be noted that the normal strategy is to use such rejection triggers to identify anomalous points *during the data acquisition and entry process*, to provide feedback to the originators of the data for verification and correction. In our present study, there is no prospect of tracing back to the originator of the data (except for verifying data entry performed during this project). Therefore, criteria for data rejection are applied to excluding data from the data base and/or analysis. As a matter of personal philosophy, related to our concern to maintain the integrity of the data, we reject no data in compilation of the source files and very little in compilation of the derivative files. Rather, we regard data rejection to fall within the purview of the analyst. In this project, rejection criteria were compiled and selected for each variable, but these served as a basis for the further data analyses reported in Ward and Armstrong (1997) and as guidance to future users, rather than as a means of excluding data from the data files themselves. Such rejection criteria as a screening device are further discussed in Section 5 below.

4. DATA SETS AND SOURCES

The principal product of this study is the compilation of a digital data base composed of water-quality, sediment-quality and tissue data from 30 data collection programs performed in the Corpus Christi Bay system. These programs are listed in Table 4-1. Most of these programs, it will be noted, are small-scale research activities, though most of the data is dominated by the few large-scale programs summarized below.

4.1 Overview of Principal Data Programs

Of central importance to Corpus Christi Bay are the existing monitoring programs, since these are the vehicles for continued, routine acquisition of data, and therefore form the backbone for determining the present water quality and any time trends. There are three major monitoring programs under way which contribute information on water and sediment quality of the bay, operated by the following agencies:

Texas Natural Resource Conservation Commission
(née Texas Water Commission)
Texas Parks & Wildlife Department
Texas Department of Health

The Texas Natural Resource Conservation Commission (TNRCC) Statewide Monitoring Network (SMN) is a major continuing source of a broad spectrum of data. The SMN sampling program is a program of sampling at fixed stations at regular intervals, usually carried out by headquarters, field and/or district offices of the TNRCC. Generally, field parameters are obtained *in situ*, by means of electrometric probes or portable analytical kits, and water/sediment samples are shipped to the external laboratories for analysis. (The laboratory used has varied over the years according to the parameter suite desired and to funds available for contracting. Past laboratories included the Texas State Department of Health, TNRCC/TWC Houston lab, Lower Colorado River Authority, Nueces County Health Department, and U.S. Corps of Engineers.) Parameters have been expanded from conventional variables in the early 1970's to trace constituents, pesticides and priority pollutants in recent years.

The term Statewide (a.k.a. Stream) Monitoring Network also refers to a data management system. The SMN data base is a digitized comprehensive data management program implemented on the TNRCC mainframe computer. The SMN data base includes all sampling activities of the Statewide Monitoring Network, as well as special studies (including microbiology and benthos) and Intensive Surveys. It also includes data from other agencies, notably Texas Water Development Board and the U.S. Geological Survey. There are over 1200 separate constituents with entries in the SMN data base, including water and sediment

Table 4-1
Current and historical sampling programs in Corpus Christi Bay study area providing data for CCBNEP Status and Trends analysis

Code	*Abbreviation*	*Agency or source*	*Project or Program*	*Format of source*	*Comments*
1	SMN	TNRCC	Statewide Monitoring Network	ASCII-coded data from TNRCC	Transferred by ftp via Internet, reformatted with special-purpose programs
2	CDS	TWDB	Coastal Data System	ASCII files	Multiple files, some combined some separated by contractor.
3	TPWD	TPWD	Coastal Fisheries Hydrographic obs	ASCII	Transported by diskette. Re-formatted with special-purpose codes
4	TGFOC	TPWD	Older hydrographic data from 1950's-1960's	hardcopy tables or field notes	Keyboarded by this project.
5	SWRI	Southwest Research Inst.	Corpus Christi Bay Project early-1970's	hardcopy typed images of field sheets	Keyboarded by this project.
6	TDH EST	Texas Dept of Health	Estuarine Data File	ASCII zipped from TSDH	Re-formatted with special-purpose codes
7	TSDH	Texas Dept of Health	Water chemistry program of 1960's and 1970's	ASCII archive files	Re-formatted with special-purpose codes

(continued)

Table 4-1 (continued)

Code	*Abbreviation*	*Agency or source*	*Project or Program*	*Format of source*	*Comments*
8	USCE7	Corps of Engineers Galveston District	O&M Division water & sediment 1970s data	hard-copy tabulations	Keyboarded by this project.
9	USCE8	Corps of Engineers Galveston District	O&M Division water & sediment 1980s data	hard-copy, some LOTUS	Keyboarded by this project. Some re-formatted.
10	USCE9	Corps of Engineers Galveston District	O&M Division water & sediment 1990s data	delimited-text ASCII from USCE	Some keyboarded by this project.
11	USGS	U.S. Geological Survey Corpus Office	Sediment chemistry & some hydrographic data	Digital QUATROPRO	Major re-formatting with special-purpose codes
12	BEG	Bureau of Economic Geology, UT	Submerged Lands Study sponsored by GLO	ASCII files	Minor re-formatting required.
13	SWRI TRL	Southwest Research Institute	Hydrographic data from 1976-77 Trawl Study	hard copy tables	Keyboarded by this project.
14	TAMU -40	Dept. Oceanogr. Texas A&M Coll.	Reynolds Metals Baseline Study	hard copy tables	Keyboarded by this project.
15	OXY CHEM	CCB Foundation/ Oxychem	La Quinta Channel Survey	hard copy	Keyboarded by this project.

(continued)

Table 4-1 (continued)

Code	*Abbreviation*	*Agency or source*	*Project or Program*	*Format of source*	*Comments*
16	MSI-LM	Marine Science Inst.—Whitledge	Laguna Madre nutrients data	digital EXCEL	Minor reformatting required.
17	MSI-NB	Marine Science Inst.—Whitledge	Corpus Christi & Aransas nutrients data	digital EXCEL	Minor reformatting required.
18	NOS	National Ocean Service of NOAA	National Status & Trends Project	digital download, but a mess	Extensive re-formatting required
19	USFWS	U.S. Fish & Wildlife Service	Corpus Christi Bay Project (late 1970's)	hard copy & graphical, very disorganized	Keyboarded by this project.
20	JMA	James Miertschin Associates	Hydrographic surveys of Nueces Bay 1990's	digital EXCEL	Minor reformatting required.
21	EMAP	Environmental Protection Agency	EMAP/REMAP	digital diskettes	Minor reformatting required.
22	CBI	Blucher Inst./ TAMU–CC	Hydrosonde data from CCBNEP area	digital ASCII Internet ftp	See discussion in text
23	TWDB	Texas Water Development Board	Hydrosonde data	digital ASCII Internet ftp	See discussion in text
24	MISC	TGFOC, Humble Oil, Sun Oil and others	Data from Laguna Madre surveys of 1940's and older data	hard copy	Keyboarded by this project. See discussion in text.

(continued)

Table 4-1 (continued)

Code	*Abbreviation*	*Agency or source*	*Project or Program*	*Format of source*	*Comments*
25	NCDH	Corpus Christi – Nueces County Health Department	Routine shoreline water quality surveys (coliforms only)	hard copy lab reports	Keyboarded by this project.
26	UTA-GEOL	Geology Dept Univ. of Texas	Masters thesis of Suter	hard copy tables	Keyboarded by this project.
27	USFWS-CCB	U.S. Fish & Wildlife Service, Corpus Christi lab	Contaminants assessment	Digital: spreadsheets	Minor reformatting required. (some parameters missing.)
28	TDH-TIS	Texas Department of Health	Seafood Safety Division tissue data	Hard copy tables	Keyboarded by this project.
29	TAMU-72	Texas A&M Univ. College Station	Estuarine systems Project	Hard copy tables in report	Keyboarded by this project.
30	TAMU-CCS	Texas A&M Univ. Corpus Christi Center for Coastal Studies	Nueces Marsh Mitigation Studies	Report and diskettes	Minor reformatting required.

parameters, and biological parameters. In the five years since the Galveston Bay NEP Status & Trends project, the TNRCC has implemented sweeping changes in the structure and operation of this data base.

The Texas Parks & Wildlife Department (TPWD) and its predecessor agencies, the Texas Game and Fish Commission and the Texas Game, Fish and Oyster Commission, have monitored the fishery resources of the system for many years, and in association with this obtains a limited suite of water-quality variables. These tend to focus on estuarine habitat characteristics, e.g. salinity, dissolved oxygen, turbidity and temperature. While the range of variables is obviously much more limited than that of the SMN, the temporal intensity of the program is much greater. The TPWD program obtains data somewhere in the system on virtually a daily basis, in contrast to the sampling interval of the SMN of one to several months. Further the spatial intensity is also greater. On the other hand, the TPWD samples a random network of stations, so there is no time continuity at a fixed point in the bay. The data is now entered into a digital data base at TPWD headquarters for detailed statistical analyses.

In order to regulate the harvesting of oysters in Corpus Christi Bay, the Seafood Safety Division (nee Shellfish Sanitation Division) of the Texas Department of Health (TDH) samples the bay at regular stations at varying temporal intensity, depending upon the season of year and upon the antecedent hydrological conditions. For the purpose of this program, the sampling is now limited to coliforms and a few associated hydrographic variables, salinity, temperature and pH. Like the TPWD, this program samples more intensely in space and time than the TNRCC SMN and has accumulated data from many years from Corpus Christi Bay. The collected data is maintained in a digital data base at TDH headquarters in Austin.

In addition, there are important recent or ongoing data collection programs in Corpus Christi Bay, also listed in Table 4-1, however these are not *monitoring* programs because they do not exhibit the regularity and time continuity implied by that term. One of the more important of these is the sampling performed by Galveston District Corps of Engineers in association with its Operations and Maintenance Program on navigation projects. This is intense sampling emphasizing sediment quality that is performed in association with dredging activities. The sampling interval is therefore dictated by the condition of the channel, i.e. sediment accumulation, and may be as long as several years. The Corps data program has been subdivided in Table 4-1 according to the suite of parameters obtained. Generally, there has been an evolution from an emphasis on conventional chemistry and metals to specific hydrocarbons.

Of the historical programs available, there are several which are noteworthy. The Texas Game, Fish and Oyster Commission (TGFOC) is the predecessor organization of the present TPWD, and has sampled the system on a routine basis back to the early 1950's, and on an occasional basis back to the Nineteenth Century. Data antedating 1975 is extremely inaccessible. Most of it is stored as hard-copy records (i.e., original field sheets) in a state warehouse in Olmeto. Unfortunately, the resources of this project did not permit the major effort that would be required to exhume and keyboard this old data. We did have access to some of this data copied in special project reports of the TGFOC, and extracted from older annual reports of the Coastal Fisheries Branch. This data was digitized and incorporated into the data base. It is urgent that an effort be made to recover the original data holdings and render them in a digital form for future researchers.

One of the major historical studies developed from the operation of the Ocean Science and Engineering Laboratory of Southwest Research Institute (SWRI) in Corpus Christi from the late-1960's to the mid-1970's. In concert with this lab, a routine monitoring program in Corpus Christi Bay was operated from 1970-75 with hiatuses due to shortage of funds. Also, several special-purpose studies (an example of focused research projects) were performed by the labs under sponsorship of regional agencies and industries. When SWRI closed the lab, all of its data holdings were removed and probably destroyed. SWRI would not disclose to these investigators whether or where the data presently exists, nor did SWRI extend any assistance in reconstructing the activities of this office. Fortunately, John Buckner of the Coastal Bend Council of Governments made available to this project his considerable archive of data from the system, that included reports from SWRI reproducing most of the measurements. These data were keyboarded for this project.

Another noteworthy program is the Submerged Lands Study of the University of Texas Bureau of Economic Geology, sponsored by the Texas General Land Office. This program, which focused entirely upon sediment, falls into the category of a survey, because it involved one-time only sampling. However, it is the only data set extant which sampled the *entirety* of Corpus Christi Bay at a uniform station distribution (1-mile), irrespective of the location of shoals, channels, navigation aids and reefs (which tend to spatially bias most measurements from the system).

4.2 Data Set Reports

For each of the 26 data programs listed in Table 4-1, a "Data Set Report" is presented in this section. This includes information on the source and procedures of the originator, including citations where appropriate. It also includes a description of any idiosyncrasies or inconsistencies in the data file, descriptions of errors, and how all of these were treated in compiling the source data files.

SOURCE DATA SET REPORT
Project Code 001

DATA SET: Statewide Monitoring Network, TNRCC

PROJECT ABBREVIATION: SMN

SOURCE: Texas Natural Resources Conservation Commission
P.O. Box 13087, Capitol Station
Austin, TX 78711

(and predecessor agencies: Texas Water Commission, Texas Department of Water Resources, Texas Water Quality Board)

CONTACT: Trey Murff (512-239-4596)

MEASUREMENTS:

The Statewide Monitoring Program obtains data on water, sediment and tissue samples from the freshwater and estuarine systems of the state, including the study area. The data are chiefly point measurements either by electrometric probe or by sample retrieval for laboratory analysis. Parameters have been expanded from conventional variables in the early 1970's to trace constituents, pesticides and priority pollutants in recent years. There are nearly 300 separate constituents with entries in the SMN data base for water, sediment and tissue matrices. However, for most of these only one or a few analyses have been made. An inventory of the parameters available for the CCBNEP area in the TNRCC data archive is given in Table SMN-1.

PROCEDURES:

The SMN sampling program is a continuing program of sampling at fixed stations at regular intervals, usually carried out by the field and/or District offices of the Texas Natural Resources Conservation Commission (TNRCC, and predecessor agencies, as listed above). Generally, field parameters are obtained *in situ*, throughout electrometric probes or portable analytical kits, and water/sediment samples are shipped to the laboratories of the Texas Department of Health (in early years), to District labs of TWC or to commercial labs (in recent years) for analysis.

In addition to the routine monitoring program, from time to time, the State performs Intensive Studies on a particular reach or watercourse. These TNRCC Intensive Studies are an important data source because the range of parameters sampled and the temporal intensity permit more detailed analysis of the water quality regime than is normally possible with the routine SMN observations.

Table SMN-1
Variables relating to water, sediment and tissue quality
in TNRCC data base for CCBNEP study area

STORET CODE	*variable name and units*	*number of data*
10	TEMPERATURE, WATER (DEGREES CENTIGRADE)	9264
11	TEMPERATURE, WATER (DEGREES FAHRENHEIT)	6507
20	TEMPERATURE, AIR (DEGREES CENTIGRADE)	2
21	TEMPERATURE, AIR (DEGREES FAHRENHEIT)	30
70	TURBIDITY, (JACKSON CANDLE UNITS)	1472
77	TRANSPARENCY, SECCHI DISC (INCHES)	959
78	TRANSPARENCY, SECCHI DISC (METERS)	353
80	COLOR (PLATINUM-COBALT UNITS)	23
81	COLOR,APPARENT(UNFILTERED SAMPLE) PLAT-COB UNITS	4
90	OXIDATION REDUCTION POTENTIAL (MILLIVOLTS)	5
94	SPECIFIC CONDUCTANCE,FIELD (UMHOS/CM @ 25C)	8806
95	SPECIFIC CONDUCTANCE (UMHOS/CM @ 25C)	2066
300	OXYGEN, DISSOLVED (MG/L)	9113
307	BIOCHEM OXY DEM,NIT INHIB DISS(MG/L, 5 DAY-20C)	1
308	BIOCHEM OXY DEM,NIT INHIB,TOT (MG/L,20 DAY-20C)	1
309	BIOCHEM OXY DEM,NIT INHIB DISS(MG/L,20 DAY-20C)	1
310	BIOCHEMICAL OXYGEN DEMAND (MG/L, 5 DAY - 20DEG C	563
314	BIOCHEM OXY DEM NIT INHIB, TOT (MG/L, 5 DAY-20C)	1
335	CHEMICAL OXYGEN DEMAND, .025N K2CR2O7 (MG/L)	102
339	CHEMICAL OXYGEN DEMAND, BOT. DEP. (MG/KG DRY WGT	76
340	CHEMICAL OXYGEN DEMAND, .25N K2CR2O7 (MG/L)	45
400	PH (STANDARD UNITS)	8341
403	PH (STANDARD UNITS) LAB	2507
410	ALKALINITY, TOTAL (MG/L AS CACO3)	2436
415	ALKALINITY, PHENOLPHTHALEIN (MG/L)	77
440	BICARBONATE ION (MG/L AS HCO3)	47
445	CARBONATE ION (MG/L AS CO3)	34
480	SALINITY - PARTS PER THOUSAND	1485
496	LOSS ON IGNITION, BOTTOM DEPOSITS (MG/KG)	243
500	RESIDUE, TOTAL (MG/L)	6
505	RESIDUE, TOTAL VOLATILE (MG/L)	6
510	RESIDUE, TOTAL FIXED (MG/L)	26
515	RESIDUE, TOTAL FILTRABLE (DRIED AT 105C),MG/L	13
530	RESIDUE, TOTAL NONFILTRABLE (MG/L)	3461
535	RESIDUE, VOLATILE NONFILTRABLE (MG/L)	3380
556	OIL & GREASE (FREON EXTR.-GRAV METH) TOT,REC,MG/	3
557	OIL & GREASE (FREON EXTR.-GRAV METH),BOT. DEPOS.	208
561	OIL & GREASE (FREON EXTR.-IR METHOD),BOT. DEPOS.	72
600	NITROGEN, TOTAL (MG/L AS N)	6
605	NITROGEN, ORGANIC, TOTAL (MG/L AS N)	7

Table SMN-1
(continued)

STORET CODE	*variable name and units*	*number of data*
610	NITROGEN, AMMONIA, TOTAL (MG/L AS N)	3434
615	NITRITE NITROGEN, TOTAL (MG/L AS N)	1206
620	NITRATE NITROGEN, TOTAL (MG/L AS N)	3327
625	NITROGEN, KJELDAHL, TOTAL, (MG/L AS N)	301
626	NITROGEN,ORG. KJEL.,BOT. DEPOS. (MG/KG-N DRY WGT	178
630	NITRITE PLUS NITRATE, TOTAL 1 DET. (MG/L AS N)	352
650	PHOSPHATE, TOTAL (MG/L AS PO4)	2470
660	PHOSPHATE, ORTHO (MG/L AS PO4)	1992
665	PHOSPHORUS, TOTAL, WET METHOD (MG/L AS P)	3336
668	PHOSPHORUS,TOTAL, BOTTOM DEPOSIT (MG/KG DRY WGT)	278
671	PHOSPHORUS, DISSOLVED ORTHOPHOSPHORUS(MG/L AS P)	2845
680	CARBON, TOTAL ORGANIC (MG/L AS C)	2562
681	CARBON, DISSOLVED ORGANIC (MG/L AS C)	1
684	CARBON, TOTAL ORGANIC, FILTERED (MG/L AS C)	5
900	HARDNESS, TOTAL (MG/L AS CACO3)	33
901	HARDNESS, CARBONATE (MG/L AS CACO3)	13
915	CALCIUM, DISSOLVED (MG/L AS CA)	1
916	CALCIUM, TOTAL (MG/L AS CA)	41
925	MAGNESIUM, DISSOLVED (MG/L AS MG)	6
927	MAGNESIUM, TOTAL (MG/L AS MG)	40
929	SODIUM, TOTAL (MG/L AS NA)	40
930	SODIUM, DISSOLVED (MG/L AS NA)	6
935	POTASSIUM, DISSOLVED (MG/L AS K)	1
937	POTASSIUM, TOTAL MG/L AS K)	1
940	CHLORIDE (MG/L AS CL)	3482
941	CHLORIDE, DISSOLVED IN WATER MG/L	717
945	SULFATE (MG/L AS SO4)	3378
950	FLUORIDE, DISSOLVED (MG/L AS F)	6
955	SILICA, DISSOLVED (MG/L AS SIO2)	1
1000	ARSENIC, DISSOLVED (UG/L AS AS)	6
1002	ARSENIC, TOTAL (UG/L AS AS)	120
1003	ARSENIC IN BOTTOM DEPOSITS (MG/KG AS AS DRY WGT)	261
1004	ARSENIC TOTAL IN FISH OR ANIMAL WET WGT (MG/KG)	41
1007	BARIUM, TOTAL (UG/L AS BA)	112
1008	BARIUM IN BOTTOM DEPOSITS (MG/KG AS BA DRY WGT)	226
1022	BORON, TOTAL (UG/L AS B)	22
1023	BORON IN BOTTOM DEPOSITS (MG/KG AS B DRY WGT)	47
1025	CADMIUM, DISSOLVED (UG/L AS CD)	6
1027	CADMIUM, TOTAL (UG/L AS CD)	132
1028	CADMIUM,TOTAL IN BOTTOM DEPOSITS (MG/KG,DRY WGT)	284
1029	CHROMIUM,TOTAL IN BOTTOM DEPOSITS (MG/KG,DRY WGT	278

Table SMN-1
(continued)

STORET CODE	*variable name and units*	*number of data*
1030	CHROMIUM, DISSOLVED (UG/L AS CR)	6
1034	CHROMIUM, TOTAL (UG/L AS CR)	119
1040	COPPER, DISSOLVED (UG/L AS CU)	16
1042	COPPER, TOTAL (UG/L AS CU)	128
1043	COPPER IN BOTTOM DEPOSITS (MG/KG AS CU DRY WGT)	277
1045	IRON, TOTAL (UG/L AS FE)	137
1049	LEAD, DISSOLVED (UG/L AS PB)	6
1051	LEAD, TOTAL (UG/L AS PB)	123
1052	LEAD IN BOTTOM DEPOSITS (MG/KG AS PB DRY WGT)	276
1053	MANGANESE IN BOTTOM DEPOSITS (MG/KG AS MN DRY WG	273
1055	MANGANESE, TOTAL (UG/L AS MN)	117
1065	NICKEL, DISSOLVED (UG/L AS NI)	6
1067	NICKEL, TOTAL (UG/L AS NI)	119
1068	NICKEL, TOTAL IN BOTTOM DEPOSITS (MG/KG,DRY WGT)	273
1075	SILVER, DISSOLVED (UG/L AS AG)	6
1077	SILVER, TOTAL (UG/L AS AG)	119
1078	SILVER IN BOTTOM DEPOSITS (MG/KG AS AG DRY WGT)	272
1090	ZINC, DISSOLVED (UG/L AS ZN)	6
1092	ZINC, TOTAL (UG/L AS ZN)	125
1093	ZINC IN BOTTOM DEPOSITS (MG/KG AS ZN DRY WGT)	268
1145	SELENIUM, DISSOLVED (UG/L AS SE)	6
1147	SELENIUM, TOTAL (UG/L AS SE)	56
1148	SELENIUM IN BOTTOM DEPOSITS (MG/KG AS SE DRY WT)	99
1149	SELENIUM, TOTAL IN FISH OR ANIMALS WET WGT MG/KG	13
31501	COLIFORM,TOT,MEMBRANE FILTER,IMMED.M-ENDO,	1224
31505	COLIFORM,TOT,MPN,CONFIRMED TEST,35C, #/100ML	171
31616	FECAL COLIFORM,MEMBR FILTER,M-FC BROTH, #/100ML	1082
31619	FECAL COLIFORM,MPN,BORIC ACID LACTOSE BR,#/100ML	159
31673	FECAL STREPTOCOCCI, MBR FILT,KF AGAR,35C,48HR	38
31679	FECAL STREPTOCOCCI,MF M-ENTEROCOCCUS AGAR,35C,48	26
32211	CHLOROPHYLL-A UG/L SPECTROPHOTOMETRIC ACID. METH	2817
32218	PHEOPHYTIN-A UG/L SPECTROPHOTOMETRIC ACID. METH.	2137
32231	CHLOROPHYLL B (MG/L)	4
32232	CHLOROPHYLL C (MG/L)	19
32730	PHENOLICS, TOTAL, RECOVERABLE UG/L	1
32734	PHENOLICS, TISSUE, WET WEIGHT, MG/KG	7
34204	ACENAPHTHYLENE WET WGTTISMG/KG	7
34209	ACENAPHTHENE WET WGTTISMG/KG	7
34224	ANTHRACENE WET WGTTISMG/KG	7
34241	BENZIDINE WET WGTTISMG/KG	7
34246	BENZO(K)FLUORANTHENE, TISSUE, WET WEIGHT, MG/KG	7

Table SMN-1
(continued)

STORET CODE	variable name and units	number of data
34251	BENZO-A-PYRENE, TISSUE, WET WEIGHT, MG/KG	7
34258	B-BHC-BETA, WET WGT TIS MG/KG	7
34263	DELTA BENZENE HEXACHLORIDE, WET WGT TIS MG/KG	7
34277	BIS (2-CHLOROETHYL) ETHER, TIS, WET WGT, MG/KG	7
34282	BIS (2-CHLOROETHOXY) METHANE, TIS,WET WGT, MG/KG	7
34287	BIS (2-CHLOROISOPROPYL) ETHER, TIS,WET WGT,MG/KG	7
34324	CHRYSENE, TISSUE, WET WEIGHT, MG/KG	7
34340	DIETHYL PHTHALATE WET WGTTISMG/KG	7
34345	DIMETHYL PHTHALATE WET WGTTISMG/KG	7
34350	1,2-DIPHENYLHYDRAZINE, TISSUE, WET WEIGHT, MG/KG	7
34354	ENDOSULFAN SULFATE DRY WGTBOTUG/KG	5
34355	ENDOSULFAN SULFATE, TISSUE, WET WEIGHT, MG/KG	7
34360	ENDOSULFAN,BETA TISSUE, WET WEIGHT, MG/KG	7
34370	ENDRIN ALDEHYDE, WET WGT,TISSUE, MG/KG	7
34380	FLUORANTHENE WET WGTTISMG/KG	7
34385	FLUORENE WET WGTTISMG/KG	7
34390	HEXACHLOROCYCLOPENTADIENE WET WGTTISMG/KG	7
34400	HEXACHLOROETHANE WET WGTTISMG/KG	7
34407	INDENO(1,2,3-CD) PYRENE, WETWGTTISMG/KG	7
34412	ISOPHORONE, WET WGTTISMG/KG	7
34432	N-NITROSODI-N-PROPYLAMINE, WET WGTTISMG/KG	7
34437	N-NITROSODIPHENYLAMINE, WET WGTTISMG/KG	7
34442	N-NITROSODIMETHYLAMINE, WET WGTTISMG/KG	7
34446	NAPHTHALENE, TISSUE, WET WGTTISMG/KG	7
34451	NITROBENZENE, TISSUE, WET WEIGHT, MG/KG	7
34465	PHENANTHRENE, TISSUE, WET WEIGHT, MG/KG	7
34473	PYRENE, TISSUE, WET WEIGHT, MG/KG	7
34530	BENZO(A)ANTHRACENE1,2-BENZANTHRACEN,TIS,WT,MG/KG	7
34540	1,2-DICHLOROBENZENE, TISSUE, WET WEIGHT, MG/KG	7
34555	1,2,4-TRICHLOROBENZENE, TISS, WET WEIGHT, MG/KG	7
34570	1,3-DICHLOROBENZENE, TISSUE, WET WEIGHT, MG/KG	7
34575	1,4-DICHLOROBENZENE, TISSUE, WET WEIGHT, MG/KG	7
34585	2-CHLORONAPHTHALENE, TISSUE, WET WEIGHT, MG/KG	7
34595	2-NITROPHENOL, TISSUE, WET WEIGHT, MG/KG	7
34600	DI-N-OCTYL PHTHALATE, TISSUE, WET WEIGHT, MG/KG	7
34605	2,4-DICHLOROPHENOL, TISSUE, WET WEIGHT, MG/KG	7
34610	2,4-DIMETHYLPHENOL, TISSUE, WET WEIGHT, MG/KG	7
34615	2,4-DINITROTOLUENE, TISSUE, WET WEIGHT, MG/KG	7
34620	2,4-DINITROPHENOL, TISSUE, WET WEIGHT, MG/KG	7
34625	2,4,6-TRICHLOROPHENOL, TISSUE, WET WEIGHT, MG/KG	7
34630	2,6-DINITROTOLUENE, TISSUE, WET WEIGHT, MG/KG	7
34635	3,3'-DICHLOROBENZIDINE, TISS, WET WEIGHT, MG/KG	7

Table SMN-1
(continued)

STORET CODE	*variable name and units*	*number of data*
34640	4-BROMOPHENYL PHENYL ETHER, TIS, WET WGT, MG/KG	7
34645	4-CHLOROPHENYL PHENYL ETHER, TIS, WET WGT, MG/KG	7
34650	4-NITROPHENOL, TISSUE, WET WEIGHT, MG/KG	7
34680	ALDRIN IN FISH TISSUE WET WEIGHT MG/KG	41
34682	CHLORDANE(TECH MIX & METABS),TISSUEWET WGTT,MG/K	41
34683	DI-N-BUTYL PHTHALATE, TISSUE, WET WGTWET WGT	7
34685	ENDRIN WET WGTTISMG/KG	41
34686	HEPTACHLOR EPOXIDE WET WGTTISMG/KG	23
34687	HEPTACHLOR WET WGTTISMG/KG	23
34688	HEXACHLOROBENZENE WET WGTTISMG/KG	41
34691	TOXAPHENE WET WGTTISMG/KG	23
39032	PCP (PENTACHLOROPHENOL) WHOLE WATER SAMPLE UG/L	9
39060	PCP (PENTACHLOROPHENOL) IN TISSUE WET WGT MG/KG	7
39061	PCP (PENTACHLOROPHENOL) IN BOT DEPOS DRY UG/KG	54
39062	CHLORDANE CIS ISOMER IN WHOLE WATER SAMPLE(UG/L)	5
39063	CHLORDANE-CIS ISOMER,TISSUE WET WGT (UG/G)	30
39064	CHLORDANE CIS ISOMER BOTTOM DEPOSITS(UG/KG DRY)	51
39065	CHLORDANE TRANS ISOMER, WHOLE WATER SAMPLE(UG/L)	5
39066	CHLORDANE-TRANS ISOMER,TISSUE WET WGT (UG/G)	30
39067	CHLORDANE TRANS ISOMER BOTTOM DEPOSITS UG/KG DRY	51
39068	CHLORDANE-NONACHLOR CIS,WHOLE WATER SAMPLE(UG/L)	1
39070	CHLORDANE NONACHLOR,CIS ISO BOT. DESPOSITS UG/KG	1
39071	CHLORDANE-NONACHLOR TRANS,WHOLE WATER SMPL(UG/L)	5
39072	CHLORDANE-NONACHLOR,TRANS ISO,TISSUE WETWGT UG/G	30
39073	CHLORDANE NONACHLOR,TRANS ISO BOT. DEPOS.(UG/KG)	51
39074	BHC-ALPHA ISOMER, TISSUE UG/G WET WT	33
39075	BHC-GAMMA ISOMER, TISSUE WET WGT (UG/G)	41
39076	BHC-ALPHA ISOMER, BOTTOM DEPOS (UG/KG DRY SOL)	51
39099	BIS(2-ETHYLHEXYL)PHTHALATE,TISS,WET WEIGHT,MG/KG	7
39100	BIS(2-ETHYLHEXYL) PHTHALATE,WHOLE WATER,UG/L	5
39102	BIS(2-ETHYLHEXYL) PHTHALATE SED, DRY WGT,UG/KG	24
39110	DI-N-BUTYL PHTHALATE,WHOLE WATER,UG/L	5
39112	DI-N-BUTYL PHTHALATE,SEDIMENTS,DRY WGT,UG/KG	24
39120	BENZIDINE IN WHOLE WATER SAMPLE (UG/L)	3
39300	P,P' DDT IN WHOLE WATER SAMPLE (UG/L)	5
39301	P,P' DDT IN BOTTOM DEPOSITS (UG/KG DRY SOLIDS)	50
39302	P,P' DDT IN TISSUE, WET WEIGHT (MG/KG)	33
39305	O,P DDT IN WHOLE WATER SAMPLE (UG/L)	5
39306	O,P' DDT IN BOTTOM DEPOSITS (UG/KG DRY SOLIDS)	51
39307	O,P DDT IN TISSUE, WET WEIGHT (UG/G)	33
39310	P,P' DDD IN WHOLE WATER SAMPLE (UG/L)	5
39311	P,P DDD IN BOTTOM DEPOSITS (UG/KG DRY SOLIDS)	51

Table SMN-1
(continued)

STORET CODE	*variable name and units*	*number of data*
39312	P,P' DDD IN TISSUE, WET WEIGHT (MG/KG)	33
39315	O,P DDD IN WHOLE WATER SAMPLE (UG/L)	5
39316	O,P DDD IN BOTTOM DEPOSITS (UG/KG DRY SOLIDS)	50
39320	P,P' DDE IN WHOLE WATER SAMPLE (UG/L)	6
39321	P,P DDE IN BOTTOM DEPOSITS (UG/KG DRY SOLIDS)	51
39322	P,P' DDE IN TISSUE, WET WEIGHT (MG/KG)	33
39325	O,P DDD IN TISSUE, WET WGT (UG/G)	33
39327	O,P DDE IN WHOLE WATER SAMPLE (UG/L)	5
39328	O,P' DDE IN BOTTOM DEPOSITS (UG/KG DRY SOLIDS)	51
39329	O,P DDE IN TISSUE, WET WGT (UG/G)	33
39330	ALDRIN IN WHOLE WATER SAMPLE (UG/L)	13
39333	ALDRIN IN BOTTOM DEPOS. (UG/KILOGRAM DRY SOLIDS)	134
39337	ALPHA BENZENE HEXACHLORIDE IN WHOLE WATER SAMPLE	5
39350	CHLORDANE (TECH MIX & METABS),WHOLE WATER,UG/L	13
39351	CHLORDANE(TECH MIX&METABS) SED,DRY WGT,UG/KG	134
39360	DDD IN WHOLE WATER SAMPLE (UG/L)	13
39363	DDD IN BOTTOM DEPOS. (UG/KILOGRAM DRY SOLIDS)	133
39365	DDE IN WHOLE WATER SAMPLE (UG/L)	13
39368	DDE IN BOTTOM DEPOS. (UG/KILOGRAM DRY SOLIDS)	134
39370	DDT IN WHOLE WATER SAMPLE (UG/L)	13
39373	DDT IN BOTTOM DEPOS. (UG/KILOGRAM DRY SOLIDS)	135
39376	DDT SUM ANALOGS IN TISSUE WET WT BASIS (UG/G)	38
39380	DIELDRIN IN WHOLE WATER SAMPLE (UG/L)	13
39383	DIELDRIN IN BOTTOM DEPOS. (UG/KILOGRAM DRY SOL.)	134
39388	ENDOSULFAN IN WHOLE WATER SAMPLE (UG/L)	4
39390	ENDRIN IN WHOLE WATER SAMPLE (UG/L)	13
39393	ENDRIN IN BOTTOM DEPOS. (UG/KILOGRAM DRY SOLIDS)	134
39400	TOXAPHENE IN WHOLE WATER SAMPLE (UG/L)	13
39403	TOXAPHENE IN BOTTOM DEPOS.(UG/KILOGRAM DRY SOL.)	134
39406	DIELDRIN IN AQ ORGANISMS WT WT BASIS (UG/G)	43
39410	HEPTACHLOR IN WHOLE WATER SAMPLE (UG/L)	34
39413	HEPTACHLOR IN BOT. DEP. (UG/KILOGRAM DRY SOLIDS)	134
39420	HEPTACHLOR EPOXIDE IN WHOLE WATER SAMPLE (UG/L)	33
39423	HEPTACHLOR EPOXIDE IN BOT. DEP. (UG/KG DRY SOL.)	134
39480	METHOXYCHLOR IN WHOLE WATER SAMPLE (UG/L)	34
39481	METHOXYCHLOR IN BOTTOM DEPOSITS (UG/KG DRY SOL.)	134
39515	PCBS (MG/KG) FISH TISSUE MG/KG	44
39516	PCBS IN WHOLE WATER SAMPLE (UG/L)	34
39519	PCBS IN BOTTOM DEPOSITS (UG/KG DRY SOLIDS)	137
39530	MALATHION IN WHOLE WATER SAMPLE (UG/L)	34
39531	MALATHION IN BOT. DEPOS. (UG/KILOGRAM DRY SOLIDS	45
39540	PARATHION IN WHOLE WATER SAMPLE (UG/L)	34

Table SMN-1
(continued)

STORET CODE	*variable name and units*	*number of data*
39541	PARATHION IN BOT. DEPOS. (UG/KILOGRAM DRY SOLIDS	131
39570	DIAZINON IN WHOLE WATER SAMPLE (UG/L)	13
39571	DIAZINON IN BOT. DEPOS. (UG/KILOGRAM DRY SOLIDS)	131
39600	METHYL PARATHION IN WHOLE WATER SAMPLE (UG/L)	9
39601	METHYL PARATHION IN BOT. DEPOS.(UG/KG DRY SOLIDS	126
39700	HEXACHLOROBENZENE IN WHOLE WATER SAMPLE (UG/L)	9
39701	HEXACHLOROBENZENE IN BOT DEPOS (UG/KG DRY SOLIDS	56
39704	HEXACHLOROBUTADIENE IN TISSUE,WET WGT (UG/KG)	7
39730	2,4-D IN WHOLE WATER SAMPLE (UG/L)	33
39731	2,4-D IN BOTTOM DEPOSITS (UG/KG DRY SOLIDS)	62
39740	2,4,5-T IN WHOLE WATER SAMPLE (UG/L)	33
39741	2,4,5-T IN BOTTOM DEPOSITS (UG/KG DRY SOLIDS)	62
39760	SILVEX IN WHOLE WATER SAMPLE (UG/L)	29
39761	SILVEX IN BOTTOM DEPOSITS (UG/KG DRY SOLIDS)	98
39782	LINDANE IN WHOLE WATER SAMPLE (UG/L)	34
39783	LINDANE IN BOTTOM DEPOSITS (UG/KG DRY SOLIDS)	134
50060	CHLORINE, TOTAL RESIDUAL (MG/L)	2
70211	TIDE, HIGH OR LOW,BEFORE OR AFTER,HOUR,MINUTE	239
70300	RESIDUE,TOTAL FILTRABLE (DRIED AT 180C),MG/L	383
70507	PHOSPHORUS,IN TOTAL ORTHOPHOSPHATE (MG/L AS P)	94
71890	MERCURY DISSOLVED, IN WATER (UG/L)	6
71900	MERCURY, TOTAL (UG/L AS HG)	125
71921	MERCURY,TOT. IN BOT. DEPOS. (MG/KG AS HG DRY WGT	279
71930	MERCURY,TOTAL IN FISH OR ANIMAL-WET WEIGHT BASIS	41
71936	LEAD,TOTAL IN FISH OR ANIMALS-WET WEIGHT BASIS	41
71937	COPPER,TOTAL IN FISH OR ANIMALS-WET WEIGHT BASIS	41
71939	CHROMIUM,TOT IN FISH OR ANIMALS-WET WEIGHT BASIS	41
71940	CADMIUM,TOTAL IN FISH OR ANIMAL-WET WEIGHT BASIS	41
78877	DIPHENYLAMINE, TISSUE, WET WEIGHT, MG/KG	7
79035	CHLOROPHENOL, TISSUE, WET WEIGHT, MG/KG	7
79036	4-CHLORO-3-CRESOL, TISSUE, WET WEIGHT, MG/KG	7
79037	2,6-DINITRO-2-CRESOL, TISSUE, WET WEIGHT, MG/KG	7
79038	BUTYLBENZYL PHTHALATE, TISSUE, WET WEIGHT, MG/KG	7
79039	BENZO(J)FLUORANTHENE, TISSUE, WET WEIGHT, MG/KG	7
79040	DIBENZ(A,H)ANTHRACENE, TISSUE, WET WEIGHT, MG/KG	7
79041	BENZO(GHI)PERYLENE, TISSUE, WET WEIGHT, MG/KG	7
79043	3-PYRIDINE CARBOXAMIDE, TISS, WET WEIGHT, MG/KG	1
81614	NUMBER OF INDIVIDUALS IN COMPOSITE TISSUE SAMPLE	37
81615	NUMBER OF SPECIES IN COMPOSITE TISSUE SAMPLE	47
81644	METHOXYCHLOR IN FISH TISSUE, UG/G WET WEIGHT	40
81896	DDE TOTAL IN TISSUE WET WEIGHT MG/KG	30
81897	DDD TOTAL IN TISSUE WET WT MG/KG	26

(NB, these are not the same as the Texas Water Development Board's Intensive Inflow Surveys.)

QUALITY ASSURANCE/QUALITY CONTROL: No formal QA/QC plan exists or is reported, and no information was available to this project regarding QA/QC practices. The early years, prior to, say, 1980, laboratory analyses were carried out by TSDH, presumably in conformance to the current edition of *Standard Methods* (e.g., APHA, 1985). In recent years, the commercial lab analyses can be safely assumed to have been performed in conformance to EPA protocols.

SAMPLING LOCATIONS:

The organization of sampling and analysis of surface waters of Texas is a system of segmentation. Each watercourse is divided into a series of "designated segments" and, perhaps, "undesignated segments." The great majority of SMN sampling stations are in undesignated segments. The designated segments are identified by a unique number, Table SMN-2. Until recently, this segment number was employed as a prefix to the permanent sampling station designations. Now, however, a single 5-digit station identifier has come into use.

Station location is effected by reference to proximate landmarks, e.g. bridge crossings, shoreline features, navigation aids, and so on, and in the open waters of the bay, by the time-honored method of "eye-balling". Latitude/longitude positions are provided as part of the TNRCC's descriptions of station location. In this project, these coordinates were verified by manually plotting the lat/long coordinates and comparing to station locations based upon the descriptive information on each station's position, the same information used to locate the station in the field. Some obvious errors were detected. For example, one station plotted squarely in the center of Commercial Street in downtown Aransas Pass. For some of the stations, the description was too vague to unambiguously position the station. The best information available for each station was used for a "best-guess" position on USGS 7.5-minute quads, and copies of the maps were sent to the TNRCC District Office for verification or correction. Jim Bowman of this office helped immeasurably by going through these maps and marking the real locations of his sampling stations.

New coordinates were determined for these corrected stations and keyboarded (and a data file with the corrected coordinates was sent to TNRCC in Austin). Even at this, however, some of the older stations, now discontinued but from which historical data is available, could not be precisely positioned based upon information at the District Office. Their locations were evidently part of the "institutional memory" at the Office, now lost due to staff turnover. A complete listing of the TNRCC sampling stations, both active and inactive, with best available coordinate positions is given in Table SMN-3.

Table SMN-2

Inventory of sampling stations represented in TNRCC data file for CCBNEP study area, by TNRCC segment

(TNRCC Station ID number of samples in record)

San Antonio-Nueces Coastal Basin			
2001	*Mission River Tidal*	*2471*	*Aransas Bay*
12943	116	13402	258
		13403	2
2003	*Aransas River Tidal*		
12930	91	*2472*	*Copano Bay / Port Bay / Mission Bay*
12945	118		
12946	5	13404	212
		13405	87
2463	*Mesquite Bay / Carlos Bay / Ayres Bay*	13660	18
13400	153		
13401	13	*2473*	*St. Charles Bay*
		13406	155
Nueces River Basin			
	2101	*Nueces River Tidal*	
12960	187	12961	51
Corpus Christi Estuary			
2481	*Corpus Christi Bay*	*2484*	*Corpus Christi Inner Harbor*
13407	498	13427	20
13408	59	13428	20
13409	412	13429	20
13410	458	13430	501
13411	173	13431	20
13412	56	13432	643
13413	2	13433	20
13414	2	13434	20
13415	2	13435	20
13416	2	13436	20
13417	9	13437	20
13418	2	13438	20
13419	3	13439	522

Table SMN-2
(continued)

		Corpus Christi Estuary (continued)		
2482	*Nueces Bay*		*2485*	*Oso Bay*	
13420		131	13026		54
13421		219	13027		16
13422		131	13028		83
13423		145	13029		58
13424		19	13440		53
13425		19	13441		1
			13442		89
2483	*Redfish Bay*				
13287		188			
13426		331			
		Upper Laguna Madre			
2491	*Laguna Madre*		*2492*	*Baffin Bay / Alazan Bay / Cayo del Grullo / Laguna Salada*	
13277		17	13031		1
13278		16	13033		128
13279		20	13034		24
13280		13	13035		10
13281		14	13450		186
13443		259	13451		13
13444		244	13452		194
13445		278	13453		5
13446		238	13454		2
13447		242	13455		2
13448		219	13456		3
13449		212	13457		2
			13458		3
		Gulf of Mexico			
		2501	*Gulf of Mexico*		
13461		511	13467		187
13462		117	13468		219
13463		115	13469		161
13464		4	13470		194
13465		240	13471		89
13466		5	13472		2

Table SMN-3

TNRCC Sampling Station Positions
in CCBNEP Study Area

Station ID	*Latitude deg*	*Latitude min*	*Longitude deg*	*Longitude min*	*Station ID*	*Latitude deg*	*Latitude min*	*Longitude deg*	*Longitude min*
12930	28	5.22	97	21.90	13426	27	53.34	97	6.60
12943	28	10.98	97	12.78	13427	27	48.78	97	24.66
12945	28	4.50	97	13.26	13428	27	48.96	97	25.20
12946	28	5.28	97	15.84	13429	27	49.02	97	25.44
12960*	27	50.78	97	31.49	13430	27	49.20	97	25.74
12961	27	53.76	97	37.74	13431	27	49.32	97	26.76
13026	27	38.40	97	20.70	13432*	27	49.13	97	27.24
13027	27	39.48	97	23.82	13433	27	48.96	97	27.66
13028	27	41.82	97	27.12	13434	27	49.02	97	28.20
13029	27	42.66	97	30.12	13435*	27	49.28	97	28.89
13031	27	28.68	94	47.04	13436	27	49.38	97	29.10
13033	27	32.28	97	49.44	13437	27	49.56	97	29.52
13034	27	16.38	97	48.24	13438	27	50.04	97	30.12
13035	27	13.68	98	5.52	13439	27	50.58	97	31.20
13277	26	33.42	97	25.56	13440	27	40.86	97	18.66
13278	26	33.30	97	25.74	13441	27	42.60	97	20.22
13279	26	33.36	97	25.62	13442	27	42.54	97	18.48
13280	26	33.24	97	25.68	13443	27	36.00	97	14.40
13281	26	33.48	97	20.46	13444	27	16.56	97	24.60
13287*	27	54.11	97	8.03	13445	27	28.74	97	19.26
13400*	28	9.30	96	51.71	13446	26	4.98	97	12.00
13401	28	11.34	96	50.58	13447	26	22.02	97	19.02
13402	28	0.06	97	1.68	13448	26	34.02	97	24.00
13403*	27	51.30	97	3.29	13449	26	46.98	97	28.02
13404*	28	7.20	97	1.32	13450*	27	16.00	97	29.62
13405*	27	59.74	97	10.08	13451	27	15.78	97	34.26
13406*	28	8.52	96	58.52	13452*	27	16.50	97	37.57
13407	27	48.66	97	18.06	13453	27	16.32	97	42.60
13408	27	38.16	97	14.34	13454	27	16.20	97	44.04
13409*	27	52.35	97	14.95	13455	27	18.24	97	38.76
13410*	27	48.52	97	23.26	13456	27	22.44	97	42.00
13411	27	45.06	97	21.90	13457	27	18.48	97	32.76
13412*	27	40.84	97	10.37	13458	27	21.66	97	29.64
13413	27	49.14	97	23.10	13461	29	39.84	93	49.74
13414	27	46.98	97	18.00	13462	29	40.02	94	4.26
13415*	27	48.63	97	14.30	13463	29	33.48	94	21.24

(continued)

Table SMN-3

(continued)

Station ID	*Latitude deg*	*Latitude min*	*Longitude deg*	*Longitude min*	*Station ID*	*Latitude deg*	*Latitude min*	*Longitude deg*	*Longitude min*
13416	27	48.24	97	14.64	13464	29	22.98	94	43.02
13417*	27	49.63	97	8.89	13465	29	19.92	94	40.20
13418	27	50.10	97	8.76	13466	29	5.52	95	6.36
13419	27	50.64	97	3.48	13467	28	24.24	96	18.30
13420*	27	50.72	97	22.12	13468*	27	49.75	97	1.98
13421*	27	50.40	97	22.60	13469	26	34.02	97	16.02
13422	27	49.98	97	24.96	13470	26	4.02	97	7.98
13423*	27	51.42	97	24.13	13471	29	15.00	94	51.00
13424	27	51.42	97	25.44	13472	27	55.02	97	1.86
13425	27	51.06	97	28.86	13660	28	18.18	97	6.72

*corrected coordinates

DISCUSSION:

The SMN data base is a digitized comprehensive data management program implemented on the TNRCC mainframe computer and operated in coordination with the Texas Natural Resources Information System of the Texas Water Development Board. The SMN data base includes all sampling activities of the Statewide Monitoring Network, as well as special studies (including microbiology and benthos) and Intensive Surveys. Parameter data are identified by STORET codes, 5-digit identifiers that uniquely specify a water quality variable, including method of analysis and reporting units.

Some of the general problems of data compilation are illustrated by the TNRCC data file, which in principle should be the simplest of all to process. These investigators had originally planned to utilize programs codes developed during the Galveston Bay National Estuary Program specifically for treating the downloading procedures employed by (then) the Texas Water Commission. However, it was necessary to develop new codes for reading and reformatting this data set, because TNRCC now uses a completely different data-processing format and retrieval procedure from that employed only a few years ago. While this was an unexpected delay, the new downloading procedures are much improved over those in use in 1990. In the report for that project, Ward and Armstrong (1992) were extremely critical of the primitive methods and the great effort necessary to recover a computer-manipulable data base. At that time, almost all data retrievals were provided to a requestor as *hard-copy* tabulation. For the GBNEP project, a page-image file on magnetic tape was downloaded, so that a special-purpose program had to be devised to read this massive file, with logic to detect page headers, column headers, data versus textual entries, numeric versus textual information, and to detect the presence of pre-specified parameter codes. The data was then stripped out and re-written to smaller ASCII files for further processing. Now, a completely new data-processing format and retrieval procedure has been implemented, allowing much more sensible digital transfer. For this project, the download was accomplished via FTP on the Internet. The greatest inconvenience was the TNRCC-staff effort necessary to pull together the TNRCC data for the project area and create the mainframe file for downloading, but this was minor compared to the old process of generating line images of a printer file.

It will be noted from Table SMN-1 that some variables are present in alternative units or alternative representations. For example, temperature is reported in both degrees Fahrenheit (STORET Code 11) and degrees Celsius (Code 10), and Secchi depth is reported in both meters (Code 78) and inches (Code 77). Salinity (Code 480) is reported separately from its usual measure of conductivity (Codes 94 and 95). In many cases, one of these is obtained from the other by simple conversion, for example the entries for temperature, or organic nitrogen (Code 605) which is in fact the difference of Kjeldahl (Code 625) less ammonia (Code 610). But in other cases, these represent independent measurements; for Secchi depth, for instance, the measurement is reported either in inches or meters but not both. Therefore, in processing this data set, no assumptions can be made about parameter conversions or interrelations, but instead the set of measurements for each variable must be examined independently.

With respect to the tissue data, one idiosyncrasy of the data maintenance procedures was encountered almost immediately: while station, date, time and parameter concentration are dutifully entered, there is no information in the magnetic data base on the organism, or whether the analysis was performed on the whole specimen or specific organs. It was necessary for the TNRCC staff to retrieve the original sample tag information. Even at this, for over 30% of the tissue data the organism could not be determined. These data are retained in the present CCBNEP compilation but assigned an organism code of 00, meaning no information.

Because there is a high cook-to-broth ratio in the maintenance of the SMN data base, the values must be studied and cross-checked. An example of anomalies latent in the data is given by the salinity measures of conductivity (compensated to a standard temperature of 25°C) and chlorides, one of the few parameters for which multiple alternative measurements are available. In the Statewide Monitoring Network data, both field and laboratory conductivity measurements may be presented, and occasionally there may be a laboratory determination of chlorides as well. Where all three variables were measured, we can test the internal consistency of the data. This was carried out by Ward and Armstrong (1992) in the Galveston Bay NEP data compilation, and major problems with the historical data base were uncovered. For Corpus Christi Bay, this same analytical approach was repeated, and the same problems are evident in the data base for this estuary as well. However, in this study we gained additional insight into the sources of the discrepancies.

A clear manifestation of a problem is wide scatter in the field versus laboratory measurements of conductivity, as shown in Fig. SMN-1. Considering that conductivity probes are among the simplest instruments to maintain and employ, and granting that some noise may be expected due to the hostile conditions of field measurements, this scatter is excessive, and does not engender comfort in the overall quality of the data base. After study of that subset of over 1500 measurements for which simultaneous values for both conductivities and chlorides are given, our conclusion is that most of the "noise" is contributed by the laboratory conductivities. Part of this widespread discrepancy is due simply to degraded accuracy in the laboratory determinations. The lab conductivities are often at variance with the field values, relative to the titration for chlorides (as will be shown below), and are much more prone to aberrant values. We can only speculate as to the cause of this degraded accuracy. The lab samples analyzed by the Texas State Department of Health, especially in the 1970's and early 1980's, were subjected to extreme dilution to bring the conductivity into the narrow, low range of the laboratory meter, then the measured value was scaled back up by the reciprocal of the dilution. The larger the sample salinity, the greater the dilution necessary. This introduces several potential sources of error: the dilutions may be performed imprecisely; nonlinear variation of conductivity with salinity, though slight, may be sufficient to corrupt the measurement when large dilutions are needed; the calculations necessary are subject to arithmetical mistakes. Though field conductivity meters (which use a submerged probe and direct on-deck readout) are presumably less accurate than laboratory meters, they measure conductivity directly without any necessity for dilution. (The exception, of course, is when extraordinarily high salinities are encountered, e.g. in excess of 40 ‰, but even here, only a twofold or threefold dilution is necessary, which can be effected with reasonable accuracy.)

This is not the only source of error in laboratory conductivity values. Another contributor to the scatter is due to the fact that a significant proportion of the reported laboratory values are not really measurements, but are "invented data," i.e. entries Based On Graphical or Arithmetical Suppositions, BOGAS data. The BOGAS data were discovered in scatterplots of lab conductivity versus either field conductivities or chlorides, in which there appeared two definite regressions, of which one corresponded to the theoretical relation. This is particularly evident in the plot of lab conductivity versus chlorides, in which some of the data fall along a line with almost *zero* scatter, see Fig. SMN-2. This line proved to be the relation $y = x \cdot 4 = x \cdot 8/2$. The theoretical relation between conductivity and chlorides is given approximately by $y=x \cdot 5/2$. We infer that for much of the data set, only one of chlorides or conductivity was actually measured, and the other was computed based upon the correct rule of thumb that conductivity is 5/2 times chlorides, and upon the (incorrect) rule that conductivity is 8/2 times chlorides. A comparison of the *field* conductivities and the chlorides shows a well-behaved relation that centers upon the theoretical oceanographic relation, with realistic scatter, Fig. SMN-3. (In the case of Galveston Bay there was one more indication, in that the

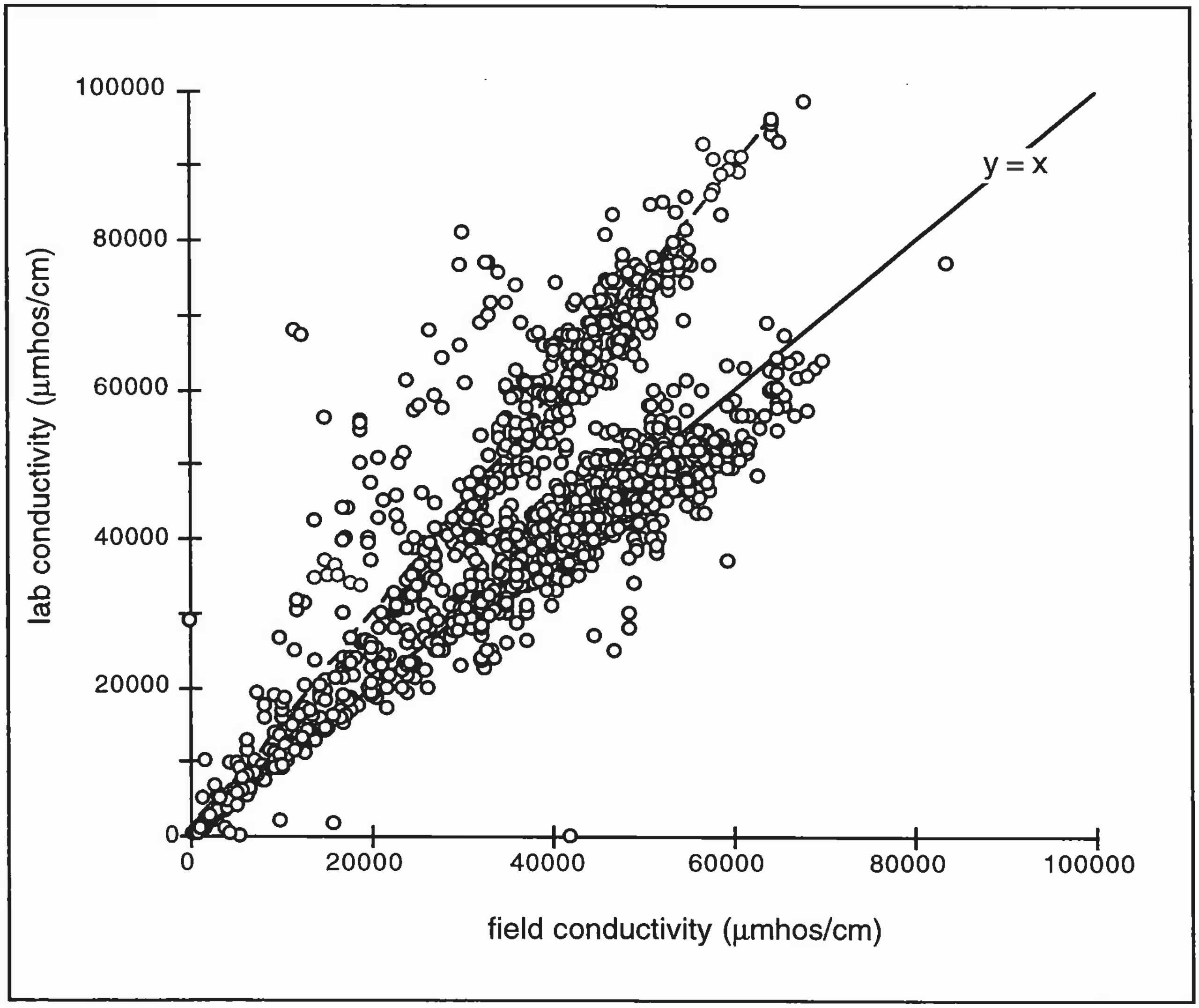


Figure SMN-1. Scatterplot of field and laboratory conductivities from SMN data base for Corpus Christi Bay system

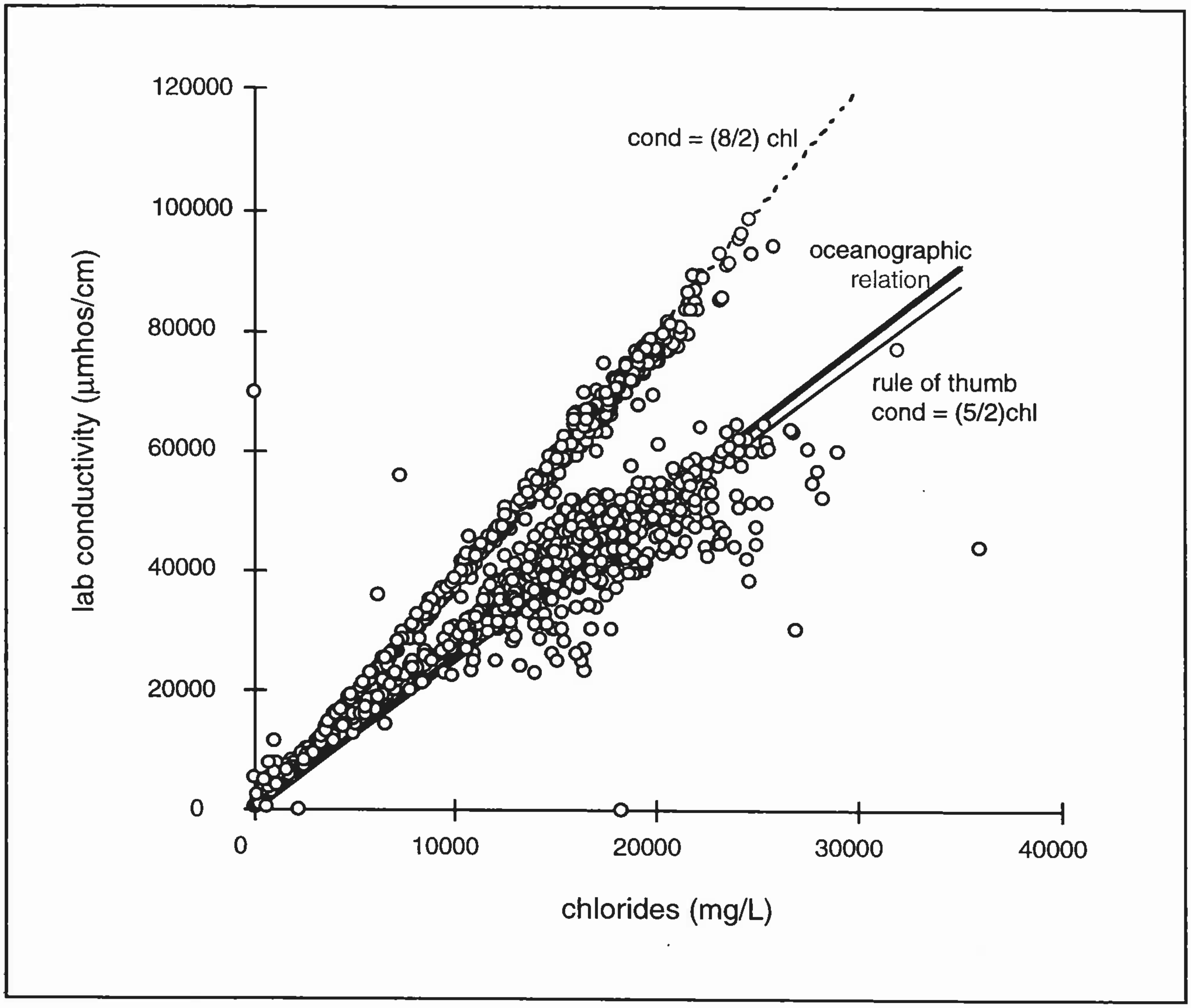


Figure SMN-2. Scatterplot of lab conductivity versus chlorides from SMN data base for Corpus Christi Bay system.

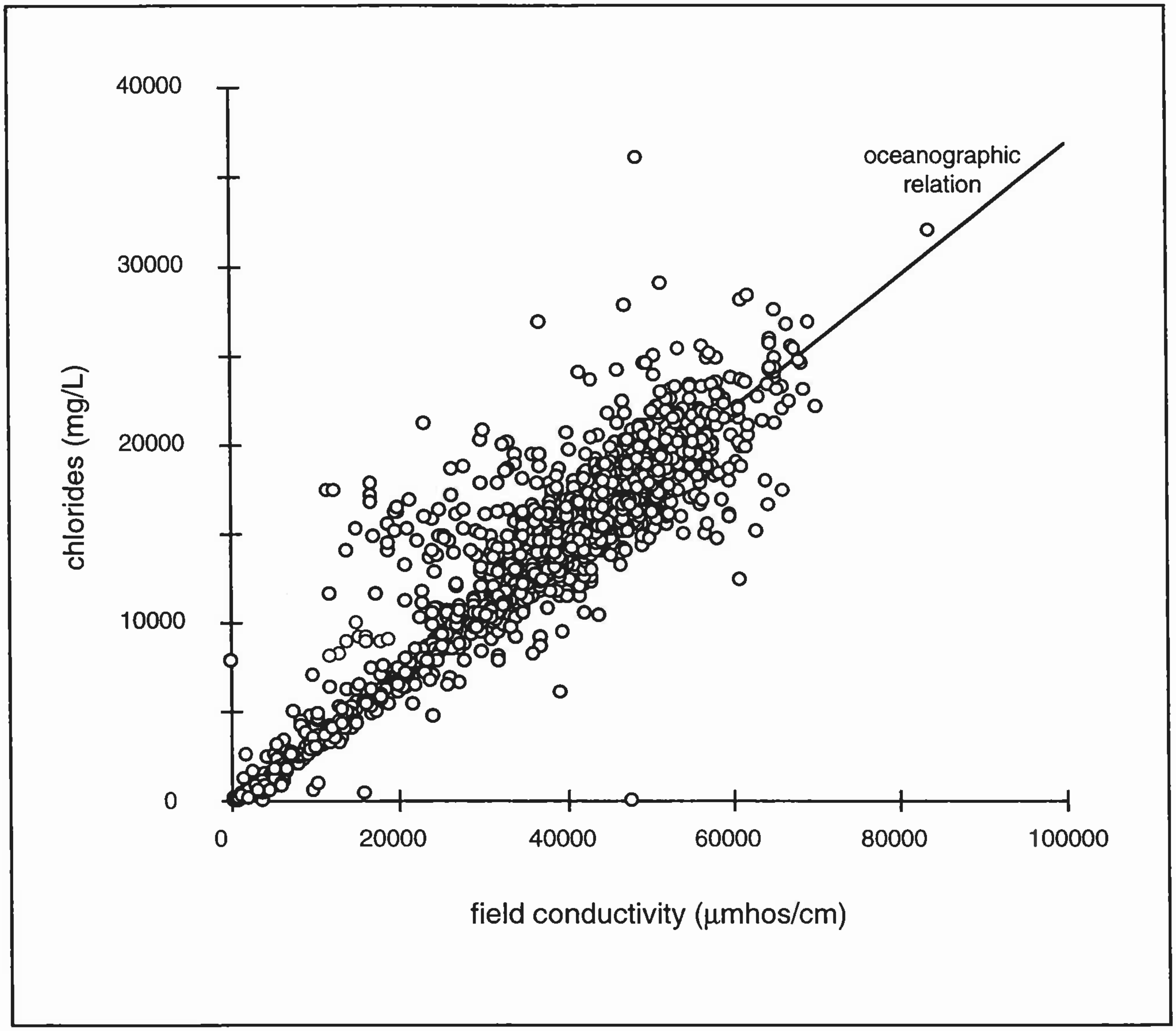


Figure SMN-3. Scatterplot of chlorides versus field conductivity from SMN data base for Corpus Christi Bay system.

lab conductivities were systematically larger than the field values by about 40%, see Ward and Armstrong, 1992).

We conclude that the lab *chlorides* and *field conductivity* values are real and the *lab conductivities* are BOGAS. We note that this practice of supplying BOGAS data, apart from corrupting the data base with non-measured values, offers one more degree of freedom for human error, and indeed this is almost certainly the reason for the second spurious regression in Figure SMN-2. (In the analysis of data from Galveston Bay, Ward and Armstrong, 1992, speculated that this erroneous regression corresponded to a relation of $y = 15/4 \cdot x$. From the Corpus data, the relation appears to be closer to 16/4, i.e. 8/2, which seems more likely as an errant version of the accurate rule of thumb of 5/2. In the larger data base for Galveston Bay, the data also revealed a few tens of points falling on the lines $y=7/4 \cdot x$ and $y= 25/4 \cdot x$, apparently also wrong rules-of thumb.) In this compilation, we need to expunge the BOGAS data from the data base.

The reader may infer that the laboratory involved, probably Texas Department of Health, has now been exposed in some sort of fraudulent practice. This would be an unfair and inappropriate judgment. One must consider the objectives of a data base such as the SMN. On the one hand, this is a permanent digital archive for all water-quality measurements performed by the TNRCC and predecessor agencies. On the other hand, this data base is the foundation for various analyses of water quality, including statistics and model validation, carried out by the agency. These objectives are potentially in conflict. To satisfy the archival objective, the actual measurements must be preserved, without any modification, even conversion of units (which can distort the precision of the original measurement). To satisfy the analytic objective, continuity in the suite of measurements in both space and time is necessary to maximize the available data base, which requires consistency in variables reported and their units. So long as the same variables are measured in the same units, there is no conflict between these objectives. Once the suite and/or units are altered, then the conflict arises. Over the past three decades, there have been many modifications to both the suite and units in water-quality surveys, and the TNRCC in trying to have its SMN data base satisfy both objectives has compromised its archival integrity. In the early period of data collection, the lab conductivity was almost always available, so it is easy to see that it would be desirable to maintain a continuity of record by supplying a "lab conductivity" when the actual measurement was chlorides or field conductivity. In all likelihood this would have been done by hand calculation either in the lab report or at the data-entry stage. The problem with the SMN practice is not this entry of BOGAS data *per se*, but the failure to flag BOGAS data and the failure to verify the calculation.

In summary, there is suspicion attaching to the SMN lab conductivities. Given this, it will probably be little surprise that similar problems were encountered with the Texas State Department of Health and TWDB Coastal Data System data bases. In this compilation, conductivity and/or chlorides were converted to equivalent salinity for entry in the CCBNEP data base. A priority of usage was observed of chlorides (3682 measurements), followed by field conductivity (6338 measurements), followed by lab conductivity. Therefore, lab conductivity data were used only when other measures were unavailable (only 19 measurements in all). One lone entry of salinity (Code 480) without an accompanying value of conductivity or chlorides was encountered: we have no earthly idea how this was measured.

Other problems with the data base include apparent data entry errors, especially unrealistically large values. For compilation purposes, these were allowed to stand, but will be screened out in the analysis stages. Also, there are numerous instances of zeroes that seem suspiciously unlikely. One danger, attending especially to standard FORTRAN input commands in conjunction with the punched-card inputs of the 1970's, is interpretation of blanks (non-measured data) as zeroes. This appears to have significantly corrupted the TWDB Coastal Data System (see Project Code 02) and may have infected the SMN data base as well. For example, in the data run of 16 January 1974, every turbidity measurement except one is reported as 0.0, a most unlikely circumstance. In addition to frequent entries of zero, occasionally we find the same non-zero number entered for many stations. For example, in the data run of 16 January 1974 (the same one just cited with the zero turbidities), the TSS for every station is 10 mg/L (which just happens to be the detection limit). For the surveys of 17 April and 20 May 1969, almost all of the ammonia entries are 1 mg/L (which just happens to be the detection limit), and for nearly all of the data from 1970, and much of the data from 1971-1974, the ammonia values are 0.1 mg/L (which again just happens to be the detection limit). Almost all of the BOD's for the survey of 10 August 1982 are 2.0 mg/L. Almost all of the total phosphorus entries for 1969 are 0.065 mg/L. The problem with these kinds of entries is that they do not fall into the category of being a "patently obvious" anomaly, nor is there any rational means for their correction, if indeed a correction is warranted. Further, even if they are determined to be errant, since their magnitude is "about right" they cannot be expunged by some automatic criterion, but rather have to be sniffed out and deleted manually.

REFERENCES:

Ward, G., and N. Armstrong, 1992: *Ambient water and sediment quality of Galveston Bay: Present status and historical trends.* Report GBNEP-22 (5 volumes), Galveston Bay National Estuary Program, Webster, Texas.

Texas Water Commission, 1990. The State of Texas Water Quality Inventory, 10th Edition 1990. TWC, Austin, Texas.

SOURCE DATA SET REPORT
Project Code 002

DATA SET: Texas Water Development Board Coastal Data System

PROJECT ABBREVIATION: TWDB-CDS

SOURCE: Texas Water Development Board
S.F. Austin Building
Austin, Texas 78711

CONTACT: Dr. David Brock (512-936-0819)

MEASUREMENTS:

General hydrographic and indicator parameters: conductivity (μmhos), temperature (°C), pH, dissolved oxygen (ppm), turbidity (JTUs), Secchi depth (cm); vertical profiles at various intervals, typically 5 ft.

Analyses (by TSDH for older data) for: CO2, carbonate as CaCO3, total phosphate [these through 1980], BOD (5 day), alkalinity & hardness as CaCO3, HCO3 ion, nitrogen series, phosphates, and carbon nutrients, calcium, magnesium, sodium, potassium, sulfate, chlorides, fluorides, silica, elemental metals and selected organic contaminants, especially pesticides. Generally, there is by far a larger data set on standard analyses than on trace contaminants.

PROCEDURES:

Specific procedures vary depending upon the particular data-collection entity (see below). For state-collected water samples, the analyses are performed by the Texas State Department of Health Austin laboratories. Many *in situ* measurements are made with State Hydrolabs. In recent years, the TWDB has been experimenting with the deployment of automatic recording hydrosondes.

QUALITY ASSURANCE/QUALITY CONTROL:

No formal QA/QC plan exists or is reported, and no information is available as to QA/QC practices.

STATION LOCATION:

TWDB station locations are expressed in terms of the line-site system instituted in the 1960's for the USGS routine surveys carried out as a part of the Bays and Estuaries Program of TEDB. The TWDB assigns an approximate line-site station based upon the sample location of the originating agency. These line-site positions have been plotted and their coordinates determined. The location coordinates for all line-site stations in the TWDB CDS were determined and are listed in Table CDS-1

Table CDS-1
Texas Water Development Board Coastal Data System
Sample station locations (CCBNEP study area)

Station designation		*latitude*			*longitude*		
line	*site*	*deg*	*min*	*sec*	*deg*	*min*	*sec*
13	2	27	53	44	97	37	41
13	3	27	50	00	97	40	00
15	2	28	11	31	97	01	05
22	2	27	51	38	97	33	19
25	2	27	45	35	97	30	18
26	2	28	06	54	97	17	39
30	2	27	51	25	97	25	28
31	2	28	04	16	97	18	03
34	2	28	04	55	97	16	38
37	2	28	01	58	97	08	32
38	2	27	50	35	97	30	18
44	1	28	03	31	97	09	25
44	2	28	04	31	97	13	03
44	3	28	05	16	97	15	42
47	2	27	51	18	97	27	10
47	3	27	50	56	97	27	05
53	1	27	51	43	97	25	29
53	2	27	51	25	97	25	28
53	3	27	50	56	97	25	26
53	4	27	50	27	97	25	23
53	5	27	49	57	97	25	20
54	1	28	04	52	97	05	48
54	2	28	06	12	97	07	04
54	3	28	07	54	97	08	40
54	4	28	08	59	97	09	41
54	5	28	10	53	97	11	27
64	1	27	50	58	97	21	40
64	2	27	50	59	97	22	32
64	3	27	50	57	97	22	32
64	4	27	50	56	97	21	40
64	5	27	50	54	97	21	40
64	6	27	50	43	97	22	00
64	7	27	50	41	97	22	00
64	8	27	50	39	97	22	00
64	9	27	50	17	97	22	32
64	10	27	50	15	97	22	32
64	11	27	50	13	97	22	32
64	12	27	50	09	97	22	40

(continued)

Table CDS-1
(continued)

Station designation line	site	latitude deg	min	sec	longitude deg	min	sec
65	1	28	06	07	97	03	09
65	2	28	07	27	97	03	27
65	3	28	08	47	97	03	47
65	4	28	10	20	97	04	08
71	2	27	50	35	97	31	16
77	1	28	07	58	97	00	41
77	2	28	07	14	97	01	24
77	4	28	07	12	97	01	14
83	2	27	49	24	97	29	07
89	2	28	13	05	96	57	20
93	2	27	49	03	97	27	13
96	2	28	14	40	96	57	28
100	2	28	07	57	96	58	07
100	6	28	08	40	96	56	50
104	2	28	08	16	96	54	28
104	4	28	06	23	96	57	08
104	6	28	06	33	96	58	12
104	7	28	06	40	96	50	15
104	8	28	06	44	96	59	34
104	10	28	06	53	97	00	33
108	2	27	48	49	97	24	56
110	2	28	08	16	96	54	28
115	3	28	08	11	96	53	56
115	4	28	08	02	96	53	44
115	5	28	07	55	96	53	31
115	6	28	07	44	96	53	15
115	7	28	07	34	96	52	58
115	9	28	07	40	96	53	50
118	1	27	48	43	97	23	42
118	2	27	48	45	97	23	42
120	1	28	03	52	96	58	15
120	2	28	04	26	96	59	35
120	3	28	04	58	97	00	48
120	4	28	05	25	97	01	51
122	1	27	51	39	97	19	21
122	2	27	51	05	97	19	31
122	3	27	50	29	97	19	43
122	4	27	49	54	97	10	53
122	5	27	49	18	97	20	04

(continued)

Table CDS-1
(continued)

Station designation line	site	latitude deg	min	sec	longitude deg	min	sec
122	6	27	48	38	97	20	17
122	7	27	47	47	97	20	33
122	8	27	47	22	97	20	41
122	9	27	46	57	97	20	48
122	10	27	46	32	97	20	55
122	11	27	46	08	97	21	03
122	12	27	45	43	97	21	11
122	13	27	45	18	97	21	19
122	14	27	44	53	97	21	26
122	15	27	44	28	97	21	35
127	2	27	51	17	97	15	57
127	3	27	49	57	97	16	26
127	4	27	48	37	97	16	55
127	6	27	46	32	97	17	41
127	7	27	45	17	97	18	08
127	8	27	43	46	97	18	42
131	1	27	52	31	97	15	29
133	1	28	01	00	96	58	38
133	2	28	01	32	97	00	22
133	3	28	01	50	97	01	17
141	1	27	57	23	97	00	13
141	2	27	57	50	97	01	54
141	3	27	58	15	97	03	18
141	4	27	58	41	97	04	52
142	1	27	48	55	97	12	44
142	2	27	48	20	97	12	59
142	3	27	47	43	97	13	17
142	4	27	47	04	97	13	35
142	5	27	46	26	97	13	52
142	6	27	45	48	97	14	10
142	7	27	45	10	97	14	27
142	8	27	44	32	97	14	45
142	9	27	43	54	97	15	03
142	10	27	43	15	97	15	20
142	11	27	42	38	97	15	38
147	1	27	49	00	97	08	22
147	2	27	47	20	97	09	26
147	3	27	45	30	97	10	36
147	4	27	43	35	97	11	17
147	5	27	41	40	97	11	59

(continued)

Table CDS-1
(continued)

Station designation		*latitude*			*longitude*		
line	*site*	*deg*	*min*	*sec*	*deg*	*min*	*sec*
147	9	27	30	12	97	18	10
147	10	27	30	14	97	18	12
147	11	27	30	16	97	18	14
151	2	27	50	31	97	09	37
152	2	27	52	20	97	07	03
159	1	27	51	50	97	04	52
159	2	27	51	52	97	05	38
159	3	27	51	54	97	05	50
159	4	27	52	37	97	05	04
159	5	27	52	35	97	05	38
159	6	27	52	28	97	05	38
159	7	27	53	26	97	06	35
159	8	27	53	22	97	06	33
159	9	27	53	37	97	07	00
159	10	27	53	47	97	08	05
159	11	27	53	56	97	08	19
165	2	27	52	32	97	02	50
168	1	27	50	25	97	04	55
168	2	27	50	23	97	04	55
168	3	27	50	21	97	04	55
170	1	27	41	03	97	12	06
170	2	27	41	11	97	12	48
170	3	27	41	08	97	13	32
170	4	27	41	23	97	14	32
170	5	27	52	35	97	05	38
170	8	27	53	22	97	06	33
170	10	27	53	47	97	08	05
170	11	27	53	56	97	08	19
172	10	27	58	41	97	04	52
183	1	27	37	56	97	13	55
183	2	27	37	54	97	13	55
183	3	27	38	11	97	14	21
183	4	27	37	52	97	13	55
183	6	27	39	30	97	15	38
183	7	27	39	30	97	15	45
200	1	27	43	07	97	19	52
200	2	27	42	36	97	18	27
271	2	27	51	17	97	15	57
901	2	27	49	55	97	02	06

(continued)

Table CDS-1
(continued)

Station designation		*latitude*			*longitude*		
line	*site*	*deg*	*min*	*sec*	*deg*	*min*	*sec*
901	70	27	49	35	97	01	35
901	70	27	49	15	97	00	02
910	2	27	48	30	96	57	00
910	70	27	45	10	96	54	20
183	5	27	38	41	97	14	46
47	4	27	50	22	97	27	05
47	5	27	49	48	97	27	05
127	1	27	52	06	97	16	00
127	10	27	42	52	97	18	23
131	2	27	52	21	97	15	00
127	5	27	47	34	97	17	18
902	2	27	49	13	97	00	51

DESCRIPTION & COMMENTS:

This is the basic data set used by the TWDB for studies of the Bays & Estuaries of Texas. Since the late 1960's the TWDB has sponsored data collection in the bays and estuaries of Texas, with the overall purpose of determining the relations between freshwater inflow and the "health" of the estuary. The actual data collection has been performed through contract with federal agencies (notably the U.S. Geological Survey), state agencies, consulting firms, and universities, as well as by the personnel of the TWDB itself. The objectives, methods, and procedures have been therefore widely variable. Management of the data base is the primary responsibility of the B&E staff of TWDB, although the data base is part of TNRIS.

The purpose of the Coastal Data System is the analyses of relations between measures of estuary health and measures of hydrography. Its objective is not archival maintenance of the data. This is unfortunate, because for most of the data-collection projects sponsored by TWDB, the Coastal Data System is the only digital record of the data collected. It was originally housed on the TNRCC mainframe, but with the impending demise of that system, the CDS has degenerated to a lengthy catalog of files maintained on various platforms, the files corresponding to older surveys of the Bays & Estuaries Program, to data from past contractors, and to data from cooperative studies of several state agencies. Moreover, no single individual seems to have control or management authority. We had to make repeated, increasingly specific requests over a sustained period to obtain all holdings for the Corpus Christi Bay study area, and discovered, too late, that these did not include the intensive inflow studies because these were in the possession and use of yet other members of the TWDB staff.

The fact that the Coastal Data System is primarily a research-support data base rather than an archival data-base means that the data is massaged in various ways as it is incorporated into the data base, and one cannot necessarily recover the raw records from the primary data collection entity. For example, the station locations are related to the (rather imprecise) line-site system instituted in the 1960's for the USGS routine surveys. Also, error detection seems to be rather *ad hoc* with no formal procedure for proofing input data or screening for aberrants. (In this compilation, for example, the field measurements at depth 34 ft at station 376-2 from 6 October 1970 were discovered to have also been entered as 6 October 1972, an entry error that will defy most traditional screening procedures.) Numerous zero values of turbidity, dissolved oxygen, metals and hydrophobic organics are entered into the data from the 1970's. The latter could mean "below detection limits" though no information on the detection limits is available from TWDB, but the turbidity and dissolved oxygen zeroes look suspiciously like blanks incorporated into the data file as zeroes. There is, however, no practical way for TWDB to verify these data.

Reference is made to the data report for the Texas Natural Resources Conservation Commission Statewide Monitoring Network (SMN, Project 001), in which various problems and anomalies associated with conductivity data from TSDH are discussed. Since the TSDH is responsible for most of the lab analyses in this data base, one might anticipate the same problems. A review of the relation between lab and field conductivity, and between chlorides and field conductivity, did not reveal as egregious a problem, though there is an uncomfortable degree of noise in the data, see Figures CDS-1 through CDS-3. The order of priority in establishing a salinity value was: field conductivity, field salinity, chlorides, lab conductivity. There were some 1797 measurements of lab conductivity, of the total of 2651, for which there was not a corresponding measurement of field conductivity or lab chlorides. (This was in the Corpus Christi system *per se*. In the Mission-Aransas, there were an additional 557 measurements of lab conductivity, and in the upper Laguna Madre portion of the CCBNEP study area, an additional 1697 measurements, for a grand total throughout the CCBNEP study area of 4905 which had to be used in the data base in lieu of either a field measurement or a chlorides titration.)

One problem with the CDS data base is its overlap with the SMN. As noted above, the CDS is a data base employed primarily for the in-agency use of TWDB in its Bays & Estuaries Program. In principle, all data collected by TWDB and its contractors should be input into the SMN. However, this is not the case: there are numerous field data sets in the CDS, from TWDB activities or its contractors, that are not in the SMN. On the other hand, some of the data in the CDS does appear to be duplicated within the SMN. This posed a data management problem for this project, and created much nonproductive but unavoidable effort. Ultimately, we used everything in the CDS, interleaved this data into the master file, then

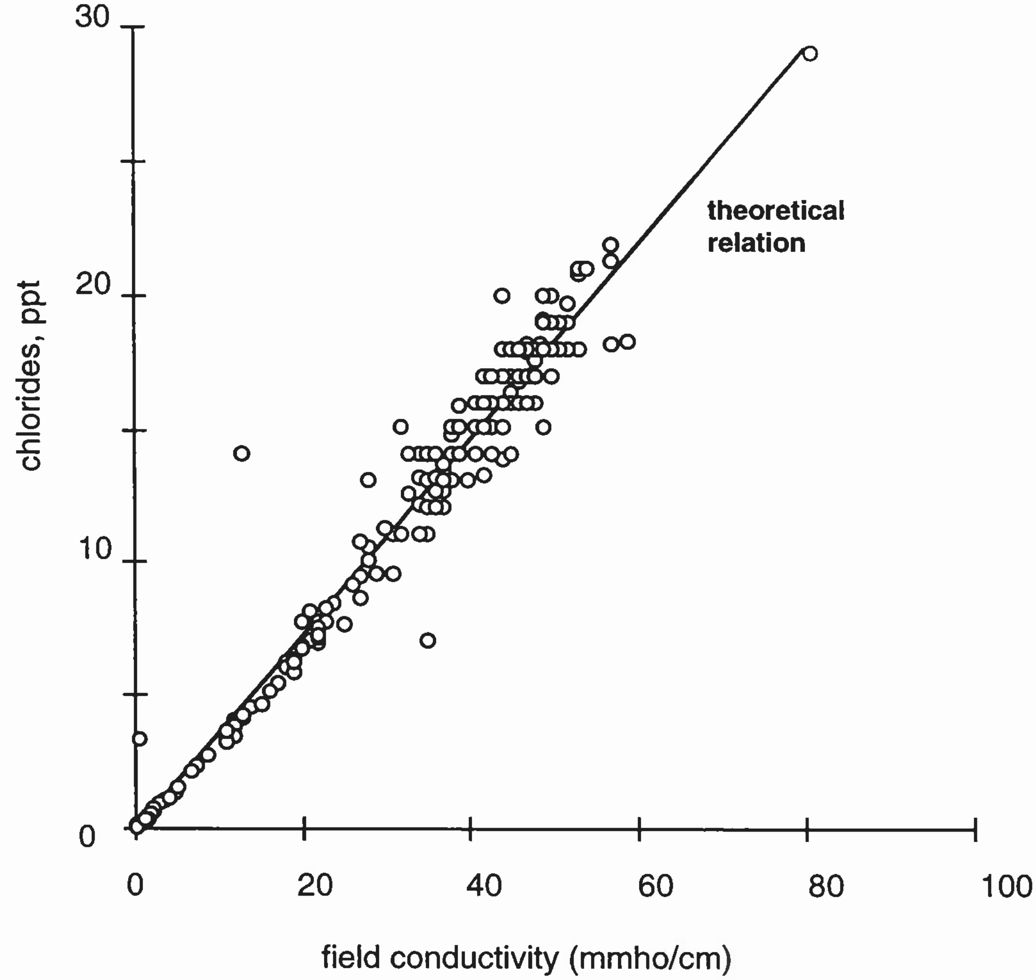


Figure CDS-1 Chlorides and field conductivity from TWDB-CDS database

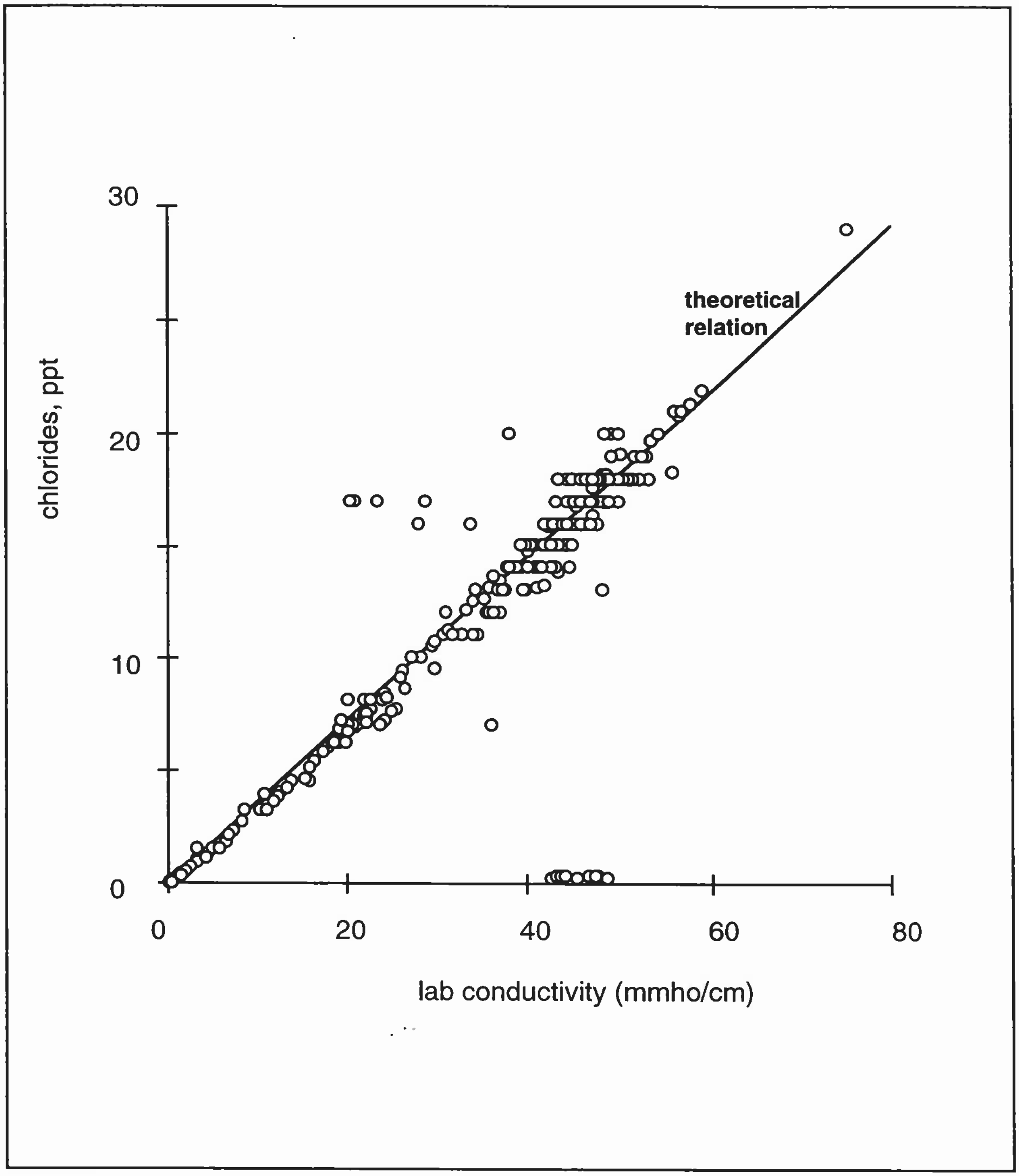


Figure CDS-2 Chlorides and lab conductivity from TWDB-CDS database

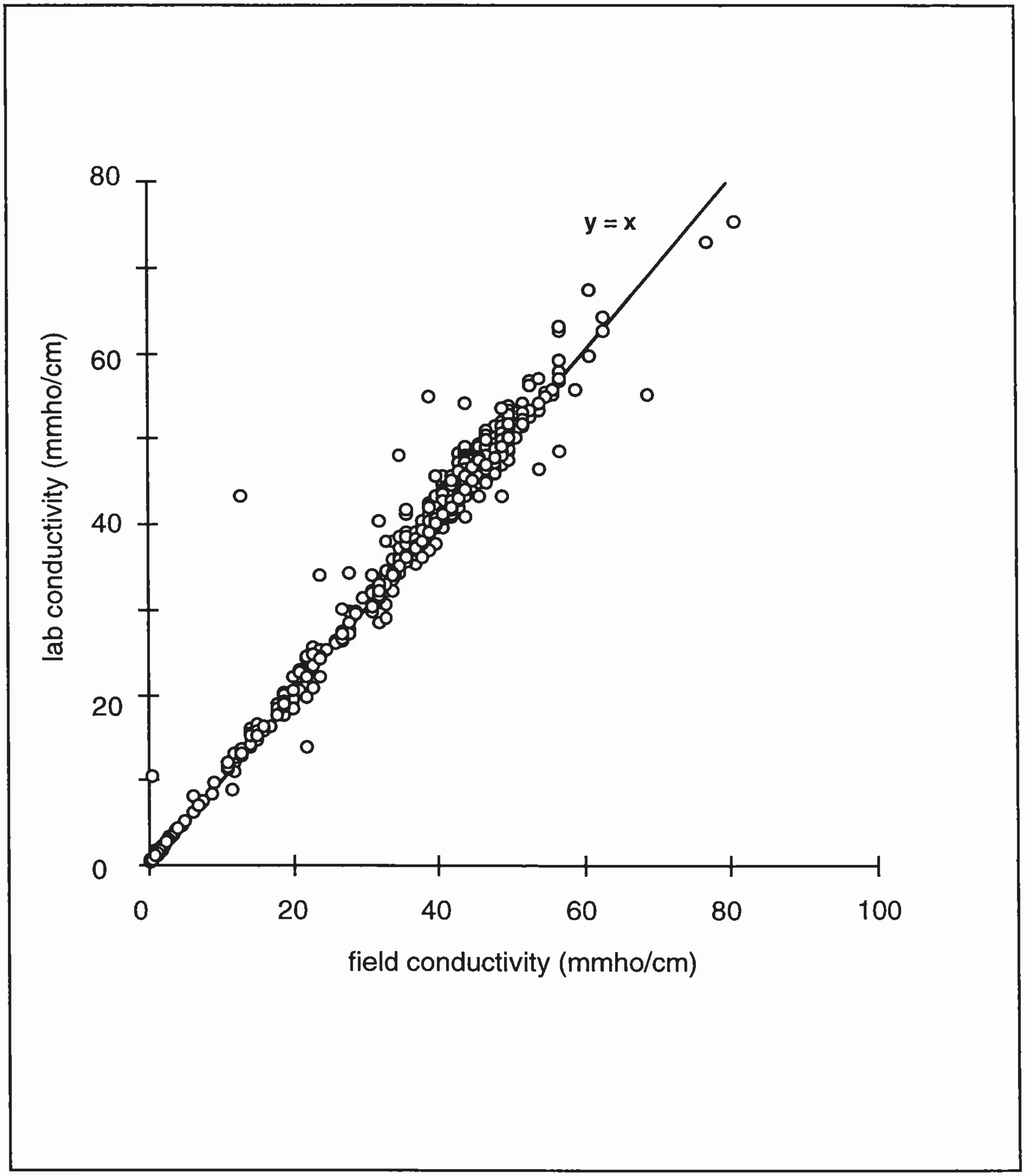


Figure CDS-3 Field and lab conductivity from TWDB-CDS database searched for duplication at a later stage of the processing. (The alternative, of searching for duplication before interleaving would have been much more laborious.) Duplicates may still remain, however, due to the sample station re-numbering procedure. As noted above, the TWDB assigns an approximate line-site station based upon the sample location of the originating agency. These line-site positions have been plotted and their coordinates determined, but these may differ from the coordinates of the original SMN station, in which case the data will not be recognized as duplicates.

After publication of the Summary Report for Water Quality (Ward and Armstrong, 1997), some questions were raised among reviewers as to the substantial declining trend in nitrates in Copano Bay. This trend arises from high average values in Copano Bay, driven largely by very high values reported by USGS during a TWDB survey in March 1968 performed under contract to the Texas Water Development Board, from the TWDB Coastal Data System. Values exceeding 1 ppm and ranging up to 8.5 ppm were measured throughout Copano Bay on this occasion. These are very high values, but not so high that they exceed the range of possibility. There are also high values in Corpus Christi and Nueces Bay during the 1960's and early 1970s, also from the USGS analyses of the TWDB CDS. In the data compilation process, we, in fact, questioned these TWDB values (and others of the same vintage elsewhere in the Corpus system). Dr. Brock of TWDB advises that the only validation possible for these values is the printed report which USGS gave to TWDB, published as Hahl and Ratzlaff (1970). In trying to track down the discrepancy we were told by USGS that none of the original field/lab sheets were preserved.

It is noteworthy that other surveys in other bays, such as Sabine Lake, Matagorda and Nueces, in the 1967-68 period also recorded elevated nitrates, as high as a whopping 12 ppm in Nueces Bay on 6 Dec 67. Is this a reflection of a natural range of variation? Was there any event that might have produced such high values? Hurricane Beulah occurred in September 1967 and produced heavy rainfall and high runoff. But it's hard to attribute elevated nitrates to Beulah eight months after the event, and as far up the coast as the Neches watershed.

One would like to believe that the USGS lab, which in those years was the bellwether of Q/A protocol, would not have let such values slip by without validating them. The weak link in the process, we suggested, may be a clerk-typist in the USGS Houston Office, the office responsible for the field work and for preparing the report to the TWDB. Here values from the lab analysis sheets were typed onto 11x17 pages to form the body of the report. While the transcription of the numbers was doubtless proofed, could the lab have reported some of these values as ppb's rather than ppm's, and the clerk (as well as the proofer) failed to notice? The only way to know would be to go back to the files of lab analysis sheets and verify the numbers/units directly, which could not be done because they no longer exist. The great dilemma is what to do with such unusual data points. Do we label them "outliers" and expunge them from the analysis, for no other reason than that they fail to conform to our conception of how the system works? Or do we accept them, and run the risk of corrupting real and valuable data with spurious numbers? We believe the latter is the sounder course and have observed this throughout this project.

The above remarks implicating USGS as the probable source of error—if such error in fact exists—were transmitted to CCBNEP in a memorandum response to this inquiry. USGS then promptly took a closer look at its files, and, lo, the lab sheets were produced after all. These were provided to us in June 1997, long after the books were closed on this data compilation and the reports. They verify that the numbers listed in Hahl and Ratzlaff (1970) were in fact correctly transcribed from the lab sheets. USGS also notes that the personnel checking the results were a chemist and a physical scientist, both professional and capable. One fact came to light, that the numbers were reported as NO_3, not as NO_3-N, which would mean that they are a factor of 4.4 higher than they should be if (as assumed in our data compilation) reported as N-equivalent. But even at this, they are still high. And the question of whether they are real or the result of some systematic analytical error stands.

REFERENCES

Hahl, D. and K. Ratzlaff, 1970: *Chemical and physical characteristics of water in estuaries of Texas, September 1967 - September 1968*. Report 117, Texas Water Development Board, Austin.

Ward, G. and N. Armstrong, 1997: *Current status and historical trends of ambient water, sediment, fish and shellfish tissue quality in the Corpus Christi Bay National Estuary Program study area*. Report CCBNEP-13, Coastal Bend Bays Estuary Program, Texas Natural Resource Conservation Commission, Austin.

SOURCE DATA SET REPORT
Project Code 003

DATA SET: Coastal Fisheries Hydrographic Observations

PROJECT ABBREVIATION: TPWD

SOURCE: Texas Parks & Wildlife Department
4200 Smith School Road
Austin, Texas 78744

CONTACT: Al Green (512-912-7012)

MEASUREMENTS:

Temperature - YSI DO meter (glass thermometer backup)
Dissolved Oxygen - YSI DO meter (Hach Winkler backup)
Salinity - refractometer
Turbidity - Hach turbidimeter

PROCEDURES:

Water quality data are taken at the beginning of the sample run and at the end (if the total duration exceeds 4 hours). Sample depth depends on the nature of the biological sampling:

Surface, for seines, trammel and gill nets
1 ft above bottom for trawl and oyster dredge

In compiling this data set, we assigned a sample depth value of 0.3 m (1 ft) to gill nets and bagseines, and a total depth value to trawls. (Since the total depth is reported only to the nearest meter, there is little point in subtracting 0.3 m from this.)

QUALITY ASSURANCE/QUALITY CONTROL:

For the earlier data (from the 1970's) no formal QA/QC plan exists or is reported, and no information is available as to QA/QC practices. In recent years, procedures have adhered to a data-collection manual. Similarly, screening and checking procedures have been implemented in the data-entry process at Austin headquarters. (See Comments, below.)

DESCRIPTION:

The purpose of these measurements is to document environmental conditions attending routine biological collections of the TPWD Coastal Fisheries Monitoring Program. Therefore, the data collection strategy is driven by biology. The TPWD is the most spatially and temporally intense monitoring program performed by a public agency in the Corpus Christi Bay area, involving data collection somewhere in the system on a weekly, almost daily, basis. This data set dates back back to approximately 1972 (depending upon the sub-area), and encompasses all of the estuarine embayments as well as the nearshore Gulf of Mexico.

SAMPLING LOCATIONS:

Unlike most agency sampling programs, the TWPD does not return to a fixed network of sampling stations but rather determines sample location by a method of random selection, with the objective of eliminating long-term bias in the data that might result from continued sampling of the same stations. The entire coastal zone is divided into a grid of 1-minute cells, each of which is designated as to whether it is sampleable by the various gear types. The grid cells to be sampled are determined in Austin by a randomized procedure. In the field, the designated grid is further subdivided into a 12x12 network of "gridlets", each of which is 5 latitude/longitude seconds on a side. Gridlets appropriate to the intended gear are selected at random for actual sampling. Further adjustment in the selected station is made to accommodate the sampling (e.g., nearshore for seines) or to facilitate positioning (e.g., near some identifiable feature).

Positioning in the field is apparently accomplished by the time-honored method of "eye-balling" based whenever possible on identifiable geographical references in the area. Latitude and longitude are determined from navigation maps and/or quad sheets and entered onto the forms that are sent to Austin for data entry. Information on the actual sampling site is maintained in the files of the Rockport Lab.

COMMENTS:

The TPWD has instituted a comprehensive, well-organized program of coastal sampling, which includes digitized data entry and centralized data management as a key component. The general field procedures are specified in the *Marine Resource Monitoring Operations Manual*, which is revised annually and assures a uniform methodology in the field samples. The data base entry, error checking, and file maintenance are detailed in *Coastal Fisheries Data Processing Manual*, which is revised frequently.

The data entry Q/A procedures seem to be effective in minimizing data-entry errors. On the other hand, there seems to be no easy means of verifying the field data transcriptions, especially the latitude/longitude determinations which are particularly prone to map-reading errors. We subjected the TPWD data file to a simple screen for points lying outside the rectangles:

29°	to	29° 50'
94° 30'	to	95° 15'

which would obviously be outside the Corpus Christi Bay system. This screen disclosed 52 erroneous coordinates. (One such point plotted due south of the Azores). This does give an indication of the probable fraction of location errors. Similar errors were found in the data files from Galveston Bay analyzed earlier in the Galveston Bay National Estuary Program. During that project, time permitted tracking down the correct positions from records at the Seabrook Lab. Almost all of these errors resulted from incorrect reading of the degree portion of the coordinate, notably the second digit. If we assume the same proportion of random errors in the minutes and seconds, this implies a 2% rate of position error. Further, errors in the minutes and seconds places cannot be easily screened (since they will usually also plot out in the Galveston Bay system), so the only means of reducing these errors would be to proof against the Seabrook files, a monumental--and probably unwarranted--effort. Also in this same data set of 12,000 records, we located only one "patently obvious" data entry error, a date given as 1930 instead of 1990. On the other hand there were numerous errors in parameter magnitudes, especially dissolved oxygen, whose correction was not "patently obvious."

SOURCE DATA SET REPORT
Project Code 04

DATA SET: Texas Fish, Game & Oyster Commission

PROJECT ABBREVIATION: TGFOC

SOURCE: various (see Discussion)

MEASUREMENTS:

Water temperature	deg F
salinity	ppt
dissolved oxygen	ppm
pH	
turbidity	ppt [*sic*]

PROCEDURES: Grab sampling at a single depth in vertical, usually near the surface but sometimes near the bottom. Sampling frequency was highly variable, but generally once or twice per month. Salinity was measured by oceanographic hydrometers, Mohr titration, Goldberg refractometer and conductivity. Though this is the chronological order, it is not clear when one methodology replaced another. DO was measured by a Hach-kit Winkler titration. The acquisition of "turbidity" began ca. 1966; no explanation of this parameter is given in the reports of that period other than its units ("ppt") until 1969, when it is reported that the measurement was made "in parts per million" with a Jackson turbidimeter. In this compilation, we assume that these turbidity values are in fact JTU's.

QUALITY ASSURANCE/QUALITY CONTROL:

No formal QA/QC plan exists or is reported. Very little documentation has survived on procedures apart from the information in the annual report summaries.

DESCRIPTION & COMMENTS:

The oldest systematic routine sampling program on the Texas coast is that implemented by the Texas Game, Fish & Oyster Commission, later the Texas Game & Fish Commission, now the Texas Parks & Wildlife Department. The overall purpose of the program was to monitor the status of the coastal fisheries, in the course of which hydrographic parameters were measured in association with biological collections. At first only salinity and temperature were measured. Later DO began to be measured during special-purpose studies of short duration. Turbidity was added to the program around 1966, and DO and pH became regular measurements a couple of years later. The exact procedures varied greatly from one year to the next and from lab to lab, even varying with the particular personnel.

SAMPLING LOCATIONS:

While the programs in the individual bays attempted to establish routine sampling stations, these were frequently moved and/or renumbered from year to year, and are located only by very crude maps, or occasionally by reference to geographical landmarks (though that is also imprecise). Routine stations were fairly well established for Corpus Christi and Nueces Bays, and for the Upper Laguna Madre, as listed in Tables 1 and 2. (While many of the Upper Laguna stations are located in the GIWW and referenced to buoy numbers, one must bear in mind that these buoys were have been re-deployed and renumbered several times, since 1950. Therefore, navigation charts contemporaneous with a given sampling year must be used to locate the stations.) Even at this, individual stations were moved occasionally, and one must consult the maps for each year to be sure of the location. Numerous stations were employed in the Aransas-Copano system. These were changed frequently (once midway through the 1969 sampling year) and extensively renumbered, so it is not even possible to provide a single general summary of the sampling network in this system.

DISCUSSION

Measurements of at least temperature and salinity on a quasi-routine basis have been carried out by the TGFOC since as early as 1927, as reflected by the annual reports of the agency. Since the late 1940's the intensity of data collection has been close to that currently practiced. The management of this data is one of the great tragedies in aquatic science in the state. Prior to implementation of the present data-collection procedures (see Project 03), the data were maintained as the original field sheets in files at the various TGFOC laboratories. Much of this data was lost to floods and fires. In recent years it has been further ravaged by neglect, and by the recent philosophy of "records management" that value is inversely proportional to age. Because of the potential utility of this older data in extending the period of record and thereby improving the validity of trend analyses, some effort was invested in seeking data prior to 1970.

It is rumored that much of the original data is stored in a warehouse in Weslaco, but the resources of this project did not allow searching this warehouse and digitizing the holdings. Instead, we used the hardcopy summaries presented in the annual reports of the TGFOC from about 1960-70, supplemented by photocopies of field sheets from the Coastal Bend Council of Governments and the files relating to the Humble Oil & Refining lawsuit for ownership of the mudflats. The annual report summaries were problematical in that the date and depth of measurement are rarely given. We assumed therefore that data were taken on the 15th of the month and represented a depth of 0.3 m. While this provides about a decade more of hydrographic data, we note that it does not include the droughts of the 1950's and 1930's, nor does it include a number of major floods that occurred in the coastal bend area prior to 1960.

Table TGFOC-1
Principal routine stations through 1970
Corpus Christi system

Station	*geographical location*	*latitude*		*longitude*	
1	Nueces #1	27	50.83	97	24.58
2	Nueces #2	27	50.73	97	25.48
3	E. of Causeway	27	50.42	97	22.11
4	Reynolds #4	27	51.56	97	15.60
5	Reynolds #5	27	50.42	97	14.10
6	Redfish Bay	27	50.47	97	8.25
7	East Flats	27	47.81	97	7.89
8	Shamrock	27	44.69	97	10.24
9	Bulkheads	27	42.76	97	11.44
10	Alta Vista	27	46.88	97	21.75
11	Mkr 67	27	48.54	97	18.37
12	Mkr 22	27	49.74	97	9.28
13	Mkr 1 ICW	27	41.77	97	14.22
14	Navy Channel	27	44.69	97	15.84
15	Oso Bay	27	42.92	97	18.49
16	Nueces #3	27	51.98	97	22.83
17	Viola*	27	49.00	97	25.40
18	Harbor*	27	48.80	97	24.50
19	Mkr 38*	27	48.96	97	13.50

Table TGFOC-2
Principal routine stations through 1970
Upper Laguna Madre system

Station	*geographical location*	*latitude*		*longitude*	
	Upper Laguna Madre system				
1	Humble Brdg	27	39.53	97	15.95
2	JFK Causeway	27	38.05	97	14.34
5	Tylers Pt	27	36.53	97	15.36
3	GIWW Mkr 21	27	36.42	97	17.38
25	Pita Island	27	35.68	97	17.26
27	Pure Oil Reef	27	32.63	97	19.76
26	GIWW Mkr 45	27	32.37	97	17.26
28	Big Bird Is.	27	30.00	97	18.27
29	Green Hill Reef	27	27.47	97	20.18
30	GIWW Mkr 75	27	23.89	97	21.96
31	Green Hill	27	22.53	97	22.02
32	Point of Rocks	27	19.63	97	24.34
34	Penascal Point	27	14.93	97	25.36
35	Yarborough Pass	27	13.84	97	24.05
36	Yarborough Pass	27	12.25	97	25.24
37	GIWW Mkr 175	27	10.25	97	26.13
Land cut	In GIWW mud flats reach	27	9.93	97	26.07

SOURCE DATA SET REPORT
Project code 05

DATA SET: Southwest Research Institute, Ocean Science & Engineering Laboratory, Corpus Christi

PROJECT ABBREVIATION: SWRI

SOURCE: SWRI (1972a, 1972b, 1972c, 1974)

MEASUREMENTS:

Hydrographic observations as part of long-term monitoring program in Corpus Christi Bay. Although the project was titled "Water quality baseline study", in fact water quality was limited to measurements of salinity, dissolved oxygen, temperature and light transmissivity. (Phytoplankton concentration was also determined for selected water samples, but this data is not included in the present data-base compilation.)

PROCEDURES:

Data collection frequency varied from weekly to monthly. Sampling was performed from a 60-ft research vessel, the *Southwest Researcher*, operated by SWRI for several years. Draft of the boat was 1.5 m. Measurements were made at the surface and at 1.5-m (5-ft) intervals below the surface to the bottom. Depth at the time of sampling was measured with a Bendix DR-9 depth sounder.

Salinity and temperature were measured with a Beckman RS5-3 Portable Salinometer. DO was measured by a Martek Model DOA. Transmissivity was measured with a Hydro Products Model 410-BR transmissometer, providing the percent transmissivity of a 10 cm path. pH was obtained with a Leeds & Northrup Model 7403 pH meter immersed in a water sample collected with a Kahlsico 135WA142 sampling bottle.

The vessel was secured by a two-point anchor, and current velocity measured by a Marine Advisors Q-12 meter, which employs a Savonius rotor and magnetic direction vane, with an onboard readout. Wind velocity was measured with a Kahlsico hand-held anemometer. Wave height was measured by lowering an inscribed vertical rod on a boom 12 ft to windward of the boat. Presumably, the maximum water excursion during an observation period of a few seconds was the basis of measurement, but this is not stated in the report.

QUALITY ASSURANCE/QUALITY CONTROL:

No formal QA/QC plan exists or is reported, and little information is available as to QA/QC practices. Stated accuracy of the Beckman instrument is ± 0.5 °C and

±0.3 ‰. (But see the discussion below.) Stated accuracy of the MA current meter is ± 2% of reading (on either of two scales: 0.05 - 0.7 or 0.05 - 5 knots) and ±10°. The stated accuracy of the Martek meter is 1 % of full scale (one of 0-2, 0-10, 0-20 ppm), and was spot-checked by comparison to a shipboard Winkler. The pH meter is rated at ±0.05 over the range 0-14, and ±0.005 over any 2-unit span.

DESCRIPTION & COMMENTS:

This project evolved from a course in Marine Science technology taught at Del Mar College jointly with technical staff of SWRI, under the sponsorship of the National Science Foundation. To support processing and analysis of the data collected by students in the course, SWRI appealed to local and regional agencies for additional funding, and received sufficient support to institute a quasi-permanent data-collection activity. The study period extended for four years, beginning in summer 1970, with occasional hiatuses due to lack of funding. The principal objective as indicated by the title was establishing a "water quality baseline" for the bay, by occupying fixed stations on a routine basis. The data were logged onto index cards, and photocopied to form the "raw data" sections of the report. It is possible that later in the project the data may have been keypunched. In any event, no records of the project or the data base have survived, except for that contained in the project reports, SWRI (1971a) *et seq.*, of which very few copies exist. The data collection period provided propitious, including two hurricanes (Celia and Fern), flooding, and a regional drought.

In addition to the routine stations, several special purpose studies were conducted. Among these were detailed surveys of the Inner Harbor, occupying as many as 12 stations, and sampling along radials extending out from oil well brine disposal outfalls. None of the raw data have survived from these projects.

As a final note, the loss of the sampling data from this operation is unfortunate. Equally sad is the fact that the staff of the Ocean Science and Engineering Lab acquired a great amount of data from other programs in the area, including Corpus Christi Sewer Department, Pittsburg Plate Glass, City-County Health Department, Texas Game & Fish Commission, and Texas State Health Department, which was also lost when the lab closed. This data has not been recovered from the original sources, and is probably gone forever.

SAMPLING LOCATIONS:

Twelve permanent stations were established at the outset of the program, as detailed in Table SWRI-1. A thirteenth station, in the GIWW at the Kennedy Causeway, was later added. The coordinates are those provided in the SWRI report. The value of depth is approximate, since the actual depth encountered will vary depending upon tide and meteorological conditions, and upon precise positioning of the boat. These are shown in Figs. SWRI-1 and SWRI-2.

Table SWRI-1
Routine stations for SWRI baseline program

Station	Location	Depth (ft)	Latitude deg	Latitude min	Latitude sec	Longitude deg	Longitude min	Longitude sec
A	Open Bay out from marina	11	27	47	23	97	22	38
B	Mouth of CC Inner Harbor	35	27	48	43	97	23	50
C	North Bay south of Reynolds	12	27	51	10	97	17	30
D	La Quinta Channel area	38	27	50	26	97	13	58
E	Junction of CCSC & La Quinta Ch	40	27	48	51	97	13	3
F	CCSC near Aransas Pass	40	27	49	51	97	7	30
G	Open bay west of Port Aransas	10	27	48	3	97	9	27
H	Off Shamrock Point	12	27	44	57	97	10	45
I	South bay in GIWW	13	27	42	1	97	13	18
J	Entrance to Oso Bay	12	27	43	4	97	18	14
K	Center of Bay south of CCSC	12	27	46	47	97	18	18
L	Entrance to Nueces Bay	10	27	50	9	97	22	26
U	GIWW south of Kennedy Causeway	16	27	37	5	97	14	52

DISCUSSION

Generally, data are given both for salinity and conductivity, enabling a cross comparison of the two. Despite the vaunted accuracy of the Beckman meter and its internal compensation for salinity, there are two problems.

First, there is unacceptable scatter in the conductivity versus salinity data, as exhibited in Figure SWRI-3. Close examination of this figure reveals that the data are not randomly scattered about a general trend, but are scattered along certain linear relations. As the parameters of the salinity-conductivity-temperature relation are built into the Beckman compensation circuitry, this suggests one of the following possibilities: (1) inadequate precision in the temperature sensor, or in coupling the temperature into the compensation relation, (2) a faulty component in the circuitry, taking on several quantum values, (3) mechanical slippage in a knob, creating the same effect as (2), (4) despite the statements in the report, at least some of the salinities were hand-calculated from measured conductivities, using a relation that differed slightly from that internal to the Beckman meter. The straight line shown on Figure SWRI-3 is the salinity dependence upon 25° conductivity fitted to the data from USNHO (1956). In debating how to handle this data, we ultimately decided upon assuming that the conductivity data as given are correct, and computing salinity using the USNHO (1956) relation. Thus, in the CCBNEP data file, the salinities for this project are as computed from the conductivities, except for the small number of instances in which SWRI neglected to log the conductivity, so we must use the salinity value as given by them.

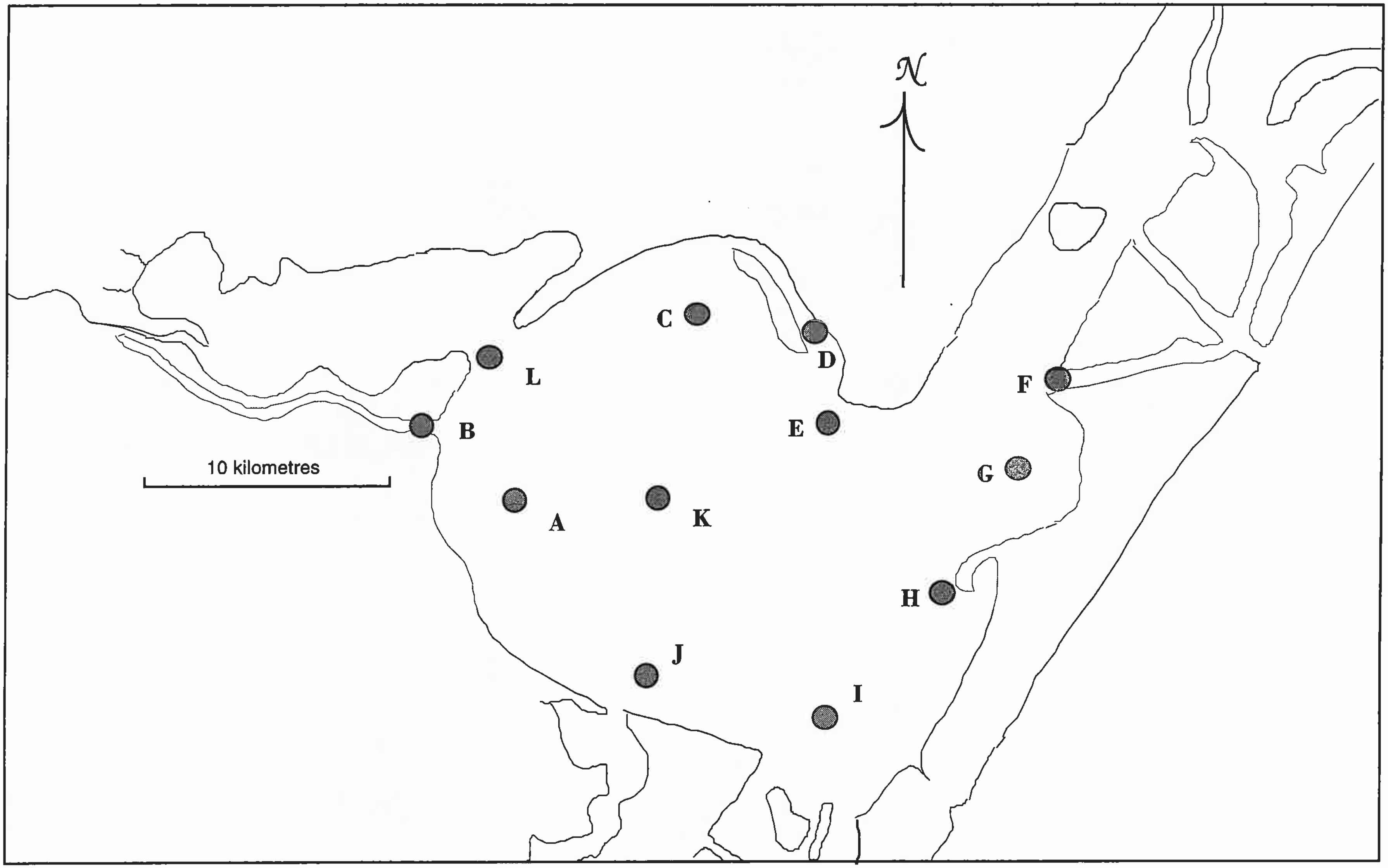


Fig. SWRI-1. Station locations, Corpus Christi Bay

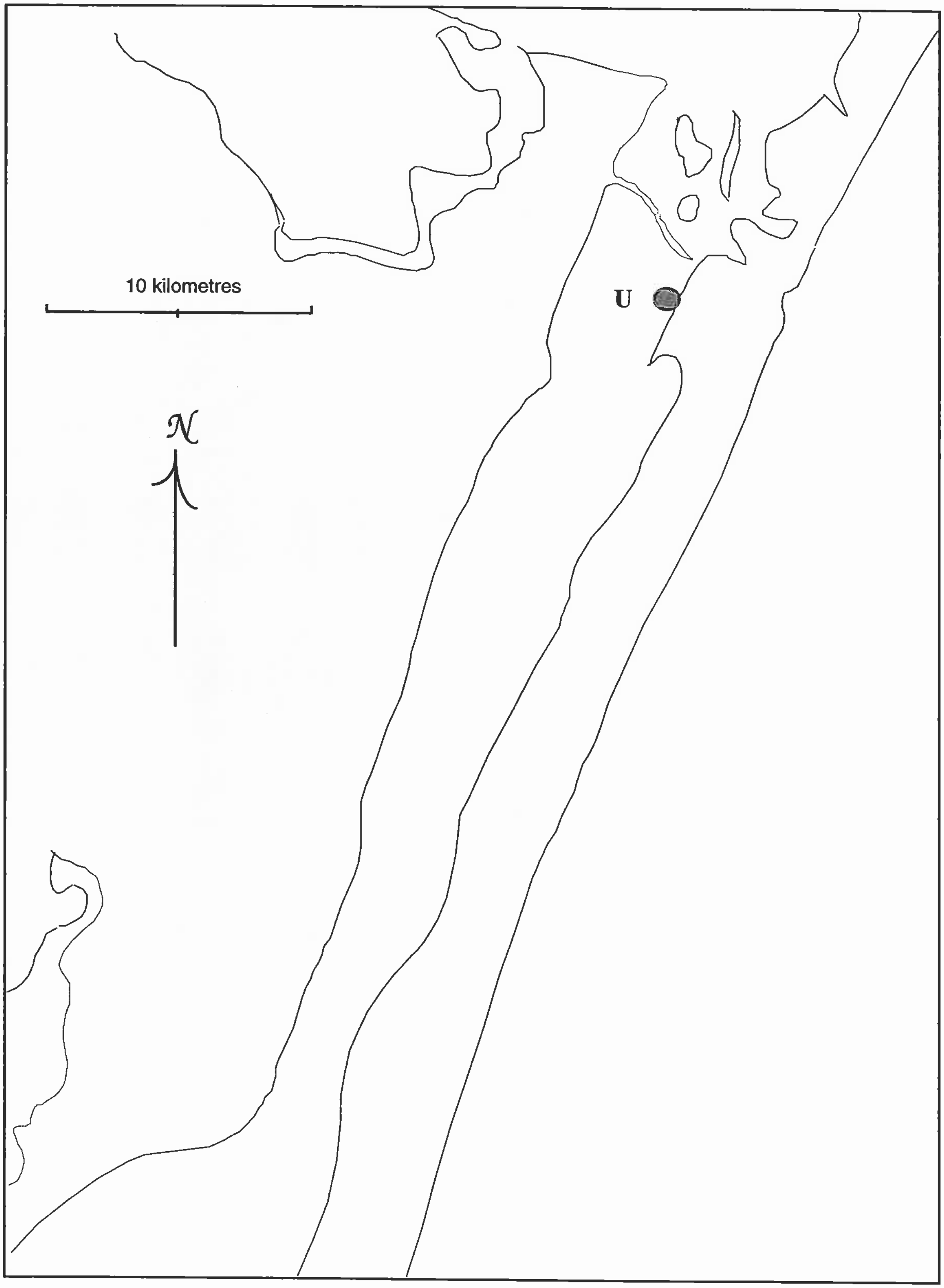


Fig. SWRI-2. Station location, Upper Laguna Madre

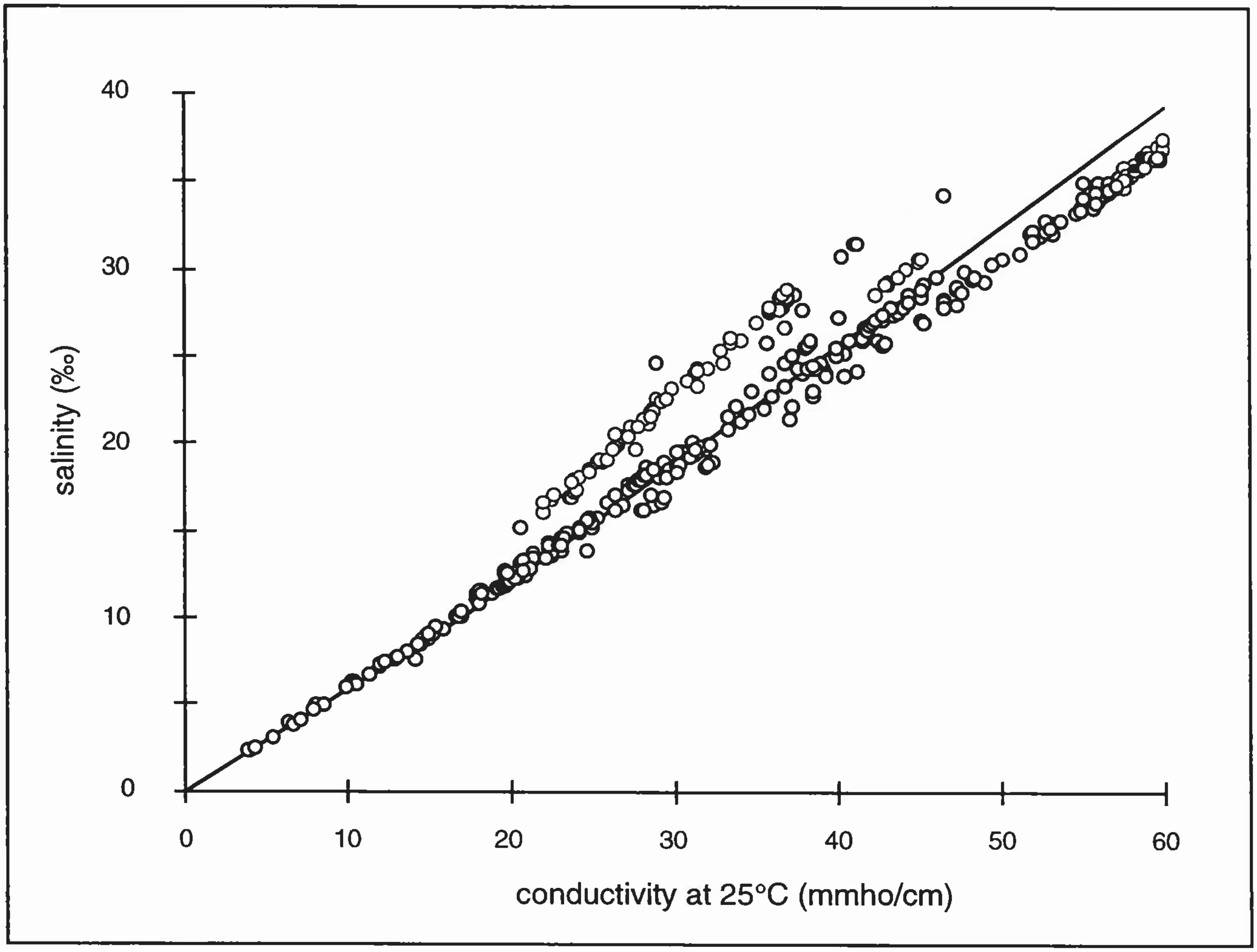


Figure SWRI-3 - Scatter plot of salinity versus conductivity from a portion of the SWRI data record

The second problem is exemplified by the data entries from the conductivity/salinity data base shown in Table SWRI-2. Sequences of the precise value 65.00 mmho/cm occur several times in the data record, without corresponding salinity values. It is our belief that this is the upper limit of the readout of the Beckman, i.e. the meter was "pegged" at this value. The corresponding value of salinity, based upon the USNHO (1956) relation (which, by the way, lies beyond the range of values in that report) is about 43‰. In compiling the CCBNEP data base, these values were therefore entered as ">43", and the ">" will require special processing in the analysis phase.

REFERENCES:

Southwest Research Institute, 1972a: Water quality baseline study for Corpus Christi Bay from June 1970 to June 1971. SWRI Project 18-2880-01, Ocean Science & Engineering Lab, Corpus Christi.

Southwest Research Institute, 1972b: Raw Data Supplement, Water quality baseline study for Corpus Christi Bay from June 1970 to June 1971. SWRI Project 18-2880-01, Ocean Science & Engineering Lab, Corpus Christi.

Southwest Research Institute, 1972c: Water quality baseline study for Corpus Christi Bay from July 1971 through December 1972. SWRI Project 18-2880-01, Ocean Science & Engineering Lab, Corpus Christi.

Southwest Research Institute, 1974: Water quality baseline study for Corpus Christi Bay from January 1972 through May 1972 and March 1973 through August 1973. SWRI Project 18-2880-01, Ocean Science & Engineering Lab, Corpus Christi.

U.S. Naval Hydrographic Office, 1956: Tables for rapid computation of density and electrical conductivity of sea water. Publ. SP-11, U.S. Navy, Washington, D.C.

Table SWRI-2
Segment of data record from Station E

mo	*da*	*yr*	*depth (ft)*	*temp (°C)*	*cond (mmho/cm)*	*sal (‰)*
6	3	71	0	27.70	54.36	34.38
			5	27.62	54.35	34.34
			10	27.61	54.32	34.40
			15	27.58	54.37	34.46
			20	27.61	54.85	34.67
			25	27.79	54.90	34.66
			30	27.70	54.68	34.66
			35	27.20	54.36	34.72
			40	27.08	54.40	34.80
6	18	71	0	28.60	58.60	36.45
			5	28.60	58.58	36.35
			10	28.70	59.00	36.74
			15	28.94	59.80	37.00
			20	29.20	65.00	
			25	29.38	65.00	
			30	29.32	65.00	
			35	29.23	65.00	
			40	29.25	65.00	

SOURCE DATA SET REPORT
Project Codes 006 and 007

DATA SET: Texas State Department of Health Estuarine Data File

PROJECT ABBREVIATION: TSDH

SOURCE: Division of Seafood Safety, Texas Department of Health

MEASUREMENTS:

Water temperature	deg F
salinity	ppt
dissolved oxygen	ppm
total coliforms	MPN per 100 mL
fecal coliforms	MPN per 100 mL

PROCEDURES: Grab sampling at a single depth in vertical, usually either at or near the surface or at mid-depth.

QUALITY ASSURANCE/QUALITY CONTROL:

No formal QA/QC plan exists or is reported. In recent years, most of the data (i.e., except bacteriological analyses) are performed *in situ* using electrometric instruments. In earlier years, water samples were retrieved, and all parameters measured in the laboratory. Analyses are performed by the TSDH laboratory in conformance with *Standard Methods* (e.g. APHA, 1985).

DESCRIPTION & COMMENTS:

This is the data from the active monitoring program of the Seafood Safety (a.k.a. Shellfish Sanitation) Division at TDH, referred to as the Estuarine Data File. The principal thrust of the program is measurement of coliforms for the purpose of regulation of shellfish harvesting on the coast. Early in the program other water quality variables were taken with the prospect of uncovering correlations with coliforms; as the program has progressed, most of these measurements have been dropped (though salinity, pH and temperature are nearly always obtained). However, this data file reports temperature, dissolved oxygen and salinity, and laboratory coliforms, only. (See Project Code 007, Coastal Data File.) Moreover, the record is limited to those samples in which fecal coliforms were obtained, with or without a companion measurement of total coliforms. In recent years, all measurements and samples are taken at a single depth. Older data include profiles or multiple samples within the water column. The data are keyboarded into a continuously maintained digitized data base.

Three source files were used in the CCBNEP project, two in the Estuarine Data File format (one for the period from the 1950's through 1979, and the second for the period from 1980 through 1995), and one from the Coastal Data Program (identified separately as Project Code 007). Data management and errors in the entries have been a problem with TDH data files in the past, but these appear to have been largely eliminated in the Estuarine Data File. However, data from several stations are included in the file for which we have no location information.

The salinity measurements retained in this file are probably reliable. The data were combined with the Coastal Data file, which includes conductivity and chlorides. With some of these, there are problems. In the discussion of the TNRCC SMN, Project Code 001, errors in salinity/conductivity determinations originating at the TSDH lab in the 1970's and 1980's were identified. As noted in that discussion, laboratory conductivities are found to be noisy and error-prone, probably because the samples in those years were subjected to extreme dilution to bring the conductivity into the narrow, low range of the laboratory meter, then the measured value was scaled back up by the reciprocal of the dilution. The larger the sample salinity, the greater the dilution necessary. This introduces several potential sources of error, both analytical and computational. Also, another contributor to the scatter is due to the fact that a significant proportion of the reported laboratory values are not really measurements, but are "invented data," referred to in the Project Code 001 discussion as BOGAS data, i.e. entries Based On Graphical or Arithmetical Suppositions. As the present data set contains salinity/conductivity data analyzed by the same lab, it is not surprising that exactly the same problem emerged. The same conclusion follows for this data set: that the lab *chlorides* and *field conductivity* values are real and the *lab conductivities* are BOGAS. In this compilation, conductivity and/or chlorides were converted to equivalent salinity for entry in the CCBNEP data base. The same priority of usage was observed as in the case for the TNRCC SMN data, of chlorides, followed by field conductivity, followed by lab conductivity.

In addition to the salinity data problem, there are occasional aberrant values in other variables that may be keyboard errors. For example, at COP00005 on 10/11/83 the water temperature is reported as 25°F. While this value is highly unlikely, our philosophy is to retain this in the basic data file, then screen it out in the data-analysis stage. Other similar aberrant values occur in a few places in the data files.

SAMPLING LOCATIONS:

The principal source for station locations is a set of maps and station description/coordinates prepared by TDH and provided to this project. These represent current or recent sampling locations of the Shellfish Sanitation Control Division, many of which have been historically occupied since the 1960's or even earlier. These stations, with latitude/longitude coordinates, are listed in Table TSDH06-01. As noted above, there are stations in the data record for which locations are not determinable.

Table TSDH-01
TDH Sampling Station coordinates
Corpus Christi Bay system

ARA00001	28	1.3	97	2.1	COR00001	27	42.8	97	18.3
ARA0001A	28	0.3	97	2.8	COR00002	27	43.3	97	19.8
ARA00002	28	1.5	97	1.2	COR00003	27	43.9	97	20.9
ARA00003	28	3.3	97	1.2	COR00004	27	44.5	97	21.8
ARA00004	28	4.1	97	1.5	COR00005	27	45.7	97	22.4
ARA00005	28	5.6	97	1.4	COR00006	27	46.3	97	23.0
ARA00006	28	6.5	97	0.7	COR00007	27	47.2	97	23.3
ARA00007	28	3.5	96	57.6	COR00008	27	48.2	97	23.3
ARA00008	28	4.7	97	0	COR0008A	27	47.7	97	23.3
ARA00009	28	6.1	96	55.3	COR00009	27	48.7	97	24.6
ARA00010	28	7.2	96	58.8	COR0009A	27	48.7	97	25.0
ARA00011	28	0.2	97	1.5	COR00010	27	48.9	97	23.2
ARA00012	28	7.0	96	55.6	COR0010A	27	48.8	97	23.7
ARA00013	28	2.4	96	57.4	COR00011	27	49.3	97	22.9
ARA00014	28	10.1	96	57.4	COR0011A	27	49.6	97	22.7
ARA00015	28	11.8	96	56.6	COR00012	27	50.2	97	22.5
ARA00016	28	4.5	96	56.1	COR00013	27	50.5	97	21.9

Table TSDH-01
TDH Sampling Station coordinates
(continued)

ARA00017	27	56.6	97	20.5
ARA00018	27	57.1	97	0.7
ARA00019	27	55.5	97	20.0
COP00001	28	6.8	97	1.2
COP00002	28	7.4	97	0.9
COP00003	28	7.8	97	0.6
COP00004	28	7.1	97	3.3
COP00005	28	6.6	97	6.0
COP00006	28	5.8	97	7.0
COP00007	28	4.4	97	7.7
COP00008	28	5.7	97	11.7
COP00009	28	6.1	97	8.3
COP00010	28	7.4	97	4.3
COP00011	28	8.2	97	2.3
COP00012	28	3.4	97	8.8
COP00013	28	4.9	97	11.4
COP00014	28	4.7	97	12.9
COP00018	27	59.6	97	10.2
COP00019	28	9.8	97	1.8
MES00001	28	10.0	96	51.5
MES00002	28	8.5	96	49.5
MES00003	28	9.0	96	51.1
RDF00001	27	53.0	97	8.5
RDF00002	27	52.1	97	7.7
RDF00003	27	51.2	97	7.6
RDF00004	27	49.7	97	8.4
RDF00005	27	50.4	97	10.7
RDF00006	27	51.4	97	10.1
RDF00007	27	53.7	97	8.1
RDF00008	27	53.4	97	6.6
RDF00009	27	50.7	97	3.5
RDF00010	27	55.3	97	3.9
RDF00011	27	58.4	97	3.6
RDF00012	27	59.5	97	4.0
RDF00013	27	58.3	97	5.2
RDF00014	27	56.4	97	6.5
MBY00001	28	9.7	97	10.2
MBY00002	28	8.5	97	9.6
MBY00003	28	9.3	97	9.6
COR00014	27	50.7	97	21.1
COR00015	27	51.5	97	19.8
COR00016	27	51.8	97	19.2
COR00017	27	48.9	97	8.0
COR00018	27	47.2	97	8.0
COR00019	27	45.7	97	9.4
COR0019A	27	44.2	97	10.6
COR00020	27	52.6	97	16.4
COR00021	27	50.3	97	17.0
COR00022	27	48.5	97	13.6
COR00023	27	49.1	97	11.4
COR00024	27	49.3	97	25.2
COR00025	27	49.4	97	26.8
COR00026	27	48.9	97	27.8
COR00027	27	49.6	97	29.0
COR00028	27	50.6	97	31.2
NUE00001	27	50.5	97	23.0
NUE00002	27	50.7	97	22.5
NUE00003	27	51.1	97	22.1
NUE00004	27	51.6	97	21.6
NUE0005A	27	52.5	97	20.2
NUE00006	27	50.4	97	23.7
NUE00007	27	50.3	97	24.4
NUE00008	27	49.8	97	24.9
NUE00009	27	50.2	97	25.5
NUE00010	27	50.2	97	26.3
NUE00011	27	50.2	97	27.2
NUE00012	27	50.2	97	28.2
LAG00001	27	35.8	97	15.6
LAG00002	27	25.9	97	20.9
LAG00003	27	17.3	97	24.5
LAG00004	27	11.8	97	25.6
BAF00001	27	16.3	97	28.1
BAF00002	27	15.7	97	34.0
BAF00003	27	17.0	97	38.4

SOURCE DATA SET REPORT
Project Codes 008, 009, 010

DATA SET: Water and sediment chemistry, Federal channel projects

PROJECT ABBREVIATIONS: USCE7, USCE8, USCE9

SOURCE: Operations & Maintenance, U.S. Corps of Engineers, Galveston District

MEASUREMENTS:

Various constituents (metals, organics, pesticides) in sediment sample and water sample just above (within ca. 5 ft) bottom. The suites of measurements have been changed over the years, depending upon concerns and current emphasis of the Corps. For data compilation purposes, these suites have been placed in three categories, with abbreviations USCE7 (Project Code 8), USCE8 (Project Code 9) and USCE9 (Project Code 10), corresponding *roughly* to data taken in the 1970's, 1980's and 1990's (see Description below). The specific suites of variables associated with each are listed in Tables USCE-1-3. Generally, Suite USCE7 emphasized conventional water/sediment chemistry, metals and a few organics, USCE8 dropped the conventional parameters and expanded both the metals and the organics, the latter in the PAH's, and USCE9 dropped most of the pesticides and analyzed a lengthy suite of PAH's.

PROCEDURES:

A variety of field procedures and laboratory arrangements has been employed as this program evolved. Some of the sampling has been carried out by Corps personnel, some by contractors. In the 1970's, laboratory analyses were handled by the USCE lab in Dallas, but since the 1980's, commercial labs have been used.

Data were recorded in tabular formats. In the 1970's, this was large-format typewritten tables which were then photoreduced for incorporation into USCE documents. Since about 1990, the data were keyboarded into LOTUS spreadsheet templates and printed out. Now the data are keyboarded into database software. The Corps is gradually keyboarding the older data to bring the entire data set into a computer-manipulable, consistent format. For the study systems, however, much of the older data had to be keyboarded by this project.

QUALITY ASSURANCE/QUALITY CONTROL: All QA/QC is in strict conformance to EPA protocols. But see reporting of detection limits in Description below.

DESCRIPTION & COMMENTS:

This sampling program has evolved since the early 1970's and has the general objective of characterizing sediments prior to dredging. The sampling is therefore in and adjacent to dredging projects and/or disposal areas, including all GIWW, deepdraft and service channels in the Texas estuary systems. In the dredging projects of the mid-1970's, for the deepdraft projects in open water, a spatially intense network was established to determine details of sediment quality in the neighborhood of the project. For convenience of handling, we have separated the source files into water and sediment. (Elutriate data are also available, but this data is not used in the present compilation.)

Chemistry data from the early 1970's emphasized conventional contaminants and metals. As the program has evolved, more organics have been added to the suite of analyses. From the mid-1970's to the-mid 1980's metals and selected pesticides were analyzed. Recently, an expanded suite of PAH's have been included. For this reason, as noted above, the data files have been separated into three categories, with different project codes, as follows:

Project Code 008	Older data from the late 1970's	Table USCE-1
Project Code 009	Data primarily from the 1980's	Table USCE-2
Project Code 010	Data primarily from the 1990's	Table USCE-3

While the data is indicated to be associated with the decade of operation, the key criterion is in fact the suite of parameters.

During the data input and review process, occasional obviously typographical errors were noted. Except when the correction was "patently obvious", the O&M branch of the Corps was contacted to determine the correct entry before being incorporated into the data file.

In the 1970s data set especially, there is inconsistency in reporting of detection limits for metals. In particular, for cadmium there are numerous entries of 0, and for lead and chromium there are a substantial number of such entries, though not so much as cadmium. Generally, we chose to let 0-values stand in cases like this, leaving it to later processing to screen them out. In the more recent data, a new problem in reporting detection limits has emerged. In its contracts, the Corps specifies the detection limits as listed in Table USCE-4. However, occasionally the lab achieves even lower detection limits and reports values smaller than those specified in Table USCE-4. Unfortunately, the real detection limits are not recorded, but rather those that are specified in the lab contract (Table USCE-4) which leads to two problems: lower reported value than the indicated detection limits, and an uncertainty in the values reported as "BDL" as to which detection limit they are less than. For example, in the data from the GIWW San Antonio Bay reach, for sample GIC-SAB-94-9, the reported sediment TOC is 42.0 mg/kg, well below the specified detection limit of 100 mg/kg. From this same area, values as low as 21 mg/kg were reported, so at times the lab was achieving a detection limit of at most 20 mg/kg. Yet there are also values reported as "BDL". We are forced to assume these to be < 100 mg/kg, but in fact they may be a order of magnitude better resolved (i.e., smaller) than this.

SAMPLING LOCATIONS:

The general format used by the Corps to identify its stations is:

PROJ-YR-NO

where PROJ is an abbreviation for the channel project, e.g.

B	-	Brownsville Ship Channel
CC	-	Corpus Christi Ship Channel
GIP-S	-	Sabine Pass Outer Bar Channel

YR is the last two digits of the year of sample collection, and NO is the sample station identifier, which can be as simple as a digit number or a complex alphanumeric indicator, e.g. REF200. This scheme has the considerable advantage that every water sample is assigned a *unique* identifier encoding the year, project, and sample station.

Stations are located by reference to the USCE project coordinates, the key dimension of which is distance along the centerline of the channel from some point of reference unique to the channel project. Frequently, stations are offset, i.e., occupied on a line normal to the centerline, in which case they are further identified by the offset in distance and direction. In this project, all stations were located on project maps, transferred if necessary to a navigation or topographic map, and the corresponding latitude-longitude painstakingly determined and keyboarded. This data file of latitude/longitude was re-numbered to correspond to the specific "sample numbers" of the Corps (which are unique to a sample, and include the information on sample station and sampling date). This is the "Station" data file.

In the early 1970's stations were assigned rather *ad hoc*, so many of the stations from these surveys were never occupied again. Thus, the proportion of samples from the early 1970's in the Station file is quite large. Beginning about 1980, the Corps established a network of permanent stations which are sampled during each subsequent survey, thus building a continuity of data. Many of these permanent stations correspond in position to those occupied in the 1970s but generally the station number designations have changed. Moreover, many stations were re-numbered and the current station bearing a given number may be in a different position than the station with that number during the 1975-77 program. One must be cautious in using station numbers without verifying the survey date and regions. Of course, all of this has been worked out in the creation of the "Station" data file.

The complete tabulation of Corps stations and latitude/longitude coordinates are given in Table USCE-5.

REFERENCES:

Some discussion of the Corps program is given in the Galveston Bay National Estuary Report:

Ward, G.H., and N. E. Armstrong, 1992: Data bases on ambient water and sediment quality. GBNEP-22, Vol. 5, Webster, Texas.

TABLE USCE-1
Parameters for Project Code 008 (File Designation "7")

parameter	*water units*	*sediment units*
Dissolved Oxygen	mg/L	
salinity	ppt	
pH		
Water Temp	deg C	
Total Solids	mg/L	
Tot Vol. Solids	mg/L	% dry wt
Tot Kjeld Nitrogen	mg/L	mg/kg
Tot Org Nitrogen	mg/L	mg/kg
Ammonia Nitrogen	mg/L	mg/kg
Oil & Grease	mg/L	mg/kg
Chemical Oxygen Demand	mg/L	mg/kg
Arsenic	µg/L	mg/kg
Cadmium	µg/L	mg/kg
Chromium (Total)	µg/L	mg/kg
Copper	µg/L	mg/kg
Iron	mg/L	mg/kg
Lead	µg/L	mg/kg
Mercury	µg/L	mg/kg
Nickel	µg/L	mg/kg
Zinc	µg/L	mg/kg
Total PCB's	µg/L	µg/kg
Aldrin	µg/L	µg/kg
Chlordane	µg/L	µg/kg
4,4'-DDD	µg/L	µg/kg
4.4'-DDE	µg/L	µg/kg
4,4'-DDT	µg/L	µg/kg
Dieldrin	µg/L	µg/kg
Endosulfan	µg/L	µg/kg
Toxaphene	µg/L	µg/kg
Heptachlor	µg/L	µg/kg
Lindane	µg/L	µg/kg

TABLE USCE-2
Parameters for Project Code 009 (File Designation "8")

parameter	*water units*	*sediment units*
Total Organic Carbon	mg/L	
Oil & Grease	mg/L	mg/kg
Chemical Oxygen Demand	mg/L	mg/kg
Arsenic	µg/L	mg/kg
Cadmium	µg/L	mg/kg
Chromium (Total)	µg/L	mg/kg
Copper	µg/L	mg/kg
Lead	µg/L	mg/kg
Mercury	µg/L	mg/kg
Nickel	µg/L	mg/kg
Selenium	µg/L	mg/kg
Zinc	µg/L	mg/kg
Total PCB's	µg/L	µg/kg
Chlordane	µg/L	µg/kg
Toxaphene	µg/L	µg/kg
4,4'-DDT	µg/L	µg/kg
Total PAH's*	µg/L	µg/kg
Napthalene	µg/L	µg/kg
Fluoranthene	µg/L	µg/kg
Benzo(a)pyrene	µg/L	µg/kg

*Fluoranthene equivalents

TABLE USCE-3
Parameters for Project Code 010 (File Designation "9")

parameter	*water units*	*sediment units*
Total Organic Carbon	mg/L	
Chemical Oxygen Demand	mg/L	mg/kg
Arsenic	µg/L	mg/kg
Barium	µg/L	mg/kg
Cadmium	µg/L	mg/kg
Chromium (Total)	µg/L	mg/kg
Copper	µg/L	mg/kg
Lead	µg/L	mg/kg
Mercury	µg/L	mg/kg
Nickel	µg/L	mg/kg
Silver	µg/L	mg/kg
Selenium	µg/L	mg/kg
Zinc	µg/L	mg/kg
Total PCB's	µg/L	µg/kg
Chlordane	µg/L	µg/kg
Toxaphene	µg/L	µg/kg
4,4'-DDT	µg/L	µg/kg
Total PAH's*	µg/L	µg/kg
Napthalene	µg/L	µg/kg
Acenapthene	µg/L	µg/kg
Fluoranthene	µg/L	µg/kg
Benzo(a)pyrene	µg/L	µg/kg
Benzo(e)pyrene	µg/L	µg/kg
Acenapthylene	µg/L	µg/kg
Fluorene	µg/L	µg/kg
Phenanthrene	µg/L	µg/kg
Anthracene	µg/L	µg/kg
Pyrene	µg/L	µg/kg
Benzo(a)anthracene	µg/L	µg/kg
Chrysene	µg/L	µg/kg
Benzo(b)fluoranthene	µg/L	µg/kg
Benzo(k)fluoranthene	µg/L	µg/kg
Benzo(ghi)perylene	µg/L	µg/kg
Dibenzo(ah)anthracene	µg/L	µg/kg
Indeno(123cd)pyrene	µg/L	µg/kg

*Fluoranthene equivalents

TABLE USCE-4
Specified minimal analytical detection limits
(Units provided in Table USCE-3)

parameter	*water* 1990-1992	*water* 1993-1996	*sediment* 1990-1992	*sediment* 1993-1996
Arsenic	2	1	1	0.1
Barium		1		0.1
Cadmium	2	0.1	0.1	0.1
Chromium	10	1	1	0.1
Copper	1	1	1	0.1
Lead	5	1	1	0.1
Mercury	0.2	0.2	0.1	0.2
Nickel	5	1	1	0.1
Silver		1		0.2
Selenium	2	2	0.5	0.1
Zinc	5	1	1	0.1
TOC	1	1	100	100
Total PCB	0.5	0.5	5	5
"4,4'-DDT"	0.02	0.12	0.2	10
Chlordane	0.02	0.14	0.2	10
Toxaphene	0.5	0.5	50	50
Total PAH	5	5	0.5	0.5
Naphthalene	2	2	50	30
Acenaphthene	2	2	50	30
Fluoranthene	0.5	0.5	10	30
Benzo(a)pyrene	0.5	0.5	10	30
Benzo(e)pyrene		0.5		30
Acenaphthylene	2.5	2.5	50	30
Fluorene	0.5	0.5	10	30
Phenanthrene	1	1	20	30
Anthracene	1	0.5	20	30
Pyrene	0.5	0.5	10	30
Benzo(a)anthracene	1	1	20	30
Chrysene	0.5	0.5	10	30
Benzo(b)fluoranthene	0.1	0.1	2	30
Benzo(k)fluoranthene	0.1	0.1	2	30
Benzo(ghi)perylene	0.1	0.1	2	30
Dibenzo(ah)anthracene	0.5	0.5	10	30
Indeno(123cd)pyrene	0.5	0.5	10	30

Table USCE-5
Corps of Engineers sampling stations in CCBNEP study area

Identifier	*Station* (ft)*	*Latitude deg*	*Latitude min*	*Longitude deg*	*Longitude min*	*location relative to project (ft)*
			Deepdraft Channel Projects			
			Corpus Christi Bay			
CC-82-J-1	0+00	27	50.42	97	3.00	200 N Outer Bar & Jetty Channel
CC-82-J-2	50+00	27	49.99	97	2.21	
CC-82-J-3	100+00	27	49.52	97	1.46	
CC-82-J-4	150+00	27	49.08	97	0.66	
CC-82-J-5	200+00	27	48.66	96	59.87	
CC-82-J-6	100+00	27	49.13	97	1.70	
CC-82-J-7	150+00	27	49.59	97	0.31	
CC-84-J-DA1	100+00	27	49.30	97	1.60	1250 S
CC-75A-49	1030+00	27	48.66	97	22.32	Corpus Christi Ship Channel
CC-75A-50	1060+00	27	48.66	97	22.94	(1975 survey)
CC-75A-51	1090+00	27	48.68	97	23.42	
CC-75A-52	1120+00	27	48.78	97	23.93	
CC-75A-53	1160+00	27	48.78	97	24.70	
CC-75A-54	1190+00	27	48.94	97	25.20	
CC-75A-55	1220+00	27	49.20	97	25.69	
CC-75A-56	1250+00	27	49.38	97	26.22	
CC-75A-57	1280+00	27	49.35	97	26.75	
CC-75A-58	1310+00	27	49.08	97	27.23	
CC-75A-59	1340+00	27	48.96	97	27.72	
CC-75A-60	1370+00	27	49.06	97	28.30	
CC-75A-61	1400+00	27	49.23	97	28.82	
CC-75A-62	1430+00	27	49.48	97	29.29	
CC-75A-63	1450+00	27	49.63	97	29.64	
CC-75A-64	1490+00	27	50.08	97	30.18	
CC-75A-65	1520+00	27	50.38	97	30.61	
CC-75A-66	1555+00	27	50.57	97	31.24	
CC-80-L-1	50+000	27	49.21	97	13.43	Channel to La Quinta and Jewel
CC-80-L-2	100+000	27	49.96	97	13.76	Channel
CC-80-L-3	150+000	27	50.72	97	14.14	
CC-80-L-4	200+000	27	51.58	97	14.51	
CC-80-L-5	250+000	27	52.53	97	14.87	
CC-80-L-6	300+000	27	52.83	97	15.68	
CC-81-HL-7	300+00	27	49.62	97	8.89	Corpus Christi Ship Channel
CC-81-HL-8	350+00	27	49.46	97	9.80	Inner Basin to La Quinta Junction
CC-81-HL-9	400+00	27	49.29	97	10.71	
CC-81-HL-10	450+00	27	49.12	97	11.62	
CC-81-HL-11	500+00	27	48.94	97	12.52	
CC-87-B-1	550+00	27	48.78	97	13.43	CCSC La Quinta jncn to Beacon 82
CC-87-B-2	600+00	27	48.62	97	14.34	
CC-87-B-3	650+00	27	48.62	97	15.27	
CC-87-B-DA 14B	670+00	27	49.22	97	15.64	3500N
CC-87-B-RF 14B	670+00	27	48.04	97	15.67	3500S

(contined)

Table USCE-5
(contined)

Identifier	Station* (ft)	Latitude deg	Latitude min	Longitude deg	Longitude min	location relative to project (ft)
CC-87-B-4	700+00	27	48.62	97	16.20	
CC-87-B-5	750+00	27	48.61	97	17.12	
CC-87-B-DA 15B	775+00	27	48.94	97	17.59	2000N
CC-87-B-RF 15B	775+00	27	48.27	97	17.61	2000S
CC-87-B-6	800+00	27	48.61	97	18.06	
CC-87-B-DA 16A	840+00	27	48.03	97	18.81	3500S
CC-87-B-RF 16A	840+00	27	49.18	97	18.79	3500N
CC-87-B-7	850+00	27	48.61	97	18.99	
CC-87-B-8	900+00	27	48.60	97	19.92	
CC-87-B-9	950+00	27	48.60	97	20.85	
CC-87-B-DA 17B	970+00	27	48.18	97	20.41	2000S
CC-87-B-RF 17B	970+00	27	48.91	97	21.21	2000N
CC-87-B-10	1000+00	27	48.59	97	21.78	
CC-88-B-11	1050+00	27	48.58	97	22.70	CCSC Beacon 82 thru Main Turning
CC-yr-TB-1	1100+00	27	48.72	97	23.62	Basin
CC-yr-TB-2	1150+00	27	48.80	97	24.50	
CC-yr-TB-3	1200+00	27	48.98	97	25.36	
CC-yr-TB-4	1250+00	27	49.39	97	26.18	
CC-yr-TB-5	1300+00	27	49.16	97	27.06	
CC-yr-TB-6	1350+00	27	49.00	97	27.94	
CC-yr-TB-7	1400+00	27	49.24	97	28.82	
CC-yr-TB-8	1450+00	27	49.64	97	29.64	
CC-yr-TB-9	1500+00	27	50.19	97	30.33	
CC-yr-TB-10	1550+00	27	50.56	97	31.13	
			Gulf Intracoastal Waterway			
			Corpus Christi Bay			
GIC-AP-94-01	0+00	27	50.79	97	3.64	GIWW - Channel to Aransas Pass
GIC-AP-94-02	50+00	27	51.39	97	4.24	Channel to Aransas Pass
GIC-AP-94-03	100+00	27	51.97	97	4.89	
GIC-AP-94-04	150+00	27	52.60	97	5.48	
GIC-AP-94-05	200+00	27	53.13	97	6.16	
GIC-AP-94-06	250+00	27	53.69	97	6.94	
GIC-AP-94-07	300+00	27	53.82	97	7.82	
GIC-AP-94-08	10+00	27	54.12	97	8.18	Aransas Pass Turning Basin
			Laguna Madre reach			
GIC-CBB-93-01	0+000	27	42.35	97	13.20	Gulf Intracoastal Waterway
GIC-CBB-93-02	5+000	27	41.54	97	13.40	Corpus Christi Bay to Mudflats
GIC-CBB-93-03	10+000	27	40.75	97	13.60	
GIC-CCB-90-07	30+000	27	37.58	97	14.64	
GIC-CCB-90-09	40+000	27	36.08	97	15.43	
GIC-CCB-90-11	50+000	27	34.59	97	16.20	
GIC-CCB-90-13	60+000	27	33.10	97	16.99	
GIC-CCB-88-21	100+000	27	27.11	97	20.14	GIWW CCB to Mud Flats
GIC-CBB-93-22	105+000	27	26.36	97	20.52	

(contined)

Table USCE-5
(contined)

Identifier	Station* (ft)	Latitude deg	Latitude min	Longitude deg	Longitude min	location relative to project (ft)
GIC-CCB-88-DA187	100+000	27	27.03	97	20.00	
GIC-CCB-88-REF187	100+000	27	27.17	97	20.26	
GIC-CCB-88-23	110+000	27	25.62	97	20.90	
GIC-CCB-88-25	120+000	27	24.13	97	21.69	
GIC-CCB-88-27	130+000	27	22.62	97	22.44	
GIC-CCB-88-DA192	130+000	27	22.58	97	22.30	
GIC-CCB-88-REF192	130+000	27	22.68	97	22.58	
GIC-CCB-88-29	140+000	27	21.08	97	23.11	
GIC-CBB-93-30	145+000	27	20.31	97	23.45	
GIC-CCB-88-31	150+000	27	19.54	97	23.78	
GIC-CBB-93-32	155+000	27	18.77	97	24.12	
GIC-CCB-88-33	160+000	27	17.97	97	24.32	
GIC-CCB-88-DA197	160+000	27	17.96	97	24.18	
GIC-CCB-88-REF197	160+000	27	17.98	97	24.47	
GIC-CCB-90-01	10+000	27	42.35	97	13.20	
GIC-BBMF-93-01	165+000	27	17.16	97	24.50	Gulf Intracoastal Waterway
GIC-BBMF-88-2	170+000	27	16.35	97	24.67	Baffin Bay to Mud Flats
GIC-BBMF-93-03	175+000	27	15.55	97	24.84	
GIC-BBMF-88-4	180+000	27	14.73	97	25.03	
GIC-BBMF-93-05	185+000	27	13.91	97	25.20	
GIC-BBMF-88-6	190+000	27	13.09	97	25.36	
GIC-BBMF-93-07	195+000	27	12.28	97	25.56	
GIC-BBMF-88-8	200+000	27	11.46	97	25.73	
GIC-BBMF-90-DA200	190+000	27	13.07	97	25.22	
GIC-BBMF-90-REF200	190+000	27	13.12	97	25.51	
GIC-BBMF-88-DA201	200+000	27	11.43	97	25.58	
GIC-BBMF-88-REF201	200+000	27	11.48	97	25.87	
GIC-BBMF-93-09	205+000	27	10.79	97	25.91	
GIC-BBMG-88-10	210+000	27	9.87	97	26.09	
GIC-BBMF-88-14	230+000	27	6.6	97	26.5	
GIC-BBMF-88-16	240+000	27	4.95	97	26.6	
			Aransas Bay reach			
GIC-AB-84-1	830+000	28	7.97	96	54.72	
GIC-AB-84-2	835+000	28	7.30	96	55.17	
GIC-AB-84-3	840+000	28	6.66	96	55.84	
GIC-AB-88-DA132	842+000	28	6.38	96	55.84	
GIC-AB-88-Ref132	842+000	28	6.36	96	56.47	
GIC-AB-84-4	845+000	28	6.01	96	56.42	
GIC-AB-88-5	850+000	28	5.37	96	56.98	
GIC-AB-88-DA133	850+000	28	5.36	96	56.67	
GIC-AB-88-Ref133	850+000	28	5.34	96	57.39	
GIC-AB-84-6	855+000	28	4.74	96	57.51	
GIC-AB-88-DA134	855+000	28	4.71	96	57.20	
GIC-AB-88-Ref134	855+000	28	4.47	96	57.20	

(contined)

Table USCE-5
(contined)

Identifier	Station* (ft)	Latitude deg	min	Longitude deg	min	location relative to project (ft)
GIC-AB-88-7	860+000	28	4.09	96	58.07	
GIC-AB-84-8	865+000	28	3.63	96	58.66	
GIC-AB-93-09	870+000	28	2.63	96	59.18	
GIC-AB-90-DA136	873+000	28	2.62	96	59.76	
GIC-AB-90-REF136	873+000	28	2.31	96	59.25	
GIC-AB-90-10	875+000	28	2.22	96	59.73	
GIC-AB-90-11	880+000	28	1.57	97	0.34	
GIC-AB-90-DA137	880+000	28	1.72	97	0.56	
GIC-AB-90-12	885+000	28	0.90	97	0.89	
GIC-AB-90-DA138	887+000	28	0.87	97	1.33	
GIC-AB-90-REF138	887+000	28	0.49	97	0.90	
GIC-AB-90-13	890+000	28	0.30	97	1.45	
GIC-AB-90-14	895+000	27	59.91	97	2.22	
GIC-AB-90-DA139	895+000	28	0.19	97	2.32	
GIC-AB-90-DA140	897+000	27	59.61	97	2.44	
GIC-AB-93-REF140	897+000	28	0.14	97	2.66	
GIC-AB-93-15	900+000	27	59.68	97	3.13	
GIC-AB-93-DA136	873+000	28	2.62	96	59.76	
GIC-AB-93-DA140	897+000	27	59.61	97	2.44	
GIC-AB-93-REF136	873+000	28	2.31	96	59.25	
		San Antonio Bay reach				
GIC-SAB-88-4	740+000	28	17.65	96	42.25	
GIC-SAB-88-5	745+000	28	17.12	96	42.82	
GIC-SAB-88-6	750+000	28	16.60	96	43.54	
GIC-SAB-88-7	755+000	28	16.09	96	44.14	
GIC-SAB-88-8	760+000	28	15.58	96	45.02	
GIC-SAB-88-9	765+000	28	15.04	96	45.72	
GIC-SAB-88-10	770+000	28	14.53	96	46.45	
GIC-SAB-88-11	775+000	28	14.04	96	47.14	
GIC-SAB-93-12	780+000	28	13.50	96	47.87	Gulf Intracoastal Waterway
GIC-SAB-93-13	785+000	28	12.99	96	48.60	San Antonio Bay to Aransas Bay
GIC-SAB-93-14	790+000	28	12.39	96	49.26	
GIC-SAB-93-15	795+000	28	11.79	96	49.92	
GIC-SAB-93-16	800+000	28	11.28	96	50.64	
GIC-SAB-93-17	805+000	28	10.77	96	51.35	
GIC-SAB-yy-18		28	10.27	96	52.10	
GIC-SAB-yy-19		28	9.76	96	52.83	
GIC-SAB-yy-20		28	9.24	96	53.56	
GIC-SAB-84-21	825+000	28	8.62	96	54.10	
ML-1		28	13.85	96	47.54	Mustang Lake
ML-2		28	13.81	96	47.66	Mustang Lake
RS-1		28	13.18	96	48.51	Red Fish Slough
RS-2		28	12.95	96	48.79	Red Fish Slough
SB-1		28	11.65	96	50.28	Sundown Bay

(contined)

Table USCE-5
(contined)

Identifier	*Station** (ft)*	*Latitude deg*	*min*	*Longitude deg*	*min*	*location relative to project (ft)*
SB-2		28	11.39	96	50.68	Sundown Bay
SB-3		28	10.88	96	51.40	Sundown Bay
SB-4		28	10.57	96	51.86	Sundown Bay
RI-1		28	11.24	96	50.47	Roddy Island
RI-2		28	10.48	96	51.51	Roddy Island
DB-1		28	8.02	96	54.82	Dunham Bay
DB-2		28	8.05	96	54.78	Dunham Bay
DB-3		28	7.74	96	55.04	Dunham Bay
DB-4		28	8.12	96	55.28	Dunham Bay
Mustang (A)	775+000	28	14.21	96	47.36	1900 NW
Mustang (B)	777+000	28	13.87	96	47.56	400NW
Beacon 47 (A)	783+000	28	13.28	96	48.35	400NW
Beacon 47 (B)	786+500	28	12.88	96	48.88	400NW
Sundown (A)	797+600	28	11.61	96	50.33	400NW
Ayres (A)	799+500	28	11.26	96	50.46	800SE
Sundown (B)	802+500	28	11.09	96	51.04	400NW
Mesquite (A)	806+000	28	10.49	96	51.35	1500SE
Mesquite (B)	808+500	28	10.27	96	51.63	1500SE
Sundown (C)	809+000	28	10.46	96	52.06	700NW
Carlos (A)	824+500	28	8.53	96	53.90	1200SE
Dunham (A)	829+200	28	8.12	96	54.73	600NW
Dunham (B)	831+000	28	8.16	96	55.24	2800NW
DA 133	846+200	28	6	96	56.80	1800NW

* USCE Project coordinates

SOURCE DATA SET REPORT
Project code 11

DATA SET: Water and sediment chemistry

PROJECT ABBREVIATION: USGS

SOURCE: U.S. Geological Survey Corpus Christi Laboratory

MEASUREMENTS:

Chemical analyses on water and sediment samples from Corpus Christi Bay system. Various parameters, see Table USGS-2 below.

PROCEDURES:

No information has survived on specific procedures. Apparently a network of stations was established, and subjected to quasi-regular sampling, but at long intervals (months). Laboratory methodologies were presumably those published contemporaneously by USGS, e.g. Skougstad et al. (1979).

QUALITY ASSURANCE/QUALITY CONTROL:

No formal QA/QC plan exists or is reported, and no information is available as to QA/QC practices. It is reasonable to surmise that the laboratory procedures were consistent with the published methodologies of USGS current during the 1970's. Data entry procedures appear to be problematic and ultimately undermined the utility of this data set for the present project, see Discussion below.

DESCRIPTION & COMMENTS:

From approximately 1967 until about 1980, USGS maintained an active field office in Corpus Christi. This office engaged in occasional hydrographic projects (e.,g., surface drifter releases and tracking in the Corpus Christi coastal area) but spent most of its attention on inner continental shelf, stratigraphy, sediment geochemistry and water biochemistry. Most of the activities of the office concentrated upon field data collection. These included coastal zone mapping of sand lenses, analysis of the stability of the outer continental shelf, and related large-scale geological investigations. Field sampling in the bays was a relatively minor activity, however the extensive chemical analyses make the data collected by this office some of the earliest analyses of trace constituents, therefore the data is of potentially great value to the present data compilation. The office was taken over by the Minerals Management Service around 1980, and operated until about 1984, when it was closed.

SAMPLING LOCATIONS:

No information is available as to the network of stations, the motivation for sample station implementation, or method of positioning. From the data files provided to this project (see Discussion below), most of the sampling stations are represented in Table USGS-1. Nor is there any means of checking station locations. Obvious errors can, of course, be identified: one of the USGS stations plotted out in the middle of downtown Corpus Christi.

DISCUSSION:

Due to personnel turnover, the transfer of the office to another agency, and its final closure, its data holdings became scattered. The District Office of USGS (Austin) was contacted in an effort to track down the fate of the data holdings. Although some of the present District Office's personnel previously served in the Corpus Christi operation, they stated that no data or information was brought with them to Austin. Apparently, the last surviving data holdings from this operation are being held by Dr. Charles Holmes, a member of the Corpus Christi USGS staff until the bitter end, now at the Denver USGS office. Dr. Holmes provided QUATROPRO copies of his data sets to this project. The data generally cover a period from 1969 until 1983, although the stations sampled and the frequency of sampling are highly variable.

The suites of parameters listed in the headers of the data files are shown in Table USGS-2. The size of the data files and the extensive suites of variables listed lead one to expect a massive data collection. Data for the full suites are, however, not given for all samples. Rather, a given sample usually has only a handful of the analyses actually reported. Some parameters are not represented at all in the entire data set. Two of the files proved to be BEG data (see Project Code 12) that had been reformatted in USGS convention.

One ambiguity in the data base is the interpretation of blank entries, i.e., whether these indicate NO DATA (i.e., no analyses performed), or NONDETECT (i.e., an analysis performed but the concentration was below detection limits). The former is no information, the latter is clearly information, and should be entered into the present data base. There is no indication in the data files as to which is which. Dr. Holmes stated in response to this question that the blank entries mean NONDETECT. This left us with a dilemma as to how to treat the data. Given that the principal interest of the Corpus Christi lab, and of Dr. Holmes in particular, was sediment processes, it seems likely that the metallic elements for sediment samples were probably really analyzed and the entry blanks are indeed NON DETECT's. Even at this, many of the entries in the sediment data base clearly correspond to electrometric profiles in the water column, and the blanks under sediment parameters *must* mean no sample taken (and therefore NO DATA). We therefore assume that if any sediment parameter is reported, and therefore a sediment sample was taken, the analyses for metals was performed and the blanks represent NONDETECT's. This assumption leads to eliminating the vast majority of blank entries in the sediment data files. Where we assume the blanks to mean NONDETECT'S we take the detection limits to have values current ca. 1975 (e.g., as reported by BEG and USGS) for these types of analyses.

The water samples are even more puzzling. For standard chemical parameters, some sample events (date/station) have non-blank entries only for the variables usually measured *in situ* by electrometric probes, e. g., temperature, DO, pH, and (perhaps) conductivity, so it is clear that no water sample was taken for analysis. This means blanks must be interpreted as NO DATA, rather than NONDETECT. (Surely COD or conductivity could not have been nondetectable!) In other instances, only certain nutrients, e.g. orthophosphorus, orthophosphate, DOC, have non-blank entries. This is strongly suggestive that in these cases, blanks mean NO DATA. We have made this assumption in this data compilation. Whether this assumption should be extended to the metals when companion sediment data exist is not clear, because of the assumption that such analyses *were* performed for sediment samples. After much deliberation, we decided to apply the assumption of NO DATA whenever *all* metals for a given sample are blank entries. On the other hand, when *some* metals are reported, we assume the other metals were analyzed also but yielded nondetects. (This assumption is applied separately to the dissolved and "total" data sets. I.e., if a filtration was done to determine dissolved fraction for any metal, we assume all dissolved metals were analyzed. As matters developed, there are only five analyses for "dissolved" fraction in the entire data set.)

For the organic constituents in both water and sediment, most of the sample events have blanks for the complete suite of organics. Again, in view of the principal emphasis of the Corpus lab during this period, it is hard to accept that such extensive organic parameter suites were analyzed for so many samples. On the other hand, when some organics *are* reported it is likely that the companion compounds were also analyzed but found to be nondetectable. We have therefore assumed that the entire suite of organics was analyzed for those samples in which some of the compounds were reported as detected, but if all entries are blank, we assume there to be NO DATA for any of these compounds. As before, detection limits typical of those achieved in the 1970's are assumed.

The net effect of applying these assumptions is that the actual data for metals in sediment and water, and organics in sediment and water, reduce to only a handful of measurements: 40 separate samples for metals in water, 5 for metals in sediment, 7 for organics in water, and 6 for organics in sediment. While it is likely that we are discarding some real information in this process of treating most of the blank entries as NO DATA, we are also avoiding incorporating no-data information falsely as non-detects.

However, there are additional problems even with these surviving data. Upon closer examination, many of the entries are obviously out of the reasonable range for the variables they are supposed to represent. For the water phase, dissolved lead ranges 20,000-40,000 μg/L, total mercury 50-100 μg/L, dissolved cadmium 2,000-5,000 μg/L (see further discussion below), for chromium and copper the *dissolved* concentrations are much larger than the *total* concentrations. The concentrations of organic pesticides, when given, are miraculously nearly all the same value, 0.010 µg/L, which looks suspiciously like a detection limit. For the sediment phase, the metals look about right except for iron (order of magnitude too high), lead and manganese (order of magnitude too low), but for the organic pesticides, except for PCB's, the few values that are given appear to be detection limits rather than actual concentrations. This situation can be described—charitably—as a total mess. In this compilation therefore, all water phase metals and organics were ignored, and for the sediment phase only the metals excluding Fe, Pb and Mn and PCB's were incorporated into the data base.

With respect to water chemistry data, yet more aberrations were encountered. The data under the heading RESIDUE DISS 180C MG/L are on the order of magnitude of 5-10, while those under the heading TOTAL RESIDUE MG/L are on the order of 20,000-40,000. It appears that the header is incorrect for the former column, and these are in fact suspended solids (i.e. RESIDUE SUSS). The halogens appear to be scrambled. Typical orders of magnitude represented in the data are: chlorides 3,000, fluorides 20,000, bromides 1, iodides 50. Silica concentrations, on the order of 0.05 are 1-2 orders of magnitude too small. There is a heading for TOC, but only one measurement in the entire data base (and that value is so small that one must wonder if it was entered incorrectly). There are columns for both dissolved organic carbon (DOC) and suspended organic carbon (SOC), but for the great majority of samples only one of the two is reported.

A great number of measurements of cyanide in both water and sediment appear in the data base, suggesting a special survey for this purpose. There are also a great number of measurements of *dissolved cadmium* in water, suggesting a special survey for this parameter. This is curious, since the expense of sample collection and preparation would argue against both a large number of cadmium determinations and analyses without any other accompanying metals! Moreover, the values do not make sense, being on the order of 5,000 µg/L. It is our guess that these are instead dissolved *calcium* measurements in mg/L, simply entered in an incorrect column.

An extensive sampling of chlorophyll was carried out, but the values are for chlorophyll-*b*, on the order of 5 µg/L. No chlorophyll-*a* values are reported. Considering that chlorophyll-*b* values are much smaller, and less reliably measured than chl-*a*, and have almost no utility in biomass or productivity studies, it is puzzling why this parameter would have been given so much attention. (The sample events for the extensive sampling of "dissolved cadmium" do not correlate with the extensive sampling of chlorophyll-b. Could this mean completely separate sampling runs, or mis-entered dates?)

The electrometric water-column measurements (conductivity, pH, DO, temperature) appear to be in good shape, so these were compiled into the data base, along with TSS (assuming that to be the data under the header RESIDUE DISS), nitrate, and orthophosphorus. The chlorophyll-b and cyanide data (both water and sediment) were also compiled, though they will probably not be of much use. For the sediment sampling, metals (with exceptions noted above) and PCB's were compiled. All other parameters were considered to be obviously aberrant and unreliable, and omitted from this compilation. It is unfortunate that better data entry procedures were not observed by the USGS, but given the history of this data-collection enterprise we are fortunate that any information survived at all.

REFERENCES:

Skougstad, M., M. Fishman, L. Friedman, D. Erdmann, and S. Duncan (Eds.), 1979: Methods for determination of inorganic substances in water and fluvial sediments. Chapter A1, Book 5 (Laboratory analysis), *Techniques of water-resource investigations of the U.S. Geological Survey*. GPO, Washington, D.C.

Table USGS-1
Sampling stations occupied during course of Corpus Christi Lab operations

Latitude			*Longitude*		
deg	*min*	*sec*	*deg*	*min*	*sec*
25	57	1	97	24	4
27	37	34	97	13	33
27	38	3	97	14	6
27	38	7	97	14	13
27	38	7	97	14	12
27	39	18	97	15	23
27	41	8	97	13	17
27	41	12	97	14	20
27	41	24	97	11	36
27	42	23	97	15	23
27	43	9	97	15	12
27	43	21	97	11	10
27	43	21	97	11	10
27	43	27	97	18	25
27	43	33	97	15	2
27	44	19	97	14	27
27	44	19	97	14	27
27	44	32	97	21	15
27	45	6	97	14	16
27	45	10	97	18	5
27	45	11	97	21	12
27	45	18	97	10	22
27	45	18	97	10	22
27	45	26	97	21	7
27	45	26	97	21	6
27	45	29	97	14	6
27	45	29	97	14	6
27	46	5	97	21	2
27	46	16	97	13	31
27	46	19	97	17	25
27	46	19	97	17	25
27	46	34	97	20	29
27	47	2	97	13	21
27	47	12	97	9	16
27	47	12	97	9	15
27	47	13	97	20	25
27	47	21	97	17	11
27	47	26	97	13	10
27	48	12	97	12	35
27	48	12	97	12	35
27	48	22	97	16	33
27	48	23	97	20	10
27	48	23	97	20	10
27	48	27	97	23	25
27	48	27	97	23	25
27	48	29	97	24	34
27	48	30	97	24	33
27	48	33	97	12	26
27	48	33	97	12	26
27	49	0	97	8	13
27	49	2	97	27	8
27	49	12	97	0	33
27	49	15	97	29	4
27	49	21	97	1	21
27	49	31	97	26	30
27	49	34	97	16	16
27	49	34	97	25	12
27	50	5	97	22	24
27	50	9	97	26	34
27	50	10	97	22	19
27	50	10	97	22	19
27	50	14	97	4	33
27	50	16	97	25	14
27	50	16	97	25	14
27	50	18	97	19	26
27	50	21	97	30	11
27	50	21	97	30	11
27	50	21	97	31	9
27	50	26	97	22	0
27	50	34	97	27	3
27	50	34	97	25	16
27	50	34	97	27	3
27	51	3	97	19	18
27	51	3	97	19	19
27	51	10	97	15	34
27	51	10	97	15	34
27	51	11	97	27	6
27	51	15	97	25	17
27	51	15	97	25	17
27	51	23	97	33	12
27	51	26	97	25	17
27	52	13	97	31	30
27	52	19	97	15	17
27	52	19	97	2	30
27	52	34	97	5	60
27	53	7	97	31	33
27	53	16	97	6	20
27	53	26	97	37	25
27	53	27	97	37	25
27	53	28	97	37	22
27	53	28	97	8	3
27	53	34	97	8	11
27	57	14	97	0	8
27	57	30	97	1	33
27	58	9	97	3	11

TABLE USGS-2

Parameters listed in data files from
USGS monitoring monitoring program in Corpus Christi Bay
(organics abbreviated)

Ag (silver)	P,Ortho	CHLOROPHYLL-B, P
Al (aluminum)	PO4, ortho	PCB
As (arsenic)	TOC	PCN
Au (gold)	Carbonate CO3	ALDRIN
Ba (barium)	Carbon (carbonate)	AMETRYNE
Be (beryllium)	Carbon (organic)	CHLORDANE
Bi (bismuth)	Carbon (Total)	CYANAZINE
B (boron)	Cyanide	DDD
Ca (calcium)	Hydrogen	P,P' DDD
Cd (cadmium)	Nitrogen (Total)	DDE
Ce (cerium)	Nitrogen (organic)	P,P' DDE
Cl (chloride)	Nitrogen	DDT
Co (cobalt)	Nitrogen, Kjeldahl (total)	DIAZINON
Cr (chromium)	Nitrogen (Ammonia)	DIELDRIN
Cu (copper)	Ammonia (NH3)	DISYSTON
Fe (iron)	Nitrate (NO3)	ENDOSULFAN I
Ga (gallium)	Nitrite (NO2)	ENDOSULFANE
Hg (mercury)	Oxygen (O2)	ENDRIN
K (potassium)	Sulfide (SO2)	ETHION
La (lanthanum)	Sulfite (SO3)	HEPTACHLOR
Mg (magnesium)	Sulfate (SO4)	HEPT EPOX
Mn (manganese)	Acid Volatile Sulfides (AVS)	LINDANE
Mo (molybdenum)	Chem Oxygen Demand (COD)	MALATHION
Na (sodium)	Cation Exchange Capacity (CEC)	METHOXYCHLOR
Nb (niobium)	Loss on Ignition	MTHOXYCLR
Ni (nickel)	TOT SOLIDS	MET PARTH
P (phosphorous)	SPECIFIC CONDUCT US/CM @ 25C	MET TRITH
Pb (lead)	PH, WH, FIELD	MIREX
Sb (antimony)	WATER TEMPERATURE	PARATHION
Sc (scandium)	OXYGEN DISSOLVED	PERTHANE
Se (selenium)	SODIUM ADSORPTIO (RATIO)	SEVIN
Si (silicon)	POTASSIUM	SILVEX
Sn (tin)	ALKALINITY	TOXAPHENE
Sr (strontium)	CHLORIDE	ETH TRITH
Th (thorium)	FLUORIDE	2,4-D
Ti (titanium)	BROMIDE	2, 4-DP
Tl (thallium)	IODIDE	2,4,5-T
U (uranium)	SILICA	
V (vanadium)	RESIDUE TOTAL	
W (tungsten)	CYANIDE	
Y (yttrium)	STRONTIUM	
Zn (zinc)	TRITIUM	
Zr (zirconium)	RADIUM	
Li (lithium)	URANIUM	

SOURCE DATA SET REPORT
Project code 012

DATA SET: BEG Submerged Lands of Texas Survey

PROJECT ABBREVIATION: BEG

SOURCE: Bureau of Economic Geology, University of Texas

MEASUREMENTS:

Total organic carbon
Selected elements: boron, barium, calcium, chromium, copper, iron, lead, manganese, nickel, strontium, zinc

PROCEDURES:

Sampling was performed by Ponar clam-shell dredge in the bay and Smith-McIntyre samplers for the shelf, to obtain surficial 4-10 cm depth of sediment.

Parameters and methodologies were:

Total organic carbon - wet combustion technique
Selected elements by inductively coupled plasma-atomic emission spectrometer

While all stations were analyzed for TOC, only about a third of the station samples were analyzed for elemental metals.

In addition grain-size analyses were performed using Rapid Sediment Analyzer and (for muds) Coulter Counter. The GLO staff (pers. comm., 1991) indicated that these analyses were carried out for samples different than those subjected to elemental analysis, i.e. taken on different surveys and only in the same "general location". Therefore, these data are not included in Data Set 012.

QUALITY ASSURANCE/QUALITY CONTROL:

No formal QA/QC plan exists or is reported, and no information is available as to QA/QC practices.

DESCRIPTION & COMMENTS:

Complete data listing in Appendices of White et al. (1983, 1989). Dates of samples are only generally indicated (their Table 3), as range of dates in which sampling was performed in specific subareas of bay system. Based upon the meager information in these tables, the following dates were assigned:

Copano Bay	31 March 1976	Aransas Bay	31 May 1976
Aransas River	19 September 1976	Mission Bay & Lake	17 September 1976
Port Bay	16 September 1976	Redfish Bay	13 July 1976
Oso Bay	16 September 1976	Upper Laguna Madre (CCB)	25 September 1976
Nueces Bay	10 September 1976	Corpus Christi Bay	25 June 1977
Inner Shelf	11 May 1976	Laguna Madre GIWW (N)	18 June 1976
Swan Lake	16 September 1976	Alazan Bay	21 September 1976
Baffin Bay	22 September 1976	Laguna Madre (near Baffin)	10 February 1977
Laguna GIWW (S)	18 March 1977	Inner Shelf (south)	3 March 1976

except where specific stations and dates could be deduced from their Table 3 information and that in the BEG records.

SAMPLING LOCATIONS:

A network of stations on a grid of approximately 2 km spacing was established throughout the bay, and up the major tributaries, the positions shown on a station map published with the report (White et al., 1983, 1989). The precise method of positioning was the time-honored method of "eye-balling". (For offshore stations, LORAN-C was used.) As a part of its work for the NRI, the BEG staff recovered the navigation charts used for positioning and carefully read off latitude/longitude for each of the stations. A digital copy of this data file was provided to this project. These stations were then matched to the elemental analysis data files and merged into combined records.

DISCUSSION:

Staff of BEG indicated that, although the data base was keyboarded onto magnetic media for publication of the report, the software was a word-processor with proprietary and non-transferable format, nor can the files be written in ASCII file. For practical purposes, therefore, the only version accessible was the hard-copy publication. Accordingly, in the EPA sediment-data project, the entire data set, including a 5-mile band along the shelf was keyboarded in a dBase format. This data file was downloaded and re-formatted in ASCII files for incorporation in the present data base. This was supplemented with data files keyboarded by BEG as part of its earlier work for the TGLO Natural Resources Inventory.

REFERENCES:

White, W.A., T. Calnan, R. Morton, R. Kimble, T. Littleton, J. McGowen, H. Nance, and K. Schmedes, 1983: *Submerged lands of Texas, Corpus Christi area*. Bureau of Economic Geology, University of Texas at Austin.

White, W.A., T. Calnan, R. Morton, R. Kimble, T. Littleton, J. McGowen, H. Nance, and K. Schmedes, 1989: *Submerged lands of Texas, Kingsville area*. Bureau of Economic Geology, University of Texas at Austin.

SOURCE DATA SET REPORT
Project code 13

DATA SET: Trawling project, Southwest Research Institute, Ocean Science & Engineering Laboratory, Corpus Christi

PROJECT ABBREVIATION: SWRI-TRL

SOURCE: Case and Wimer (1977)

MEASUREMENTS: Hydrographic observations, i.e. salinity and temperature, taken in association with the occupation of trawl stations in Corpus Christi Bay.

PROCEDURES:

Sampling was performed from a 60-ft research vessel, the *Southwest Researcher*, operated by SWRI for several years. Draft of the boat was 1.5 m. Salinity and temperature measured with a Beckman RS5-3 Portable Salinometer, at the top and bottom of the water column.

QUALITY ASSURANCE/QUALITY CONTROL:

No formal QA/QC plan exists or is reported, and no information is available as to QA/QC practices. Stated accuracy of the instrument is ± 0.5 °C and ± 0.3 ‰.

DESCRIPTION & COMMENTS:

Reference is made to the Discussion of Project Code 005 for a description of the SWRI lab and measurement program.

Data were collected during the period February 1976 through March 1977, in association with a program of introducing high school students to marine science. The principal objective was performing repeated trawls at a network of 28 stations distributed through the bay. The data were keypunched for computer analysis, but no records of the project or the data base have survived. The data employed in this set are taken from a copy of the final report, Case and Wimer (1977), in the archive of the Coastal Bend Council of Governments.

While the observations themselves are routine, the data reported present several problems. First, each sampling run was extended over a period of 3 or more days, but there is no information as to when exactly each station was occupied. Therefore, we have assigned a median date to all of the stations. The stated sampling periods and the assigned dates are given in the Table SRIT-1. (Collection number 14 is included for completeness. No hydrographic data were taken on this run.)

Table SRIT-1
Inferred data collection dates

Collection	*Date*		*Date assigned*	
1	4-6 Feb	76	5 Feb	76
2	15-16 Mar	76	15 Mar	76
3	9, 12-14 April	76	12 Apr	76
4	13-17 May	76	15 May	76
5	12-14 July	76	13 Jul	76
6	30 July - 2,3 Aug	76	2 Aug	76
7	18-20 Aug	76	19 Aug	76
8	1-3 Sept	76	2 Sep	76
9	15-17 Sept	76	16 Sep	76
10	6-8 Oct	76	7 Oct	76
11	1-3 Dec	76	2 Dec	76
12	13-15 Dec	76	14 Dec	76
13	12-14 Jan	77	13 Jan	77
14	2-4 Feb	77	3 Feb	77
15	16-18 Feb	77	17 Feb	77
16	1-3 Mar	77	2 Mar	77

Second, although the data are stated to be taken at surface and bottom, no depth information is provided. The stations were located as precisely as possible from the (poor) figures in the report, and a depth assigned based upon average bathymetry in the area. We assume that the surface measurement was at a depth of 0.3 m (1 ft) and the bottom 0.3 m (1 ft) above the associated station depth. The assigned station depths are given along with the latitude/longitude coordinates in the next section.

SAMPLING LOCATIONS:

A total of 28 stations were occupied. (The stations are numbered from 1 to 30, but during the first sampling run, Stations 22 and 23 were deleted from the program.) These stations were located on navigation charts of the area, the latitude/longitude coordinates determined, and the water depths estimated, all of which are given in the following table. For those stations located in proximity to an identifiable landmark, e.g. a navigation beacon or an onshore reference, the position was determined to the nearest 0.01 minute (about 20 m). For those in open water without any navigational reference, we assume the boat was positioned by the time-honored technique of "eye-balling" and the position is read to only 0.1 minute (nominally about 200 m, which may be charitable in many instances.)

REFERENCES:

Case, R., and A. Wimer, 1977: A trawl study of Corpus Christi Bay, Volume 1. SWRI Project 22-4237, Final Report to James Dougherty , Jr. Foundation, Sid W. Richardson Foundation, H.E. Butt Grocery Company, Hershey Foundation, Taub Foundation. Southwest Research Institute, Corpus Christi.

Table SRIT-2
Station locations

Station	*latitude*		*longitude*		*depth*
	deg	*min*	*deg*	*min*	*ft*
1	27	48.74	97	23.71	38
2	27	50.58	97	22.28	5
3	27	51.72	97	21.68	6
4	27	48.57	97	21.96	38
5	27	47.5	97	22.5	6
6	27	45.2	97	21.1	8
7	27	48.64	97	18.08	38
8	27	52.15	97	16.35	12
9	27	52.5	97	15.75	35
10	27	51.0	97	14.3	35
11	27	48.62	97	15.45	38
12	27	46.50	97	16.5	12
13	27	43.30	97	18.3	12
14	27	45.0	97	14.1	12
15	27	37.9	97	14.5	12
16	27	41.5	97	13.5	12
17	27	42.0	97	11.5	10
18	27	45.8	97	10.8	10
19	27	48.9	97	12.9	38
20	27	49.8	97	8.0	38
21	27	52.4	97	5.4	12
24	27	55.75	97	3.6	8
25	27	57.8	97	1.9	10
26	27	58.5	97	3.7	6
27	28	0.3	96	59.8	10
28	28	1.0	97	1.2	6
29	28	2.9	96	57.8	9
30	28	3.6	96	58.5	12

SOURCE DATA SET REPORT
Project code 14

DATA SET: Hydrographic & chemical study of Corpus Christi Bay

PROJECT ABBREVIATION: TAMC-40

SOURCE: Hood, 1952, Hood, 1953; copies from Reynolds Metals files

MEASUREMENTS:

Hydrographic observations, i.e. salinity and temperature, with occasional water-chemistry determinations, viz.: pH, dissolved oxygen, bacteria, inorganic phosphorus. Current observations were made utilizing current crosses, drift bottles, and a Price meter.

PROCEDURES:

A series of transects were executed over Corpus Christi Bay, with hydrographic stations occupied roughly every 1 km. Some stations were located adjacent to well-marked features, e.g. the Reynolds Pier, navigation beacons, etc. Most of the open-water stations required positioning. This was achieved by setting the boat on a constant heading to a landmark (a navigation beacon, or some feature on the opposite shore), and determining intersecting bearings to other features at each station on the primary heading. This method is, of course, rather crude, and in our judgment the accuracy of location is rarely better than 100-500 m, worsening with distance from the landmarks.

Sampling was performed from a 40-ft, 250 HP shallow draft vessel, the *Atchafalaya*, of the TAMC Department of Oceanography, and an 18-ft skiff on loan from the Marine Science Institute at Port Aransas. The Atchafalaya broke down in May and was replaced by a rented "speed boat". The report states that the boat was equipped with "current fins", a salinity meter, temperature gauge, turbidity meter and, later, a modified pH meter. The data stated to be collected were:

salinities by conductivity meter	surface temperature
temperature at depth of salinity msmt	DO†
pH	dissolved phosphate†
count of marine aerobic bacteria†	turbidity
current speed	current direction

The parameters were to be measured at all stations, except those marked "†" which were to be measured at one-fourth of the stations.

Turbidity, pH and conductivity (salinity) were determined by electrometric probes sampling the water supply line on the boat (intake depth at about 3 ft). The conductivity meter was built by TAMC personnel specifically designed for operation in the *Atchafalaya*. DO samples were obtained by sampling the water supply line on the boat, preserving the sample and running Winklers at the lab. Occasional titrations for chlorinity were carried out to verify and supplement the conductivity measurements. Dissolved phosphate was analyzed by the method of Robinson and Thompson (1948, *J. Mar Res. 7*, p. 33) and Wooster and Rakestraw (1951, *J. Mar. Res. 10*, p. 91) through the 29 June surveys. A new method was devised (Procter, 1953), considered to be more sensitive, and applied to the October field survey.

The turbidity meter was abandoned (no data being reported), and replaced by a transmittance meter developed by Parrack and Hood "as a means of determining the depth at which a preselected minimum extinction value is obtained when the incident light energy is of a value found to be average for the Corpus Christi Bay area." No data are reported from this instrument either, and the subject is conspicuously absent from the annual report (Hood, 1953).

Substitution of the speed boat after the May survey eliminated the pumped supply line, and therefore the electrometric equipment for turbidity, salinity and pH. Water samples were then collected by a weighted, stoppered bottle, the stopper being pulled when the bottle was at the desired depth. In August and October, some surface/bottom samples were obtained but no information is given on the water depth.

The "metal-fin" measurements appear from the description to be an adaptation of what was later known as "Chesapeake Bay current crosses", orthogonal fins set at a prescribed depth and suspended from a davit on an anchored boat. The angle from vertical can be used to determine the current velocity at the depth of the fins. A Price meter was secured after the February survey (which apparently lacked a directional capability except when held near the surface so that the orientation was visible). In the data presentations, there is no distinction between measurements with the current cross and with the Price meter. No information is given on the deflection versus current speed relation for the current cross; we doubt that the accuracy is better than 20%.

QUALITY ASSURANCE/QUALITY CONTROL:

No formal QA/QC plan exists or is reported, and no information is available as to QA/QC practices. Some information regarding accuracy and precision is provided with the details of analytical methodologies. Stated precision of the custom-built conductivity meter is ±0.0003 mhos/cm, or about 0.2 ‰ salinity. The overall accuracy was believed to be about 0.3‰ chlorinity equivalent, or about 0.5‰ salinity, which we have used in the present date compilation. Chlorinity titrations are accurate to ±0.05 ‰. No temperature data are presented, though this was undoubtedly measured.

DESCRIPTION & COMMENTS:

The principal objective of the study was to establish baseline conditions in the bay, especially in the vicinity of the Reynolds Metals operation, prior to a major expansion of the facility. Unfortunately, no post-project surveys were ever carried out. The only record of the data are the typed tabulations in a series of progress reports submitted to Reynolds during the course of the project (see References, below). The data employed in this set are taken from a copy of these reports provided to this project by Reynolds Metals.

Field surveys were performed on the following occasions:

26-28 November 1951	14-16 December 1951
12-14 January 1952	15-18 February 1952
22-24 March 1952	5-7 April 1952
10-12 May 1952	28-30 June 1952
7-12 August 1952	9-13 October 1952

No data are reported for the 1951 surveys nor for the 28-30 June survey. Data from the other surveys in the period January through October 1952 are scattered through the reports, in various formats. Dissolved oxygen data for the August and October surveys are presented as an appendix to the annual report (Hood, 1953), but, exasperatingly, only as per cent saturation. No temperature data are given, so it is impossible to recover the DO concentrations.

The data presentation is a mess. For the January run, the data are annotated on a small-scale map of the bay, multiply reduced and nearly illegible. For later, surveys, they are tabulated, but often without depths of measurements or specific dates. (For the February-May data, only the pH values have dates, so by cross-comparing these to the station data for salinity and temperature, we were able to sort out the dates of measurement for most of the samples.) In the August and October measurements, surface and bottom data are given without further specificity. We employed charts of Corpus Christi Bay bathymetry ca. 1950 to assign depths to these points, and assume the surface sample to be taken at 1 ft (0.3 m).

SAMPLING LOCATIONS:

Relatively few surveys were performed, but many stations were occupied on each survey. The first survey reported (12-14 January 1952) consisted of a major transect along the Corpus Christi Ship Channel followed by shorter transects in the upper and lower bays, along which stations were located "on the fly." After this experience, a more careful transect layout was devised, which then formed the basis for the remainder of the surveys. The stations identified in this layout are given in Table TAMC-1.

These positions were laboriously determined from a poorly reproduced, reduced map of Corpus Christi Bay, so their accuracy is certainly no better than the 0.1-minute precision. As noted above, however, the positioning method employed in the field was probably no better than several hundred meters, except when in the immediate vicinity of identifiable landmarks. Not all stations were occupied on every survey; some stations were never occupied. Data are reported from some

Table TAMC-1
Station Locations

1	27	50.4	97	4.9	CCSC FL "2"
2	27	50.1	97	6.2	
3	27	49.9	97	7.6	
4	27	49.6	97	8.9	
5	27	49.4	97	10.2	
6	27	49.3	97	11.5	
7	27	48.8	97	13.1	
8	27	78.7	97	14.2	
9	27	48.7	97	15.4	
10	27	48.7	97	16.8	CCSC FL "56"
11	27	49.5	97	16.7	
12	27	50.3	97	16.7	
13	27	51.2	97	16.6	
14	27	51.8	97	16.6	
15	27	52.5	97	16.5	
16	27	52.4	97	16.2	
17	27	51.6	97	15.7	
18	27	51.0	97	15.3	
19	27	51.4	97	14.9	
20	27	50.6	97	15.5	
21	27	51.0	97	16.2	
22	27	51.4	97	17.2	
23	27	51.7	97	17.7	
24	27	51.8	97	18.0	
25	27	52.0	97	18.5	
26	27	52.0	97	19.0	
27	27	51.6	97	18.7	
28	27	51.4	97	18.5	
29	27	50.9	97	18.3	
30	27	50.4	97	17.9	
31	27	49.9	97	17.6	
32	27	49.4	97	17.3	
33	27	49.2	97	17.8	
34	27	49.6	97	18.6	
35	27	49.9	97	19.3	
36	27	50.3	97	20.0	
37	27	50.6	97	20.6	
38	27	50.7	97	21.1	
39	27	50.5	97	21.8	
40	27	49.9	97	21.9	
41	27	49.4	97	21.9	
FL80	27	48.7	97	22.0	CCSC FL "80"
42	27	49.2	97	21.4	
43	27	49.6	97	20.9	
71	27	48.3	97	19.1	
72	27	48.7	97	19.4	CCSC FL "68"
73	27	48.0	97	19.2	
74	27	47.3	97	18.8	
75	27	46.6	97	18.6	
76	27	46.1	97	18.4	
77	27	45.7	97	18.3	
78	27	45.0	97	18.0	
79	27	44.4	97	17.7	
80	27	43.7	97	17.5	
81	27	43.1	97	17.3	
NTS	27	42.3	97	16.8	NAS dock
82	27	43.3	97	17.6	
83	27	44.0	97	18.2	
84	27	44.6	97	18.8	
85	27	45.1	97	19.2	
86	27	45.9	97	19.8	
87	27	46.6	97	20.3	
88	27	47.3	97	20.8	
89	27	48.1	97	21.7	
90	27	47.9	97	22.1	
91	27	46.8	97	22.4	
92	27	46.1	97	22.6	
93	27	45.5	97	21.9	
94	27	45.4	97	21.1	
95	27	45.4	97	20.6	
96	27	45.3	97	19.9	
97	27	45.1	97	18.6	
98	27	44.9	97	17.4	
99	27	44.8	97	16.6	
100	27	45.4	97	15.9	
101	27	45.9	97	15.8	
102	27	46.5	97	15.8	
103	27	47.0	97	15.7	
104	27	47.6	97	15.7	
105	27	48.2	97	15.6	
106	27	49.5	97	15.1	
107	27	50.0	97	14.9	
108	27	48.5	97	14.0	
109	27	48.0	97	13.5	
110	27	47.6	97	13.0	
111	27	47.1	97	12.4	
112	27	46.6	97	11.8	
113	27	46.2	97	11.4	

(continued)

Table TAMC-1
(continued)

44	27	49.9	97	20.4		114	27	45.9	97	11.0	
45	27	50.6	97	19.6		SL	27	45.5	97	11.5	Shamrock Light†
46	27	51.0	97	19.0		115	27	45.3	97	11.1	
47	27	52.1	97	17.6		116	27	45.1	97	11.6	
48	27	52.4	97	17.2		117	27	44.8	97	12.1	
49	27	52.7	97	16.9		118	27	44.6	97	12.6	
RP	27	52.8	97	15.9	Reynolds Pier	119	27	44.3	97	13.1	
50	27	52.4	97	15.5		120	27	44.0	97	13.6	
51	27	52.0	97	15.2		121	27	43.7	97	14.2	
52	27	51.7	97	15.0		122	27	43.5	97	14.7	
53	27	51.4	97	15.0		123	27	43.2	97	15.3	
54	27	50.9	97	14.9		124	27	42.9	97	15.8	
55	27	50.1	97	15.2		125	27	42.6	97	15.4	
56	27	49.7	97	15.7		126	27	42.4	97	15.0	
57	27	49.2	97	16.3		127	27	42.1	97	14.5	
58	27	48.3	97	16.8		128	27	41.8	97	14.0	
59	27	47.6	97	16.6		GIWW	27	41.4	97	13.3	GIWW beacon
60	27	47.2	97	16.4		129	27	42.2	97	12.9	
61	27	46.6	97	16.3		130	27	42.7	97	12.5	
62	27	46.0	97	16.2		131	27	43.4	97	12.1	
63	27	45.6	97	16.1		132	27	43.9	97	11.7	
64*	27	45.5	97	16.2		133	27	44.4	97	11.4	
FL31	27	44.7	97	15.9	Chnl to NAS FL "31"	134	27	44.9	97	11.0	
65	27	45.4	97	16.6		135	27	46.4	97	10.0	
66	27	46.0	97	17.1		136	27	47.1	97	9.5	
67	27	46.6	97	17.6		137	27	47.9	97	9.0	
68	27	47.1	97	18.0		138	27	48.5	97	8.4	
69	27	47.6	97	18.4		139	27	49.3	97	8.0	
70	27	48.0	97	18.9							

*nearly co-located with 63

† Also Shamrock Point

stations which are not located, including stas 150-157 and several stations identified by appending "A" after the station number. Some are only vaguely located ("Corpus Christi boat basin", "Nueces Bay entrance"). We positioned these as best we could from the descriptions, and where we could not, we had to simply disregard the data. Station 128A was assumed to be the light beacon in the GIWW out from the Laguna Madre entrance (i.e., the causeway), and 99A was assumed to be FL 31 out from the Naval Air Station. Station 41 A is probably FL "80" in the CCSC.

Some of the conductivity data was converted and reported as salinity. However, many of the conductivity measurements were reported simply as measured. For a minority of these there is an accompanying value of chlorinity determined by titration. While there are nowadays generally valid relations between salinity and conductivity, we are uncomfortable in applying these relations to the conductivity meter built especially by TAMC, and for which we have no operating specifications. The best procedure would be to use the relation Hood and his workers developed for that equipment, but that is not presented. Therefore, we used those data where there are paired measurements of conductivity and chlorinity. These data are plotted in Fig. TAMC-1. The correlation is only about 65%, but one must recognize the small range of variation of these data. In fact, over this period there was very little salinity gradient in Corpus Christi Bay. The regression relation developed is plotted in the figure, and is given by

$$\text{chlorinity (‰)} = 0.254 \cdot \text{conductivity} + 7.49$$

This was used to convert the recorded conductivities to equivalent chlorinities.

Phosphates are reported in micrograms PO4 per litre. This was converted to micrograms P per litre by multiplying by 31/95. We have little confidence in the PO4 data and assigned it a standard deviation of ±75% (a judgement call which is probably charitable). Dissolved oxygen is reported in millilitres per litre, which was converted to parts per million by multiplying by 1.39.

One must bear in mind the philosophy and limitations underlying much of the work done in this period in comparison to the present. Very little measurement equipment could be purchased off-the-shelf, but had to be designed and built, and analytical procedures had to be devised. Much of the effort of a project such as this was therefore devoted to these activities. Permanent archiving of data was rarely done. Data was an intermediate step in arriving at conclusions about the system being studied. Data transmittal in itself was labor-intensive, i.e. typed tabulations, and considered to be of little use to any one except the investigator carrying out the work. Even if a permanent data transmittal was intended for this project, it was apparently not achieved. The tone of these reports suggest that the researchers expected the project to be sustained for more than a year, including a post-expansion survey, but of course this was not done. It is likely that the annual report was prepared in a hasty attempt to document the work carried out thusfar, with a minimum of staff and clerical effort.

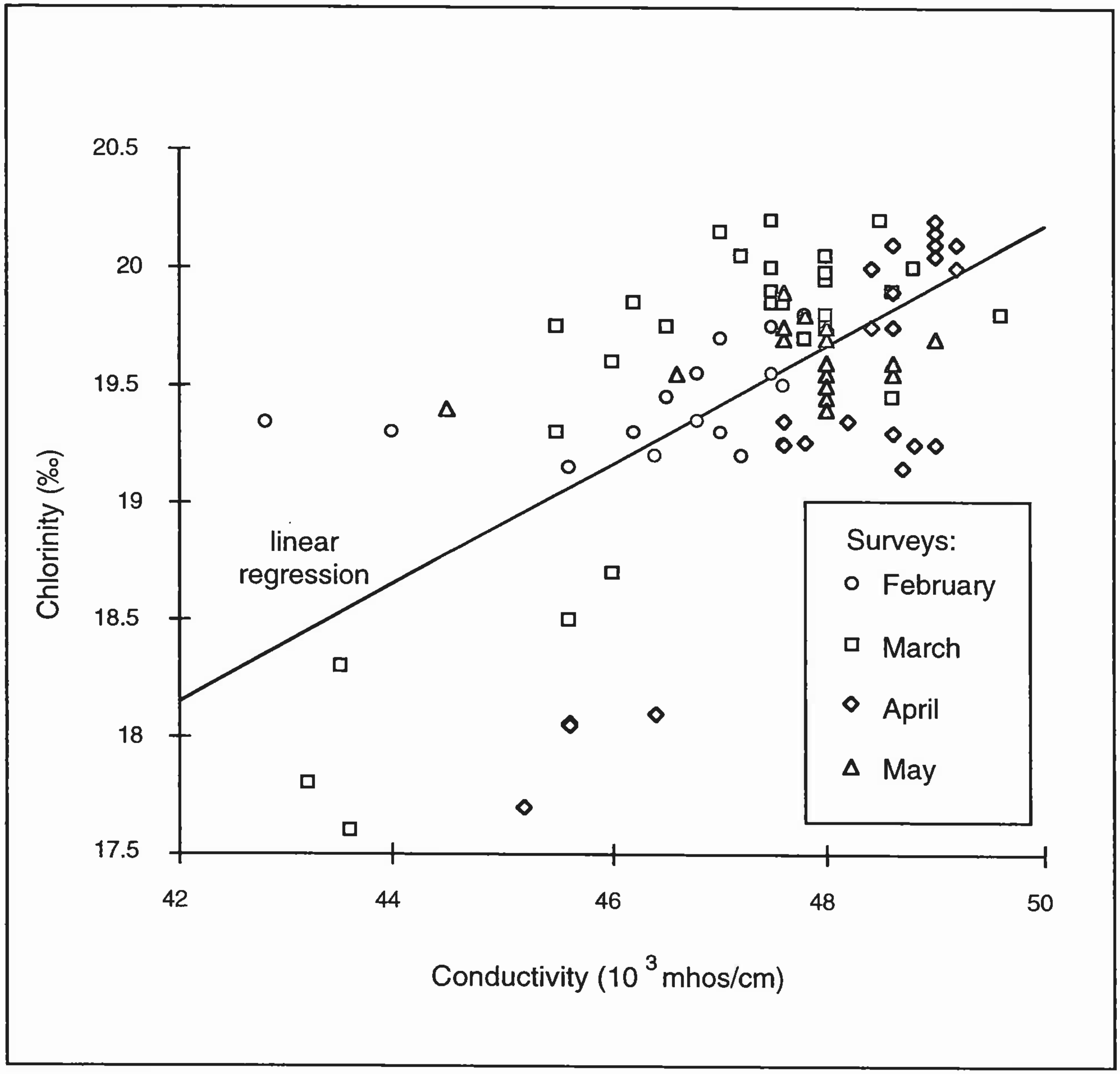


Fig. TAMC-1 Chlorinity versus conductivity for TAMC Project 40 data

Given the relatively little data, and the great effort on our part to sort through the information and put it in a form adequate for incorporation in the master data base, one must wonder whether it is worth the effort. The importance of this data lies in its age and the relative care with which it was collected. Its inclusion enables us to extend the data base, for salinity at least, back to the early 1950's, a period encompassing an extreme drought condition.

REFERENCES:

Hood, D., W., 1952: A hydrographic and pollution survey of Corpus Christi Bay and connecting water bodies; Progress report for quarter ending January 31, 1952. Project 40, Department of Oceanography, TAMC, College Station.

Hood, D., W., 1952: A hydrographic and pollution survey of Corpus Christi Bay and connecting water bodies; Progress report for quarter ending April 30, 1952. Project 40, Department of Oceanography, TAMC, College Station.

Hood, D., W., 1952: A hydrographic and chemical survey of Corpus Christi Bay and connecting water bodies; Progress report for quarter ending July 31, 1952. Project 40, Department of Oceanography, TAMC, College Station.

Hood, D., W., 1952: A hydrographic and chemical survey of Corpus Christi Bay and connecting water bodies; Progress report for quarter ending January 31, 1952. Project 40, Department of Oceanography, TAMC, College Station.

Hood, D., W., 1953: A hydrographic and chemical survey of Corpus Christi Bay and connecting water bodies; Annual report for year ending November 1, 1952. Project 40, Department of Oceanography, TAMC, College Station.

Procter, C., 1953: Determination of inorganic phosphate in sea water by a butanol extraction procedure. Tech. Rep., Department of Oceanography, Texas A&M College.

SOURCE DATA SET REPORT
Project code 15

DATA SET: Hydrographic & chemical study of La Quinta Channel

PROJECT ABBREVIATION: OXYCHEM

SOURCE: Coastal Bend Bays Foundation

MEASUREMENTS:

Surficial water samples and occasional sediment samples, analyzed for an extensive suite of parameters. Hydrographic profiles, i.e. salinity (conductivity), dissolved oxygen, temperature, with occasional fecal coliform determinations. A few fish have been collected for tissue analyses.

PROCEDURES:

This program has been conducted since early 1993 as a joint activity of the Coastal Bend Bays Foundation, Oxychem, Eclipse, the Texas Natural Resources Conservation Commission and students of Gregory/Portland Junior High School. Six stations have been established for routine sampling which is carried out generally on a quarterly basis.

Chemical parameters initially included metals and selected hydrocarbons. As the data collection has progressed, the suite of parameters has been expanded to the complete EPA priority pollutants list. All analyses are carried out for the water as sampled, i.e. without filtration.

QUALITY ASSURANCE/QUALITY CONTROL:

Profiling is carried out with TNRCC equipment under the supervision of TNRCC staff, and the water and sediment chemistry analyses are performed by a commercial laboratory in strict conformance to EPA protocols.

Q/A data were provided to this project along with the measurements. This Q/A data included, for a selection of parameters, the "precision" of the measurement, by which is meant the percent difference between two measurements of the analyte from aliquots of the same sample. This data can be converted to the measure of accuracy used in this project, *viz.* the measurement standard deviation σ, since the unbiased estimate of variance from two measurements r_1 and r_2 is

$$\sigma^2 = (r_1 - m)^2 + (r_2 - m)^2$$

$m \equiv (r_1 + r_2)/2$ denoting their mean, whence

$$\sigma^2 = (r_1^2 + 2\, r_1 r_2 + r_2^2 - 4\, r_1 r_2)/2 \;=\; (r_2 - r_1)^2$$

so that $\sigma = (r_2 - r_1)/\sqrt{2}$

or relative to the mean

$$\sigma/m = (r_2 - r_1)/m\sqrt{2}$$

so that the analytical "precision" in percent is divided by $\sqrt{2}$ to obtain the estimate of standard deviation relative to the mean (coefficient of variation). In this project, we use a general linear formulation of the variation of σ with sample value r, of the form:

$$\sigma = \sigma_a + \sigma_r \cdot r$$

so in effect the laboratory precision data can be used to compute σ_r.

The precision data from the Oxychem data sets are given in Table OXY-1, and the computed equivalent values of σ_r are given in Table OXY-2. Generally, these are much smaller than the values used for other projects in this study, derived from data on standard deviation published in reports of USGS and EPA. There are two possible reasons for this. First, this is a reflection of the latest analytical methods as practiced by a modern commercial laboratory that employs the methods on a regular basis, while the EPA and USGS data are older (as much as 20 years) and may have included results from labs that did not regularly employ these methodologies. Second, these reflect intralaboratory comparisons, i.e. precision of measurement from a single laboratory, so there is consistency in using the same instrumentation and the same technicians. On the other hand, the EPA/USGS data are based upon *inter*lab comparisons, thereby including uncertainty that will arise from different instruments and personnel. Strictly, the accuracy data used in this project should be based upon interlab comparisons. But it is difficult to judge which of these two reasons is more responsible for the smaller values of σ. We have elected to use the Oxychem precision data as the basis for accuracy value associated with this data set.

DESCRIPTION & COMMENTS:

The principal objective of this program is to provide quantitative information on the chemical quality of water and sediment in and adjacent to the La Quinta Channel, on the north shore of Corpus Christi Bay.

Field surveys have been performed on the following occasions:

9 January 1993	16 March 1994
3 April 1993	17 June 1994
7 July 1993	10 September 1994
20 November 1993	3 December 1994

(Data from a later field survey were provided to this project, but unfortunately after the data compilation was complete, and the analysis task well underway.)

SAMPLING LOCATIONS:

Six stations were established, three in the La Quinto Channel, and three off the channel but immediately adjacent. The area sampled is small enough that location of the stations relative to navigation aids or shore landmarks is more than adequate. The six stations and their coordinates are:

station	*latitude*		*longitude*	
		(degrees & minutes)		
1A	27	52.35	97	14.94
1B	27	52.30	97	15.05
2A	27	50.40	97	13.98
2B	27	50.31	97	13.59
3A	27	48.96	97	13.00
3B	27	49.18	97	12.95

DISCUSSION:

The primary value of this program is in the comprehensive suite of parameters analyzed. For many of these parameters, this program provides virtually the only measurements from Corpus Christi Bay.

TABLE OXY-1
Precision data from Oxychem analyses:
precision and equivalent standard deviation, as a percentage of concentration

	9 Jan 93		3 Apr 93		7 Jul 93		20 Nov 93	
WATER	prcn	st dev	prcn	st dev	prcn	st dev	prcn	st dev
C.O.D.			1	0.707	0	0	1.4	0.99
pH	0	0	0	0	0.3	0.212	0	0
Total phenols	4.2	2.969	4.1	2.899	0.8	0.566	3	2.121
Total suspended solids			0	0	0	0	10.88	7.692
Antimony/GFAA	7.2	5.09	3.7	2.616	18.2	12.87	0.3	0.212
Arsenic/GFAA	7.4	5.232	6.7	4.737	3.1	2.192	14.1	9.969
Barium			3.7	2.616	0.6	0.424	0.8	0.566
Beryllium/ICP	1.1	0.778	2.3	1.626	0.1	0.071	0.3	0.212
Cadmium/ICP	4.4	3.111	1.3	0.919	0.6	0.424	0.4	0.283
Chromium/ICP	1.4	0.99	1.7	1.202	0.5	0.354	9.9	6.999
Copper/ICP	4.8	3.394	0.5	0.354	0.2	0.141	6.1	4.313
Lead/GFAA	9.3	6.575	6.5	4.596	0.6	0.424	0.2	0.141
Magnesium/ICP			1.5	1.061	0.6	0.424	5.6	3.959
Mercury/CVAA	1	0.707	4.7	3.323	2.3	1.626	1.4	0.99
Nickel/ICP	1.4	0.99	0.4	0.283	0.2	0.141	0.9	0.636
Selenium/GFAA	9.3	6.575	1.7	1.202	3.3	2.333	5.8	4.101
Silver/GFAA	3.6	2.545	3.8	2.687	11.2	7.918	0	0
Thallium/GFAA	14.4	10.18	8.8	6.222	0.8	0.566	1.5	1.061
Zinc/ICP	4.6	3.252	0.2	0.141	0.3	0.212	10	7.07
Cyanide	2.1	1.485	1.3	0.919	1.5	1.061	3.5	2.475
SEDIMENT								
Total phenols	2.1	1.485						
Antimony/GFAA	0	0						
Arsenic/GFAA	0	0						
Beryllium/ICP	0.3	0.212						
Cadmium/ICP	0.4	0.283						
Chromium/ICP	4.7	3.323						
Copper/ICP	0.3	0.212						
Lead/GFAA	1.4	0.99						
Mercury/CVAA	8	5.656						
Nickel/ICP	0.1	0.071						
Selenium/GFAA	10.1	7.141						
Silver/GFAA	2	1.414						
Thallium/GFAA	10.3	7.282						
Zinc/ICP	0.2	0.141						
Cyanide	1.6	1.131						

(continued)

TABLE OXY-1
(continued)

WATER	16 Mar 94 prcn	16 Mar 94 st dev	17 Jun 94 prcn	17 Jun 94 st dev	10 Sep 94 prcn	10 Sep 94 st dev	3 Dec 94 prcn	3 Dec 94 st dev
C.O.D.	1.2	0.848			2.7	1.909	0.5	0.354
pH	0	0			1.2	0.848	0	0
Total phenols	1	0.707	6.4	4.525	15.6	11.03	0.3	0.212
Total suspended solids	2.41	1.704			10.14	7.169	2.53	1.789
Antimony/GFAA			9.4	6.646	3.5	2.475	0.3	0.212
Arsenic/GFAA			8	5.656	7	4.949	10.9	7.706
Barium	9.7	6.858			2.3	1.626	1.4	0.99
Beryllium/ICP			1.3	0.919	1.8	1.273	1.7	1.202
Cadmium/ICP			2.8	1.98	3.2	2.262	3.3	2.333
Chromium/ICP			0.3	0.212	1.3	0.919	2.6	1.838
Copper/ICP			1.8	1.273	3.1	2.192	2.6	1.838
Lead/GFAA			3.3	2.333	0.9	0.636	10.2	7.211
Magnesium/ICP	3.6	2.545			0.9	0.636	1.2	0.848
Mercury/CVAA			1.9	1.343	6	4.242	5.6	3.959
Nickel/ICP			1.1	0.778	3.4	2.404	2.9	2.05
Selenium/GFAA			1.4	0.99	2.1	1.485	1.7	1.202
Silver/GFAA			0.8	0.566	2.4	1.697	0	0
Thallium/GFAA			22.6	15.98	0.4	0.283	2.5	1.768
Zinc/ICP			2.9	2.05	3	2.121	3.6	2.545
Cyanide	4.7	3.323						
SEDIMENT								
Total phenols			0.8	0.566				
Antimony/GFAA			4	2.828				
Arsenic/GFAA			3.4	2.404				
Beryllium/ICP			1.7	1.202				
Cadmium/ICP			0.9	0.636				
Chromium/ICP			0	0				
Copper/ICP			0.9	0.636				
Lead/GFAA			0.5	0.354				
Mercury/CVAA			8.3	5.868				
Nickel/ICP			0.1	0.071				
Selenium/GFAA			11.6	8.201				
Silver/GFAA			8	5.656				
Thallium/GFAA			0.2	0.141				
Zinc/ICP			1.4	0.99				
Cyanide								

TABLE OXY-2
Statistics of precision from Oxychem data summarized

ANALYTE	WATER mean st dev (%)	WATER data points in mean	SEDIMENT mean st dev (%)	SEDIMENT data points in mean
C.O.D.	0.80	6		
pH	0.15	7		
Total phenols	3.13	8	1.03	2
Total suspended solids	3.06	6		
Antimony/GFAA	4.30	7	1.41	2
Arsenic/GFAA	5.78	7	1.20	2
Barium	2.18	6		
Beryllium/ICP	0.87	7	0.71	2
Cadmium/ICP	1.62	7	0.46	2
Chromium/ICP	1.79	7	1.66	2
Copper/ICP	1.93	7	0.42	2
Lead/GFAA	3.13	7	0.67	2
Magnesium/ICP	1.58	6		
Mercury/CVAA	2.31	7	5.76	2
Nickel/ICP	1.04	7	0.07	2
Selenium/GFAA	2.56	7	7.67	2
Silver/GFAA	2.20	7	3.54	2
Thallium/GFAA	5.15	7	3.71	2
Zinc/ICP	2.48	7	0.57	2
Cyanide	1.85	5	1.13	1

SOURCE DATA SET REPORT
Project code 16

DATA SET: Nutrients and associated parameters in Laguna Madre including Baffin Bay

PROJECT ABBREVIATION: MSI-LM

SOURCE: Data provided by:

Dr. Terry Whitledge
Marine Science Institute
University of Texas
Port Aransas, TX 78373

MEASUREMENTS:

Hydrographic parameters measured *in situ*:

salinity	temperature
Secchi depth	

Analysis of water samples for:

nitrogen series (ammonia, nitrite, nitrate)
phosphate
silicate

Surface and bottom samples were taken at each station. Samples were almost always unfiltered. The nutrients measurements are presented in units of µgm-at/L (µmoles/L), which were converted to mg/L for this data compilation using the following factors:

nitrate as N	0.014
nitrite as N	0.014
ammonia as N	0.014
phosphate as PO_4	0.095
silica as SiO_2	0.060

Apparently chlorophyll-a and phaeophytin were also analyzed, but these data were not provided.

PROCEDURES:

Water sampling and *in situ* electrometric determination performed at sites from a pre-established network of about 45 stations distributed throughout the Laguna Madre system, from the Arroyo Colorado region to the JKF Causeway. Some of these stations lie outside the CCBNEP study area and were therefore not included in the present compilation. The data collection period extended from March 1989 through October 1993. Sampling occurred on a minimum sampling interval of a month, though for some years the interval between samples ranged from 1 to 6 months, depending upon the station and the season.

According to Zheng (1994), the water samples were collected in clean polyethylene bottles, by hand for the surface sample and with a van Dorn sampler for the bottom, and stored on ice for transport back to the lab. Salinity and temperature were determined using a Sea Bird Model SBE-19, salinity being computed in PSU's internally based upon conductivity and temperature. The manufacturer's stated accuracy is ± 0.01 °C and ± 0.01 PSU (i.e., ‰) for temperature and salinity, respectively. Secchi depth was reported to the nearest 0.1 m. Chemical analyses are described in Whitledge et al. (1981).

QUALITY ASSURANCE/QUALITY CONTROL:

No formal QA/QC plan is reported, and no information was available as to QA/QC practices. The Marine Science Institute, as a research laboratory, performs its analyses utilizing state-of-the-art methodologies appropriate to the research objective.

DESCRIPTION & COMMENTS:

The data were collected opportunistically in association with other sampling excursions, some supported by extramural funding, some not. The data are being prepared for analysis and separate publication, but were provided for use in the CCBNEP project. An analysis of some of the data is reported by Zheng (1994).

SAMPLING LOCATIONS:

The sampling stations for the entire Laguna Madre are listed in Table MSI-LM-1. Those utilized in the CCBNEP data compilation are identified on Figures MSI-LM-1 and MSI-LM-2. No information is available as to how the stations were identified in the field, though most are at or near identifiable landmarks, such as navigation beacons and buoys. The coordinates were determined from a portable GPS navigation system and provided by Dr. Whitledge, except for those stations marked with an asterisk (*) whose positions were estimated from the map in Zheng (1994). Not all of the stations given are represented in the 1989-93 data base, however for archival purposes their coordinates are included in Table MSI-LM-1.

DISCUSSION:

Since this data is opportunistic sampling from the personal archives of Dr. Whitledge, there is no general reference as to procedures. However, the reader is directed to the discussion of Project Code 17, to the thesis of Zheng (1994), and to Whitledge (1981).

The data file omitted day of the month in the date columns. Therefore, we assumed that each sample was taken on the 15th of the month cited. Depths were also omitted. These were estimated by locating the sample stations on recent navigation charts of the region and judging the depths from the published soundings. These depths are included in Table MSI-LM-1.

REFERENCES:

Whitledge, T., S. Malloy, C. Patton and C. Wirick, 1981: Automated nutrient analyses in seawater. Report 51398, Brookhaven National Laboratory, Upton, NY.

Zheng, Z., 1994: A multivariate study of the ecosystem of Baffin Bay and Laguna Madre, Texas. M.A. Thesis, Dept. of Marine Science, University of Texas at Austin.

Table MSI-LM-1

Sampling station coordinates in Laguna Madre provided by Dr. Terry Whitledge (pers. comm, 1996)

Stations in CCBNEP study area for which data is available

Station	*location*	*depth (m)*	*latitude deg*	*latitude min*	*longitude deg*	*longitude min*
0	In GIWW, N of JFK Causeway	6	27	41.70	97	14.08
1	In GIWW at JFK Causeway	6	27	38.03	97	14.95
3	W of GIWW	2	27	32.27	97	19.84
4	In GIWW	5	27	27.96	97	20.13
6	E of GIWW	1	27	24.71	97	21.62
7	In GIWW	5	27	20.71	97	23.60
9	Baffin mouth	3	27	16.70	97	26.60
12*	Baffin	3	27	15.7	97	30.0
15*	Baffin	3	27	15.6	97	33.1
18*	Baffin	2	27	15.8	97	37.0
21*	Cayo del Grullo mouth	2	27	17.0	97	38.0
24*	Laguna Salada mouth	2	27	16.9	97	39.6
26	Laguna Salada	2	27	16.41	97	42.00
28	Laguna Salada	1	27	15.98	97	43.94
34	Alazan Mouth	2	27	17.15	97	34.45
40*	GIWW opposite Baffin mouth	5	27	16.6	97	24.6
41	E of GIWW near Yarborough	2	27	10.62	97	24.41

Additional stations for which no data is available

CCBNEP Study Area					*Landbridge and Lower Laguna*				
Sta	*latitude*		*longitude*		*Sta*	*latitude*		*longitude*	
2	27	36.31	97	17.42	42	27	9.4	97	26.39
5	27	27.69	97	19.7	43	27	4.37	97	25.14
8	27	20.79	97	23.72	44	26	56.5	97	27.35
17	27	17.3	97	32.85	45	26	48.25	97	28.2
20	27	17	97	36.87	48	26	44.02	97	27.53
30	27	18.15	97	39.05	49	26	44.03	97	26.05
31	27	18.2	97	38	50	26	44	97	26.35
32	27	21.9	97	40.6	51	26	38.17	97	25.65
33	27	21.4	97	41.5	52	26	38.14	97	26.58
35	27	17.9	97	35.45	53	26	37.95	97	23.72
36	27	18.2	97	31.2	54	26	33.22	97	24.49
37	27	21.02	97	31.2	55	26	32.28	97	21.79
38	27	20.02	97	29.7					
39	27	21.6	97	29.25					

* Position estimated from map (Figure 1 in Zheng, 1994)

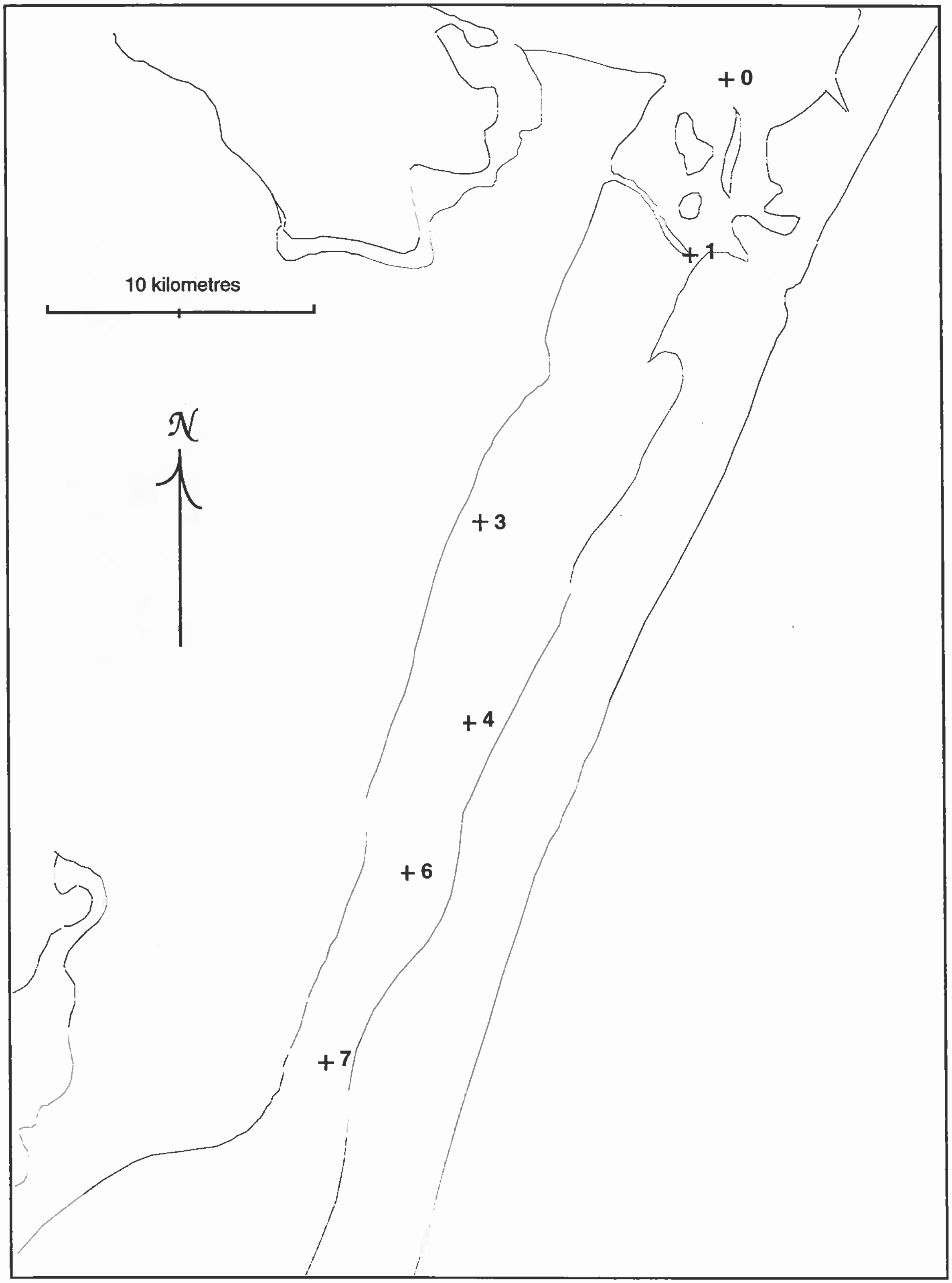


Figure MSI-LM-1 - Station locations for MSI in Upper Laguna Madre

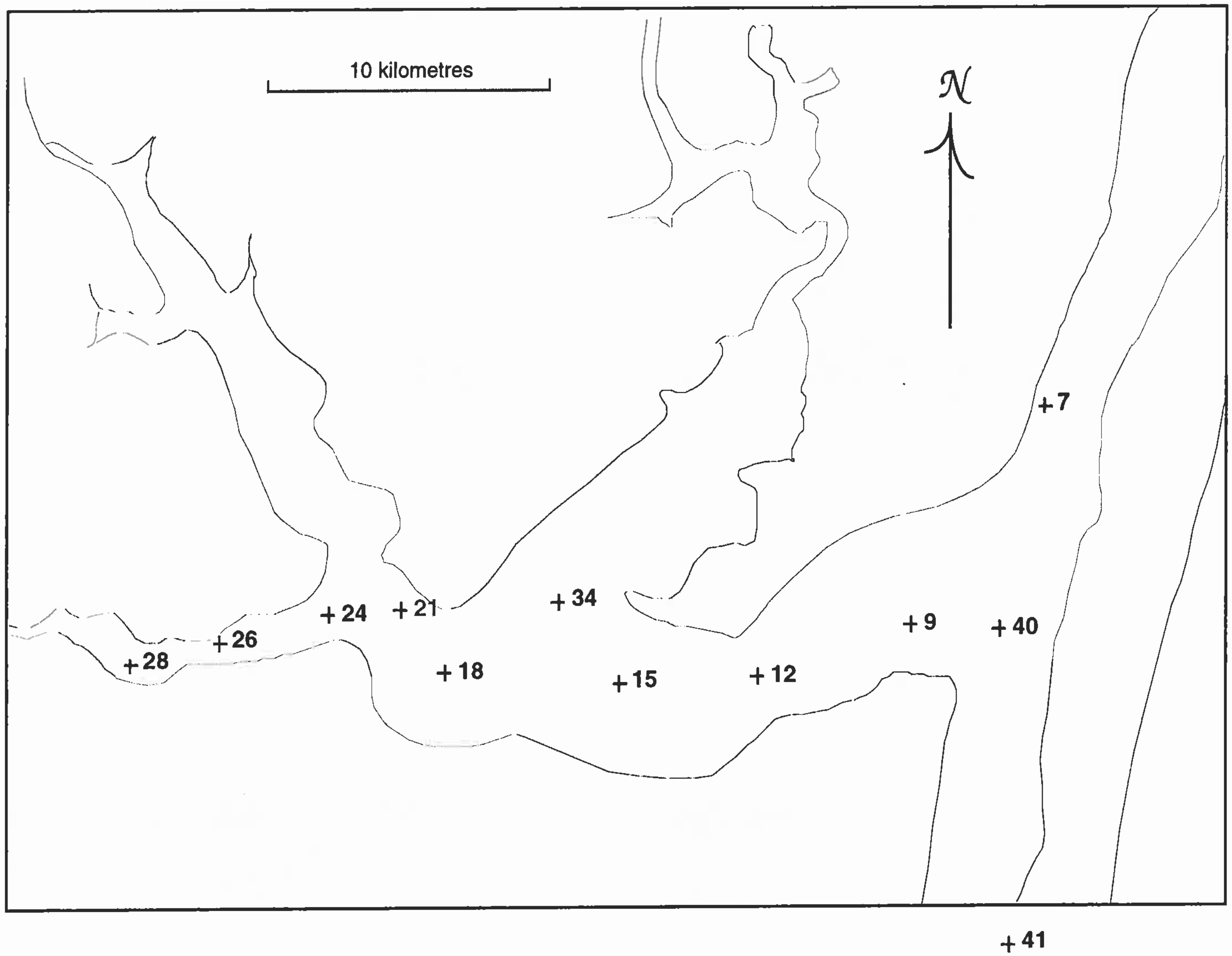


Figure MSI-LM-2 - Sampling stations in Baffin Bay and adjacent Laguna Madre

SOURCE DATA SET REPORT
Project code 17

DATA SET: Nutrients and associated parameters in Corpus Christi and San Antonio Bays

PROJECT ABBREVIATION: MSI-NB

SOURCE: Data provided by:

Texas Water Development Board
S.F. Austin Bldg.
Austin, TX 78711

Project performed by:

Marine Science Institute
University of Texas
Port Aransas, TX 78373

Principal Investigator: Terry Whitledge

MEASUREMENTS:

Hydrographic parameters measured *in situ*:

salinity	pH
temperature	dissolved oxygen
Secchi depth	

Analysis of water samples for

nitrogen series (ammonia, nitrite, nitrate),
orthophosphate
silicate
chlorophyll-a
phaeophytin

Surface and bottom samples were taken at each station. Samples were usually unfiltered. The nutrients measurements are presented in units of µgm-at/L (µmoles/L), which were converted to mg/L for this data compilation using the following factors:

nitrate as N	0.014
nitrite as N	0.014
ammonia as N	0.014
phosphate as PO_4	0.095
silica as SiO_2	0.060

Analytical methods are described in Whitledge (1989) and Whitledge et. al. (1981). Dr. Whitledge (pers. comm, 1996) notes that the samples almost always were unfiltered, the exception being when the samples were so turbid as to affect the spectrophotometer.

PROCEDURES:

Two types of data collection strategies are reported. First a synoptic survey was performed at 35 stations distributed throughout the Corpus Christi Bay system, at roughly monthly intervals. A similar monthly synoptic survey was performed for San Antonio Bay, for which four stations fall within the CCBNEP study area. The second type of strategy was a diurnal survey at which four stations were occupied for at least 24 hours, samples being obtained at hourly intervals. The data collection period in Corpus Christi Bay extended from September 1987 through August 1988, with diurnal surveys in October, December, February, April, May and July. Synoptic surveys from the San Antonio Bay work were available for January, March, April, June, and July 1987 and July 1988.

QUALITY ASSURANCE/QUALITY CONTROL:

No formal QA/QC plan was provided, and no information was available as to QA/QC practices. The Marine Science Institute, as a research laboratory, performs its analyses utilizing state-of-the-art methodologies appropriate to the research objective. Also, Dr. Whitledge notes that a formal QA/QC report has been filed with both the National Ocean Service (related to the National Status and Trends Project) and the U.S. Fish and Wildlife Service.

DESCRIPTION & COMMENTS:

This work was performed under the sponsorship of the Texas Water Development Board Bays and Estuaries Program, with the overall objective of accumulating data on the relation between productivity of the Texas bays and the influx of freshwater.

SAMPLING LOCATIONS:

LORAN-derived coordinates were provided for the MSI stations in Corpus and Nueces Bays. In comparison to a hand-plotted map, these looked "about right" but upon closer verification, 12 out of 33 had to be mapped and their coordinates determined by hand because the LORAN positions were over a kilometre in error. One of these, in lower Nueces Bay, plotted out according to LORAN in a cow pasture near Odem. Another, in the Ship Channel near Harbor Island, plotted out in the surf off of Packery Channel.

The synoptic stations for Corpus Christi Bay are listed in Table MSI-NB-1, those for the diurnal surveys in Table MSI-NB-2, and the synoptic survey stations for

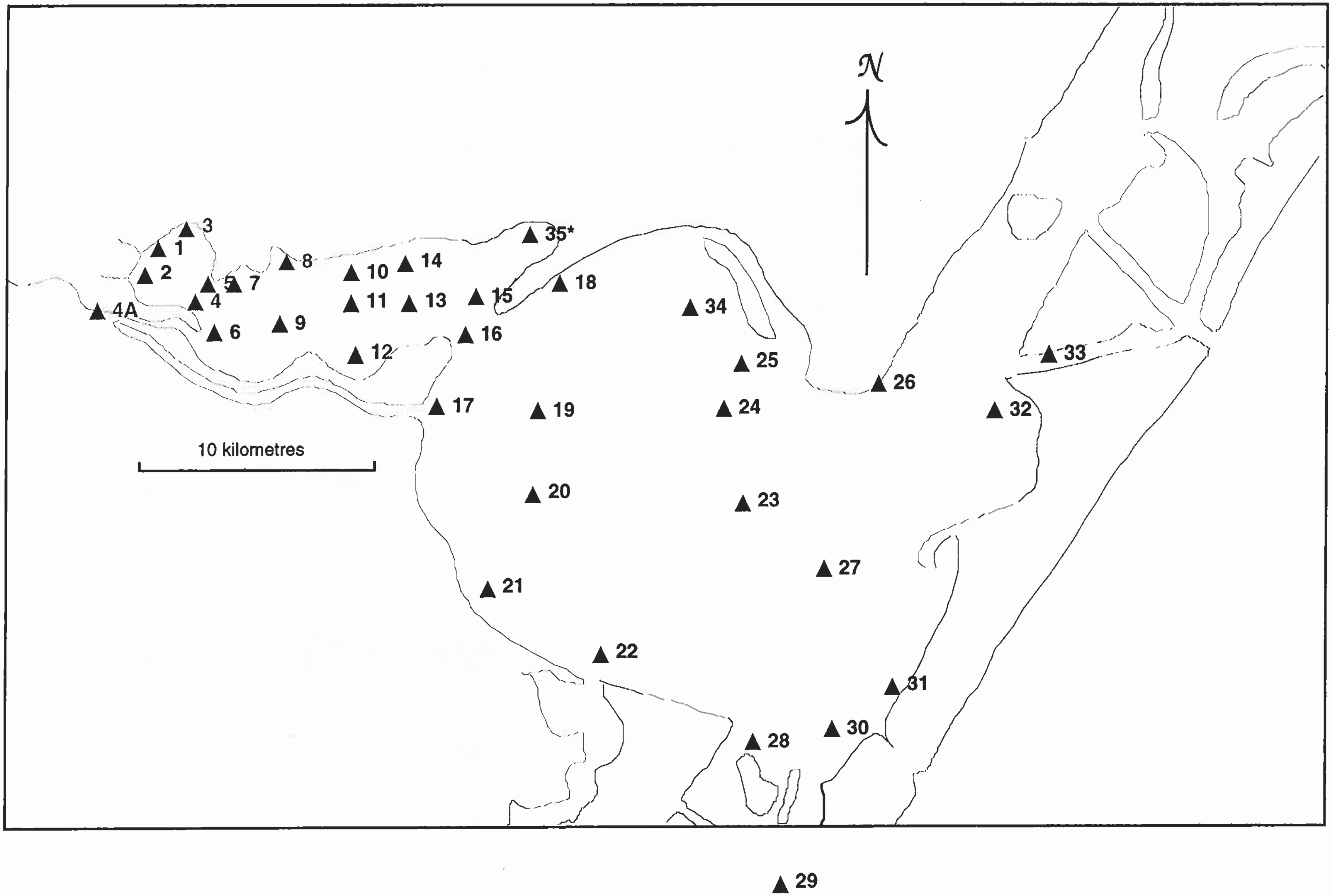


Figure MSI-NB-1 - Sampling stations in Corpus Christi Bay system

San Antonio Bay within the CCBNEP study area in Table MSI-NB-3. The depth for the bottom sample was omitted from some of the entries in the data file, either through oversight or the malevolence of the spreadsheet software. For each such missing entry, the average depth for that station was inserted in the data base. The statistics for these average depths are given in Tables MSI-NB-1 - 3. The Corpus Christi Bay stations are plotted in Fig. MNS-NB-1.

DISCUSSION:

Among the data from this study are field salinities determined both by conductivity and by hand-held refractometer. The former were used preferentially in compiling the salinity data base when both types of measurement were available, which was the usual situation. The refractometer is a common means of field measurement of salinity in the data files from Corpus Christi Bay, but, except for this study, there do not exist companion measurements using alternate methodologies. Therefore, it is of particular interest to compare these to determine their relative agreement. A scatterplot of those data from the Corpus Christi Bay synoptic surveys is shown in Fig. MSI-NB-2. The linear correlation coefficient is 0.825, not particularly high in view of the common assumption that refractometry is a suitable substitute for more precise methods (even for the relatively low precision demands of estuary work). The standard error of the estimate is about 3 ‰, independent of whether the regression is constrained through (0,0). Presuming that the determination by conductivity is the more precise measurement, this standard error would then correspond to the estimated accuracy of the refractometer. It is interesting to compare this to the data of Behrens (1965) who found a standard error of approximately ± 1‰ for the range of salinities represented here, approximately three times better than indicated in the data of Fig. MSI-NB-2. His data represent probably the very best precision that the refractometer is capable of, while the data analyzed in Fig. MSI-NB-2 are more typical of the usual field operation of the refractometer.

REFERENCES:

Behrens, E.W., 1965. Use of the Goldberg refractometer as a salinometer for biological and geological field work. *J. Mar. Res. 23* (2), pp. 165-171.

Whitledge, T.E., 1989: Data synthesis and analysis, nitrogen process study (NIPS): nutrient distribution and dynamics in Nueces-Corpus Christi Bays in relation to freshwater inflow. Report to Texas Water Development Board, Marine Science Institute, University of Texas at Austin, Port Aransas, TX.

Whitledge, T., S. Malloy, C. Patton and C. Wirick, 1981: Automated nutrient analyses in seawater. Formal Report BNL51398, Brookhaven National Laboratory, Upton, NY.

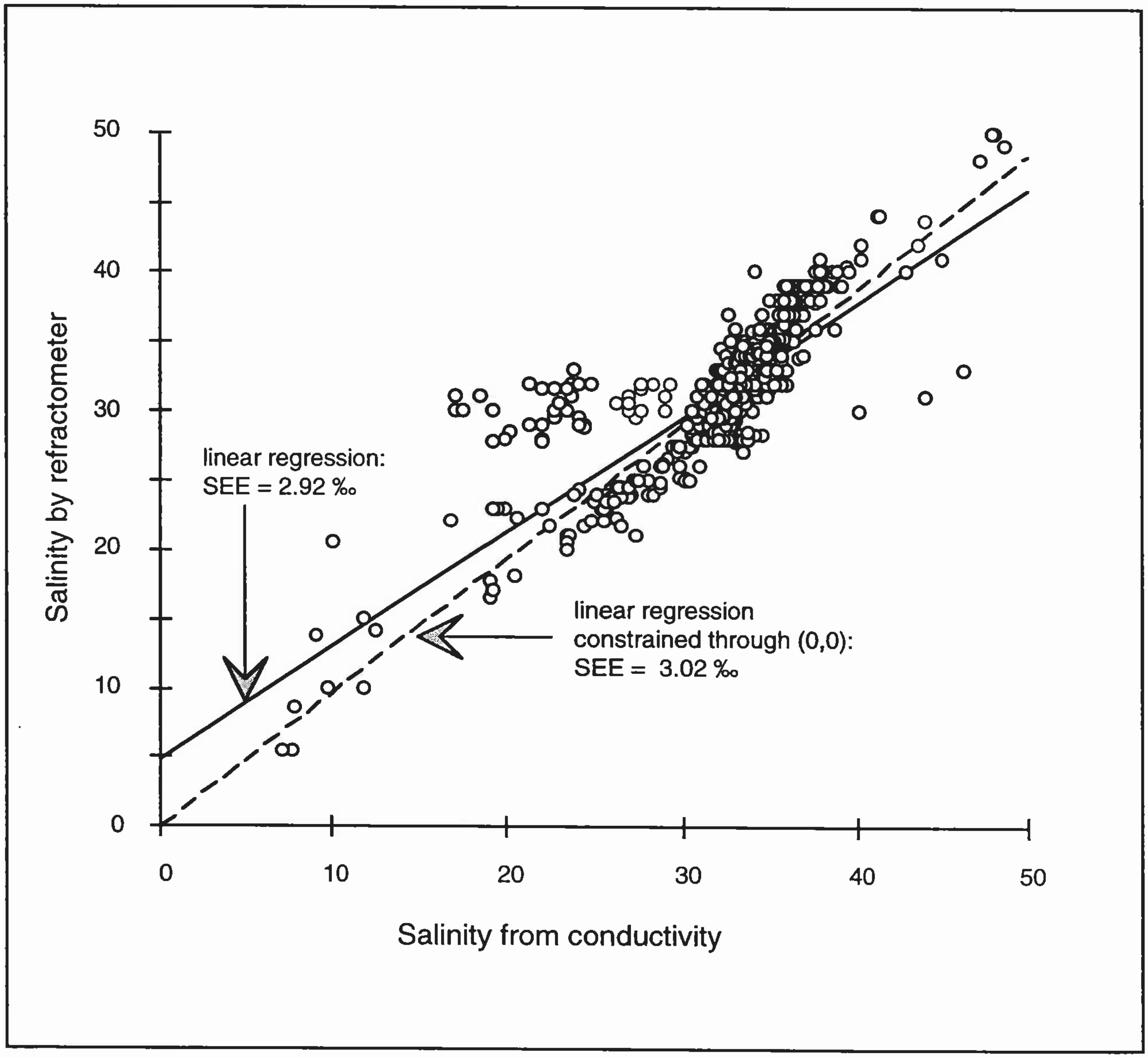


Figure MSI-NB - 2. Scatterplot of companion salinities determined from conductivity and from refractometer

Table MSI-NB - 1
Corpus Christi Bay synoptic station locations, sampling dates and observed depths

Station			*sampling dates (YR-MO) and reported depths (m)*												*depth statistics*			
ID	*latitude*	*longitude*	*8709*	*8710*	*8711*	*8712*	*8801*	*8802*	*8803*	*8804*	*8805*	*8806*	*8807*	*8808*	*number of reports*	*range*		*mean*
1	27.8670	97.5200	0.67	0.62	0.80	1.00	1.00	0.70	0.70	0.45	0.90	1.10	1.00	0.70	12	0.45	1.1	0.80
2	27.8620	97.5250		0.62	0.75	0.85	0.85	0.60	0.60	0.32	0.85	0.95	1.10	0.70	11	0.32	1.1	0.74
3	27.8760	97.5070		0.62	0.85	1.00	1.00	0.80	0.70		0.95	1.10	1.30	0.80	10	0.62	1.3	0.91
4	27.8470	97.5010	1.23	1.23	1.00	0.95	0.95	0.50	0.50	0.40	1.10	1.40	1.30	1.20	12	0.4	1.4	0.98
4A	27.8480	97.5440		1.54	1.20	1.00		1.00			1.20	1.70	1.60		7	1	1.7	1.32
5	27.8600	97.4950		1.54	1.40	1.50	1.50	0.75	2.00	1.70	2.00	1.90	1.30	1.20	11	0.75	2	1.53
6	27.8350	97.4900	0.67	0.92	1.10	1.00	1.00	0.80	0.90	0.60	0.90	1.30	1.30	0.90	12	0.6	1.3	0.95
7	27.8500	97.4800	1.85	1.85	2.00	1.20	1.20	1.00	1.60	1.00	1.20	1.35	1.30	1.20	12	1	2	1.40
8	27.8600	97.4610	0.92	0.92	1.00	0.95	0.95	0.90	1.00	0.60	1.00	1.20	1.20	1.00	12	0.6	1.2	0.97
9	27.8420	97.4550	1.85	1.54	1.30	1.35	1.35	1.00	1.00	0.92	1.30	1.60	1.50	1.10	12	0.92	1.85	1.32
10	27.8610	97.4250	0.92	1.23	1.30	1.30	1.30	0.90	1.10	0.80	1.25	1.50	1.60	1.10	12	0.8	1.6	1.19
11	27.8500	97.4250	1.23	1.23	1.40	1.30	1.30	1.00	1.20	0.85	1.45	1.60	1.40	1.20	12	0.85	1.6	1.26
12	27.8310	97.4230	0.92	1.23	1.20	1.15	1.15	0.95	1.00	0.35	1.20	1.40	1.40	1.30	12	0.35	1.4	1.10
13	27.9100	97.4960	1.85	1.23	2.10	1.00	1.00	1.50	0.50	0.40	1.35	1.90	1.30	1.20	12	0.4	2.1	1.28
14	27.8650	97.4020		1.23	1.50	1.40	1.40		1.80	0.95	1.20	1.50	1.30	1.00	10	0.95	1.8	1.33
15	27.8520	97.3710		0.92	0.70	0.55	0.55		0.40	0.70	0.80	1.00	0.80	0.40	10	0.4	1	0.68
16	27.8380	97.3760	5.54	6.77	7.69	5.54	5.54	6.15		5.54	7.69				8	5.54	7.69	6.31
17	27.8120	97.3880	14.77	15.38	16.30			16.31	14.46	16.31	15.38	15.38	16.92		10	14.46	16.92	15.69
18	27.8570	97.3350	2.77	3.38	3.38	2.77	2.77	3.08	3.08	2.46	2.76				9	2.46	3.38	2.94
19	27.8150	97.3590	4.00	4.00	4.00	3.69	3.69	4.00	3.69	3.69	3.69	3.69			10	3.69	4	3.81
20	27.7900	97.3730	4.00		4.00			4.00	4.00				3.38		6	3.38	4	3.88
21	27.7440	97.3710		3.08	3.08	3.08	3.08	3.38	3.07	2.46	2.76				8	2.46	3.38	3.00
22	27.7140	97.3140	3.08	3.08	1.23	2.15	2.15	1.40	2.76	1.54	2.76		1.52		10	1.23	3.08	2.17
23	27.7760	97.3170	4.31	4.00	4.00	4.00	4.00	3.08	4.00	2.46	2.76				9	2.46	4.31	3.62
24	27.8110	97.2640	14.77	14.77	15.38	16.00	16.00	15.38	14.70	14.15	14.15				9	14.15	16	15.03
25	27.8280	97.2570	2.46	2.77	3.69	3.38	3.38	2.46	2.76	2.46	2.46				9	2.46	3.69	2.87
26	27.8200	97.1980	13.85	15.38	15.38	14.46	14.46	13.85	14.76	14.77	14.10	13.84			10	13.84	15.38	14.49
27	27.7510	97.2210		4.00	4.00	4.00	4.00	4.00	3.69	3.69	4.00				8	3.69	4	3.92

(continued)

Table MSI-NB - 1
(continued)

Station			*sampling dates (YR-MO) and reported depths (m)*												*depth statistics*			
ID	*latitude*	*longitude*	*8709*	*8710*	*8711*	*8712*	*8801*	*8802*	*8803*	*8804*	*8805*	*8806*	*8807*	*8808*	*number of reports*	*range*		*mean*
28	27.6860	97.2510		1.85	1.23	2.30	2.30		3.07	2.46	6.15		1.85		8	1.23	6.15	2.65
29	27.6330	97.2390	6.15	5.85	5.85	6.15	6.15		6.15	6.15	1.10		8.62		9	1.1	8.62	5.80
30	27.6910	97.2170	3.08	1.54	2.15	2.15	2.15	2.20	2.46	2.46	1.10				9	1.1	3.08	2.14
31	27.7070	97.1910	1.54	3.08	3.08	3.08	3.08	3.08	2.76	3.08	2.76	2.50			10	1.54	3.08	2.80
32	27.8100	97.1480	1.84	1.23	2.15	1.54	1.54	2.46	1.23	1.30	1.70	2.50	1.85		11	1.23	2.5	1.76
33	27.6840	97.1540	13.85	12.31	15.38	16.90	16.90	14.30	14.46	14.77	14.46	13.80			10	12.31	16.9	14.71
34	27.8480	97.2790		3.69	3.69	3.38	3.38	3.69	3.69	2.46	3.38	34	2.46		10	2.46	3.69	3.31
35*	27.8750	97.3480							0.80	0.60			1.50	0.90	4	0.6	1.5	0.95

*added March 1988

Table MSI-NB - 2
Corpus Christi Bay diurnal station locations, sampling dates and observed depths

Station			*sampling dates (YR-MO) and reported depths (m)*						*depth statistics*			
ID	*latitude*	*longitude*	*8710*	*8712*	*8802*	*8804*	*8805*	*8807*	*number of reports*	*range*		*mean*
A	27.8500	97.4800	1.00	1.38	0.92		1.23		4	0.92	1.38	1.13
B	27.9100	97.4960	1.20	1.20	1.20	0.90	1.23	0.90	6	0.9	1.23	1.11
C	27.8150	97.3590	3.70	4.31	4.00	3.69	3.69	3.69	6	3.69	4.31	3.85
D	27.7070	97.1910	2.60	3.00	3.08	3.08	3.69	3.69	6	2.6	3.69	3.19

Table MSI-NB - 3
San Antonio Bay synoptic station locations (in study area), sampling dates and observed depths

Station			*sampling dates (YR-MO) and reported depths (m)*						*depth statistics*			
ID	*latitude*	*longitude*	*8701*	*8703*	*8704*	*8706*	*8707*	*8807*	*number of reports*	*range*		*mean*
35	28.1438	96.8320	1.50	1.40	1.50	1.80	1.75	1.50	6	1.4	1.8	1.58
36	28.1022	96.8347	2.30	1.90	2.30	1.40	1.50	1.70	6	1.4	2.3	1.85
37	28.1333	96.8547	1.50	1.30	1.50	1.90	1.50	1.45	6	1.3	1.9	1.53
38	28.1508	96.8653	1.50	1.40	1.50	1.50	1.50	1.40	6	1.4	1.5	1.47

SOURCE DATA SET REPORT
Project code 018

DATA SET: National Ocean Service National Status & Trends Projects

PROJECT ABBREVIATION: NOSS&T

SOURCE: National Ocean Service, National Oceanic and Atmospheric Administration

Data can be directly downloaded from the home page at address:

http://seaserver.nos.noaa.gov/projects/nsandt/nsandt.html

MEASUREMENTS:

Two separate projects have operated within the project area: the Benthic Surveillance Project which concentrates upon sediment chemistry, and the Mussel Watch Project which collects both sediment and tissue samples. For sediments the following parameters are measured:

Trace metals:	*Organics*:
Cadmium	DDT (including DDE and DDD) p-isomers
Chromium	chlordane
Copper	PCBs (various)
Lead	PAHs (various)
Mercury	TOC
Silver	
Zinc	Grain-size analysis

Occasional other metals such as selenium and thalium.

In addition, TIC and grain-size analyses are performed. For tissue samples, the same suite of parameters is analyzed excluding TOC, TIC and grain-size. All concentrations are reported on a *dry-weight* basis. The complete suites of analyses are listed in Tables NOS-1-3.

PROCEDURES:

Surficial sediment samples are collected at three stations within 500 m of designated ("nominal") site location. Sampling was performed by either a specially constructed box corer or a Smith-MacIntyre bottom grab. Each sediment sample was then subsampled with a 3x15 cm "mini-corer" from the undisturbed surficial matter near the center of the original sample. Samples were frozen for transport and storage until subjected to laboratory analyses. Protocols and methodologies are presented in NOS (1988) and Lauenstein and Cantillo (1993), and references therein. Occasionally, the actual sample site departed from the nominal site by more that 500 m, whereupon the actual coordinates are given. No information is given on the positioning methodology.

Table NOS-1

Suites of elemental metals analyzed in sediment and tissue samples

Al	Aluminum
Si	Silicon
Cr	Chromium
Mn	Manganese
Fe	Iron
Ni	Nickel
Cu	Copper
Zn	Zinc
As	Arsenic
Se	Selenium
Ag	Silver
Cd	Cadmium
Sn	Tin
Sb	Antimony
Hg	Mercury
Pb	Lead

Table NOS-2

Suites of polychlorinated biphenyls (PCB's) analyzed in sediment and tissue samples

Grouped by level of chlorination	*Grouped by congenor*	
Dichlorobiphenyls	PCB8	PCB128
Trichlorobiphenyls	PCB18	PCB138
Tetrachlorobiphenyls	PCB28	PCB153
Pentachlorobiphenyls	PCB44	PCB170
Hexachlorobiphenyls	PCB52	PCB180
Heptachlorobiphenyls	PCB66	PCB187
Octachlorobiphenyls	PCB101	PCB195
Nonachlorobiphenyls	PCB105	PCB206
Decachlorobiphenyls	PCB118	PCB209

Table NOS-3

Suites of polycyclic aromatic hydrocarbons (PAH's)
and chlorinated hydrocarbons
analyzed in sediment and tissue samples

Acenaphthene	Aldrin
Acenaphthylene	cis-Chlordane
Anthracene	Dieldrin
Benz[a]anthracene	Heptachlor
Benzo[b]fluoranthene	Heptachlorepoxide
Benzo[k]fluoranthene	Hexachlorobenzene
Benzo[ghi]perylene	gamma-HCH
Benzo[a]pyrene	Mirex
Benzo[e]pyrene	trans-Nonachlor
Biphenyl	2,4'-DDD
Chrysene	4,4'-DDD
Dibenz[a,h]anthracene	2,4'-DDE
2,6-Dimethylnaphthalene	4,4'-DDE
Fluoranthene	2,4'-DDT
Fluorene	4,4'-DDT
Indeno[1,2,3-cd]pyrene	
1-Methylnaphthalene	
2-Methylnaphthalene	
1-Methylphenanthrene	
Naphthalene	
Perylene	
Phenanthrene	
Pyrene	
1,6,7-Trimethylnaphthalene	

DESCRIPTION & COMMENTS:

This is a nationwide program sampling about 290 sites in the coastal U.S., of which eight (8) are located in the Corpus Christi Bay project area. The Benthal Surveillance project began in the mid-1980's, several years before the Mussel Watch project, but we consider the data together in this compilation and combine them into one project data file. Collections are made annually, at best, and dates are given only by year, so we assigned an arbitrary date of mid-July for each year given. Under the presumption that sediment chemistry should vary on a longer time frame, the analyses will be restricted to longer time scales anyway, so this artifice merely enables us to use a uniform data entry format. It has been necessary to supply dates in this manner to other sets of sediment data in the data base.

QUALITY ASSURANCE/QUALITY CONTROL:

The laboratory analyses are performed through contract. For the data used in this compilation, the analyses were performed either by the South East Fishery Science Center of NMFS, in Charleston, SC or by GERG at Texas A&M University. The program has emphasized quality assurance as a central element of its strategy, and an extensive documentation of the methodologies and associated QA practices is given in Lauenstein and Cantillo (1993). Detection limits are stated as either LOD's (limits of detection) or MDL's (method detection limits).

SAMPLING LOCATIONS:

As noted above, each "site" in the data base is a composite of several stations that are "as much as" 1 km separated. Further, there is no information in the data base to allow separation or precise positioning of the individual samples, except for the rare instances when a sample site departed too much from the nominal location. Approximate ("nominal") positions are listed in Table NOS-4.

DISCUSSION:

Clearly the strategy of the NOSS&T program is to emphasize long-term temporal trends on a nationwide comparative basis. The spatial resolution within any estuarine area is very low, limited to one or a few stations, which are selected to be "representative" of the estuary, rather than being unduly influenced by local runoff or wasteloads. The importance of this data to the present compilation is in the extensive chemical analyses that are carried out.

Despite the fact that the data files are available via the Internet in ASCII format, their manipulation became a huge problem, because (1) it was discovered that the

Table NOS-4
Station locations

Site	*Bay*	*Description*	*Latitude*			*Longitude*		
			deg	*min*	*sec*	*deg*	*min*	*sec*
ABHI	ARANSAS BAY	HARBOR ISLAND	27	50	20	97	4	31
ABLR	ARANSAS BAY	LONG REEF	28	3	53	96	57	48
CBCR	COPANO BAY	COPANO REEF	28	8	28	97	7	40
CCBH	CORPUS CHRISTI	BOAT HARBOR	27	50	10	97	22	43
CCIC	CORPUS CHRISTI	INGLESIDE COVE	27	50	17	97	14	17
CCNB	CORPUS CHRISTI	NUECES BAY	27	51	10	97	21	33
MBAR	MESQUITE BAY	AYRES REEF	28	10	9	96	49	57
CCBLR	CORPUS CHRISTI	LONG REEF	27	49	36	97	17	24

filter by Estuarine Drainage Area did not retrieve all of the data for the study area, so the full Gulf of Mexico data file had to be searched manually; (2) the benthic surveillance and mussel watch files are in different formats; (3) the ASCII characters separating fields are not employed uniformly, so the data files had to be completely re-formatted and corrected; (4) zeroes are used to signify unquantifiable concentrations, which had to be replaced with an entry of "<" the applicable detection limit. The lab detection limits are tabulated separately and had to be manually inserted in the data files. (Moreover, there are measurements that are less than the stated detection limit.)

While the tissue data were compiled as part of this process, these data are noncomparable to any other tissue data in the data compilation, because these are reported as dry-weight concentration rather than weight-weight. Also, inexplicably, NOS does not tabulate the fraction of water in the tissue sample (though it does for the sediment samples), so there is no way to convert the dry-weight data to equivalent wet weights. For this reason, these data could not be included in the status and trends analyses of this project.

REFERENCES:

Lauenstein, G. and A. Cantillo (Eds.), 1993: Sampling and analytical methods of the National Status and Trends Program National Benthic Surveillance and Mussel Watch Projects, 1984-1992. NOAA Tech. Memo. NOS ORCA 71, NOAA, Silver Spring, Maryland.

National Ocean Service, 1988: A summary of selected data on chemical contaminants in sediments collected during 1984, 1985, 1986 and 1987. Tech. Memo. NOS OMA 44, NOAA, Rockville, MD.

National Ocean Service, 1991: Second summary of data on chemical concentrations in sediments from the National Status and Trends Program. Tech. Memo. NOS OMA 59, NOAA, Rockville, MD.

SOURCE DATA SET REPORT
Project code 19

DATA SET: FRESHWATER NEEDS OF FISH & WILDLIFE RESOURCES IN NUECES-CORPUS CHRISTI BAY AREA, PHASE 3

PROJECT ABBREVIATION: USFWS3, FWS3

SOURCE: U.S. Fish & Wildlife Service

MEASUREMENTS:

Hydrographic parameters measured *in situ*:

salinity (conductivity)	pH and redox potential
temperature	dissolved oxygen

Analysis of water samples for

nitrogen series (organic, ammonia, nitrite, nitrate),
phosphorus (total, ortho),
carbon (TOC, POC, inorganic)

Methods are those of Strickland and Parsons, and *Standard Methods* (e.g., APHA, 1985). However, it is not stated whether the sample is filtered. We assume it is not, and therefore the concentrations are "total" rather than "dissolved". The measurements are presented in units of g/m^3, but it is not stated whether these are elemental. We assume they are.

PROCEDURES:

In situ parameters measured by YSI probes with onboard readouts. Water sampling performed during diurnal (tidal-cycle) measurements, via van Dorn sampler, acidified and iced for transport to lab.

Sampling periods :

period	*dates*	*period*	*dates*
1	13-20 October 1978	5	1-8 March 1979
2	8-15 November 1978	6	4-7 April 1979
3	29 November - 8 December 1978	7	3-8 May 1979
4	5-12 February 1979	8	6-11 June 1979

QUALITY ASSURANCE/QUALITY CONTROL:

No formal QA/QC plan exists or is reported, and no information is available as to QA/QC practices. See Discussion below.

DESCRIPTION & COMMENTS:

In the late 1970's, the U.S. Fish & Wildlife Service sponsored a major research project whose objective was to determine the freshwater inflow needs of the Corpus Christi Bay system. This work was performed by the Austin office of Henningson, Durham, Richardson with principal subcontractor North Texas State University. The HDR project director was Don Rauschuber, and the NTSU PI was Dr. Don Henley. The research was conducted in five phases:

1 - Literature synthesis of the present knowledge of the bay system
2 - Identification of data needs and informational deficiencies, and specification of a data-collection and research program to supply the needed information
3 - Data collection and related activities
4 - Determination of impacts of perturbations to the system, especially the proposed Choke Canyon reservoir, and final project report
5 - Preparation of public information media

The Phase 1 report was published as Henley and Rauschuber (1981). This report has been given wide currency, and formed the basis for the inflow requirement stated in the operating permit for Choke Canyon reservoir. It contains no original data however, only data obtained from programs of state agencies.

The core of the USFWS project, from the standpoint of original data, is Phase 3, in which an extensive biological and chemical data-collection program was executed during a study period of October 1978 through June 1979. Generally, the work appears to have focused on the system marshes, and the open waters of Corpus Christi bay. Water chemistry and hydrographic parameters were obtained in conjunction with the biological sampling, therefore the stations are associated with tow/seine sites and marsh transects. Tidal-cycle sampling was performed at the mouths of Rincon Bayou and Marsh Creek in Nueces Bay, at a transect station on the western edge of Harbor Island, and in the Corpus Christi Ship Channel adjacent to Harbor Island.

SAMPLING LOCATIONS:

As noted above, the chemistry stations are associated with tow/seine sites and marsh transects. Four such stations are identified as follows:

Table FWS-1
Phase 3 sampling stations

station	location	latitude		longitude	
1	Ship Channel	27	50.00	97	07.00
2	Redfish Bay in seagrasses	27	51.50	97	07.00
3	Mouth of Rincon Bayou	27	52.25	97	30.95
4	Mouth of Marsh Creek	27	52.65	97	30.45

DISCUSSION:

Unfortunately, the results of Phase 3 of the project have fallen victim to age and neglect. The raw data vanished years ago. The final report of Phase 3 was completed in two volumes, HDR and NTSU (1979a, 1979b), but was not formally published by USFWS, though the Information Transfer Office at Slidell was to disseminate photocopies upon request. Very few copies have survived. No library in the area, in the state university systems, or the state agencies (including TWDB/TNRCC) have copies in their collections. The masters and all photocopies have been lost by the Information Transfer Office at Slidell. We were able to obtain a copy of Volume II—finally—from the Project Director Don Rauschuber's personal library, housed in a corner of his garage behind the lawnmower, and a copy of Volume I from storage at the Corpus Christi area office of USF&WS. Only Vol. I contains information related to water quality, though Vol. II does contain a significant amount of biological data.

Moreover, the purpose of the final report was to interpret the data, not to preserve raw data, so information had to be extracted from widely scattered figures and tables through the report, then manually keyboarded. For one thing, the chemical data are presented as "means" over the sampling period. Therefore, the data cannot be associated with a single date. For purposes of data entry we have *assumed* dates in the midpoint of the above sample periods, namely,

period	date	period	date
1	17 October 1978	5	5 March 1979
2	12 November 1978	6	5 April 1979
3	4 December 1978	7	5 May 1979
4	9 February 1979	8	8 June 1979

On the other hand, the data are presented as "high tide", "low tide", "high slack", and "low slack" measurements, meaning (presumably) the extrema and zero-crossings of the tidal cycle experienced during the sampling period. For present analytical purposes, there is no value in preserving these individual means, so these have been averaged together to yield a single average value for each sampling event. We note that on a few occasions substantial changes in temperature (>5°C) and dissolved oxygen (> 5 mg/l) were recorded at these different stages of a tidal cycle, the former in association with frontal passages, and the latter with flow from a shallow marsh during the warm season.

Although samples were collected from multiple depths in the vertical (either by probe readout, or by use of the van Dorn sampler),the data are averaged before presentation in the report. Therefore, the data are incorporated into the data base as "vertical means". It is unfortunate that the raw data were not preserved.

Some of the data is suspicious. For example nitrite is given as a constant concentration of 0.02 for every sampling event except for the three measurements for the sampling period of March 1979, which are 0.2 . First, this looks more like a detection limit than a concentration. Second, the March 1979 data look like a typo. Without the raw lab sheets, however, this cannot be resolved.

REFERENCES:

HDR and NTSU, 1979a: Additional studies on freshwater needs of fish and wildlife resources in Nueces-Corpus Christi Bay area, Texas: data report; Phase 3 Draft Report Volume I. Unpublished manuscript, USFWS, Slidell, LA.

HDR and NTSU, 1979b: Additional studies on freshwater needs of fish and wildlife resources in Nueces-Corpus Christi Bay area, Texas: data report; Phase 3 Draft Report Volume II. Unpublished manuscript, USFWS, Slidell, LA.

Henley, D and D. Rauschuber, 1981: Freshwater needs of fish and wildlife resources in the Nueces-Corpus Christi Bay area, Texas: a literature synthesis. Doc. FWS/OBS-80/10, Biological Services Program, U.S. Fish & Wildlife Service, Slidell, LA.

SOURCE DATA SET REPORT
Project code 20

DATA SET: Thermal surveys in vicinity of CP&L Nueces Station discharge

PROJECT ABBREVIATION: JMA

SOURCE: James Miertschin & Associates, Inc.
P.O. Box 162305
Austin, TX 78716-2305

MEASUREMENTS:

Hydrographic parameters measured *in situ*:

temperature	dissolved oxygen
salinity (conductivity)	

PROCEDURES:

Parameters measured by YSI probes with onboard readouts. Stations marked by anchored temporary buoys and positioned from shore-based transits.

Sampling periods :

1 1500 17 - 1800 18 September 1992 CDT
2 1800 27 - 1800 29 July 1993 CDT
3 1000 15 - 1800 16 September 1993 CDT

QUALITY ASSURANCE/QUALITY CONTROL:

No formal QA/QC plan exists or is reported, and no information is available as to QA/QC practices. However, JMA maintains its meters in good condition, with frequent calibration. The greatest source of error is in the dissolved oxygen measurements due to degradation of the membrane in the salt-water environment. For this reason, JMA frequently replaced the membrane and re-calibrated the instrument.

DESCRIPTION & COMMENTS:

For over 30 years, Central Power & Light has operated a large generating station on the south shore of Nueces Bay, that withdraws cooling water from the Inner Harbor and discharges the heated return flow to Nueces Bay. The objective of this project was to map the extent of the plume created by the cooling-water return in

Nueces Bay from the CP&L Nueces S.E.S. Accordingly, the distribution of stations and the frequency of measurement are both dense in space and time, but the sampling periods themselves are chosen deliberately to maximize plant loads and thermal plume size, viz. warm, quiescent summer conditions.

Because the data were used to evaluate the heat and oxygen budgets within the plume, they were digitized from the field notes. These data were provided to the present project in the form of EXCEL spreadsheets, which were then re-formatted as a part of the data-compilation process.

SAMPLING LOCATIONS:

Not all of the data stations occupied were used in this data compilation, however a workable subset was selected to be representative of conditions in this general area of Nueces Bay. In addition to a dense network of stations in the thermal plume, JMA performed measurements at stations lying outside of the plume, in the open waters of Nueces Bay, near the power plant intake in the Inner Harbor, and in the open waters of Corpus Christi Bay. The data from these stations are all included in this compilation.

In the field work, stations were located with respect to fixed landmarks, such as gas wells and the three lines of transmission poles crossing Nueces Bay from the generating station. In addition, stations were marked by temporary buoys. All of these were fixed in position using bearings from shoreline transits. In the present compilation, the mapped station locations were transferred to a large-scale map of the area and geographical coordinates determined. The sampling stations and latitude/longitude coordinates are presented in Table JMA-1.

DISCUSSION:

While the Nueces Station thermal plume has been the subject of intense field work from time to time, especially by CP&L personnel themselves, the raw data generally no longer exists, though the contoured plumes do (see, e.g., Ward, 1982). This set of recent data therefore is of some value in documenting the temperature and hydrographic structure within this limited area of the system.

REFERENCES:

Ward, G.H., 1982: Thermal plume area calculation. *J. Energy Div., ASCE, 108* (EY2), pp. 104-115.

Table JMA-1
JMA Nueces Bay stations
S3=Sep 93, J3=Jul 93

sta ID	*Latitude*		*Longitude*		*sta ID*	*Latitude*		*Longitude*	
	deg	*min*	*deg*	*min*		*deg*	*min*	*deg*	*min*
J3B5	27	49.95	97	24.70	FWPP2	27	49.73	97	25.62
J3B7	27	50.01	97	25.71	FWPP3	27	49.79	97	25.65
J3B8	27	50.14	97	26.00	FWPP4	27	49.85	97	25.75
J3B10	27	50.38	97	25.98	FWPP5	27	49.91	97	25.82
J3B12	27	49.79	97	24.76	FWPP6	27	49.91	97	25.92
J3P3	27	49.52	97	24.93	FWPP8	27	49.91	97	26.10
BT	27	50.92	97	25.24	FWPP10	27	49.91	97	26.28
AP	27	50.11	97	25.62	FWPP12	27	49.92	97	26.46
YM	27	50.38	97	25.68	FWPP14	27	49.92	97	26.64
BF	27	50.25	97	24.43	FWPP15	27	49.92	97	26.73
PP1	27	49.40	97	25.15	UGW	27	50.35	97	26.50
PP2	27	49.47	97	25.12	NGW	27	51.85	97	26.6
PP3	27	49.54	97	25.08	INT	27	49.01	97	25.37
PP5	27	49.69	97	25.01	CCB	27	49	97	21
PP7	27	49.83	97	24.93	S3B1	27	49.81	97	25.15
PP9	27	49.98	97	24.86	S3P4	27	49.52	97	24.93
PP10	27	50.06	97	24.82	S3B10	27	50.09	97	27.57
PP11	27	50.12	97	24.78	S3B9	27	49.79	97	24.76
PP13	27	50.28	97	24.71	S3B2	27	50.01	97	25.71
PP15	27	50.43	97	24.64	S3B4	27	50.38	97	25.98
PP17	27	50.56	97	24.57	S2P2	27	49.52	97	24.93
PP19	27	50.71	97	24.50	PPb2	27	49.67	97	25.34
PP20	27	50.78	97	24.46	PPb1	27	49.59	97	25.33
WPP1	27	49.59	97	25.33	WPP11	27	50.40	97	25.40
WPP2	27	49.67	97	25.34	WPP13	27	50.55	97	25.42
WPP3	27	49.75	97	25.34	WPP15	27	50.71	97	25.43
WPP5	27	49.92	97	25.36	WPP17	27	50.88	97	25.44
WPP7	27	50.07	97	25.37	WPP19	27	51.02	97	25.46
WPP9	27	50.24	97	25.39	WPP20	27	51.10	97	25.46
WPP10	27	50.31	97	25.39					

SOURCE DATA SET REPORT
Project code 021

DATA SET: Environmental Monitoring and Assessment Program (EMAP)

PROJECT ABBREVIATION: EMAP

SOURCE: EMAP Province Manager
U.S.E.P.A.
Environmental Research Laboratory
Gulf Breeze, FL 32561

MEASUREMENTS:

The initial EMAP Demonstration Project, which was initiated in 1991, examined an extensive suite of chemical compounds in sediment and tissue. For sediment samples, these suites are summarized as follows:

Trace metals:	*Organics*:
Antimony	
Arsenic	Butyl tin compounds
Cadmium	pesticides
Chromium	alkanes
Copper	PCBs (various)
Iron	
Lead	PAHs (various)
Manganese	
Mercury	TOC
Nickel	
Silver	*Others*
Selenium	AVS
Tin	
Zinc	Grain-size analysis

For tissue samples, generally the same suites of parameters are analyzed excluding TOC, AVS and grain-size. The complete suites of analyses are listed in Tables 1-5. Many of these are not monitored by other programs hence are not incorporated into the master data bases for the study area.

In association with sediment sampling, water-column profiles were obtained, as well as short-duration hydrosonde records. These variables included:

temperature	Secchi depth
salinity	PAR at various depths
pH	relative to incident at surface
dissolved oxygen	

Table EMAP-1
Suites of polychlorinated biphenyls (PCB's) analyzed in sediment and tissue samples

PCB 101	PCB 153	PCB 209
PCB 105	PCB 170	PCB 28
PCB 110/77	PCB 18	PCB 44
PCB 118/108/149	PCB 180	PCB 52
PCB 126	PCB 187/182/159	PCB 66
PCB 128	PCB 195	PCB 8
PCB 138	PCB 206	
		TOTAL PCBS

Table EMAP-2
Suites of pesticides analyzed in sediment and tissue samples

ALDRIN	LINDANE (gamma-BHC)	TOTAL DDT
alpha-BHC	delta-BHC	MIREX
alpha-CHLORDANE	DIELDRIN	o,p'DDD
beta-BHC	alpha-ENDOSULFAN	o,p'DDE
TOTAL BHC	beta-ENDOSULFAN	o,p'DDT
TOTAL CHLORDANE	OXYCHLORDANE	ENDRIN
CIS-NONACHLOR	gamma-CHLORDANE	p,p'DDD
op-DDD + pp-DDD	HEPTACHLOR	p,p'DDE
op-DDE + pp-DDE	HEPTACHLOR-EPOXIDE	p,p'DDT
op-DDT + pp-DDT	HEXACHLOROBENZENE	
TOXAPHENE	TRANSNONACHLOR	

Table EMAP-3
Suites of miscellaneous organics analyzed in sediment and tissue samples

Isoprenoids	*Butyltin*	*Organophosphates*
PHYTANE	Mono butyl Tin	CHLORPYRIFOS
PRISTANE	Di-butyl Tin	DICOFOL
TOTAL ISOPRENOIDS	Tri-butyl Tin	

Table EMAP-4

Suites of polycyclic aromatic hydrocarbons (PAH's) analyzed in sediment and tissue samples

ACENAPHTHENE	DIBENZO(a,h)ANTHRACENE
ACENAPHTHYLENE	2,6-DIMETHYLNAPHTHALENE
BENZO(a)ANTHRACENE	(i)1,2,3-c,d-PYRENE
BENZO(a)PYRENE	1-METHYLNAPHTHALENE
BENZO(e)PYRENE	2-METHYLNAPHTHALENE
BENZO(b)FLUORANTHENE	1-METHYLPHENANTHRENE
BENZO(k)FLUORANTHENE	PERYLENE
BENZO(g,h,i)PERYLENE	PYRENE
BIPHENYL	2,3,5-TRIMETHYLNAPHTHALENE
C1-CHRYSENES	
C2-CHRYSENES	C1-PHENANTHRENES
C3-CHRYSENES	C2-PHENANTHRENES
C4-CHRYSENES	C3-PHENANTHRENES
CHRYSENE	C4-PHENANTHRENES
	PHENANTHRENE
C1-FLUORENES	
C2-FLUORENES	C1-NAPHTHALENES
C3-FLUORENES	C2-NAPHTHALENES
FLUORENE	C3-NAPHTHALENES
	C4-NAPHTHALENES
C1-DIBENZOTHIOPHENES	NAPHTHALENE
C2-DIBENZOTHIOPHENES	
C3-DIBENZOTHIOPHENES	C1-FLUORANTHENE PYRENE
DIBENZOTHIOPHENE	FLUORANTHENE
	TOTAL PAHS

Table EMAP-5

Suites of alkanes
analyzed in sediment and tissue samples

---

n-Decane Aliphatic Hydrocarbons
n-Docosane Aliphatic Hydrocarbons
n-Dodecane Aliphatic Hydrocarbons
n-Dotriacontane Aliphatic Hydrocarbons
n-Eicosane Aliphatic Hydrocarbons
n-Heneicosane Aliphatic Hydrocarbons
n-Hentriacontane Aliphatic Hydrocarbons
n-Heptadecane Aliphatic Hydrocarbons
n-Heptacosane Aliphatic Hydrocarbons
n-Hexadecane Aliphatic Hydrocarbons
n-Hexacosane Aliphatic Hydrocarbons
n-Nonadecane Aliphatic Hydrocarbons
n-Nonacosane Aliphatic Hydrocarbons
n-Octadecane Aliphatic Hydrocarbons
n-Octacosane Aliphatic Hydrocarbons
n-Pentedecane Aliphatic Hydrocarbons
n-Pentacosane Aliphatic Hydrocarbons
n-Tetratriacontane Aliphatic Hydrocarbon
n-Tetradecane Aliphatic Hydrocarbons
n-Tetracosane Aliphatic Hydrocarbons
n-Triacontane Aliphatic Hydrocarbons
n-Tricosane Aliphatic Hydrocarbons
n-Tridecane Aliphatic Hydrocarbons
n-Tritriacontane Aliphatic Hydrocarbons
n_Undecane Aliphatic Hydrocarbons

TOTAL ALKANES

PROCEDURES:

Annual sampling in the summer seasons was carried out at a network of nearly 200 sites along the northern Gulf of Mexico. Sampling included vertical profiling, deployment of hydrosondes for short-period (12 hours) monitoring, marine debris observations, and sediment and biological collections. Sediment sampling was performed by multiple (6-10) grabs with a Young-modified Van Veen sampler, each of which was subsampled from the top 2 cm to create a composite sediment sample, which was preserved on ice and frozen pending analysis. The same sediment samples were used for characterization of the benthos, and for laboratory toxicity bioassays. Vertical profiling was carried out with Hydrolab Surveyor 2. Photosynthetically available radiation (PAR), essentially the visible band, was measured with a LICOR LI-1000 submersible sensor. Provision is made in the date base for other parameters, including TSS and fluorescence, but these are not reported for the stations in the study area.

DESCRIPTION & COMMENTS:

In many respects, the EMAP program has similar objectives to the National Ocean Service Status & Trends Project (see Project Code 18), i.e. of building a data base to allow discrimination of very-long-term trends in environmental quality indicators, and to allow regional comparisons. The primary differences between this program and the NOSS&T are

- even more extensive suite of organic compounds
- more detailed and involved statistical procedure for station selection and data analysis
- more highly organized and controlled field procedures
- biological sampling, including benthal ecological measures, and bioassays
- water profile measurements

QUALITY ASSURANCE/QUALITY CONTROL:

The program has emphasized quality assurance as a central element of its strategy, and an extensive documentation of the methodologies and associated QA practices is given in EMAP publications (e.g., Summers and Macauley, 1993, and references therein). Every aspect of the program has been carefully planned and evaluated, from initial station selection, to field procedures and crew training, to the ultimate analysis of the data. The laboratory analyses are performed through contract. For the data used in this compilation, the analyses were performed by GERG at Texas A&M University.

SAMPLING LOCATIONS:

Latitude and longitude coordinates are supplied as part of the data base. There is no separate information on station locations, so there is no means to verify the correctness of these locations. The EMAP stations in the CCBNEP study area are listed in Table EMAP-6.

DISCUSSION:

Clearly the strategy of the EMAP program, like NOSS&T, is to emphasize long-term temporal trends on a nationwide comparative basis. The spatial resolution within any estuarine area is very low, limited to one or a few stations, which are selected to be "statistically representative" of the estuary. The importance of this data to the present compilation is in the extensive chemical analyses that are carried out.

Table EMAP-6
EMAP Station locations in CCBNEP study area

EMAP Site	*Bay*	*Latitude*			*Longitude*		
		deg	*min*	*sec*	*deg*	*min*	*sec*
LA91LR55	LAGUNA MADRE	27	0	13.2	97	27	4.8
LA91SR26	COPANO BAY	28	4	51.6	97	8	46.2
LA91SR45	TULE LAKE CHANNEL	27	49	53.4	97	26	46.8
LA92LR62	CORPUS CHRISTI BAY	27	47	42	97	15	25.2
LA92LR63	CORPUS CHRISTI BAY	27	50	14.4	97	16	12
LA92SR32	REDFISH BAY	27	52	22.2	97	7	25.8
LA92TR05	COPANO BAY	28	7	36	97	1	20.4
LA92TT05	COPANO BAY	28	7	34.8	97	1	23.4
LA93LR63	CORPUS CHRISTI BAY	27	45	29.4	97	14	54
LA93LR64	CORPUS CHRISTI BAY	27	46	15	97	23	20.4
LA93SP25	ARANSAS BAY	27	59	58.8	97	0	58.2
LA93SR25	ARANSAS BAY	28	4	10.8	97	1	28.8
LA93SR26	NUECES BAY	27	50	7.8	97	26	41.4
LA93SR29	ARANSAS PASSES	27	53	46.8	97	2	0.6
LA93TR05	COPANO BAY	28	7	36	97	1	21.6
LA93TT05	COPANO BAY	28	7	34.2	97	1	21
LA94LR56	CORPUS CHRISTI BAY	27	45	45	97	13	10.8
LA94LR60	LAGUNA MADRE	27	5	34.8	97	26	59.4
LA94TR05	COPANO BAY	28	7	32.4	97	1	22.2
LA94TT05	COPANO BAY	28	7	36.6	97	1	18

Data files were provided to this project encompassing the period 1991-94. The suite of compounds analyzed was extensively reduced after 1993. Data are maintained in delimited ASCII files. Unfortunately, the formatting is eccentric (presumably governed by the analytical objectives of the project); synthesis of a single record of a tissue analysis, for example, required searching for latitude/longitude in the STATIONS file, for station depth in the EVENTS file, for the organisms species in the FISHCODE file, and the measurement and date in the TISUCHEM file. Moreover, the formats vary with the class of parameters, e.g. TISUCHEM follows a different format (and order of variables) from that of SEDCHEM. All of this translated to a tedious process in building up data files for this project. Blanks are used to signify unquantifiable concentrations, which is certified by a character entry in a separate column, whereupon the applicable detection limit is provided in yet another column.

While the tissue data were compiled as part of this process, these data are noncomparable to other tissue data in the data compilation, except that of Texas Department of Health, because only the edible portion of the organisms were analyzed, i.e. filets for finfish, tails for shrimp.

REFERENCES:

Macauley, J. and K. Summers, 1994: Statistical summary: EMAP-estuaries Louisianian Province - 1992. Report EPA/620/R-94/002, ERL, USEPA, Gulf Breeze, FL.

Summers, K. and J. Macauley, 1993: Statistical summary: EMAP-estuaries Louisianian Province - 1991. Report EPA/620/R-93/007, ERL, USEPA, Gulf Breeze, FL.

SOURCE DATA SET REPORT
Project code 022

DATA SET: Robot-monitored data from Conrad Blucher Institute, Texas A&M University—Corpus Christi

FILE NAME: n/a

SOURCE: Rocky Freund, TAMU–CC

MEASUREMENTS:

temperature
conductivity
salinity (computed from above parameters)
pH
dissolved oxygen*
turbidity*

PROCEDURES:

The Blucher Institute operates a network of platform mounted robot data monitors, consisting of electrometric probes, a digital data acquisition systems, and either a data logger or transmission link to CBI headquarters at TAMU-CC. This monitoring program is part of the Texas Coastal Ocean Observing Network (TCOON), a network of such robot monitors along the Texas coast established primarily for tide and meteorology.

DESCRIPTION & COMMENTS:

At the time this work was done, data base transfers were accomplished via the Internet using ftp protocols. One requested data files from CBI in advance and these were prepared for ftp transfer to the requestor. Each such download was therefore an *ad hoc* procedure requiring staff time for the data download and reformatting. For various reasons, the data requests from this project were not responded to until late 1996, when the data compilation was nearing its end, and the analytical effort and report preparation were about to begin. At this critical point, the PI's were advised by Dr. Kraus, the Director of CBI, that some fundamental problems had been uncovered in the calibration of conductivity/ salinity and this data would be of questionable validity until the issue was resolved. Because of this, and the problem of subsampling (see below), it was decided to exclude the CBI data from the present data base.

Since then, the data download procedure has been greatly simplified and streamlined by a user-driven web page site:

http://tcoon.cbi.tamucc.edu/pquery

Some of the CBI data was used in evaluating TWDB sonde data, which were similarly excluded from this compilation (see Project Code 23).

A data compilation problem that must be addressed in combining data sets such as these with the conventional boat-occupied measurements is the disparity in volume of data. The robots are capable of measuring the parameters at intervals of minutes. While most of the measurements are redundant, due to the high autocorrelation of the hydrographic variables, to include these without subsampling or averaging will lead to their domination of any linear statistics analysis in which they are included. It appears to these PI's that some carefully formulated data resolution protocols need to be devised to guide the combination of data taken at such wide limits of resolution. (The same problem, but to a lesser degree, attends use of diurnal surveys, or TWDB Intensive Inflow Study data together with measurements taken less frequently, e.g., TNRCC quarterly sampling.) As the CBI and TWDB robot data were excluded from this compilation for reasons of data quality, the issue was mooted. But as this type of data collection becomes more frequent, the problem will require attention.

SAMPLING LOCATIONS:

Present and historical platform locations are shown on the above website.

SOURCE DATA SET REPORT
Project Code 023

DATA SET: Hydrosonde ("sonde") records

PROJECT ABBREVIATION: TWDB-SND

SOURCE: Texas Water Development Board
S.F. Austin Building
Austin, Texas 78711

Raw data files available from INTERNET site:

http://www.twdb.state.tx.us or info@twdb.state.tx.us

CONTACT: Dr. David Brock (512-936-0819) or Dr. Reuben Solis (512-936-0823)

MEASUREMENTS:

Electrometric hydrographic parameters: conductivity (mmhos), temperature (°C), pH, dissolved oxygen (ppm). Salinity is computed from conductivity.

PROCEDURES:

All measurements are performed automatically and internally logged by a moored sonde, usually on a 90-min sampling interval for a period of deployment of about one month. (Some of the later data is sampled at a 1-hour interval.) Hydrolab sondes have been utilized since the outset of the program. The instrument is housed in a heavy steel case with vents for water exchange, suspended from a fixed structure such as a pier, with the sonde at approximately mid-depth.

QUALITY ASSURANCE/QUALITY CONTROL:

No formal QA/QC plan exists or is reported, and no information is available as to QA/QC practices. Records of monthly instrument calibration, with standards values, are kept on file. Also on file are records of hydrographic measurements independently collected at sonde deployment and retrieval. (This information was not available to the present project.) The TWDB advises that these data should also be available electronically soon.

DESCRIPTION & COMMENTS:

Since the mid-1980's, the TWDB has been experimenting with moored, automatically recording hydrosondes, maintaining in service about 12 such sondes in the Texas bays. As noted above, the sondes are generally deployed for about one month, during which automatic readings of conductivity, temperature, pH and DO are logged, usually at 90-min intervals. Such records provide excellent time continuity and therefore offer the ability to examine short time-frame response events, such as DO P-R curves and salinity extrusion in a freshet, as well as time series and spectral aspects of water quality. Physical operation of the program, routine maintenance, deployment and retrieval, have been usually performed by staff from other agencies, under interagency contract with TWDB. In the Coastal Bend Bays, the Corpus Christi field office of the Texas Water Commission (now TNRCC) performed this service from 1986 through September 1989, Beginning in 1990, the Texas Parks and Wildlife Department has been responsible for some sites, TWDB Austin staff maintained some sites, and since August 1995, staff of the Conrad Blucher Institute of TAMU—CC have maintained three sites.

The same advantage that sondes offer of untended, temporally intense sampling over an extended period also entails potential problems with the data. The sampling interval is dictated by the internal electronics of the instrument, which is liable to drift, especially as battery reserves diminish and external conditions change rapidly. (The TWDB notes that Hydrolab Corporation of Austin,the manufacturer of the hydrosonde used by TEDB, has information to address these concerns.) Table TWDB-1 displays a summary of the time history of one of the sonde stations (at the JFK Causeway) for 1991-94. The time continuity of the record is clearly discontinuous. The probes themselves are prone to physical and biochemical fouling and organism growth. Without frequent maintenance and calibration by independent calibration measurements, substantive and unknown drift errors can creep into the records. The data sets available to this study are the raw data records from the sondes, the record for each deployment period being in a separate file. At the time this compilation was carried (1996) there are 409 such files from the 12 deployment stations in the CCBNEP study area, so there are over 23,000 files of data records to process. To use the data record for *each* deployment period would require a major analytical effort, in which the clock error and the measurement drift for each parameter on that sonde would have to be determined from companion measurements by independent instruments, a determination made of data that are irretrievably corrupted, and instrument- and deployment-period-specific correction relations developed. (In a minority of instances, corrected salinity records were available at the above URL for which presumably these procedures have been carried out. In 1996 there were 57 such files.)

Until all of the necessary processing steps have been carried out to produce a "clean" data record, these data should properly be regarded as research-in-progress on alternative means of water-quality measurement, but not as final monitoring data based upon established and accepted field procedures. For present purposes, we have used a subsampling of the sonde records for temperature and salinity (i.e. conductivity) only, within the first two weeks of the

Table TWDB-1
Detailed accounting of time continuity *
at sonde station at JFK Causeway
1991 - 1994

data missing	910714-910813	910906-910909
	911012-911022	920314-921318
	920624-920723	920929-921211
	930506-931221	940223-940323
	949423-940502	940602-940921
overlapping	920416 / 1020 - 920417 / 0730	
time shifts	0.5 hr	920826/1200
	0.5 hr	930305/1100
	0.5 hr	930408/1200
	0.5 hr	940121/1431
	0.5 hr	940121/1431

*exclusive of short gaps in the record

deployment period. The exception was the "corrected" salinity records, when available, which were assumed to be valid in their entirety. None of the pH or DO data have been used, because these probes can be quickly fouled in a saline environment, and without the companion calibration measurements it is not clear *a priori* how much of the record can be considered valid.

SONDE LOCATIONS (CCBNEP study area):

There have been 12 separate sonde locations at which deployments have been made since 1986. These are listed in Table TWDB-2, along with geographical positions determined by TWDB, and with the overall period of record of deployment at each station. (This of course does not account for missing data or record gaps.)

Table TWDB-2
TWDB sonde locations and period of record

Oso Bay at mid-span SPID May 1995 - January 1996	27 40 47	97 18 44
Mid-Nueces Bay at upstream powerpole line December 1986 - September 1990	27 50 56	97 25 26
Upper Nueces Bay June - August 1990	27 51 30	97 28 30
Mesquite Bay near channel jog December 1986 - August 1989	28 9 36	96 51 4
Baffin Bay at marker #4 May 1991 - June 1995	27 16 40	97 25 15
Baffin Bay* August 95 - August 96	27 17 8	97 24 57
Laguna Madre at JFK causeway in GIWW** February 1991 - June 1995	27 38 4	97 14 22
Riviera Beach, Upper Baffin Bay May - July 1995	27 17 26	97 39 35
Corpus Christi Bay near Ingleside, at range marker December 1986 - September 1989 May - July 1994	27 44 30	97 13 0
Port Aransas Jetties May 1994 - July 1995	27 50 17	97 3 2
Copano Bay causeway near end of south fishing pier November 1986 - August 1989 September - October 1995	28 7 14	97 1 24
Upper Copano Bay near Bayside September - October 1995	28 4 28	97 13 14
Aransas Bay east of Rockport December 1986 - August 1989 March 1994 - March 1996	27 59 21	97 0 34

* TWDB staff notes that this location is the CBI platform in Baffin Bay. It is not clear whether the data is from the TCOON program, or is independent data of TWDB.

** Starting December 1992, sonde moved from just east of channel at 12 ft to east of channel at dock of Clems Marina in 5-8 ft water. This sonde was moved again to the west bank of the GIWW channel at the JFK Causeway in August 1995.

DISCUSSION:

The decision to exclude robot-collected data, viz. the TWDB sonde data and the CBI platform data (see Project Code 22), from the present compilation was not made lightly. A considerable effort was investing in downloading, inspecting, and attempting to "scrub" the data files for use in this project. Only after the extent of aberrancies in the data was discovered and the effort assessed to correct these (presuming the information to do so was complete and accurate, which cannot be really determined until one works through the process for *each* file), did it become apparent that the necessary time far exceeded the resources of this project.

One might reason that since the sondes are checked and calibrated before deployment, at least the first few days of the record could be expected to be accurate. However, this calibration apparently does not include adjustment of the instrument to agree with the standard, and comparison of the TWDB-corrected records versus the raw data quickly dispels this hope, see, e.g. Fig. TWDB-1. Moreover, an examination of the "corrected" files that are available shows that other sorts of problems, such as aberrant values, have not been removed. Fig. TWDB-2 shows one "corrected" record from Nueces Bay with obviously incorrect values. The CBI data does not appear to be in any better shape. While calibration data are noted by CBI staff, none of the records have been corrected; also, what may be major calibration problems have been discovered recently and are presently being investigated (N. Krause, CBI, pers. comm., 1996, see also Project Code 22). A comparison of the raw records for TWDB and CBI sondes located in proximity at the JFK Causeway is shown in Fig. TWDB-3. Not only do the raw values differ substantially (which is to be expected), but the time responses of the two are uncomfortably dissimilar.

The use of robot data collection offers great potential to the study of the Texas bays. We repeat the recommendation of Ward and Armstrong (1997) for continuation of this work, but with increased attention given to Q/A procedures, data scrubbing and reconciliation, and drift control. *NB*, such data acquisition should not replace routine sampling, since routine sampling provides far better spatial continuity than is economical to achieve with robot monitors.

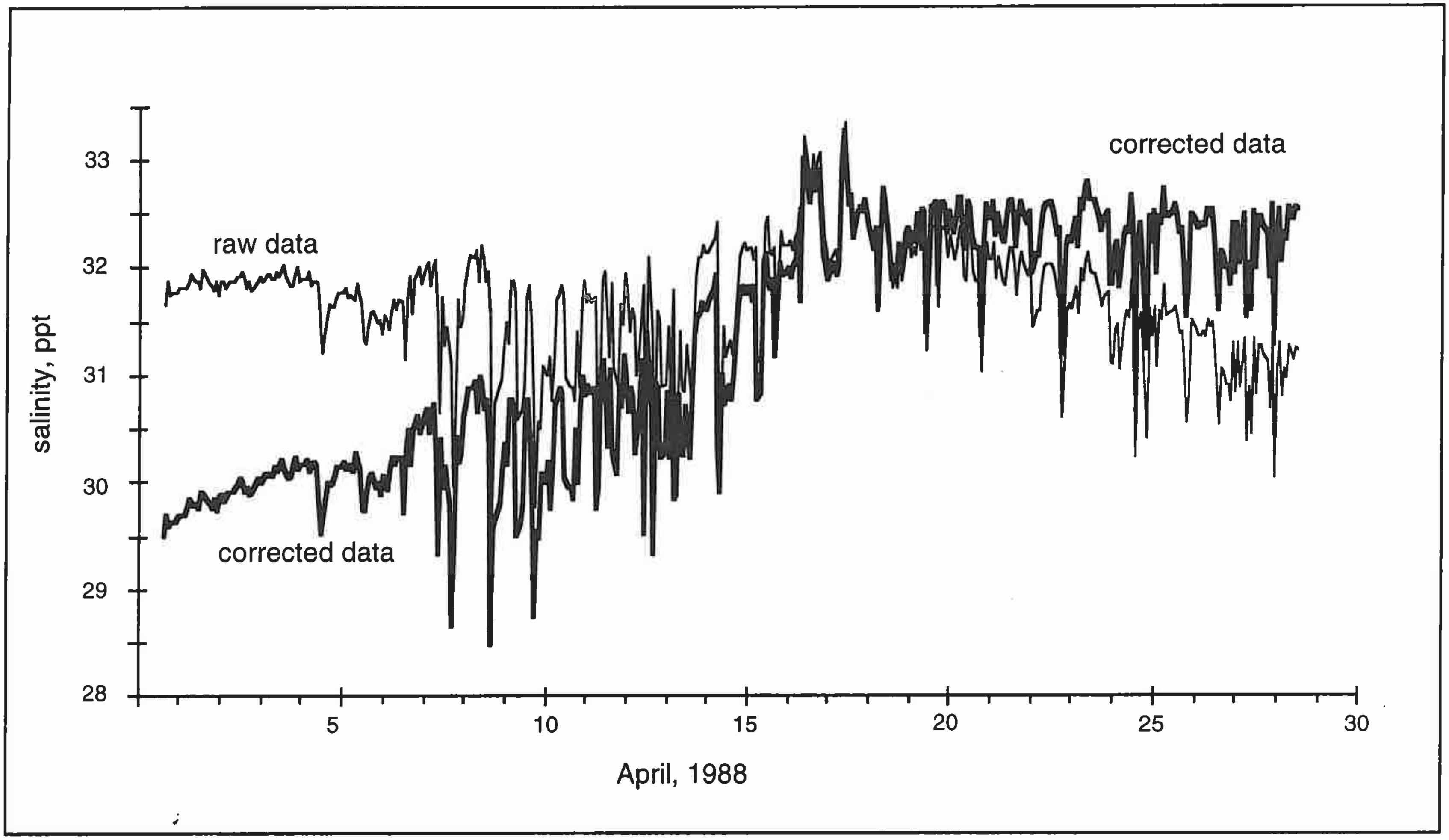


Figure TWDB-1. Salinity record from hydrosonde in Corpus Christi Bay near Ingleside, raw data and corrected

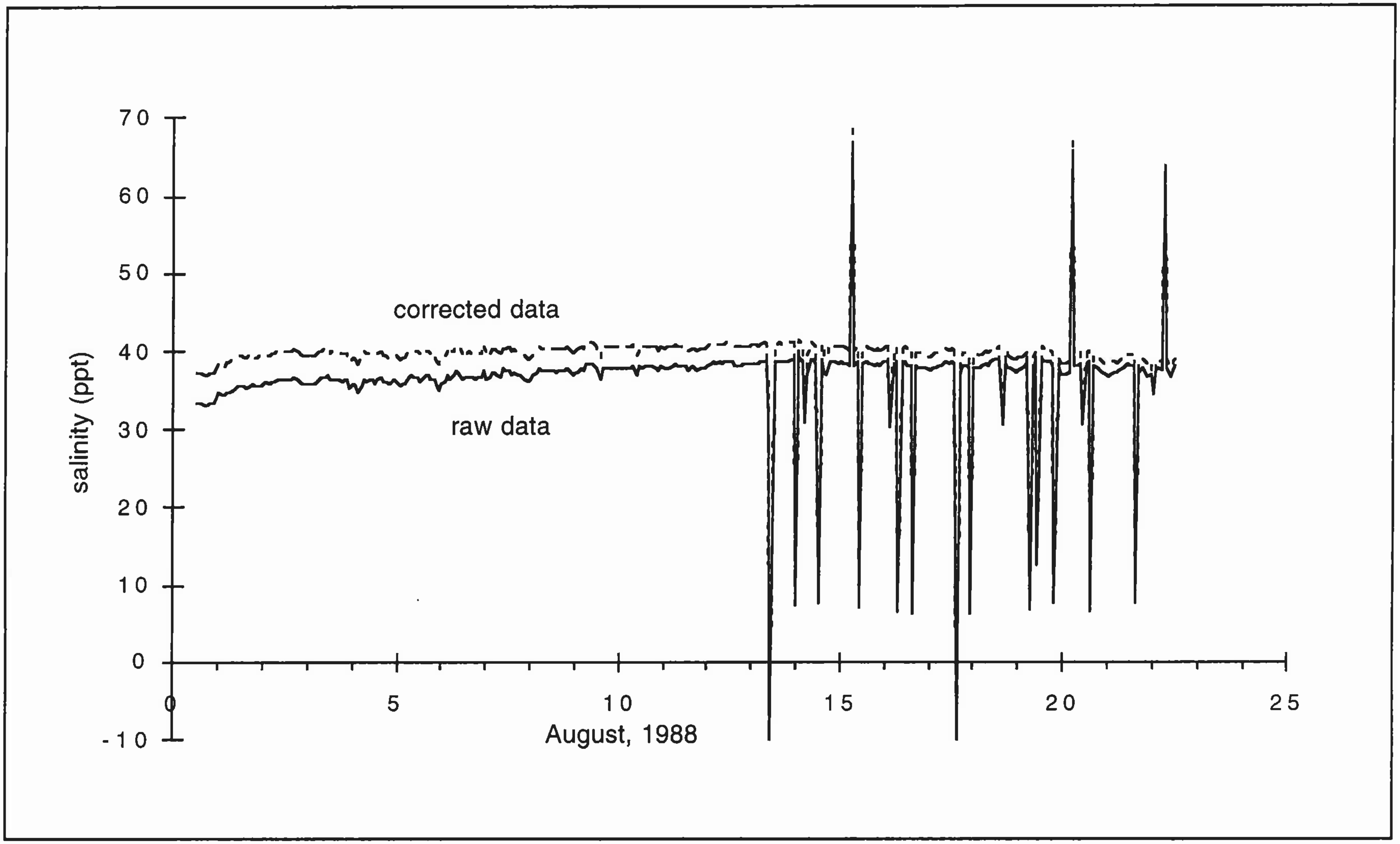


Figure TWDB-2. Salinity record from hydrosonde in Nueces Bay, raw data and corrected

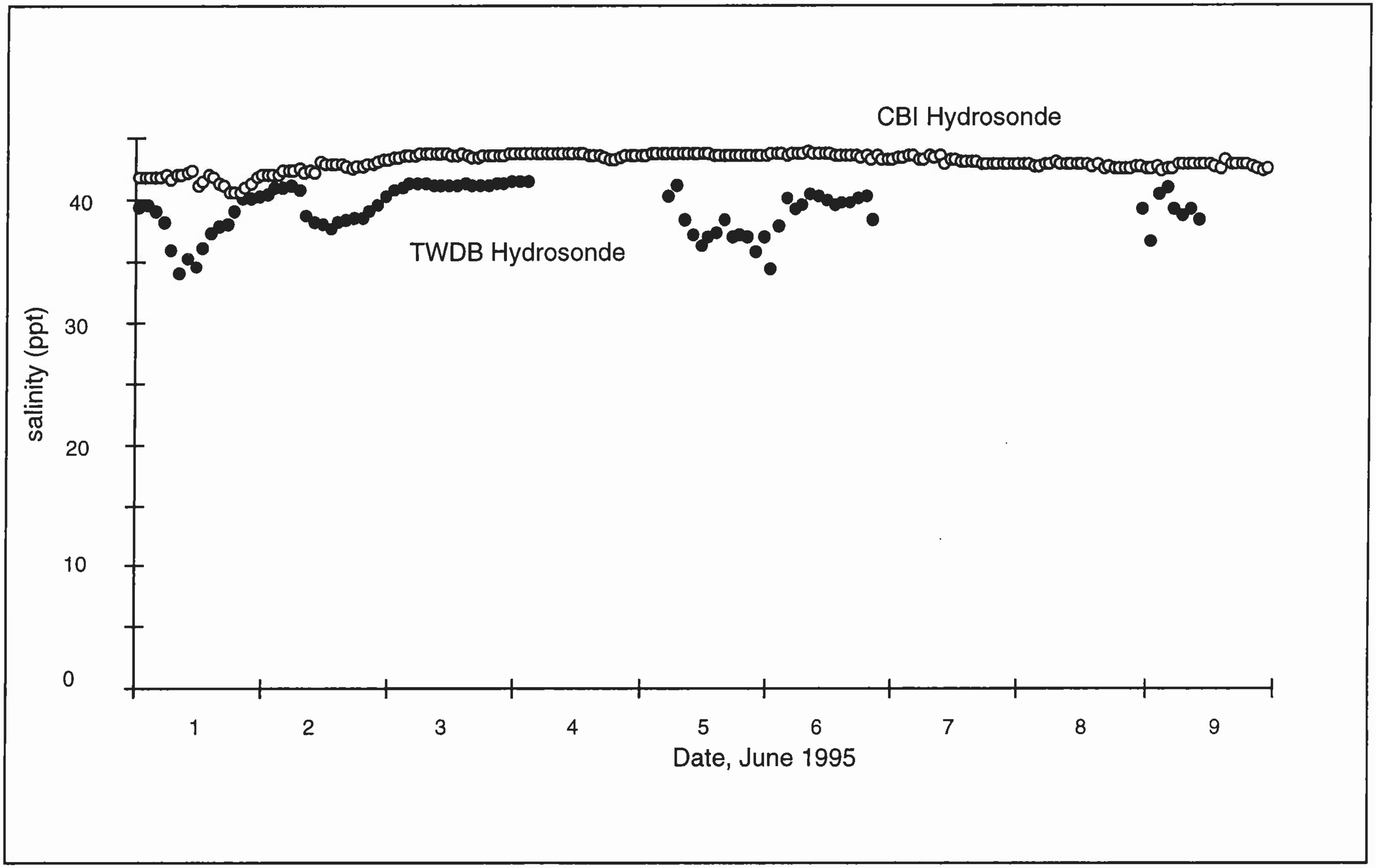


Figure TWDB-3. Salinity records from hydrosondes moored in GIWW at JFK Causeway

SOURCE DATA SET REPORT
Project code 024

DATA SET: Older literature values, primarily TGFOC

PROJECT ABBREVIATION: n/a

SOURCE: Grey literature reports, files

CONTACT: n/a

MEASUREMENTS:

Primarily salinity and temperature, occasional dissolved oxygen (via Winkler)

PROCEDURES:

Sampling from boat. No other information available.

QUALITY ASSURANCE/QUALITY CONTROL:

No formal QA/QC plan exists or is reported.

DESCRIPTION:

This Project Code was reserved to accommodate various data from the early part of this century. An example is the salinity measurements, determined from titration for chlorides, from File TK001255 of Exxon, deriving from the 1950's Exxon lawsuit for ownership of some of the lands of the Laguna Madre mudflats. Additional similar data exist in the early hydrographic surveys of the U.S. Bureau of Commercial Fisheries (e.g., Galtsoff). As matters developed, the loss of the TGFOC data from the 40's and 50's destroyed the time continuity in the older data, and the cost of keyboarding the little data that could be recovered did not warrant its limited utility in time trend studies.

SOURCE DATA SET REPORT
Project code 25

DATA SET: Fecal coliforms in contact recreation areas

PROJECT ABBREVIATION: NCHD

SOURCE: Corpus Christi-Nueces County Department of Public Health

MEASUREMENTS: Fecal coliform concentrations from surface water samples.

PROCEDURES:

Surface samples are obtained from beach sites or the vicinities of outfall drains, especially stormwater outfalls. Frequency has varied over the years, from weekly to bi-monthly, either throughout the year or in the warm-season months of highest recreation activity. Although the samples are taken in nearshore areas, the immediate vicinity of the shoreline is avoided. Samples are obtained by inserting a sterilized glass bottle into a wire basket on a long pole, and dragged through the water at a depth of 0.2-0.3 m until the bottle is filled. The samples are stored on ice and returned to the lab within two hours. Analyses are performed using the membrane filter technique with mEndo media.

QUALITY ASSURANCE: No formal QA/QC plan was reported, and no information was provided as to QA/QC practices. The lab is, however, regularly inspected by various regulatory agencies and can be assumed to perform all analyses in conformance with *Standard Methods* (e.g., APHA, 1985).

DESCRIPTION & COMMENTS:

The prime objective of this sampling program is verifying the safety of the waters of the Corpus Christi Bay system for swimming and contact recreation. In addition to the lab's own data, the department also receives data and reports for the Texas Department of Health and the Texas Natural Resources Conservation Commission. Data management is therefore not a major objective of the lab; results are maintained as hardcopy lab reports, and were furnished to this project in that form. Data were provided for years 1976-1995, except for 1977, 1983 and 1984. No other data is available. No additional parameters are measured.

A few determinations are described simply as "confluent", by which we presume that the growth was so dense that individual colonies could not be distinguished. As the largest reported concentration was 340,000 col./100 mL, we have replaced the "confluent" entries with ">340000". In the analysis of coliform variation, these instances are replaced with the value 340000, which probably underestimates the actual concentration but is clearly a better strategy than simply omitting these rare but large values.

SAMPLING LOCATIONS:

Sampling stations have varied considerably during the past 20 years. Also, since a station is recorded for the internal use of the lab, many of the site descriptions, while perfectly clear to the field and laboratory personnel at the time, depend upon institutional memory for specificity, for example:

Puerto del Sol Beach (trailer park)
Kennedy Causeway - Telephone Pole
CC Beach - near bathhouse, jetty area

The laboratory personnel were very helpful in identifying locations. Some locations were capable of being located approximately from the descriptions. Some had to be guessed at, particularly the multiple stations around the breakwater during the 1970's. All of the stations referenced in the field sheets and various sketch maps provided to the project, with the latitude and longitude coordinates determined by this study, are given in Table NCHD-1.

DISCUSSION

The Nueces County Health Department has been an active data-collection and monitoring entity in the Corpus Christi area since at least the early 1940's. In its earlier programs, salinity, temperature, dissolved oxygen, and various ions were measured as well as coliforms. Also the Department carried out intensive special-purpose investigation of specific areas of the bay, such as the open waters of Corpus Christi Bay and the Inner Harbor. Copies of some of this data were obtained by Southwest Research Institute during its program in the early 1970's, and used to establish the quality of the bay back to about 1960 (Oetking, 1972).

None of this historical data now exists. The Nueces County lab has evidently discarded much of it, for the obvious reason that it is no longer pertinent to monitoring the public health of the estuary. The holdings of the SWRI lab were discarded when the office closed (see Project Code 005). No other offices of the City of Corpus Christi have provided any indication that they might have such holdings.

REFERENCES:

Oetking, P., 1972: Water quality baseline study for Corpus Christi Bay from June 1970 to June 1971. SwRI Proj. 18-2880-01, Ocean Science and Engineering Laboratory, Corpus Christi, Texas.

TABLE NCHD-1
Locations of NCHD sampling stations used in data compilation

Station ID (proj use only)	*Latitude deg*	*Latitude min*	*Longitude deg*	*Longitude min*	*USGS Quad: 2797-*	*NCHD Station name and comments*
CCB-NF	27	50.16	97	22.71	432	CC Beach - North (Timon St)
TWP	27	50.08	97	22.72	432	North Beach Tidal Wading Pool
CCNB-J	27	49.93	97	22.70	432	CC North Beach - Jetty
CCB	27	49.59	97	22.97	432	CC Beach - Central (Gulfspray St.)
CCB-SP	27	49.36	97	22.99	432	CC Beach - Central (Stewart St)
CCB-SF	27	49.02	97	23.35	432	CC Beach - South (Coastal St)
BWP	27	48.94	97	23.38	432	Breakwater Park
BP	27	48.94	97	23.38	432	ditto, alternate designation
McGB(P)	27	47.17	97	23.54	432	McGee Beach (Park St)
McGB(F)	27	47.02	97	23.59	432	McGee Beach (Furman St)
CPB	27	46.57	97	23.45	432	Cole Park Beach
CP-TP	27	46.53	97	23.41	432	Cole Park Tidal Pool
CP-W(O)	27	46.06	97	23.06	432	Cole Park - Windsurfing (Oleander St)
CP-SS	27	46.00	97	22.99	432	Cole Park S. Windsurfing (storm sewer outflow)
CP-W(K)	27	45.95	97	22.96	432	Cole Park - Windsurfing (Kush St)
RP-W	27	45.20	97	22.52	432	Ropes Park - Windsurfing (Ropes St)
KC-WS	27	38.48	97	14.95	413	Kennedy Causeway -Windsurfing South
CCSU-W	27	43.17	97	19.94	424	CCSU - Windsurfing (Joslin St)
CCSU-WN	27	43.07	97	19.69	424	CCSU - Windsurfing N
CCSU-WS	27	42.61	97	18.45	424	CCSU - Windsurfing S
KC-WN	27	39.33	97	15.68	424	Kennedy Causeway - Windsurfing North
KNICKERB	27	38.48	97	14.95		Knickerbocker = KC-WS
WHITELY	27	37.00	97	18.00		Whitely (position approximate)
WHITELYDR	27	37.00	97	18.00		Whitley Drive
CPN-W	27	46.57	97	23.45		Cole Park North - Windsurfing = CPB
CPS-W	27	46.06	97	23.06		Cole Park South - Windsurfing = CP-W(O)
McB(C)	27	47.17	97	23.54		McGee Beach (Coliseum) = McGB (P)
CCB-CF	27	49.36	97	22.99	432	Assumed same as CCB-SP
PDSB	27	50.16	97	22.71	432	Puerto del Sol Beach (trailer park), same as CCB-NF

(continued)

TABLE NCHD-1
(continued)

Station ID (proj use only)	*Latitude deg*	*Latitude min*	*Longitude deg*	*Longitude min*	*USGS Quad: 2797-*	*NCHD Station name and comments*
PDS-TP	27	50.08	97	22.72	432	Puerto del Sol Tidal Pool, same as TWP
KC-N	27	39.33	97	15.68	424	Kennedy Causeway North - assumed same as KC-WN
KC-S	27	38.48	97	14.95	413	Kennedy Causeway South - assumed same as KC-WS
NRP	27	53.76	97	37.74		Nueces River Park = TNRCC 12961
KC-T	27	38.48	97	14.95		Kennedy Causeway - Tank = KC-WS
KC-TPole	27	39.33	97	15.68		Kennedy Causeway - Telephone Pole = KC-WN
HWY 181-T	27	50.16	97	22.71		Highway 181 - Timon=CCB-NF
HWY181-T2	27	50.16	97	22.71		ditto
GB	27	49.59	97	22.97		Gulfbreeze = CCB
SB	27	50.16	97	22.71		Sandbar = CCB-NF
CP-Send	27	46.06	97	23.06		Cole Park South End = CP-W(O)
CP-Send2	27	46.06	97	23.06		ditto
McB	27	47.02	97	23.59		McGee Beach = McGB(F)
CP	27	46.53	97	23.41		Cole Park = CP-TP
CCB-J	27	49.93	97	22.70		CC Beach - near bathhouse, jetty area =CCNB-J
CCB-P	27	49.36	97	22.99		CC Beach - middle point near old pier = CCB-SP
CPSA	27	46.57	97	23.45		Cole Park Swimming Area =CPB
McB	27	47.02	97	23.59		McGee Beach = McGB(F)
"T"HB	27	47.50	97	23.20		"T" Head Basin (position approximate)
CCB	27	48.94	97	23.38		Corpus Christi Beach =BWP
NAS G	27	43.07	97	19.69		NAS North Gate = CCSU-WN
N.A.S.NG	27	43.07	97	19.69		alternate designation
OB	27	43.17	97	19.94		Oso Bridge = CCSU-W
CM	27	42.61	97	18.45		Canta Mar = CCSU-WS
SSO	27	45.20	97	22.52		Brawner Parkway = RP-W
FBC	27	45.95	97	22.96		First Baptist Church = CP-W(K)
HB	27	48.72	97	23.69		Harbor Bridge
BSO	27	48.76	97	24.65		Brdyw. Sew. Outlet

(continued)

TABLE NCHD-1
(continued)

Station ID (proj use only)	*Latitude deg*	*Latitude min*	*Longitude deg*	*Longitude min*	*USGS Quad: 2797-*	*NCHD Station name and comments*
SBD	27	48.87	97	25.11		Southwestern Barge Dock
CCS	27	49.02	97	25.44		Cable Crossing Sign = TNRCC 13429
OD #7	27	49.20	97	25.74		Oil Dock No. 7 = TNRCC13430
TLBI	27	49.07	97	27.26		Tule Lift Bridge Inlet
PGPT	27	48.96	97	27.71		Producer Grain Port Terminal
CD #3	27	49.01	97	28.18		Champlin Dock No. 3 (Valero)
ESC	27	49.56	97	29.52		End of Ship Channel=Tule Lake TB=TNRCC13437
McB#1	27	47.17	97	23.54	Guessed	McGee Beach #1
McB#4	27	47.02	97	23.59	Guessed	McGee Beach #4
C"L"H#1	27	47.40	97	23.50	Guessed	Cooper L-head #1
C"L"H#2	27	47.40	97	23.50	Guessed	Cooper L-head #2
C"L"H#3	27	47.40	97	23.50	Guessed	Cooper L-head #3
C"L"H#4	27	47.40	97	23.50	Guessed	Cooper L-head #4
LS"T"H#1	27	47.60	97	23.50	Guessed	Lawrence St. T-head #1
LS"T"H#2	27	47.60	97	23.50	Guessed	Lawrence St. T-head #2
LS"T"H#3	27	47.60	97	23.50	Guessed	Lawrence St. T-head #3
LS"T"H#4	27	47.60	97	23.50	Guessed	Lawrence St. T-head #4
PS"T"H#1	27	48.00	97	23.50	Guessed	People's St. T head #1
PS"T"H#2	27	48.00	97	23.50	Guessed	People's St. T head #2
PS"T"H#3	27	48.00	97	23.50	Guessed	People's St. T head #3
PS"T"H#4	27	48.00	97	23.50	Guessed	People's St. T head #4
NBSA	27	50.16	97	22.71	Guessed	North Beach Swimming area
PSO	27	48	97	23.5	Guessed	Power St. Outlet
BD	27	48.70	97	24	Guessed	Barge Dock
SEHB	27	48.60	97	23.69		South end Harbor Bridge
NEHB	27	48.80	97	23.69		North end Harbor Bridge

SOURCE DATA SET REPORT
Project code 26

DATA SET: Heavy metals in Inner Harbor sediments

FILE NAME: UTA-GEOL

SOURCE: Master's Thesis of Suter (1980), University of Texas at Austin, Geology Department

MEASUREMENTS: Sediment analyses for zinc, cadmium, lead and manganese. Grain-size analysis were also performed for one set of samples from Stations 5, 7, and 8, but only the corresponding data for Zn are reported.

PROCEDURES:

Surface samples obtained from hand-operated clamshell dredge, the sample being taken from the undisturbed center of the clamshell dredge and stored in acid-washed container. Cores were taken in 2-inch PVC tubes. All sampling performed by SCUBA divers to minimize disturbance of sample. Cores were subsampled to provide a depth profile of metals.

Emphasis on mud-dominated samples, to be indicative of Inner Harbor sediments. Any samples obviously dominated by sands or shells were rejected and the station re-sampled.

Analysis employed AA spectrophotometry. All samples were subjected to total concentration determinations. Two replicates were analyzed for each sample, and extraction employed hot HNO_3 leaching (see Agemian and Chau, 1976). Selected samples (all surface samples & some subsurface) were further subjected to successive selective extractions: adsorbed, oxidized, carbonate (physico-adsorption, ion-exchangeable), reducible, and residual (primarily detrital silicates).

QUALITY ASSURANCE: All samples subjected to replicate analyses. Estimated accuracies:

parameter	*working range*	*precision over range (%)*
Zn	1.2 - 2.4 ppm	±5 - 10
Mn	0.72 - 7.2 ppm	±5 - 10
Cd	0.004 - 0.20 ppm	±5
Pb	0.24 - 1.2 ppm	±5

In addition, particularly for Zn and Cd, the sample had to be greatly diluted to bring the concentration into the working range. With respect to the laboratory procedures *per se*, no formal QA/QC plan is reported or apparently exists.

DESCRIPTION & COMMENTS:

Sampling period extended from August 1978 through November 1979. Data collection periods are designated simply as "summer" and "winter", without further specificity. "During span of about a year, the stations were visited under both summer and winter conditions." Replicate samplings in the field were performed on a number of occasions during this sampling period, see Suter (1980) pp 32-34, so it appears that more than two sampling trips were involved.

Data were hand-keyboarded from tabular presentations in Suter (1980), primarily his Appendix 1. Because only one set of grain-size analyses were given (his Table 11), and the associated metal concentrations given only for Zn, without dates or even seasonal indications, and in view of the apparent heterogeneity of grain-size in the Inner Harbor, these data were not keyboarded.

The replicate sampling in the field consisted of repeated samples within about the length of the boat. While the raw data is not reported, Suter (1980) summarizes this as "dramatic" fluctuation, on the order of 300% for Zn at Station 5. Other reported variations range several tens of percents.

The vertical variability in metals concentration reflected in the cores is interpreted by Suter (1980) to be the result of episodic runoff events, an interpretation supported by his data on mineralogy and selective absorption analyses.

SAMPLING LOCATIONS:

Eight sampling stations occupied from entrance of Inner Harbor to Turning Basin. Locations are indicated on a very large-scale hand drawn map (Fig. 2 of Suter, 1980), therefore there is considerable uncertainty in their precise placement in the channel. These locations were estimated on USGS 7.5-minute quadrangles by assuming that they would have been placed at or near obvious landmarks (e.g. the drawbridge), and latitude/longitude determined, given in Table UTA-GEOL-1.

DISCUSSION: Contact with the author was not successful, so dates were assigned to these samples to be:

Winter:	1 February 1979
Summer	1 July 1979

As there is only one winter in the study period (August 1978 through November 1979), there is probably not too much error in the assigned winter date, certainly in view of the longer time frame of variability of sediment concentrations.

Table UTA-GEOL-1
Sampling stations in Inner Harbor

1	Just outside entrance to Inner Harbor	27	48.52	97	23.26
2	Near CP&L Nueces SES Intake	27	48.96	97	25.20
3	Avery Point Turning Basin	27	49.20	97	25.74
4	Drawbridge	27	49.13	97	27.24
5	Considered to be principal source of metals, ASARCO	27	48.99	97	27.93
6		27	49.32	97	29.00
7	Tule Lake Turning Basin, near primary drainage into Inner Harbor	27	49.56	97	29.52
8	Viola Turning Basin	27	50.58	97	31.20

However, it seems likely that samples were collected in both summer 1978 and summer 1979, so the assigned date is potentially as much as 11 months off. In our view, the value of the data to the overall compilation outweighs the potential effects of an erroneous sampling date.

REFERENCES:

Agemian, H. and A. Chau, 1976: Evaluation of extraction techniques for the determination of metals in aquatic sediments. *Analyst 101*, pp. 761-767.

Suter, John R., 1980: Concentration, distribution, and behavior of heavy metals in recent sediments, Corpus Christi Ship Channel Inner Harbor. Department of Geology, University of Texas at Austin.

SOURCE DATA SET REPORT
Project code 27

DATA SET: CONTAMINANTS ASSESSMENT OF THE CORPUS CHRISTI BAY COMPLEX

PROJECT ABBREVIATION: USFWS-CCB

SOURCE: U.S. Fish & Wildlife Service
Corpus Christi Ecological Services Field Office
Texas A&M University — Corpus Christi
Corpus Christi, Texas 78412

MEASUREMENTS:

A comprehensive suite of trace contaminants, including both metals and organics, in sediment and fish tissue, listed in Table FWS-1. (Other PAH's were analyzed but not listed in Table FWS-1, see DISCUSSION.)

Table FWS-1
Analytes for fish tissue and sediment samples

trace elements		*organochlorines*		*PAH's*
Sb	Cu	alpha-BHC	endrin	benz(a)anthracene
Hg	Fe	beta-BHC	mirex	napthalene
Se	Mg	delta-BHC	o,p-DDE	fluorene
As	Mn	gamm-BHC	op-DDD	phenanthrene
Ag	Mo	heptachlor epoxide	op-DDT	anthracene
Al	Ni	HCB	pp-DDE	fluoranthrene
B	Pb	total PCBs	pp-DDD	pyrene
Ba	Sr	alpha chlordane	pp-DDT	benzo(ghi)perylene
Be	Tl	gamma chlordane	Toxaphene	chrysene
Cd	V	oxy chlordane	Lindane	benzo(b)fluoranthene
Cr	Zn	trans nonachlor	Aldrin	benzo(k)fluoranthene
		cis nonachlor	oil & grease	benzo(e)pyrene
		dieldrin		benzo(a)pyrene
				1256-dibenzanthracene

PROCEDURES:

Stations were established on one-mile centers throughout Redfish Bay, Nueces Bay, Corpus Christi Bay, the Inner Harbor, Oso Bay, the Upper Laguna Madre, and Baffin Bay. The sites were "estimated" in the field by timing boat transects along a fixed magnetic heading, aided as necessary by triangulation on known landmarks. Nearly 300 stations were occupied in the period May-July 1988, at which sediment samples were taken by either Ekman or Ponar dredge, according to EPA (1992) procedures. Trace elements and oil & grease were determined for all of this samples. Fifty stations were selected from this group for extensive organics analyses.

In the following year, 37 sites distributed through the same area were sampled for biota, focusing on six species: hardhead catfish, toadfish, calico crab, blue crab eastern oyster and shoal grass. Organisms were carefully containered and kept on ice in the field then frozen prior to shipping to labs. Analyses were performed for a the same extensive suites of organics and trace elements, for the whole organism, except for oysters which were shucked and shoal grass for which only rhyzomes were analyzed.

All analyses were performed at commercial or academic laboratories using current analytical methodologies.

QUALITY ASSURANCE/QUALITY CONTROL:

While no formal QA/QC procedures are reported in the technical report (Barrera et al., 1995), analyses were performed by state-of-the-art laboratories, and it can be safely assumed that QA procedures met or exceeded EPA protocols.

DESCRIPTION & COMMENTS:

This project is one of several recent intensive field investigations carried out by this Field Office of U.S. Fish & Wildlife Service, and a comprehensive presentation is given in the Final Report for the project, Barrera et al. (1995). The report is remarkably complete. Only two interventions were required to merge this data with those from other programs. First, specific sampling dates were not given; only the three-month or four-month periods during which samples were collected are stated in the report. Therefore, for this compilation, we assumed a sampling date of the midpoint of the periods, i.e. 15 June 1988 for the sediment sampling, and 1 September 1989 for the biota. Sediment concentrations are not envisioned to change over short time scales, compared to concentrations in the water phase, so this is not thought to impose serious corruption of the data, especially for trend analyses carried out over time periods of many years. We note that the same kind of assumptions had to be made for other sediment data bases in this project, e.g. that of the Bureau of Economic Geology (Project Code 012). Similarly, the biological organisms act as integrators of contaminants over time periods long compared to the uncertainty in the precise date of sampling, so again no serious error is anticipated.

The second intervention is due to the fact that the analyses for organics in sediments are reported in ppm wet weight, rather than dry weight. Fortunately the fraction of water f in the sediment sample is given in the data (as percent water), so an equivalent dry weight concentration could be estimated by the relation:

$$\text{dry-weight concentration} = (\text{wet-weight concentration})/(1 - f)$$

The problem with this arises in converting the detection limits. In a laboratory setting, the data from replicates and blanks would be re-expressed as dry weight, and the detection limit re-computed. We do not, of course, have access to those data, and have to estimate the equivalent dry-weight detection limit from only the wet-weight DL's. A straightforward application of the same correction factor based upon f to the reported detection limit produces a scattering of values. We chose to assign a DL value to the data equal to the mean estimated DL rounded to the same significance as the original wet-weight DL. For example, for organochlorines and PAH's with a reported wet-weight detection limit of 0.01 μg/g, the dry-weight DL values estimated by the conversion above were determined to have a mean of 0.023 μg/g with a standard deviation of 0.016 μg/g, and a minimum value of 0.012 μg/g. In this case, the assigned dry-weight DL was 0.02 μg/g.

The reverse problem occurs with the tissue data, in that trace elements (mainly metals) are reported as dry weight. Again, since the fraction of water f in the tissue is given, we are able to convert by the relation:

$$\text{wet-weight concentration} = (\text{dry-weight concentration}) \bullet (1 - f)$$

An analogous conversion and rounding of the equivalent DL's was employed. This is also the only instance in the CCBNEP data base for tissue results that fractions of water are provided for various species. It is therefore worthwhile to tabulate these as independent data in their own right:

Table FWS-2
Average water content of organisms
(% whole body except meat-only for oyster)

Organism	*CCBNEP code*	*number of samples*	*H_2O (%) mean*	*st dev*
OYSTER	4	4	84.5	1.2
HH CATFISH	5	25	71.8	3.6
BLUE CRAB	10	33	71.9	5.8
TOAD FISH	11	1	77.1	-
CALICO CRAB	12	1	60.6	-
SEAGRASS	13	16	74.8	3.1

SAMPLING LOCATIONS:

Two independent networks of sampling stations were used for sediment and biology. The sediment stations were laid out in advance on approximately one-mile centers, while the biology stations were selected to represent different habitat types. The station locations are shown in the report as computer-plotted maps. No coordinates are given, so latitude/longitude coordinates were determined for all of the stations, as tabulated in Tables FWS-3 and FWS-4. The accuracy of these coordinates is probably overstated, however, because the actual field location technique was to orient the boat along a magnetic course direction and travel for the requisite time based upon the estimate of boat speed. (Of course, some of the stations were situated near identifiable landmarks. Nonetheless, it is unlikely the average position accuracy is better than 500 ft.

DISCUSSION:

This is a valuable data set. It is commendable that the Ecological Services Field Office made a concerted effort to preserve and disseminate the raw data, including a digitized version of the data, in spreadsheet format, in a diskette as part of the report. Perhaps illustrative of the pervasiveness of Murphy's famous law, as well as the malevolence of computers, these good intentions were frustrated by the apparent loss of about half of the aromatic hydrocarbons from the sediment analyses, which were simply absent from the spreadsheet, and *all* of the organic analyses for the tissue samples. It is noteworthy that the missing data records begin at pagebreak positions in the spreadsheet. Apparently, due to a bug in the software or an incorrect print-range specification, these data were simply not transferred to diskette. The computer used for the master data file has since been purged and there were no hard copies or digital backups retained. USF&WS advises that the only way to recover the lost data would be to go back to the raw lab sheets (which are in storage, and presumably recoverable) and completely re-keyboard them.

REFERENCES:

Barrera, T., L. Gamble, G. Jackson, T. Maurer, S. Robertson, and M. Lee, 1995: Contaminants assessment of the Corpus Christi Bay complex, Texas, 1988-89. Technical report, Ecological Services Field Office, USFWS, Corpus Christi, Texas.

Environmental Protection Agency, 1982: Handbook for sampling and sample preservation of water and wastewater. Report 600/4-82-029, EPA, Washington, D.C.

Table FWS-3
Sediment station coordinates in Corpus Christi Bay system

Sta No	*Longitude*		*Latitude*		*Sta No*	*Longitude*		*Latitude*	
	deg	*min*	*deg*	*min*		*deg*	*min*	*deg*	*min*
1	97	28.2	27	48.9	146	97	8.0	28	49.5
2	97	27.3	27	48.9	147	97	9.1	28	48.4
3	97	25.0	27	48.8	148	97	9.3	28	47.2
4	97	24.1	27	48.7	149	97	9.4	28	46.1
5	97	31.6	27	51.7	150	97	9.6	28	44.9
6	97	30.9	27	52.7	151	97	6.5	28	52.9
7	97	29.6	27	52.6	152	97	6.7	28	51.2
8	97	30.9	27	51.4	153	97	6.8	28	49.6
9	97	29.5	27	51.6	154	97	7.9	28	48.2
10	97	29.6	27	50.6	155	97	8.3	28	47.1
11	97	27.4	27	52.2	156	97	5.1	28	53.6
12	97	27.3	27	51.3	157	97	5.2	28	52.5
13	97	27.7	27	50.0	158	97	6.4	28	52.7
14	97	25.3	27	52.0	159	97	16.7	27	38.8
15	97	25.4	27	51.0	160	97	14.4	27	37.5
16	97	25.3	27	50.3	161	97	16.0	27	37.8
17	97	25.4	27	49.6	162	97	17.3	27	37.9
18	97	24.1	27	52.0	163	97	15.4	27	37.4
19	97	24.0	27	50.9	164	97	16.6	27	37.2
20	97	23.3	27	48.8	165	97	17.7	27	37.2
21	97	23.3	27	48.3	166	97	16.0	27	36.3
22	97	23.4	27	47.6	167	97	16.7	27	36.1
23	97	23.0	27	52.2	168	97	18.0	27	35.9
24	97	22.9	27	51.0	169	97	15.6	27	35.0
25	97	22.3	28	49.8	170	97	16.5	27	34.9
26	97	22.5	28	48.7	171	97	17.9	27	35.0
27	97	22.6	28	47.8	172	97	16.5	27	33.8
28	97	22.6	28	46.7	173	97	17.9	27	33.7
29	97	20.9	27	52.8	174	97	19.3	27	33.7
30	97	21.2	28	50.8	175	97	17.4	27	32.5
31	97	21.2	28	49.7	176	97	18.8	27	32.5
32	97	21.4	28	48.6	177	97	20.0	27	32.4
33	97	21.4	28	47.6	178	97	17.1	27	31.6
34	97	21.5	28	46.3	179	97	18.7	27	31.5
35	97	21.4	28	45.6	180	97	20.0	27	31.4
36	97	21.5	28	44.6	181	97	17.8	27	30.6
37	97	20.0	28	51.4	182	97	19.4	27	30.6
38	97	20.1	28	50.6	183	97	20.5	27	30.5
39	97	20.3	28	49.6	184	97	18.7	27	29.6
40	97	20.4	28	48.4	185	97	20.1	27	29.6
41	97	20.3	28	47.5	186	97	19.9	27	28.8
42	97	20.4	28	46.4	187	97	18.9	27	28.8
43	97	20.5	28	45.5	188	97	20.8	27	28.8
44	97	20.5	28	44.5	189	97	19.3	27	27.8
45	97	20.2	28	43.7	190	97	20.2	27	27.8

(continued)

Table FWS-3
(continued)

Sta No	*Longitude*		*Latitude*		*Sta No*	*Longitude*		*Latitude*	
	deg	*min*	*deg*	*min*		*deg*	*min*	*deg*	*min*
46	97	19.1	28	51.3	191	97	21.3	27	27.8
47	97	19.2	28	50.5	192	97	20.1	27	26.7
48	97	19.3	28	49.5	193	97	21.6	27	26.6
49	97	19.2	28	48.4	194	97	20.4	27	25.4
50	97	19.2	28	47.4	195	97	21.7	27	25.3
51	97	19.3	28	46.3	196	97	20.3	27	24.1
52	97	19.3	28	45.3	197	97	22.0	27	24.3
53	97	19.3	28	44.3	198	97	21.0	27	23.5
54	97	19.3	28	43.4	199	97	22.4	27	23.4
55	97	19.9	28	42.9	200	97	21.4	27	22.8
56	97	18.0	28	52.4	201	97	22.6	27	22.8
57	97	18.1	28	51.2	202	97	22.3	27	22.0
58	97	18.2	28	50.4	203	97	22.2	27	21.3
59	97	18.2	28	49.4	204	97	23.2	27	21.4
60	97	18.2	28	48.2	205	97	22.3	27	20.6
61	97	18.3	28	47.2	206	97	23.6	27	20.5
62	97	18.3	28	46.2	207	97	22.1	27	19.6
63	97	18.3	28	45.2	208	97	23.8	27	19.7
64	97	18.3	28	44.2	209	97	22.4	27	18.6
65	97	18.5	28	43.3	210	97	24.2	27	18.6
66	97	18.4	28	42.9	211	97	25.5	27	18.6
67	97	16.8	28	52.3	212	97	22.8	27	17.6
68	97	17.0	28	51.1	213	97	24.4	27	17.7
69	97	17.1	28	50.3	214	97	25.5	27	17.6
70	97	17.2	28	49.2	215	97	26.5	27	17.9
71	97	17.2	28	48.1	216	97	27.9	27	18.2
72	97	17.2	28	47.1	217	97	22.8	27	16.7
73	97	17.2	28	46.0	218	97	24.5	27	16.7
74	97	17.2	28	45.0	219	97	25.5	27	16.7
75	97	17.2	28	44.0	220	97	26.5	27	17.0
76	97	17.3	28	43.1	221	97	27.9	27	17.3
77	97	18.0	28	41.9	222	97	28.8	27	16.8
78	97	16.1	28	51.0	223	97	23.0	27	15.8
79	97	16.1	28	50.2	224	97	24.7	27	15.9
80	97	16.1	28	49.1	225	97	26.5	27	16.2
81	97	16.1	28	48.0	226	97	27.7	27	16.3
82	97	16.1	28	47.0	227	97	28.6	27	15.6
83	97	16.1	28	45.9	228	97	23.3	27	14.6
84	97	16.1	28	44.8	229	97	25.0	27	14.9
85	97	16.1	28	43.8	230	97	23.4	27	13.7
86	97	16.4	28	42.9	231	97	25.0	27	13.6
87	97	16.5	28	42.6	232	97	23.6	27	12.2
88	97	14.8	28	52.1	233	97	25.2	27	12.2
89	97	14.9	28	50.1	234	97	23.8	27	11.0
90	97	14.9	28	49.0	235	97	25.4	27	11.2
91	97	14.9	28	47.8	236	97	23.9	27	10.0
92	97	14.9	28	46.8	237	97	25.2	27	10.0

(continued)

Table FWS-3
(continued)

Sta No	Longitude		Latitude		Sta No	Longitude		Latitude	
	deg	min	deg	min		deg	min	deg	min
93	97	14.9	28	45.9	239	97	23.8	27	9.0
94	97	15.0	28	44.7	240	97	25.6	27	9.0
95	97	15.1	28	43.6	241	97	29.2	27	22.9
96	97	15.1	28	42.7	242	97	28.9	27	21.9
97	97	15.7	28	42.4	243	97	29.8	27	16.5
98	97	16.6	27	39.8	244	97	29.7	27	15.4
99	97	13.5	28	50.8	245	97	29.9	27	21.4
100	97	13.5	28	50.2	246	97	29.3	27	20.2
101	97	13.7	28	48.8	247	97	30.8	27	18.5
102	97	13.8	28	47.2	248	97	30.8	27	16.6
103	97	13.8	28	46.6	249	97	30.5	27	15.6
104	97	13.8	28	45.5	250	97	30.5	27	14.7
105	97	13.8	28	44.5	251	97	31.2	27	20.7
106	97	14.0	28	43.5	252	97	30.6	27	19.9
107	97	13.9	28	42.5	253	97	32.5	27	18.5
108	97	14.0	28	41.9	255	97	32.2	27	16.6
109	97	14.4	27	41.3	256	97	32.0	27	15.7
110	97	14.9	27	40.1	257	97	32.0	27	14.7
111	97	15.3	27	38.9	258	97	32.1	27	19.7
112	97	12.4	28	48.6	259	97	34.0	27	18.6
113	97	12.8	28	47.5	260	97	33.4	27	17.6
114	97	12.8	28	46.5	261	97	33.5	27	16.7
115	97	12.7	28	45.4	262	97	33.2	27	15.8
116	97	12.9	28	44.4	263	97	33.2	27	14.8
117	97	12.2	28	44.5	264	97	34.6	27	17.6
118	97	13.0	28	43.4	265	97	34.6	27	17.0
119	97	13.0	28	42.4	266	97	34.6	27	15.9
120	97	13.0	28	42.0	267	97	34.6	27	14.9
121	97	14.1	27	39.4	268	97	35.5	27	17.7
123	97	11.5	28	48.6	269	97	35.8	27	16.8
124	97	11.7	28	47.4	270	97	35.8	27	15.9
125	97	11.7	28	46.4	271	97	36.0	27	15.0
126	97	11.7	28	45.2	272	97	37.2	27	16.3
127	97	11.8	28	44.2	273	97	37.3	27	15.1
128	97	11.8	28	43.2	274	97	37.4	27	17.3
129	97	12.0	28	42.2	275	97	38.3	27	15.8
130	97	12.0	28	41.5	276	97	38.0	27	15.2
131	97	12.4	27	41.0	277	97	38.0	27	18.3
132	97	12.9	27	39.7	278	97	39.1	27	17.2
133	97	13.0	27	38.5	279	97	39.5	27	19.5
134	97	9.4	28	52.4	280	97	39.6	27	18.4
135	97	10.2	28	50.8	281	97	39.9	27	16.5
136	97	10.6	28	49.5	282	97	40.1	27	20.6
137	97	10.6	28	48.5	283	97	40.7	27	19.6

(continued)

Table FWS-3
(continued)

Sta No	*Longitude*		*Latitude*		*Sta No*	*Longitude*		*Latitude*	
	deg	*min*	*deg*	*min*		*deg*	*min*	*deg*	*min*
138	97	10.6	28	47.3	284	97	41.1	27	16.8
139	97	10.6	28	46.2	285	97	41.7	27	21.8
140	97	10.6	28	45.1	286	97	41.5	27	20.8
141	97	10.8	28	44.0	287	97	42.3	27	16.0
142	97	10.9	28	42.9	288	97	42.6	27	16.5
143	97	11.0	28	42.1	289	97	38.4	27	16.5
144	97	8.5	28	52.6	1000	97	32.4	27	51.2
145	97	7.9	28	50.6					

Table FWS-4
Biology sampling station coordinates in Corpus Christi Bay system

Sta No	*Longitude*		*Latitude*		*Sta No*	*Longitude*		*Latitude*	
	deg	*min*	*deg*	*min*		*deg*	*min*	*deg*	*min*
1	97	28.5	27	51.6	20	97	14.3	28	42.2
2	97	25.0	27	49.9	21	97	14.4	27	40.6
3	97	21.7	27	52.4	22	97	17.4	27	35.8
4	97	22.9	28	48.9	23	97	15.2	27	36.7
5	97	13.1	28	49.1	24	97	15.2	27	35.5
6	97	8.5	28	45.5	25	97	20.8	27	26.9
7	97	16.4	28	43.2	26	97	22.9	27	19.6
8	97	30.4	27	50.4	27	97	22.1	27	16.8
9	97	26.4	27	48.8	28	97	26.0	27	10.3
10	97	22.9	28	47.5	29	97	26.0	27	15.2
11	97	17.3	28	52.4	30	97	24.8	27	20.8
12	97	15.5	28	51.8	31	97	37.0	27	15.7
13	97	14.3	28	49.5	32	97	40.8	27	21.4
14	97	8.5	28	52.1	33	97	43.5	27	15.9
15	97	6.6	28	52.2	34	97	17.8	28	42.1
16	97	8.0	28	48.8	35	97	5.1	28	53.0
17	97	20.8	28	44.2	36	97	5.8	28	49.4
17	97	16.5	28	46.4	37	97	21.9	27	51.2
19	97	12.1	28	48.6	38	97	29.8	27	51.1

SOURCE DATA SET REPORT
Project Code 028

DATA SET: Texas Department of Health Tissue Analyses

PROJECT ABBREVIATION: TDHTIS

SOURCE: Division of Seafood Safety, Texas Department of Health

MEASUREMENTS:

metals
pesticides
hydrocarbons

All determinations are made on the edible portions of the organism.

DESCRIPTION:

The Seafood Safety (a.k.a. Shellfish Sanitation) Division at TDH monitors tissue concentrations of metals and organics along the Texas coast. This is a completely separate effort from the Coastal Monitoring program, and data management protocols are different.

The tissue data used in this compilation came from two sources: a data report (TDH, 1994?) issued by TDH tabulating tissue measurements from the state for the period 1980-93, and an internal memorandum (Villanacci, 1995) documenting metals analyses on fish and shellfish from Nueces Bay in 1994.

PROCEDURES:

Summary documentation of a general nature is provided by TDH (1995). Basically field personnel are given great latitude in how the organisms are to be taken, the only caution being that passive techniques (e.g. gill nets) should involve frequent checking to avoid sample deterioration. Detailed instructions are provided as to the method of filleting, packing and preservation of the sample.

QUALITY ASSURANCE/QUALITY CONTROL:

See discussion under Project Code 06 for information on laboratory procedures at TDH. Analysis for metals and organics follows EPA protocols.

SAMPLING LOCATIONS:

Whereas the water sampling activities are carried out on an established network of sampling stations, the locations from which organisms for tissue analysis are taken are specified only by the state land tract number. For the information from TDH (1994?), no additional location data was given. To assign latitude/longitude coordinates to this data therefore required some judgment. The state tract was located on a large-scale map of the area, and a location inside that area was assigned based upon the particular species. This was the centroid of the water area, except for oysters, in which case a location was based upon the centroid of the principal reef areas. Table TDHTIS-1 summarizes the sample ID's and station locations assigned. For the data from the internal memo (Villanacci, 1995), latitudes and longitudes for the sample stations are provided.

DISCUSSION:

The tissue data used in this compilation came from two sources: a data report (TDH, 1994?) issued by TDH tabulating tissue measurements from the state for the period 1980-93, and an internal memorandum (Villanacci, 1995) documenting metals analyses on fish and shellfish from Nueces Bay in 1994. While the information in the two source documents were keyboarded for publication format, the TDH was unable to provide any magnetic copies of this information to this project. It was therefore necessary for this project to manually keyboard all of this information for inclusion in the CCBNEP data base.

Generally, the five metals Cd, Cu, Hg, Pb and Zn are analyzed and all information reported, including the concentrations below detection limits. Occasionally, a sixth metal, As, will be included in the suite. For pesticides and hydrocarbons, however, only those measurements above detection limits are reported. Moreover, there is no indication given in TDH (1994?) as to the complete suite of analytes. According to TDH (1995) there are several alternatives to the suites of organics, apparently depending upon judgment of the analyst. TDL personnel report that there is means of reconstructing the complete suite of measurements carried out for the samples. Our approach therefore was to assume the minimum list of analytes, and assume the detection limits listed in Table TDHTIS-2. While this no doubt will exclude the fact that for many samples, analytes were determined to be nondetects, it has the advantage of not introducing spurious information into the data base.

Table TDHTIS-1
TDH Sampling Station coordinates
Corpus Christi Bay system

Station / sample ID	*date*	*latitude*			*longitude*		
ARA 114	820810	28	5	0	96	58	15
ARA 120-1	820210	28	5	0	97	1	15
ARA 121	820125	28	5	0	97	1	45
ARA 125-1	820810	28	4	15	97	0	45
ARA 138-1	840207	28	3	15	96	57	30
ARA 162-1	820810	28	1	30	96	58	45
ARA 206-1	840725	27	59	15	96	58	15
ARA 235-1	840725	27	57	30	96	59	0
ARA 240-1	840725	27	56	15	97	1	45
ARA 81-1	830317	28	6	45	97	0	45
ARA 93	820810	28	6	0	97	0	45
ARA 96-1	830608	28	6	0	96	59	15
BAF 1-1	840815	27	18	30	97	26	0
BAF 79-1	840817	27	20	30	97	40	15
COP 122	840627	28	3	15	97	9	0
COP 124	840627	28	3	15	97	8	15
COP 39	820125	28	7	30	97	1	45
COP 40-1	830217	28	7	30	97	2	15
COP 64-1	820802	28	6	45	97	6	15
COR 404-1	840709	27	46	15	97	7	45
LAG 193-1	800708	27	25	0	97	20	0
LAG 205-1	800708	27	19	45	97	23	45
LAG 223	800708	27	13	45	97	25	30
LAG 52-1	840706	27	39	0	97	14	0
LAG 57	840706	27	39	30	97	12	45
LAG 577	860430	26	23	45	97	19	0
LAG 599-1	870723	26	22	0	97	19	0
LAG 638-1	860430	26	18	30	97	19	45
LAG 744-1	810317	26	5	30	97	13	0
LAG 745-1	810317	26	5	30	97	12	0
LAG 746-1	840514	26	5	30	97	11	0
LAG 747-1	840808	26	5	30	97	10	15
LAG 749	810317	26	4	30	97	11	0
LAG 751-1	840822	26	3	30	97	11	0
MES 12-1	820810	28	10	15	96	51	45
MES 13-1	830621	28	9	30	96	51	45
MES 14-1	830621	28	8	30	96	51	45
MES 19-1	830621	28	9	30	96	50	45
MES 25-1	820810	28	9	30	96	49	45
NUE 708-1	830310	27	50	30	97	25	0
NUE 710-1	840712	27	50	30	97	24	15
NUE 723-1	800505	27	50	30	97	25	45
NUE 746	820923	27	50	30	97	27	15
NUE 788-1	801223	27	50	45	97	22	30

REFERENCES:

Texas Department of Health, 1994?: Fish tissue sampling data, 1980-1993. TDH, Austin, Texas.

Texas Department of Health, 1995: Seafood Safety Division Tissue Sampling Procedures. TDH, Austin, Texas.

Villanacci, J.F., 1995: Nueces Bay and Port of Corpus Christi Seafood Sampling Data. Inter-Office Memo to Kirk Wiles, TDH, Austin, Texas.

Table TSHTIS-2
Detection limits assumed for nonreported hydrocarbon parameters

parameter	*DL mg/kg wet* *EPA Method 8270*	*parameter*	*DL ug/kg wet* *EPA Method 8080*
TF-acen	<1	TF-abhc	<2
TF-acena	<1	TF-aldr	<2
TF-anthr	<1	TF-chlr	<10
TF-bnza	<1	TF-diel	<6
TF-bnze	<1	TF-ENDR	<6
TF-bnzb	<1	TF-HEPT	<2
TF-bnzk	<1	TF-hepx	<4
TF-bnzgp	<1	TF-MTHX	<30
TF-chrys	<1	TF-TOXA	<100
TF-dbane	<1	TF-HXCLB	<2
TF-flra	<1	TF-ENDO	<10
TF-flrn	<1	TF-abhc	<2
TF-hexa	<1	TF-lind	<2
TF-I123p	<1	TF-ddd	<10
TF-napt	<19	TF-DDE	<5
TF-phnan	<1	TF-DDT	<10
TF-pyrn	<1	TF-PCB	<20

SOURCE DATA SET REPORT
Project code 29

DATA SET: Pilot study of Corpus Christi Ship Channel and contiguous waters

PROJECT ABBREVIATION: TAMU-72

SOURCE: Hann et al. (1972)

MEASUREMENTS:

Water samples and *in situ* measurements:

salinity (conductivity)	dissolved oxygen
temperature	nitrate
orthophosphate	BOD5
COD	chlorophyll (mg/L)

light penetration (assumed to mean Secchi depth)
Metals: zinc, lead, copper, arsenic, chromium, mercury

Sediments:

volatile solids	COD
Kjeldhl-N	Oil & Grease

Metals: zinc, lead, arsenic, chromium, mercury

No statement is made as to whether the water samples were filtered. We assume they were not, and therefore the concentrations are "total" rather than "dissolved".

PROCEDURES:

Samples and measurements were performed from the *R/V Excellence*, except for the temperature data from Nueces Bay, whose shallowness prohibited use of the *Excellence*, so a small power boat was rented for the purpose. Therefore, the data were taken exclusively from ship channels and the deeper sections of the open bay.

Practically no information is provided on field and laboratory procedures. It seems safe to assume that measurements in the vertical were carried out by drawing a sample with some form of vertical sampler such as a Kemmerer. Sediment samples were probably obtained with some sort of dredge, such as the Ponar or Ekman.

Sampling periods (1972)

10-28 March	23-30 April	24 June - 17 July

QUALITY ASSURANCE/QUALITY CONTROL:

No formal QA/QC plan exists or is reported, and no information is available as to QA/QC practices.

DESCRIPTION & COMMENTS:

In 1972, under sponsorship of the Texas Water Quality Board, members of the TAMU Environmental Engineering Program, under the direction of Dr. Roy Hann, performed various water quality sampling activities in the Corpus Christi area. Sampling platform was the *R/V Excellence*, brought from its operation area in the Houston Ship Channel for this purpose. A variety of sampling activities were carried out, seemingly without planning or a broader data-collection strategy. *In situ* profiling, diurnal surveys, sediment collection, and water sampling were all performed at various stages in the program. The sampling activities and the data collected are presented in various forms in the final report Hann et al. (1972).

SAMPLING LOCATIONS:

Most of the sampling was concentrated in the deep channels, viz. the Corpus Christi Ship Channel traversing the open bay, the Inner Harbor channels, and the La Quinta Channel. Stations are referred to by mile points, but the zero reference is not given. We assume this to be the Harbor Bridge for the CCSC, and one mile east of the La Quinto junction for the LQSC. Apparently, a navigation or topographic map was to scale off distances in miles from these references, corresponding landmarks were located and used as a means of location. Unfortunately, the actual location references are not given, so while we can be certain the boat was in the channel, there is uncertainty about its longitudinal position. An example of the uncertainty is the case of the La Quinto channel. If the *logical* point of zero reference is adopted, namely the channel junction at FL 38, then scaling off miles up the channel puts the boat well beyond the turning basin in water that would have been too shallow to navigate safely. (One can't help but wonder if the mile scale employed was in error.) As best we could determine, the sampling stations are as given in Table TAMU-1.

DISCUSSION:

The value of this program lies in the age of the data, i.e. the early 1970's, representing some of the earliest work on metals in sediment and water in the Coastal Bend area. Unfortunately, the only data to have survived is that presented in the final report (Hann et al., 1973), in various vehicles of tables and figures. From the text, it is clear that many more analyses were carried out than are actually produced (the report being described as "preliminary"). During the Galveston Bay National Estuary Program Data Inventory Project, this writer contacted Dr. Hann to determine if any of the data from the old Estuarine Systems Project had survived. Dr. Hann and this writer spent a fun-filled day in the hot spring working through boxes in storage at the TAMU airfield warehouse. While some data sets from the Houston Ship Channel were found, none of the Corpus Christi data could be located. It is safe, therefore, to assume that the report for this project represents the only data available.

The presentation is a mess. Data are presented sometimes without dates of collection, or depth of sampling. Presentations range from tabular to graphical, and in a variety of formats. Data are shown for point measurements or for various vertical composites. All of the tables in the report were keyboarded for this data compilation. Some data were picked off of figures. We attempted to re-construct the sequence of sampling of each of the trips so as to estimate the dates of collections when they were missing. Even at this much had to be assumed. We note that the sediment volatile solids range 5-23%. Such very high values look unreliable. Though compiled into the data base, subsequent screening by range eliminated most from the statistical and trends analyses.

REFERENCES:

Hann, R, R. Withers, N. Burnett, R. Allison, B. Nolley, 1972: Pilot field and analytical studies of the Corpus Christi Ship Channel and contiguous waters. Final report to Texas Water Quality Board, Civil Engr. Dept., Texas A&M University, College Station.

Table TAMU-1
Station locations determined from figures and project maps

Station	Longitude Deg	Min	Latitude Deg	Min	Station	Longitude Deg	Min	Latitude Deg	Min
D4	97	24.60	27	48.78	LQ4.5	97	14.66	27	51.81
MO (CC0)	97	23.70	27	48.74	LQ5	97	14.85	27	52.21
S2	97	23.33	27	48.67	M5.5	97	28.61	27	49.14
S1	97	23.21	27	48.02	M6	97	29.02	27	49.33
S3	97	22.73	27	48.60	M6.5	97	29.43	27	49.55
S6	97	22.48	27	47.12	M7	97	29.77	27	49.83
S7	97	22.45	27	46.29	M0	97	23.69	27	48.72
S8	97	22.30	27	45.58	M0.5	97	24.18	27	48.76
S4	97	22.18	27	48.60	M1	97	24.65	27	48.76
S5	97	21.88	27	47.88	M1.5	97	25.11	27	48.87
S9	97	21.88	27	44.86	M2	97	25.55	27	49.05
CC2	97	21.70	27	48.60	M2.5	97	25.92	27	49.30
S10	97	21.27	27	44.32	M3	97	26.39	27	49.38
S11	97	20.54	27	43.81	M3.5	97	26.83	27	49.24
S12	97	19.79	27	43.45	M4	97	27.26	27	49.07
CC4	97	19.64	27	48.60	M4.5	97	27.71	27	48.96
D3	97	19.52	27	50.04	M5	97	28.18	27	49.01
S13	97	18.82	27	43.09	1K	97	27.00	27	49.93
S14	97	18.36	27	42.88	1J	97	26.82	27	49.92
D2	97	18.30	27	43.96	1I	97	26.64	27	49.92
CC6	97	17.58	27	48.60	1H	97	26.46	27	49.92
S15	97	17.12	27	42.59	1G	97	26.28	27	49.91
B62	97	16.97	27	48.60	1F	97	26.10	27	49.91
CC8	97	15.58	27	48.60	1E	97	25.92	27	49.91
S16	97	15.18	27	42.23	1D	97	25.75	27	49.85
S17	97	14.24	27	41.94	1C	97	25.62	27	49.73
CC10	97	13.64	27	48.60	1B	97	25.54	27	49.59
S18	97	13.33	27	41.76	1A	97	25.46	27	49.46
CC12	97	11.70	27	49.03	2A	97	25.31	27	49.44
CC14	97	9.79	27	49.42	2B	97	25.33	27	49.59
B19	97	8.78	27	49.57	2C	97	25.34	27	49.75
D1	97	8.67	27	48.09	2D	97	25.36	27	49.92
CC16	97	7.88	27	49.82	2E	97	25.37	27	50.07
CC18	97	5.91	27	50.22	2F	97	25.39	27	50.24
CC20	97	3.94	27	50.58	2G	97	25.40	27	50.40
B7	97	1.52	27	49.68	2H	97	25.42	27	50.55
M7.5	97	30.13	27	50.07	2I	97	25.43	27	50.71
M8	97	30.50	27	50.32	2J	97	25.44	27	50.88
M8.5	97	30.90	27	50.50	2K	97	25.46	27	51.02
LQ5.5	97	15.27	27	52.52	3A	97	25.15	27	49.40
LQ6	97	15.77	27	52.60	3B	97	25.08	27	49.54
LQ0	97	12.30	27	48.91	3C	97	25.01	27	49.69
LQ0.5	97	12.79	27	48.83	3D	97	24.93	27	49.83

(continued)

Table TAMU-1
(continued)

	Longitude		*Latitude*			*Longitude*		*Latitude*	
Station	*Deg*	*Min*	*Deg*	*Min*	*Station*	*Deg*	*Min*	*Deg*	*Min*
LQ1	97	13.22	27	49.09	3E	97	24.86	27	49.98
LQ1.5	97	13.48	27	49.45	3F	97	24.78	27	50.12
LQ2	97	13.68	27	49.84	3G	97	24.71	27	50.28
LQ2.5	97	13.88	27	50.24	3H	97	24.64	27	50.43
LQ3	97	14.06	27	50.64	3I	97	24.57	27	50.56
LQ3.5	97	14.26	27	51.03	3J	97	24.50	27	50.71
LQ4	97	14.45	27	51.43	3K	97	24.43	27	50.85

SOURCE DATA SET REPORT
Project code 30

DATA SET: Evaluation of Mitigation Project in Nueces Marsh

PROJECT ABBREVIATION: TAMUCC-CCS

SOURCE: Dr. Brien Nicolau
Center for Coastal Studies
Texas A&M University — Corpus Christi
Corpus Christi, TX 78412

MEASUREMENTS:

In situ measurements of:

salinity (conductivity)	dissolved oxygen
temperature	pH

using Hydrolab Surveyor 2 portable electrometric sensor.

PROCEDURES:

In association with monthly biological sampling, the above hydrographic measurements were carried out at a series of 4-6 stations in the vicinity of a mitigation project of the U.S. Corps of Engineers. Measurements were made at depths of 10-20 cm (20 cm assumed for data input purposes).

QUALITY ASSURANCE/QUALITY CONTROL:

No formal QA/QC plan exists or is reported. However, precision and accuracy data for the Hydrolab and associated probes are available from the manufacturer.

DESCRIPTION & COMMENTS:

Beginning in 1989, the Center for Coastal Studies began biological and hydrographic monitoring of a mitigation site under development by the U.S. Corps of Engineers. The strategy was to expand an oil-well channel in the southern region of the Nueces-Rincon Marsh, just north of the Nueces River, to achieve good circulation in the distributary channels, and to plant this area with several species, primarily smooth cordgrass (*Spartina alterniflora*). The success (or, more accurately, lack of success) in the plantings, as well as the colonization and utilization of the marsh by other species was determined from the monthly CCS samples, see Nicolau (1995).

SAMPLING LOCATIONS:

All of the sampling sites are located within the Nueces marsh area, either in or adjacent to the mitigation site. The sampling sites were chosen to be representative of either natural marsh or mitigation site conditions. Prior to September 1991, data were averaged and reported as either Natural Marsh (NM) or Mitigation Site (MS). The individual-station raw data have not survived, so in this compilation we assigned single locations labeled NM and MS in respectively the midpoint of the area sampled. As the sample stations were not more than about a kilometre apart, the position error introduced is not significant. After August 1991, all of the raw station data has been maintained by Dr. Nicolau and his staff. The positions of the various sample sites employed in this compilation are given in Table TAMU-CCS-1.

Table TAMU-CCS-1
Sampling station locations in Nueces Marsh

station ID	*latitude*		*longitude*	
NM	27	51.91	97	32.38
MS	27	51.64	97	32.38
2	27	51.67	97	32.57
3	27	51.67	97	32.2
4	27	52.04	97	32.7
5	27	51.73	97	32.13
6	27	51.84	97	32.79
7	27	51.98	97	32.82
8	27	51.84	97	32.79

REFERENCES:

Nicolau, B. A. , 1995: Estuarine faunal use in a mitigation project, Nueces River delta, Texas: Year-Five. Report TAMU-CC-9505-CCS to U.S. Corps of Engineers, Center for Coastal Studies, TAMU-CC, Corpus Christi, Texas.

5. MASTER DATA FILES

The principal product of this study is the compilation of a digital data base composed of water-quality and sediment-quality data from the 30 data collection programs listed in Table 4-1. As summarized in the preceding chapter, this compilation included data from the three most important ongoing monitoring programs in Corpus Christi Bay: the TNRCC SMN, the TPWD hydrographic observations from its Coastal Fisheries program, and the hydrographic and biochemical data of the TDH Division of Seafood Safety Program. The important surveys and research projects of the TWDB Coastal Data System are included. This compilation also entailed keyboarding of other major data sets, many of which exist in limited hardcopy and are virtually unobtainable, including the Southwest Research Institute surveys, the USCE O&M channel project surveys from the 1970's and 1980's, and the submerged lands project of the BEG. Other entries in this compilation include academic and agency research projects of limited distribution, some of whose data was available only in hardcopy and had to be keyboarded.

5.1 Source Files and Data Integration

The Source File, as defined in Chapter 3 above, codifies (in machine format) the original measurements as reported by the originating agency, in the original units. This data base therefore contains exactly the information in the original: nothing is lost or added. When the data from the source agency is already digitized, adaptation of the data file to the needs of this project may require re-formatting. This might include re-ordering of the variables, removing unneeded or redundant fields, or re-writing in a more compact format. For example, the TNRCC SMN data was completely re-formatted, in which it was stripped to a few variables in uniform ASCII format for further merging and processing. As another example, the USCE Galveston District has some of its more recent O&M data in a digital form. These were re-ordered and exported as ASCII files. We emphasize that these *source* files contain exactly the measurements in the original master file, in the original units: only their format of ordering/storage is altered. A Source File exists for each of the programs included in the compilation. For the larger data bases, e.g. the TNRCC SMN, this "Source File" may actually be several files containing various parameters. While all Source Files compiled in this project are available for dissemination, most users will prefer to acquire data from centralized, maintained data bases, such as the TNRCC SMN or the TWDB Coastal Data System, directly from that agency. Generally, the distribution formats of these agencies are designed to support a variety of uses, and the information may be more complete.

5.2 Master Files for Parameters

In this project the separate Source Files of data from the various programs were combined and merged to synthesize a comprehensive derivative data base for each parameter, the Master Derivative Files. These Master Files are considered to be one of the chief products of this project. All told, the digital compilation is the most extensive and detailed long-term record of water quality ever assembled for the Coastal Bend Bays. Details on the data sets of these individual programs are given in Section 4 above, along with any problems encountered in the data and how those problems were resolved (or reconciled). Particular note should be made of the programs which were keyboarded into a digital format for this project. This digital data set is capable of much more analysis than it was subjected to in the present project (Ward and Armstrong, 1997), and we anticipate that many researchers will make use of one or more of the Master Files.

The creation of the Master Data Files is fundamentally a matter of merging information from various Source Files and re-formatting the product. The various steps in this procedure were summarized in Chapter 3. In the data compilation process, the sampling station latitude/longitude coordinates are collected in a separate file, and accessed according to the agency station designations to merge the coordinates with the data taken at that station. At this stage of the processing, all units conversions are applied, as well as any proxy relationships by which one parameter may be transformed into another. Because we anticipate analyzing data on a time scale of days to weeks, the information on clock time (i.e., time of day) of each sample is not carried through to the Master Data Files, but the full calendar date is retained. In addition to the parameter value itself, the uncertainty is estimated and included in the data record. All of the data records are ordered chronologically, to facilitate time-series analysis.

For each of the water, sediment and tissue parameters of Tables 2-2 and 2-3, there is a separate Master File. Therefore, unlike the Source Files which contain measurements of several parameters for a specific project, the Master File contains data for a *single* parameter for all programs in the Corpus Christi Bay system that measured that parameter. All Master Files have the same format. Each record of the Master Data File represents a point in time (to resolution of a day) and space (horizontal and vertical position), together with the measurement and its uncertainty.

The format of each record in the Master Data Files for water and sediment is:

DATE LAT LONG DEP MSMT UNCRTY PRJ

Fields:

DATE	cols 1-6
LAT	cols 8-13
LONG	cols 15-20
DEP	cols 22-25
MSMT	cols 27-35
UNCRTY	cols 37-44
PRJ	cols 46-48

DATE, LAT and LONG are 6-digit fields, the date coded as YRMODA and the latitude/longitude coordinates are DDMMSS for degrees/minutes/ seconds. DEP is the sample depth in meters, MSMT is the measured value of the parameter (retaining four significant figures) in exponential format, UNCRTY is the uncertainty as a standard deviation following the convention of Section 3.2 above (to three significant digits in exponential format). Finally, PRJ is a 3-digit integer flag that identifies the agency or project that was the source of the measurement (see Table 4-1). Each record requires 50 bytes of storage. Two additional coding conventions are employed for DEP and MSMT. Since DEP is nonnegative, two negative values are used to signify special depth sampling:

-1 missing value (i.e., no sample depth reported)
-2 vertical average

Also, since most concentration variables are likewise nonnegative, we use negative values of MSMT to signify that the measurement is below detection limits, where the detection limit is the absolute value of MSMT. For example, an entry of

MSMT = -5.000E-02

indicates that concentration to have been below the detection limit of 0.05 . Of course, WQDODEF (the dissolved oxygen deficit) and WQTEMP can take on negative values, so this convention is not used for these variables.

The same basic data-record format for tissue data was the same as for water and sediment data. That is, each data entry represents a point in time (to resolution of a day) and space (horizontal position), together with the measurement of parameter concentration, in a 50-byte record. The format of each record in the Derivative Data Files for tissue analysis is:

DATE LAT LONG ORG MSMT UNCRTY PRJ

The place for measurement uncertainty UNCRTY is held in the record, to be consistent with the water/sediment data format, but separate establishment of appropriate uncertainties for the parameters in the tissue data set was beyond the scope of this effort. The salient difference between the tissue data records and those of the water/sediment data is that the depth field is replaced by ORG, an "organism field." Clearly, the depth from which an organism is captured is totally meaningless as any sort of explanatory or analytical variable (even if it were reported, which it is not). Therefore, this field is used to contain a code uniquely identifying the organism.

Organisms were identified by a two-digit code, presented in Table 5-1. It should be noted that some sampling agencies reported only a "common" name, without speciation. When we were confident of the species (e.g., blue crab or pink shrimp), the specific name was supplied, even if the sampling agency did not. In some cases, such as code 02 or 21, we have no idea.

A number of anomalies were encountered in the management of tissue data. While these are noted in the preceding data source reports, it is useful to summarize these here to give some indication of the effort necessary to put this data in a usable form. Probably, the two most important sources for tissue data were the TNRCC Statewide Monitoring Network and the Texas Department of Health, since both of these agencies have collected this sort of data for a number of years in the system. Other data sources included the OXYCHEM project in and around the La Quinta Channel, the Corps of Engineers, the NOS Status & Trends and Mussel Watch projects, and the EPA EMAP/REMAP project. Both of the last two federal projects maintain their tissue data in files in a completely different format than the water/sediment data, requiring separate retrievals and *ad hoc* decoding and processing routines. Both the Corps and the OXYCHEM project had information in hardcopy only, that required manual keyboarding.

The entirety of the available tissue data from the TDH has been compiled into a hardcopy report. Despite the fact that this entailed a substantial keyboarding effort, there is no magnetic version of this data base. Therefore, this project had to manually keyboard the information from the hardcopy report. Location of the organism collection site is given by state tract number. Each of these had to be individually identified and located on a map. A probable collection site, for which latitude/longitude were determined, was then assigned as the centroid of open water for fish and shrimp organisms, or the centroid of major reefs in the tract for oysters. Another problem encountered was the fact that only organic compounds above detection limits were reported in the TDH data. From the public-health viewpoint, this is appropriate. For the purposes of a status & trends analysis, however, the nondetects are of equal importance and need to be included in the data base. Unfortunately, several different suites of compounds are analyzed by TDH, and no records could be provided as to which were applied to a given sample. We finally elected to assume the minimum suite of analytes for all such analyses (see Project Code 028 above).

For the TNRCC tissue data, the greatest impediment to compiling the data is that no organism information is included in the TNRCC computer data base. That is, the date, station, analytes and measured concentrations for a tissue analysis are input into the system and could be retrieved for the present data compilation. But the species was not identified. Ultimately, this information had to be individually determined by looking up the tag data for each tissue sample and manually entering the organism data into our data base. Even with this effort, for a

Table 5-1
CODES FOR TISSUE ORGANISMS

Code	Common name	Specific name
00	unknown	no information provided
01	southern flounder	*Paralichthys lethostigma*
02	fin perch	unknown
03	speckled trout	
04	American oyster	*Crassostrea virginica*
05	hardhead catfish	*Arius felis*
06	gafftopsail catfish	*Bagre marinus*
07	Atlantic croaker	*Micropogonias undulatus*
08	brown shrimp	*Penaeus aztecus*
09	penaeid shrimp (undiff.)	*Penaeus spp.*
10	blue crab	*Callinectes sapidus*
11	toadfish	*Opsanus beta*
12	calico crab	*Eriphia gonagra*
13	shoalgrass	*Halodule wrightii*
14	sheepshead	*Archosargus probatocephalus*
15	black drum	*Pogonias cromis*
16	red drum (redfish)	*Sciaenops ocellatus*
17	clam	*Mercenaria*
18	menhaden	*Brevoortia patronus*
19	whiting	
20	white shrimp	*Penaeus setiferus*
21	sea catfish	
22	ladyfish	
23	alligator gar	
24	carp	*Cyprinus carpio*
25	pinfish	*Lagodon rhombiodes*
26	tarpon	*Megalops atlantica*
27	spot croaker (spot)	*Leistomus xanthurus*
28	mullet	*Mugil spp.*
29	stone crab	
30	Spanish mackerel	
31	pigfish	
32	longnose killifish	*Fundulus similis*
33	perch	unknown
34	spotted seatrout	*Cynoscion nebulosus*

significant proportion of the SMN tissue data the organism could not be identified. This information was retained in the present data base, though little use could be made of it in this analysis. This is the reason for the code 00 in Table 5-1.

5.3 Suggestions to the User

Throughout the process of data compilation, digitization and interleaving, leading to the creation of the Master Parameter Files, there were numerous error traps and cross-checks, not only to ensure that the data is not corrupted by a bug in the processing but also to detect entry errors or aberrancies in the data as reported by the agency. As discussed in Chapter 3, there remain anomalous measurements in the file representing the data entry of the originating agency. Some of these are discussed in the separate Data Set Reports of Chapter 4. The Master File can (and should) be subjected to additional screenings and data rejection, according to the preferences of the researcher.

It has become traditional in data processing to differentiate between values that are so extreme as to be rejected as "unlikely" (including "impossible") and those that are "unusual" but within the realm of possibility. This is the approach recommended by Tetra Tech (1987) who provide "A" and "B" values for an extensive list of estuarine variables, corresponding respectively to "unusual" and "unlikely." We believe that any such rejection trigger should be applied during application of the Master Files prior to a specific analysis, not to the source data (except, of course, for the "patently obvious" category described earlier) nor in the compilation of the Master Files. Therefore, as a matter of personal philosophy, we reject very little data in the formulation of the Master Files, and prefer to reserve data screening for the specific analyses to which the Master Data Bases are subject. (Data were rejected if the date, position, or depth were obviously impossible and there were no satisfactory means of judging the correct value. These data points are, of course, retained in the Source Files.)

For purposes of the analyses reported in Ward and Armstrong (1997), rejection triggers were assigned to many (not all) of the variables based upon the suggestions of Tetra Tech (1987) or on judgement of the PI's. The user may wish to consult these as guidance for her own application. These are given in Tables A-1 and A-2 of the Appendix of the final report (Ward and Armstrong, 1997). The rejection triggers were assigned as a combination of Tetra Tech (1987) and judgement calls by the PI's. (We note that many of the values in the Tetra Tech report are inapplicable to the Coastal Bend Bays because they are either patently obvious, e.g., no concentration greater than 100%, or inappropriate, e.g. a temperature limit of 30°C.) Both the uncertainty and the rejection triggers are provided more as guidance to the future users of these data sets than as absolute bounds on data inclusion, and reflect as much our judgement of the quality of the different data programs as statistical constructs.

Data rejection can be performed based upon either the level of uncertainty of the measurement or its magnitude relative to the rejection trigger (when one is provided). Each measurement in the Master Data Base is accompanied by the specified level of confidence, transformed into units of the variable and scaled (when appropriate) to the magnitude of the measurement. Thereafter, any data processing can be preceded by an assignment of acceptable accuracy of measurement; any measurements failing this level would be excluded from that analysis. But these measurements would still be retained in the data base. We believe this to be a superior approach to merely deleting data, especially older data, by a sharply defined criterion of "reliability". This is closely related to the notion of preservation of data integrity discussed above.

The user will probably be interested in a specific region of the Corpus Christi Bay system, in which case the Master File should be screened for those stations lying within the latitude/longitude boundaries of the area of interest. The user may want to consult the project report (Ward and Armstrong, 1997) in which segmentation in general is discussed. Such segmentation formed the basis for the analyses of this project. Spatial aggregation of the data was accomplished by two separate segmentation systems for the Corpus Christi Bay system, the present TNRCC Water Quality Segmentation of 20 segments (including 3 freshwater segments), and a system of 178 hydrographic segments (including 18 in the nearshore Gulf of Mexico) devised by this project and designed to depict the effects of morphology and hydrography on water properties. Each system was codified by a network of nonoverlapping quadrilaterals by which the data records could be sorted using latitude/longitude coordinates of sampling stations. One or more of these segments may help the user anticipate the available data for the region of her interest, or may even prove to be sufficiently representative that they can be employed directly.

Sampling intensity in the Corpus Christi Bay system is highly heterogeneous in space, some regions having been subjected to relatively frequent sampling, and some rarely sampled. There is a particular bias, as might be expected, for the main channels and for those areas with historical pollution problems. Reference is made to Figures 2-7 *et seq.* of Ward and Armstrong (1997), which display graphically the sampling intensity throughout the bay for the more important of the water and sediment parameters. The amount of data available is strongly dependent upon the parameter. What might appear to be a large number of historical samples for a given parameter on a baywide basis frequently proves to be quite modest—even inadequate—when related to specific regions of the system.

The treatment of detection limits in analysis of water quality is particularly vexing. There are three logical alternatives, each of which has a rational basis. First, the measurements BDL can be simply ignored, as providing essentially no quantitative information. Second, the BDL values can be replaced with zero in the analyses, on the argument that for practical purposes the parameter is not present. This is probably the most commonly elected alternative. It is, for example, the approach adopted by the National Ocean Service in its National Status & Trends Program (NOS, 1991). Third, the BDL values can be taken to be the reported detection limits, on the basis that the actual concentration could be as high as the detection limit. The statistical techniques of "censored-data analysis" represent an intermediate course between the last two.

In our view, the selection is dependent upon the purpose at hand. The non-BDL statistics can provide some insight into the precision and variability of the parameter, which the more constant DL values would corrupt or even mask. However, to completely ignore BDL results is to lose information, albeit non-quantitative. The fact is that a water or sediment sample was obtained (usually at great effort), a careful analysis performed, and an upper bound established on the concentration of the parameter. This information should not be dismissed cavalierly. The latter two alternatives use that information, either optimistically or pessimistically, depending upon the intent of the analyst.

In the analyses of this project, reported in Ward and Armstrong (1997), we decided to employ all three, i.e. to compute *appropriate* statistics with only above-DL data, with the BDL values set to zero and with the BDL values set to the DL, thereby establishing a probable *range* of the statistic. The "appropriate" statistics include averages and variability for the above-DL data, but do not include calculations of variability for the latter two, since the largely invariant values of either end of the range (i.e. either value assumed for a BDL measurement) would distort the results. Even in a trends analysis (which is variability in time), to incorporate 0 or DL values might either mask any vestige of a real trend by padding the data with zeroes or displace the real trend with a trend of measurement sensitivity.

REFERENCES

American Public Health Association, 1985: *Standard Methods for the Examination of Water and Wastewater, 16th Ed.* APHA, Washington, D.C.

Fishman, M. J. and L.C. Friedman, 1989: Methods for the determination of inorganic substances in water and fluvial sediments. *Techniques of Water-Resources Investigations of the United States Geological Survey*, Book 5, Chapter A1, USGS, Alexandria, VA.

National Ocean Service, 1991: Second summary of data on chemical concentrations in sediments from the National Status and Trends Program. NOAA Tech. Memo. NOS OMA 59, NOS/NOAA, Rockville, Maryland.

Tetra Tech, Inc., 1987: Historical data quality review for the U.S. EPA National Estuary Program. Final Report, Contract 68-03-3319, Tetra Tech, Inc., Duxbury, MA.

UNESCO, 1981: *Tenth Report of the Joint Panel on Oceanographic Tables and Standards.* Tech. Papers Mar. Sci. 36, Geneva.

U.S. Naval Hydrographic Office, 1956: Tables for rapid computation of density and electrical conductivity of sea water. SP-11, U.S. Navy, Washington, D.C.

Ward, G. and N. Armstrong, 1997: *Current status and historical trends of ambient water, sediment, fish and shellfish tissue quality in the Corpus Christi Bay National Estuary Program study area.* Report CCBNEP-13, Coastal Bend Bays Estuary Program, Texas Natural Resource Conservation Commission, Austin.

Ward, G. and N. Armstrong, 1992: *Extended Technical Report: Ambient water and sediment quality of Galveston Bay: Present status and historical trends.* Report to Galveston Bay National Estuary Program, Center for Research in Water Resources, University of Texas at Austin.

Wershaw, R., M. Fishman, et al. 1987: Methods for the determination of organic substances in water and fluvial sediments. *Techniques of Water-Resources Investigations of the United States Geological Survey*, Book 5, Chapter A1, USGS, Alexandria, VA.