Report No.: 8003-462
Rev. No.: 2

FINAL
HAZARD RANKING SYSTEM EVALUATION
LCP CHEMICALS, INC.
LINDEN TOWNSHIP, UNION COUNTY, NEW JERSEY
PREPARED UNDER

WORK ASSIGNMENT NO. 038-2JZZ
CONTRACT NO. 68-W9-0051

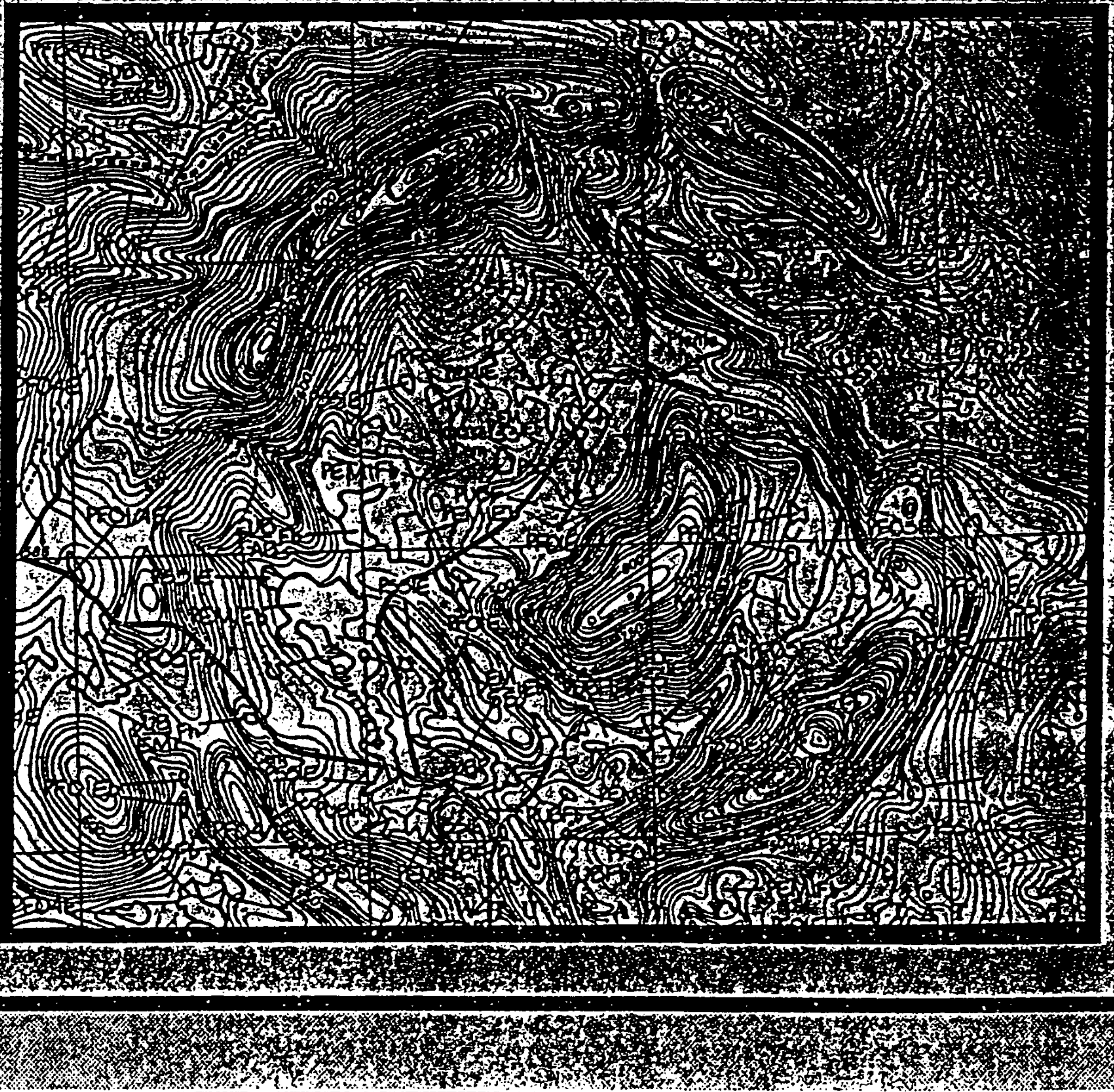
FEBRUARY 1997

VOLUME 3 OF 4

REFERENCE NUMBER 9

NWI MAPS
MADE EASY

A User's Guide to National Wetlands Inventory Maps of the Northeast Region



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NWI MAPS MADE EASY

A User's Guide to National Wetlands Inventory Maps of the Northeast Region

by

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Fish and Wildlife Enhancement
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November 1991

Additional copies may be ordered from:

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Newton Corner, MA 02158

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Introduction

The purpose of this document is to explain how to read and interpret information from a National Wetlands Inventory map. By following the "decoding" procedure examples, the user will learn to quickly decipher the wetland classification code. The user will be given definitions of specific terms, and examples of wetland types are presented in the accompanying tables. This User's Guide also clarifies some of the seemingly complex wetland terminology and provides a quick reference table to general wetland types.

National Wetlands Inventory

The U.S. Fish & Wildlife Service's National Wetlands Inventory Project (NWI) was established in 1974 to produce information on the characteristics, locations and extent of wetlands and deepwater habitats on a nationwide basis. The two main types of information produced are wetland maps and status and trends reports. The maps are used for local and regional site-specific planning and management purposes, while the status and trends reports provide information on the type, amount, location and causes of wetland changes on a regional and national scale.

Classification System

In order to provide national consistency of wetland concepts, terminology and classification for its National Wetlands Inventory Project, the U.S. Fish and Wildlife Service developed a new classification system, Classification of Wetlands and Deepwater Habitats of the United States. The classification system was developed in 1979, and takes a hierarchical approach to classifying different wetland types. It first describes wetlands broadly by five *systems*: Marine, Estuarine, Riverine, Lacustrine, and Palustrine. The term *system* is defined as "...a complex of wetlands and deepwater habitats that share the influence of similar hydrologic, geomorphologic, chemical, or biological factors" (Table 1). Each system (with the exception of the Palustrine System) is divided into *subsystems* based on major hydrologic characteristics (Table 2). Subsystems are subdivided into *classes*, describing the general vegetative types or substrate types (Table 3). The classes are then divided into *subclasses* which describe specific vegetative and substrate types. Additional "modifiers" describing hydrologic and soil properties, water chemistry, or physical modifications of the wetland, are commonly used following the class or subclass level designation (Tables 4, 5 ,6 and 7).

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The National Wetlands Inventory (NWI) Map

The main product of the National Wetlands Inventory is the large-scale NWI map. These maps show approximate boundaries and wetland classifications on a 1:24,000 scale* U.S. Geological Survey topographic base map (Figure 1). Actual wetland classifications are abbreviated on the map as alpha-numeric codes. These map codes can be translated using the map legend located in this guide and at the bottom of each NWI map.

The classification system, its terminology, and alpha-numeric map codes may seem overwhelming at first, but the user does not need a thorough understanding of the classification system to use the maps. The following section shows how quick and easy it is to translate any map code into a meaningful description of a particular wetland type.

Most maps are produced at the 1:24,000 scale, however, some maps are only available at the 1:25,000 or 1:62,500 scale.

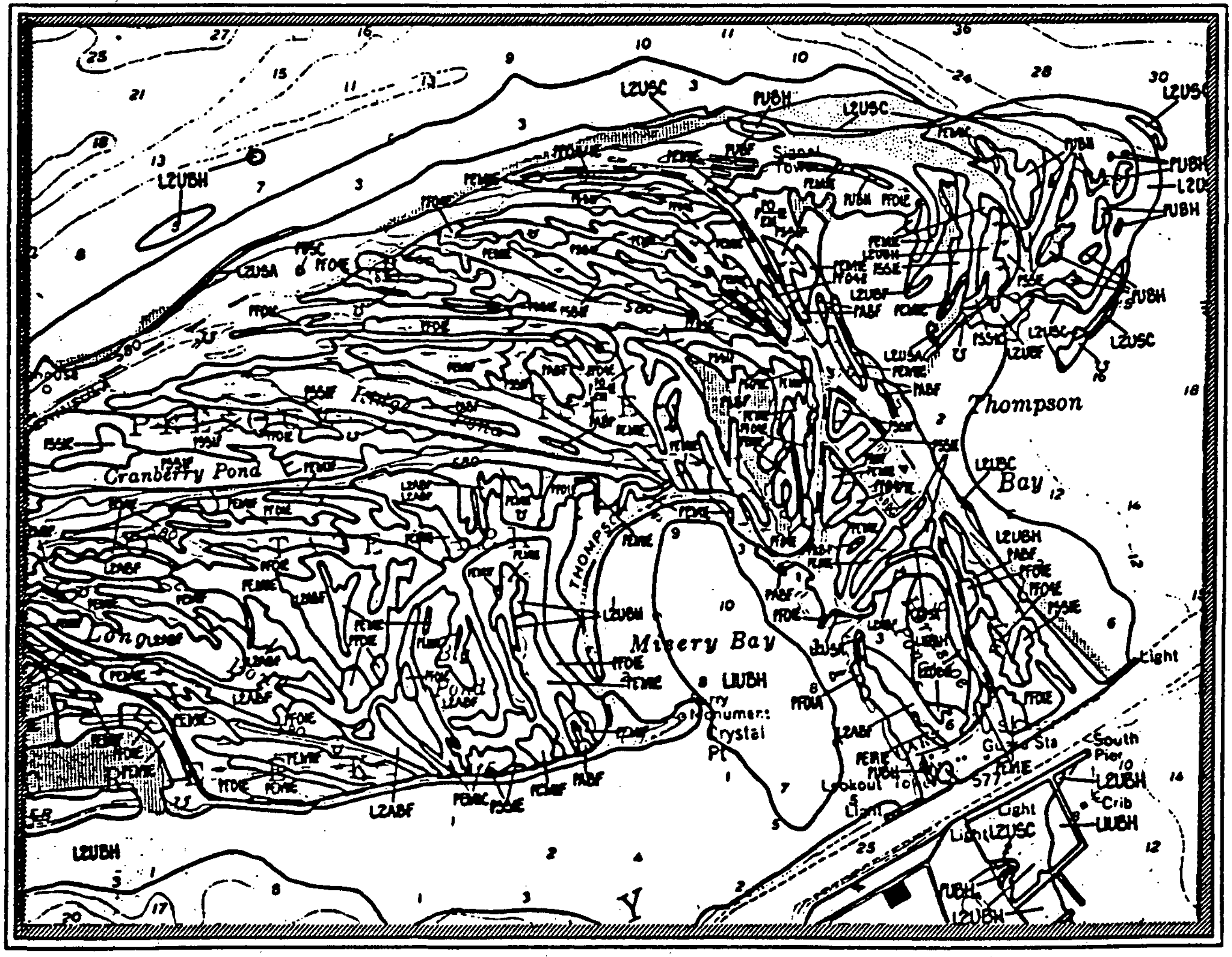

Figure 1. Section of NWI map - Presque Isle Peninsula - Erie North Quadrangle, Pennslyvania

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How To Interpret the Map Codes

Each map code consists of an ordered series of letters and numbers (alpha-numeric) that reflect certain characteristics of wetlands and deepwater habitats. While the number of characters in each map code may vary from three to ten symbols depending on the date of the map production, most codes will have from five to seven characters. All maps will have at least three characters for the system, subsystem and class. All map codes are identified <u>under the appropriate system in the map legend</u> at the bottom of each map. The most commonly used codes will be described in the tables of this guide.

Since Palustrine (inland freshwater) and Estuarine (coastal salt and brackish) wetlands are the most common types of wetlands on the maps, they will be used as examples.

Example #1: E2EM1P6

Step 1. *The first character is an <u>upper case letter</u> representing which SYSTEM the wetland belongs to.*

E = the ESTUARINE SYSTEM (salt and brackish tidal wetland)

(Refer to Table 1 for descriptions of SYSTEMS.)

Step 2. *The second character is a <u>number</u>, (except in the Palustrine System - no Subsystems) which represents the SUBSYSTEM.*

2 = the INTERTIDAL SUBSYSTEM (periodically flooded by tides).

(Refer to Table 2 for descriptions of SUBSYSTEMS.)

Step 3. *The third character is a <u>set of two upper case letters</u> representing the CLASS.*

EM = the EMERGENT CLASS (non-woody vegetation)

(Refer to Table 3 for descriptions of CLASSES.)

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Step 4. *The next character is a number representing the SUBCLASS.*

$\boxed{1}$ = the PERSISTENT EMERGENT SUBCLASS
(vegetation remains throughout the year)

(Note: To determine SUBCLASS, you *must* refer to the legend under the appropriate CLASS to find the proper subclass, i.e., SUBCLASS codes are ***not*** interchangeable between CLASSES.)

(The SUBCLASSES are generally self explanatory; refer to map legend.)

Step 5. *The next character is an upper case letter representing the WATER REGIME MODIFIER.*

$\boxed{P}$ = the IRREGULARLY FLOODED, TIDAL WATER REGIME (flooded less than once daily)

(Refer to Tables 4, 5 and 6 for descriptions of WATER REGIMES.)

Step 6. *Following the WATER REGIME MODIFIER, there may be additional numbers or lower case letters identifying WATER CHEMISTRY or SPECIAL MODIFIERS.*

$\boxed{6}$ = the OLIGOHALINE WATER CHEMISTRY MODIFIER
(salinity between 0.5 and 5.0 ppt)

(Refer to Table 7 for descriptions of commonly used additional MODIFIERS.)

There is no limit to how many additional modifiers may be used to describe a wetland. Generally, however, there will be only one modifier following the WATER REGIME MODIFIER.

Solution: **E2EM1P6** means **ESTUARINE, INTERTIDAL, PERSISTENT EMERGENT WETLAND, IRREGULARLY FLOODED, OLIGOHALINE**
(common name = slightly brackish marsh).

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Example #2: PFO1Cb

Step 1. *The first character is an upper case letter representing which SYSTEM the wetland belongs to.*

P = the PALUSTRINE SYSTEM (freshwater wetland)

(Refer to Table 1 for descriptions of SYSTEMS.)

Remember, there are no SUBSYSTEMS in the Palustrine System. Proceed to Step 2 to determine the CLASS.

Step 2. *The second character in a Palustrine wetland classification, is a set of two upper case letters representing the CLASS.*

FO = the FORESTED CLASS (tree-dominated)

(Refer to Table 3 for description of CLASS.)

Step 3. *The next character is a number representing the SUBCLASS.*

1 = the BROADLEAF DECIDUOUS SUBCLASS (hardwoods that drop their leaves annually)

(Note: To determine subclass, you *must* refer to the legend under the appropriate CLASS to find the proper subclass, i.e., subclass codes are *not* interchangeable between classes.)

(The SUBCLASSES are generally self explanatory; refer to map legend.)

Step 4. *The next character is an upper case letter which represents the WATER REGIME MODIFIER.*

C = the NONTIDAL SEASONALLY FLOODED WATER REGIME (flooded for two weeks or more during the growing season) Ref. No. 9, p. 7 of 16

(Refer to Tables 4, 5 and 6 for descriptions of WATER REGIMES.)

Step 5. *Following the WATER REGIME MODIFIER, there may be additional numbers or lower case letters identifying WATER CHEMISTRY or SPECIAL MODIFIERS.*

b = the BEAVER SPECIAL MODIFIER (created by or modified by beaver activity)

(Refer to Table 7 for descriptions of commonly used additional modifiers.)

Solution: **PFO1Cb** means: **PALUSTRINE, FORESTED WETLAND, BROADLEAF DECIDUOUS, SEASONALLY FLOODED, BEAVER MODIFIED** (common name - wooded swamp).

Review of Examples #1 and # 2:

MAP CODE	SYSTEM	SUB-SYSTEM	CLASS	SUBCLASS	WATER REGIME	SPECIAL MODIFIER	COMMON NAME
E2EM1P6	E	**2**	**EM**	**1**	**P**	**6**	**brackish marsh**
PFO1Cb	P	--	FO	**1**	**C**	**b**	**wooded swamp**

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NWI Map Uses and Limitations

The brief statement below, found in the map legend, outlines how the map was produced and some limitations of map use.

> ***SPECIAL NOTE***
>
> *This document was prepared primarily by stereoscopic analysis of high altitude aerial photographs. Wetlands were identified on the photographs based on vegetation, visible hydrology, and geography in accordance with **Classification of Wetlands and Deepwater Habitats of the United States,** (FWS/OBS - 79/31 December 1979). The aerial photographs typically reflect conditions during the specific year and season when they were taken. In addition, there is a margin of error inherent in the use of the aerial photographs. Thus, a detailed on the ground and historical analysis of a single site may result in a revision of the wetland boundaries established through photographic interpretation. In addition, some small wetlands and those obscured by dense forest cover may not be included on this document.*
>
> *Federal, State and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that used in this inventory. There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, State or local government or to establish the geographical scope of the regulatory programs of government agencies. **Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate Federal, State or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.***

The information on the NWI map is an excellent source of general wetland locations, boundaries and characteristics, however, as stated in the **SPECIAL NOTE, it is *not* a substitute for intensive on-ground, site-specific investigations when detailed information is required.** Due to the limitations of the photointerpretation process, all wetlands are not shown on the NWI map. Certain wetland types such as evergreen forests can be difficult to identify on aerial photographs and are sometimes missed. Aquatic bed wetlands are often not visible on early spring photography, making identification nearly impossible without the use of collateral information. Also, the drier wetland types are difficult to detect, especially on aerial photography taken during drier seasons, dry years or during drought conditions. NWI maps are utilized by a wide variety of users such as engineers, environmental consultants, local conservation commissions, foresters, hunters and fisherman, planning commissions as well as local, county, state and federal conservation and regulatory agencies. Some of the common uses of the maps include project review, analysis of wildlife habitat, comprehensive management plans, land aquisition, oil spill contingency plans, baseline data, environmental impact assesment, identification and education, permit review, wetland evaluation, utility corridor and facility siting.

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TABLE 1. GENERAL CHARACTERISTICS OF SYSTEMS

SYSTEM (MAP CODE)	DESCRIPTION
Marine (M)	Open ocean and its high energy shoreline; salinity >30 ppt*
Estuarine (E)	Tidal ecosystems, usually semi-enclosed by land, with varying salinities
Riverine (R)	Freshwater flowing water contained within a channel; salinity <0.5 ppt
Lacustrine (L)	Fresh waterbodies, generally >20 acres, >2 meters deep at low water
Palustrine (P)**	Mostly freshwater wetlands; and waterbodies <20 acres and <2 meters deep at low water.

*ppt = parts per thousand

**Examples of this system are ponds, freshwater swamps, marshes and bogs.

TABLE 2. GENERAL CHARACTERISTICS OF SUBSYSTEMS*

SUBSYSTEM (MAP CODE)	DESCRIPTION	RELEVANT SYSTEMS
Subtidal (1)	Permanently flooded (below mean low tide level)	Marine,Estuarine
Intertidal (2)	Periodically flooded and exposed by tides	Marine,Estuarine
Tidal (1)	Fresh water, tidally influenced river	Riverine
Lower Perennial (2)	Slow-moving river, with low gradient, and well developed floodplain	Riverine
Upper Perennial (3)	Fast moving river with high gradient and little floodplain development	Riverine
Intermittent (4)	Seasonally flowing river	Riverine
Unknown (5)	River sharing characteristics of other subsystems	Riverine
Limnetic (1)	Lake water greater than 2 meters deep	Lacustrine
Littoral (2)	Shallow lake water and adjacent shoreline, less than 2 meters deep	Lacustrine

*NOTE: There are no Subsystems in Palustrine system..

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TABLE 3. GENERAL CHARACTERISTICS OF THE CLASSES

CLASS (MAP CODE)	DESCRIPTION
Rock Bottom (RB)	Permanently flooded bedrock or large chunks of bedrock
Unconsolidated Bottom (UB)*	Permanently flooded sand, gravel, mud or cobble substrate
Unconsolidated Shore (US)	Periodically exposed sand, mud or gravel substrate
Aquatic Bed (AB)	Floating or floating-leaved submerged aquatic vegetation (e.g., duckweed, pondweed, algae)
Reef (RF)	Substrate composed of living organisms (e.g. mussels, oysters)
Rocky Shore (RS)	Periodically exposed bedrock or large chunks of bedrock
Open Water (OW)*	Open water, no visible vegetation
Streambed (SB)	Periodically flooded channel composed of gravel, sand or bedrock
Emergent Wetland (EM)	Herbaceous (non-woody) vegetation (e.g., grasses, sedges, rushes and flowering herbs)
Scrub/Shrub Wetland (SS)	Woody vegetation < 20 feet tall (includes dwarf trees in bogs, shrubs and saplings)
Forested Wetland (FO)	Woody vegetation 20 feet or taller (trees)
Moss/Lichen Wetland (ML)	Dominant vegetative cover of mosses, lichens or both

**Earlier NWI maps used the Open Water (OW) class, while present mapping conventions use the Unconsolidated Bottom (UB) class.*

TABLE 4. TIDAL WATER REGIMES (used for Marine and Estuarine systems where salinities > 0.5 ppt)

WATER REGIME (MAP CODE)	DESCRIPTION OF WATER REGIME
Subtidal (L)	Permanently flooded by tides all year long
Irregularly Exposed (M)	Flooded most times except extreme low tides
Regularly Flooded (N)	Flooded and exposed by tides at least once daily
Irregularly Flooded (P)	Flooded less often than once daily by tides

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TABLE 5. NONTIDAL WATER REGIMES (used for Riverine, Lacustrine, Palustrine Systems)

WATER REGIME (MAP CODE)	DESCRIPTION OF WATER REGIME
Temporarily Flooded (A)	Floods most years for less than two weeks during growing season; usually dry by mid-growing season
Saturated (B)	Substrate is saturated for most of growing season (commonly year round) and rarely floods
Seasonally Flooded (C)	Floods most years for two weeks or more during growing season, usually dry by end of growing season
Seasonally Flooded/Saturated (E)*	Floods most years for two weeks or more during growing season and remains saturated near the surface for most of the growing season
Semipermanently Flooded (F)	Remains flooded throughout the growing season in most years
Intermittently Exposed (G)	Nearly permanently flooded, exposed only during drought conditions
Permanently Flooded (H)	Remains flooded throughout the year in all years
Intermittently Flooded (J)	Exposed most years, but flooded(usually briefly) during growing season on an irregular basis
Artificial (K)	Flooding controlled by pumps, siphons, etc.

**Not used on all maps*

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TABLE 6. FRESHWATER - TIDAL. These areas have freshwater (having salinities of < 0.5 ppt) that fluctuates with tidal movements.

WATER REGIME (MAP CODE)	DESCRIPTION OF WATER REGIME
Temporarily Flooded-Tidal (S)	Floods most years less than two weeks during growing season, but also periodically inundated by freshwater tides*
Seasonally Flooded-Tidal (R)	Floods for two weeks or more during growing season, but also periodically inundated by freshwater tides*
Semipermanently Flooded-Tidal (T)	Remains flooded through most of growing season in most years and is affected by freshwater tides
Permanently Flooded-Tidal (V)	Remains flooded throughout the year in all years and is influenced by freshwater tides
Regularly Flooded-Tidal (N)**	Flooded and exposed at least once daily by freshwater tides

**Periodically inundated means flooded less than once daily by freshwater tides*

***This tidal (salt water) modifier is also used in the Lacustrine, Palustrine, and Riverine systems to describe the water regime of freshwater areas that are flooded (regularly) at least once daily by freshwater tides.*

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TABLE 7. COMMONLY USED MODIFIERS

MODIFIER (MAP CODE)	GENERAL DESCRIPTION
Oligohaline (6)	Used to distinguish transitional zone (slightly brackish) between freshwater tidal systems and brackish tidal systems; salinity = 0.5-5.0 ppt
Acid (a)	Used to distinguish floating mat, kettlehole type acidic bogs from other non-acidic wetland types
Beaver (b)	Used to indicate an area that has been either created by, or hydrologically affected by beaver dams
Partially ditched/drained (d)	Used to show an area that has been visibly ditched or partially drained, but maintains wetland hydrology and functions
Farmed (f)	Used in this region (Northeast) to identify commercial cranberry bogs
Artificial (r)	Used to identify manmade impoundments with artificial bottoms (i.e., concrete fish ponds, sewage treatment ponds); also used to identify wetlands created by bench mining of coal
Diked/Impounded (h)	Used to identify areas that have been hydrologically altered or created by construction of a dike or dam which obstructs or stops water flow
Excavated (x)	Created or modified by excavation and removal of existing substrate (i.e., quarries, gravel pits, farm ponds, channelized rivers, drainage ditches)

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TABLE 8. QUICK CROSS REFERENCE OF MAP CODES TO COMMON WETLAND TYPES (Using System, Subsystem and Class)

MAP CODE	COMMON NAME or WETLAND TYPE
PFO	FORESTED OR WOODED SWAMP OR BOG
PSS	SHRUB SWAMP OR BOG
PEM	EMERGENT MARSH, FEN, OR WET MEADOW
PUB	POND
PUS	POND SHORELINE
PAB	POND WITH FLOATING OR SUBMERGED AQUATIC VEGETATION (DUCKWEEDS, POND LILIES)
R1UB	FRESHWATER TIDAL RIVER
R2UB	SLOW MOVING RIVER WITH FLOODPLAIN
R2AB	RIVER WITH AQUATIC VEGETATION(PICKERELWEED)
R3US	BANK OR SHORELINE OF FAST FLOWING RIVER
R4SB	INTERMITTENT STREAM CHANNEL
R5UB	RIVER SHOWING CHARACTERISTICS OF BOTH UPPER AND LOWER PERENNIAL RIVERS
M1UB	OPEN OCEAN WITH UNCONSOLIDATED BOTTOM
M2AB	INTERTIDAL SEAWEED BED IN OCEAN
M2RF	INTERTIDAL OYSTER AND MUSSEL REEFS IN OCEAN
E2EM	SALT OR BRACKISH TIDAL MARSH
E2SS	ESTUARINE SHRUB SWAMP
E2US	ESTUARINE FLATS, BEACH, OR SAND BARS
E1UB	OPEN WATER ESTUARY
L1UB	DEEPWATER ZONE OF LAKE
L2US	LAKE SHORE OR SHALLOW WATER ZONE OF LAKE
L2AB	AQUATIC VEGETATION IN LAKE
L2UB	SHALLOW WATER ZONE OF LAKE

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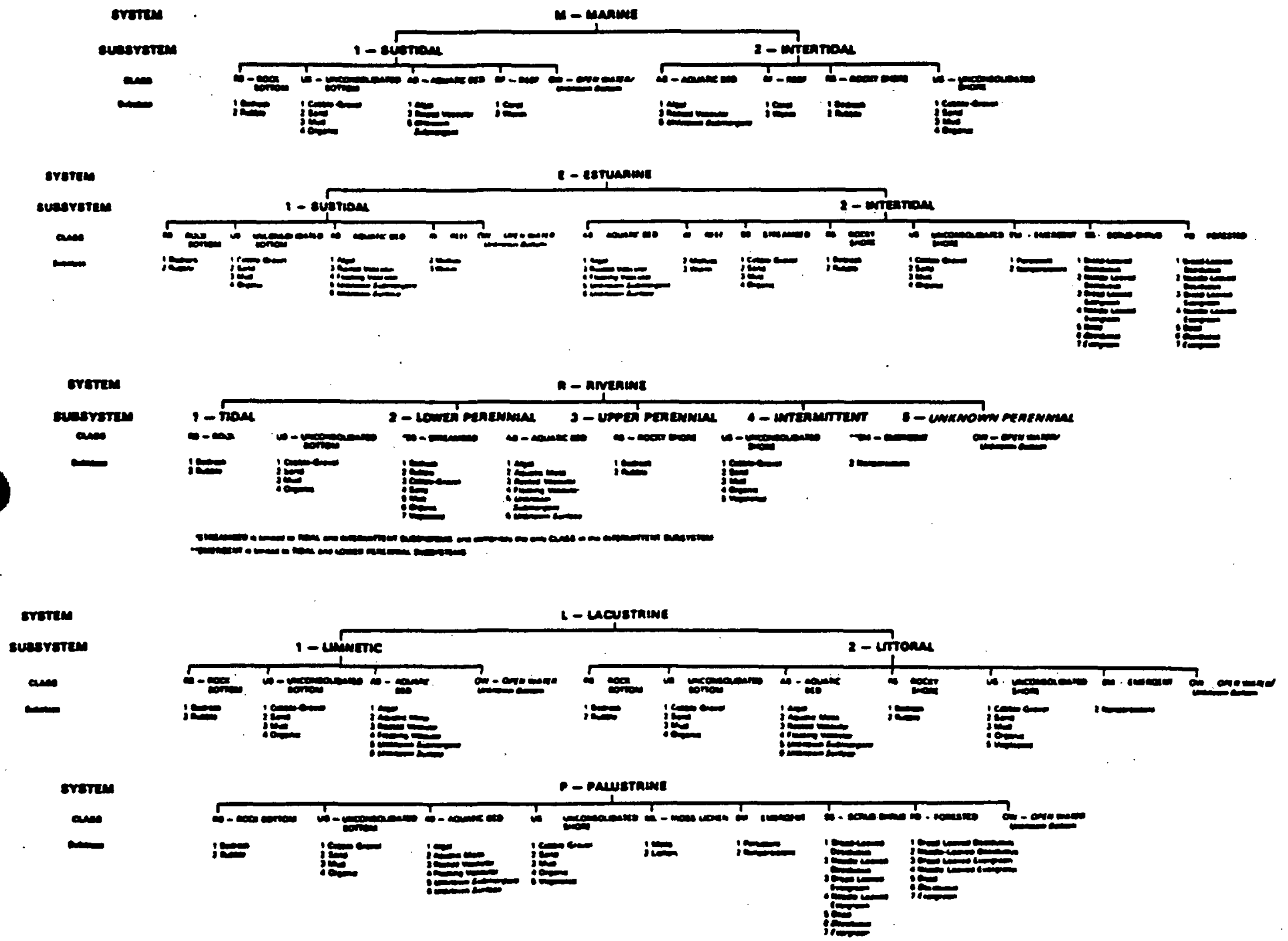
NWI MAP LEGEND

WETLANDS AND DEEPWATER HABITATS CLASSIFICATION



MODIFIERS

[illegible]

WATER REGIME		WATER CHEMISTRY			SOIL	SPECIAL MODIFIERS
Non-Tidal	Tidal	Coastal Halinity	Inland Salinity	pH Modifiers for all Fresh Water		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

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(FOUND AT THE BOTTOM OF EACH NWI MAP)

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REFERENCE NUMBER 10

WASTE LAGOON GROUND-WATER MONITORING

LCP CHEMICALS, NEW JERSEY, INC.
LINDEN, NEW JERSEY

February 1982

GERAGHTY
& MILLER, INC.

Consulting Ground-Water Geologists and Hydrologists

NORTH SHORE ATRIUM
6800 JERICHO TURNPIKE
SYOSSET, NEW YORK 11791

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WASTE LAGOON
GROUND-WATER MONITORING
LCP CHEMICALS, NEW JERSEY, INC.
LINDEN, NEW JERSEY

February 1982

Geraghty & Miller, Inc.
Consulting Ground-Water Geologists and Hydrologists
North Shore Atrium
6800 Jericho Turnpike
Syosset, New York 11791

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APPENDICES

FIGURE

TABLES

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WASTE LAGOON
GROUND-WATER MONITORING
LCP CHEMICALS, NEW JERSEY, INC.
LINDEN, NEW JERSEY

INTRODUCTION

LCP Chemicals, New Jersey, Inc. (LCP) retained Geraghty & Miller, Inc. to conduct ground-water monitoring at a waste disposal site at their Linden, New Jersey, plant. The plant produces chlorine by the electrolytic decomposition of brine using metallic mercury as an electrode. Mercury concentrations in the process wastes are high enough so that the wastes are hazardous as defined in the Resource Conservation and Recovery Act (RCRA) of 1976.

In order to comply with both the RCRA monitoring well requirements and a consent agreement with the State of New Jersey, LCP installed monitoring wells at its waste facility. This facility consists of an active brine sludge lagoon and a small, experimental lagoon used for pilot studies of the Chem-fix process for waste stablization.

SUMMARY OF FINDINGS AND CONCLUSIONS

1. Geologic data from soil borings and monitoring wells show that the study area is underlain by 30 to 50 feet of unconsolidated glacial till, organic sediments, peat, and artificial fill. These deposits are generally of low or moderately low permeability and rest on bedrock, the Brunswick shale member of the Triassic Newark Group.

2. The six monitoring wells installed near the LCP brine-sludge lagoon yielded ground-water samples with mercury levels below the U.S. Environmental Agency (USEPA) Primary Interim Drinking Water Standard of 0.002 mg/L (milligrams per litre).

3. Soil samples collected in the monitoring well borings, selected surface sites, and the South Branch Creek bed showed total mercury concentrations between 0.26 and 1,580 mg (milligrams) per kg (kilogram) of soil ppm (parts per million) as received.

4. Shallow, fill soils contained the most mercury (up to 1,580 ppm) while undisturbed, deeper soils had much lower concentrations (0.4 to 6 ppm). Intermediate concentrations (10 to 40 ppm) were found in organic sediments derived from marsh deposits taken at depths up to 17 feet below grade.

5. The soils analyses for mercury indicate ambient levels for this metal in undisturbed (uncontaminated), low permeability deposits up to approximately 5 ppm in this area.

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6. Higher levels of soils mercury, up to 40 ppm, indicate contamination by industrially derived fill materials, surface disposal of mercury compounds and/or selective fixation of mercury in organic sediments.

7. The difference between mercury levels in ground-water and soils samples arises because the soil components (silts, clays, and organic matter) tie up mercury through adsorption and complexation. Furthermore, many mercury compounds have low solubilities in water.

8. Water-level data do not reveal present leakage of water from the brine sludge lagoon via the subsurface.

9. Sources of mercury found in streambed sediments from South Branch Creek cannot be determined solely on the basis of soils or ground-water quality data. Potential sources, besides LCP's waste lagoon, may be atmospheric mercury "fallout," runoff, percolation through fill materials, and tide water from the Arthur Kill.

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RECOMMENDATIONS

1. LCP should maintain the monitoring wells in good condition for continued sampling as prescribed by RCRA. Care should be taken to avoid contamination of the wells.

2. Re-sampling and analysis of ground water (and soils, if necessary) should be performed according to the protocol currently in use (see Appendix B). All sampling procedures should be kept as constant as possible so that data from different sampling periods can be compared.

3. Water levels should be measured in each well prior to sampling using the "wetted tape" method. The date, time, tidal stage, weather conditions, and other pertinent data should be recorded along with each measurement.

4. If it becomes necessary to abandon any of the monitoring wells, closure must be performed by a licensed New Jersey water-well driller and in accord with state specifications.

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THE HYDROGEOLOGIC INVESTIGATION

Purpose and Scope

The New Jersey Department of Environmental Protection (NJDEP) administrative Consent Order of July 31, 1981 requires that LCP implement a monitoring program to evaluate the release of mercury and other metals to the ambient environment (see Appendix C). The monitoring program covers air, surface and ground water, and soils obtained from borings done on land and in the streambed. Geraghty & Miller, Inc., was retained to design and supervise the entire program except for the air monitoring studies, which were conducted by LCP.

The soil borings and monitoring well installations were made at five sites in the vicinity of the waste lagoons. Soils samples were described in detail with respect to lithologic and hydrologic characteristics and were retained for chemical analysis. Individual monitoring wells were screened in the most permeable soil materials penetrated at each boring site. Where more than one permeable zone was encountered, a multiple (cluster) well arrangement was used. Soil samples from four surface sites and a streambed site were also collected for mercury analysis. The soil boring, well construction and analytical procedures for water and soils chemistry followed USEPA procedures (see Appendix B) and were approved by NJDEP prior to field work.

Monitoring Well Installation

Six monitoring wells were installed between September 29 and October

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2, 1981 by H.P. Drilling of National Park, New Jersey, a licensed New Jersey well driller. Drilling permits were obtained for each well in accordance with New Jersey State law. Permit numbers are listed on each well log given in Appendix A.

The monitoring wells were drilled to consolidated bedrock which was encountered between 42.3 and 48.5 feet below grade at the sites shown in Figure 1. The drilling was done by cased borings (Wells 1, 1A, 2, and 3) and hollow-stem auger (Wells 4 and 5) with split-spoon core samples collected at 5-foot intervals or as directed. Water used during drilling was from an approved, potable water source. A sample of this water has been analyzed by LCP.

The monitoring wells are constructed of 1.5-inch diameter PVC pipe and have 30 to 50 feet of 1.5-inch diameter PVC screen; the screen length depended on the geologic deposits encountered. The screen was set in the drilled hole and packed with clean sand of suitable grade for the 0.020-inch screen slot opening. Bentonite seals were placed above and below the screen zone to prevent vertical flow in the drilled hole near the screen. The remaining open hole around the well casing was filled with cement grout. The top of each well is protected by a vented cap and steel standpipe which extends at least 1.5 feet above grade and is embedded in the cement grout. Well 5 was finished in a curb box because it was located in a high access area.

Sediment and water removed from the borings while drilling and from the finished monitoring wells were considered to be contaminated. There-

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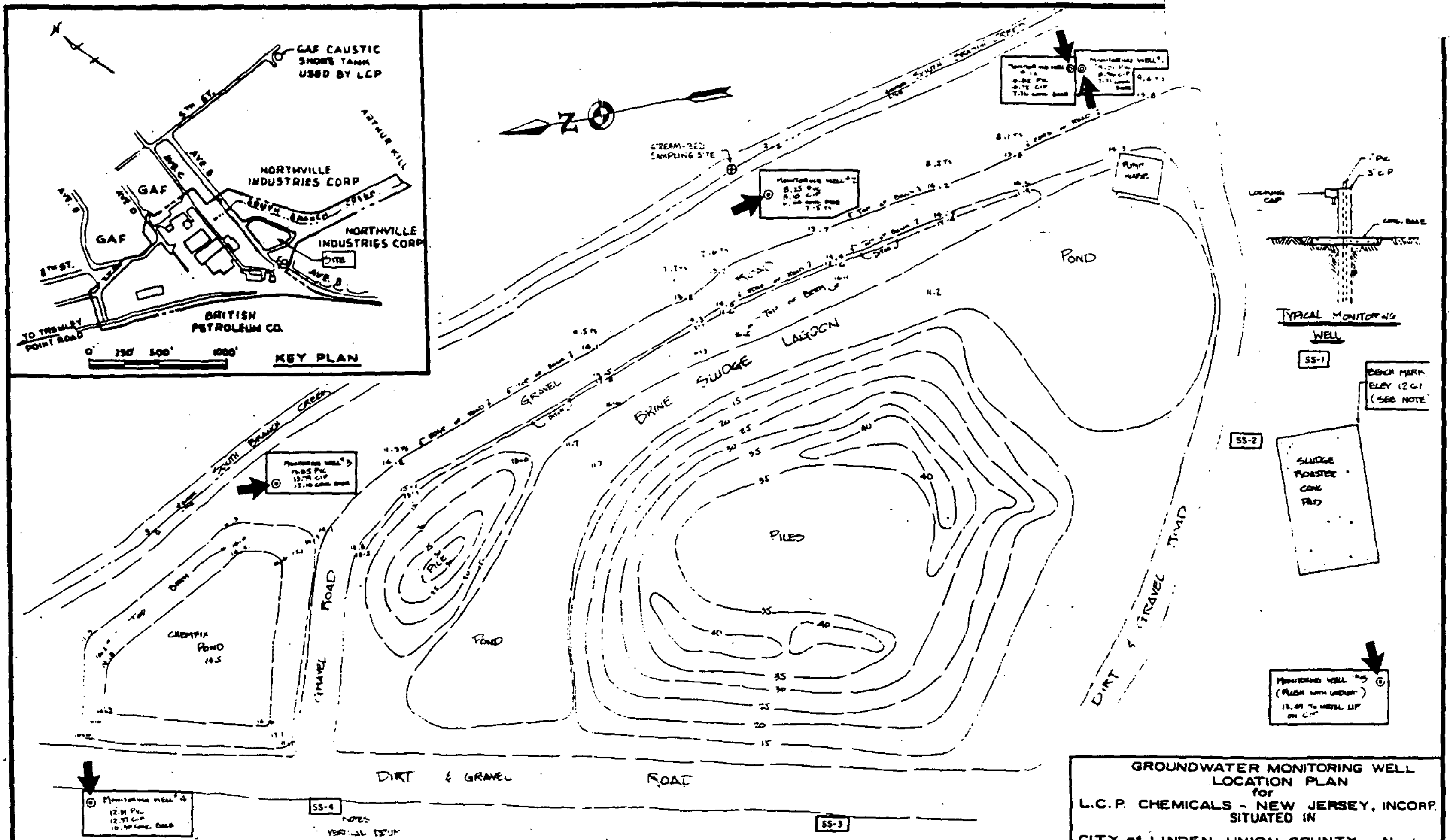

NOTES

1) VERTICAL DATUM
MON. M-37 USC & GS DISK
RESET 6/74, ELEV. 11.523' (M.L.W.)
ELEVATION BASED ON U.S.G.S.
SEA LEVEL DATUM OF 1929 (NGVD)

2) BENCH MARK SET ON SITE
PAINTED S.E. CORNER OF TOP BLOCK CONC.
SLUDGE ROASTER PAD ELEV. 12.61

3) REFERENCE MAP INFORMATION WAS TAKEN FROM
TREADWELL CORP., NEW YORK, NEW YORK
PLOT PLAN CAUSTIC-CHLORINE PLANT,
LINDEN N.J.

4) SITE PLAN AREA, PART OF BLOCK 587 LOT 3
SITUATED IN LINDEN N.J. (BRINE LAGOON AREA)

5) SS-1 SUBSURFACE SOIL SAMPLING LOCATION

0 500 1000 FT.
SCALE

GROUNDWATER MONITORING WELL LOCATION PLAN
for
L.C.P. CHEMICALS - NEW JERSEY, INCORP.
SITUATED IN
CITY of LINDEN, UNION COUNTY, N.J.

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BERNARD R BERSON
N J PE & L S No 12913

DATE	SCALE	FIGURE
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fore, they were deposited in the LCP waste lagoon.

After each monitoring well was completed, all temporary casings, tools, and equipment coming in contact with soils and water were cleaned with uncontaminated water to prevent cross-contamination.

Sampling Methods

Sediment and water samples collected throughout the investigation were delivered immediately after collection to the laboratory at LCP. Geraghty & Miller, Inc., and LCP have a list of samples collected, handled, and analyzed.

Sediment samples were collected while drilling with a split-spoon core barrel (2-inch outside diameter and 24 inches long) and placed in airtight, 8-ounce, clean, glass containers. Two sediment samples were collected from each spoon and are equally representative of the geologic deposits penetrated by the spoon. Water samples were collected from monitoring wells using a peristaltic pump after the wells were developed with a guzzler pump or bailer. Because the formation yield was typically very low, most wells were bailed dry and allowed to recover sufficiently to yield the required sample volume. For the few wells that could be pumped, at least ten times the volume of standing water in the well was removed before sampling as recommended by USEPA.

All tubing on the peristaltic pump was changed between samplings to prevent cross-contamination. Water samples were filtered immediately after collection by LCP laboratory personnel with a 0.45 micron (Millipore-type)

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filter and placed in a container, pre-treated with nitric acid to preserve the sample for metals analysis. Two quart-size water samples were collected from each well. Water samples were checked for temperature, pH, and specific conductance immediately after collection.

Hydrogeology

The site is located on Holocene and Pleistocene glacial deposits which thinly cover Triassic bedrock, the Brunswick Formation. The geology is typical of that recorded in eastern Union County by Nemickas (1976).

Unconsolidated geologic deposits in the study area can be separated in four distinct sedimentary units. From youngest to oldest, they are:

Unit A - Miscellaneous fill deposits
Unit B - Dark gray, organic clay
Unit C - Well sorted sands intercalated with poorly sorted gravelly sands
Unit D - Red-brown, tight silty clay, clay, and gravelly clay

The permeabilities of the four units varies because of differences in particle size, packing, and sorting. Observations of the split-spoon samples provide information on the relative permeabilities of these units (Table 1). A description of each unit follows.

Unit A is thin, but covers the study area continuously. It is a heterogeneous mixture of silt, sand, and gravel-sized particles with artificial components, such as slag, crushed stone, and brick. This fill layer varies in thickness from 4.5 feet near the tidal creek to 13.5 feet upgradient of the waste lagoon.- The age, source and overall composition of this unit is unknown but was in place before LCP occupied the site. No informa-

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Table 1. Permeabilities of Various Units Under the LCP Site.

Unit[1]	Relative Permeability	Probable Range of K (feet per year)[2]
A	Semi-permeable	0.1 - 100
B	Low-permeability	0.01 - 10
C	Well sorted sands -- permeable	500
	Poorly sorted sands -- semi-permeable	0.1 - 500
D	Low-permeability	0.01 - 1

1) Units are defined in the text.

2) From Sherard, et al. (1963).

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tion about the unit was available in records from the previous plant operator, GAF Corporation. Soil boring records from Hazen and Sawyer (1969) covering the general plant area show this unit to be extensive.

Due to the assortment of grain sizes and tight packing, permeabilities are relatively low. However, the base of the fill appears to be saturated. Well 1A was screened only at the base of the fill and top of Unit B, since this was recognized to be a thin, but semi-permeable zone.

Unit B is characterized by a dark gray clay with organic matter (tidal grasses) appearing throughout. Thin (2- to 12-inch) layers of brown peat are present near the top of this unit. Lenses of gray silt are also present but are generally thin and horizontally limited.

The organic clay is very cohesive and dry when examined in the sample spoons and did not yield significant water during drilling. This unit is present at all sites except five, where a dark gray, organic silty sand with pelecypods and gastropods, is found at the same horizon. This silty sand probably represents a tidal channel where water movement during the time of deposition was faster than in the rest of the area which was a tidal flat.

Unit C is present at well Sites 3, 4, and 5 and varies in thickness from 4.5 to 18 feet. This unit consists of well-sorted sand layers separated by poorly sorted gravelly sand layers. However, they are relatively thin, separated by tight, poorly sorted layers (where present) and are not present at all sites. It appears that this unit is of limited stratigraph-

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ic and lateral extent in this area.

Unit D is present at all sites and varies in thickness from about 14 to 29 feet. This unit is a till which is a heterogeneous mixture of particles deposited by a glacier. The upper part of this till unit is a silty clay or clayey silt with occasional occurrences of pebbles and cobble gravel. The middle horizons are composed predominantly of clay, with other sized particles present in trace amounts. The lower horizons above the bedrock surface are very coarse with cobbles and pebbles floating in a tight, clay matrix. The permeability of this unit is very low due to poor sorting of grain sizes, predominance of clay-sized particles, and tight packing of the individual grains. Wells screened in this unit yield water sparingly and recover very slowly after evacuation.

Bedrock was intercepted between 42.3 and 48.5 feet at the well sites. Clasts of Brunswick-type lithologices (siltstone and shale) were found in the coarse till above the bedrock surface.

Table 2 summarizes where each well has been screened with respect to geologic units present at the site.

Water and Soils Chemistry

Water samples bailed from each monitoring well were analyzed by LCP's laboratory for dissolved mercury according to approved procedures. Results are shown in Table 3. Water samples were also sent to Princeton Testing Laboratory to confirm the mercury analyses and to provide results for calcium, barium, and iron. These results appear in Table 4.

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Table 2. Units in Which Wells are Screened.

Well No.	Screen Zone	Units Screened In
1	18.5 - 38.5	D
1A	5 - 10	Bottom of A/top of B
2	18 - 28	Top of D
3	15 - 30	Bottom of B, C, and top of D
4	18 - 38	C/top of D
5	8 - 38	Bottom of A, B, C, and D

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Table 3. Dissolved Mercury Concentrations in Ground-Water Samples (concentrations in mg/L or ppm).

Well No.	Sampling Date 10-6-81	 10-15-81
1	<0.0002	0.0006
1A	<0.0002	0.0009
2	<0.0002	<0.0002
3	<0.0002	<0.0002
4	<0.0002	<0.0002
5	<0.0002	<0.0002

Samples analyzed by the LCP Laboratory, Linden, New Jersey.

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Table 4. Results of Ground-Water Quality Analyses (concentrations in mg/L or ppm).

Well No.	Calcium	Barium	Iron	Mercury
1	1,100	3.5	5.9	< 0.001
1A	2,700	7.0	0.10	< 0.001
2	1,000	3.0	2.2	< 0.001
3	800	3.0	0.10	< 0.001
4	500	2.5	0.06	< 0.001
5	500	2.0	0.50	< 0.001

Note: Samples were received for analysis on November 25, 1981 at the Princeton Testing Laboratory, Princeton, New Jersey.

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Soil samples from monitoring well borings and from the land surface were analyzed by the LCP laboratory for total desorbable mercury content. Samples were leached according to USEPA protocol and filtered. The filtrate was then analyzed for mercury. The results of soils mercury analyses from borings are given in Table 5.

Surface soil samples and a tidal creek bed sample were collected on October 15, 1981 by hand, retained and analyzed for total mercury in the same way as the other soil samples. Locations of these sampling sites are shown on Figure 1 and analytical results are given in Table 6.

The results of water and soils mercury analysis shows (1) surficial soil contamination with mercury which decreases with depth, and (2) ground water which is essentially free of mercury. Both results indicate little, if any, subsurface migration of mercury from the brine sludge lagoon. Subsurface soil types and calculated permeability values do not appear to allow significant fluid migration from the lagoon. Furthermore, the settled brine sludge itself has very low permeability.

Elevated mercury values in soils collected at depths to a maximum of 12 to 15 feet below grade are more difficult to interpret and might relate to the composition of the fill materials used to reclaim the present indusindustrial site from its past, tidal marsh condition. Ground-water samples from this zone do not contain high levels of mercury, indicating that the metal is bound to the soil particles. In general, the soils penetrated in the well borings (silts and clays predominating) would be expected to trap mercury resulting in the low mercury levels found in ground water.

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Table 5. Mercury Concentrations in Soil Boring Samples (depth in feet below grade; concentrations in ppm).

Sample	Depth	Mercury	Sample	Depth	Mercury
Well 1			**Well 2**		
1-1	0 - 2	225	2-1	0 - 2	68.1
1-2	5 - 7	17.4	2-2	5 - 7	2.1
1-3	10 - 12	1.72	2-3	10 - 12	1.0
1-4	15 - 17	1.3	2-4	15 - 17	0.32
1-5	20 - 22	1.04	2-5	20 - 22	0.91
1-6	25 - 27	0.89	2-6	25 - 27	0.26
1-7	30 - 32	2.81	2-7	30 - 32	0.34
1-8	35 - 37	1.74	2-8	35 - 37	0.34
1-9	40 - 42	0.82	2-9	40 - 42	0.79
Well 3			**Well 4**		
3- 1	0 - 2	101	4- 1	0 - 2	772
3- 2	5 - 7	528	4- 2	5 - 7	163
3- 3	10 - 12	9.12	4- 3	10 - 12	19.84
3- 4	15 - 17	0.68	4- 4	15 - 17	33.69
3- 5	20 - 22	1.00	4- 5	20 - 22	0.57
3- 6	25 - 27	0.40	4- 6	25 - 27	0.58
3- 7	30 - 32	1.18	4- 7	30 - 32	0.65
3- 8	35 - 37	0.48	4- 8	34 - 36	0.72
3- 9	40 - 42	0.85	4- 9	40 - 42	1.16
3-10	45 - 47	0.60	4-10	45 - 47	3.47
Well 5					
5- 1	0 - 2	35.71			
5- 2	5 - 7	33.39			
5- 3	10 - 12	37.02			
5- 4	15 - 17	1.99			
5- 5	20 - 22	5.73			
5- 6	25 - 27	0.83			
5- 7	30 - 32	5.28			
5- 8	35 - 37	0.42			
5- 9	40 - 42	0.60			
5-10	43.5 - 45.5	4.59			

Samples analyzed by the LCP Laboratory, Linden, New Jersey.

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Table 6. Mercury Concentrations in Surface Soil and Tidal Creek Bed Samples (concentrations in ppm).

Sample No.	Mercury
S-1	558
S-2	27.45
S-3	1,070
S-4	1,580
Tidal Creek Bed	46.42

Samples analyzed by the LCP Laboratory, Linden, New Jersey.

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The meaning of the mercury levels found in soils at LCP is difficult to assess except in a relative sense. Natural mercury concentrations in rocks average from 0.01 to 20 ppm, with igneous rocks on the low end, and organic-rich sediments on the high end of this range (Wallace, et al., 1971). Higher concentrations may be found in areas of hydrothermal mineral deposition such as along major fault and orogenic belts. The mercury detected in soils beneath the study area most likely represent low solubility mercury compounds such as sulfides, phosphates or carbonates (Mortvedt, et al., 1972).

Pierce, et al. (1970) consider any mercury levels in soils exceeding 1 ppm, to be significant as evidence of mercury mineralization or surface contamination by mercuric wastes. Urbanized, industrial areas are known to have higher background levels of airborne mercury which is disposited on land by precipitation. Unfortunately, no published data on background levels of soil mercury in the Linden, New Jersey, area could be found.

The naturally occurring glacial tills penetrated by the monitoring well borings do not appear to show evidence of mercury contamination by human activities. Mercury levels above 1 ppm, especially near the bedrock contact may relate to ancient hydrothermal activity associated with tectonics and igneous intrusion of the Triassic sediments (Brunswick shale) underlying the site. Organic deposits, such as the peat, show high mercury levels (about 10 to 30 ppm) down to a maximum depth of 17 feet below land surface. These levels probably reflect the strong organic chelation of mercury derived from several possible sources: from surface contamination,

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mercury wastes in the artificial fill, the decay of mercury containing minerals. and from mercury contained in atmospheric precipitation. Comparatively high mercury levels (up to 1,500 ppm) occurring in soils obtained at land surface are the likely result of present and/or prior land use.

Respectfully submitted,

GERAGHTY & MILLER, INC.

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February 11, 1982

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APPENDIX A

Monitoring Well Boring Logs and Construction Data

6800 JERICHO TURNPIKE
SYOSSET, NEW YORK 11791

WELL LOG

PROJECT N 418 LD-1
CLIENT LCP Chemicals Inc.
DATE PREPARED 10-9-81 BY J. DeMartinis

DEPTH, ft		DESCRIPTION	L.S.
0		EXISTING GRADE EL 7.7 Ft.	
#1.1	S.S.	Fill, Heterogeneous: slag, cinders and bricks	A
#1.2	S.S.	Clay, Black-Gray, Organic, Moist to Dry V. Cohesive: Wet From G.S. To 8 Ft.	B
10 #1.3	S.S.	Peat, Brown (Layers 2 to 6 in. Thick) Organic Matter Disseminated Throughout; Strong H2S Ordor.	B
#1.4	S.S.	Silty, Red-Brown, Tight, Clayey, Dry: with Fine Sand and Embedded Pebble Gravel	D
20 #1.5	S.S.	Clay, Red-Brown, Tight, Dry With Fine Sand and Embedded Gravel	D
#1.6	S.S.	Clay, Red-Brown with Embedded Pebbles: Tight.	D
30 #1.7	S.S.	Clay, Red-Brown, Moist; Less Pebbly Than Above.	D
#1.8	S.S.	Clay, Silty, Red-Brown, Dry With Abundant Pebbles And Cobble, Gravel.	D
40 #1.9	S.S.	Silty, Clayey, Dry, Red-Brown; Cobbles And Gravel.	D
		Bedrock @ 42.3 Ft. Boring Stopped	

L.S.=Land Surface
# - S.S.=Split Spoon Core Sample Number

OWNER LCP Chemicals Inc.
WELL NO. 1 State # 26-5293
LOCATION Lagoon Area
Linden, N.J. Plant
TOPO SETTING Filled Coastal Marsh
GROUND ELEV. 9.7 Ft.

DRILLING STARTED 9-29-81
DRILLING COMPLETED 9-29-81
DRILLER H. P. Drilling
TYPE OF RIG Drive Boring

WELL DATA

HOLE DIAM. 2 1/2 inch.
FINAL DEPTH 38.5 Ft. From LS
CASING DIAM. 1 1/2 inch.
CASING LENGTH 20 Ft. (1.5 Ft. Above LS)
SCREEN DIAM. 1 1/2 inch.
SCREEN SETTING 18.5-38.5 Ft.
SCREEN SLOT & TYPE 20 Slot PVC
WELL STATUS Monitoring

DEVELOPMENT

TEST DATA

STATIC DEPTH TO WATER	4.78 Ft.	4.01 Ft.
DATE MEASURED	10-6-81	10-15-81
	Low Tide	High Tide

Measuring Point Top of PVC Pipe
Meas. Point Elevation 9.01 Ft.
DATE OF TEST
TYPE OF TEST
PUMP SETTING
SPECIFIC CAPACITY

FINAL PUMP CAPACITY
FINAL PUMP SETTING
AVERAGE PUMPAGE

WATER QUALITY

See Appendix

REMARKS

LITHOLOGY SEE TABLE 1
A= Miscellaneous Fill Deposits
B= Dark Gray Organic Clay
C= Well Sorted Sands Etc.
D= Silts, Clays Etc. (Glacial Till)

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6800 JERICHO TURNPIKE
SYOSSET, NEW YORK 11791

WELL LOG

PROJECT N 418 LD-1
CLIENT LCP Chemicals Inc.
DATE PREPARED 10-9-81 BY J. DeMartini

DEPTH, ft — DESCRIPTION

0

FOR LOG SEE WELL NO. 1

(DEEP WELL IN CLUSTER)

OWNER LCP Chemicals Inc.
WELL NO. 1-A State #26-5298
LOCATION Lagoon Area
Linden, N. J. Plant
TOPO SETTING Filled Coastal Marsh
GROUND ELEV. 7.7 Ft.

DRILLING STARTED 9-30-81
DRILLING COMPLETED 9-30-81
DRILLER H. P. Drilling
TYPE OF RIG Drive Boring

WELL DATA

HOLE DIAM. 2 1/2 inch.
FINAL DEPTH 10 Ft.
CASING DIAM. 1 1/2 inch.
CASING LENGTH 8 Ft. (3Ft. Above L.S.)
SCREEN DIAM. 1 1/2 inch.
SCREEN SETTING 5-10 Ft.
SCREEN SLOT & TYPE 20 Slot PVC
WELL STATUS Monitoring

DEVELOPMENT

TEST DATA

STATIC DEPTH TO WATER 5.42 Ft 4.54 Ft
DATE MEASURED 10-6-81 10-15-81
Low Tide High Ti
Measuring Point Top of PVC Pipe
Measuring Point Elevation 10.82 Ft.
DATE OF TEST
TYPE OF TEST
PUMP SETTING
SPECIFIC CAPACITY

FINAL PUMP CAPACITY
FINAL PUMP SETTING
AVERAGE PUMPAGE

WATER QUALITY

REMARKS

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6800 JERICHO TURNPIKE
SYOSSET, NEW YORK 11791

WELL LOG

PROJECT N 418 LD-1
CLIENT LCP Chemicals Inc.
DATE PREPARED 10-9-81 BY J. DeMartinis

DEPTH, ft		DESCRIPTION	
0		EXISTING GRADE EL. 6.5 Ft.	L.S.
	#2.1 S.S.	Fill, Loose Brown Silt and Sand: Abundant Organic Matter	A
	#2.2 S.S.	Clay, Silty, Gray; Moist to Dry Organic Matter Disseminated Throughout. Strong H2S. Smell	B
10	#2.3 S.S.	Clay, Silty, Gray, Dry with Strong H2S smell; 0.5 Ft. Layer of Brown Peat	B
	#2.4 S.S.	Clay, Silty, Red-Brown, Dry with Fine Sand and Gravel Pockets; Basalt Clasts. Green Staining; Reducing Conditions	D
20	#2.5 S.S.	Clay, Silty, Dry, Red-Brown, Tight with Metamorphic and Igneous rock fragments.	D
	#2.6 S.S.	Clay, Red-Brown, Dry with Sparse Gravel	D
30	#2.7 S.S.	Clay, Red-Brown, Dry, Soft	D
	#2.8 S.S.	Clay, Red-Brown, Dry with Embedded Gravel	D
40	#2.9 S.S.	Clay, Red-Brown, Dry with Abundant Gravel; Granite Fragments	D
		Bedrock @ 43 Ft. Boring Stopped	

L. S.=Land Surface
-S. S. = Split Spoon Core Sample Number

OWNER LCP Chemicals Inc.
WELL NO. 2 State # 26-5294
LOCATION Lagoon Area
Linden, N.J. Plant
TOPO SETTING Filled Coastal Marsh
GROUND ELEV. 6.5 Ft.

DRILLING STARTED 9-30-81
DRILLING COMPLETED 10-1-81
DRILLER H.P. Drilling
TYPE OF RIG Drive Boring

WELL DATA

HOLE DIAM. 2 1/2 inch.
FINAL DEPTH 28 Ft.
CASING DIAM. 1 1/2 inch.
CASING LENGTH 20 Ft. (2Ft. Above L.S.)
SCREEN DIAM. 1 1/2 inch.
SCREEN SETTING 18-28 Ft.
SCREEN SLOT & TYPE 20 Slot PVC
WELL STATUS Monitoring

DEVELOPMENT

TEST DATA

STATIC DEPTH TO WATER	5.29 Ft.	3.68 Ft
DATE MEASURED	10-6-81	10-15-81

Measuring Point Top of PVC Pipe
Measuring Point Elevation 8.25 Ft.

DATE OF TEST
TYPE OF TEST
PUMP SETTING
SPECIFIC CAPACITY

FINAL PUMP CAPACITY
FINAL PUMP SETTING
AVERAGE PUMPAGE

WATER QUALITY

See Appendix

LITHOLOGY REMARKS SEE TABLE 1
A=Miscellaneous Fill Deposits
B=Dark Gray Organic Clay
C=Well sorted Sands Etc.
D=Silts, Clays Etc. (Glacial Till)

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6800 JERICHO TURNPIKE
SYOSSET, NEW YORK 11791

WELL LOG

PROJECT N 418 LD-1
CLIENT LCP Chemical Inc
DATE PREPARED 10-9-81 BY J. DeMartinis

DEPTH, ft		DESCRIPTION EXISTING GRADE EL. 12.1 Ft.	L.S.
0			
#3.1	S.S.	Fill: Gravel and silt, Brown to Black: Slag and Traprock	A
#3.2	SS.	Fill: Medium Sand and Gravel: Yellow to Gray: Clean	A
		Clay, Gray-Black, Orange, Dry H2S Odor	B
10 #3.3	S.S.	Clay, Gray, Black, Dry, Organic (Plant Material): Thin (1-2 inch) Layers of Brown Peat	B
#3.4	S.S.	As Above W/6 inch Peat Layer Base	B
20 #3.5	S.S.	*Sand, Fine to Medium, Gray,* Wet Grading into Silty sands, Clays with Layers of Gray Organic Clay and Brown Peat and Red-Brown, Sandy Silt.	*B-C*
#3.6	S.S.	Sand, Fine to Medium, Red-Brown, Well Sorted with Poorly Sorted Gravelly Layers 2-6 inches Thich	C
30 #3.7	S.S.	Clay, Silty, Dry, Cohesive	D
#3.8	S.S.	Clay, Stiff, Dry with Embedded Pebbles	D
40 #3.9	S.S.	Dry Pebbles in Tight Clay Matrix	D
#3.10	S.S.	Clay, Dry, Silty with Pebbles	D
		Bedrock @ 47.5 Ft. Boring Stopped	

L. S. = Land Surface
\# - S. S. = Split Spoon Core Sample Number

OWNER LCP Chemicals Inc.
WELL NO. 3 State # 26-5295
LOCATION Lagoon Area
Linden, N.J. Plant
TOPO SETTING Filled Coastal Marsh
GROUND ELEV. 12.1 Ft.

DRILLING STARTED 10-1-81
DRILLING COMPLETED 10-1-81
DRILLER H.P. Drilling
TYPE OF RIG Drive Boring

WELL DATA

HOLE DIAM. 2 1/2 inch
FINAL DEPTH 30 Feet
CASING DIAM. 1 1/2 incn
CASING LENGTH 17 Ft. (2Ft. Above L.S.)
SCREEN DIAM. 1 1/2 inch
SCREEN SETTING 15-30 Ft.
SCREEN SLOT & TYPE 20 Slot PVC
WELL STATUS Monitoring

DEVELOPMENT

TEST DATA

STATIC DEPTH TO WATER 7.83 Ft. 7.72 Ft.
DATE MEASURED 10-6-81 10-15-81
PUMPING DEPTH TO WATER Low Tide High Tide
Measuring Point Top of PVC Pipe
Measuring Point Elevation 13.85 Ft.
DATE OF TEST
TYPE OF TEST
PUMP SETTING
SPECIFIC CAPACITY

FINAL PUMP CAPACITY
FINAL PUMP SETTING
AVERAGE PUMPAGE

WATER QUALITY

See Appendix

LITHOLOGY **REMARKS** SEE TABLE 1
A= Miscellaneous Fill Deposits
B= Dark Gray Organic Clay
C= Well sorted sands Etc.
D= Silts, Clays Etc. (Glacial Till)

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GERAGHTY & MILLER
6800 JERICHO TURNPIKE
SYOSSET, NEW YORK 11791

WELL LOG

PROJECT N 418 LD-1
CLIENT LCP Chemicals Inc.
DATE PREPARED 10-9-81 BY J. DeMartinis

DEPTH, ft		DESCRIPTION	
0		EXISTING GRADE EL. 10.3 Ft.	L.S.
	#4.1 S.S.	Fill, Redish Brown; sand and Gravel	A
	#4.2 S.S.	Fill, Heterogengeous, Brown, Wet At Base	A
10	#4.3 S.S. #4.4 S.S.	Much, wet, organic changing to dry organic clay with thin layers of brown Peat and Reeds; H2S Smell	A
20	#4.5 S.S.	Sand, Fine, Green, wet, Well Sorted Feldspathic wiht Organic materials present; H2S odor grades to Coarser; Brown at Bottom	C
30	#4.6 S.S. #4.7 S.S.	Clay, Red-Brown, Dry with Embedded pebbles	D
	#4.8 S.S.	Clay, Red-Brown, Dry with Abundant Cobbles	D
40	#4.9 S.S.	Clay, Red-Brown, Dry and Pebbles in clay matrix in alternating layers	D
	#4.10 S.S.	Clay, Dense, Dry with Siltstone Clasts	D
		Bedrock @ 48.5 Ft. Boring Stopped	

L.S. = Land Surface
# -S.S.= Split Spoon Core Sample Number

OWNER LCP Chemical Inc.
WELL NO. 4 State # 26-5296
LOCATION Lagoon Area
Linden, N.J. Plant
TOPO SETTING Filled Coastal Marsh
GROUND ELEV. 10.3 Ft.

DRILLING STARTED 10-1-81
DRILLING COMPLETED 10-1-81
DRILLER H. P. Drilling
TYPE OF RIG Auger

WELL DATA

HOLE DIAM. 8 inch.
FINAL DEPTH 38 Feet
CASING DIAM. 1 1/2 inch
CASING LENGTH 20 Feet (2' above L.S.)
SCREEN DIAM. 1 1/2 inch
SCREEN SETTING 18-38 Feet
SCREEN SLOT & TYPE 20 Slot PVC
WELL STATUS Monitoring

DEVELOPMENT

TEST DATA

STATIC DEPTH TO WATER 6.64 Ft 6.30 Ft
DATE MEASURED 10-6-81 10-15-81
Low Tide High Tide
Measuring Point Top of PVC pipe
Measuring Point Elevation 12.31 Ft.
DATE OF TEST
TYPE OF TEST
PUMP SETTING
SPECIFIC CAPACITY

FINAL PUMP CAPACITY
FINAL PUMP SETTING
AVERAGE PUMPAGE

WATER QUALITY

See Appendix

REMARKS

A= Miscellaneous Fill Deposits
B= Dark Gray Organic Clay
C= Well Sorted Sands Etc.
D= Silts, Clays Etc. (Glacial Till)

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6800 JERICHO TURNPIKE
SYOSSET, NEW YORK 11791

WELL LOG

PROJECT N 418 LD-1
CLIENT LCP Chemical Inc.
DATE PREPARED 10-9-81 BY J. DeMartinis

DEPTH, ft		DESCRIPTION EXISTING GEADE EL. 12.5 Ft.	L.S.
0	#5.1 S.S.	Fill: Bricks on top 1 ft. with clean brown sand and abundant traprock cobbles below	A
	#5.2 S.S.	Fill: Loose, brown, silty sand with cobbles grading to loose grayish-brown silt and sand; wet at 11.8 Ft.	A
10	#5.3 S.S.		
	#5.4 S.S.	Sand, Silty, organic: dark grayish-brown with Molusck shells; moist	B-C
20	#5.5 S.S.	Sand, grayish-Brown, moist with organic matter	C
	#5.6 S.S.	Clay, moist, organic and dry, red-brown silty clay with pebbles	B
30	#5.7 S.S.	Sand, silty, gray, organic, moist alternating with poorly sorted, red, wet, gravelly sands	C
	#5.8 S.S.	Clay, red-brown, dry, stiff	D
40	#5.9 S.S.	Red-Brown, pebbles gravel in clay matrix grading to a dry cobble and pebbles gravel	D
	#5.10 S.S.	Bedrock @ 45 Ft. Boring Stopped	

OWNER LCP Chemical Inc.
WELL NO. 5 State #26-5297
LOCATION Lagoon Area
Linden, N.J. Plant
TOPO SETTING Filled Coastal Marsh
GROUND ELEV. 12.5 Ft.

DRILLING STARTED 10-2-81
DRILLING COMPLETED 10-2-81
DRILLER H. P. Drilling
TYPE OF RIG Auger

WELL DATA

HOLE DIAM. 8 Inch
FINAL DEPTH 38 Feet
CASING DIAM. 1 1/2 inch
CASING LENGTH 8 Feet
SCREEN DIAM. 1 1/2 inch
SCREEN SETTING 8-38 Ft.
SCREEN SLOT & TYPE 20 Slot PVC
WELL STATUS Monitoring

DEVELOPMENT

TEST DATA

STATIC DEPTH TO WATER	5.99 Ft.	6.99 Ft.
DATE MEASURED	10-6-81	10-15-81
	Low Tide	High Tide

Measuring Point Top of PVC Pipe
Measuring Point Elevation 12.49 Ft.
DATE OF TEST
TYPE OF TEST
PUMP SETTING
SPECIFIC CAPACITY

FINAL PUMP CAPACITY
FINAL PUMP SETTING
AVERAGE PUMPAGE

WATER QUALITY

REMARKS

A= Miscellaneous Fill Deposits
B= Dark Gray Organic Clay
C= Well Sorted Sands Etc.
D= Silts, Clays Etc. (Glacial Till)

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APPENDIX B

Analytical Protocol for Mercury in Water and Soils

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EPA-600/4-79-020

METHODS FOR CHEMICAL ANALYSIS OF WATER AND WASTES

March 1979

ENVIRONMENTAL MONITORING AND SUPPORT
LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY
CINCINNATI, OHIO 45268

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DISCLAIMER

The mention of trade names or commercial products in this manual is for illustration purposes, and does not constitute endorsement or recommendation for use by the U.S. Environmental Protection Agency.

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INTRODUCTION

This third edition of "Methods for Chemical Analysis of Water and Wastes" contains the chemical analytical procedures used in U.S. Environmental Protection Agency (EPA) laboratories for the examination of ground and surface waters, domestic and industrial waste effluents, and treatment process samples. Except where noted under "Scope and Application", the methods are applicable to both water and wastewaters, and both fresh and saline water samples. The manual provides test procedures for the measurement of physical, inorganic, and selected organic constituents and parameters. Methods for pesticides, industrial organic waste materials, and sludges are given in other publications of the Agency. The methods were chosen through the combined efforts of the EPA Regional Quality Assurance Coordinators, the staff of the Physical and Chemical Methods Branch, Environmental Monitoring and Support Laboratory, and other senior chemists in both federal and state laboratories. Method selection was based on the following criteria:

(1) The method should measure the desired property or constituent with precision, accuracy, and specificity sufficient to meet the data needs of EPA, in the presence of the interfering materials encountered in water and waste samples.
(2) The procedure should utilize the equipment and skills available in modern water pollution control laboratories.
(3) The selected method is in use in many laboratories or has been sufficiently tested to establish its validity.
(4) The method should be rapid enough to permit routine use for the examination of a large number of samples.

Instrumental methods have been selected in preference to manual procedures because of the improved speed, accuracy, and precision. In keeping with this policy, procedures for the Technicon AutoAnalyzer have been included for laboratories having this equipment available. Other continuous flow automated systems using these identical procedures are acceptable.

Intralaboratory and interlaboratory precision and accuracy statements are provided where such data are available. These interlaboratory statements are derived from interlaboratory studies conducted by the Quality Assurance Branch, Environmental Monitoring and Support Laboratory; the American Society for Testing Materials; or the Analytical Reference Service of the US Public Health Service, DHEW. These methods may be used for measuring both total and dissolved constituents of the sample. When the dissolved concentration is to be determined, the sample is filtered through a 0.45-micron membrane filter and the filtrate analyzed by the procedure specified. The sample should be filtered as soon as possible after it is collected, preferably in the field. Where field filtration is not practical, the sample should be filtered as soon as it is received in the laboratory.

Many water and waste samples are unstable. In situations where the interval between sample collection and analysis is long enough to produce changes in either the concentration or the physical state of the constituent to be measured, the preservation practices in Table I are recommended.

This manual is a basic reference for monitoring water and wastes in compliance with the requirements of the Federal Water Pollution Control Act Amendments of 1972. Although other test procedures may be used, as provided in the Federal Register issue of October 16, 1973 (38FR 28758) and in subsequent amendments, the methods described in this manual will be used by the Environmental Protection Agency in determining compliance with applicable water and effluent standards established by the Agency.

Although a sincere effort has been made to select methods that are applicable to the widest range of sample types, significant interferences may be encountered in certain isolated samples. In these situations, the analyst will be providing a valuable service to EPA by defining the nature of the interference with the method and bringing this information to the attention of the Director, Environmental Monitoring and Support Laboratory, through the appropriate Quality Assurance Coordinator.

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MERCURY

Method 245.1 (Manual Cold Vapor Technique)

STORET NO. Total 71900
Dissolved 71890
Suspended 71895

1. Scope and Application

1.1 This method is applicable to drinking, surface, and saline waters, domestic and industrial wastes.

1.2 In addition to inorganic forms of mercury, organic mercurials may also be present. These organo-mercury compounds will not respond to the cold vapor atomic absorption technique unless they are first broken down and converted to mercuric ions. Potassium permanganate oxidizes many of these compounds, but recent studies have shown that a number of organic mercurials, including phenyl mercuric acetate and methyl mercuric chloride, are only partially oxidized by this reagent. Potasssium persulfate has been found to give approximately 100% recovery when used as the oxidant with these compounds. Therefore, a persulfate oxidation step following the addition of the permanganate has been included to insure that organo-mercury compounds, if present, will be oxidized to the mercuric ion before measurement. A heat step is required for methyl mercuric chloride when present in or spiked to a natural system. For distilled water the heat step is not necessary.

1.3 The range of the method may be varied through instrument and/or recorder expansion. Using a 100 ml sample, a detection limit of 0.2 ug Hg/1 can be achieved; concentrations below this level should be reported as < 0.2 (see Appendix 11.2).

2. Summary of Method

2.1 The flameless AA procedure is a physical method based on the absorption of radiation at 253.7 nm by mercury vapor. The mercury is reduced to the elemental state and aerated from solution in a closed system. The mercury vapor passes through a cell positioned in the light path of an atomic absorption spectrophotometer. Absorbance (peak height) is measured as a function of mercury concentration and recorded in the usual manner.

3. Sample Handling and Preservation

3.1 Until more conclusive data are obtained, samples should be preserved by acidification with nitric acid to a pH of 2 or lower immediately at the time of collection. If only dissolved mercury is to be determined, the sample should be filtered through an all glass apparatus before the acid is added. For total mercury the filtration is omitted.

4. Interference

4.1 Possible interference from sulfide is eliminated by the addition of potassium permanganate. Concentrations as high as 20 mg/1 of sulfide as sodium sulfide do not interfere with the recovery of added inorganic mercury from distilled water.

Approved for NPDES and SDWA
Issued 1974

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4.2 Copper has also been reported to interfere; however, copper concentrations as high as 10 mg/l had no effect on recovery of mercury from spiked samples.

4.3 Sea waters, brines and industrial effluents high in chlorides require additional permanganate (as much as 25 ml). During the oxidation step, chlorides are converted to free chlorine which will also absorb radiation of 253 nm. Care must be taken to assure that free chlorine is absent before the mercury is reduced and swept into the cell. This may be accomplished by using an excess of hydroxylamine sulfate reagent (25 ml). In addition, the dead air space in the BOD bottle must be purged before the addition of stannous sulfate. Both inorganic and organic mercury spikes have been quantitatively recovered from sea water using this technique.

4.4 Interference from certain volatile organic materials which will absorb at this wavelength is also possible. A preliminary run without reagents should determine if this type of interference is present (see Appendix 11.1).

5. Apparatus

5.1 Atomic Absorption Spectrophotometer: (See Note 1) Any atomic absorption unit having an open sample presentation area in which to mount the absorption cell is suitable. Instrument settings recommended by the particular manufacturer should be followed.

Note 1: Instruments designed specifically for the measurement of mercury using the cold vapor technique are commercially available and may be substituted for the atomic absorption spectrophotometer.

5.2 Mercury Hollow Cathode Lamp: Westinghouse WL-22847, argon filled, or equivalent.

5.3 Recorder: Any multi-range variable speed recorder that is compatible with the UV detection system is suitable.

5.4 Absorption Cell: Standard spectrophotometer cells 10 cm long, having quartz end windows may be used. Suitable cells may be constructed from plexiglass tubing, 1" O.D. X 4–1/2". The ends are ground perpendicular to the longitudinal axis and quartz windows (1" diameter X 1/16" thickness) are cemented in place. The cell is strapped to a burner for support and aligned in the light beam by use of two 2" by 2" cards. One inch diameter holes are cut in the middle of each card; the cards are then placed over each end of the cell. The cell is then positioned and adjusted vertically and horizontally to give the maximum transmittance.

5.5 Air Pump: Any peristaltic pump capable of delivering 1 liter of air per minute may be used. A Masterflex pump with electronic speed control has been found to be satisfactory.

5.6 Flowmeter: Capable of measuring an air flow of 1 liter per minute.

5.7 Aeration Tubing: A straight glass frit having a coarse porosity. Tygon tubing is used for passage of the mercury vapor from the sample bottle to the absorption cell and return.

5.8 Drying Tube: 6" X 3/4" diameter tube containing 20 g of magnesium perchlorate (see Note 2). The apparatus is assembled as shown in Figure 1.

NOTE 2: In place of the magnesium perchlorate drying tube, a small reading lamp with 60W bulb may be used to prevent condensation of moisture inside the cell. The lamp is positioned to shine on the absorption cell maintaining the air temperature in the cell about 10°C above ambient.

6. Reagents

6.1 Sulfuric Acid, Conc.: Reagent grade.

6.1.1 Sulfuric acid, 0.5 N: Dilute 14.0 ml of conc. sulfuric acid to 1.0 liter.

6.2 Nitric Acid, Conc: Reagent grade of low mercury content (See Note 3).

NOTE 3: If a high reagent blank is obtained, it may be necessary to distill the nitric acid.

6.3 Stannous Sulfate: Add 25 g stannous sulfate to 250 ml of 0.5 N sulfuric acid. This mixture is a suspension and should be stirred continuously during use. (Stannous chloride may be used in place of stannous sulfate.)

6.4 Sodium Chloride-Hydroxylamine Sulfate Solution: Dissolve 12 g of sodium chloride and 12 g of hydroxylamine sulfate in distilled water and dilute to 100 ml. (Hydroxylamine hydrochloride may be used in place of hydroxylamine sulfate.)

6.5 Potassium Permanganate: 5% solution, w/v. Dissolve 5 g of potassium permanganate in 100 ml of distilled water.

6.6 Potassium Persulfate: 5% solution, w/v. Dissolve 5 g of potassium persulfate in 100 ml of distilled water.

6.7 Stock Mercury Solution: Dissolve 0.1354 g of mercuric chloride in 75 ml of distilled water. Add 10 ml of conc. nitric acid and adjust the volume to 100.0 ml. 1 ml = 1 mg Hg.

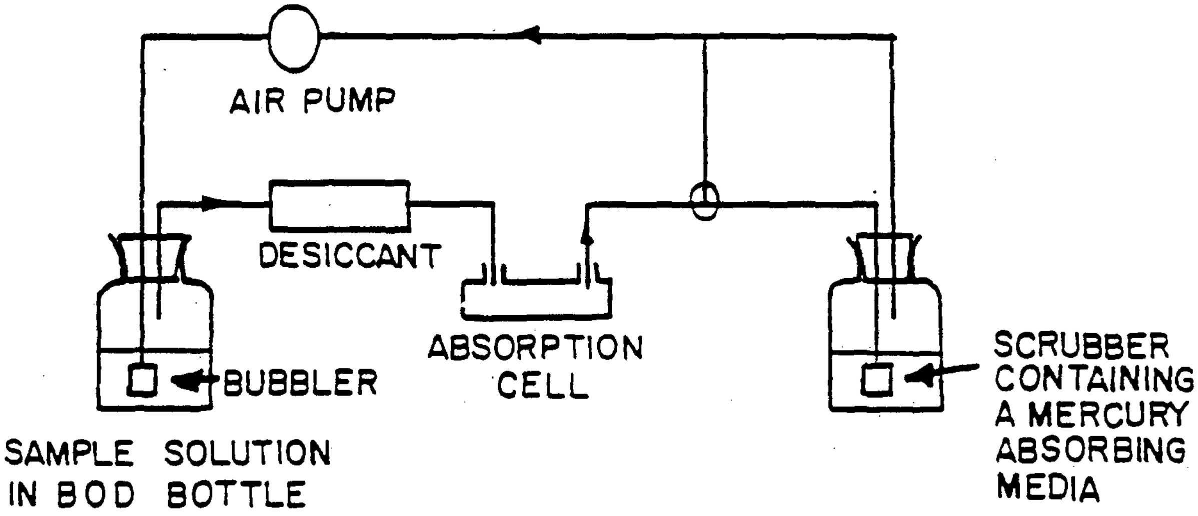

FIGURE 1. APPARATUS FOR FLAMELESS MERCURY DETERMINATION

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6.8 Working Mercury Solution: Make successive dilutions of the stock mercury solution to obtain a working standard containing 0.1 ug per ml. This working standard and the dilutions of the stock mercury solution should be prepared fresh daily. Acidity of the working standard should be maintained at 0.15% nitric acid. This acid should be added to the flask as needed before the addition of the aliquot.

7. Calibration

7.1 Transfer 0, 0.5, 1.0, 2.0, 5.0 and 10.0 ml aliquots of the working mercury solution containing 0 to 1.0 ug of mercury to a series of 300 ml BOD bottles. Add enough distilled water to each bottle to make a total volume of 100 ml. Mix thoroughly and add 5 ml of conc. sulfuric acid (6.1) and 2.5 ml of conc. nitric acid (6.2) to each bottle. Add 15 ml of $KMnO_4$ (6.5) solution to each bottle and allow to stand at least 15 minutes. Add 8 ml of potassium persulfate (6.6) to each bottle and heat for 2 hours in a water bath maintined at 95°C. Cool and add 6 ml of sodium chloride-hydroxylamine sulfate solution (6.4) to reduce the excess permanganate. When the solution has been decolorized wait 30 seconds, add 5 ml of the stannous sulfate solution (6.3) and immediately attach the bottle to the aeration apparatus forming a closed system. At this point the sample is allowed to stand quietly without manual agitation. The circulating pump, which has previously been adjusted to a rate of 1 liter per minute, is allowed to run continuously (See Note 4). The absorbance will increase and reach maximum within 30 seconds. As soon as the recorder pen levels off, approximately 1 minute, open the bypass valve and continue the aeration until the absorbance returns to its minimum value (see Note 5). Close the bypass valve, remove the stopper and frit from the BOD bottle and continue the aeration. Proceed with the standards and construct a standard curve by plotting peak height versus micrograms of mercury.

NOTE 4: An open system where the mercury vapor is passed through the absorption cell only once may be used instead of the closed system.

NOTE 5: Because of the toxic nature of mercury vapor precaution must be taken to avoid its inhalation. Therefore, a bypass has been included in the system to either vent the mercury vapor into an exhaust hood or pass the vapor through some absorbing media, such as:

a) equal volumes of 0.1 M $KMnO_4$ and 10% H_2SO_4

b) 0.25% iodine in a 3% KI solution

A specially treated charcoal that will adsorb mercury vapor is also available from Barnebey and Cheney, E. 8th Ave. and N. Cassidy St., Columbus, Ohio 43219, Cat. #580–13 or #580–22.

8. Procedure

8.1 Transfer 100 ml, or an aliquot diluted to 100 ml, containing not more than 1.0 ug of mercury, to a 300 ml BOD bottle. Add 5 ml of sulfuric acid (6.1) and 2.5 ml of conc. nitric acid (6.2) mixing after each addition. Add 15 ml of potassium permanganate solution (6.5) to each sample bottle. For sewage samples additional permanganate may be required. Shake and add additional portions of potassium permanganate solution, if necessary, until the purple color persists for at least 15 minutes. Add 8 ml of potassium persulfate (6.6) to each bottle and heat for 2 hours in a water bath at 95°C. Cool and add 6

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ml of sodium chloride-hydroxylamine sulfate (6.4) to reduce the excess permanganate. After a delay of at least 30 seconds add 5 ml of stannous sulfate (6.3) and immediately attach the bottle to the aeration apparatus. Continue as described under Calibration.

9. Calculation

9.1 Determine the peak height of the unknown from the chart and read the mercury value from the standard curve.

9.2 Calculate the mercury concentration in the sample by the formula:

$$ug\ Hg/l = \left(\begin{matrix} ug\ Hg\ in \\ aliquot \end{matrix}\right)\left(\frac{1.000}{volume\ of\ aliquot\ in\ ml}\right)$$

9.3 Report mercury concentrations as follows: Below 0.2 *ug*/l, <0.2; between 1 and 10 *ug*/l, one decimal; above 10 *ug*/l, whole numbers.

10. *Precision and Accuracy*

10.1 In a single laboratory (EMSL), using an Ohio River composite sample with a background mercury concentration of 0.35 *u*g/l, spiked with concentrations of 1.0, 3.0 and 4.0 *u*g/l, the standard deviations were ±0.14, ±0.10 and ±0.08, respectively. Standard deviation at the 0.35 level was ±0.16. Percent recoveries at the three levels were 89, 87, and 87%, respectively.

10.2 In a joint EPA/ASTM interlaboratory study of the cold vapor technique for total mercury in water, increments of organic and inorganic mercury were added to natural waters. Recoveries were determined by difference. A statistical summary of this study follows:

Number of Labs	True Values *ug*/liter	Mean Value *ug*/liter	Standard Deviation *ug*/liter	Accuracy as % Bias
76	0.21	0.349	0.276	66
80	0.27	0.414	0.279	53
82	0.51	0.674	0.541	32
77	0.60	0.709	0.390	18
82	3.4	3.41	1.49	0.34
79	4.1	3.81	1.12	-7.1
79	8.8	8.77	3.69	-0.4
78	9.6	9.10	3.57	-5.2

11. Appendix

11.1 While the possibility of absorption from certain organic substances actually being present in the sample does exist, EMSL has not encountered such samples. This is mentioned only to caution the analyst of the possibility. A simple correction that may be used is as follows: If an interference has been found to be present (4.4), the sample should be analyzed both by using the regular procedure and again under oxidizing conditions only,

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that is without the reducing reagents. The true mercury value can then be obtained by subtracting the two values.

11.2 If additional sensitivity is required, a 200 ml sample with recorder expansion may be used provided the instrument does not produce undue noise. Using a Coleman MAS-50 with a drying tube of magnesium perchlorate and a variable recorder, 2 mv was set to read full scale. With these conditions, and distilled water solutions of mercuric chloride at concentrations of 0.15, 0.10, 0.05 and 0.025 ug/1 the standard deviations were ±0.027, ±0.006, ±0.01 and ±0.004. Percent recoveries at these levels were 107, 83, 84 and 96%, respectively.

11.3 Directions for the disposal of mercury-containing wastes are given in ASTM Standards, Part 31, "Water", p 349, Method D3223 (1976).

Bibliography

1. Kopp, J. F., Longbottom, M. C. and Lobring, L. B., "Cold Vapor Method for Determining Mercury", AWWA, vol 64, p. 20, Jan., 1972.
2. Annual Book of ASTM Standards, Part 31, "Water", Standard D3223–73, p 343 (1976).
3. Standard Methods for the Examination of Water and Wastewater, 14th Edition, p 156 (1975).

MERCURY IN SEDIMENT

Method 245.5 (Manual Cold Vapor Technique)

1. Scope and Application
   - 1.1 This procedure(1) measures total mercury (organic + inorganic) in soils, sediments, bottom deposits and sludge type materials.
   - 1.2 The range of the method is 0.2 to 5 ug/g. The range may be extended above or below the normal range by increasing or decreasing sample size or through instrument and recorder control.
2. Summary of Method
   - 2.1 A weighed portion of the sample is digested in aqua regia for 2 minutes at 95°C, followed by oxidation with potassium permanganate. Mercury in the digested sample is then measured by the conventional cold vapor technique.
   - 2.2 An alternate digestion(2) involving the use of an autoclave is described in (8.2).
3. Sample Handling and Preservation
   - 3.1 Because of the extreme sensitivity of the analytical procedure and the omnipresence of mercury, care must be taken to avoid extraneous contamination. Sampling devices and sample containers should be ascertained to be free of mercury; the sample should not be exposed to any condition in the laboratory that may result in contact or air-borne mercury contamination.
   - 3.2 While the sample may be analyzed without drying, it has been found to be more convenient to analyze a dry sample. Moisture may be driven off in a drying oven at a temperature of 60°C. No mercury losses have been observed by using this drying step. The dry sample should be pulverized and thoroughly mixed before the aliquot is weighed.
4. Interferences
   - 4.1 The same types of interferences that may occur in water samples are also possible with sediments, i.e., sulfides, high copper, high chlorides, etc.
   - 4.2 Volatile materials which absorb at 253.7 nm will cause a positive interference. In order to remove any interfering volatile materials, the dead air space in the BOD bottle should be purged before the addition of stannous sulfate.
5. Apparatus
   - 5.1 Atomic Absorption Spectrophotometer (See Note 1): Any atomic absorption unit having an open sample presentation area in which to mount the absorption cell is suitable. Instrument settings recommended by the particular manufacturer should be followed.

     NOTE 1: Instruments designed specifically for the measurement of mercury using the cold vapor technique are commercially available and may be substituted for the atomic absorption spectrophotometer.

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5.2 Mercury Hollow Cathode Lamp: Westinghouse WL-22847, argon filled, or equivalent.

5.3 Recorder: Any multi-range variable speed recorder that is compatible with the UV detection system is suitable.

5.4 Absorption Cell: Standard spectrophotometer cells 10 cm long, having quartz end windows may be used. Suitable cells may be constructed from plexiglass tubing, 1" O.D. X 4-1/2". The ends are ground perpendicular to the longitudinal axis and quartz windows (1" diameter X 1/16" thickness) are cemented in place. Gas inlet and outlet ports (also of plexiglass but 1/4" O.D.) are attached approximately 1/2" from each end. The cell is strapped to a burner for support and aligned in the light beam to give the maximum transmittance.

NOTE 2: Two 2" X 2" cards with one inch diameter holes may be placed over each end of the cell to assist in positioning the cell for maximum transmittance.

5.5 Air Pump: Any peristaltic pump capable of delivering 1 liter of air per minute may be used. A Masterflex pump with electronic speed control has been found to be satisfactory. (Regulated compressed air can be used in an open one-pass system.)

5.6 Flowmeter: Capable of measuring an air flow of 1 liter per minute.

5.7 Aeration Tubing: Tygon tubing is used for passage of the mercury vapor from the sample bottle to the absorption cell and return. Straight glass tubing terminating in a coarse porous frit is used for sparging air into the sample.

5.8 Drying Tube: 6" X 3/4" diameter tube containing 20 g of magnesium perchlorate (See Note 3). The apparatus is assembled as shown in the accompanying diagram.

NOTE 3: In place of the magnesium perchlorate drying tube, a small reading lamp with 60W bulb may be used to prevent condensation of moisture inside the cell. The lamp is positioned to shine on the absorption cell maintaining the air temperature in the cell about 10°C above ambient.

6. Reagents

6.1 Aqua Regia: Prepare immediately before use by carefully adding three volumes of conc. HCl to one volume of conc. HNO_3.

6.2 Sulfuric Acid, 0.5 N: Dilute 14.0 ml of conc. sulfuric acid to 1 liter.

6.3 Stannous Sulfate: Add 25 g stannous sulfate to 250 ml of 0.5 N sulfuric acid (6.2). This mixture is a suspension and should be stirred continuously during use.

6.4 Sodium Chloride-Hydroxylamine Sulfate Solution: Dissolve 12 g of sodium chloride and 12 g of hydroxylamine sulfate in distilled water and dilute to 100 ml.

NOTE 4: A 10% solution of stannous chloride may be substituted for (6.3) and hydroxylamine hydrochloride may be used in place of hydroxylamine sulfate in (6.4).

6.5 Potassium Permanganate: 5% solution, w/v. Dissolve 5 g of potassium permanganate in 100 ml of distilled water.

6.6 Stock Mercury Solution: Dissolve 0.1354 g of mercuric chloride in 75 ml of distilled water. Add 10 ml of conc. nitric acid and adjust the volume to 100.0 ml. 1.0 ml = 1.0 mg Hg.

6.7 Working Mercury Solution: Make successive dilutions of the stock mercury solution (6.6) to obtain a working standard containing 0.1 ug/ml. This working standard and the dilution of the stock mercury solutions should be prepared fresh daily. Acidity of the

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working standard should be maintained at 0.15% nitric acid. This acid should be added to the flask as needed before the addition of the aliquot.

7. Calibration

7.1 Transfer 0. 0.5. 1.0. 2.0. 5.0 and 10 ml aliquots of the working mercury solution (6.7) containing 0 to 1.0 ug of mercury to a series of 300 ml BOD bottles. Add enough distilled water to each bottle to make a total volume of 10 ml. Add 5 ml of aqua regia (6.1) and heat 2 minutes in a water bath at 95°C. Allow the sample to cool and add 50 ml distilled water and 15 ml of $KMnO_4$ solution (6.5) to each bottle and return to the water bath for 30 minutes. Cool and add 6 ml of sodium chloride-hydroxylamine sulfate solution (6.4) to reduce the excess permanganate. Add 50 ml of distilled water. Treating each bottle individually, add 5 ml of stannous sulfate solution (6.3) and immediately attach the bottle to the aeration apparatus. At this point, the sample is allowed to stand quietly without manual agitation. The circulating pump, which has previously been adjusted to rate of 1 liter per minute, is allowed to run continuously. The absorbance, as exhibited either on the spectrophotometer or the recorder, will increase and reach maximum within 30 seconds. As soon as the recorder pen levels off, approximately 1 minute, open the bypass value and continue the aeration until the absorbance returns to its minimum value (See Note 5). Close the bypass value, remove the fritted tubing from the BOD bottle and continue the aeration. Proceed with the standards and construct a standard curve by plotting peak height versus micrograms of mercury.

NOTE 5: Because of the toxic nature of mercury vapor precaution must be taken to avoid its inhalation. Therefore, a bypass has been included in the system to either vent the mercury vapor into an exhaust hood or pass the vapor through some absorbing media, such as:

a) equal volumes of 0.1 N $KMnO_4$ and 10% H_2SO_4

b) 0.25% iodine in a 3% KI solution.

A specially treated charcoal that will absorb mercury vapor is also available from Barnebey and Cheney, E. 8th Ave., and North Cassidy St., Columbus, Ohio 43219, Cat. #580–13 or #580–22.

8. Procedure

8.1 Weigh triplicate 0.2 g portions of dry sample and place in bottom of a BOD bottle. Add 5 ml of distilled water and 5 ml of aqua regia (6.1). Heat 2 minutes in a water bath at 95°C. Cool, add 50 ml distilled water and 15 ml potassium permanganate solution (6.5) to each sample bottle. Mix thoroughly and place in the water bath for 30 minutes at 95°C. Cool and add 6 ml of sodium chloride-hydroxylamine sulfate (6.4) to reduce the excess permanganate. Add 55 ml of distilled water. Treating each bottle individually, add 5 ml of stannous sulfate (6.3) and immediately attach the bottle to the aeration apparatus. Continue as described under (7.1).

8.2 An alternate digestion procedure employing an autoclave may also be used. In this method 5 ml of conc. H_2SO_4 and 2 ml of conc. HNO_3 are added to the 0.2 g of sample. 5 ml of saturated $KMnO_4$ solution is added and the bottle covered with a piece of aluminum foil. The samples are autoclaved at 121°C and 15 lbs. for 15 minutes. Cool, make up to a volume of 100 ml with distilled water and add 6 ml of sodium chloride-hydroxylamine sulfate solution (6.4) to reduce the excess permanganate. Purge the dead air space and continue as described under (7.1).

9. Calculation

9.1 Measure the peak height of the unknown from the chart and read the mercury value from the standard curve.

9.2 Calculate the mercury concentration in the sample by the formula:

$$\mu g\ Hg/g = \frac{\mu g\ Hg \text{ in the aliquot}}{\text{wt of the aliquot in gms}}$$

9.3 Report mercury concentrations as follows: Below 0.1 ug/gm, <0.1; between 0.1 and 1 ug/gm, to the nearest 0.01 ug; between 1 and 10 ug/gm, to nearest 0.1 ug; above 10 ug/gm, to nearest ug.

10. Precision and Accuracy

10.1 The following standard deviations on replicate sediment samples were recorded at the indicated levels; 0.29 ug/g ±0.02 and 0.82 ug/g ±0.03. Recovery of mercury at these levels, added as methyl mercuric chloride, was 97% and 94%, respectively.

Bibliography

1. Bishop, J. N., "Mercury in Sediments", Ontario Water Resources Comm., Toronto, Ontario, Canada, 1971.
2. Salma, M., private communication, EPA Cal/Nev Basin Office, Almeda, California.

APPENDIX C

Administrative Consent Order of August 31, 1981 by
State of New Jersey Department of Environmental
Protection to Linden Chemicals & Plastics, Inc.

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STATE OF NEW JERSEY
DEPARTMENT OF ENVIRONMENTAL PROTECTION
OFFICE OF THE COMMISSIONER
P. O. BOX 1390
TRENTON, N. J. 08625
609-292-2885

September 18, 1981

Ronald J. Burkett
Vice President, Technical
Linden Chemicals & Plastics, Inc.
Raritan Plaza II
Raritan Center
Edison, New Jersey 08837

Dear Mr. Burkett:

Enclosed please find an original and one copy of the executed Administrative Consent Order concerning the hazardous waste treatment and disposal practices of LCP Chemicals - N.J., Inc.

As always, your courtesies in arriving at an amicable solution of this matter have been appreciated.

The Department's solid waste and waste pollution personnel will continue to work closely with your staff on the expeditious implementation of this Order.

Very truly yours,

Keith A. Onsdorff
Chief, Office of Enforcement

KAO:jb
Enclosure

cc: Jack Stanton
Lee Pereira
Ralph Pasceri
Frank Coolick
Ron Corcory
Michael Diamond
Kathy McBride

CERTIFIED MAIL NO. P18 4219752
RETURN RECEIPT REQUESTED

Ref. No 10, p. 48 of 52

100% RECYCLED

STATE OF NEW JERSEY
DEPARTMENT OF ENVIRONMENTAL PROTECTION
STEVEN J. PICCO, ASSISTANT COMMISSIONER
REGULATORY & GOVERNMENTAL AFFAIRS
P.O. BOX 1390
TRENTON, N.J. 08625
609 - 292 - 9289

(IN THE MATTER OF)
(LINDEN CHEMICALS & PLASTICS, INC.)

ADMINISTRATIVE CONSENT
ORDER

The following ADMINISTRATIVE CONSENT ORDER is issued pursuant to the authority vested in the Commissioner of the New Jersey Department of Environmental Protection (hereinafter "the Department") and duly delegated to the Director, Division of Environmental Quality, pursuant to his authority under the Solid Waste Management Act, N.J.S.A. 13:1E-1 et seq.

FINDINGS

1) Linden Chemicals & Plastics, Inc. (hereinafter "LCP" or "the company") located in the City of Linden, County of Union, and State of New Jersey has been and is continuing to operate a Hazardous Waste Facility (hereinafter "brine sludge lagoon") by lagooning mercury contaminated brine sludge at the LCP Linden Plant, being more specifically described as Lot 3 of Block 587 on the Tax Map of the City of Linden.

2) LCP also has another lagoon containing mercury contaminated sludge located on the above specified premises, known as the Chem-fix lagoon, which was used for test purposes for four days in 1976 and has not since been operated.

3) LCP has constructed and operated from time to time a mercury brine sludge roaster designed to recapture and recycle the useful portion of this waste.

ORDER

NOW, THEREFORE, by mutual agreement of the parties hereto, Linden Chemicals & Plastics, Inc., is HEREBY ORDERED to undertake the following remedial measures with respect to its Linden Plant's hazardous waste disposal practices:

Ref No 10, F - 49 of 52

(1) LCP has submitted a complete application, engineering report and design plans for its hazardous waste (roaster) treatment facility. The Department shall endeavor to fully complete the required administrative procedures and render its final decision on this brine sludge roaster application by September 15, 1981.

(2) During the period of time that said application is pending final decision by the SWA, LCP may continue to deposit its brine sludge waste generated at this Linden plant into the above referenced on-site brine sludge lagoon so long as compliance with all the terms and conditions of this Administrative Consent Order are maintained by the company. LCP shall submit written bi-weekly progress reports detailing all actions taken in furtherance of its obligations pursuant to this agreement over the reporting period, said reporting obligations to commence August 5, 1981.

(3) Upon the Department's issuance of its final decision regarding LCP's application for approval of the brine sludge roaster, the company shall forthwith cease depositing these wastes into the on-site brine sludge lagoon. If said decision is affirmative, LCP may commence utilization of its roaster to treat these wastes; but if same should be negative, then the company shall have 10 working days from receipt of this denial to arrange for off-site disposal of this hazardous waste material at a State or federally approved treatment and/or disposal facility. LCP reserves the right, however, to appeal from any negative decision by the DEP regarding the licensing of the roaster. Furthermore, LCP may petition the Department for an extension of the aforesaid 10 day deadline should off-site disposal require additional time to be implemented. In the event that the Department approves operation of LCP's brine sludge roaster, the company may continue to deposit these wastes into the existing on-site brine sludge lagoon whenever the roaster is removed from operations to be serviced, until the Department completes its review of the brine sludge lagoon closure plan to be submitted by LCP in accordance with the terms of paragraph #4. This authorization for continued use of the existing on-site brine sludge lagoon is expressly contingent upon the environmental evaluation, to be conducted by the company, conclusively showing that the operation and maintenance of the brine sludge lagoon will not cause a violation of any applicable air or water emission and/or ambient quality standard.

cdff
or until
Jan.1, 19
whichever
later,

(4) Whether the decision is affirmative or negative, LCP, upon receipt of the Department's final decision on said roaster application, shall by no later than 45 days thereafter submit to the SWA an application for the proper, final closure of the existing brine sludge lagoon. Said closure plan, signed and sealed by a licensed New Jersey Professional Engineer, shall provide for the final disposition of all wastes previously deposited into this on-site brine lagoon either by entombment or by complete excavation for ultimate disposal in a manner approved by the Department. Should LCP propose closure of this brine sludge lagoon via entombment, the company must provide sufficient revenues placed into an escrow account or surety bond, to allow for a monitoring system for the RCRA

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legally required period of time to be used to verify the continuous integrity of said full containment system. The closure plan shall be reviewed and evaluated in accordance with the requirements of all applicable federal and State regulations governing such facilities.

(5) By no later than 45 days from the date of execution of this agreement, the company shall submit to the SWA an application for the proper, final closure of the Chem-fix lagoon, which closure plan shall be prepared in accordance with all the requirements as specified hereinabove in paragraph four.

(6) In order to fully evaluate all potential avenues of mercury and other metals release into the ambient environment from the operation and maintenance of the aforesaid on-site brine sludge lagoon, LCP shall undertake forthwith the following monitoring program, which shall include but not necessarily be limited to below listed tasks:

a. ambient air monitoring of the on-site brine lagoon to measure for mercury emissions from said waste stockpile. The mobile air monitoring device shall be approved in advance by the DEP and be calibrated to record mercury levels in nanograms per cubic meter of air;

b. installation of a sufficient number of groundwater monitoring wells as required to fully delineate the impacts, if any, of the brine sludge lagoon upon the soils and waters situated in the vicinity of the brine sludge lagoon, in addition to evaluating any impacts upon the tributary flowing into the South Branch Creek and the Creek itself. Twin or cluster well installations shall be drilled if necessary to obtain screen access to all different water bearing zones in the aquifer.

c. a soils boring protocol and water sampling routine as required to obtain a determination of whether the brine sludge lagoon and/or the chem-fix lagoon has or is presently contaminating the ground or surface waters of the State of New Jersey by release of any of the pollutants presently contained therein. Said protocol and routine shall encompass preparation of a water chemistry map and soils permeability calculations — taken at a minimum of every five foot depth and at every change in the lithology utilizing split spoon sampling techniques.

Should the aforesaid evaluation determine that such contamination has or is occurring, then the company shall prepare a groundwater contour map as part of its program to delineate the full extent of the contamination of these soils and waters and the direction if its migration, if any;

d. all stream sediment samples shall be obtained at several depths beginning at the surface and continuing until the sampling instrument meets substantial resistance. At least one composite soil sample shall be obtained from a minimum of six separate locations in the vicinity of the roaster. All soil samples shall be analyzed by the company for mercury content by dry weight total mercury content;

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e. all surface water samples shall be obtained at low tide and both surface and groundwater samples shall be obtained as split samples and analyzed by the company for total mercury content by wet weight. The duplicate sample shall be retained by the company for subsequent analysis by a certified private laboratory at its sole cost should confirmation be deemed warranted in the discretion of the Department. All wells shall also be sampled at least once for the presence of calcium carbonate, barium sulfate, iron hydroxide, calcium sulfate conductivity and pH, in accordance with the aforesaid analytical protocol where applicable;

f. the purging and bailing procedures for all monitoring wells shall be approved by the Department in advance and a representative of the DEP shall be on-site for the commencement of the soils boring program and thereafter at his discretion;

g. the elevations to sea level of the tops of all the monitoring wells shall be determined by a New Jersey licensed surveyor;

h. no later than 30 days after completion of the aforesaid evaluation, all findings and data generated thereby shall be provided to the Department in writing, along with recommendations for all further monitoring as deemed necessary to complete the requirements as set forth in paragraph d.

RESERVATION OF RIGHTS

(7) It is expressly understood and AGREED by the parties hereto that the execution of this Administrative Consent Order does not waive any rights or obligations of either of them to protect the environment from pollution emanating from the industrial activites of LCP as required by all applicable State, federal and local laws, rules and regulations pertaining to these activities conducted at its Linden facility, with the sole exception of the SWA's registration requirements which shall be complied with as set forth hereinabove.

(8) LCP and the DEP hereby consent and agree to comply with all the terms and provisions of this Administrative Consent Order, which shall be fully enforceable in the Superior Court of New Jersey and also may be enforced in the same fashion as an Administrative Order issued pursuant to N.J.S.A. 13:1E-1 et seq.

(9) LCP hereby waives its right to an administrative hearing on the subject matter of this Order.

CAHansen - Sept 1, 1981

C.A. Hansen, Jr.
President
Linden Chemicals & Plastics, Inc.

Date: 9/17/81

John J. Stanton, Director
Division of Environmental Quality
Department of Environmental
Protection

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REFERENCE NUMBER 11

CLOSURE AND POST-CLOSURE PLAN
FOR BRINE-SLUDGE LAGOON
LCP CHEMICALS - N.J., INC., LINDEN, N.J.

ENGINEERING

JULY 16, 198

Ref. No. 11, p. 1 of 161

CLOSURE AND POST-CLOSURE PLAN
FOR BRINE-SLUDGE LAGOON
LCP CHEMICALS - N.J., INC., LINDEN, N.J.

INTRODUCTION

CP Chemicals - N.J., Inc. intends to close a Brine Sludge Lagoon RCRA Facility No. NJD 079303020) on its property at Linden, N.J., in ccord with this plan which complies with 40 CFR 265.110 and minimizes he post closure escape of hazardous constituents to the environment.

FACILITY DESCRIPTION

he LCP Brine Sludge Lagoon "the facility" received mercury contaminated aste generated in the electrolysis of sodium chloride to make chlorine.

he facility is located near the northeast corner of the LCP plant site Lot 3; Block 587) adjacent to the tidal South Branch Creek. The lagoon as constructed prior to LCP Chemical's purchase of the site in 1972. he facility is triangular in shape with a total surface area of approx- mately 33,500 square feet. LCP has modified its process stream to elim- nate this hazardous component and to reduce the volume of process waste to ermit the offsite removal of drummed waste. The generation of brine muds K-071) was terminated in March 1982. LCP has completed the process of ushing the plant's waste lines to the facility. The waste inventory as arch 1982 is 22,000 cubic yards. The contents of an experimental chem- ix lagoon will be excavated and placed into the Brine-Sludge lagoon prior o closure (Chem fix Lagoon closure plan submitted October 30, 1981.)

he facility is surrounded by earth dikes that are approximately 10 feet igher than the average plant ground elevation and approximately 15 feet igher than the creek high tide level. The dikes show no evidence of leak- ge, erosion, or slumping. The dike tops are graded so that rainwater runs nto a trench on the inner dike margin and flows into the facility. A pump- ng station located at the eastern corner of the facility was used to return ater to the plant after the solids settled out.

JUSTIFICATION FOR IN-PLACE CLOSURE

is facility has been operated for approximately 15 years. Down-gradient onitoring wells located in the immediate vicinity of the facility have ot intercepted contamination migrating from the facility (see Appendix A - onitoring Well Water Analyses.) The waste material is of a dense and low ermeable nature. The absence of ground-water contamination in the saturatec one surrounding the facility provides sufficient evidence to indicate at the 40 CFR 265.111 closure standard can be satisfied with the waste aterial remaining in place after closure.

Summary of Results

Independent Well Results

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indicated in Appendix A, contamination of ground water is not evi-nt. To ensure the indefinite integrity of this waste site, review s made of potential disturbance that could effect the site and more ecifically, disturbance resulting from:

. Erosion resultant from waste settling due to inadequate dewatering d compaction. The specific details outlined under Physical Closure: tivities and Specifications have been designed to: 1) eliminate the tential of erosion from settling, and 2) minimize the cost of main-nance.

. Purposefull modification. From a view point of realistic economics nsidering the area occupied by the site, the inaccessibility of the site three sides due to permanent structures and natural barriers, it is likely that economic justification would ever be proposed to modify e site for other purposes.

. Vandalism/Sabotage. The existing site location is inaccessible ex-pt through facilities of LCP Chemicals and Northville Terminal Industries. th facilities are protected by a chain link fence to impede any potential truder. Both facilities are manned on an round-the-clock basis with per-nnel cognizant of and responsible for elimination of a potential in-uder.

RCRA SUBPART G CLOSURE PLAN (40 CFR 265.110)

eneral Nature of Facility Closure

P will close the facility with the waste material in place. The facility s inactive and will be closed as a unit (no partial closure.)

RCRA ground-water monitoring system is in place at the facility with wells ocated at three downgradient locations close to the hazardous waste acility boundary. These wells are screened in unconsolidated material to etect hazardous constituents migrating from the facility in the ground ater. The monitoring data from these wells indicate that the facility as not leaked. The absence of mercury and mercury-related contaminants n ground water at the downgradient facility boundary demonstrates that he facility has not contaminated the ground water and there is a suffi-iently low potential for migration to justify closure in place.

ANTICIPATED CLOSURE SCHEDULE

CP cannot know the precise date that the Regional Administrator will ap-rove this plant before the fact. This closure schedule identifies pro-ect milestones and estimated time using target dates from the anticipated ate that the Regional Administrator approves the closure plan.

Independent

tivity (Milestone)	Target Dates
A Approval	October 1982
location of Chem-fix sludge in Brine-Sludge Lagoon	January 1983
watering completed	5/83 - 9/83
contouring equipment decontaminated	September 1983
ste compaction	9/83 - 4/84
acement of final cover initiated	April 1984
acement of final cover completed	August 1984
nal cover graded and planted	September 1984
ysical equipment decontamination	September 1984
gineer's certification	September 1984

TE: Should the RA require changes in this closure plant pursuant to the EPA's review (40 CFR 265.112(c)), LCP may have to amend the estimated schedule.

DECOMMISSIONING AND DECONTAMINATION OF EQUIPMENT AND STRUCTURES

e following equipment and structures are associated with the facility:

- 600 feet of 4 inch steel pipe
- Two Durco 4x3 stainless steel centrifugal pumps
- Plywood pumphouse on concrete slab

P plans the following decommissioning and decontamination activities:

- All pipe will be excavated as necessary, manually disassembled or cut with a torch. Decontaminated pipe will be sold as scrap.

- Pumps will be decontaminated and reused by LCP.

- The plywood pumphouse will be dismantled and placed in the facility prior to cover.

- The concrete slab will be decontaminated, washed, and left in place.

econtamination will be accomplished by high pressure washing with water nd HCl or water and HGX (a compound that binds mercury.) Pipe, pumps, nd earth moving equipment used in the physical closure will be decontaminated in the LCP plant. Wash water will be sent to the plant's wasteater treatment plant (A NPDES permitted facility.) LCP personnel will arry out decontamination activities and will be supervised by the LCP lant Engineer.

The target dates for closure milestones take into account the seasonal factors of temperature and precipitation that are critical to the proper execution of each closure operation in regard to performance standards. Hence changes in the RA approval date might require substantial revision of the closure schedule.

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GAS & LEACHATE COLLECTION SYSTEMS

e are required since the waste will not generate gasses or leachate.

PROTECTION AGAINST FLOODING

facility is located in an area classified as "flood prone" by the . Geological Survey (Arthur Kill quadrangle, 1973.) The area where ndation is predicted during a "100-year" flood coincides with the foot elevation contour with respect to mean sea level. The grade vation near the facility is approximately 8 feet, and the facility es extend another 10 to 12 feet above grade. The facility would not inundated even if the "100-year" flood elevation were exceeded by 50 cent. As part of this closure, LCP will protect the dike on all three es by covering it with clay to a minimum thickness of 1 foot, followed an additional 18" of rip rap. These costs are reflected in the closure t estimate.

POST CLOSURE MAINTENANCE AND INSPECTION

t closure maintenance will consist of the care and renovation of both soil and vegetative cover as necessary to prevent erosion. The site l be inspected by LCP personnel on a weekly basis and repairs to the er, surface draingage system and/or the dikes will be made on an as- ded basis.

P does not anticipate using the closed area. As the closed facility l not be used, the integrity of the cap and cover is not jeopardized.

e facility is located at an industrial site that is fenced for security poses. The site is not accessible to the public or to livestock or estic animals. Contact with the closed facility will not pose a risk persons or animals.

pendent upon the type of vegetative cover utilized, and the care require- nts of same, LCP estimates the total cost of inspection, vegetative care, d necessary maintenance not to exceed $10,000 annually.

POST CLOSURE MONITORING PLAN

ound-water monitoring wells are in place as required by 40 CFR 265.91 d 265.117. Monitoring for the following constituents will be performed ring the first post closure year:

	Times Per Year	Replicates	Total Analyses
Barium	4	1	4
Cadmium	4	1	4
Lead	4	1	4
Mercury	4	1	4
Silver	4	1	4
Chloride	4	1	4
Sodium	4	1	4
Sulphate	4	1	4
	4	1	4
Specific Conductance	4	1	4

Monitoring for the following constituents will be implemented after the first monitoring year

Chloride	2	1	2
Mercury	2	1	2
Sodium	2	1	2
	2	1	2
ecific Conductance	2	1	2

is monitoring program does not preclude LCP's petition for relief rsuant to 40 CFR 265.117(d).

PHYSICAL CLOSURE: ACTIVITIES AND SPECIFICATIONS

e physical closure of the facility will entail the following steps:

- The facility will be dewatered by pumping standing liquid to the LCP waste treatment plant (a NPDES facility.) Estimated volume is 50,000 to 70,000 gallons. Nature of the materials in the lower areas of the lagoon are such that the top 12-18 inches of material typicall retain moisture for a significant period of time. To eliminate the potential of any further settling as a result of this phenomenon, material in these lower areas will be systematically spread over the higher areas of the lagoon in thin layers to maximize dewatering. These lower areas will then be filled with dry dewatered material from the higher areas, mechanically compacted, and sloped to ensure rain water runoff. This procedure is expected to take 4 months, after which near final contouring will take shape and final mechanical compaction. Several months of natural settling, followed by a final mechanical compaction will ~~occur prior to ca~~pping.

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Collection of rain water runoff during this dewatering, compaction and contouring phase will be via the perimeter collection system presently in existence.

Elimination of any collected runoff will be through the LCP Waste Treatment plant (an NPDES Permitted facility.)

- Two feet of clay (with maximum permeability rate of 1 x 10-7 cm/sec) will be placed in maximum lifts of 6 inches and compacted to 90% minimum per ASTM D-1557 Method C.
- A 1-foot thick layer of soil will cover the clay cap, the top 6 inches of soil will be capable of supporting vegetation. The bottom 6 inches will be designed to provide adequate drainage. Total estimated volume of soil is 2,500 cubic yards.
- A vegetative cover approved by the NJDEP will be seeded as soon as seasonal conditions permit.

Final grading shall facilitate drainage with a maximum final top grade of at least 5%. Where this grade cannot be achieved, the final grade will be suitably terraced.

The clay cap and soil cover shall comply with general closure requirements (NJAC 7:26-9.8).

ESTIMATED CLOSURE COST (1982 DOLLARS)

estimates the cost of physical closure as follows:

Dewatering	$21,000
Reinforce north, east, and south banks using approximately 900 cubic yards of off-site clay (permeability of 10-7 cm/sec)	14,000
Recontour sludge prior to capping	20,000
Supply and install 2-foot thick clay cap	65,000
Supply and install 3-foot thick soil cover, fertilize, seed, and mulch	45,000
Decommission and decontaminate pipe, pump & pumphouse	2,000
Decontaminate equipment used in closure program	1,000
Plus 15 percent contingency override	25,200
Estimated Closure Cost	$193,200

WEEKLY INSPECTION REPORT
WASTE ENTOMBMENT

TE ______________ TIME ______________ TEMP. ____________ TIDE LEVEL ________

EMBANKMENT

	ERROSION Yes	ERROSION No	DISPLACED RIP RAP Yes	DISPLACED RIP RAP No	COMMENT
E. Side	☐	☐	☐	☐	____________
S. Side	☐	☐	☐	☐	____________
W. Side	☐	☐	☐	☐	____________

SIDE SLOPES

	ERROSION Yes	ERROSION No	Bare Spots Yes	Bare Spots No	COMMENT
E. Side	☐	☐	☐	☐	____________
S. Side	☐	☐	☐	☐	____________
W. Side	☐	☐	☐	☐	____________

	VEGETATION	SECURITY
E. Side	________ " Height	Fence Condition ____________
S. Side	________ " Height	Fence Condition ____________
W. Side	________ " Height	Fence Condition ____________

RIMETER ROADWAY CONDITION ______________________________

____

TION TAKEN

	YES	NO
pair Order Written	☐	☐
pair Order Number ______________		
rkman Assigned	☐	☐
rk Duration ______________ (hours)		
ntractor Notified	☐	☐
ntractor P.O. # ______________		
pair Work Scheduled __/__/____		

spected by: ______________________

proved by: ______________________

(Manager, ~~Operations~~)

STRUCTION: Comments must be specific.
- Errosion to be defined by depth, width, and length in inches.
- Bare spots, displaced rip rap, and roadway deterioration to be defined in sq. ft.

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DISSOLVED Hg CONCENTRATIONS IN GROUND WATER

SAMPLES (CONCENTRATIONS IN MG/L OR PPM)

Done By Sample Date	LCP 10-6-81	LCP 10-15-81	LCP 2-6-82	ETC 3-15-82	LCP 6-14-82
Well #					
1	< 0.0002	0.0006	0.0006	0.0006	0.0006
1A	< 0.0002	0.0009	0.0009		0.0005
2	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
3	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
4	< 0.0002	< 0.0002	< 0.0002		< 0.0002
5	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002

Drinking Water Standard = 0.002

Equipment Limit .0002

Equipment Specification
Perkin Elmer
Mod 50A
Cold Vapor Method

Ref. No. 11, p. 90f 161

ETC ENVIRONMENTAL
TESTING and CERTIFICATION

April 21, 1982

TECHNICAL REPORT

for

LCP CHEMICALS, NJ INC.
SOUTH WOOD AVE.
LINDEN, NJ 07036

on

Analysis of
LCP Chemicals, NJ Inc.
Sample Well #3

ETC Sample Number 001342
Order Number 0251

prepared by

Denis C. K. Lin, PhD.
Vice President
Research/Operations

Ref. No. 11, p. 1 of 161

ETC ENVIRONMENTAL TESTING and CERTIFICATION CORPORATION

DENIS C.K. LIN, Ph.D.
Vice President
Research and Operations

April 21, 1982

Mr. John Downes
Manager
Engineering and Technical Services
LCP Chemicals, NJ Inc.
South Wood Ave.
Linden, NJ 07036

Dear Mr. Downes:

We at ETC are pleased to submit the attached laboratory reports in response to your testing requirements. The analyses were performed by my staff and we are confident that you will find the results are of the highest quality.

If you have any questions regarding your report, we encourage you to contact our Customer Service organization (201/225-5600) and they will coordinate your request with appropriate laboratory personnel. You are also invited to visit with either Swep Davis or Henry Beal, Esq., if you have any questions regarding the regulatory or the legal aspects of your project. Dr. George Vander Velde is also available to assist you in defining the requirements for future testing programs.

All of us at ETC welcome your next call if we can be of further service to your organization in the future.

Sincerely

Denis C. K. Lin, PhD.
Vice President
Research/Operations

DCKL:mam

Attachments

1 of 161

284 RARITAN CENTER PARKWAY • EDISON, NJ 08837 (201) 225-5600

ETC ENVIRONMENTAL TESTING and CERTIFICATION

April 21, 1982

TECHNICAL REPORT

for

LCP CHEMICALS, NJ INC.
SOUTH WOOD AVE.
LINDEN, NJ 07036

on

Analysis of
LCP Chemicals, NJ Inc.
Sample Well ~~#4~~ 5

ETC Sample Number 001343
Order Number 0251

prepared by

Denis C. K. Lin, PhD.
Vice President
Research/Operations

ETC ENVIRONMENTAL TESTING and CERTIFICATION CORPORATION

DENIS C.K. LIN, Ph.D.
Vice President
Research and Operations

April 21, 1982

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Manager
Engineering and Technical Services
LCP Chemicals, NJ Inc.
South Wood Ave.
Linden, NJ 07036

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Sincerely,

Denis C. K. Lin, PhD.
Vice President
Research/Operations

DCKL:mam

Attachments

TABLE OF CONTENTS

INTRODUCTION

This report contains the analytical results on your sample, Well #1, submitted on March 15, 1982. In your order, Tot~~d~~al Organic Halide analysis (TOX) was requested on this sample. However, due to the sample matrix it was not possible to obtain meaningful data.

The results we obtained on your sample are presented in a tabular format immediately after this introduction. Following the sample results, the quality assurance data on your specific sample are tabulated to verify the validity of the results obtained. Also presented in the quality assurance data report is the chain-of-custody record.

The established methods we used in the analysis of your sample are described in the Methodology section after the Results. In the analysis we followed a rigidly controlled Quality Assurance Protocol. This Protocol is described after the Methodology section.

We hope our report format is useful in assisting you to obtain pertinent information on your sample.

TC ENVIRONMENTAL
TESTING and CERTIFICATION

April 21, 1982

TECHNICAL REPORT

for

LCP CHEMICALS, NJ INC.
SOUTH WOOD AVE.
LINDEN, NJ 07036

on

Analysis of
LCP Chemicals, NJ Inc.
Sample Well #1

ETC Sample Number 001340
Order Number 0251

prepared by

Denis C. K. Lin, PhD.
Vice President
Research/Operations

TC ENVIRONMENTAL TESTING and CERTIFICATION CORPORATION

S C.K. LIN, Ph.D.
ice President
ch and Operations

April 21, 1982

Mr. John Downes
Manager
Engineering and Technical Services
LCP Chemicals, NJ Inc.
South Wood Ave.
Linden, NJ 07036

Dear Mr. Downes:

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All of us at ETC welcome your next call if we can be of further service to your organization in the future.

Sincerely,

Denis C. K. Lin, PhD.
Vice President
Research/Operations

DCKL:mam

Attachments

284 RARITAN CENTER PARKWAY • EDISON, NJ 08837 *(201) 225-5600*

TABLE OF CONTENTS

INTRODUCTION

This report contains the analytical results on your sample, Well #3, submitted on March 15, 1982. In your order, Total Organic Halide analysis (TOX) was requested on this sample. However, due to the sample matrix, it was not possible to obtain meaningful data.

The results we obtained on your sample are presented in a tabular format immediately after this introduction. Following the sample results, the quality assurance data on your specific sample are tabulated to verify the validity of the results obtained. Also presented in the quality assurance data report is the chain-of-custody record.

The established methods we used in the analysis of your sample are described in the Methodology section after the Results. In the analysis we followed a rigidly controlled Quality Assurance Protocol. This Protocol is described after the Methodology section.

We hope our report format is useful in assisting you to obtain pertinent information on your sample.

RESULTS

The results obtained on your sample are listed in Table 1. For analysis of Groundwater Monitoring Metals, Pesticides and Herbicides, the contaminants are listed with their EPA Hazardous Waste number, sample concentration, and Method Detection Limit. A metal detected below its Method Detection Limit is reported in Table 1 as BMDL (Below Method Detection Limit). When a metal is searched for and cannot be found, it is reported as ND (Not Detected). In GC/ECD analysis, a contaminant not detected at or above its Method Detection Limit is reported in Table 1 as "< the method detection limit" established for that contaminant.

Quality Assurance Report (A), Table 2, contains the results obtained on the Method Blank and Spiked Blank for your sample. Quality Assurance Report (B), Table 3, lists the data on the Replicate and Matrix Spike Analysis.

The Chain-of-Custody Record on your sample is also included at the end of this Result section.

TABLE 1: QUANTITATIVE DATA ON COMPOUNDS OF INTEREST

ETC Sample No. 001340 Customer Sample ID. Well #1

GROUND WATER MONITORING METALS, PESTICIDES AND HERBICIDES

EPA HAZARDOUS WASTE NUMBER	CONTAMINANT	CONCENTRATION IN ug/l	METHOD DETECTION LIMIT IN ug/l
D004	Arsenic	ND	5
D005	Barium	700	100
D006	Cadmium	BMDL	5
D007	Chromium	ND	50
D008	Lead	ND	100
D009	Mercury	0.6	0.2
D010	Selenium	ND	5
D011	Silver	BMDL	25
D012	Endrin	<0.1	0.1 *
D013	Lindane	<2.0	2.0 *
D014	Methoxychlor	<50	50 *
D015	Toxaphene	<2.5	2.5 *
D016	2,4-D	<50	50 *
D017	2,4,5-TP (Silvex)	<5	5 *
	Iron	BMDL	50
	Manganese	4600	100
	Sodium	6000000	50

Parameters establishing ground water quality

Ref. No. 11, p. 2 of 16

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* GC/ECD Method Detection Limit established for your individual sample matrix. When a compound is not detected at or above the specific Method Detection Limit, that particular

TABLE 1: QUANTITATIVE DATA ON PARAMETERS OF INTEREST

ETC Sample No. 001340

Customer Sample ID. Well #1

CONVENTIONALS

PARAMETER	CONCENTRATION mg/l		METHOD DETECTION LIMIT mg/l	
Biological Oxygen Demand (BOD), 5 day	-		-	
Chemical Oxygen Demand (COD)	-		-	
Total Dissolved Solids (TDS)	-		-	
Chloride	12400		200	
Fluoride	0.88		0.1	
Nitrate as N	<0.1		0.1	
Total Kjeldahl Nitrogen	-		-	
Sulfate as S	490		10	
Total Phenols	<0.005		0.005	
Total Organic Carbon	8		1	
Specific Conductance	24000	umhos/cm	2000	umhos/cm
pH	7.0	Standard Units		
Turbidity	4.3	JTU	0.1	JTU

Ref. No. 11, p. 226/161

TABLE [illegible] QUANTITATIVE DATA ON PARAMETERS OF INTEREST

ETC Sample No. 001340 Customer Sample ID. Well #1

RADIOLOGICAL	CONCENTRATION pCi/L
Gross Alpha	<30
Gross Beta	<40

BACTERIOLOGICAL	COLONIES/100ml
Total Coliform	-
Fecal Coliform	-

"TNTC" Indicates Too Numerous to Count
"CF" Indicates Confluent Growth

Ref. No. 11, p. 23 of 161

TABLE 2: QUALITY ASSURANCE REPORT (A): BLANK AND SPIKED BLANK

PESTICIDES AND HERBICIDES

For ETC Sample Numbers: 001327, 001328, 001330 to 001333, 001340 to 001343

EPA HAZARDOUS WASTE NUMBER	CONTAMINANT	CONCENTRATION IN ug/l BLANK	SPIKED BLANK AMOUNT ADDED	SPIKED BLANK % RECOVERY
D012	Endrin	<0.1	0.2	90
D013	Lindane	<2.0	2.0	116
D014	Methoxychlor	<50	100	118
D015	Toxaphene	<2.5	5.0	100
D016	2,4-D	<50	100	83
D017	2,4,5-TP (Silvex)	<5	10	100

TABLE 3: QUALITY ASSURANCE REPORT (B): REPLICATE ANALYSIS AND MATRIX SPIKE ANALYSIS

** PESTICIDES AND HERBICIDES **

For ETC Sample Numbers: 001327, 001328, 001330 to 001333, 001340 to 001343

EPA HAZARDOUS WASTE NUMBER	CONTAMINANT	CONCENTRATION IN ug/l SAMPLE	REPLICATE	SAMPLE	SPIKED SAMPLE	AMOUNT ADDED	% RECOVERY
D012	Endrin	<0.1	<0.1	<0.1	0.18	0.2	90
D013	Lindane	<2.0	<2.0	<2.0	4.8	4.0	120
D014	Methoxychlor	<50	<50	<50	120	100	120
D015	Toxaphene	<2.5	<2.5	<2.5	6.0	5.0	120
D016	2,4-D	<50	<50	<50	5	100	5*
D017	2,4,5-TP (Silvex)	<5	<5	<5	2.7	10	27

* Matrix effect. Good recovery for spiked blank.

Ref. No. 11, p. 25of161

101875

ETC ENVIRONMENTAL TESTING AND CERTIFICATION CORPORATION

CHAIN OF CUSTODY

PHONE FOR CUSTOMER SERVICE: (201) 225-5600
TOLL FREE OUTSIDE NEW JERSEY: (800) 631-5382

CUSTODY NUMBER	DATE SHUTTLE SEALED
6517 6518	3/10/82

ATTENTION

This form is for the convenience of our clients. If used and sent to ETC it will serve as part of a complete chain of custody record held confidentially by ETC for the exclusive use of the client.

This form may be used in a legal proceeding. Accuracy and completeness are important. The purpose of this form is to document the chain of custody from the time the sample shuttle seal is broken until the shuttle is resealed. A person has a sample under custody if:

- it is in his/her actual possession; or
- it is in his/her view, after being in actual possession; or
- it was in his/her actual possession and he/she placed it in a locked or otherwise secure place to which any access by others is fully recorded.

ETC maintains chain of custody records before a sample shuttle is sent and after it is returned. ETC maintains records of shipping manifests. Together, these forms document a complete chain of custody for a sample.

A

COMPANY	LCP Chemicals Inc	**ATTENTION**	Max Obra
PLANT		**ACCOUNT NUMBER**	
ADDRESS	South Wood Ave Linden NJ 07036	**REQUISITION NUMBER**	000251
		TELEPHONE NUMBER	

B **SAMPLE NUMBER** 1B

BOTTLE CODES: E ____ to ____ M ____ to ____ V ____ to ____ VB ____ to ____

CN ____ to ____ PH ____ to ____ PCB ____ to ____ WO 5 to 8

PLEASE COMPLETE THE REMAINDER OF THIS FORM. ALWAYS COMPLETE ITEMS C, E AND G. COMPLETE ITEM D IF SAMPLE APPEARANCE, CONSISTENCY, ODOR WARRANT NOTICE. COMPLETE ITEMS MARKED F AS NEEDED. ADD ANOTHER SHEET FOR F 7/8 AND SO ON IF NEEDED. THE LAST PERSON TO RECEIVE THE SAMPLE MUST, IN ADDITION TO COMPLETING THE APPROPRIATE F ITEM, ALSO COMPLETE ITEM G.

C **SAMPLE LOCATION OR CODE** (e.g., permit code)	WELL #1	**D** **SAMPLE DESCRIPTION**	FILTERED WATER SAMPLE

E TO BE COMPLETED BY THE PERSON WHO ASSUMES RESPONSIBILITY FOR THE SAMPLE AND OBSERVES THE BREAKING OF THE SEAL.

NAME	MAXIMO A. OBRA	**DATE**	3/15/82
SIGNATURE	Maximo A Obra	**SEAL NO.**	6517
SEAL INTACT	✓ YES ____ NO	**SEAL BREAK TIME**	7:00 AM
CODE OF ANY LEAKING BOTTLES			
CODE OF ANY BROKEN BOTTLES			

IF SEAL IS *NOT* INTACT PLEASE CALL

WARNING
IF ANY BOTTLE IS LEAKING OR BROKEN, DO NOT HANDLE. SOME BOTTLES CONTAIN ACID. PLEASE CALL.

F1 RELINQUISHED BY	**F2** RECEIVED BY	TIME	NOTE: GIVE REASON FOR CUSTODY CHANGE, AND CODE OF ANY MISSING OR DAMAGED BOTTLES
PRINT MAXIMO A. OBRA	TONI KUZMACK	3pm	
SIGN Maximo A Obra	Toni Kuzmack	DATE 3/15	
F3 RELINQUISHED BY	**F4** RECEIVED BY	TIME	NOTE: GIVE REASON FOR CUSTODY CHANGE, AND CODE OF ANY MISSING OR DAMAGED BOTTLES
PRINT		DATE	
SIGN			
F5 RELINQUISHED BY	**F6** RECEIVED BY	TIME	NOTE: GIVE REASON FOR CUSTODY CHANGE, AND CODE OF ANY MISSING OR DAMAGED BOTTLES
PRINT		DATE	

G TO BE FILLED IN BY THE PERSON WHO HAS RESPONSIBILITY FOR THE SAMPLE AND OBSERVES RESEALING OF SAMPLE SHUTTLE.

REPLACE FORM IN ENVELOPE
PUT ENVELOPE IN SHUTTLE ▶

NAME	MAXIMO A. OBRA	**DATE**	3/15/82
SIGNATURE	Maximo A Obra		
RESEAL TIME	10:00 AM	**SEAL NO.**	6518

ETC ENVIRONMENTAL TESTING AND CERTIFICATION CORPORATION

101876

CHAIN OF CUSTODY

PHONE FOR CUSTOMER SERVICE: (201) 225-5800
TOLL FREE OUTSIDE NEW JERSEY: (800) 631-6382

CUSTODY NUMBER	DATE SHUTTLE SEALED
6515 6516	3/10/82

ATTENTION

This form is for the convenience of our clients. If used and sent to ETC it will serve as part of a complete chain of custody record held confidentially by ETC for the exclusive use of the client.

This form may be used in a legal proceeding. Accuracy and completeness are important. The purpose of this form is to document the chain of custody from the time the sample shuttle seal is broken until the shuttle is resealed. A person has a sample under custody if:

- it is in his/her actual possession; or
- it is in his/her view, after being in actual possession; or
- it was in his/her actual possession and he/she places it in a locked or otherwise secure place to which any access by others is fully recorded.

ETC maintains chain of custody records before a sample shuttle is sent and after it is returned. ETC maintains records of shipping manifests. Together, these forms document a complete chain of custody for a sample.

A

COMPANY	LCP Chemicals Inc	**ATTENTION**	Max Obra
PLANT		**ACCOUNT NUMBER**	
ADDRESS	South Wood Ave	**REQUISITION NUMBER**	000251
	Linden NJ 07036	**TELEPHONE NUMBER**	

B **SAMPLE NUMBER** 1A

BOTTLE CODES: E ____ to ____ M 1 to ____ V ____ to ____ VB ____ to ____

CN ____ to ____ PH ____ to ____ PCB ____ to ____ WO 1 to 4

PLEASE COMPLETE THE REMAINDER OF THIS FORM. ALWAYS COMPLETE ITEMS C, E, AND G. COMPLETE ITEM D IF SAMPLE APPEARANCE, CONSISTENCY, ODOR WARRANT NOTICE. COMPLETE ITEMS MARKED F AS NEEDED. ADD ANOTHER SHEET FOR F 7, 8 AND SO ON IF NEEDED. THE LAST PERSON TO RECEIVE THE SAMPLE MUST, IN ADDITION TO COMPLETING THE APPROPRIATE F ITEM, ALSO COMPLETE ITEM G.

C **SAMPLE LOCATION OR CODE (e.g., a permit code)** WELL #1

D **SAMPLE DESCRIPTION** FILTERED WATER SAMPLE

TO BE COMPLETED BY THE PERSON WHO ASSUMES RESPONSIBILITY FOR THE SAMPLE AND OBSERVES THE BREAKING OF THE SEAL.

NAME	MAXIMO A. OBRA	**DATE**	3/15/82
SIGNATURE	Maximo A. Obra	**SEAL NO.**	6515
SEAL INTACT	✓ YES ____ NO	**SEAL BREAK TIME**	7:08AM
CODE OF ANY LEAKING BOTTLES			
CODE OF ANY BROKEN BOTTLES			

IF SEAL IS *NOT* INTACT PLEASE CALL

WARNING
IF ANY BOTTLE IS LEAKING OR BROKEN, DO NOT HANDLE. SOME BOTTLES CONTAIN ACID. PLEASE CALL.

F1 RELINQUISHED BY PRINT MAXIMO A. OBRA SIGN Maximo A. Obra	**F2** RECEIVED BY TONI KUZMACK Toni Kuzmack TIME 3pm DATE 3/15	NOTE: GIVE REASON FOR CUSTODY CHANGE; AND CODE OF ANY MISSING OR DAMAGED BOTTLES
F3 RELINQUISHED BY PRINT SIGN	**F4** RECEIVED BY TIME DATE	NOTE: GIVE REASON FOR CUSTODY CHANGE; AND CODE OF ANY MISSING OR DAMAGED BOTTLES
F5 RELINQUISHED BY PRINT SIGN	**F6** RECEIVED BY TIME DATE	NOTE: GIVE REASON FOR CUSTODY CHANGE; AND CODE OF ANY MISSING OR DAMAGED BOTTLES

TO BE FILLED IN BY THE PERSON WHO HAS RESPONSIBILITY FOR THE SAMPLE AND OBSERVES RESEALING OF SAMPLE SHUTTLE.

REPLACE FORM IN ENVELOPE
PUT ENVELOPE IN SHUTTLE

NAME	MAXIMO A. OBRA	**DATE**	3/15/82
SIGNATURE	Maximo A. Obra 2 of 161		
RESEAL TIME	10:10	**SEAL NO.**	6516

ETC ENVIRONMENTAL TESTING AND CERTIFICATION CORPORATION

CHAIN OF CUSTODY

Company: LCP Chemicals Inc Job No. 251

Address: South Wood Ave
Linden NJ

Attention: Max Obra

8 Sample Shuttle(s) Received by: Toni Kuzmack

ime: 11:00Am Date: 3/15/82

Seal Number(s)	6516	6518	6520	6522
Seal Intact*	Y	Y	Y	Y
Seal Number(s)	6524	6526	6528	6530
Seal Intact*	Y	Y	Y	Y
Seal Number(s)				
Seal Intact*				
Seal Number(s)				
Seal Intact*				
Seal Number(s)				
Seal Intact*				
Seal Number(s)				
Seal Intact*				

* Yes (Y) No (N)

Ref. No. 11, p. [illegible]/161

ETC ENVIRONMENTAL TESTING AND CERTIFICATION CORPORATION

LABORATORY CHAIN-OF-CUSTODY

ETC Sample Number 001340 to 001343

Relinquished By Toni Kuzmack

Received By ______ Date 3/15/82 Time 5:10 p.m.

Relinquished By ______

Received By ______ Date ______ Time ______

Relinquished By ______

Received By ______ Date ______ Time ______

Relinquished By ______

Recieved By ______ Date ______ Time ______

ETC ENVIRONMENTAL TESTING AND CERTIFICATION CORPORATION

LABORATORY CHAIN-OF-CUSTODY CHRONICLE

ETC Sample Number 001340

Sample Preparation For	**Analyst**	**Date**
Base/Neutral/PCB's & Pesticides		
~~Acids~~ Pesticides in H_2O	Ben Gelin / Stephanie Dobbs	3/30/82.
Metals	Kristine J Kuhl	3-24-82
Others Herbicides in Water	Paul Krajczar	3/30/82

Sample Analysis For	**Analyst**	**Date**
Base/Neutral/PCB's & Pesticides		
Acids		
VOA/Purgeables		
Metals	K.J. Kuhl / A. W. Messaro	3-28-82 to 4-1-82
Others Herbicides in Water	Paul Krajczar	4/1/82
Others Pesticides in Water	Paul Krajczar	4/2-3,8/82

Verified By

3 of 161

Ref. No. 11 p.

101879

TABLE 1: QUANTITATIVE DATA ON COMPOUNDS OF INTEREST

ETC Sample No. 001341

Customer Sample ID. Well #2

GROUND WATER MONITORING METALS, PESTICIDES AND HERBICIDES

EPA HAZARDOUS WASTE NUMBER	CONTAMINANT	CONCENTRATION IN ug/l	METHOD DETECTION LIMIT IN ug/l
D004	Arsenic	BMDL	5
D005	Barium	BMDL	100
D006	Cadmium	10	5
D007	Chromium	ND	50
D008	Lead	BMDL	100
D009	Mercury	BMDL	0.2
D010	Selenium	ND	5
D011	Silver	ND	25
D012	Endrin	<0.1	0.1 *
D013	Lindane	<2.0	2.0 *
D014	Methoxychlor	<50	50 *
D015	Toxaphene	<2.5	2.5 *
D016	2,4-D	<50	50 *
D017	2,4,5-TP (Silvex)	<5	5 *
	Iron	820	50
	Manganese	1800	100
	Sodium	5000000	50

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* GC/ECD Method Detection Limit established for your individual sample matrix. When a compound is not detected at or above the specific Method Detection Limit, that particular compound is reported as "< the detection limit."

TA[illegible] 1: QUANTITATIVE DATA ON PARAMETERS OF [illegible]TEREST

ETC [illegible]ple No. 001341 Customer Sample ID. Well #2

CONVENTIONALS

PARAMETER	CONCENTRATION mg/l	METHOD DETECTION LIMIT mg/l
Biological Oxygen Demand (BOD), 5 day	-	-
Chemical Oxygen Demand (COD)	-	-
Total Dissolved Solids (TDS)	-	-
Chloride	16200	200
Fluoride	0.31	0.1
Nitrate as N	<0.1	0.1
Total Kjeldahl Nitrogen	-	-
Sulfate as S	240	10
Total Phenols	<0.005	0.005
Total Organic Carbon	6	1
Specific Conductance	26000 umhos/cm	2000 umhos/cm
pH	7.2 Standard Units	
Turbidity	0.35 JTU	0.1 JTU

Ref. No. 11, p.

326/161

TABLE 1: QUANTITATIVE DATA ON PARAMETERS OF INTEREST

ETC Sample No. 001341 Customer Sample ID. Well #2

RADIOLOGICAL	CONCENTRATION pCi/L
Gross Alpha	<30
Gross Beta	44 +/- 20

BACTERIOLOGICAL	COLONIES/100ml
Total Coliform	-
Fecal Coliform	-

"TNTC" Indicates Too Numerous to Count
"CF" Indicates Confluent Growth

Ref. No. 11, p. 33 of 161

TABLE 2: QUALITY ASSURANCE REPORT (A): BLANK AND SPIKED BLANK

PESTICIDES AND HERBICIDES

For ETC Sample Numbers: 001327, 001328, 001330 to 001333, 001340 to 001343

EPA HAZARDOUS WASTE NUMBER	CONTAMINANT	CONCENTRATION IN ug/l BLANK	SPIKED BLANK	
			AMOUNT ADDED	% RECOVERY
D012	Endrin	<0.1	0.2	90
D013	Lindane	<2.0	2.0	116
D014	Methoxychlor	<50	100	118
D015	Toxaphene	<2.5	5.0	100
D016	2,4-D	<50	100	83
D017	2,4,5-TP (Silvex)	<5	10	100

Ref No. 11, p. 346/161

TABLE 3: QUALITY ASSURANCE REPORT (B): REPLICATE ANALYSIS AND MATRIX SPIKE ANALYSIS

** PESTICIDES AND HERBICIDES **

For ETC Sample Numbers: <u>001327, 001328, 001330 to 001333, 001340 to 001343</u>

EPA HAZARDOUS WASTE NUMBER	CONTAMINANT	CONCENTRATION IN ug/l					
		SAMPLE	REPLICATE	SAMPLE	SPIKED SAMPLE	AMOUNT ADDED	% RECOVERY
D012	Endrin	<0.1	<0.1	<0.1	0.18	0.2	90
D013	Lindane	<2.0	<2.0	<2.0	4.8	4.0	120
D014	Methoxychlor	<50	<50	<50	120	100	120
D015	Toxaphene	<2.5	<2.5	<2.5	6.0	5.0	120
D016	2,4-D	<50	<50	<50	5	100	5*
D017	2,4,5-TP (Silvex)	<5	<5	<5	2.7	10	27

* Matrix effect. Good recovery for spiked blank.

101885

ETC ENVIRONMENTAL TESTING AND CERTIFICATION CORPORATION

CHAIN OF CUSTODY

PHONE FOR CUSTOMER SERVICE: (201) 225-6800
TOLL FREE OUTSIDE NEW JERSEY: (800) 631-6382

CUSTODY NUMBER	DATE SHUTTLE SEALED
6521 6522	3/10/82

ATTENTION

This form is for the convenience of our clients. If used and sent to ETC it will serve as part of a complete chain of custody record held confidentially by ETC for the exclusive use of the client.

This form may be used in a legal proceeding. Accuracy and completeness are important. The purpose of this form is to document the chain of custody from the time the sample shuttle seal is broken until the shuttle is resealed. A person has a sample under custody if:

- it is in his/her actual possession; or
- it is in his/her view after being in actual possession; or
- it was in his/her actual possession and he/she places it in a locked or otherwise secure place to which any access by others is fully recorded.

ETC maintains chain of custody records before a sample shuttle is sent and after it is returned. ETC maintains records of shipping manifests. Together these forms document a complete chain of custody for a sample.

A

COMPANY	LCP Chemicals-NJ Inc	**ATTENTION**	Max Obra
PLANT		**ACCOUNT NUMBER**	
ADDRESS	South Wood Ave	**REQUISITION NUMBER**	000251
	Linden NJ 07036	**TELEPHONE NUMBER**	

B **SAMPLE NUMBER** 2B

BOTTLE CODES: E ____ to ____ M ____ to ____ V ____ to ____ VB ____ to ____

CN ____ to ____ PH ____ to ____ PCB ____ to ____ WO 5 to 8

PLEASE COMPLETE THE REMAINDER OF THIS FORM. ALWAYS COMPLETE ITEMS C, E AND G. COMPLETE ITEM D IF SAMPLE APPEARANCE, CONSISTENCY, ODOR WARRANT NOTICE. COMPLETE ITEMS MARKED F AS NEEDED. ADD ANOTHER SHEET FOR F7, 8 AND SO ON IF NEEDED. THE LAST PERSON TO RECEIVE THE SAMPLE MUST, IN ADDITION TO COMPLETING THE APPROPRIATE F ITEM, ALSO COMPLETE ITEM G.

C **SAMPLE LOCATION OR CODE (e.g., a permit code)** WELL #2

D **SAMPLE DESCRIPTION** FILTERED WATER SAMPLE

TO BE COMPLETED BY THE PERSON WHO ASSUMES RESPONSIBILITY FOR THE SAMPLE AND OBSERVES THE BREAKING OF THE SEAL.

NAME	MAXIMO A. OBRA	**DATE**	3/15/8
SIGNATURE	Maximo A. Obra	**SEAL NO.**	6521
SEAL INTACT	✓ YES ____ NO	**SEAL BREAK TIME**	7:00 A
CODE OF ANY LEAKING BOTTLES			
CODE OF ANY BROKEN BOTTLES			

IF SEAL IS *NOT* INTACT PLEASE CALL

WARNING
IF ANY BOTTLE IS LEAKING OR BROKEN, DO NOT HANDLE. SOME BOTTLES CONTAIN ACID. PLEASE CALL.

F1 RELINQUISHED BY	**F2** RECEIVED BY	TIME	NOTE: GIVE REASON FOR CUSTODY CHANGE, AND CODE OF ANY MISSING OR DAMAGED BOTTLES
PRINT MAXIMO A. OBRA	TONI KUZMACK	3pm	
SIGN Maximo A. Obra	Toni Kuzmack	DATE 3/15	
F3 RELINQUISHED BY	**F4** RECEIVED BY	TIME	NOTE: GIVE REASON FOR CUSTODY CHANGE, AND CODE OF ANY MISSING OR DAMAGED BOTTLES
PRINT			
SIGN		DATE	
F5 RELINQUISHED BY	**F6** RECEIVED BY	TIME	NOTE: GIVE REASON FOR CUSTODY CHANGE, AND CODE OF ANY MISSING OR DAMAGED BOTTLES
PRINT			
SIGN		DATE	

TO BE FILLED IN BY THE PERSON WHO HAS RESPONSIBILITY FOR THE SAMPLE AND OBSERVES RESEALING OF SAMPLE SHUTTLE.

REPLACE FORM IN ENVELOPE
PUT ENVELOPE IN SHUTTLE

NAME	MAXIMO A. OBRA	**DATE**	3/15/8
SIGNATURE	Maximo A. Obra		
RESEAL TIME	10:20 AM	**SEAL NO.**	6522

Ref. No. 11.p. 36/61

ETC ENVIRONMENTAL TESTING AND CERTIFICATION CORPORATION

101886

CHAIN OF CUSTODY

PHONE FOR CUSTOMER SERVICE: (201) 225-5800
TOLL FREE OUTSIDE NEW JERSEY: (800) 631-6382

CUSTODY NUMBER	DATE SHUTTLE SEALED
6519 6520	3/10/82

ATTENTION

s form is for the convenience of our clients. If used and sent to ETC it will serve as part of a complete chain of custody record held confidentially by ETC for the exclusive use of the client.

This form may be used in a legal proceeding. Accuracy and completeness are important. The purpose of this form is to document the chain of custody from the time the sample shuttle seal is broken until the shuttle is received. A person has a sample under custody if:

- it is in his/her actual possession; or
- it is in his/her view, after being in actual possession; or
- it was in his/her actual possession and he/she placed it in a locked or otherwise secure place to which only access by others is fully recorded

ETC maintains chain of custody records before a sample shuttle is sent and after it is returned. ETC maintains records of shipping manifests. Together, these forms document a complete chain of custody for a sample

A

COMPANY	LCP Chemicals-NJ Inc	**ATTENTION**	Max Obra
PLANT		**ACCOUNT NUMBER**	
ADDRESS	South Wood Ave	**REQUISITION NUMBER**	000251
	Linden NJ 07036	**TELEPHONE NUMBER**	

B **SAMPLE NUMBER** 2A

BOTTLE CODES: E ____ to ____ M 1 to ____ V ____ to ____ VB ____ to ____
CN ____ to ____ PH ____ to ____ PCB ____ to ____ WO 1 to 4

PLEASE COMPLETE THE REMAINDER OF THIS FORM. ALWAYS COMPLETE ITEMS C, E AND G. COMPLETE ITEM D IF SAMPLE APPEARANCE, CONSISTENCY, ODOR WARRANT NOTICE. COMPLETE ITEMS MARKED F AS NEEDED. ADD ANOTHER SHEET FOR F 7-8 AND SO ON IF NEEDED. THE LAST PERSON TO RECEIVE THE SAMPLE MUST, IN ADDITION TO COMPLETING THE APPROPRIATE F ITEM, ALSO COMPLETE ITEM G.

C **SAMPLE LOCATION OR CODE** (e.g., a permit code): WELL #2

D **SAMPLE DESCRIPTION**: FILTER WATER SAMPLE

E TO BE COMPLETED BY THE PERSON WHO ASSUMES RESPONSIBILITY FOR THE SAMPLE AND OBSERVES THE BREAKING OF THE SEAL.

NAME	MAXIMO A. OBRA	**DATE**	3/15/82
SIGNATURE		**SEAL NO**	6519
SEAL INTACT	✓ YES ____ NO	**SEAL BREAK TIME**	7:00 AM
CODE OF ANY LEAKING BOTTLES			
CODE OF ANY BROKEN BOTTLES			

IF SEAL IS *NOT* INTACT PLEASE CALL

WARNING
IF ANY BOTTLE IS LEAKING OR BROKEN, DO NOT HANDLE. SOME BOTTLES CONTAIN ACID. PLEASE CALL.

F1 RELINQUISHED BY	**F2** RECEIVED BY	TIME	NOTE: GIVE REASON FOR CUSTODY CHANGE, AND CODE OF ANY MISSING OR DAMAGED BOTTLES
PRINT MAXIMO A. OBRA	Toni Kuzmack	3pm	
SIGN	TONI KUZMACK	DATE 3/15	
F3 RELINQUISHED BY	**F4** RECEIVED BY	TIME	NOTE: GIVE REASON FOR CUSTODY CHANGE, AND CODE OF ANY MISSING OR DAMAGED BOTTLES
PRINT		DATE	
SIGN			
F5 RELINQUISHED BY	**F6** RECEIVED BY	TIME	NOTE: GIVE REASON FOR CUSTODY CHANGE, AND CODE OF ANY MISSING OR DAMAGED BOTTLES
PRINT		DATE	
SIGN			

G TO BE FILLED IN BY THE PERSON WHO HAS RESPONSIBILITY FOR THE SAMPLE AND OBSERVES RESEALING OF SAMPLE SHUTTLE.

REPLACE FORM IN ENVELOPE
PUT ENVELOPE IN SHUTTLE

NAME	MAXIMO A. OBRA	**DATE**	3/15/8
SIGNATURE	37/161		
RESEAL TIME	10:15 AM	**SEAL NO.**	6520

Ref. No. 11, p.

101887

ETC ENVIRONMENTAL TESTING AND CERTIFICATION CORPORATION

CHAIN OF CUSTODY

Company: LCP Chemicals Inc Job No. 251

Address: South Wood Ave
Linden NJ

Attention: Max Obra

8 Sample Shuttle(s) Received by: Toni Kuzmack

Time: 11:00Am Date: 3/15/82

Seal Number(s)	6516	6518	6520	6522
Seal Intact*	Y	Y	Y	Y
Seal Number(s)	6524	6526	6528	6530
Seal Intact*	Y	Y	Y	Y
Seal Number(s)				
Seal Intact*				
Seal Number(s)				
Seal Intact*				
Seal Number(s)				
Seal Intact*				
Seal Number(s)				
Seal Intact*				

* Yes (Y) No (N)

Ref No. 11, p.
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284 RARITAN CENTER PARKWAY, EDISON, NEW JERSEY 08837 • (201) 225-5600

Ref. No. 11, p.

T-1029 3/82

ETC
ENVIRONMENTAL
TESTING AND
CERTIFICATION
CORPORATION

LABORATORY CHAIN-OF-CUSTODY

TC Sample Number 001340 to 001343

elinquished By Joni Kuzmack
eceived By Date 3/15/82 Time 5:10 p.m.

inquished By
Received By Date Time

Relinquished By
Received By Date Time

Relinquished By
Recieved By Date Time

ETC ENVIRONMENTAL
TESTING AND
CERTIFICATION
CORPORATION

LABORATORY CHAIN-OF-CUSTODY CHRONICLE

ETC Sample Number 001341

Sample Preparation For	Analyst	Date
Base/Neutral/PCB's & Pesticides		
~~Acids~~ Pesticides in H_2O	Ben Gulin / Stephanie Dibbs	3/30/82
Metals	Kristine J Kull	3-24-82
hers Herbicides in Water	Pearl Krzyzga	3/30/82

Sample Analysis For	Analyst	Date
Base/Neutral/PCB's & Pesticides		
Acids		
VOA/Purgeables		
Metals	KJ Kull / A. W. Massaro	3-28-82 to 4-1-82
Others Herbicides in Water	Pearl Krzyzga	4/1/82
Others Pesticides in Water	Pearl Krzyzga	4/2-3,8/82

Verified By

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ETC
ENVIRONMENTAL
TESTING AND
CERTIFICATION
CORPORATION

CHAIN OF CUSTODY

Company: Chyun Associates Job No. 251

Address 1101 State Rd
Princeton NJ

Attention: Mike Wright

Sample Description:

ETC Sample #:	To be Analyzed For
01340W06 to 001343W06	TOC & total phenols
01340 W07 to 001343 W07	Conventionals: specific conductance. chloride, sulfate fluoride, Nitrate, Turbidity

Please run TOC and specific conductance in quad. for sample #001343

Sample(s) Relinquished by: Carl

Time: 11:20 Am Date: 3-18-82

Sample(s) Received by: Michael W

Time: 1120 Hm Date: 3/18/82

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ETC ENVIRONMENTAL
TESTING AND
CERTIFICATION
CORPORATION

LABORATORY CHAIN-OF-CUSTODY

001340 W06 to 001343W06

ETC Sample Number 001340 W07 to 001343 W07

Relinquished By Toni Kuzmack

Received By Carl Delello Date 3-18-82 Time 10:20m

inquished By ______

Received By ______ Date ______ Time ____

elinquished By ______

eceived By ______ Date ______ Time ____

linquished By ______

cieved By ______ Date ______ Time ____

ETC ENVIRONMENTAL TESTING AND CERTIFICATION CORPORATION

TO Teledyne Isotopes:

Please complete this document and include with your report.

This shuttle contains:

ETC Sample numbers:		To be analyzed for:
001331	W05	Gross Alpha/Beta
001332	W05	Gross Alpha/Beta
001333	W05	Gross Alpha/Beta
001340	W05	Gross Alpha/Beta
001341	W05	Gross Alpha/Beta

Sample Shuttle sealed by: Toni Kuzmach

Date: 3/17/82 Time: 3:18 pm Seal Number: 6585

Sample Shuttle opened by: Edna C Cunningham

Date: 3/18/82 Time: 1600 Seal Number: 0006585

Was seal intact? Yes ✓ No ____

For return:

Sample Shuttle sealed by: Edna C Cunningham

Date: 3/19/82 Time: 1145 Seal Number: 0006586

Sample Shuttle opened by: Toni Kuzmach

Date: 3/22/82 Time: 11:37 Seal Number: 6586

Was seal intact? Yes ✓ No ____

Ref No. 43 of 161

METHODOLOGY

Analysis of Metals

The methods employed in the analysis of your sample for metals are established EPA methods for priority pollutants.

Metals analysis is performed according to the methods published by EPA in "Methods for Chemical Analysis of Water and Wastes", EPA-600/4-70-020, March 1979. Arsenic, selenium, thallium, and antimony are analyzed by furnace AA while calcium, magnesium, barium, beryllium, chromium, nickel, copper, zinc, silver, cadmium, and lead are analyzed by flame AA. Potassium and sodium are analyzed by flame emmission. Mercury is analyzed by cold vapor technique.

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Analysis of Pesticides and Herbicides

The methods employed in the analysis of your water sample for pesticides and herbicides are established EPA methods taken from the "Manual of Analytical Methods for the Analysis of Pesticides in Humans and Environmental Samples," June, 1980. The pesticide method can be summarized as follows: A measured volume of sample, approximately 500-1000ml, to which sodium sulfate has been added, is extracted with methylene chloride. The methylene chloride extract is dried and concentrated to approximately 0.5ml. The extract is brought to a final volume with hexane and injected into a gas chromatograph equipped with a ^{63}Ni electron capture detector.

The herbicide method can be summarized as follows: A measured volume of sample, approximately 500-1000 ml, to which sodium sulfate has been added, is acidified and extracted with methylene chloride. The methylene chloride extract is evaporated to dryness, and the residue is derivatized with a BF_3 esterification reagent. The derivatives are extracted into hexane for subsequent injection into a gas chromatograph equipped with a ^{63}Ni electron capture detector.

The GC operating parameters were as follows:

COLUMN

6' x 4mm glass 1.5% SP-2250 & 1.95% SP-2401
Supelcoport 100/120 mesh

CARRIER FLOW

60ml/min. Argon/Methane

SEPTUM PURGE

5ml/min. Argon/Methane

COLUMN OVEN

210°C

INJECTOR TEMPERATURE

225°C

DETECTOR TEMPERATURE

300°C

QUALITY ASSURANCE PROTOCOL

The quality assurance protocol followed in the analysis of your sample is based on the "Handbook for Analytical Control in Water and Wastewater Laboratories," EPA-600/4-79-019, March, 1979; National Enforcement Investigation Center Policies, and Procedures manual; and EPA-330/9/79/001-R, October, 1979.

Analysis of Metals (Standards)

- New working standards are prepared for each batch of samples.
- Normal calibration is performed using a blank and four standards that have been carried through the entire sample preparation procedure. A regression analysis is used to construct the calibration curve.
- For each sample analysis in the standard additions technique, a three point calibration is performed using U. S. EPA Methods for Chemical Analysis of Water and Wastes, 1979. Results are obtained using linear regression analysis. Any results obtained with a coefficient of correlation below 0.990 are considered erroneous, necessitating raw data editing or sample re-analysis.
- Normal calibration curves are constructed using greater than or equal to 5 times the Instrumental Detection Limit (IDL) as the lowest concentration level.
- All calibration standards are analyzed in duplicate, as a minimum.
- Independent reference standards are used to check the accuracy of calibration standards.
- A check standard is analyzed every ten samples to establish the validity of the normal calibration curve.

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Analysis of Metals (Sample, for all metals except Mercury)

For all homogeneous samples (minimum of 42% QC), each sample batch may include up to 30 samples and the following fixed number of QC samples:

- 3 Replicates.
- ~~2 Replicate~~ spikes.
- 2 Replicate independent reference standards.
- 8 Calibration standards (processed using the sample preparation method).
- 2 Blanks (using sample preparation method).
- 4 Calibration standards (without sample preparation).
- 1 Blank (without sample preparation).

For all heterogeneous samples (minimum of 65% QC), every field sample in a sample batch is run in duplicate. A sample batch may include up to 30 samples and the following fixed number of QC samples:

- 4 Replicates.
- 4 Replicate spikes.
- 2 Replicate independent reference standards.
- 8 Calibration standards (processed using the sample preparation method).
- 2 Blanks (using sample preparation method).
- 4 Calibration standards (without sample preparation).
- 1 Blank (without sample preparation).

Analysis of Metals (Sample, Mercury)

For every matrix (minimum of 66% QC), all the field samples in sample batch are run in duplicate. A sample batch may include up to 20 samples and the following fixed number of QC samples:

- 3 Replicates.
- 2 Replicate spikes.
- 2 Replicate independent reference standards.
- 10 Calibration standards (processed using the sample preparation method).
- 2 Blanks.

Analysis of Pesticides and Herbicides

- In every block of 20 samples extracted, there are 16 field samples, one blank, one spiked blank, one sample spiked with the standard mixture, and a duplicate field sample.
- Blind quality control samples are included in field samples at a minimum of one every ~~hundred samples.~~
- GC performance criteria as specified in EPA Method 608 are met before analysis starts.

Chain-of-Custody

The chain-of-custody procedure is part of our quality assurance protocol. We believe our chain-of-custody record fully complies with the legal requirements of federal, state and local government agencies and of the courts of law. The record covers:

- labeling of sample bottles, packing the Sample Shuttle and transferring the Shuttle under seal to the cus~~tody of a~~ shipper;
- outgoing shipping manifests;
- the chain-of-custody form completed by the person (s) breaking the seal, taking the sample, resealing the Shuttle and transferring custody to a shipper;
- incoming shipping manifests;
- breaking the Shuttle's reseal;
- storing each labeled sample bottle in a secured area;.
- disposition of each sample to an analyst or technician and;
- the use of the sample in each bottle in a testing procedure appropriate to the intended purpose of the sample.

The record shows for each link in this process:

- the person with custody;
- the time and date each person accepted or relinquished custody.

REPORT APPENDICES

The following appendices provide the support analytical data associated with your sample analyses. They are arranged as follows:

Appendix A

1) Reconstructed total ion chromatogram of GC/MS analyses of your sample.

2) The individual mass spectra of all priority pollutant compounds which have been identified as being present in your sample.

3) The individual mass spectra of the corresponding compounds as obtained from the standards.

Appendix B

1) The mass spectra of the calibration compounds, 4-bromofluorobenzene (BFB) and decafluorotriphenylphosphine (DFTPP), as obtained on the data of sample analyses.

Appendix C [for plus 10 and 50% internal standard option]

1) Spectra of tentatively identified compounds, with their differences.

Appendix D

1) Subcontractor's report.

These data are provided to present a complete report on your sample and to provide the data on which analytical decisions have been based. We hope this will aid you in your own analysis of the data.

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APPENDIX

TELEDYNE
ISOTOPES

REFERENCE: WO 3-3562

TI# 26280 is being analyzed for Ra-226 (because the GR-A was greater than 5.0 pCi/ℓ) and the result will be reported on a new Work Order.

It was not possible to reach a detection limit of 5 pCi/ℓ for GR-A for four samples because of heavy residue, even after filtration:

TI#	RESIDUE (g/ℓ)
26277	35.1
26278	31.0
26282	15.9
26283	17.9

APPENDIX D

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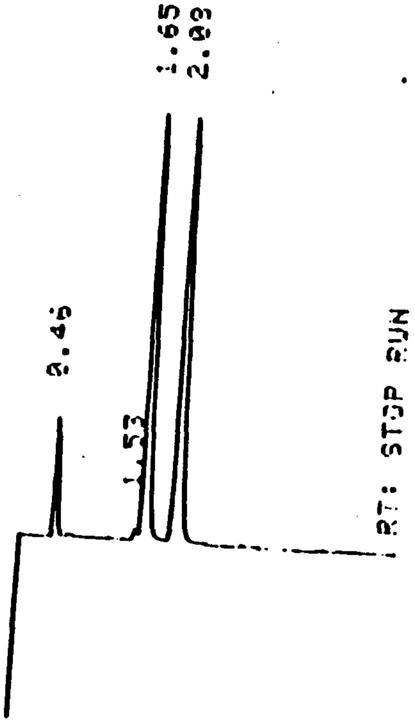

Gas Chromatogram of 2,4-D and 2,4,5-TP(Silvex) Standard
(10 ug/ml & 1 ug/ml)

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TABLE 1: QUANTITATIVE DATA ON COMPOUNDS OF INTEREST

ETC Sample No. 001342 Customer Sample ID. Well #3

GROUND WATER MONITORING METALS, PESTICIDES AND HERBICIDES

EPA HAZARDOUS WASTE NUMBER	CONTAMINANT	CONCENTRATION IN ug/l	METHOD DETECTION LIMIT IN ug/l
D004	Arsenic	10	5
D005	Barium	500	100
D006	Cadmium	BMDL	5
D007	Chromium	ND	50
D008	Lead	BMDL	100
D009	Mercury	BMDL	0.2
D010	Selenium	ND	5
D011	Silver	ND	25
D012	Endrin	<0.1	0.1 *
D013	Lindane	<2.0	2.0 *
D014	Methoxychlor	<50	50 *
D015	Toxaphene	<2.5	2.5 *
D016	2,4-D	<50	50 *
D017	2,4,5-TP (Silvex)	<5	5 *
	Iron	300	50
	Manganese	700	100
	Sodium	2000000	50

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* GC/ECD Method Detection Limit established for your individual sample matrix. When a compound is not detected at or above the specific Method Detection Limit, that particular compound is

RESULTS

The results obtained on your sample are listed in Table 1. For analysis of Groundwater Monitoring Metals, Pesticides and Herbicides, the contaminants are listed with their EPA Hazardous Waste number, sample concentration, and Method Detection Limit. A metal detected below its Method Detection Limit is reported in Table 1 as BMDL (Below Method Detection Limit). When a metal is searched for and cannot be found, it is reported as ND (Not Detected). In GC/ECD analysis, a contaminant not detected at or above its Method Detection Limit is reported in Table 1 as "< the method detection limit" established for that contaminant.

Quality Assurance Report (A), Table 2, contains the results obtained on the Method Blank and Spiked Blank for your sample. Quality Assurance Report (B), Table 3, lists the data on the Replicate and Matrix Spike Analysis.

The Chain-of-Custody Record on your sample is also included at the end of this Result section.

TABLE 1: QUANTITATIVE DATA ON PARAMETERS OF INTEREST

ETC Sample No. 001342

Customer Sample ID. Well #3

RADIOLOGICAL	CONCENTRATION pCi/L
Gross Alpha	<60
Gross Beta	330 +/- 60

BACTERIOLOGICAL	COLONIES/100ml
Total Coliform	-
Fecal Coliform	-

"TNTC" Indicates Too Numerous to Count
"CF" Indicates Confluent Growth

TABLE 1: QUANTITATIVE DATA ON PARAMETERS OF INTEREST

ETC Sample No. 001342

Customer Sample ID. Well #3

CONVENTIONALS

PARAMETER	CONCENTRATION mg/l		METHOD DETECTION LIMIT mg/l	
Biological Oxygen Demand (BOD), 5 day	-		-	
Chemical Oxygen Demand (COD)	-		-	
Total Dissolved Solids (TDS)	-		-	
Chloride	13100		200	
Fluoride	0.32		0.1	
Nitrate as N	<0.1		0.1	
Total Kjeldahl Nitrogen	-		-	
Sulfate as S	170		10	
Total Phenols	<0.005		0.005	
Total Organic Carbon	21		1	
Specific Conductance	28000	umhos/cm	2000	umhos/cm
pH	7.3	Standard Units		
Turbidity	1.2	JTU	0.1	JTU

Ref. No. 11, p.

5596/61

TABLE 3: QUALITY ASSURANCE REPORT (B): REPLICATE ANALYSIS AND MATRIX SPIKE ANALYSIS

** PESTICIDES AND HERBICIDES **

For ETC Sample Numbers: 001327, 001328, 001330 to 001333, 001340 to 001343

EPA HAZARDOUS WASTE NUMBER	CONTAMINANT	CONCENTRATION IN ug/l					
		SAMPLE	REPLICATE	SAMPLE	SPIKED SAMPLE	AMOUNT ADDED	% RECOVERY
D012	Endrin	<0.1	<0.1	<0.1	0.18	0.2	90
D013	Lindane	<2.0	<2.0	<2.0	4.8	4.0	120
D014	Methoxychlor	<50	<50	<50	120	100	120
D015	Toxaphene	<2.5	<2.5	<2.5	6.0	5.0	120
D016	2,4-D	<50	<50	<50	5	100	5*
D017	2,4,5-TP (Silvex)	<5	<5	<5	2.7	10	27

* Matrix effect. Good recovery for spiked blank.

TABLE 2: QUALITY ASSURANCE REPORT (A): BLANK AND SPIKED BLANK

PESTICIDES AND HERBICIDES

For ETC Sample Numbers: 001327, 001328, 001330 to 001333, 001340 to 001343

EPA HAZARDOUS WASTE NUMBER	CONTAMINANT	CONCENTRATION IN ug/l BLANK	SPIKED BLANK	
			AMOUNT ADDED	% RECOVERY
D012	Endrin	<0.1	0.2	90
D013	Lindane	<2.0	2.0	116
D014	Methoxychlor	<50	100	118
D015	Toxaphene	<2.5	5.0	100
D016	2,4-D	<50	100	83
D017	2,4,5-TP (Silvex)	<5	10	100

101911

TC ENVIRONMENTAL TESTING AND CERTIFICATION CORPORATION

CHAIN OF CUSTODY

PHONE FOR CUSTOMER SERVICE: (201) 225-6800
TOLL FREE OUTSIDE NEW JERSEY: (800) 631-6382

CUSTODY NUMBER	DATE SHUTTLE SEALED
6525 6526	3/10/82

ATTENTION

form is for the convenience of our clients. If used and sent to ETC it will serve as part of a complete chain of custody record held confidentially by ETC for the exclusive use of the client.

This form may be used in a legal proceeding. Accuracy and completeness are important. The purpose of this form is to document the chain of custody from the time the sample shuttle seal is broken until the shuttle is resealed. A person has a sample under custody if:

- it is in his/her actual possession; or
- it is his/her view, after being in actual possession; or
- it was in his/her actual possession and he/she places it in a locked or otherwise secure place to which any access by others is fully recorded

ETC maintains chain of custody records before a sample shuttle is sent and after it is returned. ETC maintains records of shipping manifests. Together, these forms document a complete chain of custody for a sample.

COMPANY	LCP Chemicals-NJ Inc	**ATTENTION**	Max Obra
PLANT		**ACCOUNT NUMBER**	
ADDRESS	South Wood Ave	**REQUISITION NUMBER**	000251
	Linden NJ 07036	**TELEPHONE NUMBER**	

SAMPLE NUMBER 3B

BOTTLE CODES: E ____ to ____ M ____ to ____ V ____ to ____ VB ____ to ____
CN ____ to ____ PH ____ to ____ PCB ____ to ____ WO 5 to 8

PLEASE COMPLETE THE REMAINDER OF THIS FORM. ALWAYS COMPLETE ITEMS C, E AND G. COMPLETE ITEM D IF SAMPLE APPEARANCE, CONSISTENCY, ODOR WARRANT NOTICE. COMPLETE ITEMS MARKED F AS NEEDED. ADD ANOTHER SHEET FOR F7-8 AND SO ON IF NEEDED. THE LAST PERSON TO RECEIVE THE SAMPLE MUST, IN ADDITION TO COMPLETING THE APPROPRIATE F ITEM, ALSO COMPLETE ITEM G.

SAMPLE LOCATION OR CODE (e.g. permit code)		**D SAMPLE DESCRIPTION**	

COMPLETED BY THE PERSON WHO ASSUMES RESPONSIBILITY FOR THE PLE AND OBSERVES THE BREAKING OF THE SEAL.

NAME	MAXI~~MO A.~~ A. OBRA	**DATE**	3/15/82
SIGNATURE	Maximo A. Obra	**SEAL NO.**	6525
SEAL INTACT	✓ YES ____ NO	**SEAL BREAK TIME**	7:00AM
CODE OF ANY LEAKING BOTTLES			
CODE OF ANY BROKEN BOTTLES			

IF SEAL IS *NOT* INTACT PLEASE CALL

WARNING
IF ANY BOTTLE IS LEAKING OR BROKEN, DO NOT HANDLE. SOME BOTTLES CONTAIN ACID. PLEASE CALL.

1 RELINQUISHED BY	F2 RECEIVED BY DATE	NOTE: GIVE REASON FOR CUSTODY CHANGE, AND CODE OF ANY MISSING OR DAMAGED BOTTLES
3 RELINQUISHED BY	F4 RECEIVED BY TIME DATE	NOTE: GIVE REASON FOR CUSTODY CHANGE, AND CODE OF ANY MISSING OR DAMAGED BOTTLES
5 RELINQUISHED BY	F6 RECEIVED BY TIME DATE	NOTE: GIVE REASON FOR CUSTODY CHANGE, AND CODE OF ANY MISSING OR DAMAGED BOTTLES Ref. No. ll.p. 6 of 161

FILLED IN BY THE PERSON WHO HAS RESPONSIBILITY FOR THE SAMPLE OBSERVES RESEALING OF SAMPLE SHUTTLE

REPLACE FORM IN ENVELOPE
PUT ENVELOPE IN SHUTTLE

NAME	MAXIMO A. OBRA	**DATE**	3/15/82
SIGNATURE	Maximo A. Obra		
RESEAL TIME	10:30AM	**SEAL NO**	6526

Ref. No. Am.-p.

101912

ETC ENVIRONMENTAL TESTING AND CERTIFICATION CORPORATION

CHAIN OF CUSTODY

PHONE FOR CUSTOMER SERVICE: (201) 225-6800
TOLL FREE OUTSIDE NEW JERSEY: (800) 631-5382

CUSTODY NUMBER	DATE SHUTTLE SEALED
6523 6524	3/10/82

ATTENTION

This form is for the convenience of our clients. If used and sent to ETC it will serve as part of a complete chain of custody record held confidentially by ETC for the exclusive use of the client.

This form may be used in a legal proceeding. Accuracy and completeness are important. The purpose of this form is to document the chain of custody from the time the sample shuttle seal is broken until the shuttle is resealed. A person has a sample under custody if:

- it is in his/her actual possession; or
- it is in his/her view, after being in actual possession, or
- it was in his/her actual possession and he/she places it in a locked or otherwise secure place to which any access by others is fully recorded

ETC maintains chain of custody records before a sample shuttle is sent and after it is returned. ETC maintains records of shipping manifests. Together these forms document a complete chain of custody for a sample.

A

COMPANY	LCP Chemicals-NJ Inc	**ATTENTION**	Max Obra
PLANT		**ACCOUNT NUMBER**	
ADDRESS	South Wood Ave	**REQUISITION NUMBER**	000251
	Linden NJ 07036	**TELEPHONE NUMBER**	

B **SAMPLE NUMBER** 3A

BOTTLE CODES: E ____ to ____ M 1 to ____ V ____ to ____ VB ____ to ____
CN ____ to ____ PH ____ to ____ PCB ____ to ____ WO 1 to 4

PLEASE COMPLETE THE REMAINDER OF THIS FORM. ALWAYS COMPLETE ITEMS C, E, AND G. COMPLETE ITEM D IF SAMPLE APPEARANCE, CONSISTENCY, ODOR WARRANT NOTICE. COMPLETE ITEMS MARKED F AS NEEDED. ADD ANOTHER SHEET FOR F 7/8 AND SO ON IF NEEDED. THE LAST PERSON TO RECEIVE THE SAMPLE MUST, IN ADDITION TO COMPLETING THE APPROPRIATE F ITEM, ALSO COMPLETE ITEM G.

C **SAMPLE LOCATION OR CODE** (e.g., a permit code): WELL # 3

D **SAMPLE DESCRIPTION**: FILTERED WATER SAMPLE

E TO BE COMPLETED BY THE PERSON WHO ASSUMES RESPONSIBILITY FOR THE SAMPLE AND OBSERVES THE BREAKING OF THE SEAL

NAME	MAXIMO A. OBRA	**DATE**	3/15/8
SIGNATURE	Maximo A. Obra	**SEAL NO.**	6523
SEAL INTACT	✓ YES ____ NO	**SEAL BREAK TIME**	7:00A
CODE OF ANY LEAKING BOTTLES			
CODE OF ANY BROKEN BOTTLES			

IF SEAL IS *NOT* INTACT PLEASE CALL

WARNING
IF ANY BOTTLE IS LEAKING OR BROKEN, DO NOT HANDLE. SOME BOTTLES CONTAIN ACID. PLEASE CALL.

F1 RELINQUISHED BY
PRINT: MAXIMO A. OBRA
SIGN: Maximo A. Obra

F2 RECEIVED BY
PRINT: TONI KUZMACK TIME: 3pm
SIGN: Toni Kuzmack DATE: 3/15

NOTE: GIVE REASON FOR CUSTODY CHANGE, AND CODE OF ANY MISSING OR DAMAGED BOTTLES

F3 RELINQUISHED BY
PRINT:
SIGN:

F4 RECEIVED BY
TIME:
DATE:

NOTE: GIVE REASON FOR CUSTODY CHANGE, AND CODE OF ANY MISSING OR DAMAGED BOTTLES

F5 RELINQUISHED BY
PRINT:
SIGN:

F6 RECEIVED BY
TIME:
DATE:

NOTE: GIVE REASON FOR CUSTODY CHANGE, AND CODE OF ANY MISSING OR DAMAGED BOTTLES

63of (6)

G TO BE FILLED IN BY THE PERSON WHO HAS RESPONSIBILITY FOR THE SAMPLE AND OBSERVES RESEALING OF SAMPLE SHUTTLE

REPLACE FORM IN ENVELOPE
PUT ENVELOPE IN SHUTTLE

NAME	MAXIMO A. OBRA	**DATE**	3/15/8
SIGNATURE	Maximo A. Obra		
RESEAL		**SEAL**	

ETC
ENVIRONMENTAL
TESTING AND
CERTIFICATION
CORPORATION

LABORATORY CHAIN-OF-CUSTODY

TC Sample Number 001340 to 001343

elinquished By Toni Kuzmach
eceived By Date 3/15/82 Time 5:10 p.m.

linquished By
eceived By Date Time

elinquished By
eceived By Date Time

linquished By
cieved By Date Time

Ref No 11, p. 64 of 161

ETC ENVIRONMENTAL
TESTING AND
CERTIFICATION
CORPORATION

CHAIN OF CUSTODY

Company: LCP Chemicals Inc Job No. 251

Address: South Wood Ave
Linden NJ

Attention: Max Obra

8 Sample Shuttle(s) Received by: Toni Kuzmack

Time: 11:00Am Date: 3/15/82

Seal Number(s)	6516	6518	6520	6522
Seal Intact*	Y	Y	Y	Y
Seal Number(s)	6524	6526	6528	6530
Seal Intact*	Y	Y	Y	Y
Seal Number(s)				
Seal Intact*				
Seal Number(s)				
Seal Intact*				
Seal Number(s)				
Seal Intact*				
Seal Number(s)				
Seal Intact*				

* Yes (Y) No (N)

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284 RARITAN CENTER PARKWAY, EDISON, NEW JERSEY 08837 • (201) 225-5600

ETC ENVIRONMENTAL TESTING AND CERTIFICATION CORPORATION

CHAIN OF CUSTODY

Company: Chyun Associates Job No. 251

Address 1101 State Rd
Princeton NJ

Attention: Mike Wright

Sample Description:

ETC Sample #:	To be Analyzed for
01340W06 to 001343W06	TOC + total phenols
01340 W07 to 001343 W07	Conventionals: specific conductance. chloride, sulfate fluoride, Nitrate, Turbidity

Please run TOC and specific conductance in quad. for sample #001343

Sample(s) Relinquished by: Carl Dattilo

Time: 11:20 Am Date: 3-18-82

Sample(s) Received by: Michael Wright

Time: 1120 AM Date: 3/18/82

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ETC ENVIRONMENTAL
TESTING AND
CERTIFICATION
CORPORATION

LABORATORY CHAIN-OF-CUSTODY CHRONICLE

ETC Sample Number 001342

Sample Preparation For	Analyst	Date
Base/Neutral/PCB's & Pesticides		
~~Acids~~ Pesticides in H_2O	Ben [illegible] / Stephanie Dobbs	3/30/82
Metals	Kristine J. Kuhl	3-24-82
Others Herbicides in Water	Paul Krajczar	3/30/82

Sample Analysis For	Analyst	Date
Base/Neutral/PCB's & Pesticides		
Acids		
VOA/Purgeables		
Metals	K J Kuhl / A. W. Masson	3-28-82 & 4-1-82
Others Herbicides in Water	Paul Krajczar	4/1/82
Others Pesticides in Water	Paul Krajczar	4/2-3,8/82

Verified By

Ref. No. 11, p. 67 of 161

ETC ENVIRONMENTAL
TESTING AND
CERTIFICATION
CORPORATION

To Teledyne Isotopes:

Please complete this document and include with your report.

This shuttle contains:

ETC Sample numbers:		To be analyzed for:
001327	W05	Gross Alpha/Beta
001328	W05	Gross Alpha/Beta
001330	W05	Gross Alpha/Beta
001342	W05	Gross Alpha/Beta
001343	W05	Gross Alpha/Beta

Sample Shuttle sealed by: Toni Kuzmack

Date: 3/17/82 Time: 3:15 pm Seal Number: 6583

Sample Shuttle opened by: Edna C Cunningham

Date: 3/18/82 Time: 1600 Seal Number: 0006583

Was seal intact? Yes ✓ No ____

For return:

Sample Shuttle sealed by: Edna C Cunningham

Date: 3/19/82 Time: 1150 Seal Number: 0006584

Sample Shuttle opened by: Toni Kuzmack

Date: 3/22/82 Time: 11:39 Seal Number: 6584

Was seal intact? Yes ✓ No ____

284 RARITAN CENTER PARKWAY, EDISON, NEW JERSEY 08837 • (201) 225-5600

ETC ENVIRONMENTAL
TESTING AND
CERTIFICATION
CORPORATION

LABORATORY CHAIN-OF-CUSTODY

TC Sample Number 001340 W06 to 001343W06
001340 W07 to 001343 W07

elinquished By Toni Kuzmack

eceived By Carl Dilello Date 3-18-87 Time 10:20am

inquished By ____

eceived By ____ Date ____ Time ____

elinquished By ____

eceived By ____ Date ____ Time ____

elinquished By ____

ecieved By ____ Date ____ Time ____

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Analysis of Pesticides and Herbicides

The methods employed in the analysis of your water sample for pesticides and herbicides are established EPA methods taken from the "Manual of Analytical Methods for the Analysis of Pesticides in Humans and Environmental Samples," June, 1980. The pesticide method can be summarized as follows: A measured volume of sample, approximately 500-1000ml, to which sodium sulfate has been added, is extracted with methylene chloride. The methylene chloride extract is dried and concentrated to approximately 0.5ml. The extract is brought to a final volume with hexane and injected into a gas chromatograph equipped with a ^{63}Ni electron capture detector.

The herbicide method can be summarized as follows: A measured volume of sample, approximately 500-1000 ml, to which sodium sulfate has been added, is acidified and extracted with methylene chloride. The methylene chloride extract is evaporated to dryness, and the residue is derivatized with a BF_3 esterification reagent. The derivatives are extracted into hexane for subsequent injection into a gas chromatograph equipped with a ^{63}Ni electron capture detector.

The GC operating parameters were as follows:

COLUMN

6' x 4mm glass 1.5% SP-2250 & 1.95% SP-2401
Supelcoport 100/120 mesh

CARRIER FLOW

60ml/min. Argon/Methane

SEPTUM PURGE

5ml/min. Argon/Methane

COLUMN OVEN

210°C

INJECTOR TEMPERATURE

225°C

DETECTOR TEMPERATURE

300°C

METHODOLOGY

Analysis of Metals

The methods employed in the analysis of your sample for metals are established EPA methods for priority pollutants.

Metals analysis is performed according to the methods published by EPA in "Methods for Chemical Analysis of Water and Wastes", EPA-600/4-70-020, March 1979. Arsenic, selenium, thallium, and antimony are analyzed by furnace AA while calcium, magnesium, barium, beryllium, chromium, nickel, copper, zinc, silver, cadmium, and lead are analyzed by flame AA. Potassium and sodium are analyzed by flame emmission. Mercury is analyzed by cold vapor technique.

QUALITY ASSURANCE PROTOCOL

The quality assurance protocol followed in the analysis of your sample is based on the "Handbook for Analytical Control in Water and Wastewater Laboratories," EPA-600/4-79-019, March, 1979; National Enforcement Investigation Center Policies, and Procedures manual; and EPA-330/9/79/001-R, October, 1979.

Analysis of Metals (Standards)

- New working standards are prepared for each batch of samples.
- Normal calibration is performed using a blank and four standards that have been carried through the entire sample preparation procedure. A regression analysis is used to construct the calibration curve.
- For each sample analysis in the standard additions technique, a three point calibration is performed using U. S. EPA Methods for Chemical Analysis of Water and Wastes, 1979. Results are obtained using linear regression analysis. Any results obtained with a coefficient of correlation below 0.990 are considered erroneous, necessitating raw data editing or sample re-analysis.
- Normal calibration curves are constructed using greater than or equal to 5 times the Instrumental Detection Limit (IDL) as the lowest concentration level.
- All calibration standards are analyzed in duplicate, as a minimum.
- Independent reference standards are used to check the accuracy of calibration standards.
- A check standard is analyzed every ten samples to establish the validity of the normal calibration curve.

Analysis of Metals (Sample, for all metals except Mercury)

For all homogeneous samples (minimum of 42% QC), each sample batch may include up to 30 samples and the following fixed number of QC samples:

- 3 Replicates.
- 2 Replicate spikes.
- 2 Replicate independent reference standards.
- 8 Calibration standards (processed using the sample preparation method).
- 2 Blanks (using sample preparation method).
- 4 Calibration standards (without sample preparation).
- 1 Blank (without sample preparation).

For all heterogeneous samples (minimum of 65% QC), every field sample in a sample batch is run in duplicate. A sample batch may include up to 30 samples and the following fixed number of QC samples:

- 4 Replicates.
- 4 Replicate spikes.
- 2 Replicate independent reference standards.
- 8 Calibration standards (processed using the sample preparation method).
- 2 Blanks (using sample preparation method).
- 4 Calibration standards (without sample preparation).
- 1 Blank (without sample preparation).

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Analysis of Pesticides and Herbicides

- In every block of 20 samples extracted, there are 16 field samples, one blank, one spiked blank, one sample spiked with the standard mixture, and a duplicate field sample.
- Blind quality control samples are included in field samples at a minimum of one every hundred samples.
- GC performance criteria as specified in EPA Method 608 are met before analysis starts.

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Ref. No. 11, p.

Analysis of Metals (Sample, Mercury)

For every matrix (minimum of 66% QC), all the field samples in sample batch are run in duplicate. A sample batch may include up to 20 samples and the following fixed number of QC samples:

- 3 Replicates.
- 2 Replicate spikes.
- 2 Replicate independent reference standards.
- 10 Calibration standards (processed using the sample preparation method).
- 2 Blanks.

REPORT APPENDICES

The following appendices provide the support analytical data associated with your sample analyses. They are arranged as follows:

Appendix A

1) Reconstructed total ion chromatogram of GC/MS analyses of your sample.

2) The individual mass spectra of all priority pollutant compounds which have been identified as being present in your sample.

3) The individual mass spectra of the corresponding compounds as obtained from the standards.

Appendix B

1) The mass spectra of the calibration compounds, 4-bromofluorobenzene (BFB) and decafluorotriphenylphosphine (DFTPP), as obtained on the data of sample analyses.

Appendix C [for plus 10 and 50% internal standard option]

1) Spectra of tentatively identified compounds, with their differences.

Appendix D

1) Subcontractor's report.

These data are provided to present a complete report on your sample and to provide the data on which analytical decisions have been based. We hope this will aid you in your own analysis of the data.

Chain-of-Custody

The chain-of-custody procedure is part of our quality assurance protocol. We believe our chain-of-custody record fully complies with the legal requirements of federal, state and local government agencies and of the courts of law. The record covers:

- labeling of sample bottles, packing the Sample Shuttle and transferring the Shuttle under seal to the custody of a shipper;
- outgoing shipping manifests;
- the chain-of-custody form completed by the person (s) breaking the seal, taking the sample, resealing the Shuttle and transferring custody to a shipper;
- incoming shipping manifests;
- breaking the Shuttle's reseal;
- storing each labeled sample bottle in a secured area;
- disposition of each sample to an analyst or technician and;
- the use of the sample in each bottle in a testing procedure appropriate to the intended purpose of the sample.

The record shows for each link in this process:

- the person with custody;
- the time and date each person accepted or relinquished custody.

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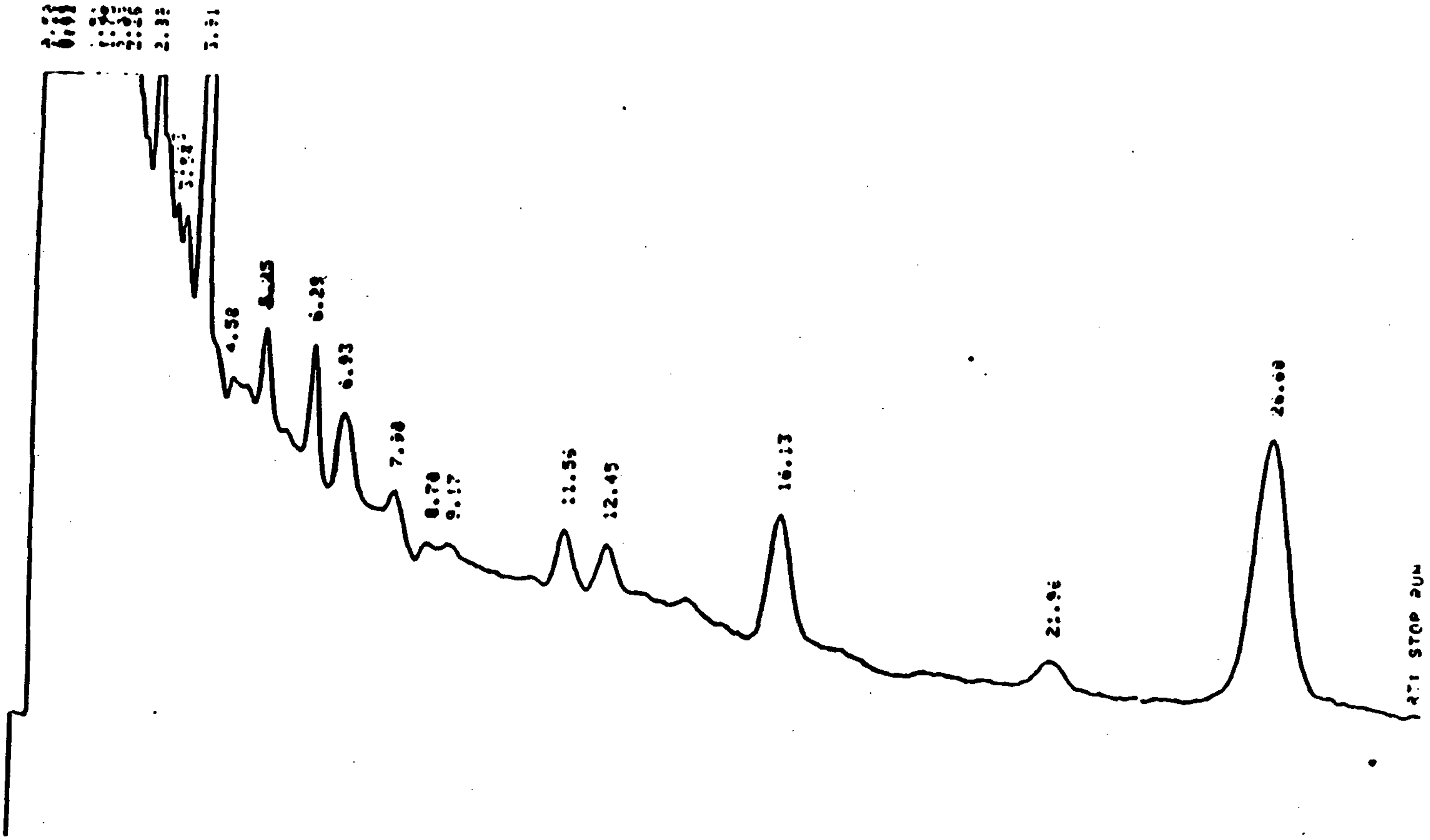

Gas Chromatogram of Well #3
ETC Sample No. 001342
for the Analysis of Endrin and Toxaphene

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APPENDIX

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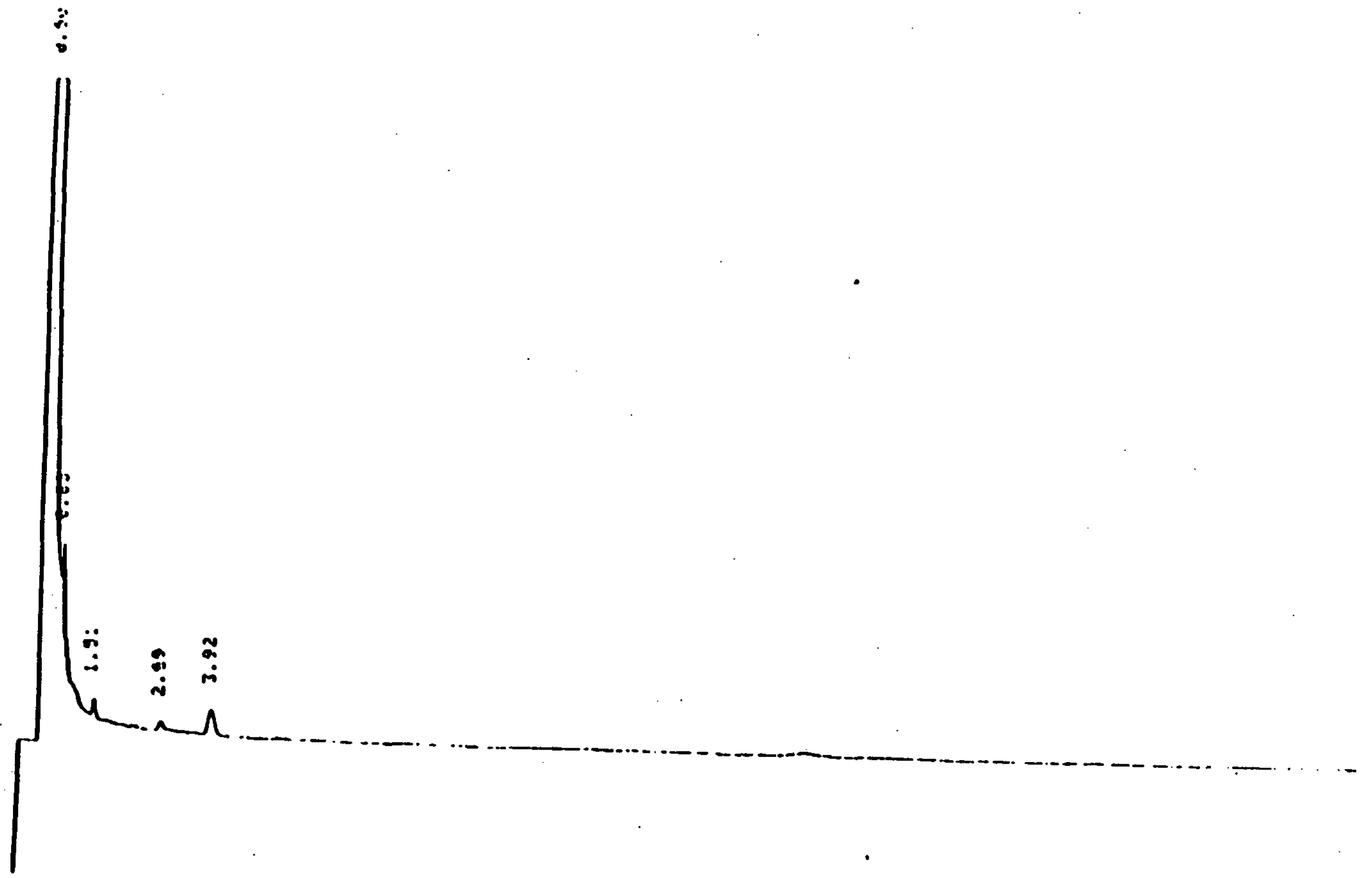
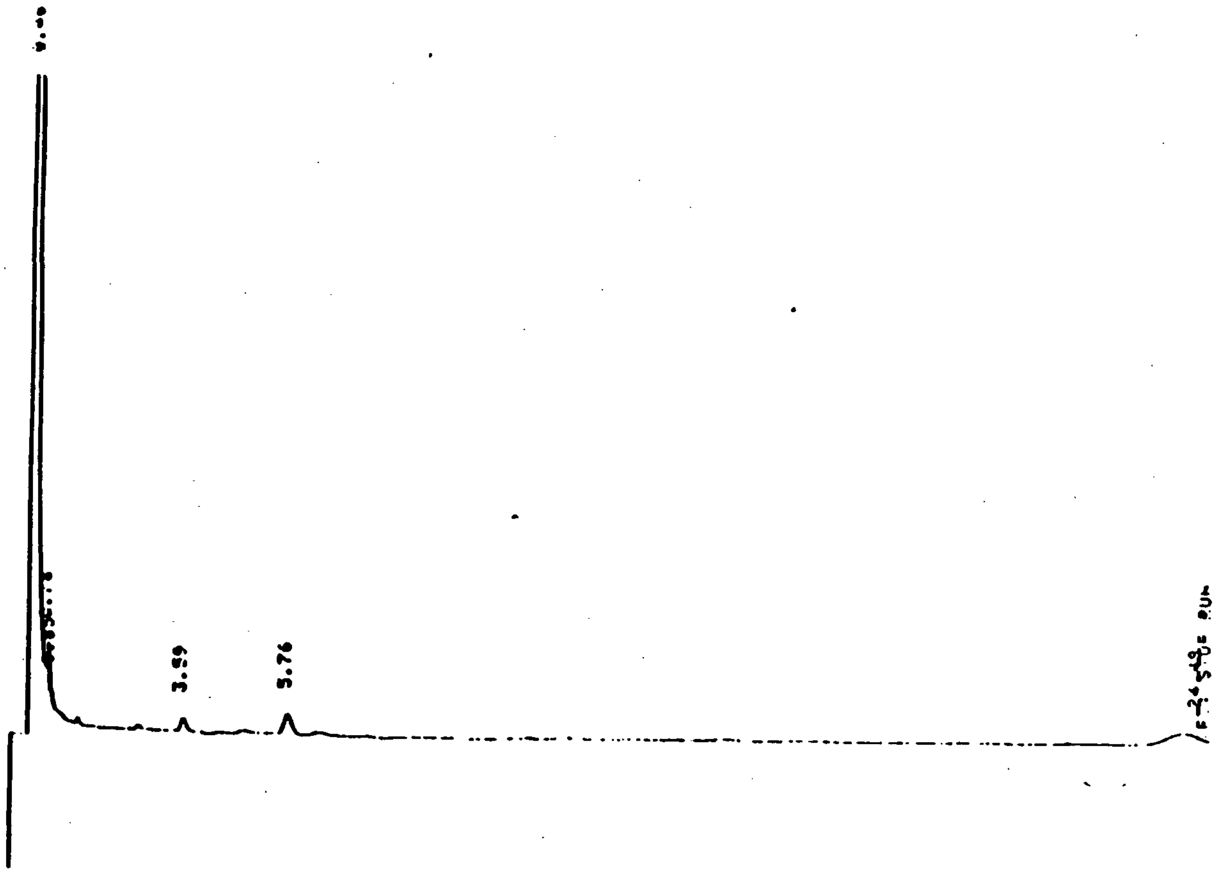


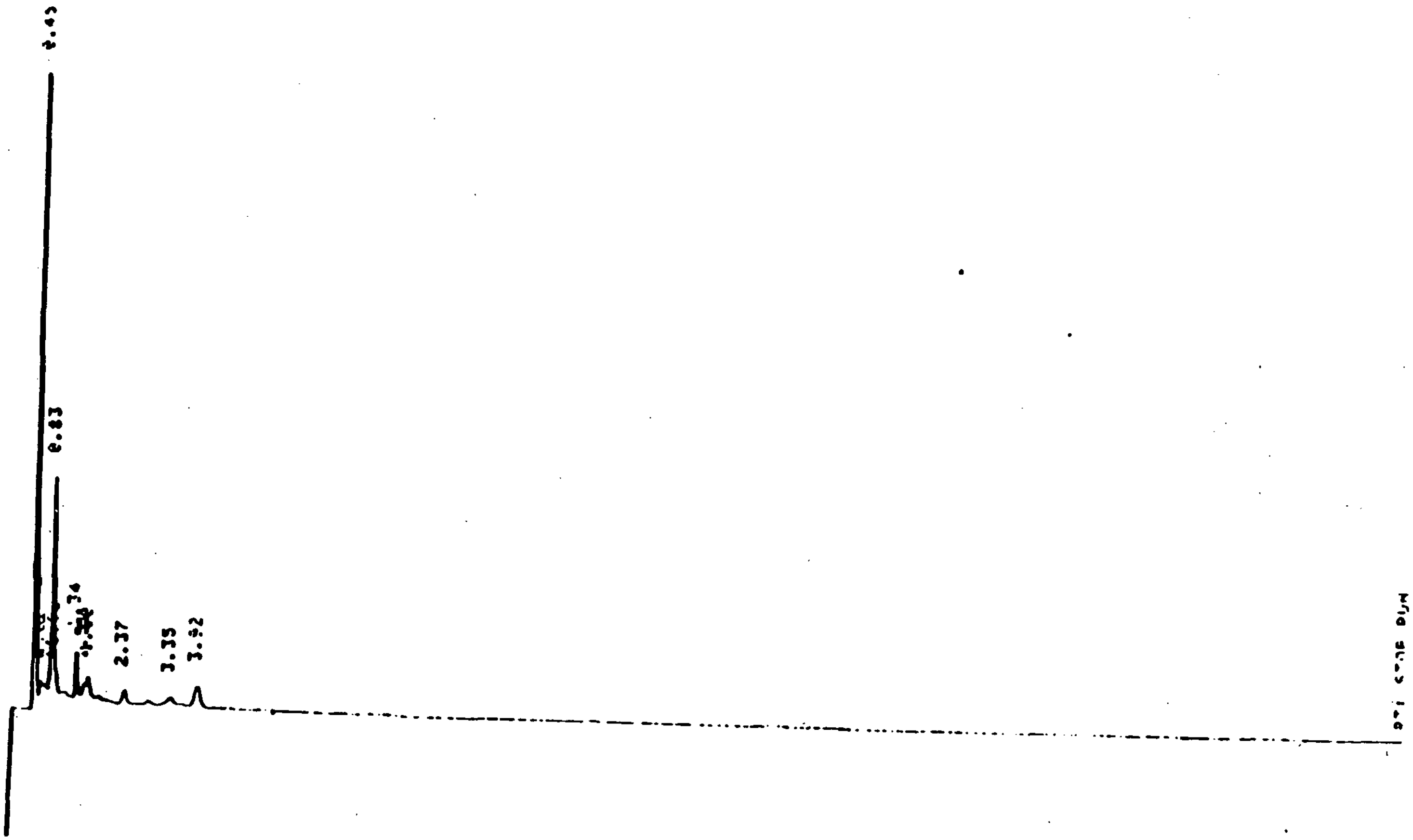
Gas Chormatogram of Well #3
ETC Sample No. 001342
for the Analysis of Lindane

Ref. No. 11, p. 60 of 161



Gas Chromatogram of Well #3
ETC Sample No. 001342
for the Analysis of Methoxychlor

Ref. No. 11, p. 8/of/161



Gas Chromatogram of Well #2
ETC Sample No. 001341
for the Analysis of Lindane

Ref. No. 11, p.

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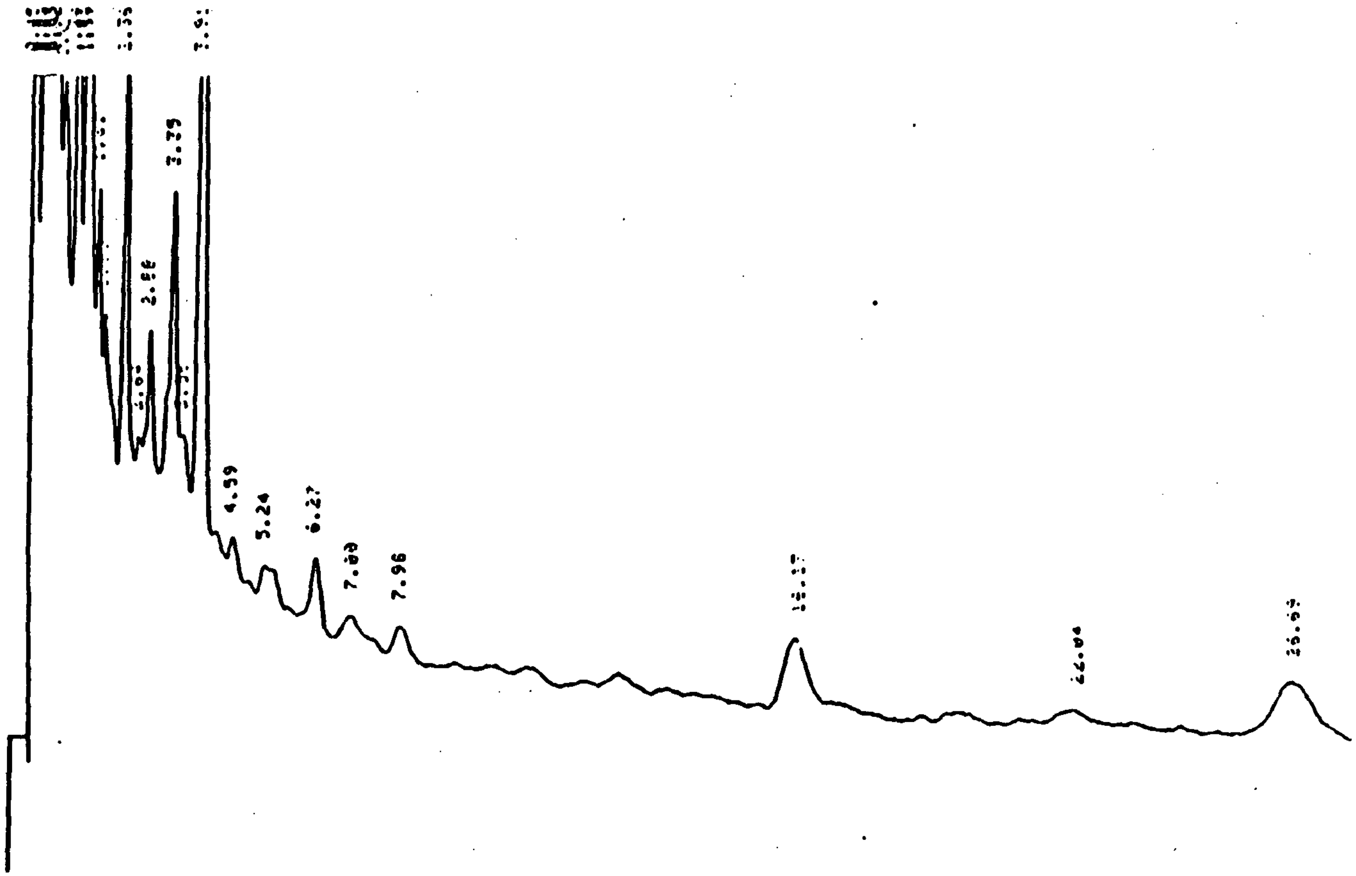

Gas Chromatogram of Well #2
ETC Sample No. 001341
for the Analysis of Endrin and Toxaphene

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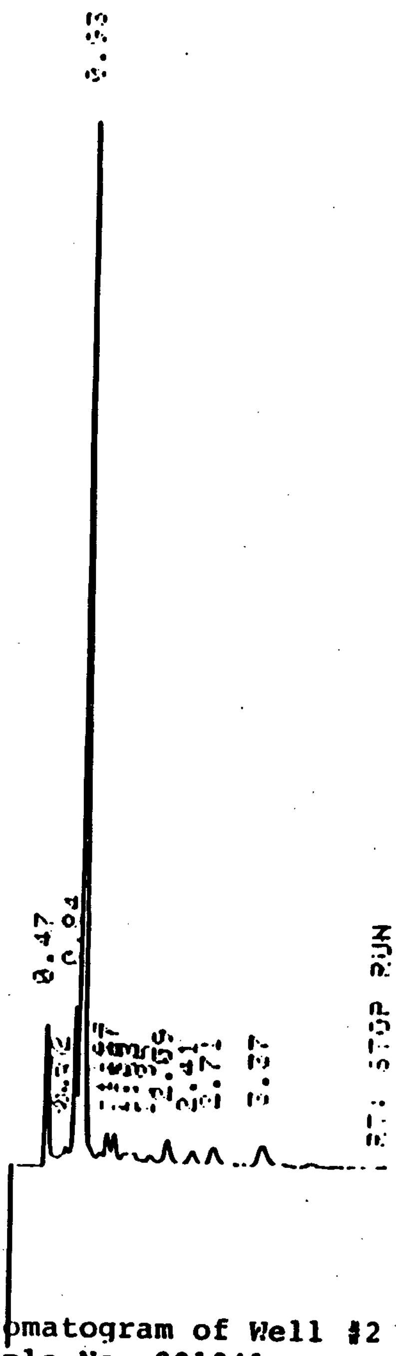
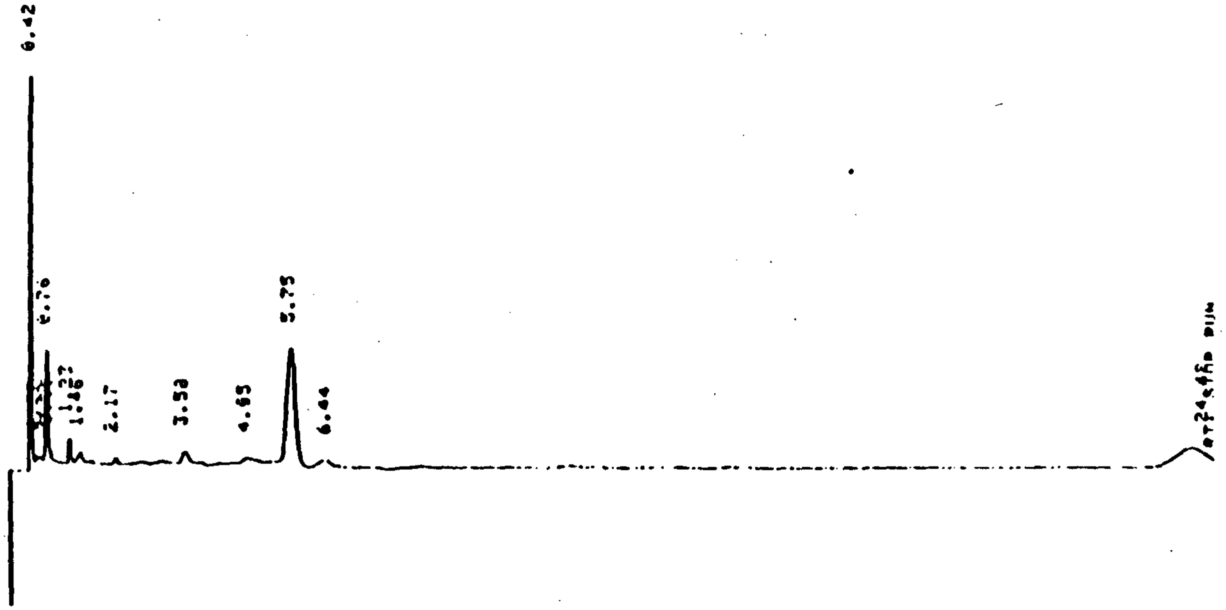
Ref. No. 11, p.

846/161

101933



Gas Chromatogram of Well #2
ETC Sample No. 001341
for the Analysis of 2,4-D and 2,4,5-TP (Silvex)



Gas Chromatogram of Well #2
ETC Sample No. 001341
for the Analysis of Methoxychlor

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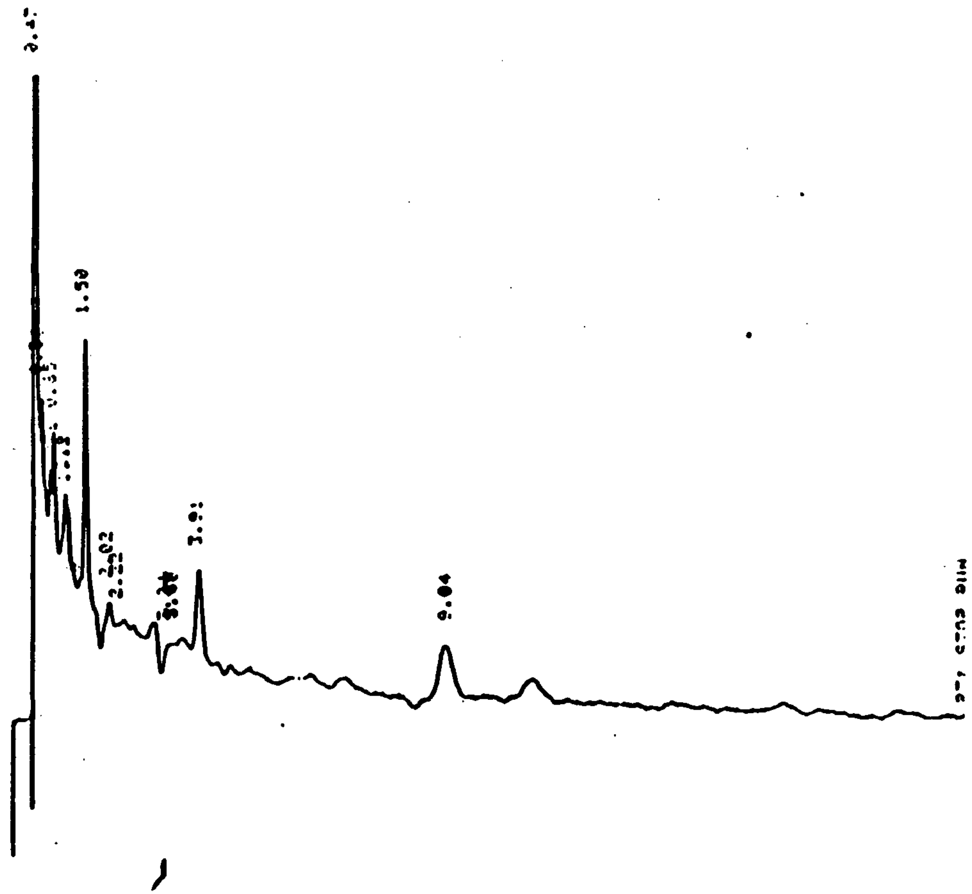
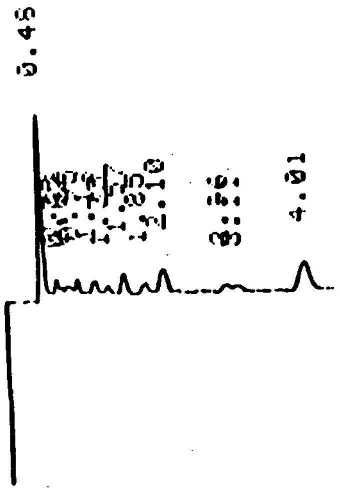
101934



Gas Chromatogram of Endrin Standard
(0.01 ng/ul)

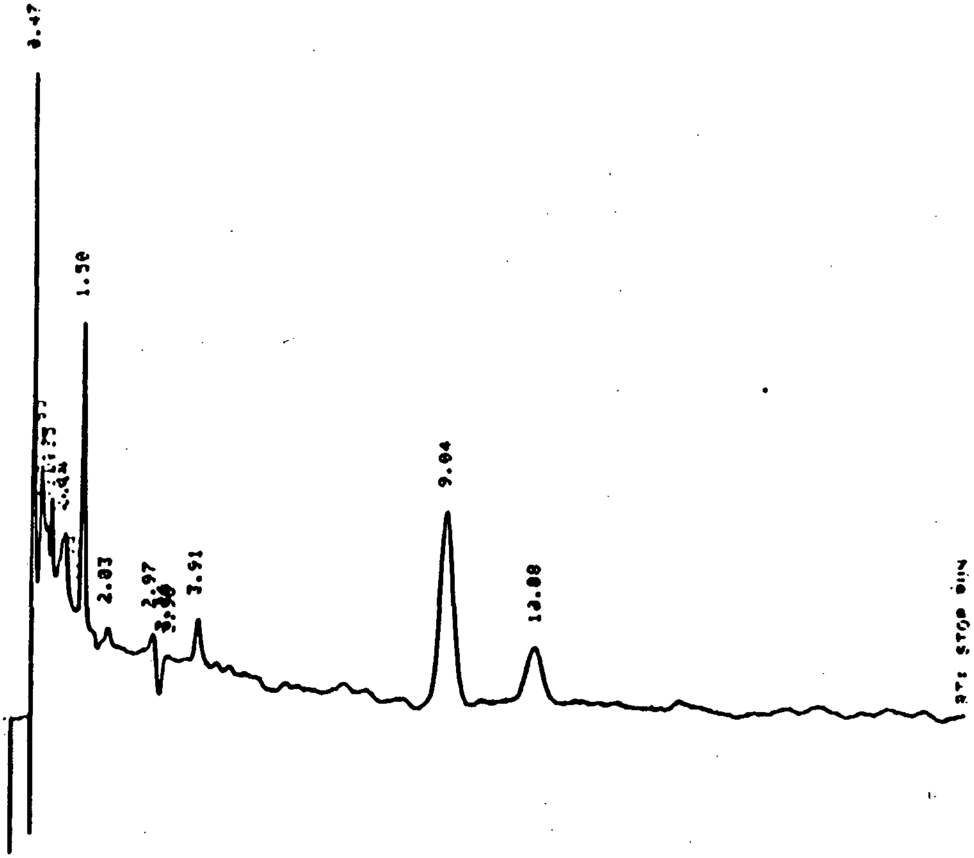
Ref. No. 11, p. 86 of 161

101935



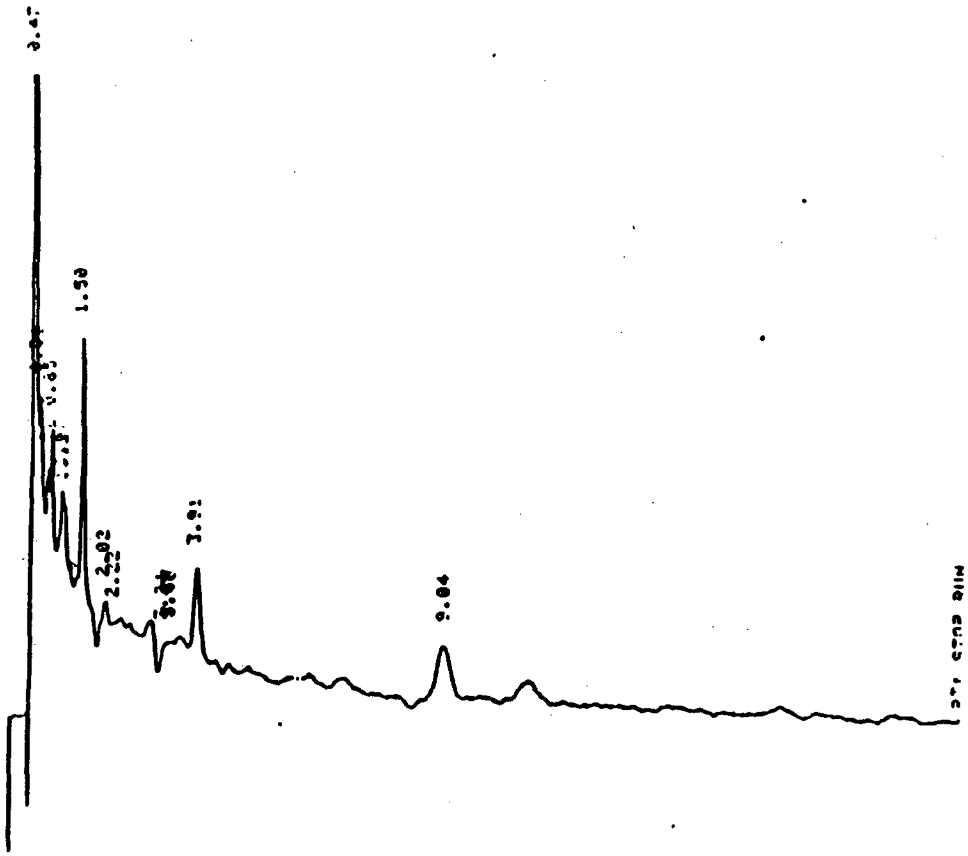
Gas Chromatogram of Well #3
ETC Sample No. 001342
for the Analysis of 2,4-D and 2,4,5-TP (Silvex)

Ref. No. 11, p. 87 of 161



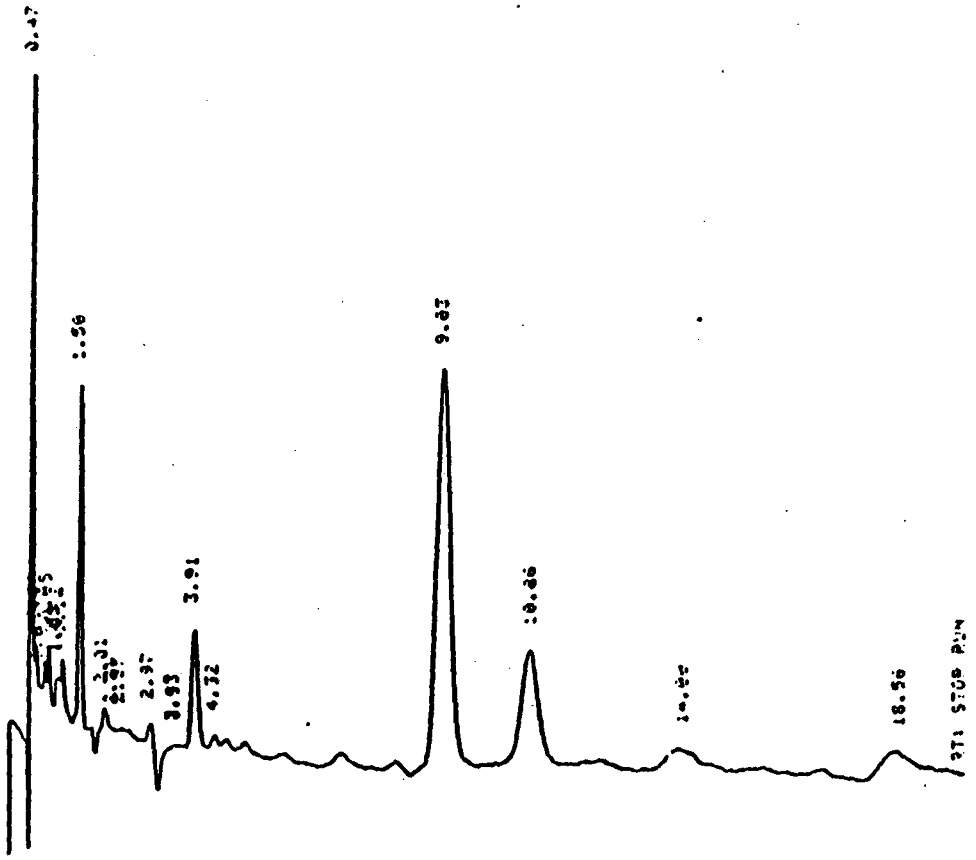
Gas Chromatogram of Endrin Standard
(0.05 ng/ul)

Ref. No. 11, p. 88-161



Gas Chromatogram of Endrin Standard
(0.01 ng/ul)

Ref. No. 11, p. 86/161

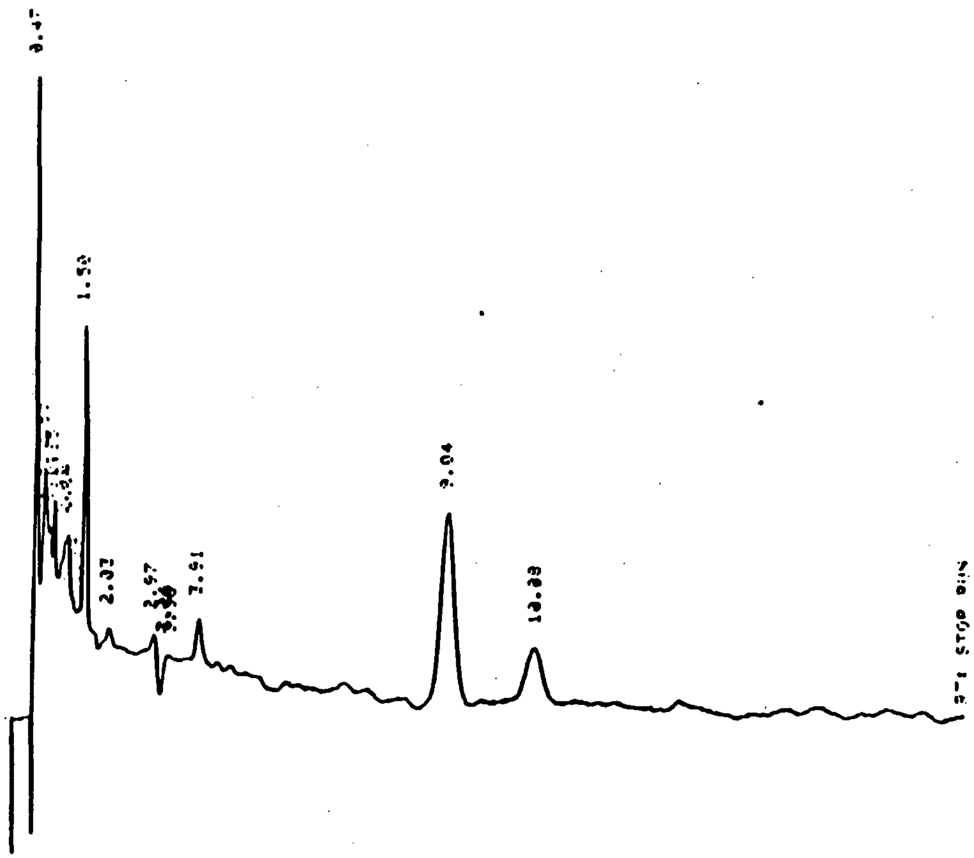


Gas Chromatogram of Endrin Standard
(0.1 ng/ul)

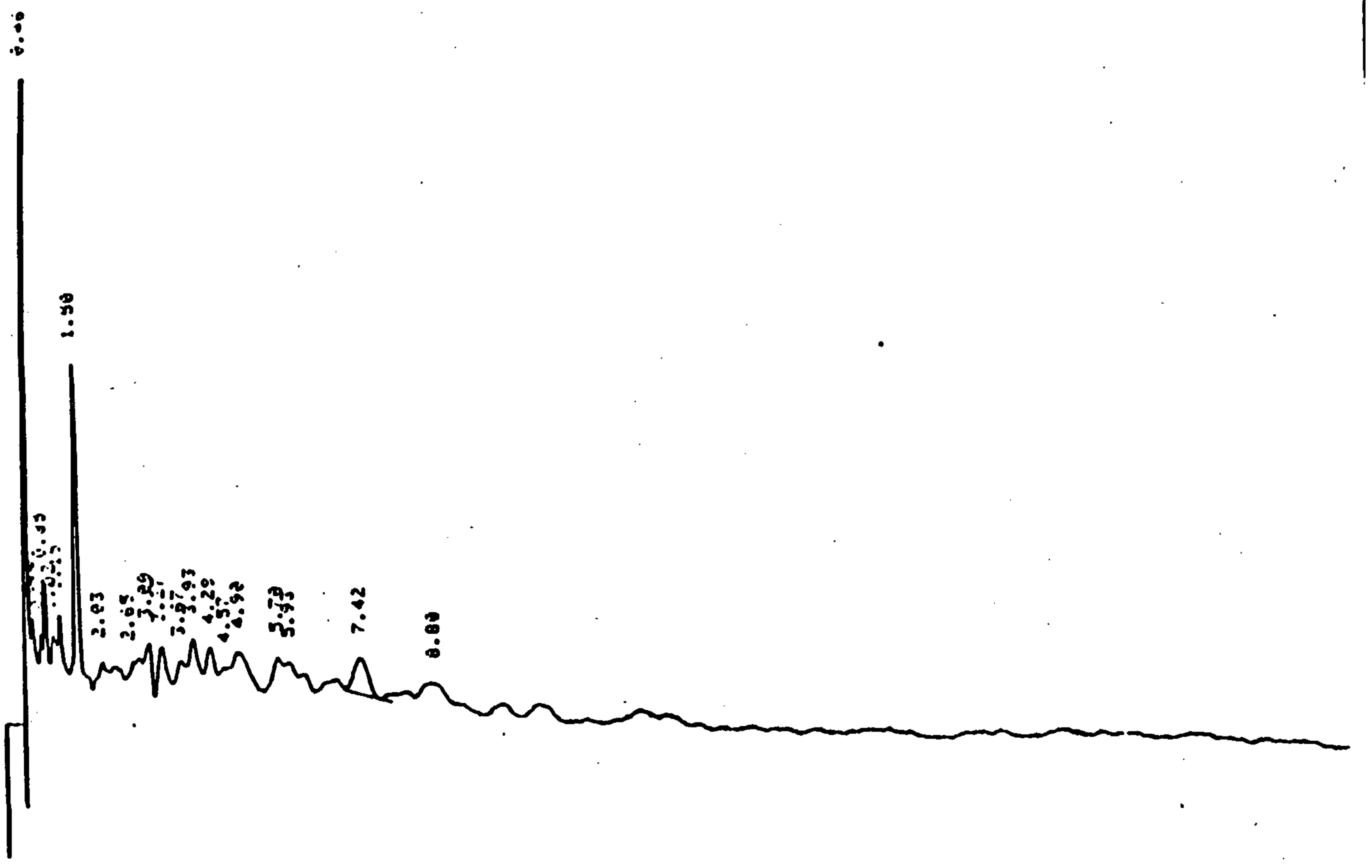
Ref. No. 11, p.

900f/61

101939

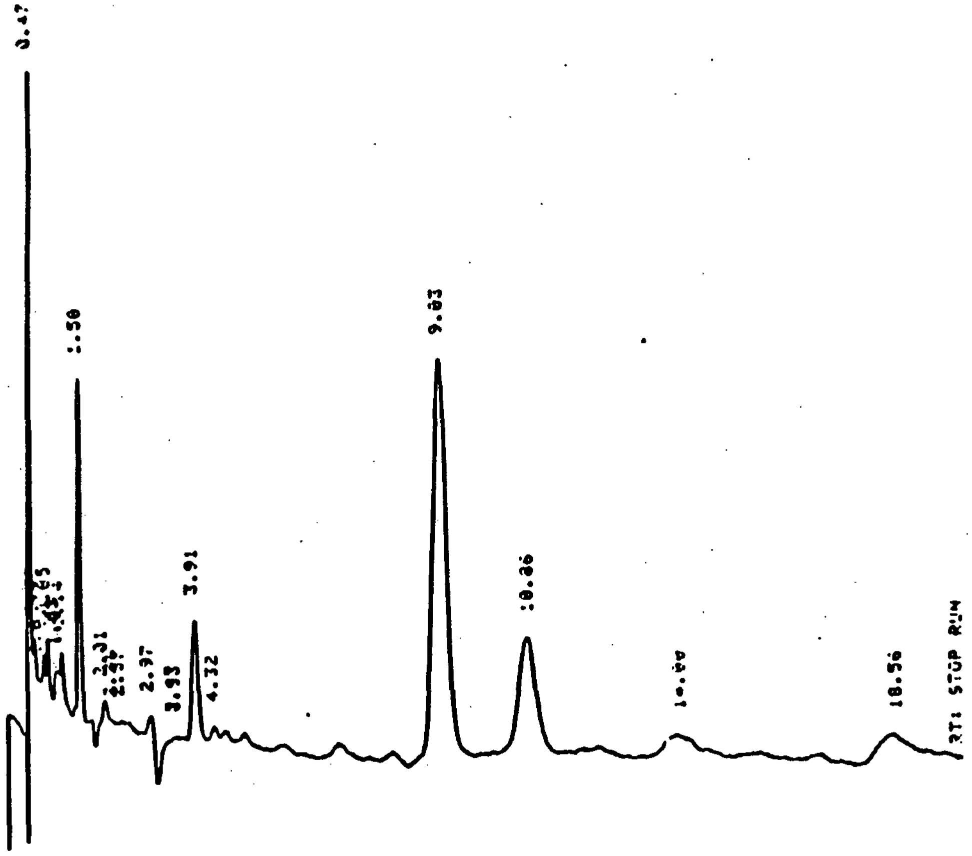


Gas Chromatogram of Endrin Standard
(0.05 ng/ul)



Gas Chromatogram of Toxaphene Standard
(0.25 ng/ul)

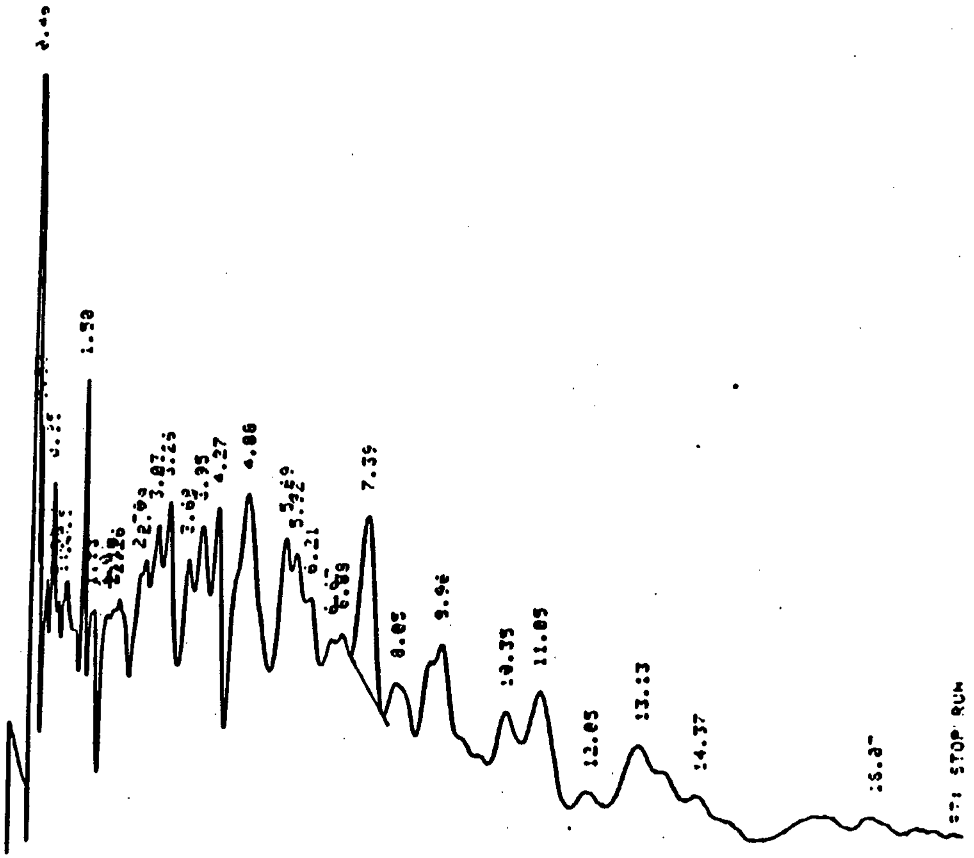
Ref. No. 11, p. 92 of 161



Gas Chromatogram of Endrin Standard
(0.1 ng/ul)

Ref. No. 11, p.

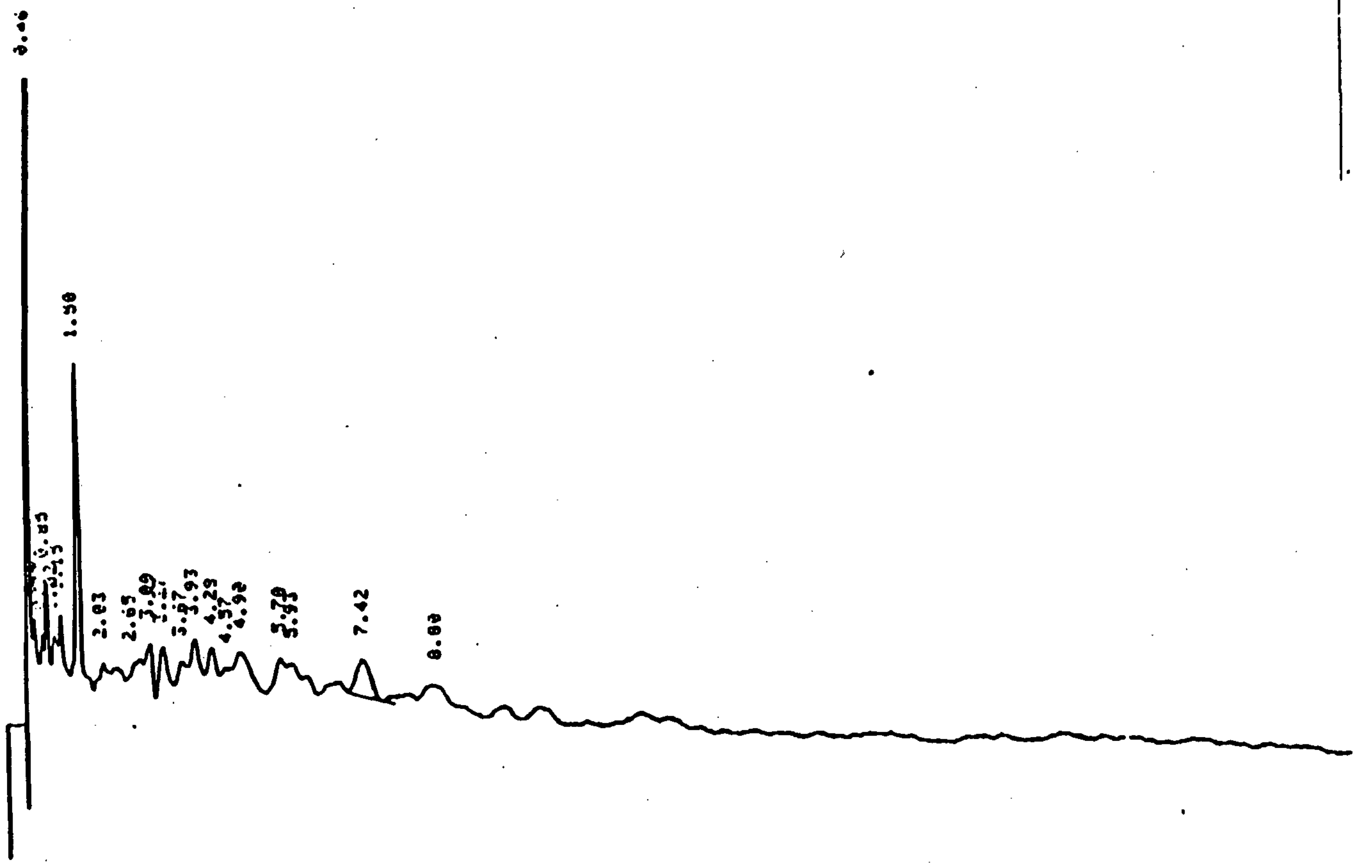
9367/161



Gas Chromatogram of Toxaphene Standard
(1.0 ng/ul)

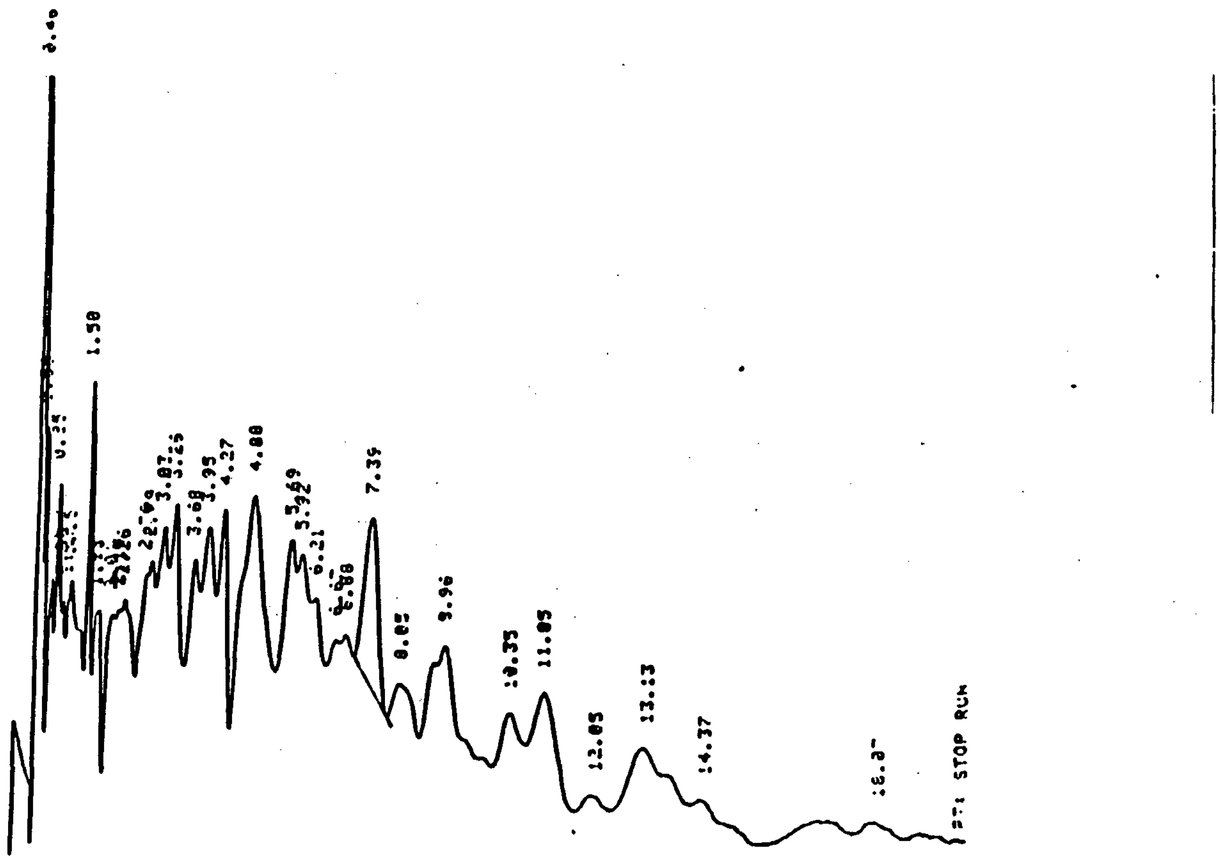
Ref. No. 11, p.

946/161



Gas Chromatogram of Toxaphene Standard
(0.25 ng/ul)

Ref. No. 11, p. 95of/161

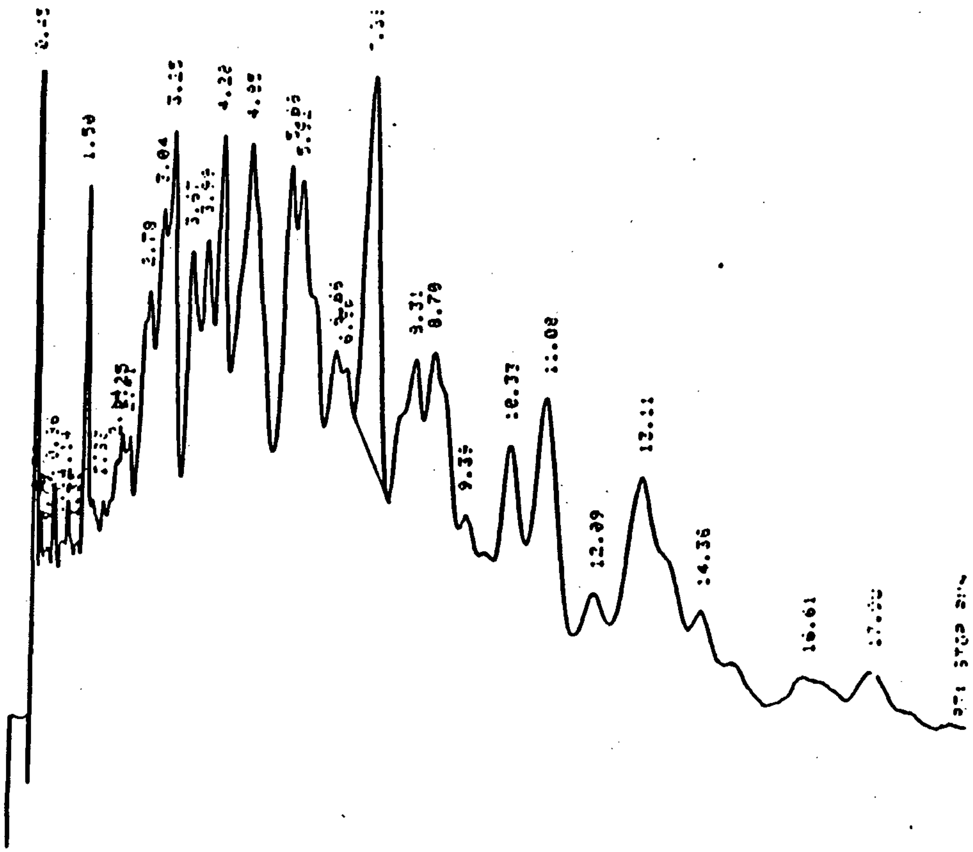


Gas Chromatogram of Toxaphene Standard
(1.0 ng/ul)

Ref. No. 11, p.

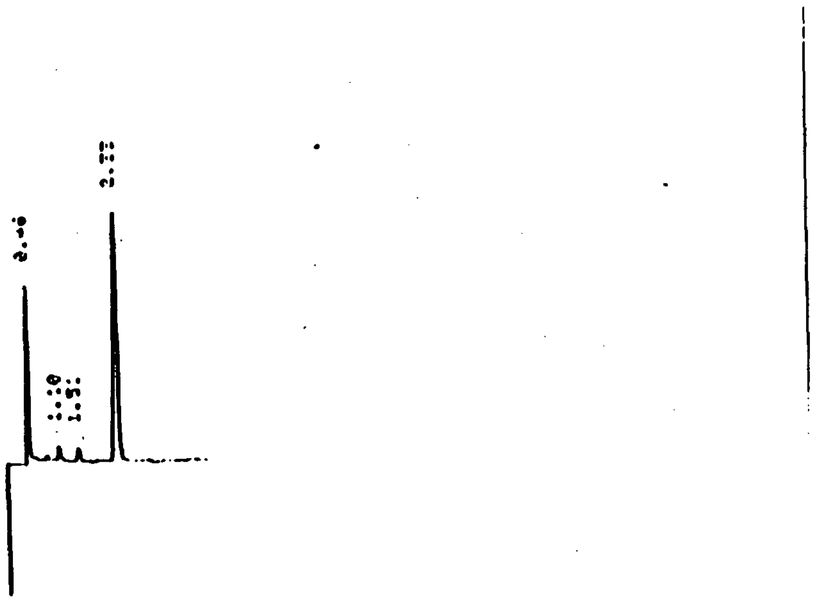
96/161

101945



Gas Chromatogram of Toxaphene Standard
(2.0 ng/ul)

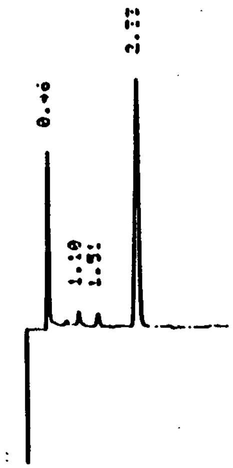
Ref. No. 11, p. 97of161



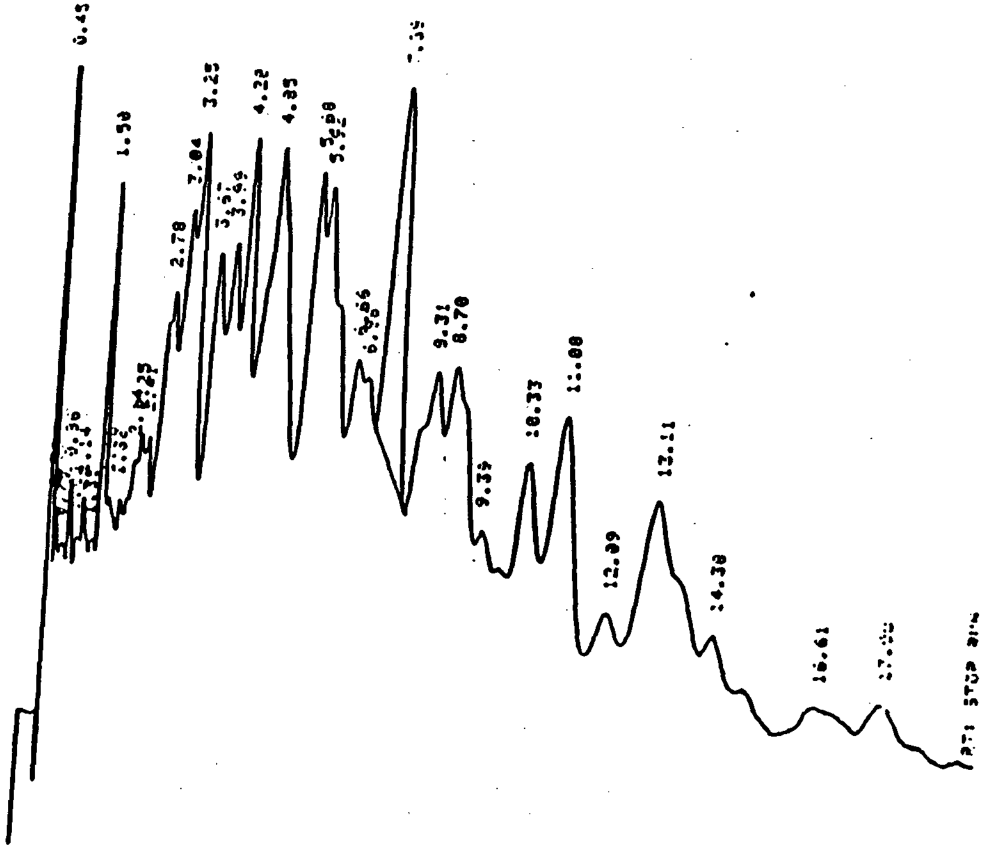
Gas Chromatogram of Lindane Standard (0.2 ug/ml)

Ref. No. 11, p.

980/61

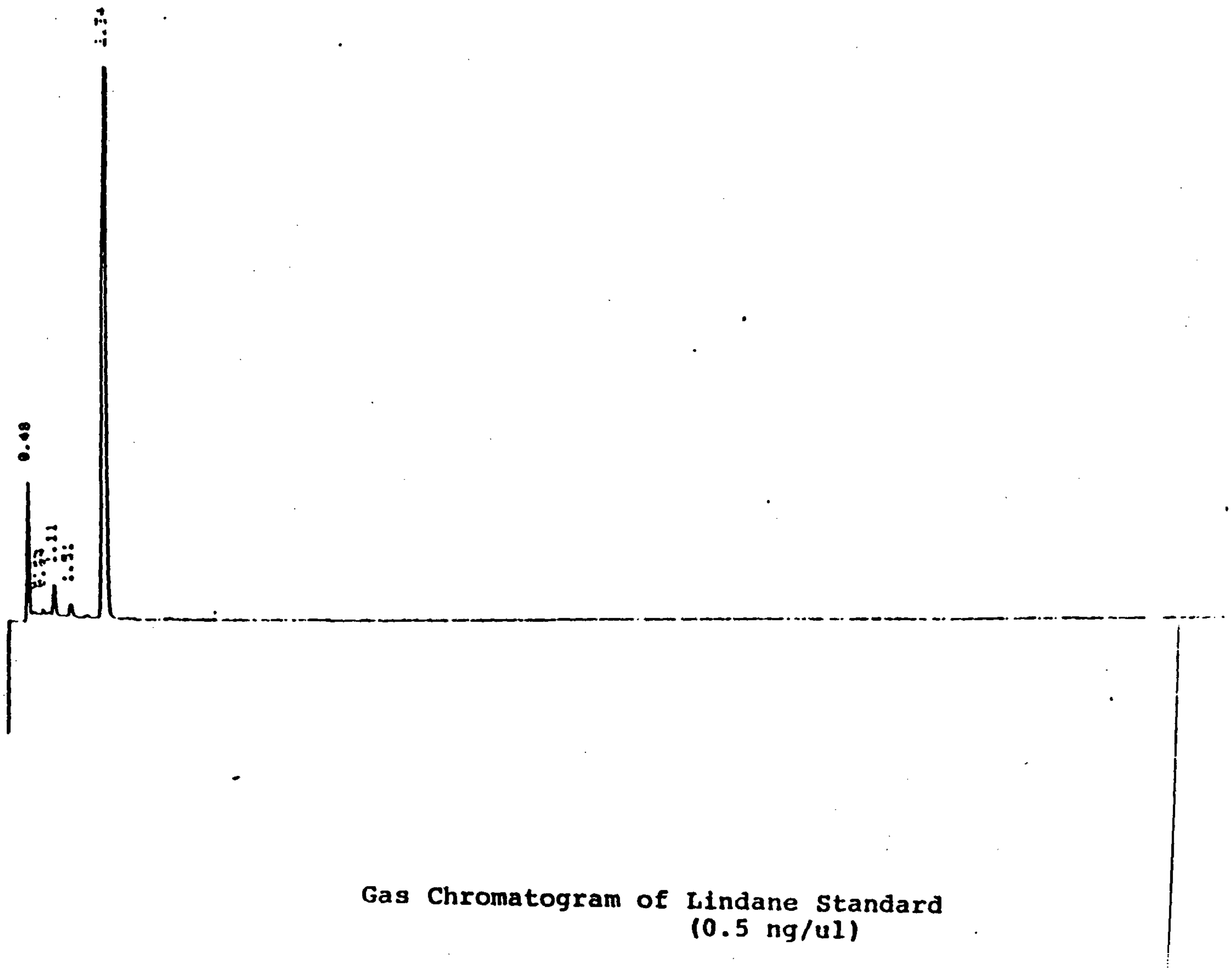


Gas Chromatogram of Lindane Standard
(0.2 ug/ml)



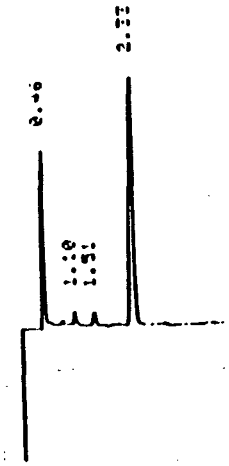
Gas Chromatogram of Toxaphene Standard
(2.0 ng/ul)

Ref. No. 11, p. 1006/161



Gas Chromatogram of Lindane Standard
(0.5 ng/ul)

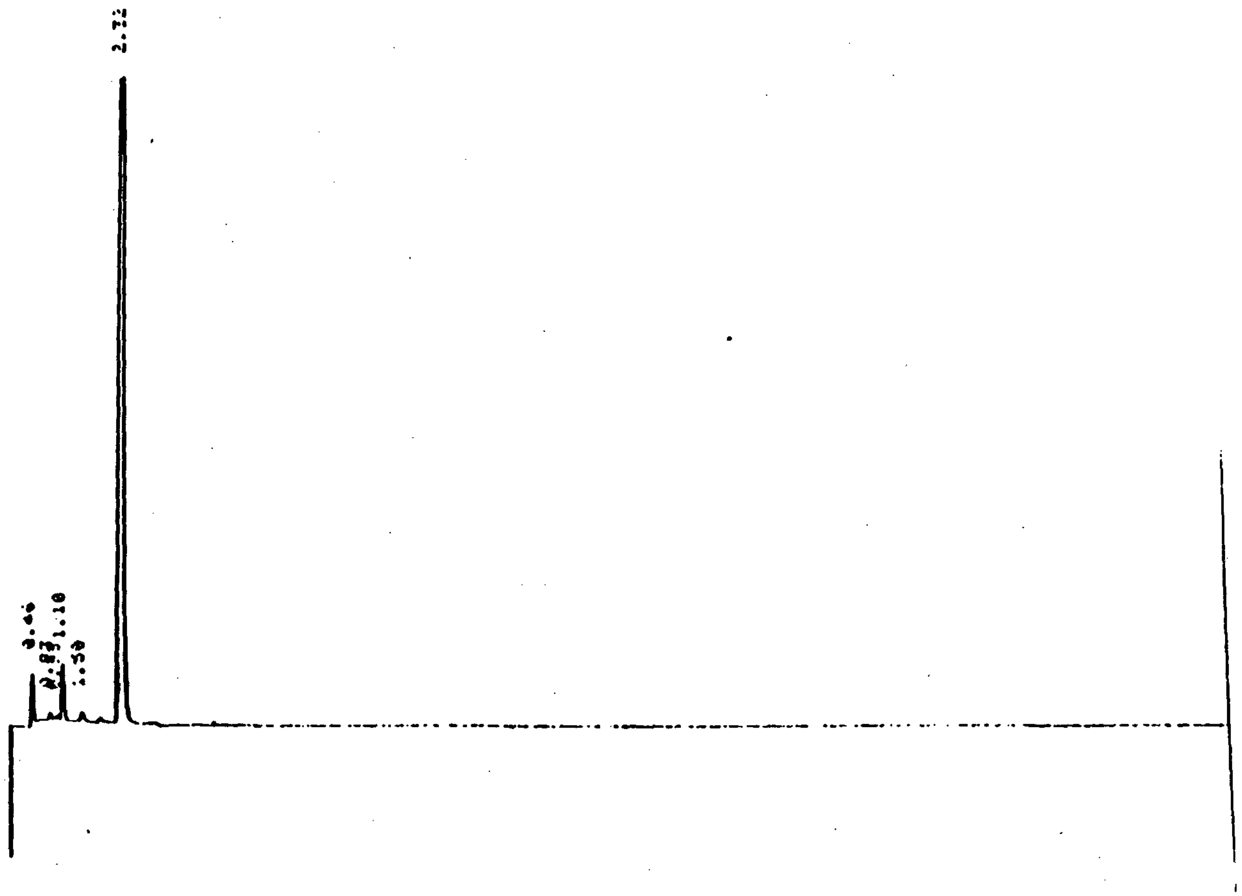
Ref. No. 11, p. 101 of 161



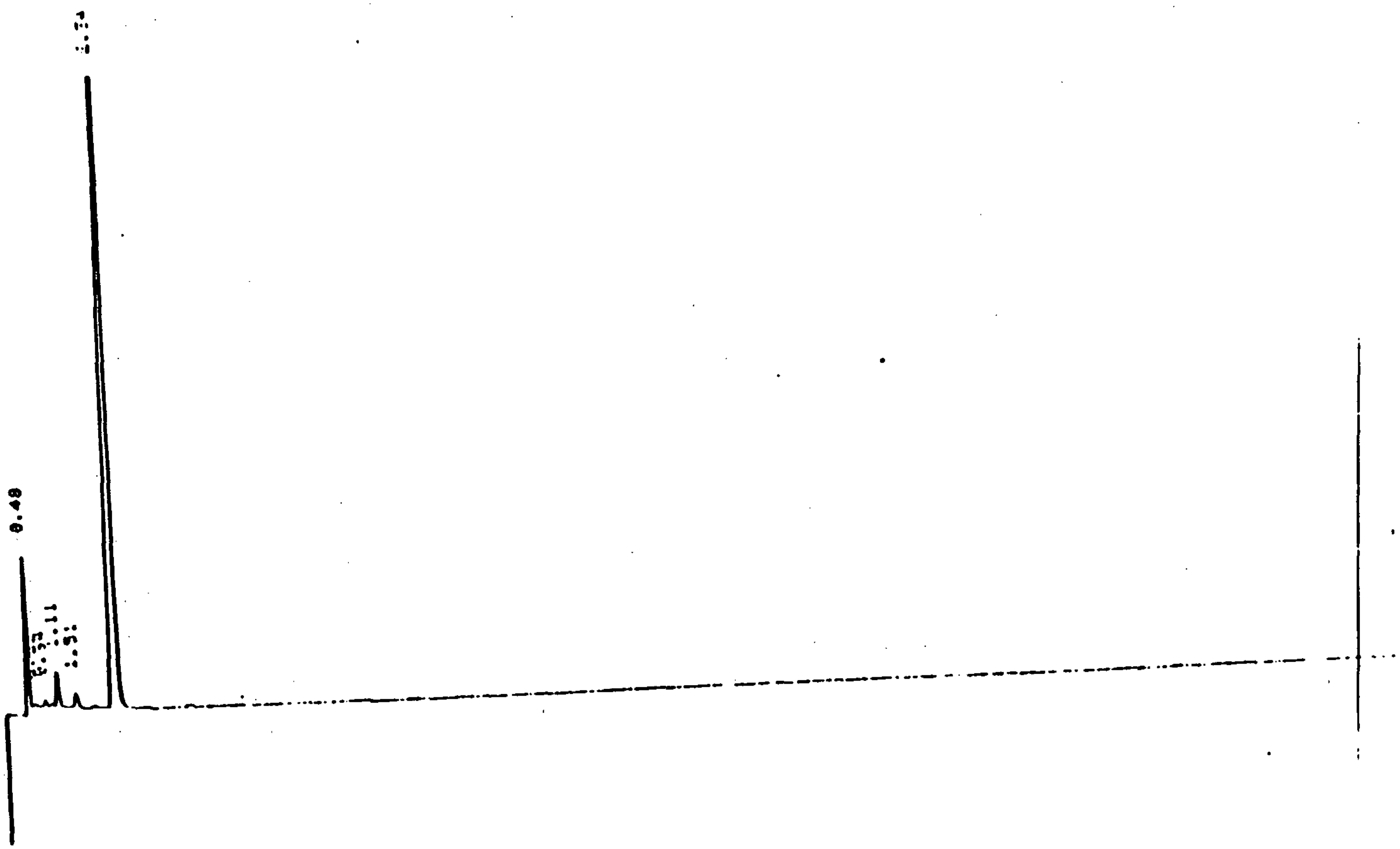
Gas Chromatogram of Lindane Standard
(0.2 ug/ml)

Ref. No. 11, p. 162 of 161

101951



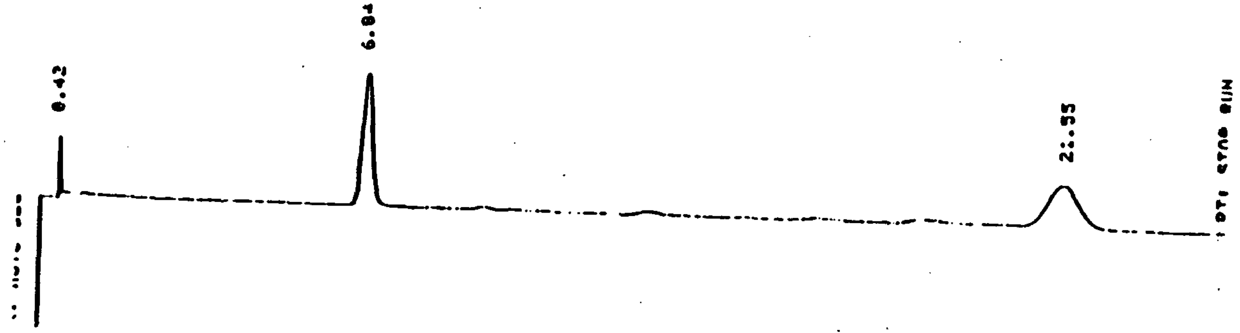
Gas Chromatogram of Lindane Standard
(1.0 ng/ul)



Gas Chromatogram of Lindane Standard
(0.5 ng/ul)

Ref. No. 11, p. 1040X/161

101953

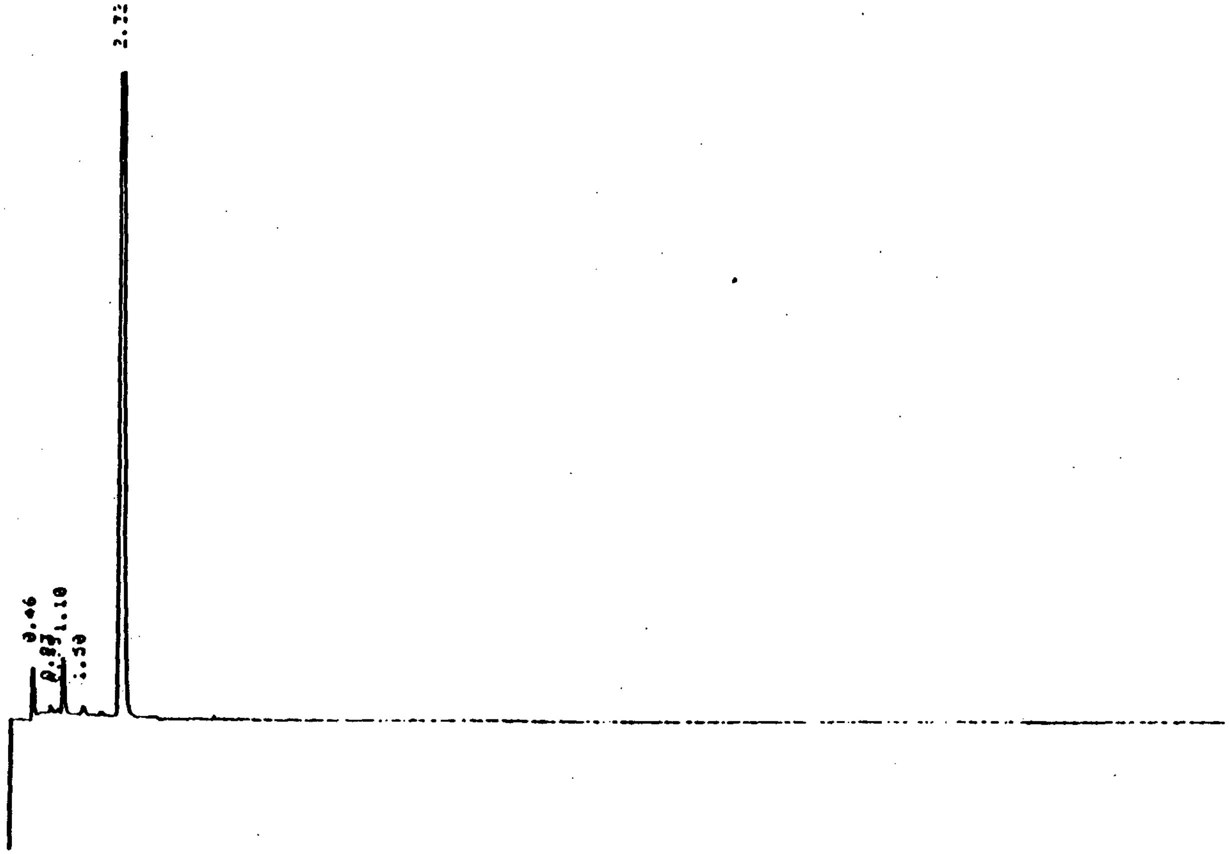


Gas Chromatogram of Methoxychlor Standard
(5.0 ng/ul)

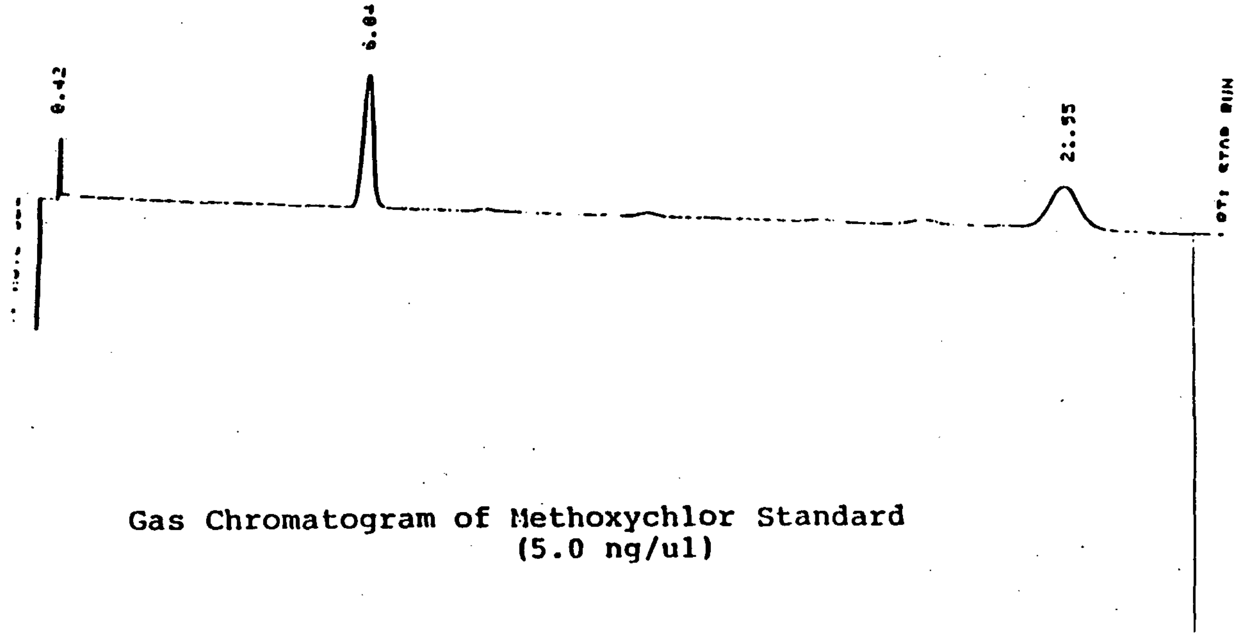
Ref. No. 11, p. 105 of 161

101954

Ref. No. 11, p. 1064/161



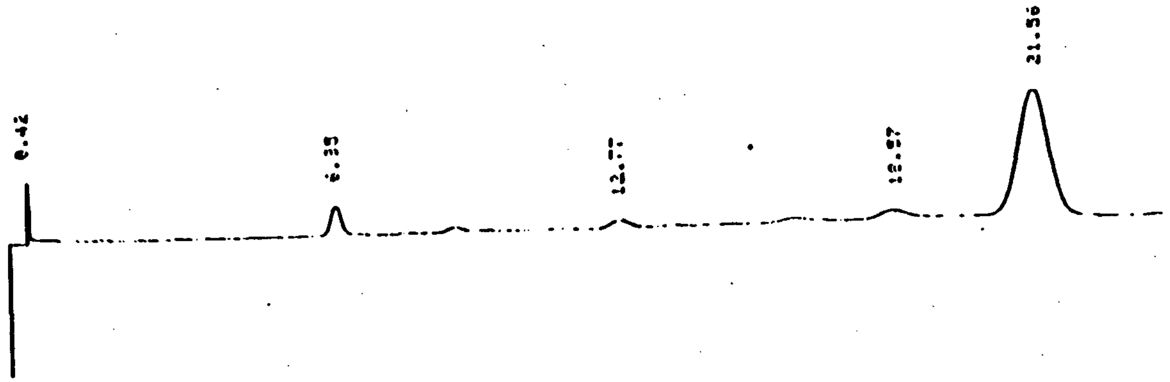
Gas Chromatogram of Lindane Standard
(1.0 ng/ul)



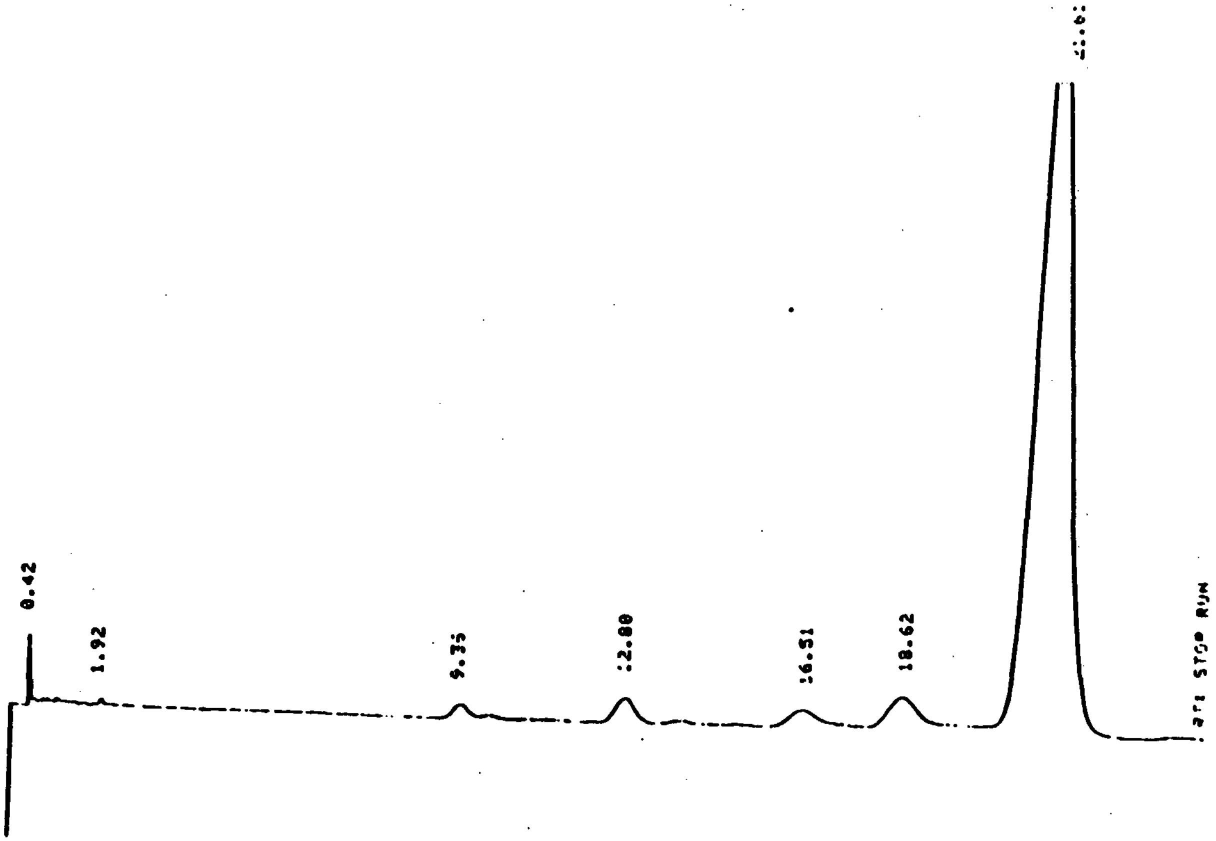
Gas Chromatogram of Methoxychlor Standard
(5.0 ng/ul)

Ref. No. 11, p. 107 of 161

101956



Gas Chromatogram of Methoxychlor Standard
(10.0 ng/ul)



Gas Chromatogram of Methoxychlor Standard
(50.0 ng/ul)

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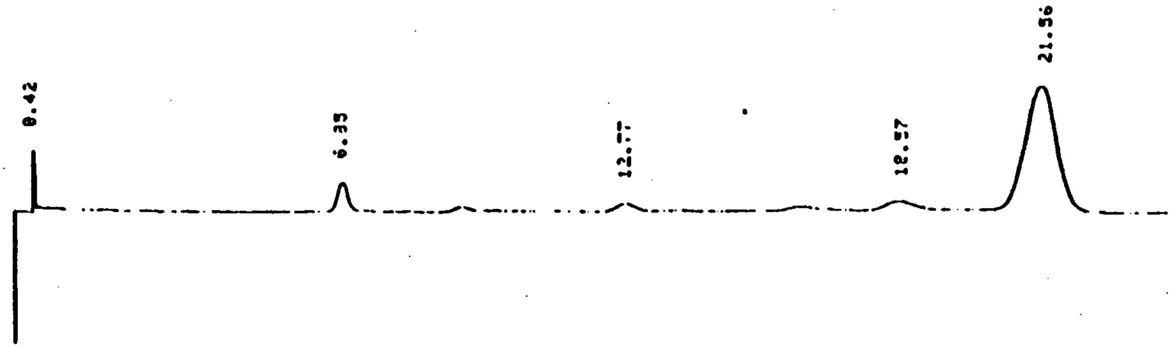
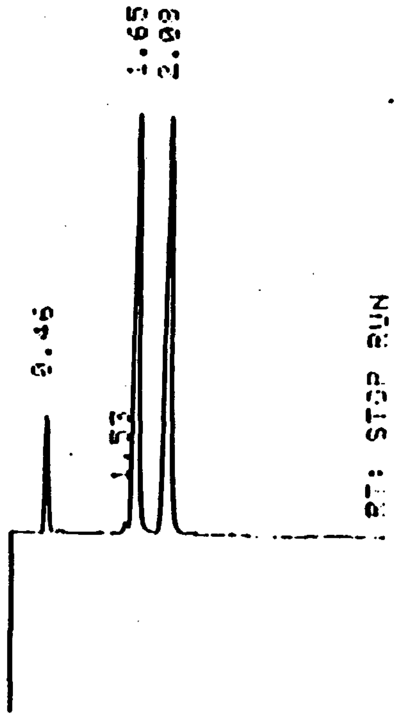
101958



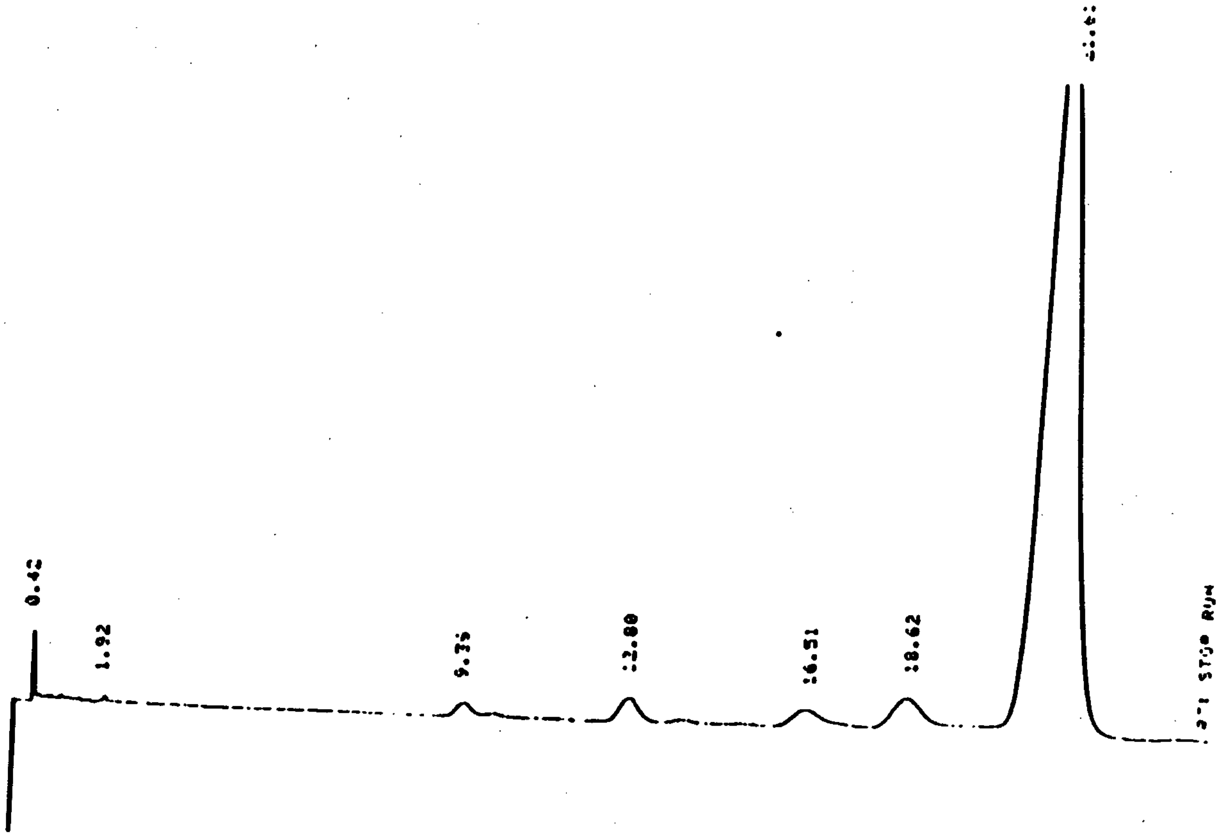
Gas Chromatogram of Methoxychlor Standard
(10.0 ng/ul)

Ref. No. 11, p. 110of161



Gas Chromatogram of 2,4-D and 2,4,5-TP(Silvex) Standard
(10 ug/ml & 1 ug/ml)

Ref. No. 11, p. 111 of 161



Gas Chromatogram of Methoxychlor Standard
(50.0 ng/ul)

Ref. No. 11, p. 112 of 161

101961

CHYUN ASSOCIATES
Architectural, Engineering & Laboratory

1101 State Road, Building B
Princeton, New Jersey 08540
609-924-5151

LABORATORY ANALYSIS REPORT

Client: ETC Corporation
Address: 284 Raritan Center Parkway
Edison, N.J. 08837

Attention: Dr. Denis Lin

Test Number: L82125
Date Received: 3/18/82
Date Sampled: Unknown
Job Number: 02299

SAMPLE NUMBER	SAMPLE DESIGNATION/DESCRIPTION
1	001340
2	001341
3	001342
4	001343
DL	Detection Limit

CHARGED APR 2 1982

PARAMETER/CONSTITUENT	SAMPLE NUMBER 1	2	3	4	DL
Total Organic Carbon	8	6	21	12	1
Phenolics as Phenol	<0.005	<0.005	<0.005	0.006	0.005
Specific Conductance, micromhos	24,000	26,000	28,000	24,000	2,000
Chloride	12,400	16,200	13,100	10,500	200
Fluoride	0.88	0.31	0.32	0.21	0.1
Nitrate as N	<0.1	<0.1	<0.1	<0.1	0.1
Sulfate	490	240	170	290	10
Turbidity (JTU)	4.3	0.35	1.2	0.55	0.1

Page 1 of 2

All results in mg/1 (ppm) except where noted.

Laboratory ID No. 11198

March 30, 1982
Date

Michael Wright
Michael Wright
Laboratory Supervisor

Ref. No. 11, p. 113 of 161

REFERENCE: WO 3-3562

TI# 26280 is being analyzed for Ra-226 (because the GR-A was greater than 5.0 pCi/ℓ) and the result will be reported on a new Work Order.

It was not possible to reach a detection limit of 5 pCi/ℓ for GR-A for four samples because of heavy residue, even after filtration:

TI#	RESIDUE (g/ℓ)
26277	35.1
26278	31.0
26282	15.9
26283	17.9

REPORT [illegible]NALYSIS

RUN[illegible]TE 04/07/82

WORK ORDER NUMBER	CUSTOMER P.O. NUMBER	DATE RECEIVED	DELIVERY DATE	PAGE 1
3-3562		03/18/82	04/20/82	

MS D FOSTER
EIC ENVIRON TESTING & CERT CORP
2[illegible] RARITAN CENTER PKWY
EDISON NJ 08837

RECEIVED APR 1 2 1982

WATER

TELEDYNE SAMPLE NUMBER	CUSTOMER'S IDENTIFICATION	STA NUM	COLLECTION-DATE START DATE	START TIME	STOP DATE	STOP TIME	NUCLIDE	ACTIVITY (pCi/liter)	NUCL-UNIT-% U/M *	MID-COUNT TIME DATE	MID-COUNT TIME	VOLUME - UNITS ASH-WGHT-% *	LAB.
26274	NO 001327 W05		03/08				GR-A	L.T. 1. E 00		03/31			3
							GR-B	1.2 +-0.2 E 01		03/31			3
26275	NO 001328 W05		03/08				GR-A	L.T. 3. E 00		03/31			3
							GR-B	5.9 +-2.4 E 00		03/31			3
26276	NO 001330 W05		03/08				GR-A	L.T. 2. E 00		03/31			3
							GR-B	4.0 +-1.7 E 00		03/31			3
26277	NO 001342 W05		03/08				GR-A	L.T. 6. E 01		03/31			3
							GR-B	3.3 +-0.6 E 02		03/31			3
26278	NO 001343 W05		03/08				GR-A	L.T. 5. E 01		03/31			3
							GR-B	1.3 +-0.4 E 02		03/31			3
26279	NO 001331 W05		03/08				GR-A	L.T. 4. E 00		03/31			3
							GR-B	1.8 +-0.3 E 01		03/31			3
26280	NO 001332 W05		03/08				GR-A	5.3 +-1.9 E 00		03/31			3
							GR-B	2.3 +-0.3 E 01		03/31			3
26281	NO 001333 W05		03/08				GR-A	L.T. 2. E 00		03/31			3
							GR-B	8.6 +-2.2 E 00		03/31			3
26282	NO 001340 W05		03/08				GR-A	L.T. 3. E 01		03/31			3
							GR-B	L.T. 4. E 01		03/31			3
26283	NO 001341 W05		03/08				GR-A	L.T. 3. E 01		03/31			3
							GR-B	4.4 +-2.0 E 01		03/31			3

Ref. No. 11, p.

1150/61

LAST PAGE OF REPORT

APPROVED BY H. KING H. King 04/07/82

SEND 1 COPIES TO EN450S MS D FOSTER

2 - GAS LAB. 3 - RADIO CHEMISTRY LAB. 4 - Ge(Li) GAMMA SPEC LAB. 5 - TRITIUM GAS/L.S. LAB.

101964

INTRODUCTION

This report contains the analytical results on your sample, Well #4, submitted on March 15, 1982. In your order, Total Organic Halide analysis (TOX) was requested on this sample. However, due to the sample matrix, it was not possible to obtain meaningful data.

The results we obtained on your sample are presented in a tabular format immediately after this introduction. Following the sample results, the quality assurance data on your specific sample are tabulated to verify the validity of the results obtained. Also presented in the quality assurance data report is the chain-of-custody record.

The established methods we used in the analysis of your sample are described in the Methodology section after the Results. In the analysis we followed a rigidly controlled Quality Assurance Protocol. This Protocol is described after the Methodology section.

We hope our report format is useful in assisting you to obtain pertinent information on your sample.

TABLE OF CONTENTS

ABLE 1: QUANTITATIVE DATA ON COMPOUNDS OF INTEREST

ETC Sample No. 001343 Customer Sample ID. Well #4

GROUND WATER MONITORING METALS, PESTICIDES AND HERBICIDES

EPA HAZARDOUS WASTE NUMBER	CONTAMINANT	CONCENTRATION IN ug/l	METHOD DETECTION LIMIT IN ug/l	
D004	Arsenic	BMDL	5	
D005	Barium	800	100	
D006	Cadmium	BMDL	5	
D007	Chromium	ND	50	
D008	Lead	BMDL	100	
D009	Mercury	BMDL	0.2	
D010	Selenium	ND	5	
D011	Silver	ND	25	
D012	Endrin	<0.1	0.1	*
D013	Lindane	<2.0	2.0	*
D014	Methoxychlor	<50	50	*
D015	Toxaphene	<2.5	2.5	*
D016	2,4-D	<50	50	*
D017	2,4,5-TP (Silvex)	<5	5	*
	Iron	150	50	
	Manganese	8500	100	
	Sodium	5000000	50	

---

* GC/ECD Method Detection Limit established for your individual sample matrix. When a compound is not detected at or above the specific Method Detection Limit, that particular compound is reported as "< the detection limit."

RESULTS

The results obtained on your sample are listed in Table 1. For analysis of Groundwater Monitoring Metals, Pesticides and Herbicides, the contaminants are listed with their EPA Hazardous Waste number, sample concentration, and Method Detection Limit. A metal detected below its Method Detection Limit is reported in Table 1 as BMDL (Below Method Detection Limit). When a metal is searched for and cannot be found, it is reported as ND (Not Detected). In GC/ECD analysis, a contaminant not detected at or above its Method Detection Limit is reported in Table 1 as "< the method detection limit" established for that contaminant.

Quality Assurance Report (A), Table 2, contains the results obtained on the Method Blank and Spiked Blank for your sample. Quality Assurance Report (B), Table 3, lists the data on the Replicate and Matrix Spike Analysis.

The Chain-of-Custody Record on your sample is also included at the end of this Result section.

TABLE 1: QUANTITATIVE DATA ON PARAMETERS OF INTEREST

ETC Sample No. 001343 Customer Sample ID. Well #4

CONVENTIONALS

PARAMETER	CONCENTRATION mg/l		METHOD DETECTION LIMIT mg/l	
Biological Oxygen Demand (BOD), 5 day	-		-	
Chemical Oxygen Demand (COD)	-		-	
Total Dissolved Solids (TDS)	-		-	
Chloride	10500		200	
Fluoride	0.21		0.1	
Nitrate as N	<0.1		0.1	
Total Kjeldahl Nitrogen	-		-	
Sulfate as S	290		10	
Total Phenols	0.006		0.005	
Total Organic Carbon (quadruplicate)	12		1	
	12			
	12			
	10			
Specific Conductance (quadruplicate)	24000	umhos/cm	2000	umhos/cm
	22000			
	24000			
	25000			
pH (quadruplicate)	7.8	Standard Units		
	7.7			
	7.7			
	7.7			
Turbidity	0.55	JTU	0.1	JTU

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TABLE 1: QUANTITATIVE DATA ON PARAMETERS OF INTEREST

ETC Sample No. 001343 Customer Sample ID. Well #4

RADIOLOGICAL	CONCENTRATION pCi/L
Gross Alpha	<50
Gross Beta	130 +/- 40
BACTERIOLOGICAL	**COLONIES/100ml**
Total Coliform	-
Fecal Coliform	-

"TNTC" Indicates Too Numerous to Count
"CF" Indicates Confluent Growth

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TABLE 2: QUALITY ASSURANCE REPORT (A): BLANK AND SPIKED BLANK

PESTICIDES AND HERBICIDES

For ETC Sample Numbers: 001327, 001328, 001330 to 001333, 001340 to 001343

EPA HAZARDOUS WASTE NUMBER	CONTAMINANT	CONCENTRATION IN ug/1 BLANK	SPIKED BLANK AMOUNT ADDED	SPIKED BLANK % RECOVERY
D012	Endrin	<0.1	0.2	90
D013	Lindane	<2.0	2.0	116
D014	Methoxychlor	<50	100	118
D015	Toxaphene	<2.5	5.0	100
D016	2,4-D	<50	100	83
D017	2,4,5-TP (Silvex)	<5	10	100

Ref. No. 11, p. 1225/161

TABLE 3: QUALITY ASSURANCE REPORT (B): REPLICATE ANALYSIS AND MATRIX SPIKE ANALYSIS

** PESTICIDES AND HERBICIDES **

For ETC Sample Numbers: 001327, 001328, 001330 to 001333, 001340 to 001343

EPA HAZARDOUS WASTE NUMBER	CONTAMINANT	CONCENTRATION IN ug/l SAMPLE	REPLICATE	SAMPLE	SPIKED SAMPLE	AMOUNT ADDED	% RECOVERY
D012	Endrin	<0.1	<0.1	<0.1	0.18	0.2	90
D013	Lindane	<2.0	<2.0	<2.0	4.8	4.0	120
D014	Methoxychlor	<50	<50	<50	120	100	120
D015	Toxaphene	<2.5	<2.5	<2.5	6.0	5.0	120
D016	2,4-D	<50	<50	<50	5	100	5*
D017	2,4,5-TP (Silvex)	<5	<5	<5	2.7	10	27

* Matrix effect. Good recovery for spiked blank.

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ETC TESTING AND CERTIFICATION CORPORATION

CHAIN OF CUSTODY

PHONE FOR CUSTOMER SERVICE: (201) 225-6800
TOLL FREE OUTSIDE NEW JERSEY: (800) 631-6382

CUSTODY NUMBERS	DATE SHUTTLE SEALED
6529 6530	3/10/82

ATTENTION

…orm is for the convenience of our clients. If used and sent to ETC it will serve as part of a complete chain of custody record held confidentially by ETC for the exclusive use of the client.

This form may be used in a legal proceeding. Accuracy and completeness are important. The purpose of this form is to document the chain of custody from the time the sample shuttle seal is broken until the shuttle is resealed. A person has a sample under custody if:

- it is in his/her actual possession; or
- it is his/her view after being in actual possession; or
- it was in his/her actual possession and he/she places it in a locked or otherwise secure place to which any access by others is fully recorded

ETC maintains chain of custody records before a sample shuttle is sent and after it is returned. ETC maintains records of shipping manifests. Together these forms document a complete chain of custody for a sample.

A

COMPANY	LCP Chemicals - NJ Inc	**ATTENTION**	max Obra
PLANT		**ACCOUNT NUMBER**	
ADDRESS	South Wood Ave	**REQUISITION NUMBER**	000251
	Linden NJ 07036	**TELEPHONE NUMBER**	

B **SAMPLE NUMBER** 4B

BOTTLE CODES: E ____ to ____ M ____ to ____ V ____ to ____ VB ____ to ____
CN ____ to ____ PH ____ to ____ PCB ____ to ____ WO 5 to 8

PLEASE COMPLETE THE REMAINDER OF THIS FORM. ALWAYS COMPLETE ITEMS C, E AND G. COMPLETE ITEM D IF SAMPLE APPEARANCE, CONSISTENCY, ODOR WARRANT NOTICE. COMPLETE ITEMS MARKED F AS NEEDED. ADD ANOTHER SHEET FOR F 7/8 AND SO ON IF NEEDED. THE LAST PERSON TO RECEIVE THE SAMPLE MUST, IN ADDITION TO COMPLETING THE APPROPRIATE F ITEM, ALSO COMPLETE ITEM G.

C **SAMPLE LOCATION OR CODE** (e.g., a permit code): WELL #5

D **SAMPLE DESCRIPTION**: FILTERED WATER SAMPLE

E …COMPLETED BY THE PERSON WHO ASSUMES RESPONSIBILITY FOR THE …LE AND OBSERVES THE BREAKING OF THE SEAL.

NAME	MAXIMO A. OBRA	**DATE**	3/15/82
SIGNATURE	Maximo A. Obra	**SEAL NO.**	6529
SEAL INTACT	[✓ YES] ____ NO	**SEAL BREAK TIME**	7:00 AM
CODE OF ANY LEAKING BOTTLES			
CODE OF ANY BROKEN BOTTLES			

IF SEAL IS *NOT* INTACT PLEASE CALL

WARNING
IF ANY BOTTLE IS LEAKING OR BROKEN, DO NOT HANDLE. SOME BOTTLES CONTAIN ACID. PLEASE CALL.

F1 RELINQUISHED BY …INT: …	**F2** RECEIVED BY DATE	NOTE: GIVE REASON FOR CUSTODY CHANGE, AND CODE OF ANY MISSING OR DAMAGED BOTTLES.
F3 RELINQUISHED BY …INT: …ON:	**F4** RECEIVED BY TIME DATE	NOTE: GIVE REASON FOR CUSTODY CHANGE, AND CODE OF ANY MISSING OR DAMAGED BOTTLES
F5 RELINQUISHED BY …INT:	**F6** RECEIVED BY TIME DATE	NOTE: GIVE REASON FOR CUSTODY CHANGE, AND CODE OF ANY MISSING OR DAMAGED BOTTLES Ref Vol I, p. 124 of 161

G TO BE FILLED IN BY THE PERSON WHO HAS RESPONSIBILITY FOR THE SAMPLE … OBSERVES RESEALING OF SAMPLE SHUTTLE.

…EPLACE FORM IN ENVELOPE
…PUT ENVELOPE IN SHUTTLE

NAME	MAX ~~IMO A~~. OBRA	**DATE**	3/15/82
SIGNATURE	Maximo A. Obra		
RESEAL TIME	10:35 AM	**SEAL NO.**	6530

Ref. No. 11, p.

101974

ETC ENVIRONMENTAL TESTING AND CERTIFICATION CORPORATION

CHAIN OF CUSTODY

PHONE FOR CUSTOMER SERVICE: (201) 225-6800
TOLL FREE OUTSIDE NEW JERSEY: (800) 631-6382

CUSTODY NUMBER	DATE SHUTTLE SEALED
6527 6528	3/10/82

ATTENTION

form is for the convenience of our clients. If used and sent to ETC it will serve as part of a complete chain of custody record held confidentially by ETC for the exclusive use of the client.

This form may be used in a legal proceeding. Accuracy and completeness are important. The purpose of this form is to document the chain of custody from the time the sample shuttle seal is broken until the shuttle is resealed. A person has a sample under custody if

- it is in his/her actual possession; or
- it is in his/her view, after being in actual possession; or
- it was in his/her actual possession and he/she places it in a locked or otherwise secure place to which any access by others is fully recorded

ETC maintains chain of custody records before a sample shuttle is sent and after it is returned. ETC maintains records of shipping manifests. Together these forms document a complete chain of custody for a sample.

A

COMPANY	LCP Chemicals - NJ Inc	**ATTENTION**	Max Obra
PLANT		**ACCOUNT NUMBER**	
ADDRESS	South Wood Ave	**REQUISITION NUMBER**	000251
	Linden NJ 07036	**TELEPHONE NUMBER**	

B **SAMPLE NUMBER** 4A

BOTTLE CODES: E ____ to ____ M 1 to ____ V ____ to ____ VB ____ to ____
CN ____ to ____ PH ____ to ____ PCB ____ to ____ WO 1 to 4

PLEASE COMPLETE THE REMAINDER OF THIS FORM. ALWAYS COMPLETE ITEMS C, E, AND G. COMPLETE ITEM D IF SAMPLE APPEARANCE, CONSISTENCY, ODOR WARRANT NOTICE. COMPLETE ITEMS MARKED F AS NEEDED. ADD ANOTHER SHEET FOR F 7-8 AND SO ON IF NEEDED. THE LAST PERSON TO RECEIVE THE SAMPLE MUST, IN ADDITION TO COMPLETING THE APPROPRIATE F ITEM, ALSO COMPLETE ITEM G.

C **SAMPLE LOCATION OR CODE** (e.g., a permit code)	WELL #5	**D** **SAMPLE DESCRIPTION**	FILTERED WATER SAMPLE

E COMPLETED BY THE PERSON WHO ASSUMES RESPONSIBILITY FOR THE SAMPLE AND OBSERVES THE BREAKING OF THE SEAL.

NAME	MAXIMO A. OBRA	**DATE**	3/15/82
SIGNATURE	Maximo A. Obra	**SEAL NO.**	6527
SEAL INTACT	✓ YES ____ NO	**SEAL BREAK TIME**	7:00 AM
CODE OF ANY LEAKING BOTTLES			
CODE OF ANY BROKEN BOTTLES			

IF SEAL IS *NOT* INTACT PLEASE CALL

WARNING
IF ANY BOTTLE IS LEAKING OR BROKEN, DO NOT HANDLE. SOME BOTTLES CONTAIN ACID. PLEASE CALL.

F1 RELINQUISHED BY: PRINT: SIGN:	**F2** RECEIVED BY DATE.	NOTE: GIVE REASON FOR CUSTODY CHANGE; AND CODE OF ANY MISSING OR DAMAGED BOTTLES
F3 RELINQUISHED BY PRINT:	**F4** RECEIVED BY TIME: DATE.	NOTE: GIVE REASON FOR CUSTODY CHANGE, AND CODE OF ANY MISSING OR DAMAGED BOTTLES
F5 RELINQUISHED BY PRINT:	**F6** RECEIVED BY TIME DATE	NOTE: GIVE REASON FOR CUSTODY CHANGE; AND CODE OF ANY MISSING OR DAMAGED BOTTLES Ref.No.11, p. 125 of 161

G FILLED IN BY THE PERSON WHO HAS RESPONSIBILITY FOR THE SAMPLE AND OBSERVES RESEALING OF SAMPLE SHUTTLE.

REPLACE FORM IN ENVELOPE
PUT ENVELOPE IN SHUTTLE

NAME	MAXIMO A. OBRA	**DATE**	3/15/82
SIGNATURE	Maximo A. Obra		
RESEAL TIME	10:30 AH	**SEAL NO.**	6528

Ref. No. 11, p.

ETC ENVIRONMENTAL TESTING AND CERTIFICATION CORPORATION

LABORATORY CHAIN-OF-CUSTODY

ETC Sample Number 001340 to 001343

Relinquished By Toni Kuzmack

eceived By Date 3/15/82 Time 5:10 p.m.

inquished By

eceived By Date Time

elinquished By

eceived By Date Time

elinquished By

ecieved By Date Time

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ETC ENVIRONMENTAL
TESTING AND
CERTIFICATION
CORPORATION

CHAIN OF CUSTODY

ompany: LCP Chemicals Inc Job No. 251

ddress: South Wood Ave
Linden NJ

ttention: Max Obra

8 Sample Shuttle(s) Received by: Toni Kuzmack

e: 11:00Am Date: 3/15/82

Seal Number(s)	6516	6518	6520	6522
Seal Intact*	Y	Y	Y	Y
Seal Number(s)	6524	6526	6528	6530
Seal Intact*	Y	Y	Y	Y
Seal Number(s)				
Seal Intact*				
Seal Number(s)				
Seal Intact*				
Seal Number(s)				
Seal Intact*				
Seal Number(s)				
Seal Intact*				

es (Y) No (N)

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Ref. No. 11, p.

L-1029 3/82

ETC ENVIRONMENTAL
TESTING AND
CERTIFICATION
CORPORATION

CHAIN OF CUSTODY

Company: Chyun Associates Job No. 251

Address 1101 State Rd
Princeton NJ

Attention: Mike Wright

Sample Description:

ETC Sample #:	To be Analyzed for
001340W06 to 001343W06	TOC + total phenols
001340 W07 to 001343 W07	Conventionals: specific conductance. chloride, sulfate fluoride, Nitrate, Turbidity

Please run TOC and specific conductance in quad. for sample #001343

Sample(s) Relinquished by:

Time: 11:20 Am Date: 3-18-82

Sample(s) Received by:

Time: 1120 Am Date: 3/18/82

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ETC ENVIRONMENTAL
TESTING AND
CERTIFICATION
CORPORATION

LABORATORY CHAIN-OF-CUSTODY CHRONICLE

ETC Sample Number 001343

Sample Preparation For	Analyst	Date
Base/Neutral/PCB's & Pesticides		
~~Acids~~ Pesticides in H_2O	[illegible]/Stephanie Dibbs	3/30/82
Metals	Kristine J Kull	3-24-82
Others Herbicides in Water	Paul Krajczar	3/30/82

Sample Analysis For	Analyst	Date
Base/Neutral/PCB's & Pesticides		
Acids		
VOA/Purgeables		
Metals	KJ Kull / A.W. Massen	3-28-82 to 4-1-82
Others Herbicides in Water	Paul Krajczar	~~3/~~ 4/1/82
Others Pesticides in Water	Paul Krajczar	4/2-3,8/82

Verified By

ETC
ENVIRONMENTAL
TESTING AND
CERTIFICATION
CORPORATION

To Teledyne Isotopes:

Please complete this document and include with your report.

This shuttle contains:

ETC Sample numbers:		To be analyzed for:
001327	W05	Gross Alpha/Beta
001328	W05	Gross Alpha/Beta
001330	W05	Gross Alpha/Beta
001342	W05	Gross Alpha/Beta
001343	W05	Gross Alpha/Beta

Sample Shuttle sealed by: Toni Kuzmack
Date: 3/17/82 Time: 3:15 pm Seal Number: 6583

Sample Shuttle opened by: Edna C Cunningham
Date: 3/18/82 Time: 1600 Seal Number: 0006583
Was seal intact? Yes ✓ No

For return:

Sample Shuttle sealed by: Edna C Cunningham
Date: 3/19/82 Time: 1150 Seal Number: 0006584

Sample Shuttle opened by: Toni Kuzmack
Date: 3/22/82 Time: 11:39 Seal Number: 6584
Was seal intact? Yes ✓ No

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ETC ENVIRONMENTAL TESTING AND CERTIFICATION CORPORATION

LABORATORY CHAIN-OF-CUSTODY

001340 W06 to 001343W06

ETC Sample Number 001340 W07 to 001343 W07

Relinquished By Toni Kuzmack

Received By Care Delello **Date** 3-18-87 **Time** 10:20m

Relinquished By ______

Received By ______ **Date** ______ **Time** ______

Relinquished By ______

Received By ______ **Date** ______ **Time** ______

Relinquished By ______

Recieved By ______ **Date** ______ **Time** ______

METHODOLOGY

Analysis of Metals

The methods employed in the analysis of your sample for metals are established EPA methods for priority pollutants.

Metals analysis is performed according to the methods published by EPA in "Methods for Chemical Analysis of Water and Wastes", EPA-600/4-70-020, March 1979. Arsenic, selenium, thallium, and antimony are analyzed by furnace AA while calcium, magnesium, barium, beryllium, chromium, nickel, copper, zinc, silver, cadmium, and lead are analyzed by flame AA. Potassium and sodium are analyzed by flame emmission. Mercury is analyzed by cold vapor technique.

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Analysis of Pesticides and Herbicides

The methods employed in the analysis of your water sample for pesticides and herbicides are established EPA methods taken from the "Manual of Analytical Methods for the Analysis of Pesticides in Humans and Environmental Samples," June, 1980. The pesticide method can be summarized as follows: A measured volume of sample, approximately 500-1000ml, to which sodium sulfate has been added, is extracted with methylene chloride. The methylene chloride extract is dried and concentrated to approximately 0.5ml. The extract is brought to a final volume with hexane and injected into a gas chromatograph equipped with a ^{63}Ni electron capture detector.

The herbicide method can be summarized as follows: A measured volume of sample, approximately 500-1000 ml, to which sodium sulfate has been added, is acidified and extracted with methylene chloride. The methylene chloride extract is evaporated to dryness, and the residue is derivatized with a BF_3 esterification reagent. The derivatives are extracted into hexane for subsequent injection into a gas chromatograph equipped with a ^{63}Ni electron capture detector.

The GC operating parameters were as follows:

COLUMN

6' x 4mm glass 1.5% SP-2250 & 1.95% SP-2401
Supelcoport 100/120 mesh

CARRIER FLOW

60ml/min. Argon/Methane

SEPTUM PURGE

5ml/min. Argon/Methane

COLUMN OVEN

210°C

INJECTOR TEMPERATURE

225°C

DETECTOR TEMPERATURE

300°C

QUALITY ASSURANCE PROTOCOL

The quality assurance protocol followed in the analysis of your sample is based on the "Handbook for Analytical Control in Water and Wastewater Laboratories," EPA-600/4-79-019, March, 1979; National Enforcement Investigation Center Policies, and Procedures manual; and EPA-330/9/79/001-R, October, 1979.

Analysis of Metals (Standards)

- New working standards are prepared for each batch of samples.
- Normal calibration is performed using a blank and four standards that have been carried through the entire sample preparation procedure. A regression analysis is used to construct the calibration curve.
- For each sample analysis in the standard additions technique, a three point calibration is performed using U. S. EPA Methods for Chemical Analysis of Water and Wastes, 1979. Results are obtained using linear regression analysis. Any results obtained with a coefficient of correlation below 0.990 are considered erroneous, necessitating raw data editing or sample re-analysis.
- Normal calibration curves are constructed using greater than or equal to 5 times the Instrumental Detection Limit (IDL) as the lowest concentration level.
- All calibration standards are analyzed in duplicate, as a minimum.
- Independent reference standards are used to check the accuracy of calibration standards.
- A check standard is analyzed every ten samples to establish the validity of the normal calibration curve.

Analysis of Metals (Sample, for all metals except Mercury)

For all homogeneous samples (minimum of 42% QC), each sample batch may include up to 30 samples and the following fixed number of QC samples:

- 3 Replicates.
- 2 Replicate spikes.
- 2 Replicate independent reference standards.
- 8 Calibration standards (processed using the sample preparation method).
- 2 Blanks (using sample preparation method).
- 4 Calibration standards (without sample preparation).
- 1 Blank (without sample preparation).

For all heterogeneous samples (minimum of 65% QC), every field sample in a sample batch is run in duplicate. A sample batch may include up to 30 samples and the following fixed number of QC samples:

- 4 Replicates.
- 4 Replicate spikes.
- 2 Replicate independent reference standards.
- 8 Calibration standards (processed using the sample preparation method).
- 2 Blanks (using sample preparation method).
- 4 Calibration standards (without sample preparation).
- 1 Blank (without sample preparation).

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Analysis of Metals (Sample, Mercury)

For every matrix (minimum of 66% QC), all the field samples in sample batch are run in duplicate. A sample batch may include to 20 samples and the following fixed number of QC samples:

- 3 Replicates.
- 2 Replicate spikes.
- 2 Replicate independent reference standards.
- 10 Calibration standards (processed using the sample preparation method).
- 2 Blanks.

Analysis of Pesticides and Herbicides

- In every block of 20 samples extracted, there are 16 field samples, one blank, one spiked blank, one sample spiked with the standard mixture, and a duplicate field sample.
- Blind quality control samples are included in field samples at a minimum of one every hundred samples.
- GC performance criteria as specified in EPA Method 608 are met before analysis starts.

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Chain-of-Custody

The chain-of-custody procedure is part of our quality assurance protocol. We believe our chain-of-custody record fully complies with the legal requirements of federal, state and local government agencies and of the courts of law. The record covers:

- labeling of sample bottles, packing the Sample Shuttle and transferring the Shuttle under seal to the custody of a shipper;
- outgoing shipping manifests;
- the chain-of-custody form completed by the person (s) breaking the seal, taking the sample, resealing the Shuttle and transferring custody to a shipper;
- incoming shipping manifests;
- breaking the Shuttle's reseal;
- storing each labeled sample bottle in a secured area;
- disposition of each sample to an analyst or technician and;
- the use of the sample in each bottle in a testing procedure appropriate to the intended purpose of the sample.

The record shows for each link in this process:

- the person with custody;
- the time and date each person accepted or relinquished custody.

REPORT APPENDICES

The following appendices provide the support analytical data associated with your sample analyses. They are arranged as follows:

Appendix A

1) Reconstructed total ion chromatogram of GC/MS analyses of your sample.

2) The individual mass spectra of all priority pollutant compounds which have been identified as being present in your sample.

3) The individual mass spectra of the corresponding compounds as obtained from the standards.

Appendix B

1) The mass spectra of the calibration compounds, 4-bromofluorobenzene (BFB) and decafluorotriphenylphosphine (DFTPP), as obtained on the data of sample analyses.

Appendix C [for plus 10 and 50% internal standard option]

1) Spectra of tentatively identified compounds, with their differences.

Appendix D

1) Subcontractor's report.

These data are provided to present a complete report on your sample and to provide the data on which analytical decisions have been based. We hope this will aid you in your own analysis of the data.

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APPENDIX

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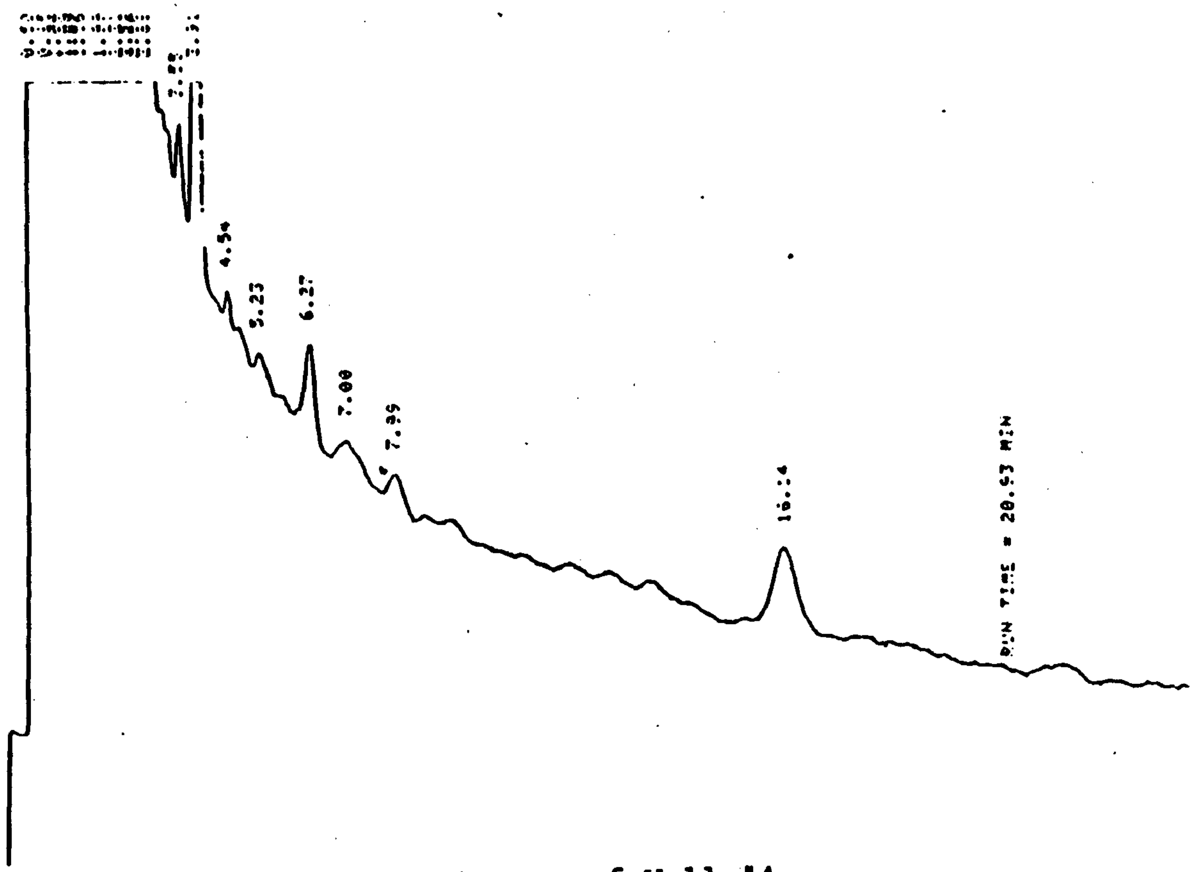

Gas Chromatogram of Well #4
ETC Sample No. 001343
for the Analysis of Endrin and Toxaphene

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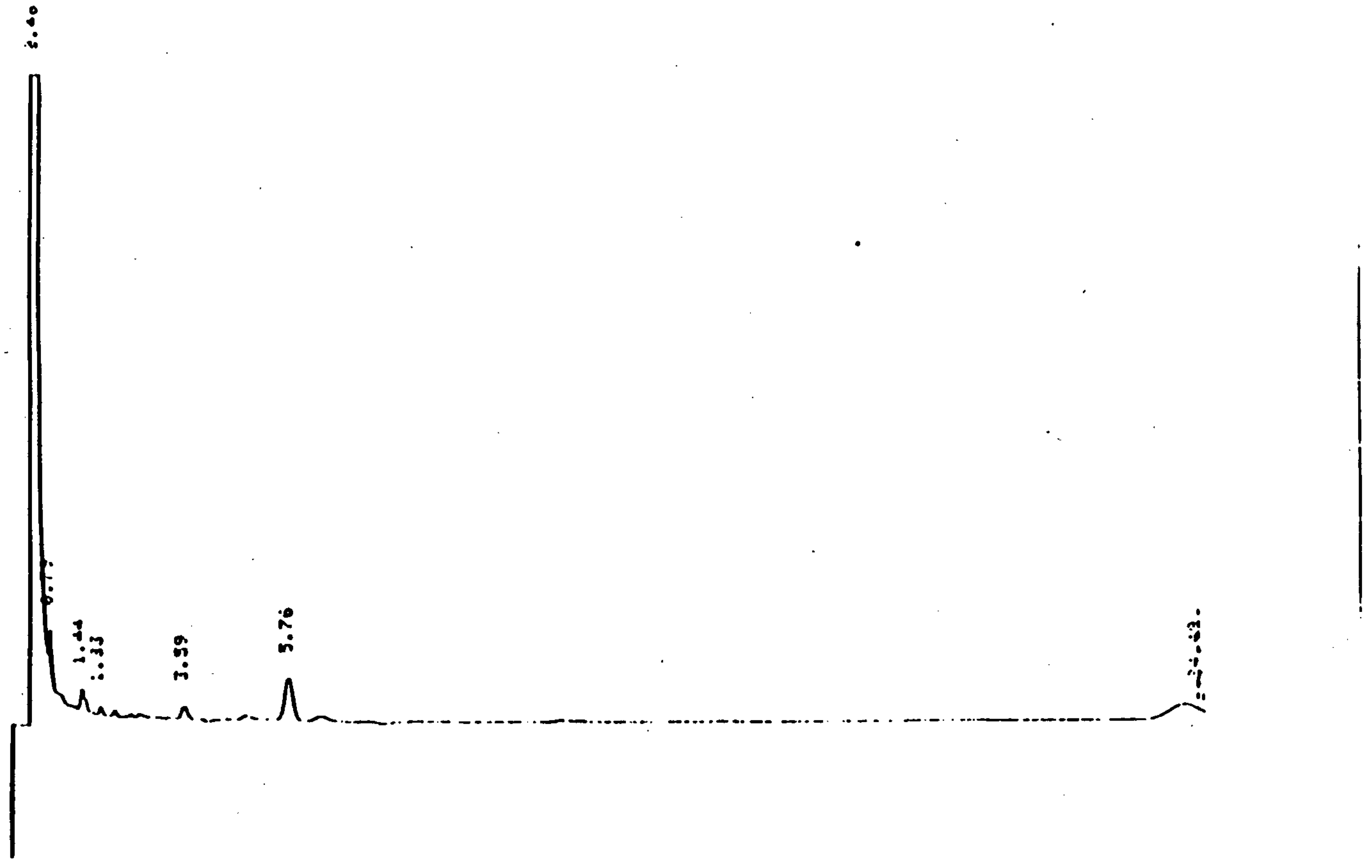
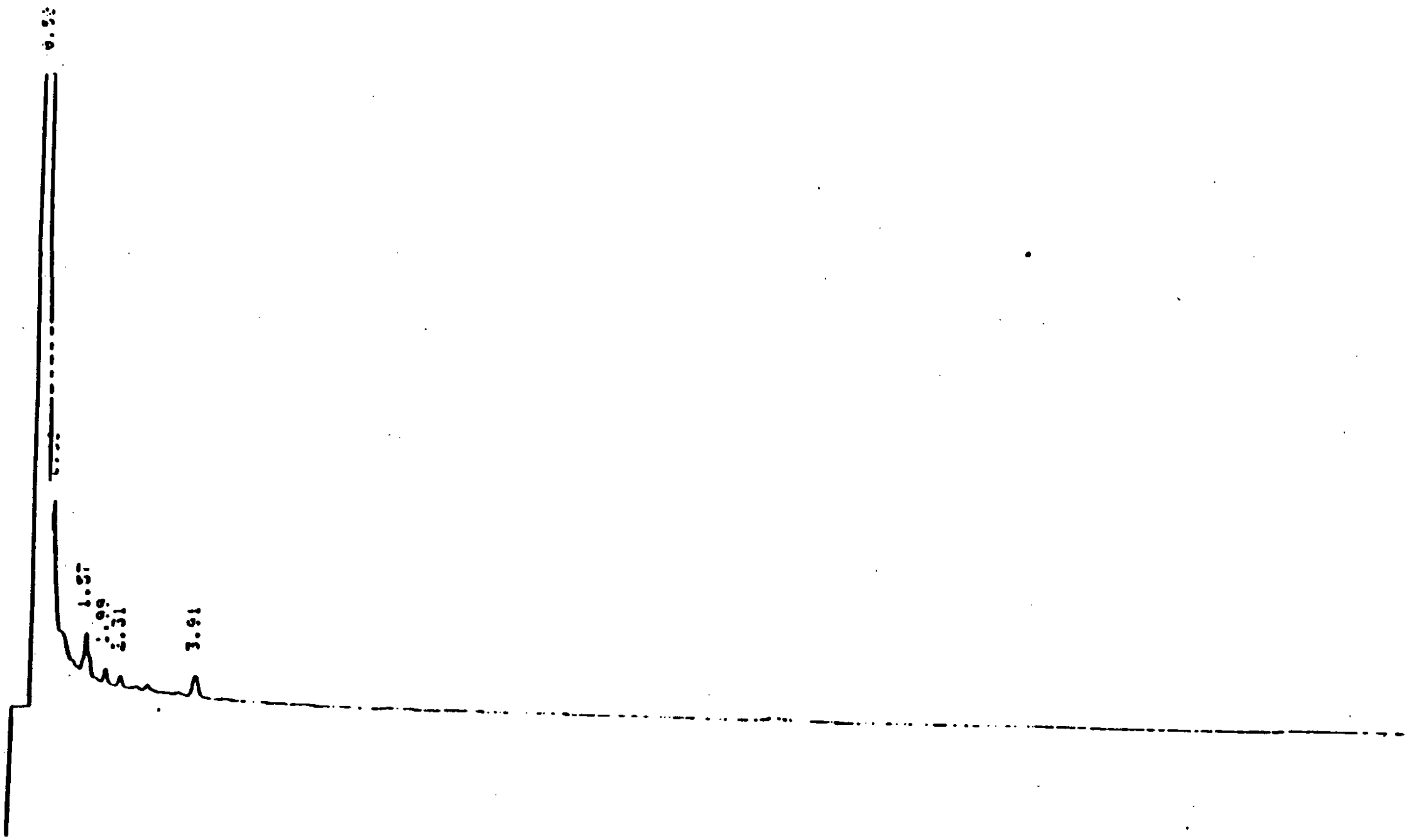


Gas Chromatogram of Well #4
ETC Sample No. 001343
for the Analysis of Methoxychlor

Ref. No. 11, p. 142 of 161



Gas Chromatogram of Well #4
ETC Sample No. 001343
for the Analysis of Lindane

Ref. No. 11, p.

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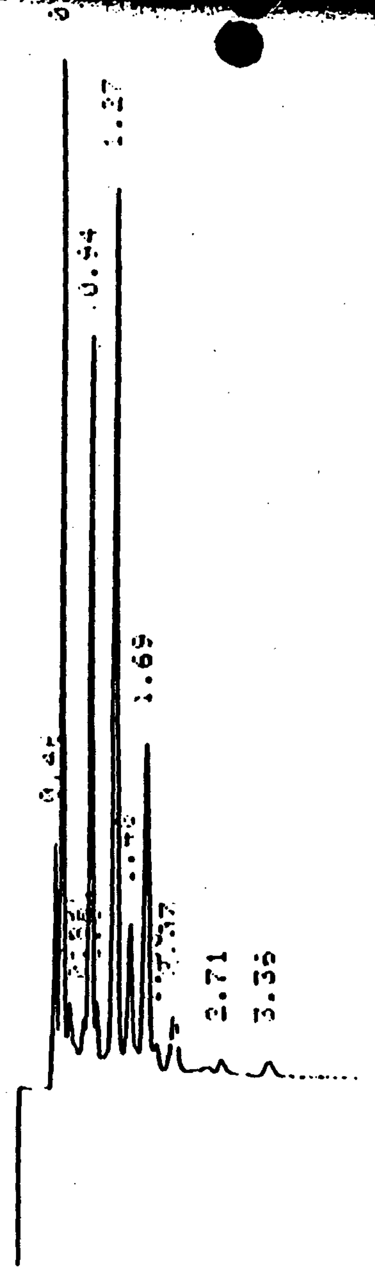
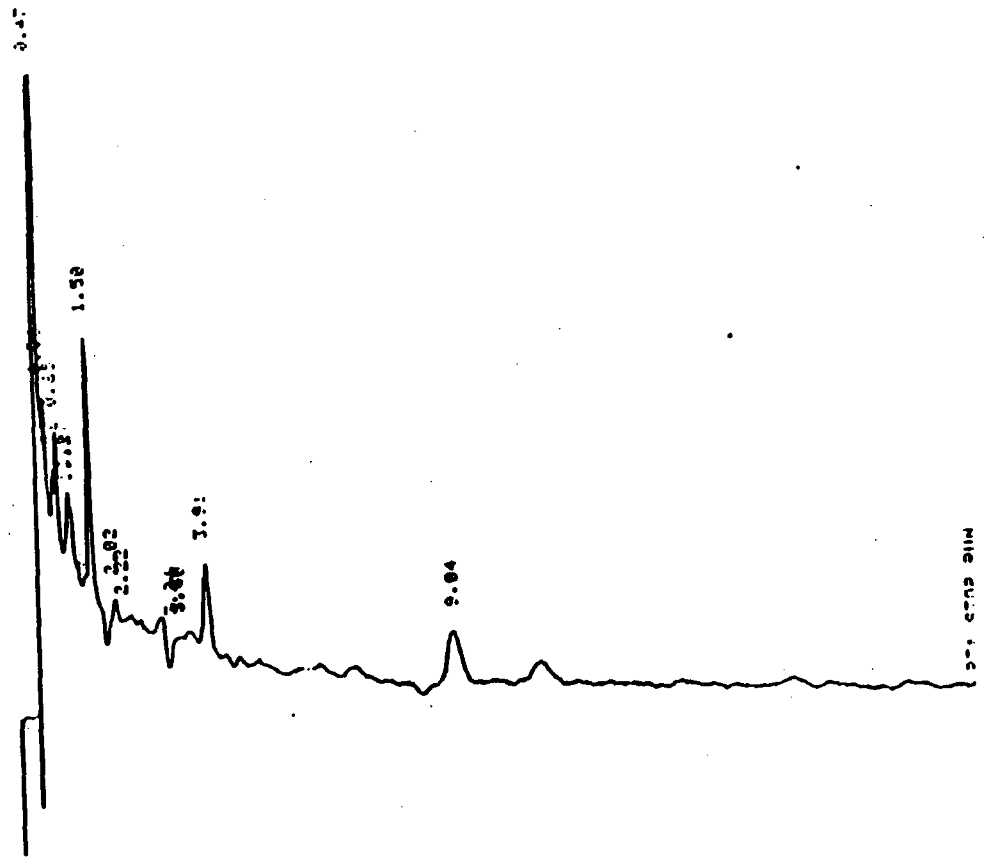
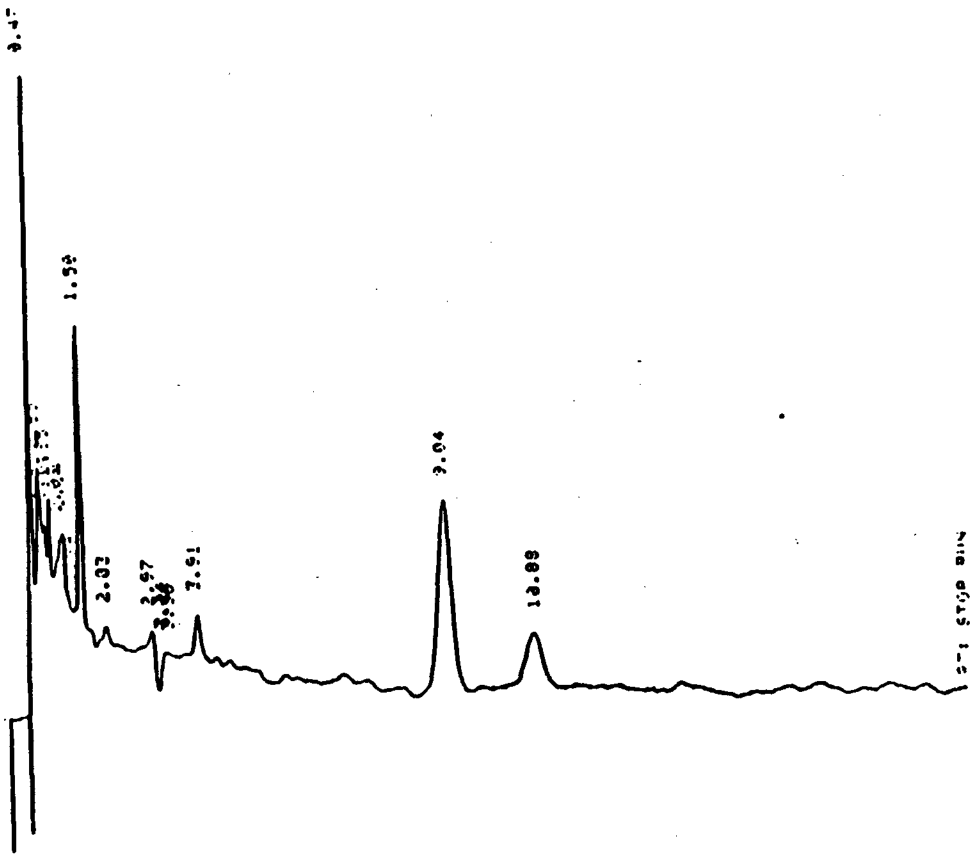


Gas Chromatogram of Well #4
ETC Sample No. 001343
for the Analysis of 2,4-D and 2,4,5-TP (Silvex)

Ref. No. 11, p. 144 of 161



Gas Chromatogram of Endrin Standard
(0.01 ng/ul)



Gas Chromatogram of Endrin Standard
(0.05 ng/ul)

Ref. No. 11, p.

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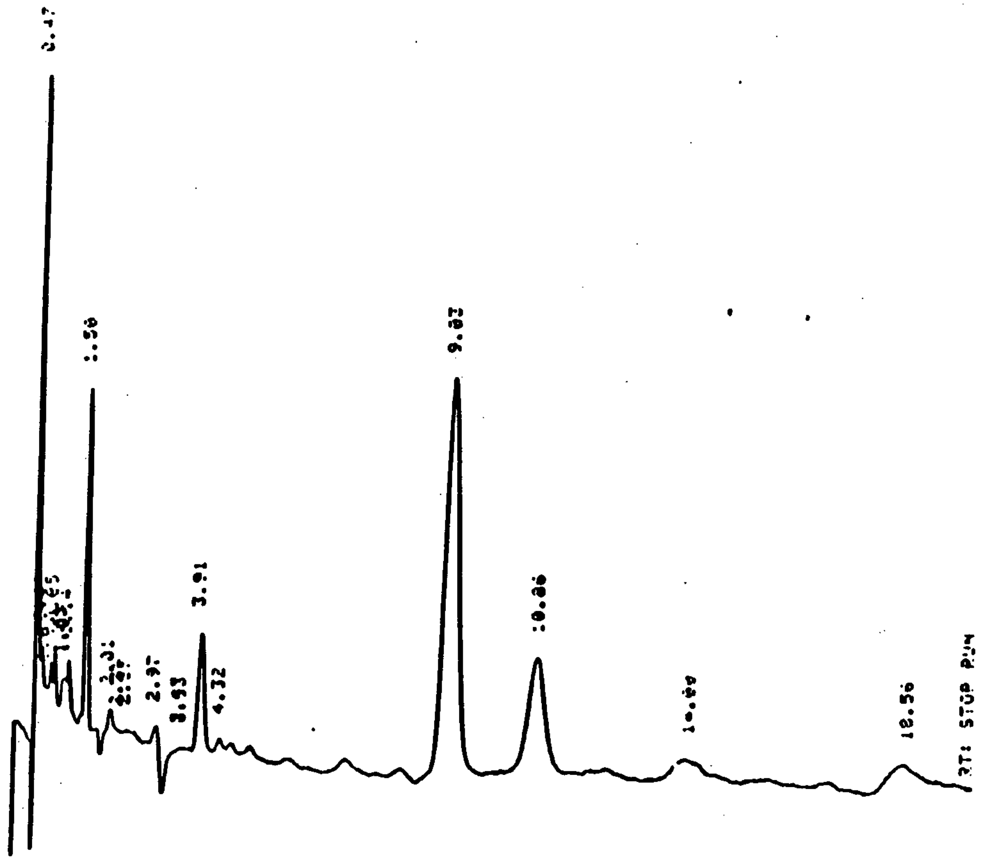

Gas Chromatogram of Endrin Standard
(0.1 ng/ul)

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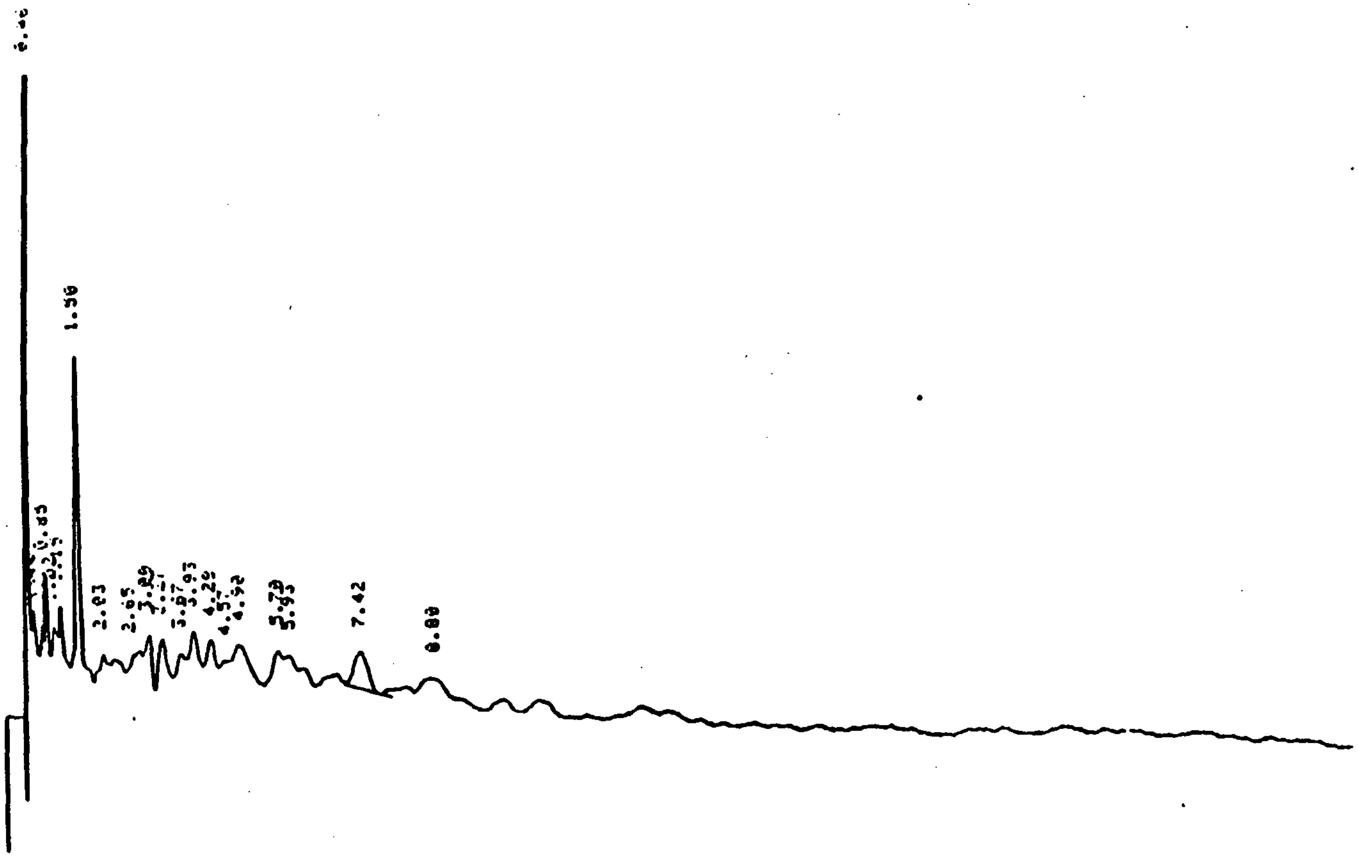
101996



Gas Chromatogram of Toxaphene Standard
(0.25 ng/ul)

Ref. No. 11, p.

101997

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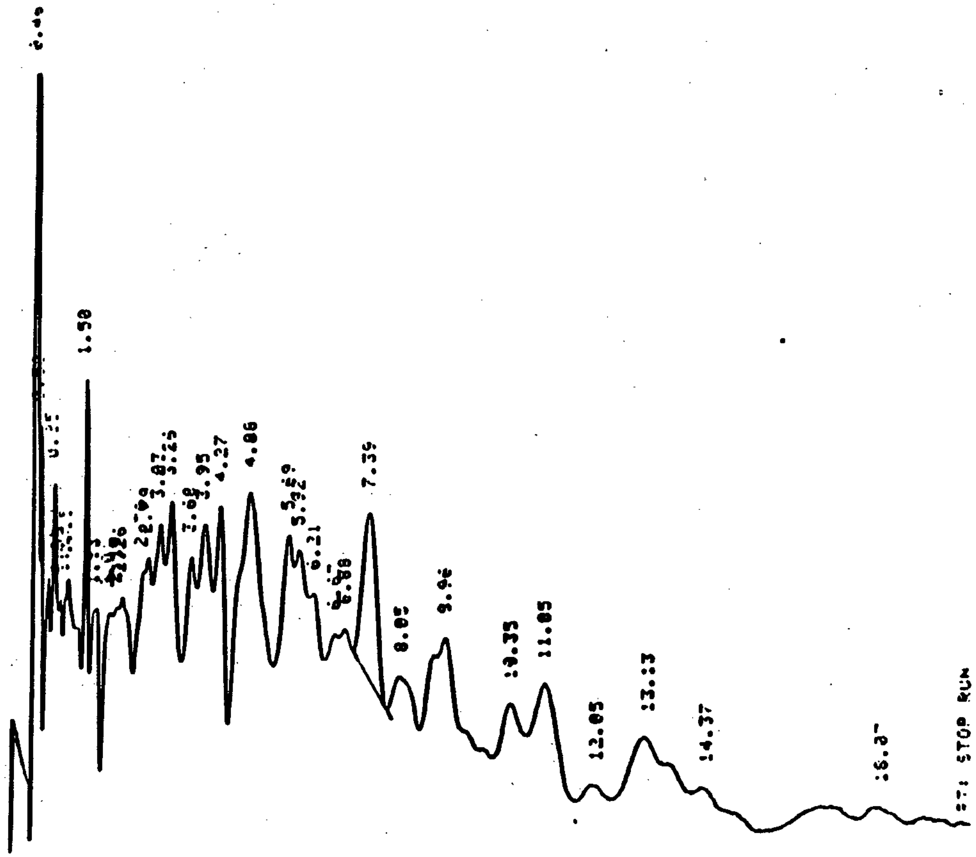
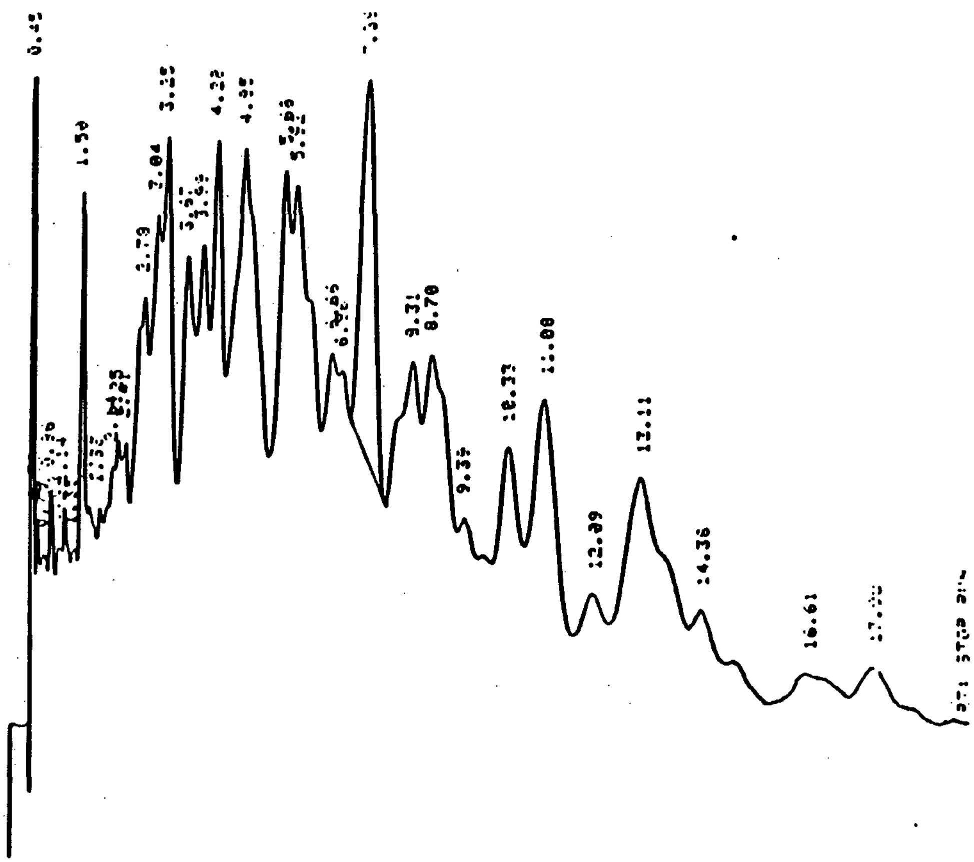


Gas Chromatogram of Toxaphene Standard
(1.0 ng/ul)

Ref. No. 11, p.

146 of 1411



Gas Chromatogram of Toxaphene Standard
(2.0 ng/ul)

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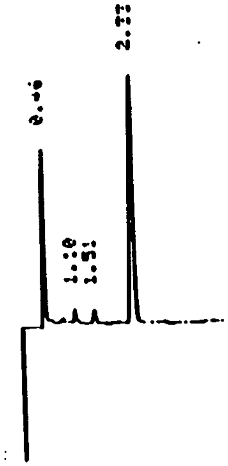
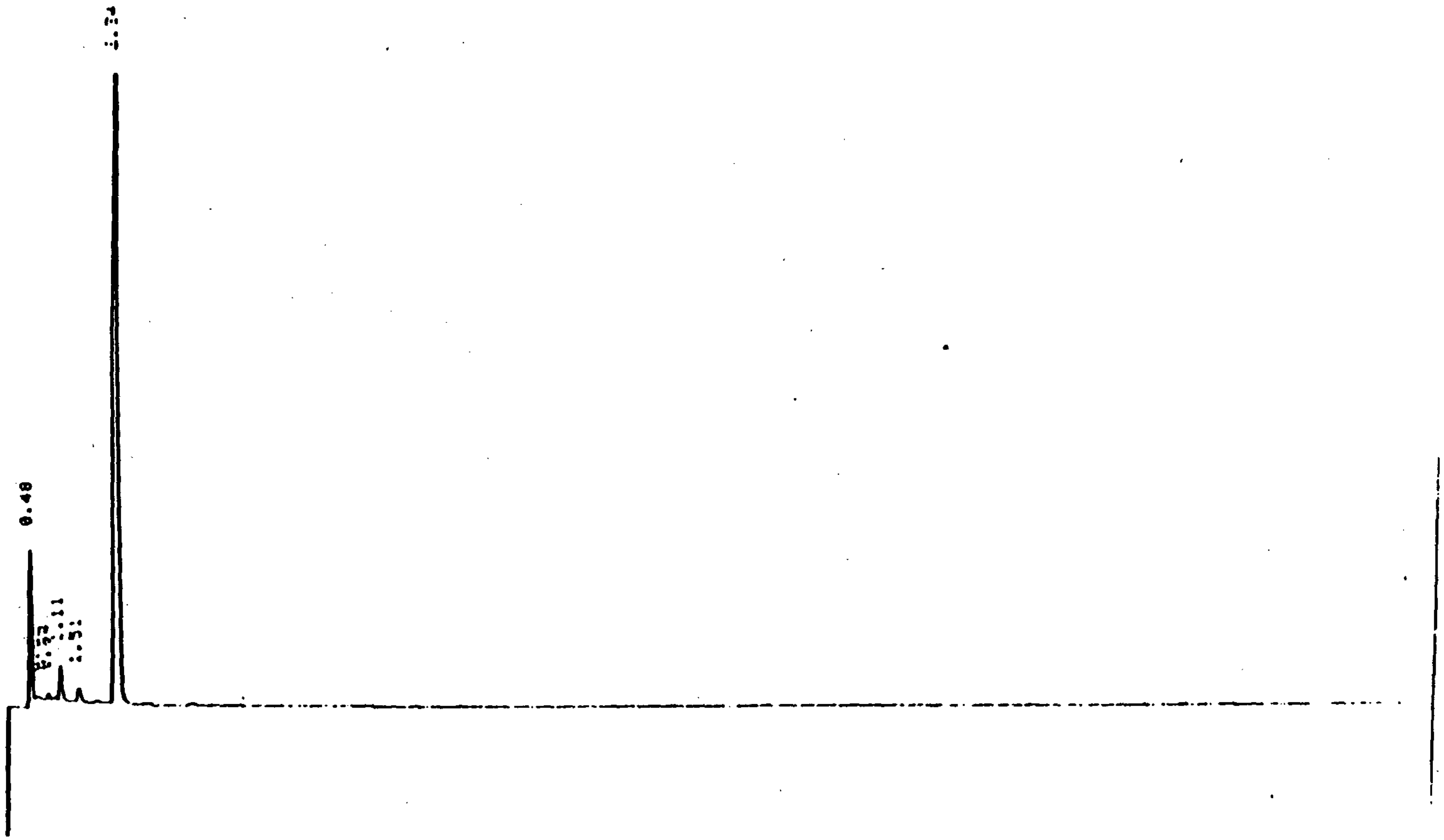


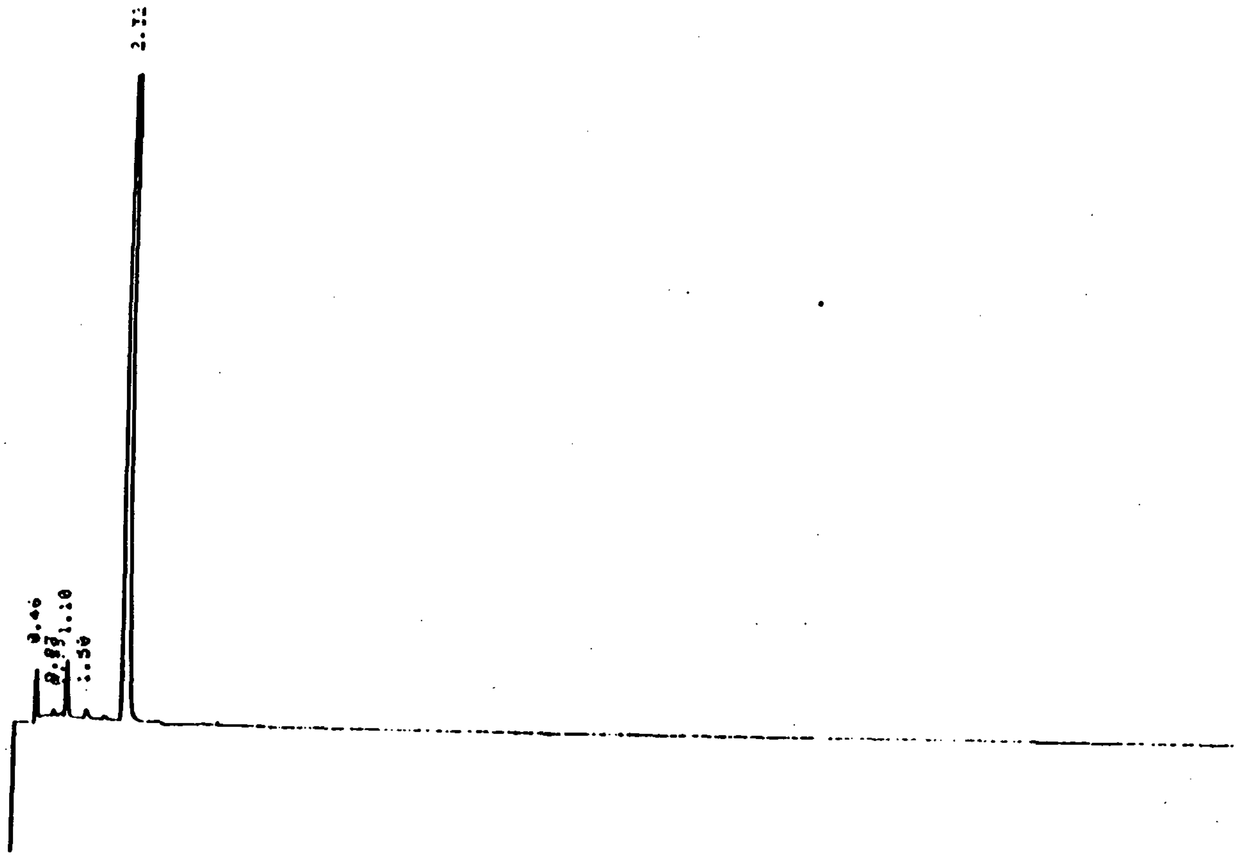
Gas Chromatogram of Lindane Standard
(0.2 ug/ml)

Ref. No. 11, p. 157 of 161



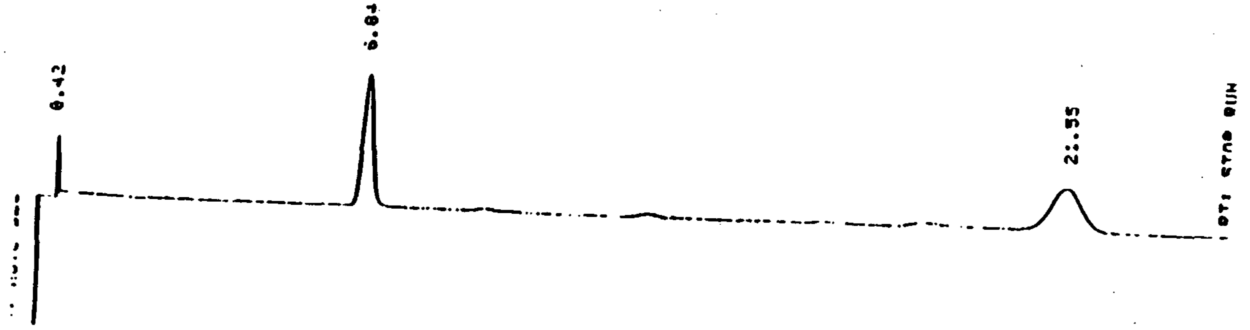
Gas Chromatogram of Lindane Standard
(0.5 ng/ul)

Ref. No. 11, p. 152 of 161



Gas Chromatogram of Lindane Standard
(1.0 ng/ul)

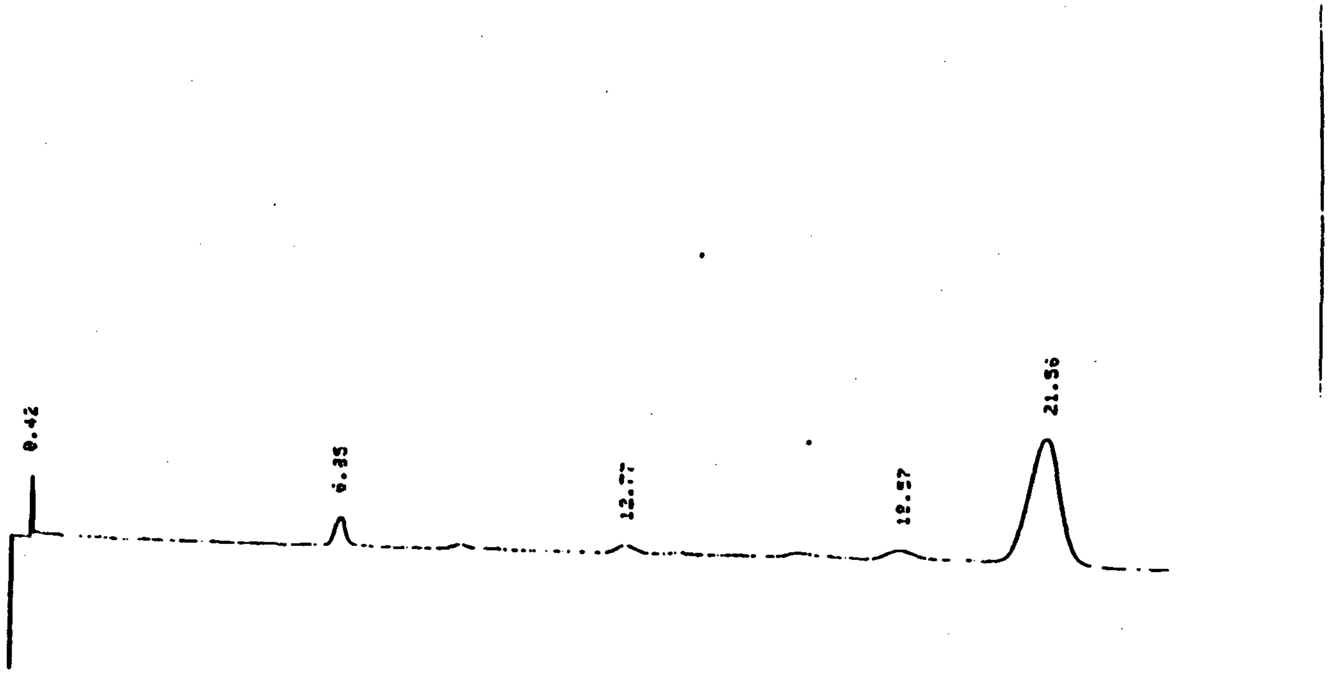
Ref. No. 11, p. 153 of 161



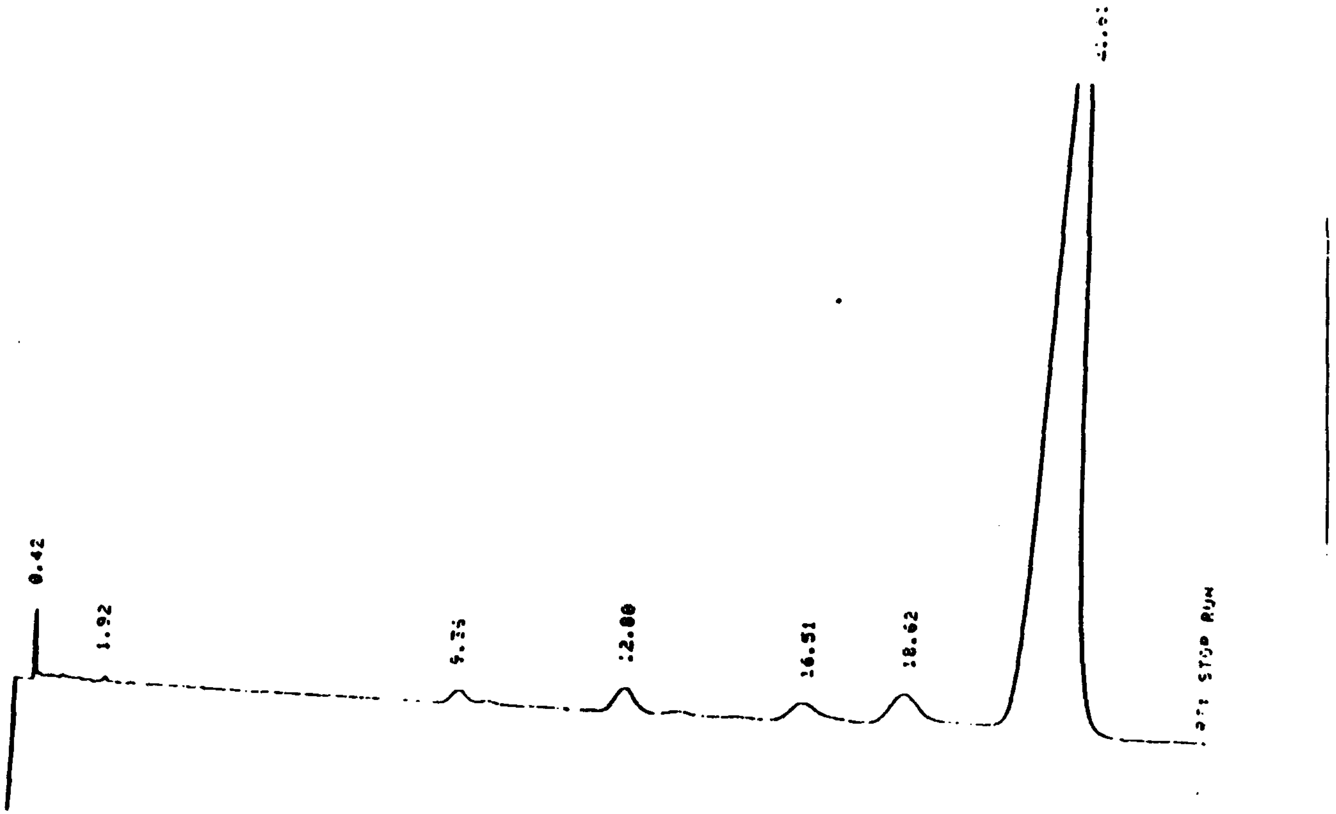
Gas Chromatogram of Methoxychlor Standard
(5.0 ng/ul)

Ref. No. 11, p.
102003

1846f/61



Gas Chromatogram of Methoxychlor Standard
(10.0 ng/ul)



Gas Chromatogram of Methoxychlor Standard
(50.0 ng/ul)

Ref. No. 11, p. 102005

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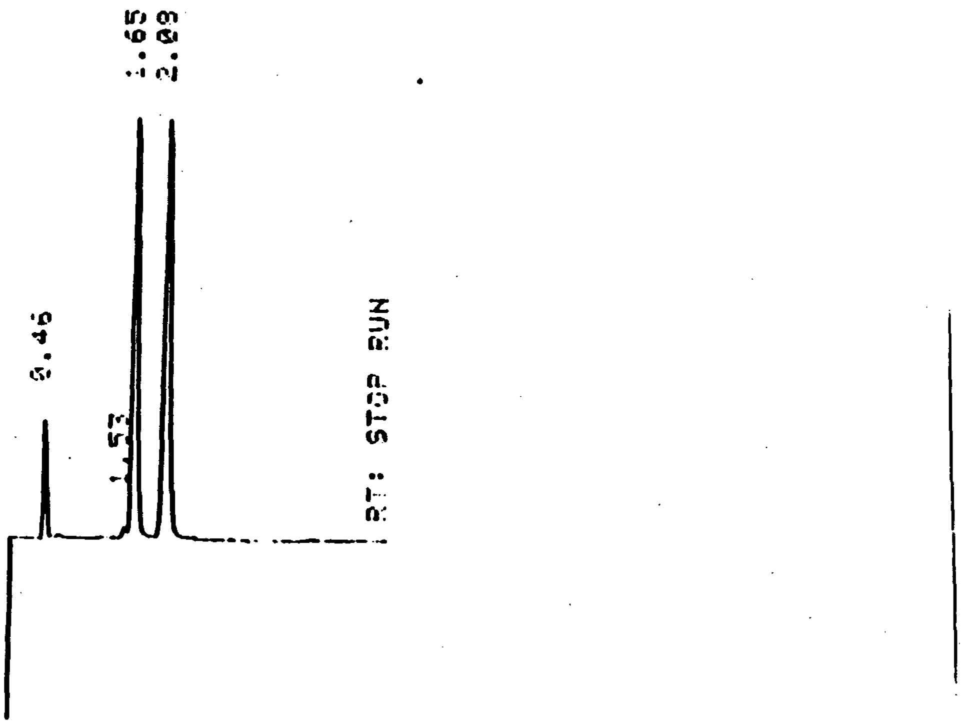

Gas Chromatogram of 2,4-D and 2,4,5-TP(Silvex) Standard
(10 ug/ml & 1 ug/ml)

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APPENDIX D

CHYUN ASSOCIATES
Architectural, Engineering & Laboratory

1101 State Road, Building B
Princeton, New Jersey 08540
609-924-5151

LABORATORY ANALYSIS REPORT

Client: ETC Corporation
Address: 284 Raritan Center Parkway
Edison, N.J. 08837

Attention: Dr. Denis Lin

Test Number: L82125
Date Received: 3/18/82
Date Sampled: Unknown

Job Number: 02299

SAMPLE NUMBER	SAMPLE DESIGNATION/DESCRIPTION
1	001340
2	001341
3	001342
4	001343
DL	Detection Limit

CHARGED APR 2 1982

SAMPLE NUMBER

PARAMETER/CONSTITUENT	1	2	3	4	DL	
Total Organic Carbon	8	6	21	12	1	
Phenolics as Phenol	<0.005	<0.005	<0.005	0.006	0.005	
Specific Conductance, micromhos	24,000	26,000	28,000	24,000	2,000	
Chloride	12,400	16,200	13,100	10,500	200	
Fluoride	0.88	0.31	0.32	0.21	0.1	
Nitrate as N	<0.1	<0.1	<0.1	<0.1	0.1	
Sulfate	490	240	170	290	10	
Turbidity (JTU)	4.3	0.35	1.2	0.55	0.1	

Page 1 of 2

All results in mg/l (ppm) except where noted.

Laboratory ID No. 11198

March 30, 1982
Date

Michael Wright
Michael Wright
Laboratory Supervisor

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TELEDYNE ISOTO[illegible]

REPORT OF ANAL[illegible]IS

RUN DATE [illegible]/07/82

WORK ORDER NUMBER	CUSTOMER P.O. NUMBER	DATE RECEIVED	DELIVERY DATE	PAGE 1
3-3562		03/18/82	04/20/82	

MS D FOSTER
EIC ENVIRON TESTING & CERT CORP
264 RARITAN CENTER PKWY
EDISON NJ 08837

RECEIVED APR 12 1982

W A T E R

TELEDYNE SAMPLE NUMBER	CUSTOMER'S IDENTIFICATION	STA NUM	COLLECTION-DATE START DATE	START TIME	STOP DATE	STOP TIME	NUCLIDE	ACTIVITY (pCi/liter)	NUCL-UNIT-% U/M *	MID-COUNT TIME DATE	MID-COUNT TIME TIME	VOLUME - UNITS ASH-WGHT-% *	LAB.
26274	NO 001327 WO5		03/08				GR-A	L.T. 1. E 00		03/31			3
							GR-B	1.2 +-0.2 E 01		03/31			3
26275	NO 001328 WO5		03/08				GR-A	L.T. 3. E 00		03/31			3
							GR-B	5.9 +-2.4 E 00		03/31			3
26276	NO 001330 WO5		03/08				GR-A	L.T. 2. E 00		03/31			3
							GR-B	4.0 +-1.7 E 00		03/31			3
26277	NO 001342 WO5		03/08				GR-A	L.T. 6. E 01		03/31			3
							GR-B	3.3 +-0.6 E 02		03/31			3
26278	NO 001343 WO5		03/08				GR-A	L.T. 5. E 01		03/31			3
							GR-B	1.3 +-0.4 E 02		03/31			3
26279	NO 001331 WO5		03/08				GR-A	L.T. 4. E 00		03/31			3
							GR-B	1.8 +-0.3 E 01		03/31			3
26280	NO 001332 WO5		03/08				GR-A	5.3 +-1.9 E 00		03/31			3
							GR-B	2.3 +-0.3 E 01		03/31			3
26281	NO 001333 WO5		03/08				GR-A	L.T. 2. E 00		03/31			3
							GR-B	8.6 +-2.2 E 00		03/31			3
26282	NO 001340 WO5		03/08				GR-A	L.T. 3. E 01		03/31			3
							GR-B	L.T. 4. E 01		03/31			3
26283	NO 001341 WO5		03/08				GR-A	L.T. 3. E 01		03/31			3
							GR-B	4.4 +-2.0 E 01		03/31			3

Ref. No. 31, p.

LAST PAGE OF REPORT

APPROVED BY H. KING 04/07/82

H. King

SEND 1 COPIES TO EN450S MS D FOSTER

2 - GAS LAB. 3 - RADIO CHEMISTRY LAB. 4 - Ge(Li) GAMMA SPEC LAB. 5 - TRITIUM GAS/L.S. LAB.

Ref. 11, p.
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[illegible]. Denis Lin
ETC Corporation
Test Report L32125
Job No. 02299
March 30, 1982
Page 2

Sample Number	Trial	Specific Conductance micromhos	TOC mg/l
001343	1	24,000	12
	2	22,000	12
	3	24,000	12
	4	25,000	10

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REFERENCE NUMBER 12

MALCOLM
PIRNIE

INTEROFFICE CORRESPONDENCE

To: David Kahlenberg

Date: May 19, 1995

From: Lisa Greco, Certified Wetland Expert

Re: LCP Wetland Delineation

On January 11, 1995, during the LCP sampling event, a wetland delineation was performed at the site by myself. The wetland delineation covered the area located along the South Branch Creek in between surface water/sediment sample number 10 (SW/SED10) and SW/SED4. This area is highlighted on the attached map. The delineation was performed using the method outlined in the "Federal Manual for Identifying and Delineating Jurisdictional Wetlands". According to this manual, there are three mandatory technical criteria for wetland identification. These criteria are outlined below:

1) **Hydrophytic Vegetation**

In order to meet the hydrophytic vegetation criteria, "more than 50 percent of the composition of the dominant species from all strata are obligate wetland (OBL), facultative wetland (FACW), and/or facultative (FAC) species...". At LCP, the dominant species (>99%) was the common reed (*Phragmites australis*). Since the dominant vegetation type is FACW, the hydrophytic vegetation criteria is met.

2) **Hydric Soils**

Hydric soils are defined as "soils that are saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions in the upper part". Hydric soils can often be identified by the soil color. A soil with a matrix chroma of 2 or less (in mottled soils) or a soil with a matrix color of 1 or less (with or without mottles) is generally considered a hydric soil. In this case, the soil at the LCP site was examined, and the color of the soil was determined by comparison to the Munsell Soil Color Chart. According to this chart, the soil at the LCP site has a chroma of 1. Therefore, this soil meets the hydric soil criteria.

3) **Wetland Hydrology**

Wetland hydrology refers to establishing that an area has "permanent or periodic inundation, or soil saturation for a significant period (usually a week or more) during the growing season". At the LCP site, oxidized rhizospheres were observed. Oxidized rhizospheres are one field indicator of wetland hydrology. In reducing environments (i.e., saturated soil), iron oxide concretions (orange or reddish-brown) form along the channels of the living roots and rhizomes. Therefore, the wetland hydrology criteria is met for this area.

Therefore, since this area met all three technical criteria for wetlands, this area was determined to be a wetland.

The following documents are attached to this memo:

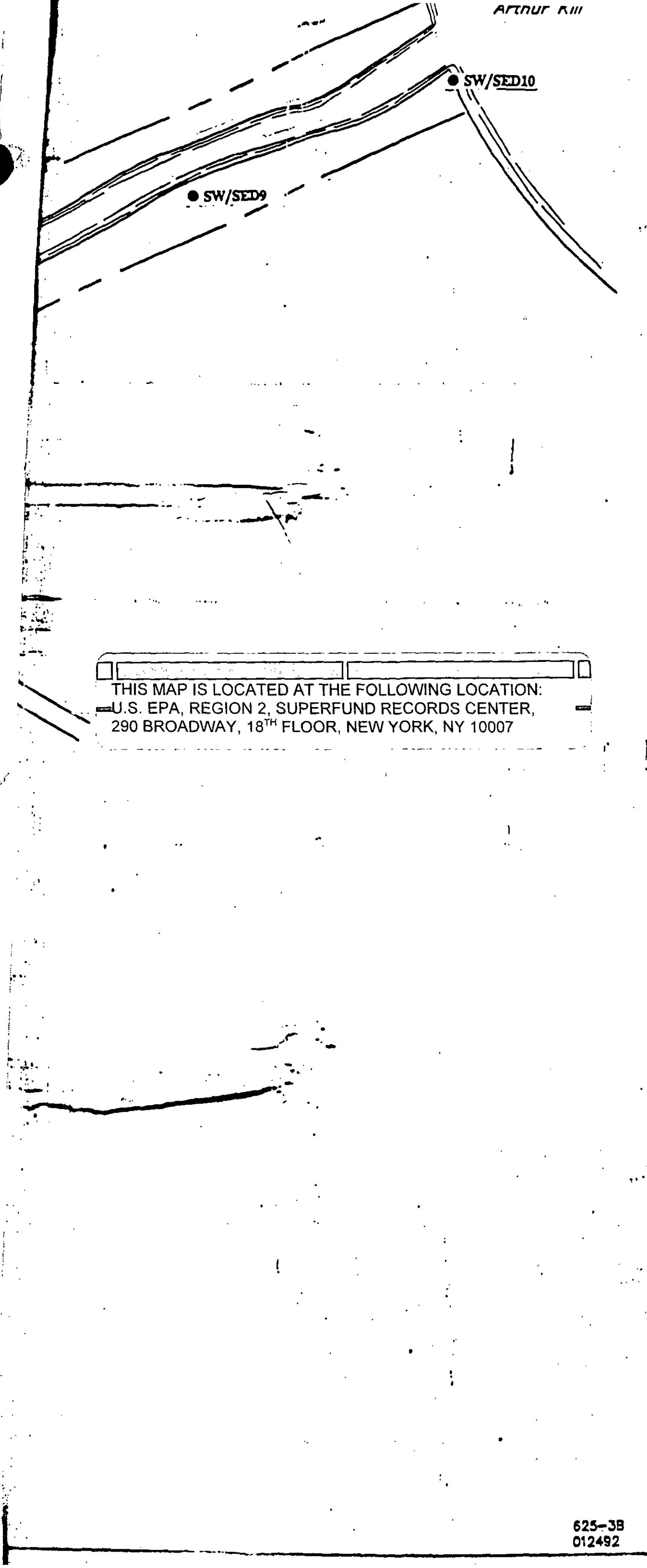
1) A map showing the delineated area (the area of interest is highlighted).

2) Pictures from the on-site reconnaissance and the on-site sampling event. These pictures indicate that the entire area of interest has the same vegetation type (common reed).

3) Data Form - Routine Onsite Determination Method.

4) Copies of pertinent pages from the "Federal Manual for Identifying and Delineating Jurisdictional Wetlands".

5) Copies of pertinent pages from the "National List of Plant Species that Occur in Wetlands: Northeast (Region 1)".



THIS MAP IS LOCATED AT THE FOLLOWING LOCATION:
U.S. EPA, REGION 2, SUPERFUND RECORDS CENTER,
290 BROADWAY, 18TH FLOOR, NEW YORK, NY 10007

625-3B
012492

RCRA FACILITY INVESTIGATIO
LCP CHEMICALS-NEW JERSEY, INC
A DIVISION OF HANLIN GROUP, INC.
LINDEN, NEW JERSEY

eder associates consulting engineer
NEW YORK MICHIGAN WISCONSIN GEORG

PROJECT
RCRA FACILITY INVESTIGATION
LCP CHEMICALS-NEW JERSEY, INC.
A DIVISION OF HANLIN GROUP, INC.
LINDEN, NEW JERSEY

TITLE
FIGURE 2: SAMPLE LOCATION MAP
Note: Sample locations are not located to scale.
Map based upon a RCRA Facility Investigation
prepared by Eder Associates Consulting Engineers, P.C.

eder associates consulting engineers, p.c.
LOCUST VALLEY, NEW YORK • MADISON, WISCONSIN
ANN ARBOR, MICHIGAN • AUGUSTA, GEORGIA

DRAWN BY MSA	SCALE 1" = 100'-0"
DESIGNED BY KJP	PROJECT No. 625-3
APPROVED BY SJO	DWG. No. 1
DATE JANUARY, 1992	

DATA FORM
ROUTINE ONSITE DETERMINATION METHOD[1]

Field Investigator(s): Lisa Greco Date: 1/11/95

Project/Site: LCP Chemical State: NJ County: Union

Applicant/Owner: Plant Community #/Name:

Note: If a more detailed site description is necessary, use the back of data form or a field notebook.

Do normal environmental conditions exist at the plant community?

Yes X No ___ (If no, explain on back)

Has the vegetation, soils, and/or hydrology been significantly disturbed?

Yes ___ No X (If yes, explain on back)

VEGETATION

Dominant Plant Species	Indicator Status	Stratum	Dominant Plant Species	Indicator Status	Stratum
1. common reed	FACW	grass	11.		
2.			12.		
3.			13.		
4.			14.		
5.			15.		
6.			16.		
7.			17.		
8.			18.		
9.			19.		
10.			20.		

Percent of dominant species that are OBL, FACW, and/or FAC 100%

Is the hydrophytic vegetation criterion met? Yes X No ___

Rationale: This area has hydrophytic vegetation since >50% of the dominant species is FAC or wetter

SOILS

Series/phase: Subgroup:[2]

Is the soil on the hydric soils list? Yes ___ No ___ Undetermined ___

Is the soil a Histosol? Yes ___ No X Histic epipedon present? Yes ___ No X

Is the soil: Mottled? Yes ___ No X Gleyed? Yes ___ No X

Matrix Color: 2.5Y 5/1 Mottle Colors:

Other hydric soil indicators:

Is the hydric soil criterion met? Yes X No ___

Rationale: Soils with a chroma of 1 are hydric soils

HYDROLOGY

Is the ground surface inundated? Yes ___ No X Surface water depth:

Is the soil saturated? Yes ___ No X

Depth to free-standing water in pit/soil probe hole: N/A

List other field evidence of surface inundation or soil saturation.

oxidized rhizospheres

Is the wetland hydrology criterion met? Yes X No ___

Rationale: Oxidized rhizospheres are an indicator of wetland hydrology

JURISDICTIONAL DETERMINATION AND RATIONALE

Is the plant community a wetland? Yes X No ___

Rationale for jurisdictional decision: All 3 technical criteria are met

---

[1] This data form can be used for the Hydric Soil Assessment Procedure and the Plant Community Assessment Procedure.

[2] Classification according to "Soil Taxonomy."

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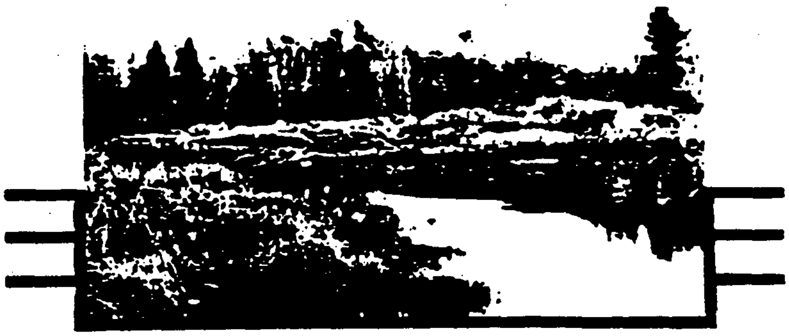
Federal Manual for Identifying and Delineating Jurisdictional Wetlands



AN INTERAGENCY COOPERATIVE PUBLICATION

Fish and Wildlife Service	Environmental Protection Agency
Department of the Army	Soil Conservation Service

January 1989

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Part II.

Mandatory Technical Criteria for Wetland Identification

2.0. Wetlands possess three essential characteristics: (1) hydrophytic vegetation, (2) hydric soils, and (3) wetland hydrology, which is the driving force creating all wetlands. These characteristics and their technical criteria for identification purposes are described in the following sections. The three technical criteria specified are mandatory and must all be met for an area to be identified as wetland. Therefore, areas that meet these criteria are wetlands.

Hydrophytic Vegetation

2.1. For purposes of this manual, hydrophytic vegetation is defined as macrophytic plant life growing in water, soil or on a substrate that is at least periodically deficient in oxygen as a result of excessive water content. Nearly 7,000 vascular plant species have been found growing in U.S. wetlands (Reed 1988). Out of these, only about 27 percent are "obligate wetland" species that nearly always occur in wetlands under natural conditions. This means that the majority of plant species growing in wetlands also grow in nonwetlands in varying degrees.

2.2. The FWS in cooperation with CE, EPA, and SCS has published the "National List of Plant Species That Occur in Wetlands" from a review of the scientific literature and review by wetland experts and botanists (Reed 1988). The list separates vascular plants into four basic groups, commonly called "wetland indicator status," based on a plant species' frequency of occurrence in wetlands: (1) *obligate wetland plants* (OBL) that occur almost always (estimated probability >99%) in wetlands under natural conditions; (2) *facultative wetland plants* (FACW) that usually occur in wetlands (estimated probability 67-99%), but occasionally are found in nonwetlands; (3) *facultative plants* (FAC) that are equally likely to occur in wetlands or nonwetlands (estimated probability 34-66%); and (4) *facultative upland plants* (FACU) that usually occur in nonwetlands (estimated probability 67-99%), but occasionally are found in wetlands (estimated probability 1-33%). If a species occurs almost always (estimated probability >99%) in nonwetlands under natural conditions, it is considered an *obligate upland plant* (UPL). These latter plants do not usually appear on the wetland plant list; they are listed only when found in wetlands with a higher probability in one region of the country. If a species is not on the list, it is presumed to be an obligate upland plant. The "National List of Plant Species That Occur in Wetlands" has been subdivided into regional and state lists. There is a formal procedure to petition the interagency plant review committee for making additions, deletions, and changes in indicator status. Since the lists are periodically updated, the U.S. Fish and Wildlife Service should be contacted to be sure that the most current version is being used for wetland determinations. The appropriate plant list for a specific geographic region should be used when making a wetland determination and evaluating whether the following hydrophytic vegetation criterion is satisfied.

Hydrophytic Vegetation Criterion

2.3. An area has hydrophytic vegetation when, under normal circumstances: (1) more than 50 percent of the composition of the dominant species from all strata are obligate wetland (OBL), facultative wetland (FACW), and/or facultative (FAC) species, or (2) a frequency analysis of all species within the community yields a prevalence index value of less than 3.0 (where OBL = 1.0, FACW = 2.0, FAC = 3.0, FACU = 4.0, and UPL = 5.0). *CAUTION*: When a plant community has less than or equal to 50 percent of the dominant species from all strata represented by OBL, FACW, and/or FAC species, or a frequency analysis of all species within the community yields a prevalence index value of greater than or equal to 3.0, *and* hydric soils and wetland hydrology are present, the area also has hydrophytic vegetation. (*Note*: These areas are considered problem area wetlands.)

2.4. For each stratum (e.g., tree, shrub, and herb) in the plant community, dominant species are the most abundant plant species (when ranked in descending order

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of abundance and cumulatively totaled) that immediately exceed 50 percent of the total dominance measure (e.g., basal area or areal coverage) for the stratum, plus any additional species comprising 20 percent or more of the total dominance measure for the stratum. All dominants are treated equally in determining the presence of hydrophytic vegetation.

2.5. (*Note*: The "National List of Plant Species that Occur in Wetlands" uses a plus (+) sign or a minus (-) sign to specify a higher or lower portion of a particular wetland indicator frequency for the three facultative-type indicators; for purposes of identifying hydrophytic vegetation according to this manual, however, FACW+, FACW-, FAC+, and FAC are included as FACW and FAC, respectively, in the hydrophytic vegetation criterion.)

Hydric Soils

2.6. Hydric soils are defined as soils that are saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions in the upper part (U.S.D.A. Soil Conservation Service 1987). In general, hydric soils are flooded, ponded, or saturated for usually one week or more during the period when soil temperatures are above biologic zero 41° F as defined by "Soil Taxonomy" (U.S.D.A. Soil Survey Staff 1975). These soils usually support hydrophytic vegetation. The National Technical Committee for Hydric Soils has developed criteria for hydric soils and a list of the Nation's hydric soils (U.S.D.A. Soil Conservation Service 1987). (*Note*: Caution must be exercised in using the hydric soils list for determining the presence of hydric soil at specific sites; see p. 12.)

Hydric Soil Criterion

2.7. An area has hydric soils when the National Technical Committee for Hydric Soils (NTCHS) criteria for hydric soils are met.

NTCHS Criteria for Hydric Soils (U.S.D.A. Soil Conservation Service 1987):

"1. All Histosols except Folists; or

2. Soils in Aquic suborders, Aquic subgroups, Albolls suborder, Salorthids great group, or Pell great groups of Vertisols that are:

- **a. somewhat poorly drained and have water table less than 0.5 feet from the surface for a significant period (usually a week or more) during the growing season, or**
- **b. poorly drained or very poorly drained and have either:**
  - **(1) water table at less than 1.0 feet from the surface for a significant period (usually a week or more) during the growing season if permeability is equal to or greater than 6.0 inches/hour in all layers within 20 inches, or**
  - **(2) water table at less than 1.5 feet from the surface for a significant period (usually a week or more) during the growing season if permeability is less than 6.0 inches/hour in any layer within 20 inches; or**

3. Soils that are ponded for long duration or very long duration during the growing season; or

4. Soils that are frequently flooded for long duration or very long duration during the growing season."

(*Note*: Long duration is defined as inundation for a single event that ranges from seven days to one month; very long duration is defined as inundation for a single event that is greater than one month; frequently flooded is defined as flooding likely to occur often under usual weather conditions - more than 50 percent chance of flooding in any year or more than 50 times in 100 years. Other technical terms in the NTCHS criteria for hydric soils are generally defined in the glossary.)

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Wetland Hydrology

2.8. Permanent or periodic inundation, or soil saturation to the surface, at least seasonally, are the driving forces behind wetland formation. The presence of water for a week or more during the growing season typically creates anaerobic conditions in the soil, which affect the types of plants that can grow and the types of soils that develop. Numerous factors influence the wetness of an area, including precipitation, stratigraphy, topography, soil permeability, and plant cover. All wetlands usually have at least a seasonal abundance of water. This water may come from direct precipitation, overbank flooding, surface water runoff due to precipitation or snow melt, ground water discharge, or tidal flooding. The frequency and duration of inundation and soil saturation vary widely from permanent flooding or saturation to irregular flooding or saturation. Of the three technical criteria for wetland identification, wetland hydrology is often the least exact and most difficult to establish in the field, due largely to annual, seasonal, and daily fluctuations.

Wetland Hydrology Criterion

2.9. An area has wetland hydrology when saturated to the surface or inundated at some point in time during an average rainfall year, as defined below:

1. **Saturation to the surface normally occurs when soils in the following natural drainage classes meet the following conditions:**
   - **A. In somewhat poorly drained mineral soils, the water table is less than 0.5 feet from the surface for usually one week or more during the growing season; or**
   - **B. In low permeability (<6.0 inches/hour), poorly drained or very poorly drained mineral soils, the water table is less than 1.5 feet from the surface for usually one week or more during the growing season; or**
   - **C. In more permeable (≥ 6.0 inches/hour), poorly drained or very poorly drained mineral soils, the water table is less than 1.0 feet from the surface for usually one week or more during the growing season; or**
   - **D. In poorly drained or very poorly drained organic soils, the water table is usually at a depth where saturation to the surface occurs more than rarely. (*Note*: Organic soils that are cropped are often drained, yet the water table is closely managed to minimize oxidation of organic matter; these soils often retain their hydric characteristics and if so, meet the wetland hydrology criterion.)**
2. **An area is inundated at some time if ponded or frequently flooded with surface water for one week or more during the growing season.**

(*Note*: An area saturated for a week during the growing season, especially early in the growing season, is not necessarily a wetland. However, in the vast majority of cases, an area that meets the NTCHS criteria for hydric soil is a wetland.)

Summary

2.10. The technical criteria are mandatory and must be satisfied in making a wetland determination. Areas that meet the NTCHS hydric soil criteria and under normal circumstances support hydrophytic vegetation are wetlands. Field indicators and other information provide direct and indirect evidence for determining whether or not each of the three criteria are met. Sound professional judgement should be used in interpreting these data to make a wetland determination. It must be kept in mind that exceptional and rare cases are possibilities that may call any generally sound principle into question.

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Part III.

Field Indicators and Other Available Information

3.0. When conducting a field inspection to make a wetland determination, the three identification criteria, listed in Part II of this manual, alone may not provide enough information for users to document whether or not the criteria themselves (i.e., hydrophytic vegetation, hydric soils, and wetland hydrology) are met. Various physical properties or other signs can be readily observed in the field to determine whether the three wetland identification criteria are satisfied. Besides these field indicators, good baseline information may be available from site-specific studies, published reports, or other written material on wetlands. In the following sections, field indicators and primary sources of information for each of the three criteria are presented to help the user identify wetlands.

Hydrophytic Vegetation

3.1. All plants growing in wetlands have adapted in one way or another to life in permanently or periodically inundated or saturated soils. Some plants have developed structural or morphological adaptations to inundation or saturation. These features, while indicative of hydrophytic vegetation, are used as indicators of wetland hydrology in this manual, since they are a response to inundation and soil saturation. Probably all plants growing in wetlands possess physiological mechanisms to cope with prolonged periods of anaerobic soil conditions. Because they are not observable in the field, physiological and reproductive adaptations are not included in this manual.

3.2. Persons making wetland determinations should be able to identify at least the dominant wetland plants in each stratum (layer of vegetation) of a plant community. Plant identification requires use of field guides or more technical taxonomic manuals (see Appendix A for sample list). When necessary, seek help in identifying difficult species. Once a plant is identified to genus and species, one should then consult the appropriate Federal list of plants that occur in wetlands to determine the "wetland indicator status" of the plant (see p. 5). This information will be used to help determine if hydrophytic vegetation is present.

Dominant Vegetation

3.3. Dominance as used in this manual refers strictly to the spatial extent of a species that is directly discernable or measurable in the field. When identifying dominant vegetation within a given plant community, one should consider dominance within each stratum. All dominants are treated equally in characterizing the plant community to determine whether hydrophytic vegetation is present. The most abundant plant species (when ranked in descending order of abundance and cumulatively totaled) that immediately exceed 50 percent of the total dominance measure for a given stratum, plus any additional species comprising 20 percent or more of the total dominance measure for that stratum are considered dominant species for the stratum. Dominance measures include percent areal coverage and basal area, for example.

3.4. Vegetative strata for which dominants should be determined may include: (1) tree (≥5.0 inches diameter at breast height (dbh) and 20 feet or taller); (2) sapling (0.4 to <5.0 inches dbh and 20 feet or taller); (3) shrub (usually 3 to 20 feet tall including multi-stemmed, bushy shrubs and small trees and saplings); (4) woody vine; and (5) herb (herbaceous plants including graminoids, forbs, ferns, fern allies, herbaceous vines, and tree seedlings). Bryophytes (mosses, horned liverworts, and true liverworts) should be sampled as a separate stratum in certain wetlands, including shrub bogs, moss-lichen wetlands, and wooded swamps where bryophytes are abundant and represent an important component of the community; in most other wetlands, bryophytes should be included within the herb stratum due to their scarcity.

3.5. There are many ways to quantify dominance measures; Part IV provides recommended approaches. Alternatively, one may wish to visually estimate percent coverage when possible or perform a frequency analysis of all species within a

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given plant community. These are accepted methods for evaluating plant communities.

Field Indicators

3.6. Having established the community dominants for each stratum or performed a frequency analysis, hydrophytic vegetation is considered present if:

1) OBL species comprise all dominants in the plant community (*Note*: In these cases, the area can be considered wetland without detailed examination of soils and hydrology, provided significant hydrologic modifications are not evident); or

2) OBL species do not dominate each stratum, but more than 50 percent of the dominants of all strata are OBL, FACW, or FAC species (including FACW+, FACW-, FAC+, and FAC-); or

3) A plant community has a visually estimated percent coverage of OBL and FACW species that exceed the coverage of FACU and UPL species; or

4) A frequency analysis of all species within the community yields a prevalence index value of less than 3.0 (where OBL = 1.0, FACW = 2.0, FAC = 3.0, FACU = 4.0, and UPL = 5.0); or

5) A plant community has less than or equal to 50 percent of the dominant species from all strata represented by OBL, FACW, and/or FAC species, *or* a frequency analysis for all species within the community yields a prevalence index value greater than or equal to 3.0, *and* hydric soils and wetland hydrology are present. (*Note*: In other words, if the hydric soil and wetland hydrology criteria are met, then the vegetation is considered hydrophytic. For purposes of this manual, these situations are treated as disturbed or problem area wetlands because these plant communities are usually nonwetlands.)

Other Sources of Information

3.7. Besides learning the field indicators of hydrophytic vegetation presented above, one should also become familiar with the technical literature on wetlands, especially for one's geographic region. Sources of available literature include: taxonomic plant manuals and field guides; scientific journals dealing with botany, ecology, and wetlands in particular; technical government reports on wetlands; proceedings of wetland workshops, conferences, and symposia; and the FWS's national wetland plant database, which contains habitat information on about 7,000 plant species. Appendix A presents examples of the first four sources of information. In addition, the FWS's National Wetlands Inventory (NWI) maps provide information on locations of hydrophytic plant communities that may be studied in the field to improve one's knowledge of such communities in particular regions.

Hydric Soils

3.8. Due to their wetness during the growing season, hydric soils usually develop certain morphological properties that can be readily observed in the field. Prolonged anaerobic soil conditions typically lower the soil redox potential and causes a chemical reduction of some soil components, mainly iron oxides and manganese oxides. This reduction affects solubility, movement, and aggregation of these oxides which is reflected in the soil color and other physical characteristics that are usually indicative of hydric soils. (*Note*: Much of the background material for this section was taken from "Hydric Soils of New England" [Tiner and Veneman 1987].)

3.9. Soils are separated into two major types on the basis of material composition: organic soil and mineral soil. In general, soils with at least 18 inches of organic material in the upper part of the soil profile and soils with organic material resting on bedrock are considered organic soils (Histosols). Soils largely composed of sand, silt, and/or clay are mineral soils. (For technical definitions, see "Soil Taxonomy", U.S.D.A. Soil Survey Staff 1975).

3.10. Accumulation of organic matter in most organic soils results from prolonged anaerobic soil conditions associated with long periods of submergence or soil saturation during the growing season. These saturated conditions impede aerobic decomposition (oxidation) of the bulk organic materials such as leaves, stems, and roots, and encourage their accumulation over time as peat or muck. Consequently, most organic soils are characterized as very poorly drained soils. Organic soils typically form in waterlogged depressions, and peat or muck deposits may range from about two feet to more

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than 30 feet deep. Organic soils also develop in low-lying areas along coastal waters where tidal flooding is frequent.

3.11. Hydric organic soils are subdivided into three groups based on the presence of identifiable plant material: (1) muck (Saprists) in which two-thirds or more of the material is decomposed and less than one-third of the plant fibers are identifiable; (2) peat (Fibrists) in which less than one-third of the material is decomposed and more than two-thirds of the plant fibers are still identifiable; and (3) mucky peat or peaty muck (Hemists) in which the ratio of decomposed to identifiable plant matter is more nearly even (U.S.D.A. Soil Survey Staff 1975). A fourth group of organic soils (Folists) exists in tropical and boreal mountainous areas where precipitation exceeds the evapotranspiration rate, but these soils are never saturated for more than a few days after heavy rains and thus do not develop under hydric conditions. All organic soils, with the exception of the Folists, are hydric soils.

3.12. When less organic material accumulates in soil, the soil is classified as mineral soil. Some mineral soils may have thick organic surface layers due to heavy seasonal rainfall or a high water table, yet they are still composed largely of mineral matter (Ponnamperuma 1972). Mineral soils that are covered with moving (flooded) or standing (ponded) water for significant periods or are saturated for extended periods during the growing season are classified as hydric mineral soils. Soil saturation may result from low-lying topographic position, groundwater seepage, or the presence of a slowly permeable layer (e.g., clay, confining bedrock, or hardpan).

3.13. The duration and depth of soil saturation are essential criteria for identifying hydric soils and wetlands. Soil morphological features are commonly used to indicate long-term soil moisture regimes (Bouma 1983). The two most widely recognized features that reflect wetness in mineral soils are gleying and mottling.

3.14. Simply described, gleyed soils are predominantly neutral gray in color and occasionally greenish or bluish gray. In gleyed soils, the distinctive colors result from a process known as gleization. Prolonged saturation of mineral soil converts iron from its oxidized (ferric) form to its reduced (ferrous) state. These reduced compounds may be completely removed from the soil, resulting in gleying (Veneman, *et al.* 1976). Mineral soils that are always saturated are uniformly gleyed throughout the saturated area. Soils gleyed to the surface layer are hydric soils. These soils often show evidence of oxidizing conditions only along root channels. Some nonhydric soils have gray layers (E-horizons) immediately below the surface layer that are gray for reasons other than saturation (e.g., leaching due to organic acids). These soils often have brighter (e.g., brownish or reddish) layers below the gray layer and can be recognized as nonhydric on that basis.

3.15. Mineral soils that are alternately saturated and oxidized (aerated) during the year are usually mottled in the part of the soil that is seasonally wet. Mottles are spots or blotches of different colors or shades of colors interspersed with the dominant (matrix) color. The abundance, size, and color of the mottles usually reflect the duration of the saturation period and indicate whether or not the soil is hydric. Mineral soils that are predominantly grayish with brown or yellow mottles are usually saturated for long periods during the growing season and are classified as hydric. Soils that are predominantly brown or yellow with gray mottles are saturated for shorter periods and may not be hydric. Mineral soils that are never saturated are usually bright-colored and are not mottled. Realize, however, that in some hydric soils, mottles may not be visible due to masking by organic matter (Parker, *et al.* 1984).

3.16. It is important to note that the gleization and mottle formation processes are strongly influenced by the activity of certain soil microorganisms. These microorganisms reduce iron when the soil environment is anaerobic, that is, when virtually no free oxygen is present, and when the soil contains organic matter. If the soil conditions are such that free oxygen is present, organic matter is absent, or temperatures are too low (below 41°F) to sustain microbial activity, gleization will not proceed and mottles will not form, even though the soil may be saturated for prolonged periods of time (Diers and Anderson 1984).

Soil Colors

3.17. Soil colors often reveal much about a soil's wetness, that is, whether the soil is hydric or nonhydric. Scientists and others examining the soil can determine the approximate soil color by comparing

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the soil sample with a Munsell soil color chart. The standardized Munsell soil colors are identified by three components: hue, value, and chroma. The hue is related to one of the main spectral colors: red, yellow, green, blue, or purple, or various mixtures of these principal colors. The value refers to the degree of lightness, while the chroma notation indicates the color strength or purity. In the Munsell soil color book, each individual hue has its own page, each of which is further subdivided into units for value (on the vertical axis) and chroma (horizontal axis). Although theoretically each soil color represents a unique combination of hues, values, and chromas, the number of combinations common in the soil environment usually is limited. Because of this situation and the fact that accurate reproduction of each soil color is expensive, the Munsell soil color book contains a limited number of combinations of hues, values, and chromas. The color of the soil matrix or a mottle is determined by comparing a soil sample with the individual color chips in the soil color book. The appropriate Munsell color name can be read from the facing page in the "Munsell Soil Color Charts" (Kollmorgen Corporation 1975). Chromas of 2 or less are considered low chromas and are often diagnostic of hydric soils. Low chroma colors include black, various shades of gray, and the darker shades of brown and red.

Hydric Organic Soils

3.18. Hydric organic soils can be easily recognized as black-colored muck and/or as black to dark brown-colored peat. Distinguishing mucks from peats based on the relative degree of decomposition is fairly simple. In mucks (Saprists), almost all of the plant remains have been decomposed beyond recognition. When rubbed, mucks feel greasy and leave hands dirty. In contrast, the plant remains in peats (Fibrists) show very little decomposition and the original constituent plants can be recognized fairly easily. When the organic material is rubbed between the fingers, most plant fibers will remain identifiable, leaving hands relatively clean. Between the extremes of mucks and peats, organic soils with partially decomposed plant fibers (Hemists) can be recognized. In peaty mucks up to two-thirds of the plant fibers can be destroyed by rubbing the materials between the fingers, while in mucky peats up to two-thirds of the plant remains are still recognizable *after* rubbing.

3.19. Besides the dominance of organic matter, many organic soils (especially in tidal marshes) also emit an odor of rotten eggs when hydrogen sulfide is present. Sulfides are produced only in a strongly reducing environment.

Hydric Mineral Soils

3.20. Hydric mineral soils are often more difficult to identify than hydric organic soils because most organic soils are hydric, while most mineral soils are not. A thick dark surface layer, grayish subsurface and subsoil colors, the presence of orange or reddish brown (iron) and/or dark reddish brown or black (manganese) mottles or concretions near the surface, and the wet condition of the soil may help identify the hydric character of many mineral soils. The grayish subsurface and subsoil colors and thick, dark surface layers are the best indicators of current wetness, since the orange-colored mottles are very insoluble and once formed may remain indefinitely as relict mottles of former wetness (Diers and Anderson 1984).

National and State Hydric Soils Lists

3.21. The SCS in cooperation with the National Technical Committee for Hydric Soils (NTCHS) has prepared a list of the Nation's hydric soils. State lists have also been prepared for statewide use. The national and State lists identify those soil series that meet the hydric soil criteria according to available soil interpretation records in SCS's soils database. These lists are periodically updated, so make sure the list being used is the current list. The lists facilitate use of SCS county soil surveys for identifying potential wetlands. One must be careful, however, in using the soil survey, because a soil map unit of an upland (nonwetland) soil may have inclusions of hydric soil that were not delineated on the map or vice versa. Also, some map units (e.g., alluvial land, swamp, tidal marsh, muck and peat) may be hydric soil areas, but are not on the hydric soils lists because they were not given a series name at the time of mapping.

3.22. Because of these limitations of the national and State lists, the SCS also maintains lists of hydric soil map units for each county in the United States. These lists may be obtained from local SCS district offices and are the preferred lists to be used when locating areas of hydric soils. The hydric soil

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map units lists identify all map units that are either named by a hydric soil or that have a potential of having hydric soil inclusions. The lists provide the map unit symbol, the name of the hydric soil part or parts of the map unit, information on the hydric soil composition of the map unit, and probable landscape position of hydric soils in the map unit delineation. The county lists also include map units named by miscellaneous land types or higher levels in "Soil Taxonomy" that meet hydric soil criteria.

Soil Surveys

3.23. The SCS publishes county soil surveys for areas where soil mapping is completed. Soil surveys that meet standards of the National Cooperative Soil Survey (NCSS) are used to identify delineations of hydric soils. These soil surveys may be published (completed) or unpublished (on file at local SCS district offices). Published soil surveys of an area may be obtained from the local SCS district office or the Agricultural Extension Service office. Unpublished maps may be obtained from the local SCS district office.

3.24. The NCSS maps four kind of map units: (1) consociations, (2) complexes, (3) associations, and (4) undifferentiated groups. *Consociations* are soil map units named for a single kind of soil (taxon) or miscellaneous area. Seventy-five percent of the area is similar to the taxon for which the unit is named. When named by a hydric soil, the map unit is considered a hydric soil map unit for wetland determinations. However, small areas within these map units may not be hydric and should be excluded in delineating wetlands.

3.25. *Complexes and associations* are soil map units named by two or more kinds of soils (taxa) or miscellaneous areas. If all taxa for which these map units are named are hydric, the soil map unit may be considered a hydric soil map unit for wetland determinations. If only part of the map unit is made up of hydric soils, only those portions of the map unit that are hydric are considered in wetland determinations.

3.26. *Undifferentiated groups* are soil map units named by two or more kinds of soils or miscellaneous areas. These units are distinguished from the others in that "and" is used as a conjunction in the name, while dashes are used for complexes and associations. If all components are hydric, the map unit may be considered a hydric soil map unit. If one or more of the soils for which the unit is named are nonhydric, each area must be examined for the presence of hydric soils.

Use of the Hydric Soils List and Soil Surveys

3.27. The hydric soils list and county soil surveys may be used to help determine if the hydric soil criterion is met in a given area. When making a wetland determination, one should first locate the area of concern on a soil survey map and identify the soil map units for the area. The list of hydric soils should be consulted to determine whether the soil map units are hydric. If hydric soil map units are noted, then one should examine the soil in the field and compare its morphology with the corresponding hydric soil description in the soil survey report. If the soil's characteristics match those described for hydric soil, then the hydric soil criterion is met, unless the soil has been effectively drained (see disturbed areas section, p. 50). In the absence of site-specific information, hydric soils also may be recognized by field indicators.

Field Indicators

3.28. Several field indicators are available for determining whether a given soil meets the definition and criteria for hydric soils. Other factors to consider in recognizing hydric soils include obligate wetland plants, topography, observed or recorded inundation or soil saturation, and evidence of human alterations, e.g., drainage and filling. Any one of the following may indicate that hydric soils are present:

1) *Organic Soils* – Various peats and mucks are easily recognized as hydric soils. Organic soils that are cropped are often drained, yet the water table is closely managed to minimize oxidation of organic matter. These soils often retain their hydric soil characteristics and, if so, meet the wetland hydrology criterion.

2) *Histic epipedons* – A histic epipedon (organic surface layer) is an 8- to 16-inch organic layer at or near the surface of a hydric mineral soil that is saturated with water for 30 consecutive days or more in most years. It contains a minimum of 20 percent organic matter when no clay is present or a

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minimum of 30 percent organic matter when clay content is 60 percent or greater. Soils with histic epipedons are inundated or saturated for sufficient periods to greatly retard aerobic decomposition of organic matter, and are considered hydric soils. In general, a histic epipedon is a thin surface layer of peat or muck if the soil has not been plowed (U.S.D.A. Soil Survey Staff 1975). Histic epipedons are technically classified as Oa, Oe, or Oi surface layers, and in some cases the terms "mucky" or "peaty" are used as modifiers to the mineral soil texture term, e.g., mucky loam.

3) *Sulfidic material* – When soils emit an odor of rotten eggs, hydrogen sulfide is present. Such odors are only detected in waterlogged soils that are essentially permanently saturated and have sulfidic material within a few inches of the soil surface. Sulfides are produced only in reducing environment. Under saturated conditions, the sulfates in water are biologically reduced to sulfides as the organic materials accumulate.

4) *Aquic or peraquic moisture regime* – An *aquic* moisture regime is a reducing one, i.e., it is virtually free of dissolved oxygen, because the soil is saturated by ground water or by water of the capillary fringe (U.S.D.A. Soil Survey Staff 1975). The soil is considered saturated if water stands in an unlined borehole at a shallow enough depth that the capillary fringe reaches the soil surface, except in noncapillary pores. Because dissolved oxygen is removed from ground water by respiration of microorganisms, roots, and soil fauna, it is also implicit that the soil temperature be above biologic zero (41°F) at some time while the soil is saturated. Soils with *peraquic* moisture regimes are characterized by the presence of ground water always at or near the soil surface. Examples include soils of tidal marshes and soils of closed, landlocked depressions that are fed by permanent streams. Soils with peraquic moisture regimes are always hydric under natural conditions. Soils with aquic moisture regimes are usually hydric, but the NTCHS hydric soil criteria should be verified in the field.

5) *Direct observations of reducing soil conditions* – Soils saturated for long or very long duration will usually exhibit reducing conditions at the time of saturation. Under such conditions, ions of iron are transformed from a ferric (oxidized) state to a ferrous (reduced) state. This reduced condition can often be detected in the field by use of a colorimetric field test kit. When a soil extract changes to a pink color upon addition of a-a-dipyridil, ferrous iron is present, which indicates a reducing soil environment at the time of the test. A negative result (no pink color) only indicates that the soil is not reduced at this moment; it does not imply that the soil is not reduced during the growing season. Furthermore, the test is subject to error due to the rapid change of ferrous iron to ferric iron when the soil is exposed to air and should *only* be used by experienced technicians. (*CAUTION*: This test cannot be used in hydric mineral soils having low iron content or in organic soils. Also it does not determine the duration of reduced conditions.)

6) *Gleyed, low chroma, and low chroma/mottled soils* – The colors of various soil components are often the most diagnostic indicator of hydric soils. Colors of these components are strongly influenced by the frequency and duration of soil saturation which leads to reducing soil conditions. Hydric mineral soils will be either gleyed or will have low chroma matrix with or without bright mottles.

A) *Gleyed soils* – Gleying (bluish, greenish, or grayish colors) immediately below the A-horizon is an indication of a markedly reduced soil, and gleyed soils are hydric soils. Gleying can occur in both mottled and unmottled soils. Gleyed soil conditions can be determined by using the gley page of the "Munsell Soil Color Charts" (Kollmorgen Corporation 1975). (*CAUTION*: Gleyed conditions normally extend throughout saturated soils. Beware of soils with gray E-horizons due to leaching and not to saturation; these latter soils can often be recognized by bright-colored layers below the E-horizon.)

B) *Other low chroma soils and mottled soils (i.e., soils with low matrix chroma and with or without bright mottles)* – Hydric mineral soils that are saturated for substantial periods of the growing season, but are unsaturated for some time, commonly develop mottles. Soils that have brightly colored mottles and a low chroma matrix are indicative of a fluctuating water table. Hydric mineral soils usually have one of the following color features in the horizon immediately below the A-horizon:

(1) Matrix chroma of 2 or less in mottled soils, or
(2) Matrix chroma of 1 or less in unmottled soils.

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(*Note*: See p. 59 for mollisols exception.)

Colors should be determined in soils that are or have been moistened. The chroma requirements above are for soils in a moistened condition. Colors noted for dry (unmoistened) soils should be clearly stated as such. The colors of the topsoil are often not indicative of the hydrologic situation because cultivation and soil enrichment affect the original soil color. Hence, the soil colors below the A-horizon (usually below 10 inches) often must be examined.

(*CAUTION*: Beware of problematic hydric soils that have colors other than those described above; see problem area wetlands section, p. 55.)

7) *Iron and manganese concretions* – During the oxidation-reduction process, iron and manganese in suspension are sometimes segregated as oxides into concretions or soft masses. Concretions are local concentrations of chemical compounds (e.g., iron oxide) in the form of a grain or nodule of varying size, shape, hardness, and color (Buckman and Brady 1969). Manganese concretions are usually black or dark brown, while iron concretions are usually yellow, orange or reddish brown. In hydric soils, these concretions are also usually accompanied by soil colors described above.

8) *Coarse-textured or sandy hydric soils* – Many of the indicators listed above cannot be applied to sandy soils. *In particular, soil color should not be used as an indicator in most sandy soils* (see problem area wetlands section, p. 55). However, three soil features may be used as indicators of hydric sandy soils:

A) *High organic matter content in the surface horizon* – Organic matter tends to accumulate above or in the surface horizon of sandy soils that are inundated or saturated to the surface for a significant portion of the growing season. The mineral surface layer generally appears darker than the mineral material immediately below it due to organic matter interspersed among or adhering to sand particles. (*Note*: Because organic matter also accumulates on upland soils, in some instances it may be difficult to distinguish a surface organic layer associated with a wetland site from litter and duff associated with an upland site unless the species composition of the organic materials is determined.)

B) *Dark vertical streaking of subsurface horizons by organic matter* – Organic matter is moved downward through sand as the water table fluctuates. This often occurs more rapidly and to a greater degree in some vertical sections of a sandy soil containing high content of organic matter than in others. Thus, the sandy soil appears vertically streaked with darker areas. When soil from a darker area is rubbed between the fingers, the dark organic matter stains the fingers.

C) *Wet Spodosols* – As organic matter is moved downward through some sandy soils, it may accumulate at the point representing the most commonly occurring depth to the water table. This organic matter may become slightly cemented with aluminum. Spodic horizons often occur at depths of 12 to 30 inches below the mineral surface. Wet spodosols (formerly called "groundwater podzolic soils") usually have thick dark surface horizons that are high in organic matter with thick, dull gray E-horizons above a very dark-colored (black) spodic horizon. (*CAUTION*: Not all soils with spodic horizons meet the hydric soil criterion; see p. 58.)

(*Note*: In recently deposited sandy material, such as accreting sand bars, it may be impossible to find any of the above indicators. Such cases are considered natural, problem area wetlands and the determination of hydric soil should be based on knowledge of local hydrology. See p. 57-58).

Wetland Hydrology

3.29. The driving force creating wetlands is "wetland hydrology", that is, permanent or periodic inundation, or soil saturation for a significant period (usually a week or more) during the growing season. All wetlands are, therefore, at least periodically wet. Many wetlands are found along rivers, lakes, and estuaries where flooding is likely to occur, while other wetlands form in isolated depressions surrounded by upland where surface water collects. Still others develop on slopes of varying steepness, in surface water drainageways or where ground water discharges to the land surface in spring or seepage areas.

3.30. Numerous factors influence the wetness of an area, including precipitation, stratigraphy, topography, soil permeability, and plant cover. The

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frequency and duration of inundation or soil saturation are important in separating wetlands from nonwetlands. Duration usually is the more important factor. Areas of lower elevation in a floodplain or marsh have longer duration of inundation and saturation and often more frequent periods of these conditions than most areas at higher levels. Floodplain configuration may significantly affect the duration of inundation by facilitating rapid runoff or by causing poor drainage. Soil permeability related to the texture of the soil also influences the duration of inundation or soil saturation. For example, clayey soils absorb water more slowly than sandy or loamy soils, and therefore have slower permeability and remain saturated much longer. Type and amount of plant cover affect both degree of inundation and duration of saturated soil conditions. Excess water drains more slowly in areas of abundant plant cover, thereby increasing duration of inundation or soil saturation. On the other hand, transpiration rates are higher in areas of abundant plant cover, which may reduce the duration of soil saturation.

3.31. To determine whether the wetland hydrology criterion is met, one should consider recorded data, aerial photographs, and field indicators that provide direct or indirect evidence of inundation or soil saturation.

Recorded Data

3.32. Recorded hydrologic data usually provides both short- and long-term information on the frequency and duration of flooding, but little or no information on soil saturation periods. Recorded data include stream gauge data, lake gauge data, tidal gauge data, flood predictions, and historical flood records. Use of these data is commonly limited to areas adjacent to streams and other similar areas. Recorded data may be available from the following sources:

1) CE district offices (data for major waterbodies and for site-specific areas from planning and design documents)

2) U.S. Geological Survey (stream and tidal gauge data)

3) National Oceanic and Atmospheric Administration (tidal gauge data)

4) State, county and local agencies (flood data)

5) SCS state offices (small watershed projects data)

6) private developers or landowners (site-specific hydrologic data, which may include water table or groundwater well data).

Aerial Photographs

3.33. Aerial photographs may provide direct evidence of inundation or soil saturation in an area. Inundation (flooding or ponding) is best observed during the early spring in temperate and boreal regions when snow and ice are gone and leaves of deciduous trees and shrubs are not yet present. This allows detection of wet soil conditions that would be obscured by the tree or shrub canopy at full leaf-out. For marshes, this season of photography is also desirable, except in regions characterized by distinct dry and rainy seasons, such as southern Florida and California. Wetland hydrology would be best observed during the wet season in these latter areas.

3.34. It is most desirable to examine several consecutive years of early spring or wet season aerial photographs to document evidence of wetland inundation or soil saturation. In this way, the effects of abnormally dry springs, for example, may be minimized. In interpreting aerial photographs, it is important to know the antecedent weather conditions. This will help eliminate potential misinterpretations caused by abnormally wet or dry periods. Contact the U.S. Weather Service for historical weather records. Aerial photographs for agricultural regions of the country are often available at county offices of the Agricultural Stabilization and Conservation Service.

Field Indicators

3.35. At certain times of the year in most wetlands, and in certain types of wetlands at most times, wetland hydrology is quite evident, since surface water or saturated soils (e.g., soggy or wetter underfoot) may be observed. Yet in many instances, especially along the uppermost boundary of wetlands, hydrology is not readily apparent. Consequently, the wetland hydrology criterion is often impracticable for delineating precise wetland boundaries. Despite this limitation, hydrologic indicators can be useful for confirming that a site with hydrophytic vegetation and hydric soils still exhibits wetland hydrology and that the hydrology has not been significantly modified to the extent that the area is now effectively drained. In other words, while hydrologic indicators are sometimes diagnostic of the presence of wetlands, they are generally either operationally impracticable (e.g., in the case of recorded data) or technically inaccurate (e.g., in the case of some field indicators) for delineating wetland boundaries. In the former case, surveying the wetland boundary according to elevation data related to recorded flood data, for example, is generally too time-consuming and may not actually be a true correlation. In the latter case, it should be quite obvious that indicators of flooding often extend well beyond the wetland boundary into low-lying upland areas that were flooded by an infrequent flood. Consequently the emphasis on delineating wetland boundaries should be placed on hydrophytic vegetation and hydric soils in the absence of significant hydrologic modification, although wetland hydrology should always be considered.

3.36. If significant drainage or groundwater alteration has taken place, then it is necessary to determine whether the area in question is effectively drained and is now nonwetland or is only partly drained and remains wetland despite some hydrologic modification. Guidance for determining whether an area is effectively drained is presented in the section on disturbed areas (p. 50). In the absence of visible evidence of significant hydrologic modification, wetland hydrology is presumed to occur in an area having hydrophytic vegetation and hydric soils.

3.37. The following hydrologic indicators can be assessed quickly in the field. Although some are not necessarily indicative of hydrologic events during the growing season or in wetlands alone, they do provide evidence that inundation or soil saturation have occurred at some time. One should use good professional judgement in deciding whether the hydrologic indicators demonstrate that the wetland hydrology criterion has been satisfied. When considering these indicators, it is important to be aware of recent extreme flooding events and heavy rainfall periods that could cause low-lying nonwetlands to exhibit some of these signs. It is, therefore, best to avoid, if possible, field inspections during and immediately after these events. If not possible, then these events must be considered in making a wetland determination. Also, remember that hydrology varies seasonally and annually as well as daily, and that at significant times of the year (e.g., late summer for most of the country) the water tables are at their lowest points. At these low water periods, signs of soil saturation and flooding may be difficult to find in many wetlands.

1) *Visual observation of inundation* – The most obvious and revealing hydrologic indicator may be simply observing the areal extent of inundation. However, both seasonal conditions and recent weather conditions should be considered when observing an area because they can affect whether surface water is present on a nonwetland site.

2) *Visual observation of soil saturation* – In some cases, saturated soils are obvious, since the ground surface is soggy or mucky under foot. In many cases, however, examination of this indicator requires digging a hole to a depth of 18 inches and observing the level at which water stands in the hole after sufficient time has been allowed for water to drain into the hole. The required time will vary depending on soil texture. In some cases, the upper level at which water is flowing into the hole can be observed by examining the wall of the hole. This level represents the depth to the water table. The depth to saturated soils will always be nearer the surface due to a capillary fringe. In some heavy clay soils, water may not rapidly accumulate in the hole even when the soil is saturated. If water is observed at the bottom of the hole but has not filled to the 12-inch depth, examine the sides of the hole and determine the shallowest depth at which water is entering the hole. Saturated soils may also be detected by a "squeeze test," which involves taking a soil sample within 18 inches (actual depth depends on soil permeability) and squeezing the sample. If free water can be extracted, the soil is saturated at the depth of the sample at this point in time. When applying the soil saturation indicator, both the season of the year and the preceding weather conditions must be considered. (*Note*: It is not necessary to directly demonstrate soil saturation at the time of inspection. If the NTCHS criteria for hydric soil are met, it can be assumed that an area is saturated to the surface or inundated at some point in time during an average rainfall year.)

3) *Oxidized channels (rhizospheres) associated with living roots and rhizomes* – Some plants are

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PB89-128680

NATIONAL LIST OF PLANT SPECIES THAT OCCUR IN WETLANDS: NORTHEAST (REGION 1)

U.S. FISH AND WILDLIFE SERVICE
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indicates a frequency toward the lower end of the category (less frequently found in wetlands).

Indicator Categories

Obligate Wetland (OBL). Occur almost always (estimated probability >99%) under natural conditions in wetlands.

Facultative Wetland (FACW). Usually occur in wetlands (estimated probability 67%-99%), but occasionally found in nonwetlands.

Facultative (FAC). Equally likely to occur in wetlands or nonwetlands (estimated probability 34%-66%).

Facultative Upland (FACU). Usually occur in nonwetlands (estimated probability 67%-99%), but occasionally found in wetlands (estimated probability 1%-33%).

Obligate Upland (UPL). Occur in wetlands in another region, but occur almost always (estimated probability >99%) under natural conditions in nonwetlands in the region specified. If a species does not occur in wetlands in any region, it is not on the *National List*.

The wetland indicator categories should not be equated to degrees of wetness. Many obligate wetland species occur in permanently or semipermanently flooded wetlands, but a number of obligates also occur and some are restricted to wetlands which are only temporarily or seasonally flooded. The facultative upland species include a diverse collection of plants which range from weedy species adapted to exist in a number of environmentally stressful or disturbed sites (including wetlands) to species in which a portion of the gene pool (an ecotype) always occurs in wetlands. Both the weedy and ecotype representatives of the facultative upland category occur in seasonally and semipermanently flooded wetlands.

R_IND (Regional Indicator)

The estimated probability (likelihood) of a species occurring in wetlands versus nonwetlands in the region. Regional Indicators reflect the unanimous agreement of the Regional Interagency Review Panel. If a regional panel was not able to reach a unanimous decision on a species, NA (no agreement) was recorded in the regional indicator (R_IND) field. An NI (no indicator) was recorded for those species for which insufficient information was available to determine an indicator status. A nonoccurrence (NO) designation indicates that the species does not occur in that region. An asterisk (*) following a regional indicator identifies tentative assignments based on limited information from which to determine the indicator status. In the listings for the States divided into two regions (Montana, Wyoming, and Colorado), both regional indicators are reported.

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NATIONAL LIST OF PLANT SPECIES THAT OCCUR IN WETLANDS: 1988--NORTHEAST (REGION 1)

SCI-NAME	AUTHOR	COMMON-NAME	R1IND	NAT-IND	HABIT
PASPALUM PRAECOX	WALTER	PASPALUM,EARLY	FACW+	FACW,OBL	PNG
PASPALUM PUBIFLORUM	RUPR. EX FOURN.	PASPALUM,HAIRY-SEED	FAC	FAC,FACW	PNG
PASPALUM REPENS	BERGIUS	PASPALUM,WATER	OBL	OBL	G
PASPALUM SETACEUM	MICHX.	PASPALUM,THIN	FACU+	UPL,FAC	PNG
PASPALUM URVILLEI	STEUD.	GRASS,VASEY	FAC	FAC	PIG
PASPALUM VAGINATUM	SWARTZ	PASPALUM,SEASHORE	NI	FACW,OBL	PNG
PEDICULARIS CANADENSIS	L.	LOUSEWORT,EARLY WOOD	FACU	FACU,FAC+	PNF
PEDICULARIS FURBISHIAE	S. WATS.	LOUSEWORT,FURBISH	FACW+	FACW+	PNF
PEDICULARIS LANCEOLATA	MICHX.	LOUSEWORT,SWAMP	FACW	FACW,OBL	PNF
PELTANDRA LUTEOSPADIX	FERNALD	ARUM,GREEN ARROW	OBL	OBL	PNEF
PELTANDRA VIRGINICA	(L.) KUNTH	ARUM,ARROW	OBL	OBL	PNEF
PENSTEMON ALLUVIORUM	PENNELL	BEARDTONGUE,LOWLAND	FACW	FACW,FACW+	PNF
PENSTEMON DIGITALIS	NUTT.	BEARDTONGUE,FOXGLOVE	FAC	FAC-,FACW-	PNF
PENSTEMON LAEVIGATUS	SOLAND.	BEARDTONGUE,SMOOTH	FACU	FACU,FAC	PNF
PENSTEMON PALLIDUS	SMALL	BEARDTONGUE,PALE	FACU	UPL,FACU	PNF
PENTHORUM SEDOIDES	L.	DITCH-STONECROP	OBL	OBL	PNF
PERILLA FRUTESCENS	(L.) BRITTON	PLANT,BEEF-STEAK	FACU+	FACU+,FAC+	AIF
PERSEA BORBONIA	(L.) SPRENG.	BAY,RED	FACW	FACW	NT
PETASITES FRIGIDUS	(L.) FR.	COLTSFOOT,ARCTIC SWEET	FACW	FAC,FACW	PNF
PETASITES PALMATUS	(AIT.) GRAY	COLTSFOOT,SWEET	FACW	FAC,FACW+	PNF
PETUNIA PARVIFLORA	JUSS.	PETUNIA,SEASIDE	FACW	FAC,FACW	ANF
PHACELIA RANUNCULACEA	(NUTT.) CONSTANCE	SCORPION-WEED,BLUE	FACW	FACW	ANF
PHACELIA VISCIDA	(BENTH. EX LINDL.) TORR.	SCORPION-WEED,STICKY	NI	UPL	ANF
PHALARIS ARUNDINACEA	L.	GRASS,REED CANARY	FACW+	FACW,OBL	PNG
PHALARIS CANARIENSIS	L.	GRASS,COMMON CANARY	FACU	UPL,FACU+	AIG
PHALARIS CAROLINIANA	WALTER	GRASS,CAROLINA CANARY	FACW	FACW	ANG
PHLEUM ALPINUM	L.	TIMOTHY,ALPINE	FACW	FACU,FACW	PNG
PHLEUM PRATENSE	L.	TIMOTHY	FACU	FACU	PIG
PHLOX CAROLINA	L.	PHLOX,THICK-LEAF	FACU	FACU,FACW	PNF
PHLOX DIVARICATA	L.	PHLOX,WOODLAND	FACU	UPL,FACU	PNF
PHLOX GLABERRIMA	L.	PHLOX,SMOOTH	FAC	FAC,FACW	PNF
PHLOX MACULATA	L.	PHLOX,MEADOW	FACW	FAC,FACW+	PNF
PHLOX PANICULATA	L.	PHLOX,FALL	FACU	FACU	PNF
PHLOX PILOSA	L.	PHLOX,DOWNY	FACU	FACU,FAC	PNF
PHRAGMITES AUSTRALIS	(CAV.) TRIN. EX STEUD.	REED,COMMON	FACW	FACW,FACW+	PNEG
PHYLA LANCEOLATA	(MICHX.) GREENE	FROG-FRUIT,LANCE-LEAF	OBL	FACW,OBL	PNF
PHYLA NODIFLORA	(L.) GREENE	FROG-FRUIT,COMMON	FACW	FACW,OBL	PNF
PHYLLANTHUS CAROLINIENSIS	WALTER	LEAF-FLOWER,CAROLINA	FAC+	FAC,FAC+	ANF
PHYSALIS ANGULATA	L.	GROUND-CHERRY,CUT-LEAF	FAC	FACU,FAC	ANF
PHYSALIS PUBESCENS	L.	GROUND-CHERRY,LOW HAIRY	FACU-	UPL,FAC	ANF
PHYSOCARPUS OPULIFOLIUS	(L.) MAXIM.	NINEBARK,EASTERN	FACW-	UPL,FACW-	NS
PHYSOSTEGIA INTERMEDIA	(NUTT.) ENGELM. & GRAY	DRAGON-HEAD,SLENDER	FACW-	FACW-,OBL	PNF
PHYSOSTEGIA LEPTOPHYLLA	SMALL	DRAGON-HEAD,SLENDER-LEAF	OBL	OBL	PNF
PHYSOSTEGIA PURPUREA	(WALTER) BLAKE	DRAGON-HEAD,PURPLE	FACW	FACW	PNF
PHYSOSTEGIA VIRGINIANA	(L.) BENTH.	DRAGON-HEAD,FALSE	FAC+	FAC+,OBL	PNF
PHYTOLACCA AMERICANA	L.	POKEWEED,COMMON	FACU+	FACU+,FAC	PNF
PICEA GLAUCA	(MOENCH) VOSS	SPRUCE,WHITE	FACU	FACU	NT
PICEA MARIANA	(MILL.) B.S.P.	SPRUCE,BLACK	FACW-	FACW-,FACW	NT
PICEA RUBENS	SARG.	SPRUCE,RED	FACU	FACU	NT
PILEA FONTANA	(LUNELL) RYDB.	CLEARWEED,SPRINGS	FACW+	FACW,OBL	ANF
PILEA PUMILA	(L.) GRAY	CLEARWEED,CANADA	FACW	FAC,FACW	ANF
PINGUICULA VULGARIS	L.	BUTTERWORT,COMMON	OBL	OBL	PNF

PASPALUM PRAECOX

PINGUICULA VULGARIS

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REFERENCE NUMBER 13

Surface Water Quality Standards

N.J.A.C. 7:9B

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION AND ENERGY

Office of Land and Water Planning
April 1994

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(f) A reclassification for more restrictive uses may be made when:

1. It is demonstrated to the satisfaction of the Department that the waters should be set aside to represent the natural aquatic environment and its associated biota: or

2. It is demonstrated to the satisfaction of the Department that a more restrictive use is necessary to protect a unique ecological system or threatened/endangered species.

(g) In those cases in which a thermal discharge is involved, the procedures for reclassifying segments for more restrictive uses shall be consistent with section 316 of the Federal Clean Water Act.

7:9B-1.12 Designated uses of FW1, PL, FW2, SE1, SE2, SE3, and SC waters

(a) In all FW1 waters the designated uses are:

1. Set aside for posterity to represent the natural aquatic environment and its associated biota;

2. Primary and secondary contact recreation;

3. Maintenance, migration and propagation of the natural and established aquatic biota; and

4. Any other reasonable uses.

(b) In all PL waters the designated uses are:

1. Cranberry bog water supply and other agricultural uses:

2. Maintenance, migration and propagation of the natural and established biota indigenous to this unique ecological system;

3. Public potable water supply after such treatment as required by law or regulations;

4. Primary and secondary contact recreation; and

5. Any other reasonable uses.

(c) In all FW2 waters the designated uses are:

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1. Maintenance, migration and propagation of the natural and established biota;
2. Primary and secondary contact recreation;
3. Industrial and agricultural water supply;
4. Public potable water supply after such treatment as required by law or regulation; and
5. Any other reasonable uses.

(d) In all SE1 waters the designated uses are:

1. Shellfish harvesting in accordance with N.J.A.C. 7:12;
2. Maintenance, migration and propagation of the natural and established biota;
3. Primary and secondary contact recreation; and
4. Any other reasonable uses.

(e) In all SE2 waters the designated uses are:

1. Maintenance, migration and propagation of the natural and established biota;
2. Migration of diadromous fish;
3. Maintenance of wildlife;
4. Secondary contact recreation; and
5. Any other reasonable uses.

(f) In all SE3 waters the designated uses are:

1. Secondary contact recreation;
2. Maintenance and migration of fish populations;
3. Migration of diadromous fish;
4. Maintenance of wildlife; and

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5. Any other reasonable uses.

g) In all SC waters the designated uses are:

1. Shellfish harvesting in accordance with N.J.A.C. 7:12;
2. Primary and secondary contact recreation;
3. Maintenance, migration and propagation of the natural and established biota; and
4. Any other reasonable uses.

7:9B-1.13 Designated uses of mainstem Delaware River and Delaware Bay as set forth in the "Delaware River Basin Commission, dministrative Manual - Part III Water Quality Regulations," rticle 3, dated May 22, 1991 including all amendments and future supplements thereto.

(a) The designated uses for the mainstem Delaware River and Delaware Bay are those contained in "Delaware River Basin Commission, Water Quality Regulations, Administrative Manual - Part III," Article 3, dated May 22, 1991, including all amendments and future supplements thereto.

(b) The designated uses for other waters under the jurisdiction of the DRBC are as set forth at N.J.A.C. 7:9B-1.15(d).

7:9B-1.14 Surface water quality criteria

(a) Surface water quality criteria for FW1 waters shall be maintained as to quality in their natural state.

(b) Surface water quality criteria for PL waters are as follows:

1. These waters shall be maintained as to quality in their existing state or that quality necessary to attain or protect the designated uses, whichever is more stringent.
    - i. For Nitrate-Nitrogen a level of 2 mg/l shall be maintained in the surface waters unless it is shown that a lower level must be maintained to protect the existing surface water quality.
    - ii. A pH level between 3.5 and 5.5 shall be maintained unless it is demonstrated that a pH level outside of that range is necessary to protect the existing/ designated uses.

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7:9B-1.15 Surface water classifications for the waters of the State of New Jersey

(a) This section contains the surface water classifications for the waters of the State of New Jersey. Surface water classifications are presented in tabular form. Subsections (c) through (g) contain surface water classifications by major drainage basin. Subsection (h) lists FW1 waters by tract within basins and subsection (i) identifies the Outstanding National Resource Waters of the State.

(b) The following are instructions for the use of Tables 1 through 5 found in N.J.A.C. 7:9B-1.15(c) through (g) respectively:

1. The surface water classification tables give the surface water classifications for waters of the State. Surface waters of the State and their classification are listed in the table covering the major drainage basin in which they are located. The major drainage basins are:
   - i. The Atlantic Coastal drainage basin which contains the surface waters listed in Table 1 in (c) below;
   - ii. The Delaware River drainage basin which contains the surface waters listed in Table 2 in (d) below;
   - iii. The Passaic River, Hudson River and New York Harbor Complex drainage basin which contains the surface waters listed in Table 3 in (e) below;
   - iv. The Raritan River and Raritan Bay drainage basin which contains the surface waters listed in Table 4 in (f) below; and
   - v. The Wallkill River drainage basin which contains the surface waters listed in Table 5 in (g) below.

2. Within each basin the waters are listed alphabetically and segment descriptions begin at the headwaters and proceed downstream.

3. To find a stream:
   - i. Determine which major drainage basin the stream is in;
   - ii. Look for the name of the stream in the appropriate Table and find the classification;
   - iii. For unnamed or unlisted streams, find the stream or other waterbody that the stream of interest flows into and look for the classification of that stream or waterbody. The classification of the stream of interest may then be determined by referring to (b)5 below. If the second stream or waterbody is also unlisted, repeat the process until a listed stream or waterbody is found. Use (b)5iv below to classify streams entering unlisted lakes.

4. To find a lake or other non-stream waterbody:
   - i. Determine which major drainage basin the waterbody is in;
   - ii. Look for the waterbody name in the appropriate Table;
   - iii. If the waterbody is not listed, use (b)5ii, 5iii, 5vi, and 5vii below to determine the appropriate classification.

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5. To find unnamed waterways or waterbodies or named waterways or waterbodies which do not appear in the listing, use the following instructions:
   i. Unnamed or unlisted freshwater streams that flow into streams classified as FW2-TP, FW2-TM, or FW2-NT take the classification of the classified stream they enter, unless the unlisted stream is a PL water which is covered in (b)5vii below. If the stream could be a C1 water, see (b)5vi below.
   ii. All freshwater lakes, ponds and reservoirs that are five or more acres in surface area, that are not located entirely within the Pinelands Area boundaries (see (b)5vii below) and that are not specifically listed as FW2-TP or FW2-TM are classified as FW2-NT. This includes lakes, ponds and reservoirs on segments of streams which are classified as FW2-TM or FW2-TP such as Saxton Lake on the Musconetcong River. If the waterbody could be a C1 water, also check (b)5vi below.
   iii. All freshwater lakes, ponds and reservoirs, that are less than five acres in surface area, upstream of and contiguous with FW2-TP or FW2-TM streams, and which are not located entirely within the Pinelands Area boundaries (see(b)5vii below) are classified as FW2-TM. All other freshwater lakes, ponds and reservoirs that are not otherwise classified in this subsection or the following Tables are classified as FW2-NT. If the waterbody could be a C1 water, also check (b)5vi below.
   iv. Unnamed or unlisted streams that enter FW2 lakes, ponds and reservoirs take the classification of either the listed tributary stream flowing into the lake with the highest classification or the listed tributary stream leaving the lake with the highest classification, whichever has the highest classification, or, if there are no listed tributary or outlet streams to the lake, the first listed stream downstream of the lake. If the stream is located within the boundaries of the Pinelands Area, see (b)5.vii. below; if it could be a C1 water, also see (b)5vi below.
   v. Unnamed or unlisted saline waterways and waterbodies are classified as SE1 in the Atlantic Coastal Basin. Unnamed or unlisted saline waterways which enter SE2 or SE3 waters in the Passaic, Hackensack and New York Harbor Complex basin are classified as SE2 unless otherwise classified within Table 3 in (e) below. Freshwater portions of unnamed or unlisted streams entering SE1, SE2, or SE3 waters are classified as FW2-NT. This only applies to waters that are not PL waters (see (b)5vii below). If the waterbody or waterway could be a C1 water, also see (b)5vi below.
   vi. If the waterway or waterbody of interest flows through or is entirely located within State parks, forests or fish and game lands, Federal wildlife refuges, other special holdings, or is a State shellfish water as defined in this subchapter, the Department's maps should be checked to determine if the waterbody of interest is mapped as a C1 water. If the waterway or waterbody does not appear on the United States Geological Survey quadrangle that the Department used as a base map in its designation of the

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C1 waters, the Department will determine on a case-by-case basis whether the waterway or waterbody should be designated as C1.

vii. All waterways or waterbodies, or portions of waterways or waterbodies, that are located within the boundaries of the Pinelands Area established at N.J.S.A. 13:18A-11a are classified as PL unless they are listed as FW1 waters in Table 6 in (h) below. A tributary entering a PL stream is classified as PL only for those portions of the tributary that are within the Pinelands Area. Lakes are classified as PL only if they are located entirely within the Pinelands Area.

6. The following 10 classifications are used for the sole purpose of identifying the water quality classification of the waters listed in the Tables in (c) through (h) below:
    - i. "FW1" means freshwaters wholly within Federal or State lands or special holdings that are preserved for posterity and are not subject to manmade wastewater discharges.
    - ii. "FW2-TP" means FW2 Trout Production.
    - iii. "FW2-TM" means FW2 Trout Maintenance.
    - iv. "FW2-NT" means FW2 Non Trout.
    - v. "PL" means Pinelands Waters.
    - vi. "SE1" means saline estuarine waters whose designated uses are listed in N.J.A.C. 7:9B-1.12(d).
    - vii. "SE2" means saline estuarine waters whose designated uses are listed in N.J.A.C. 7:9B-1.12(e).
    - viii. "SE3" means saline estuarine waters whose designated uses are listed in N.J.A.C. 7:9B-1.12(f).
    - ix. "SC" means the general surface water classification applied to saline coastal waters.
    - x. FW2-NT/SE1 (or a similar designation that combines two classifications) means a waterway in which there may be a salt water/fresh water interface. The exact point of demarcation between the fresh and saline waters must be determined by salinity measurements and is that point where the salinity reaches 3.5 parts per thousand at mean high tide. The stream is classified as FW2-NT in the fresh portions (salinity less than or equal to 3.5 parts per thousand at mean high tide) and SE1 in the saline portions.

7. The following water quality designations are used in Tables 1 through 5 in (c) through (g), respectively, below:
    - i. "(C1)" means Category 1 waters;
    - ii. "(tp)" indicates trout production in waters which are classified as FW1. This is for information only and does not affect the water quality criteria for those waters;
    - iii. "(tm)" indicates trout maintenance in waters which are classified as PL or FW1. For FW1 waters this is for information only and does not affect the water quality criteria for those waters.

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(e) The surface water classifications in Table 3 are for waters of the Passaic, Hackensack and New York Harbor Complex Basin:

TABLE 3

Waterbody	Classification
APSHAWA BROOK (Macopin) - Entire length	FW2-TP(C1)
ARTHUR KILL	
(Perth Amboy) - The Kill and its saline New Jersey tributaries between the Outerbridge Crossing and a line connecting Ferry Pt., Perth Amboy to Wards Pt., Staten Island, New York	SE2
(Elizabeth) - From an east-west line connecting Elizabethport with Bergen Pt., Bayonne to the Outerbridge Crossing	SE3
(Woodbridge) - All freshwater tributaries	FW2-NT
BEAR SWAMP BROOK (Mahwah) - Entire length	FW2-TP(C1)
BEAR SWAMP LAKE (Ringwood State Park)	FW2-NT(C1)
BEAVER BROOK	
(Meriden) - From Splitrock Reservoir Dam downstream to Meriden Road Bridge	FW2-TP(C1)
(Denville) - Meriden Road Bridge to Rockaway River	FW2-NT
TRIBUTARIES	
(Meriden) - Two tributaries located approximately three quarters of a mile southwest of Meriden	FW2-TP(C1)
BEECH BROOK	
(West Milford) - From State line downstream to Monksville Reservoir	FW2-TM
BELCHER CREEK (W. Milford) - Entire length	FW2-NT
BERRYS CREEK (Secaucus) - Entire length	FW2-NT/SE2
BLACK BROOK	
(Meyersville) - Entire length, except segment described below	FW2-NT
(Great Swamp) - Segment and tributaries within the Great Swamp National Wildlife Refuge	FW2-NT(C1)
BLUE MINE BROOK	
(Wanaque) - Entire length, except segment described below	FW2-TM
(Norvin Green State Forest) - That portion of the stream and any tributaries within the Norvin Green State Forest	FW2-TM(C1)
BRUSHWOOD POND (Ringwood State Park)	FW2-TM(C1)

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Channel Marker Flashing Red 2 and terminating on the eastern shoreline of the Galilee section of Monmouth Beach.	
NESHANIC RIVER (Reaville) - Entire length	FW2-NT
NORTON BROOK (Norton) - Entire length	FW2-TP(C1)
OAKDALE CREEK (Chester) - Entire length	FW2-TP(C1)
OAKEYS BROOK (Deans) - Entire length	FW2-NT
OCEANPORT CREEK	
(Fort Monmouth) - Source to a line beginning on the easternmost extent of Horseneck Point and bearing approximately 140 degrees T (True North) to its terminus on the westernmost extent of an unnamed extent of Monmouth Boulevard in Oceanport	FW2-NT/SE1
(Oceanport) - Creek downstream of line described above	SE1(C1)
PARKERS CREEK	
(Fort Monmouth) - Source to a line beginning on the easternmost extent of Horseneck Point and bearing approximately 000 degrees T (True North) to its terminus on Breezy Point on the Little Silver side (north) side of the creek	FW2-NT/SE1
(Fort Monmouth) - Creek downstream of line described above	SE1(C1)
PEAPACK BROOK (Gladstone) - Entire length	FW2-TP(C1)
PETERS BROOK (Somerville) - Entire length	FW2-NT
PIGEON SWAMP (Pigeon Swamp State Park) - All waters within the boundaries of Pigeon Swamp State Park	FW2-NT(C1)
PIKE RUN (Belle Meade) - Entire length	FW2-NT
PINE BROOK (Clarks Mills) - Entire length	FW2-NT
PINE BROOK (Cooks Mill) - Entire length	FW2-TM
PLEASANT RUN (Readington) - Entire length	FW2-NT
PRESCOTT BROOK (Stanton Station) - Entire length	FW2-TM
RAMANESSIN (HOP) BROOK (Holmdel) - Entire length	FW2-TM
RARITAN BAY - Entire drainage	FW2-NT/SE1
RARITAN RIVER	
NORTH BRANCH (Also see INDIA BROOK)	
(Pleasant Valley) - Source to, but not including, Ravine Lake	FW2-TP(C1)
(Far Hills) - Ravine Lake dam to Rt. 512 bridge	FW2-TM
(Bedminister) - Rt. 512 bridge to confluence with South Branch, Raritan River	FW2-NT
SOUTH BRANCH RARITAN RIVER	
(Mt. Olive) - Source to the dam that is 390 feet	FW2-NT(C1)

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upstream of the Flanders-Drakestown Road bridge and the two tributaries which originate north and east of the Budd Lake Airfield	
(Mt. Olive) - Dam to confluence with Turkey Brook	FW2-TM(C1)
(Naughright) - Confluence with Turkey Brook to confluence with Electric Brook	FW2-TP(C1)
(Clinton) - Confluence with Electric Brook to downstream end of Packers Island, except segment described separately, below	FW2-TM
(Ken Lockwood Gorge) - River and tributaries within Ken Lockwood Gorge Wildlife Management Area	FW2-TM(C1)
(Neshanic Sta.) - Downstream end of Packers Island to confluence with North Branch, Raritan River	FW2-NT
MAIN STEM RARITAN RIVER	
(Bound Brook) - From confluence of North and South Branches to Landing Lane bridge in New Brunswick and all freshwater tributaries downstream of Landing Lane bridge.	FW2-NT
(Sayreville) - Landing Lane bridge to Raritan Bay and all saline water tributaries	SE1
RINEHART BROOK (Hacklebarney) - Entire length	FW2-TP(C1)
ROCK BROOK (Montgomery) - Entire length	FW2-NT
ROCKAWAY CREEK	
NORTH BRANCH	
(Mountainville) - Source to Rt. 523 bridge	FW2-TP(C1)
(Whitehouse) - Rt. 523 bridge to confluence with South Branch	FW2-TM
SOUTH BRANCH (Whitehouse) - Entire length	FW2-TM
MAIN STEM (Whitehouse) - Confluence of North and South Branches to Lamington River	FW2-NT
ROCKY RUN - (Lebanon) - Entire length	FW2-TP(C1)
ROUND VALLEY RESERVOIR (Clinton)	FW2-TP
ROYCE BROOK (Manville) - Entire length	FW2-NT
SHREWSBURY RIVER	
(Little Silver) - Source to Rt. 36 highway bridge	SE1(C1)
(Highlands) - Rt. 36 bridge to Sandy Hook Bay	SE1
SIMONSON BROOK (Griggstown) - Entire length	FW2-NT
SIX MILE RUN	
(Franklin Church) - Entire length, except segment described below	FW2-NT
(Hillsborough) - Segment within the boundaries of Six Mile Run State Park	FW2-NT(C1)

REFERENCE NUMBER 14

Revised 03-Mar-94

SURFACE WATER INTAKES
BUREAU OF SAFE DRINKING WATER
NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION AND ENERGY

SOURCE WATERS	PWSID#	PURVEYOR NAME	PHONE NUMBERS	PURVEYOR MAILING ADDRESS
DOUGHTY POND ATLANTIC CITY RES.	0102001	ATLANTIC CITY MUA	609-345-3315	401 North Virginia Ave. Atlantic City, N.J. 08404
HACKENSACK R.upstream ORADELL RESERVOIR WANAQUE RESERVOIR MONKSVILLE RESERVOIR PASSAIC RIVER SADDLE RIVER RAMAPO RIVER GREENWOOD LAKE	0238001	HACKENSACK WATER COMPANY	201-767-9300	200 Old Hook Road Harrington Park, N.J. 07640
LAKE TAMARACK	0242300	CAMP TAMARACK	201-337-8316	P.O.BOX 4237 RIVER EDGE,N.J.07661
DELAWARE RIVER TIDAL PORTION	0305001	BURLINGTON CITY WATER DEPARTMENT	609-386-0307	P.O. Box 43 Burlington, N.J. 08016
N.BR.RANCOCAS CREEK	0325001	FORT DIX WATER SYSTEM	609-562-5040	D E W Fort Dix, N.J. 08640
DELAWARE RIVER TIDAL PORTION	0408002	N.J.AMERICAN WATER DELAWARE VALLEY SYSTEM	609-547-1700	515 GROVE ST. HADDON HEIGHTS, NJ ATTN. MANAGER
RAHWAY RIVER	0717001	CITY OF ORANGE WATER DEPARTMENT	201-762-7000	29 NORTH DAY STREET Orange, N.J. 07050
PASSAIC RIVER CANOE BROOK RES.	0712001	N.J.AMERICAN WATER NORTHERN DIVISION	201-376-8800	233 Canoe Brook Road Short Hills, N.J. 07078

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SURFACE WATER INTAKES
BUREAU OF SAFE DRINKING WATER
NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION AND ENERGY

SOURCE WATERS	PWSID#	PURVEYOR NAME	PHONE NUMBERS	PURVEYOR MAILING ADDRESS
PEQUANNOCK RIVER CHARLOTTEBURG RES. CLINTON RES. OAK RIDGE RES. CANNONSVILLE RES.	0714001	NEWARK WATER DEPT	201-256-4965	1294 McBride Avenue Little Falls, N.J. 07424
ROCKAWAY RIVER BOONTON RESERVOIR SPLIT ROCK RES.	0906001	JERSEY CITY WATER DEPARTMENT	201-547-4390	60 Collard Street Jersey City, N.J. 07305
	1003001	BLOOMSBURY W.D.	201-782-4200	P.O. BOX 98 BLOOMSBURY, N.J. 08804
RARITAN R.,SO. BRANCH	1009001	FLEMINGTON W.D.	201-782-9840	38 Park Avenue Flemington, N.J. 08822
	1014001	HIGH BRIDGE W.D.	201-638-4209	26 West Main Street High Bridge, N.J. 08829
SWAN CREEK RESERVOIR DEL.& RAR. CANAL DELAWARE RIVER ABOVE BULLS ISLAND	1017001	LAMBERTVILLE WATER COMPANY	609-397-0576	26 Coryell St.,P.O. Box 126 Lambertville, N.J. 08530
DELAWARE RIVER ABOVE TIDAL INFLUENCE	1111001	CITY OF TRENTON WATER WORKS	609-989-3640	Box 528 Trenton, N.J. 08604
TENNENTS BROOK TENNENTS POND	1216001	PERTH AMBOY WATER UTILITY	908-826-0290	260 High Street Perth Amboy, N.J. 08861
DEL.& RAR.CANAL FROM DELAWARE RIVER ABOVE BULLS ISLAND	1225001	MIDDLESEX WATER CO	908-634-1500	P.O. Box 1500, Iselin, N.J. 08830
	1225001	MIDDLESEX WATER CO.	908-634-1500	

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SURFACE WATER INTAKES
BUREAU OF SAFE DRINKING WATER
NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION AND ENERGY

SOURCE WATERS	PWSID#	PURVEYOR NAME	PHONE NUMBERS	PURVEYOR MAILING ADDRESS
LAWRENCE BROOK FARRINGTON LAKE	1214001	NEW BRUNSWICK WATER DEPARTMENT	908-745-5060	P.O. Box 546 78 Bayard Street New Brunswick, N.J. 08903
DEL.&RAR.CANAL FROM DELAWARE RIVER ABOVE BULLS ISLAND	1214001	NEW BRUNSWICK WATER DEPARTMENT		
SPRUCE RUN SOUTH BR. RARITAN R.	1352005	NEW JERSEY WATER SUPPLY AUTHORITY	908-638-6121	P.O. Box 5196, Route 31 Clinton, N.J. 08809
ROUND VALLEY RES. SOUTH BR. RARITAN R.	1352005	NEW JERSEY WATER SUPPLY AUTHORITY	908-638-6121	P.O.Box 5196, Route 31 Clinton, N.J. 08809
INDIA BROOK N.BR.RARITAN R.		BORO OF MENDHAM WATER DEPT.	201-543-7152	
DEL.&RAR.CANAL FROM DELAWARE RIVER ABOVE BULLS ISLAND	1215001	NORTH BRUNSWICK WATER DEPARTMENT	908-247-0922	711 Hermann, RD Box 182 North Brunswick, N.J. 08902
SOUTH RIVER DUHERNAL LAKE	1219001	SAYREVILLE WATER DEPARTMENT	908-390-7000	167 Main Street Sayreville, N.J. 08872
MANASQUAN RIVER MANASQUAN RESERVOIR	1352005	NEW JERSEY WATER SUPPLY AUTH.	908-638-6121	P.O.Box 5196, Rt.31 Clinton, N. J.
SWIMMING RIVER/RES. MANASQUAN RIVER JUMPING BROOK/RES. SHARK RIVER GLENDOLA RES.	1345001	NJ AMERICAN WATER - EASTERN DIVISION	908-642-6900	661 Shrewsbury Avenue Shrewsbury, N.J. 07701

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SURFACE WATER INTAKES
BUREAU OF SAFE DRINKING WATER
NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION AND ENERGY

SOURCE WATERS	PWSID#	PURVEYOR NAME	PHONE NUMBERS	PURVEYOR MAILING ADDRESS
MANASQUAN RIVER	1319002	HOWELL TWP. DEPT. S & W		Municipal Bldg., P.O. Box580 Howell Twp., N.J. 07731-0580
MATCHAPONIX CREEK	1328004	MATCHAPONIX WATER SUPPLY CO.	908-478-4108	P.O. Box 249 Mullica Hill, N.J. 08062
TAYLORTOWN RES. ROCKAWAY RIVER	1401001	TOWN OF BOONTON WATER UTILITY	201-299-7740	100 Washington Street Boonton, N.J. 07005
KIKEOUT RES. PEQUANNOCK RIVER	1403001	BUTLER WATER DEPT	201-838-7200	One Acre Road Butler, N.J. 07405
LAKE WINONA	1414011	JEFFERSON TWP MUA	201-697-1500	Municipal Bldg., Weldon Rd. Lake Hopatcong, N.J. 07849
LAKE SHAWNEE	1414011	JEFFERSON TWP MUA		
CLYDE POTTS RES. WHIPPANY RIVER	1424001	SOUTHEAST MORRIS COUNTY MUA	201-538-5600	101 Western Avenue Morristown, N.J. 07960
METEDECONK R.	1506001	BRICK TWP MUA	908-458-7000	1551 Route 88 West Bricktown, N.J. 08723
MOLLY ANN'S BK. RES. LOWER PASSAIC R.TRIB	1603001	HALEDON WATER DEPT	201-427-0096	407 North Belmont Avenue North Haledon, N.J. 07508
PASSAIC RIVER POMPTON RIVER	1605002	PASSAIC VALLEY WATER COMMISSION	201-256-1566	P.O. Box 198 Little Falls, N.J. 07424
WANAQUE RIVER WANAQUE RES. MONKSVILLE RES. PASSAIC RIVER POMPTON RIVER	1613001	NORTH JERSEY DISTRICT WATER SUPPLY COMMISSION	201-575-0225	741 Ringwood Avenue Wanaque, N.J. 07465

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SURFACE WATER INTAKES
BUREAU OF SAFE DRINKING WATER
NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION AND ENERGY

SOURCE WATERS	PWSID#	PURVEYOR NAME	PHONE NUMBERS	PURVEYOR MAILING ADDRESS
SALEM CANAL	1708300	E.I. DUPONT DEMOURS	609-299-5000 609-540-2900	Route 130 Gibbstown, N.J.
LAUREL LAKE	1712001	SALEM WATER DEPT	609-935-0350	520 Grieves Parkway Salem, N.J. 08079
ELKINGTON MILL PD. ALLOWAYS CREEK	1712001	SALEM WATER DEPT		
PAULINSKILL TRIB.	1903001	BRANCHVILLE WATER DEPARTMENT	201-948-9919	P.O. Box 840 Branchville, N.J. 07826
WALLKILL RIVER FRANKLIN POND	1906002	FRANKLIN WATER COMM.		46 Main Street Franklin, N.J. 07416
MORRIS LAKE WALLKILL RIVER	1915001	NEWTON WATER DEPT	201-383-3521	39 Trinity Street Newton, N.J. 07566
COLESVILLE RES. WALLKILL RIVER LAKE RUTHERFORD	1921001	SUSSEX WATER DEPT	201-875-4831	2 Main Street Sussex, N.J. 07461
WALLKILL RIVER TRIB LAKE WALLKILL	1922017	LK. WALLKILL CLUB		P.O. Box 795 Vernon, N.J.07462
WALLKILL RIVER TRIB. POCHUCK CREEK RESERVOIR	1922017	HIGHLAND LAKES IMPROV.		
RAHWAY RIVER	2013001	RAHWAY WATER DEPT	908-388-0086	1045 Westfield Avenue Rahway, N.J. 07065
RARITAN RIVER MILLSTONE RIVER DEL.&RAR.CANAL FROM DELAWARE RIVER ABOVE BULLS ISLAND	2004002	ELIZABETHTOWN WATER COMPANY	908-654-1234	P.O. Box 788 Westfield, N.J. 07091

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SURFACE WATER INTAKES
BUREAU OF SAFE DRINKING WATER
NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION AND ENERGY

SOURCE WATERS	PWSID#	PURVEYOR NAME	PHONE NUMBERS	PURVEYOR MAILING ADDRESS
DELAWARE RIVER	2103307	BASF COATINGS & INK	908-475-2220	P.O.BOX 328.JAMES ST. BELVIDERE.07823
MUSCONETCONG TRIB. MINE HILL RESERVOIR BURD RESERVOIR DELAWARE RIVER TRIB.	2108001	HACKETTSTOWN MUA	201-852-3622	424 Hurley Dr. P.O. Box 450 Hackettstown, N.J. 07840
BRASS CASTLE CREEK POHATCONG CREEK TRIB DELAWARE RIVER TRIB.	2121001	N.J.AMERICAN WATER CO. WASHINGTON SYSTEM	201-689-0037	233 Canoe Brook Road Short Hills, N.J. 07078
BUCKHORN CREEK RES. DELAWARE RIVER TRIB. EMERGENCY ONLY	2103001	NJ AMERICAN WATER BELVIDERE SYSTEM	201-689-0037	233 Canoe Brook Road Short Hills, N.J. 07078

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REFERENCE NUMBER 15

ARCS II CONTRACT 68-W9-0051
MALCOLM PIRNIE, INC.
RECORD OF TELEPHONE CONVERSATION/AGREEMENT

File No. 8003-293

Date: April 14, 1994

Time: 10:00 AM [x] PM [ ]

Outgoing Call

To: Mark Boriek

(609)-771-3967
Telephone No.

Affiliation: NJDEPE Freshwater Fisheries

Malcolm Pirnie Staff: Mark Muller

(914) 641-2984
Telephone No.

Summary of Conversation:

Mr. Boriek stated that the Arthur Kill supports both freshwater and saltwater fish. He listed american eels, crabs, stripe bass, white perch, and blue fish as the most commonly caught fish. The NJDEPE has an advisory for fish caught in the Arthur Kill. He will fax me the terms of the advisory. Mr. Boriek said he knows that people do eat fish from the Arthur Kill because the NJDEPE is trying to address the problem of people ignoring the advisory.

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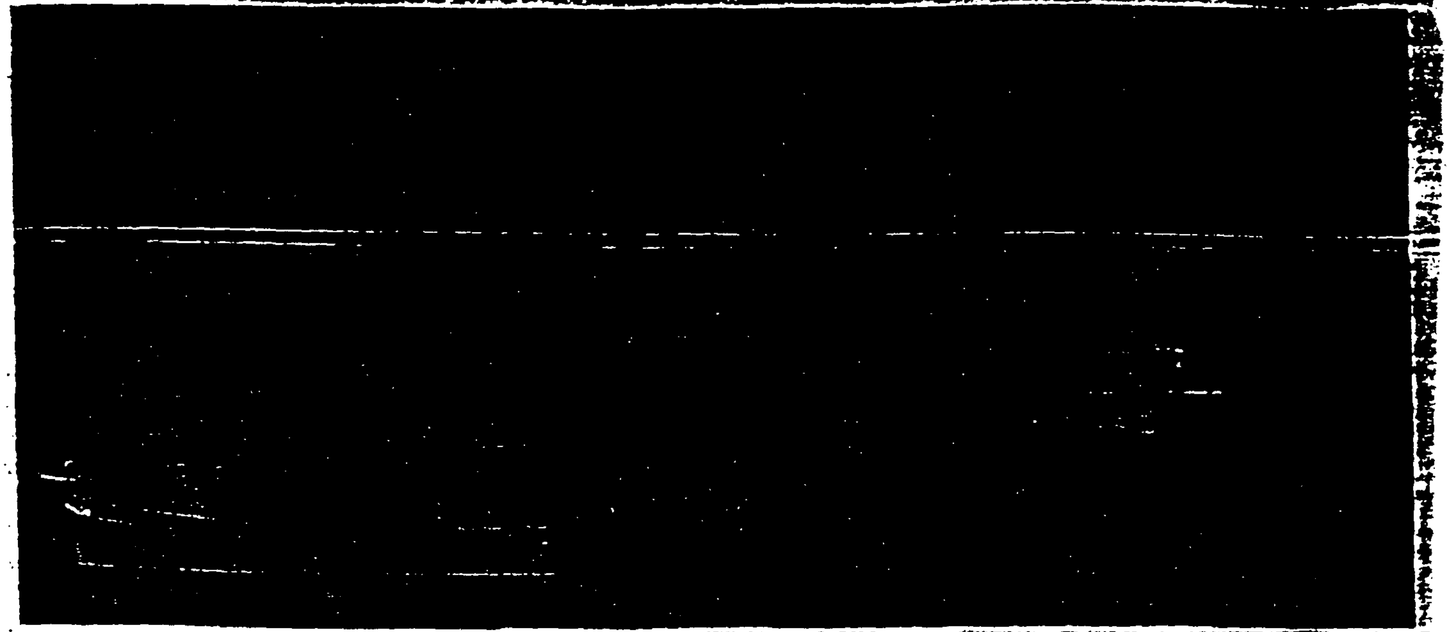
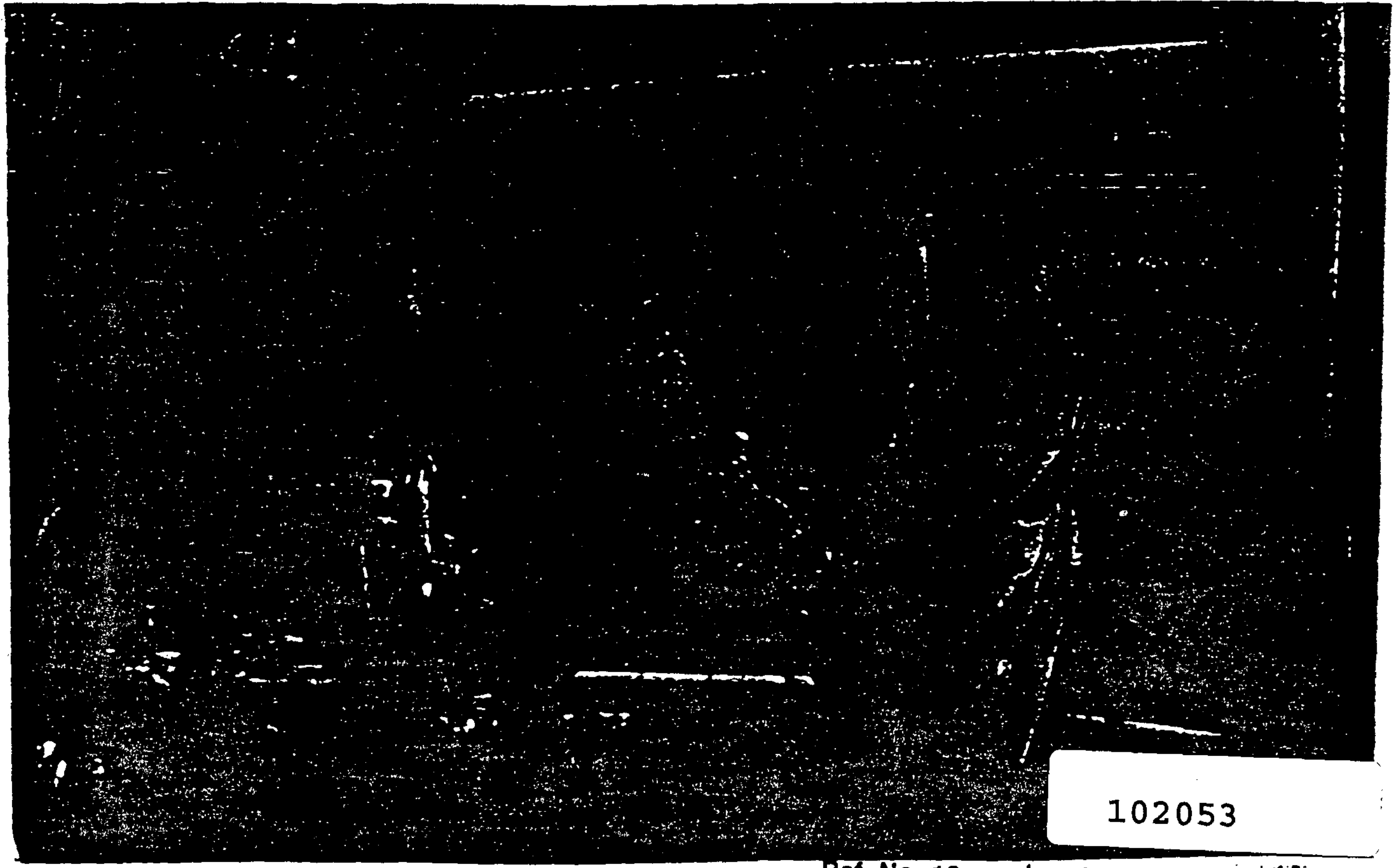
REFERENCE NO. 16



New Jersey's Recreational and Commercial Fishing Grounds of Raritan Bay, Sandy Hook Bay and Delaware Bay and The Shellfish Resources of Raritan Bay and Sandy Hook Bay



-20

New Jersey Department of Environmental Protection
Division of Fish, Game and Wildlife
Marine Fisheries Administration
Bureau of Marine Fisheries
Bureau of Shellfisheries

October, 1988

New Jersey's
Recreational and Commercial Fishing Grounds
of
Raritan Bay, Sandy Hook Bay
and
Delaware Bay

by William Figley

and

The Shellfish Resources of Raritan Bay and Sandy Hook Bay

by Thomas McCloy

Charts by Barry Preim

New Jersey Department of Environmental Protection
Division of Fish, Game and Wildlife
Marine Fisheries Administration

Thomas H. Kean, Governor
Richard T. Dewling, Commissioner, Environmental Protection
George P. Howard, Director, Fish, Game and Wildlife
Bruce L. Freeman, Administrator, Marine Fisheries

Financial assistance for this report was furnished by the Commercial Fisheries Research and Development Act (P.L. 88-309) administered by the National Marine Fisheries Service and from the Coastal Zone Management Act.

Technical Series 88-1

Marine Fisheries Administration, CN 400
Trenton, NJ 08625

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Delaware Bay

Commercial Fisheries
Raritan Bay and Sandy Hook Bay

Delaware Bay

The Shellfish Resources of Raritan Bay and Sandy Hook Bay

CHARTS

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ACKNOWLEDGMENTS

This project was supported in part with funds from the Commercial Fisheries Research and Development Act (P.L. 88-309) which is administered by the National Marine Fisheries Service. The remaining funds were provided by the State of New Jersey. Richard Seagraves and Ronald Smith of the Delaware Division of Fish and Wildlife furnished information regarding the fishing grounds for Delaware's portion of Delaware Bay. Bruce Freeman, Paul Hamer, Bruce Halgren, John Makai, Donald Byrne, Joseph Dobarro, Diana Jones and Peggy Andrews of the Marine Fisheries Administration assisted in the preparation or review of the text. Cover photo by Hank Wurzberger.

The shellfish inventory of Raritan and Sandy Hook Bays was funded in part by the Commercial Fisheries Research and Development Act (P.L. 88-309) and funds from the Coastal Zone Management Act of 1972. The remaining funds were provided by the State of New Jersey.

James Joseph, Leo Jennings, Thomas Baum, Jr. and Paul Kraus, all of the Bureau of Shellfisheries, participated in various phases of sampling and data analysis. Barry Preim of the Bureau of Marine Fisheries was responsible for the preparation of the shellfish resource charts.

Most of the credit for this publication lies with the nearly 200 recreational and commercial fishermen who provided the information contained within this report. Without their help and knowledge, this work would not exist. They are listed by embayment.

RARITAN BAY AND SANDY HOOK BAY

Recreational
J. Adams
E. Aras
F. Azzollini
D. Bennett
R. Blashfield
W. Bontemps
T. Brown
S. Callari
D. Christensen
A. Cimilluca
E. Freer
J. Freidman
R. Giessuebel
G. Graf
J. Graf
M. Grecco
S. Green
J. Gould
H. Hagaman
A. Hilliard
V. Hockenbury
G. Hoffman
R. Jakub
R. Kantor
K. Kaulfers
K. Kjellberg
J. Klaczkiewicz
J. Krajewski
R. Leyner
J. Lipton
P. Maresca
T. Matulewicz
M. McLean
F. Morenz
W. Morse
S. Muratore
L. Nvves-Vais
T. Oberlerton
L. Palmer
J. Palumbo
R. Perrini
R. Pfluger
S. Radossi
H. Rauer, Jr.
O. Ressler
J. Ross
M. Ross
R. Semkewyc
L. Silver
M. Siwiec
W. Spiess, Jr.
M. Vander Zwan
R. Van Reed
J. Vena
R. Wallenstein
R. Walsh
J. Wilkinson
J. Wood

Commercial
K. Baumie
D. Bigelow
W. Braun
F. Brink
H. Brink
J. Caplinger
R. Caplinger
E. Fisler
E. Fisler, III
R. Fisler, Jr.
K. Ignotis
A. Klein
L. Layton
E. Mosinak
D. Neslon
G. Panko
O. Schnoor
A. Thorstensen
J. White

DELAWARE BAY

Recreational
F. Ascoli
P. Barrett
S. Bent
R. Bobo
M. Bonino
F. Callio
K. Calloway
G. Carlson
J. Clark
H. Clifford
J. Cobb
F. Couch
R. Cossaboon
C. Depriest
D. Douglass
A. Dulinski
J. Eagan
E. Gandy
L. Haubois
R. Heineman
A. Heizman
L. Hughes
D. Imbrihco
E. King
R. Knisell
L. Lapin
J. Lazarich
T. Mahoney
R. McDowell
J. Meadows
N. Menaco
J. Monaghan
J. Moore, III
S. Norton
D. Parsons
W. Powell
A. Quincy
S. Rea
G. Rossi
H. Schroeder
B. Sereni
J. Solley
F. Speigel, Jr.
B. Sterrnele
K. Takeda
S. Tompson
J. Wallace
D. Weber

Commercial
L. Abrams
E. Anderson
J. Bailey, Jr.
S. Blizzard
C. Bragg
G. Carlson
C. Clark
S. Crane
E. Dawson
L. Donelson, Jr.
A. Dowe
G. Downs
F. Franklin
N. Franklin
C. Givens
C. Goldmark
D. Harbison
P. Hank
J. Hayes
H. Henderson, III
N. Hoffman
P. Homick
C. Jack
R. James
G. Kumor
R. Laudeman
R. Malinowski
F. McBride
B. Palmer
L. Perry, Sr.
J. Phrampor
L. Peterson
S. Riley
J. Rust
L. Streeper
L. Veach
C. Walzer
C. Wettstein
G. White
T. White

New Jersey's Recreational and Commercial Fishing Grounds of Raritan Bay, Sandy Hook Bay and Delaware Bay

INTRODUCTION

New Jersey's two largest embayments, Raritan Bay and Sandy Hook Bay in the north and Delaware Bay at the southern end of the state, contain important fishing grounds for a large number of recreational and commercial fishermen. In addition to providing important fisheries, there are other uses of the resources of these bays. Shipping requires the maintenance of deepwater channels and the disposal of massive quantities of dredge spoil. The mining industry has an interest in sand deposits for fill material and building aggregates. Various industries and municipalities use the bay water for treatment and dilution of wastes and for cooling water. Unfortunately, many of these uses often adversely affect the fish and shellfish resources, commonly referred to as the living marine resources, by degrading their living space and thereby reducing their populations. Also, because of our carelessness in disposing of toxic chemicals, we contaminate many seafood species. These and other uses of our coastal waters can directly affect fishermen by disrupting or preventing fishing operations.

Unfortunately, during the past, exploitation of the physical resources of these large embayments has been done with little thought given to the fishery resources or the fishermen who depend upon them. Now, however, all proposed resource development activities are subject to the process of environmental review. This process has greatly reduced many of the negative effects.

Information regarding the location of fishing grounds is needed to protect both fish and shellfish resources and the fishermen that derive their recreation or livelihood from them. The recreational and commercial fishing grounds of New Jersey's ocean waters were described in "New Jersey's Recreational and Commercial Ocean Fishing Grounds" (Technical Series 81-1). This report is a continuation of our mapping efforts and presents the fishing grounds of Raritan Bay, Sandy Hook Bay and Delaware Bay.

METHODS

The fishing grounds of Raritan Bay, Sandy Hook Bay and Delaware Bay were determined through a survey of commercial and recreational fishermen from New Jersey and Delaware. Although some fishermen were contacted in person, most were mailed survey forms and charts. Our list of commercial fishermen was derived from commercial fishing licenses. Party and charter boat captains were selected from our statewide list. Names of other recreational fishermen were obtained from fishing clubs, bait shops and the suggestions of other anglers.

Fishermen were requested to delineate specific areas they fished during the past five years by each type of fishing gear, in the case of commercial fishermen, and by species, in the case of recreational fishermen. The completed charts were then analyzed in two ways. First, the irregular outlines of delineated fishing grounds were transferred to master charts, one for each species or gear type. When completed, these charts depicted the entire area fished by species or gear type for all the fishermen surveyed. Survey charts were then analyzed quantitatively by overlaying each chart with a grid and tallying each grid block that was covered by any portion of a delineated fishing ground. The grid size was 1.25 minutes square (latitude) for Raritan Bay and Sandy Hook Bay and 2.5 minutes square (latitude) for Delaware Bay. Separate tallies were kept for each type of gear and species. The highest scoring grid blocks were designated as primary fishing grounds for each particular gear or species, and the lower scoring blocks were designated secondary fishing grounds. However, in preparing the final composite charts, only the irregularly-shaped outlines obtained from the first transfer were plotted. This was to insure that only that portion of a grid block that was actually fished was plotted.

It should be noted that these charts show the fishing grounds and not the distribution of each species. Fishing grounds represent only a portion of the geographic range of a species. Their extent is often limited by factors such as the density of fish, the suitability of an area for fishing, depth, regulations, pollution and distance from port. Furthermore, the charts depict only primary and secondary fishing grounds, areas where the majority of recreational and commercial fishing occurs; they do not include areas where rare or infrequent catches are made or where a species is taken as a bycatch of another species. In addition, fishing ground

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boundaries are not permanent. Fishing effort adapts to changes in fish distribution and the location of grounds can vary from year to year. The information contained on these charts must therefore be considered in the context of time. Also, it must be recognized that although the survey included a large and diverse sample of New Jersey's recreational and commercial fishermen, not all fishermen were interviewed. Therefore, some actively fished areas may have been omitted.

The charts of Raritan Bay and Sandy Hook Bay indicate the fishing grounds of only New Jersey fishermen. The charts of Delaware Bay depict the fishing grounds of fishermen from both New Jersey and Delaware. Commercial fishing activities in Delaware Bay ar greatly influenced by the state boundary line, whic generally follows the shipping channel near the middl of the bay. Commercial fishermen are, for the mo part, restricted by licenses and regulations to their re spective sides of the bay. Thus, the commercial fishin grounds of New Jersey and Delaware fishermen de picted on the charts are exclusive. In the case of rec reational fisheries, there are no area restrictions an anglers from both states mix over much of the fishin grounds. The areas on the charts labelled "Delawa Only" are fished only by Delaware anglers, becaus they lie too far across the bay for New Jersey angle to reach.

PHYSICAL CHARACTERISTICS OF THE BAYS

Raritan Bay and Sandy Hook Bay

Raritan Bay and Sandy Hook Bay is a triangular-shaped embayment measuring nine by twelve miles and has a surface area of 109 square miles. It receives freshwater inflow from several drainage systems including the Hudson, Passaic and Hackensack Rivers to the north, the Raritan River to the west and the Navesink River to the south. The Bay system is divided between New York and New Jersey. Two shipping channels lead into the bays. Starting at the seaward edge, Ambrose Channel cuts northward under the Verazano Narrows Bridge to New York Harbor and the Hudson River. Sandy Hook Channel enters at the tip of Sandy Hook and proceeds westward to Perth Amboy, the Arthur Kill and Raritan River. Chapel Hill Channel joins these two main channels in a north-south direction. Except for the shipping channels, most of Raritan Bay and Sandy Hook Bay is relatively shallow, usually less than 20 feet in depth. Tides enter and leave the bay in a counter-clockwise gyre. Flood tides bring higher salinity ocean water in through Ambrose Channel that flows along the New York shores. Ebb tides drain less saline waters from the New Jersey shore out to the ocean through Sandy Hook channel. The volume of the tidal prism is 9.2 billion cubic feet and the mean tidal range is 5.5 feet.

The shores of Raritan Bay and Sandy Hook Bay and the numerous rivers, streams and tidal creeks that flow into them are the most highly industrialized and urbanized in New Jersey. Industrial and sewage effluents and storm-water run-off have resulted in severe water pollution and fish contamination, particularly in the northern drainage systems. Fortunately, public efforts and laws to reduce pollution are leading to improved water quality. As a result, blue crabs, striped bass, bluefish and other marine organisms are returning to many areas, such as Newark Bay and the Hackensack River, where they have been absent f decades.

Delaware Bay

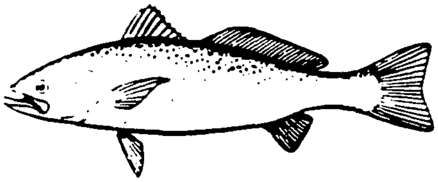
Delaware Bay is 46.7 miles long and has an avera width of 15.3 miles. It has a surface area of 720 squa miles and a volume of 4.7 trillion gallons. Although t major source of freshwater is the Delaware Riv scores of tributaries, from narrow tidal creeks to sm rivers, enter from both the Delaware and New Jers shores. Each day, an average of 13 billion gallons freshwater reach the bay from the Delaware River a the various tributaries. Tidal influence is much great however, with over a trillion gallons of seawater entering the bay daily. Tidal circulation follows a count clockwise pattern. Entering seawater tends to foll the New Jersey shore and tidal water mixed w freshwater tends to exit along the Delaware shore. F this reason, the Delaware side exhibits much grea variations in salinity. Tides extend from the mouth the bay, where the mean range is 4.1 feet, to as upstream as Trenton Falls, where the mean range 6.8 feet.

About 80 percent of Delaware Bay is less than 30 f deep. The shipping channel, with depths of 40 to feet, runs close to the center of the bay and is border on each side by shoals only 6 to 20 feet deep. A dee water area on the Delaware side of the channel ne the mouth of the bay serves as a ship anchorage, w depths of 60 feet and more. Wide shoals less than feet in depth border both the New Jersey and Delaw shores. One large shoal extends from Egg Island Po to Cape May Point. Another set of shoals, called T Rips, extends out from Cape May Point partially acr the mouth of the Bay.

Vast stretches of tidal marsh border Delaware Bay in sharp contrast to the urbanized shores of Raritan Bay and Sandy Hook Bay. Unlike the northern part of the state, there has been much less industrial or residential development along Delaware Bay.

A 1960 study by the University of Delaware indicated that 133 species of fish can be found in the bay. Over 60 of these use the estuary as both a spawning and nursery ground. The Delaware River was once an important migratory pathway and sprawning ground for anadromous species, such as shad, herring and striped bass. Heavy municipal and industrial pollution from Philadelphia and Camden, however, has resulted in seriously low dissolved oxygen levels during the summer. This pollution block had prevented fish in upstream portions of the river from returning to the sea. However, in the last few years, the City of Philadelphia has completed its last sewerage treatment facility and the water quality as well as the dissolved oxygen levels have increased considerably. This has allowed the shad runs to increase after a half century of reduced population levels. Unfortunately, striped bass reproduction in the river continued to remain at a low level.

RECREATIONAL FISHERIES



Weakfish

Season

The weakfish, sometimes called gray sea trout, is the primary target of Delaware Bay anglers. Weakfish enter the Bay, usually in mid-April, to spawn. As they first enter, they do not actively feed. By early May, however, feeding increases as water temperatures rise. The first wave of fish to enter the bay are old, mature fish weighing 6-14 pounds. Many leave after spawning in mid-June and migrate northward along the coast. A second wave, also of mature, but smaller fish (3-6 pounds), arrives as the first wave exits. After spawning, the second wave also departs and is replaced by a third group of immature one-year-old fish that stay until October.

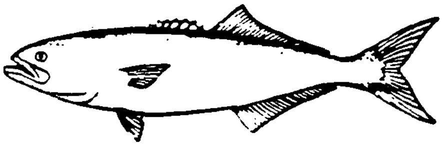
In recent years, the weakfish has increased tremendously in importance in Raritan Bay and Sandy Hook Bay, where it is believed to spawn. The first weakfish are taken by anglers during mid to late June. Large fish are caught in the bay and along the oceanfront by anglers throughout the summer.

Fishing Grounds
Raritan Bay and Sandy Hook Bay

The primary fishing grounds include the areas between Ambrose, Sandy Hook and Chapel Hill Channels, between Sandy Hook and Earle Pier and the oceanfront along Sandy Hook. Secondary grounds extend further into the bay and include a large area bordering Perth Amboy Channel and another area along the west side of Chapel Hill Channel and the Shoals surrounding West Bank Light. Another secondary ground occurs at the mouth of the bay, north and south of Ambrose and Sandy Hook Channels.

Delaware Bay

The primary sportfishing grounds extend from Brandywine Shoal up the bay to Cross Ledge and from Egg Island Point and Deadman Shoal to Blake and Lower Middle Channels. The secondary grounds cover most of the remainder of the bay from Arnold Point Shoal to the shoals at the mouth of the bay.



Bluefish

Season

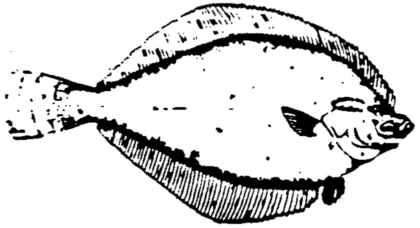
Bluefish enter New Jersey's major bays in early May. Until their departure in late October, the bluefish population is represented by one or more year classes, from young-of-the-year fish, called snappers, to 15-pound jumbos. Bluefish less than three pounds dominate the population throughout the summer.

Fishing Grounds
Raritan Bay and Sandy Hook Bay

Although bluefish are caught at one time or another throughout the entire bay, the primary fishing grounds extend from the Verrazano Narrows Bridge to Ambrose Channel, encompass the large area at the mouth of the bay bordered by Chapel Hill, Sandy Hook and Ambrose Channels, and extend along the oceanfront off Sandy Hook.

Delaware Bay

While bluefish are taken throughout the offshore portion of the bay as far upbay as Ship John Shoal, the primary grounds extend from Brandywine and Deadman Shoal up the north side of the shipping channel to Ben Davis Point Shoal.



Winter Flounder

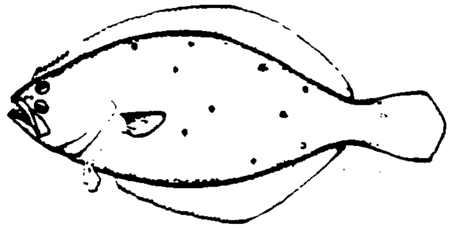
Season

Adult winter flounder enter New Jersey bays in November and remain until late April, when they return to the ocean to spend the summer. Juveniles and some adult fish remain in the bays throughout the yea
Although winter flounder enter Delaware Bay, the numbers are relatively small, particularly in recen
years, and presently do not support a sportfishery.
s, however, an important species in Raritan Bay an
Sandy Hook Bay. Most fishing activity occurs durin
March and April. With cold water temperatures in Jan
ary and February, winter flounder do little feeding an
thus are rarely caught by anglers.

An angler unhooks a bluefish caught at the mouth of Delaware Bay.

Fishing Grounds
Raritan Bay and Sandy Hook Bay

The primary fishing grounds extend from the Hig
lands Bridge along Sandy Hook to the channel ar
around Earle Pier. Secondary grounds include the are
from Sandy Hook along the shore to Matawan Cree
the mouth of the Arthur Kill and the area between Per
Amboy Channel and Great Kills Harbor.



Summer Flounder

Season

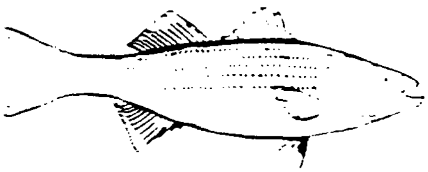
Summer flounder, called fluke in the northern p
of the state and flounder in the south, enter New Jers
bays in late April or early May. They spend the summ
feeding in the bays and then move into the ocean
early September prior to their offshore migration
wintering grounds offshore as far as the edge of
continental shelf.

Fishing Grounds
Raritan Bay and Sandy Hook Bay

The primary fishing grounds include the area at
mouth of the bay between the three channels and
tween Sandy Hook and Earle Pier. Secondary grou
include the large area spanning the length of Sta
Island and the area to the west of Earle Pier on eit
side of Perth Amboy Channel.

Delaware Bay

The primary summer flounder fishing grounds
tend from Brandywine and Deadman Shoals up b
sides of the shipping channel to Cross Ledge.
secondary grounds surround the primary grounds
include the shoals at the mouth of the bay.



Striped Bass

Season

Striped bass, called rock on Delaware Bay, are caught by anglers in Delaware Bay and Raritan Bay and Sandy Hook Bay between mid-April and mid-November. During the early season, stripers are found in the interior parts of the bay. As the season progresses, they seem to move towards the mouth of the bay.

Fishing Grounds

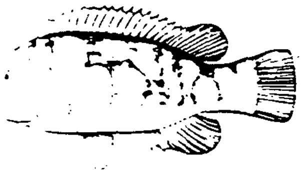
Raritan Bay and Sandy Hook Bay

The primary fishing grounds for striped bass include the area bounded by Sandy Hook and Chapel Hill Channels, Rockaway Point, West Bank, the Verazano Narrows Bridge and the beachfront along Sandy Hook. Secondary grounds include the bayfront along Staten Island and the New Jersey shore between Union Beach and Highlands, Earle Pier and the west side of Chapel Hill Channel.

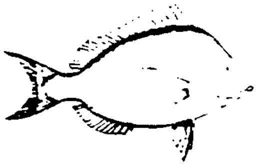
Delaware Bay

A minimal amount of fishing is directed at striped bass in Delaware Bay. Striped bass are caught at the mouth of the bay on the various shoals, collectively known as The Rips, and up the bay on shoals that border the shipping channel such as Cross Ledge, Ben Davis Point Shoal and Ship John Shoal.

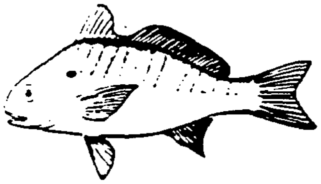
Sea Bass



Tautog



Scup



Spot

Croaker

Sea Bass, Tautog, Scup, Spot and Croaker

Season

A variety of bottom fish, including sea bass, scup, spot, croaker and tautog, are caught by anglers between April and October. Spot and croaker inhabit sand, mud and shell bottoms. Sea bass, progy and tautog prefer shell and rock.

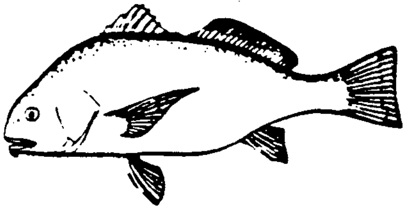
Gaffing a Sandy Hook Bay striper.

Fishing Grounds
Raritan Bay and Sandy Hook Bay

Bottom fish are found throughout the bay around natural and artificial structures such as piers, jetties, fixed channel markers, gravel bars, shellfish beds and debris. The largest areas are the Tin Can Grounds and Romer Shoal at the mouth of the bay and the shellfish beds off Union Beach. Other smaller areas include the Highlands Bridge, Earle Pier, Atlantic Highlands breakwater, the islands around West Bank, the tip of Sandy Hook, Old Orchard Shoal, the deep holes off Perth Amboy and to the west of Chapel Hill Channel.

Delaware Bay

In Delaware Bay, most of the bottom fishing grounds are on sand, mud or oyster shell bottom. The area surrounding Deadman Shoal has been productive for croakers. Spot are caught along the bayshore at Bidwell Creek, Egg Island Point and Fortescue. Sea bass are caught, usually incidentally to the taking of summer flounder, over a wide area, including Egg Island flats and the Punk Grounds on the New Jersey side, and from Fourteen Foot Light to the Shears on the Delaware side. Tautog are caught around artificial rock structures such as Brandywine Light and the Lewes Ferry breakwater.



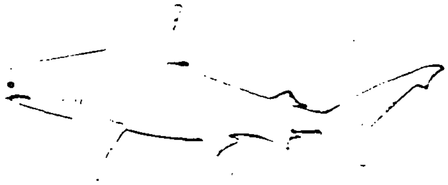
Black Drum

Season

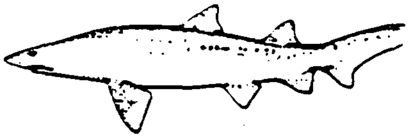
Although black drum historically were caught in the bays throughout New Jersey, they are now almost entirely restricted to Delaware Bay. Drum enter the bay in May to spawn. After spawning, they remain in the bay throughout the summer, but are most actively fished during May and early June.

Fishing Grounds
Delaware Bay

The primary sportfishing ground for black drum is bounded by Bay Shore Channel and Deadman Shoal on the east and Brandywine Shoal and Fourteen Fo Bank on the west. Secondary grounds surround th periphery of the primary grounds and include sever areas on the Delaware side near Old Bank Shoal an the Hawknest.



Sandbar shark



Sand Tiger shark

Sharks

Season

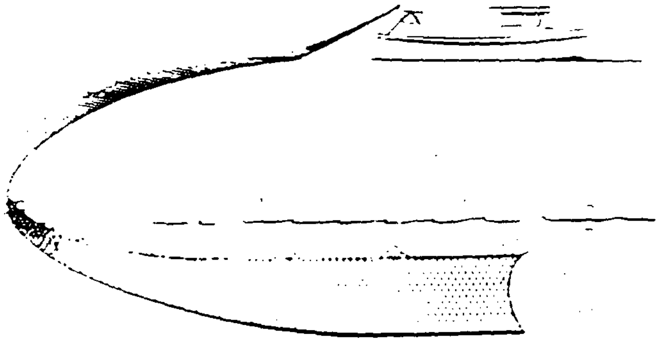
The two most common species of toothed sha caught in New Jersey bays are the sandbar or bro shark and the sand tiger. In addition, bull sharks h occasionally been taken by sportfishermen in Delaw Bay. Sharks enter the bays in June and stay until w temperatures begin to decline in September or O ber. Adult female sandbar sharks use Delaware Ba an important pupping area. They usually do not f during the time subsequent to giving birth to live yo The adult males remain offshore and thus are not fo in the bay.

Sharks have provided a popular sportfishery in D ware Bay for over 50 years, but little fishing activity been exerted for them in Raritan Bay and Sandy H Bay.

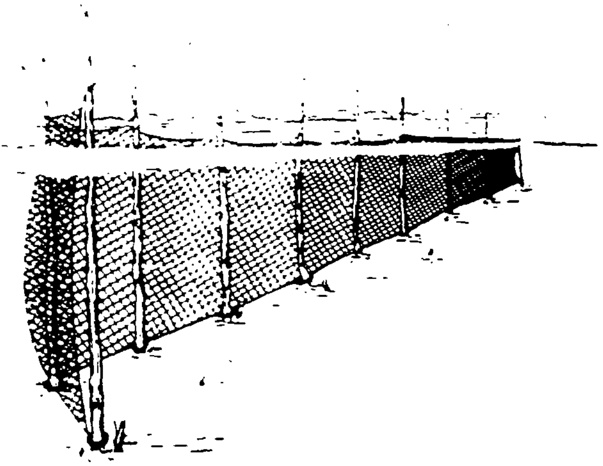
Fishing Grounds
Delaware Bay

The most productive shark fishing areas have t the ends or edges of deep sloughs and channels the mouth of Delaware Bay. There are two prin shark fishing grounds, one on the New Jersey sid the Shipping Channel to the east of Brandywine S and another on the Delaware side of the channel i anchorage. Secondary fishing grounds occur alon Shipping Channel as far up the bay as Ben Davis Shoal.

COMMERCIAL FISHERIES



Drift gill net



Staked gill net

Gill Net

Description of Gear

Two basic types of gill nets are used in Delaware Bay, the staked or anchored net and the drift net. Staked nets are set between wooden stakes or poles that are either driven or jetted into the bottom. Anchored nets are held in position by a series of anchors. Due to strong tidal currents, staked nets are usually set in coves and shoal areas less than 15 feet deep. To further reduce drag, they are also relatively short, usually less than 180 feet in length. A lead line at the base keeps the net on or near the bottom. A float line along the top rises and falls with the tide and keeps the upper edge of the net at the surface of the water.

Drift nets are allowed to drift with the current and are usually used in water deep enough so that the lead line does not touch bottom. They are much longer than staked nets, ranging from 300 to 1,200 feet in length.

Gill nets are made of monofilament or fine nylon that is relatively invisible in the turbid bay waters. The mesh size used is dependent upon the target species. Stretched mesh of 5" or larger is used for shad, large weakfish and bluefish. Mesh of 2 3/4" or larger is used [illegible] river herring, menhaden, white perch, and small [illegible]kfish.

Only staked gill nets for shad are allowed in Raritan Bay and Sandy Hook Bay and only in a limited area. On the New Jersey side of Delaware Bay both staked and drift nets are permitted. On the Delaware side, staked nets are only permitted on the oyster grounds. Elsewhere, only drift gill nets are permitted.

Season

The use of staked or anchored and drift gill nets is confined to particular seasons by law. The prescribed seasons, however, are liberal and the netting period is limited more by the availability of fish than regulation.

Staked gill nets are usually first set in late February or March, to catch shad migrating up the Delaware or Hudson Rivers to spawn. Other early species include river herring, menhaden and white perch. The herring and menhaden are sold for crab bait.

Drift netting begins with the arrival of weakfish and bluefish in mid-April. The weakfish is the moneymaker, having the highest market value of the fish caught in volume in the two bays.

Most staked nets are pulled our during mid-May due to a number of problems, including the invasion of horseshoe crabs, which create extensive net tangles and damage; warm water temperatures, which lead to spoilage of fish; and the fouling of nets with slimy algae and stinging sea nettles. The few staked nets that are fished throughout the summer are primarily intended for menhaden.

Gillnetting shad and weakfish on Delaware Bay.

Drift nets are used throughout the summer and early fall, although the greatest effort is expended during spring and early summer.

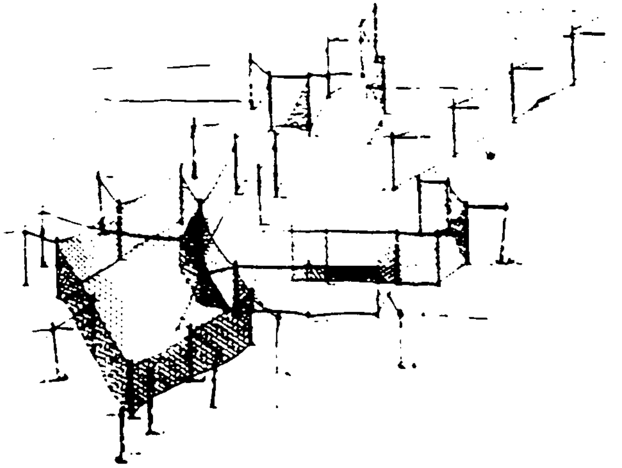
Methods

Staked gill netters operate anywhere from a couple of nets to 40 or more. A small number of nets can be checked by one man, but a large number requires a two-man crew. Weather permitting, nets are checked every day. To check the nets, a boat starts at one end of a row, and is hauled along from pole to pole, via the net lines. As the nets are lifted and pulled across the boat the fish are removed.

A drift net is followed and tended continuously by the fisherman. It is set in a line perpendicular to the flow of the current and may be set many times during the day.

Fishing Grounds

On Delaware Bay, staked gill nets are set in the shallow cove areas on the New Jersey side. The primary drifting gill net grounds here extend from the channel to the bayshore from the Cape May Canal to Egg Island Point. In Raritan Bay and Sandy Hook Bay, staked nets are confined to the nearshore area between Keyport and Port Monmouth and along Sandy Hook.



Pound Net

Description of Gear

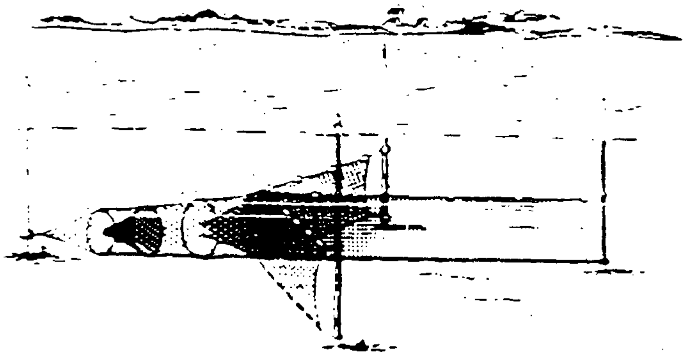
Pound nets are stationary fish traps. In Raritan Ba they have been in use for over a century. Pound ne are strung on long hardwood poles that are driven jetted into the bay bottom. They are set perpendicul to the prevailing shore and tidal currents to interce fish as they travel up and down the bay. When sever pounds are set in the same area they are aligned e to end to form a long continuous barrier to fish mov ments.

The overall length of pound nets is 500 to 750 fe A long leader (400 to 600 feet in length) consisting 9 inch stretched mesh netting acts as a barrier to mc ing fish. The natural tendency of fish encountering t leader is to go around the net by heading offshore deeper water. As fish move down the net, they en the first of two heart-shaped funnels. The heart sha tends to always direct the fish further into the inter of the net. Eventually, they pass through the final fun into the square-shaped pound or holding pocket. T pocket is about 50 feet long on a side and has a floor.

Season

Although in some years pound nets may be erec as early as late February, the more typical start operations is sometime during April. The season tends through the summer into October or Novemb After fishing operations end, the net and poles removed to prevent their loss when ice locks the in winter.

In early spring, the catch consists of shad, herr and menhaden. Menhaden caught in pounds are s as bait for other commercial and recreational fisher Summer catches are dominated by bluefish and we fish. Other species taken include summer floun butterfish, northern puffer, sea bass, sturgeon and : crab.



Methods

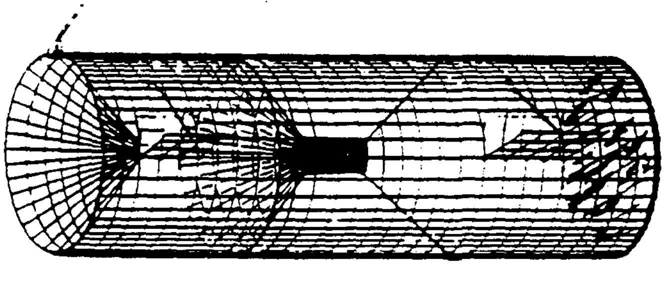
Each day, weather permitting, the nets are checked and emptied of their catch. A pound boat enters the pocket by lowering one edge of the net. The floor of the net is then raised very slowly until the fish inside are restricted to a small section of the pocket. The fishermen then ladle the catch into the boat using a long-handled dip net and a power winch.

Every two or three weeks, the nets must be taken to land for washing and drying. This process removes the algae which grows on and clogs the net. While one net is being cleaned, a fresh one is hung on the poles in its place.

Fishing Grounds

There are two primary pound net grounds in Raritan and Sandy Hook bays. The one in Sandy Hook Bay is located along Sandy Hook just north and west of Horseshoe Cove. The area in Raritan Bay is much larger, extending from Earle Pier to Keyport, although the majority of nets are located to the north of Earle Pier.

Eel Pot



Description of Gear

The typical eel pot is a 3-foot cylinder, 10-12 inches in diameter, made of plastic coated rectangular mesh wire with two net funnels. The funnels divide the pot into two compartments. The external one serves as a bait and entrance chamber, while the internal one is a holding chamber. Pots for catching large eels for sale as food are made with 1/2 inch by 1 inch mesh. Pots for small eels that are either salted for crab bait or held live for sportfish bait are made with 1/2 inch by 1/2 inch mesh.

Season

The eeling season begins in mid-April as eels emerge from their winter dormancy in the mud. Fishing continues until bay waters cool in late October. Eeling activity declines from late June to mid-August, when water tempertatures get very warm and eels become difficult to keep alive in the holding pens.

Methods

Eel pots are set in tidal creeks or along the bayshore either individually or in small strings. They are marked with floats or stakes. Individual eelers may set and tend 50 to 80 pots or more.

Eels are kept alive in large, floating boxes or pens. In the summer, when dissolved oxygen levels are low, aeration is often needed to keep the eels from suffocating. When a sufficient quantity has been caught, the eels are picked up by dealers who transport them live in tank trucks. The primary markets for eels are in Europe. They are packed on ice in crates and shipped overseas by airplanes.

Although surf clams and fish are used, female horseshoe crabs are the preferred bait for catching eels. Horseshoe crab fisheries have developed to supply bait for the eel fishery. In Delaware Bay, horseshoe crabs are caught in small wire pound nets that are set in shallow water along the beach. In Raritan Bay and Sandy Hook, they are caught mostly by modified crab dredges.

Fishing Grounds

In Raritan Bay and Sandy Hook Bay, eels are caugh in the tidal creeks and along the bayshore during the cooler months of spring and fall. During the warm summer months, pots are set along the edge of Pert Amboy Channel.

In Delaware Bay, eels are caught in the tidal creek and a 1/2 mile wide strip along the entire bayshore during October, pots are occasionally set as far off shore as 2 miles. Pots are also set along the shippin channel in the upper reaches of the bay during mi summer.

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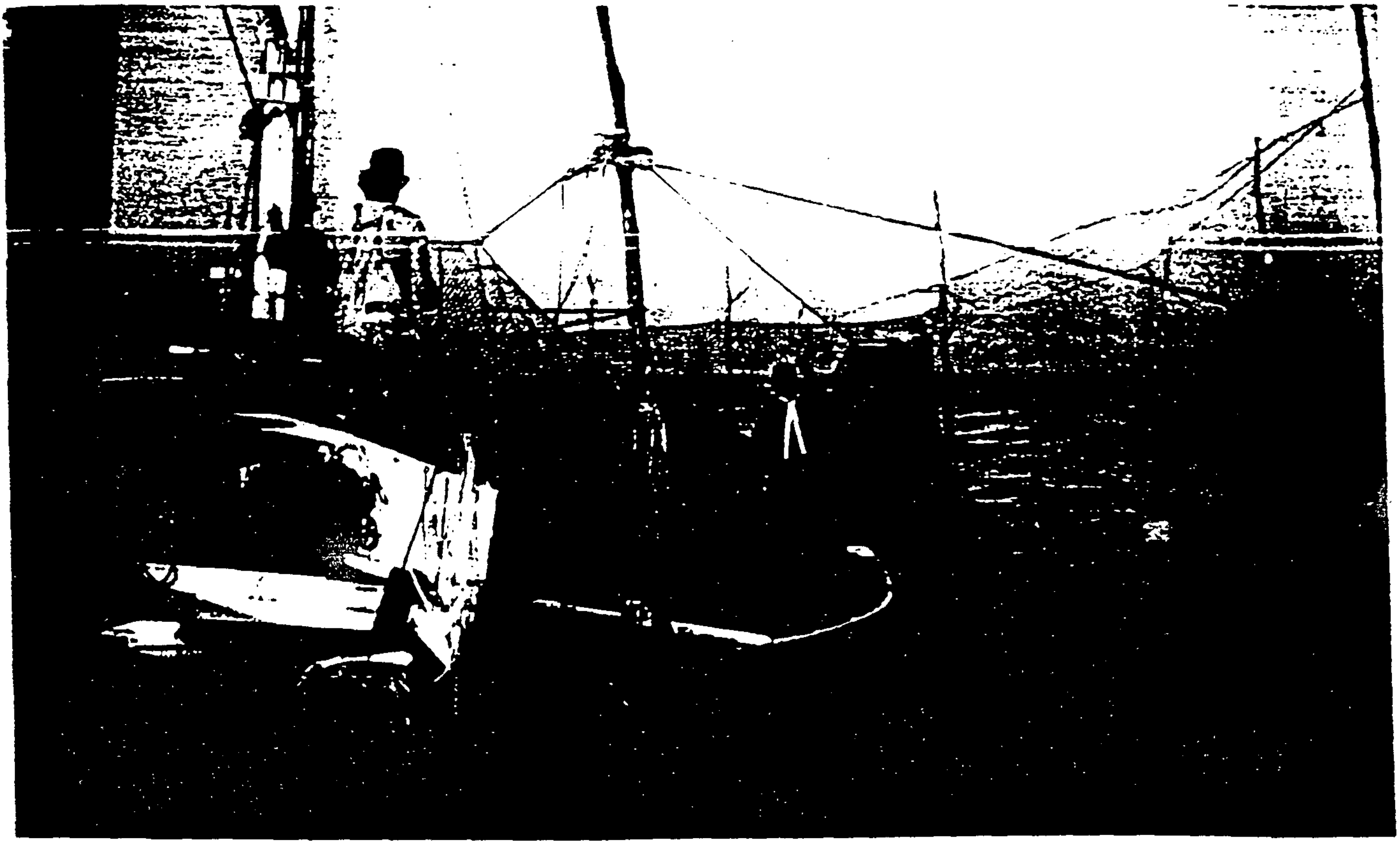
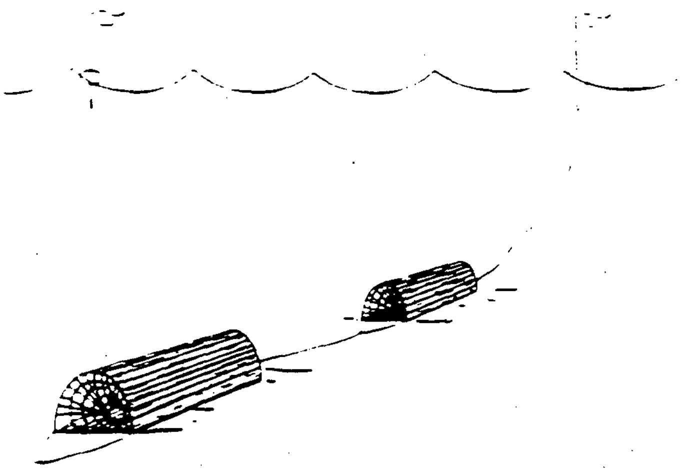


Commercial fishermen tend a pound net in Raritan Bay.

Lobster

Description of Gear

The typical New Jersey lobster pot is a rectangular box made of oak lathe with a pair of net entrance funnels. Depending on the preference of the fisherman, pots either have flat or rounded tops. A lobster pot has two compartments, with a net funnel leading into each. The initial one is for entry and bait and the second is for holding the catch. Wooden doors or flaps permit access to bait and to empty the pot. The pots are tarred to preserve the wood and netting; bricks are secured to the bottom for ballast.



Season

In the bays, lobstering begins in mid-June, extends through the summer and has a final spurt in October before the fishery drops off.

Method

Lobster pots are set in strings of 6 to 25 pots, each connected to a main line. Flag buoys, marking the location of the pot string, are attached to each end of the main line. Pots are baited with menhaden or scraps of fish.

Fishing Grounds

In Raritan Bay and Sandy Hook Bay, lobster pots are set along the edges of Ambrose, Sandy Hook, Chapel Hill, and Perth Amboy Channels and in the deep holes west of Chapel Hill Channel.

In Delaware Bay, lobstering is restricted to Delaware fishermen in the area around the breakwater at Lewes, Delaware.

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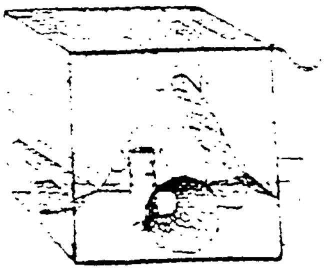
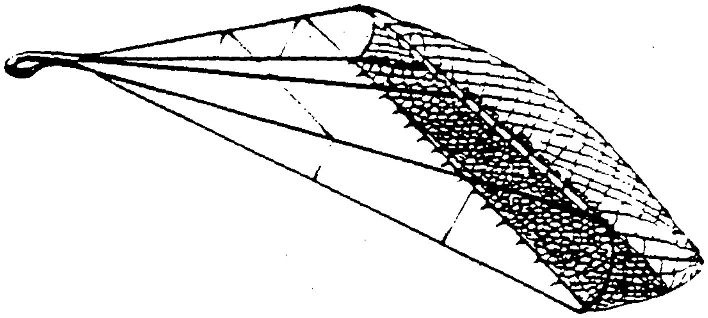


Commercial style crab pot



Crab dredge

Blue Crab Pot and Dredge

escription of Gear

Blue crabs are harvested commercially with pots in the warmer months and with dredges in the winter. The typical Delaware Bay crab pot is a 2-foot cube constructed of galvanized, hexagonal weave hardware oth. The pot consists of an upper chamber or parlor or holding crabs and a lower chamber which has 2 to entrance funnels and a bait cylinder. Four paddles of cement or asphalt are attached to the bottom of the pot for weight. Some crabbers tar their pots to inhibit corrosion and add zincs to retard electrolysis. Pots are set individually in lines or circles and are marked with numbered floats. Crab pots are baited with menhaden, herring or other fish scraps.

[illegible]b dredges have steel frames and either chain link, wire or net bags for collecting the catch. The front of the dredge is equipped with teeth that scrape a few inches into the sand or mud bottom and lift out the crabs buried there. Each boat usually drags two to six dredges simultaneously. The larger boats are equipped with hydraulic winches that pull the dredges up to the boat and out of the water. The maximum dredge size permitted in Raritan Bay and Sandy Hook Bay is a 75 inch wide bar with 6 inch teeth.

Season

Blue crabs emerge from their overwinter stay in the mud in April as water temperatures increase. The potting season usually begins in late April or May and lasts until early November when cold water temperatures send the crabs into the mud again. Shedder crabs are mostly caught in June in pots. The dredge fishery extend from December through March.

Baiting crab pots

Methods

In Delaware Bay, individual crabbers operate lines of 100 to 300 pots. Weather permitting, the pots are checked every day. Crab potting is typically a two-man operation. One man operates the boat and pulls, empties, re-baits and re-sets the pots, while the other man sorts and puts the catch into bushel baskets.

The pots are moved periodically to follow the movements of the crabs. The typical seasonal pattern of the blue crab includes a general inshore movement to the bayshore and tidal creeks during the spring and an offshore migration to deeper, saltier waters during late fall.

Fishing Grounds

On the New Jersey side of Delaware Bay, the primary potting grounds extend from Fishing Creek on Cape May up the bay to Oldman's Creek. Most fishing activity occurs within a mile or so of the bayshore and in the tidal creeks legally open to crabbing. At times, pots are set further offshore, to the edge of the shipping channel in the upstream portion of the crab grounds.

On the Delaware side, the bayward edge of the crab potting grounds is the Misipillion River. The majority of activity occurs nearshore, but at times pots are set as far as five miles offshore.

The blue crab dredging grounds in Delaware Bay are located in the deeper waters surrounding the shipping channel near the mouth of the bay. Blue crabs prefer mud bottoms in the deeper sections of the bay for overwintering. Crabs avoid oyster shell bottom, which is fortunate for crabbers, since these areas are legally off limits to crab dredging. In years when concentrations of wintering crabs are low, there is little or no dredging effort.

In Raritan Bay and Sandy Hook Bay, the dredging grounds extends from the Raritan River to the mouth of the bay in depths usually exceeding 12 feet. They include the areas on either side of Perth Amboy and Chapel Hill Channels and Sandy Hook Bay.

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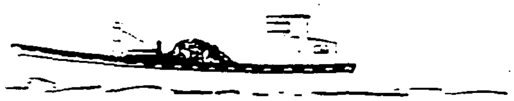


Oyster Dredge

Description of Gear

Oysters are harvested with large steel-frame dredges, up to 54 inches across the tooth-bar, that are towed across the bottom. A steel ring-mesh bag on the back of the dredge holds the catch until it is lifted hydraulically and dumped on deck. Although oysters are now harvested under power, most of the boats in the fleet were formerly sailing dredge boats that were converted to power when it became legal in 1945.

Season

Oysters may be legally harvested from all leased grounds between September and June. Since 1975, summer harvest has been permitted on leased areas below the Southwest line. Oyster seed is transplanted from state-owned beds to leased grounds during "Bay Season", in May and June.

Methods

Oyster culture begins with the transplanting of seed from state seed beds to leased ground in late spring. Seed oysters are allowed to grow on leased ground until reaching harvestable size. The peak market and harvest of oysters occurs during the fall holidays, between Thanksgiving and Christmas.

Oysters are scraped from the bottom with dredges. After the catch has been dumped on deck, fishermen cull the live oysters from shell and other debris. Culling was formerly done by hand, but most boats now use mechanical culling devices.

The day's catch is taken to processing houses in Port Norris and Bivalve where the oysters are either packed live in boxes and shipped to market or shucked and further processed. Shucked oysters are either packed fresh in tins or breaded and frozen before being sent to market. All of the shell remaining after processing is stored for eventual return to the oyster beds. Shell material is needed to provide a suitable substrate for oyster larval attachment and thus is valuable for maintaining and increasing production on the seed beds.

Fishing Grounds

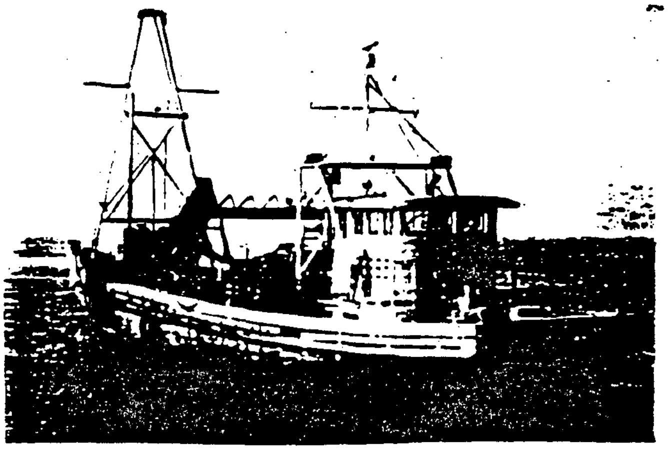
The importance of the oyster beds of Delaware Bay has been recognized since colonial times. Prior to the mid 1800s, the oyster industry primarily subsisted by the direct marketing of oysters from the "Natural Oyster Beds". The complexion of the industry changed during the decade prior to 1850 when the oystermen realized that it was economically advantageous to "plant" and establish inventories of oysters beyond the natural beds. Oysters were held in these planting areas until an optimum market size was reached. The oyster industry is now based upon two principal areas, the Natural Seed Beds and the Leased Planting Grounds.

The Natural Seed Beds, for the most part, occupy an area above the Southwest Line, a line of demarcation which has historically separated the planting grounds from the Natural Seed Beds. There are approximately 12,000 acres of productive seed beds and another 3,000 acres of marginally productive beds between the Southwest Line and Artificial Island. Average salinities for the seed areas range from 21 parts per thousand (ppt) at the Southwest Line to 4 or 5 ppt at Artificial Island. Water depth ranges from 5 to 25 feet.

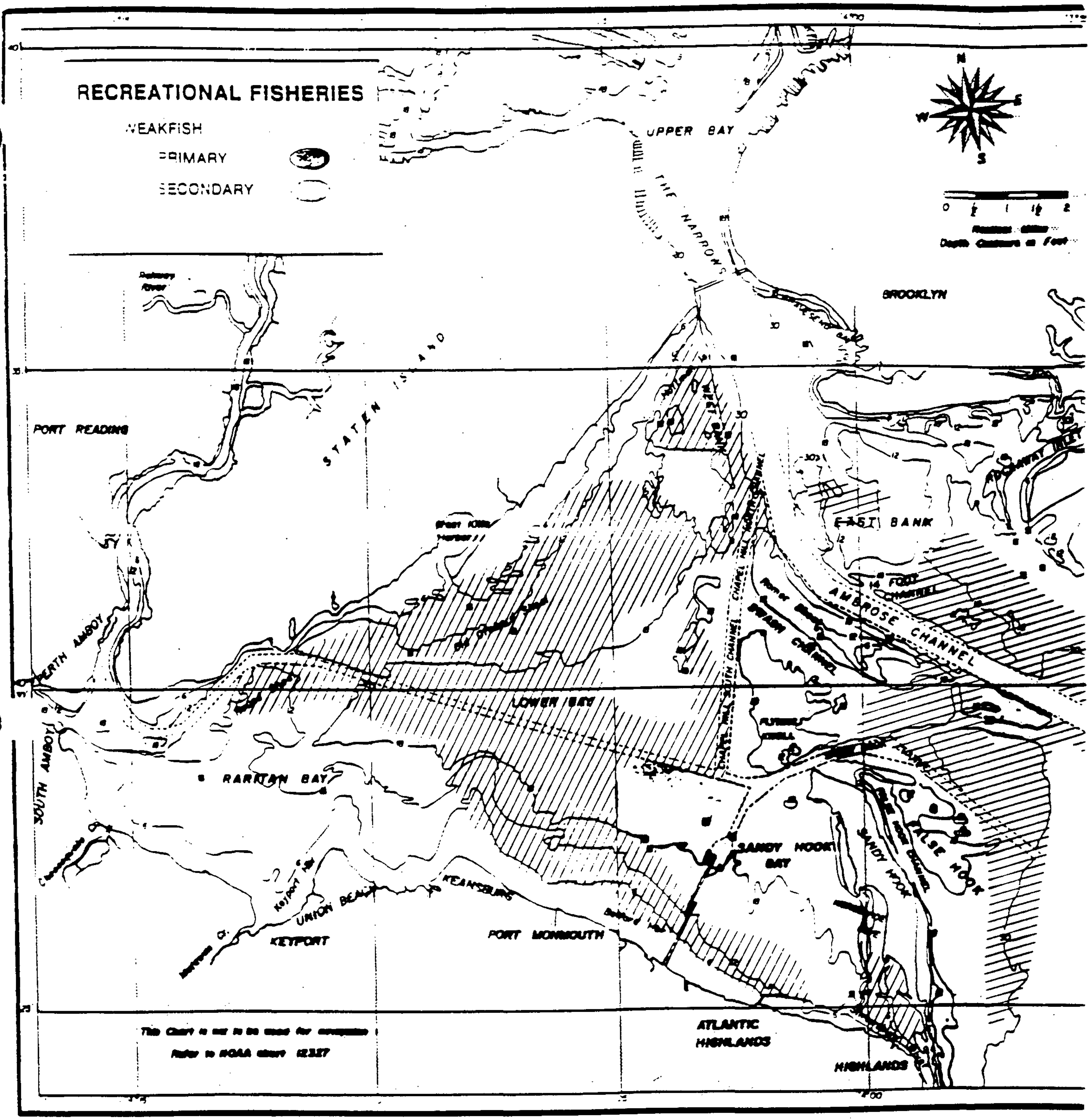
The planting grounds encompass approximately 90,000 acres, of which 29,000 acres are currently leased for planting purposes. Only a small percentage of this leased area is, however, routinely used.

Oyster production has fluctuated, sometimes rather dramatically, throughout the recorded history of the fishery. Early estimates indicated that the annual seed harvests frequently exceeded one million bushels, with occasional higher estimates. These estimates may have been somewhat inflated, however, due to the lack of discrimination between native and imported seed stocks.

During its recent history, the industry was devastated by an epizootic parasite commonly referred to as MSX. This parasite was initially recognized in the late 1950s and was responsible for the death of oysters on the planting and, to a lesser extent, the seed areas of the bay. It was estimated that as much as 95 percent of the market bed oyster stocks were lost within three years after the onset of this oyster disease. As a result of high mortalities in these traditional oyster planting grounds, a new area of approximately 7,000 acres, located above the Southwest Line and adjacent to some of the natural beds, has been made available for planting purposes. This area has lower salinity ranges and is therefore not as affected by MSX.



Oyster dredge boat


RECREATIONAL FISHERIES
WEAKFISH
PRIMARY
SECONDARY
N
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0 ½ 1 1½ 2
Nautical Miles
Depth Contours in Feet
UPPER BAY
THE NARROWS
BROOKLYN
Rahway River
PORT READING
STATEN ISLAND
Great Kills Harbor
EAST BANK
14 FOOT CHANNEL
AMBROSE CHANNEL
ROCKAWAY INLET
CHAPEL HILL SOUTH CHANNEL
CHAPEL HILL NORTH CHANNEL
SWASH CHANNEL
FLYNNS KNOLL
PERTH AMBOY
SOUTH AMBOY
LOWER BAY
RARITAN BAY
SANDY HOOK BAY
SANDY HOOK
FALSE HOOK
Keyport Hb
UNION BEACH
KEANSBURG
KEYPORT
PORT MONMOUTH
ATLANTIC HIGHLANDS
HIGHLANDS
This Chart is not to be used for navigation
Refer to NOAA chart 12327

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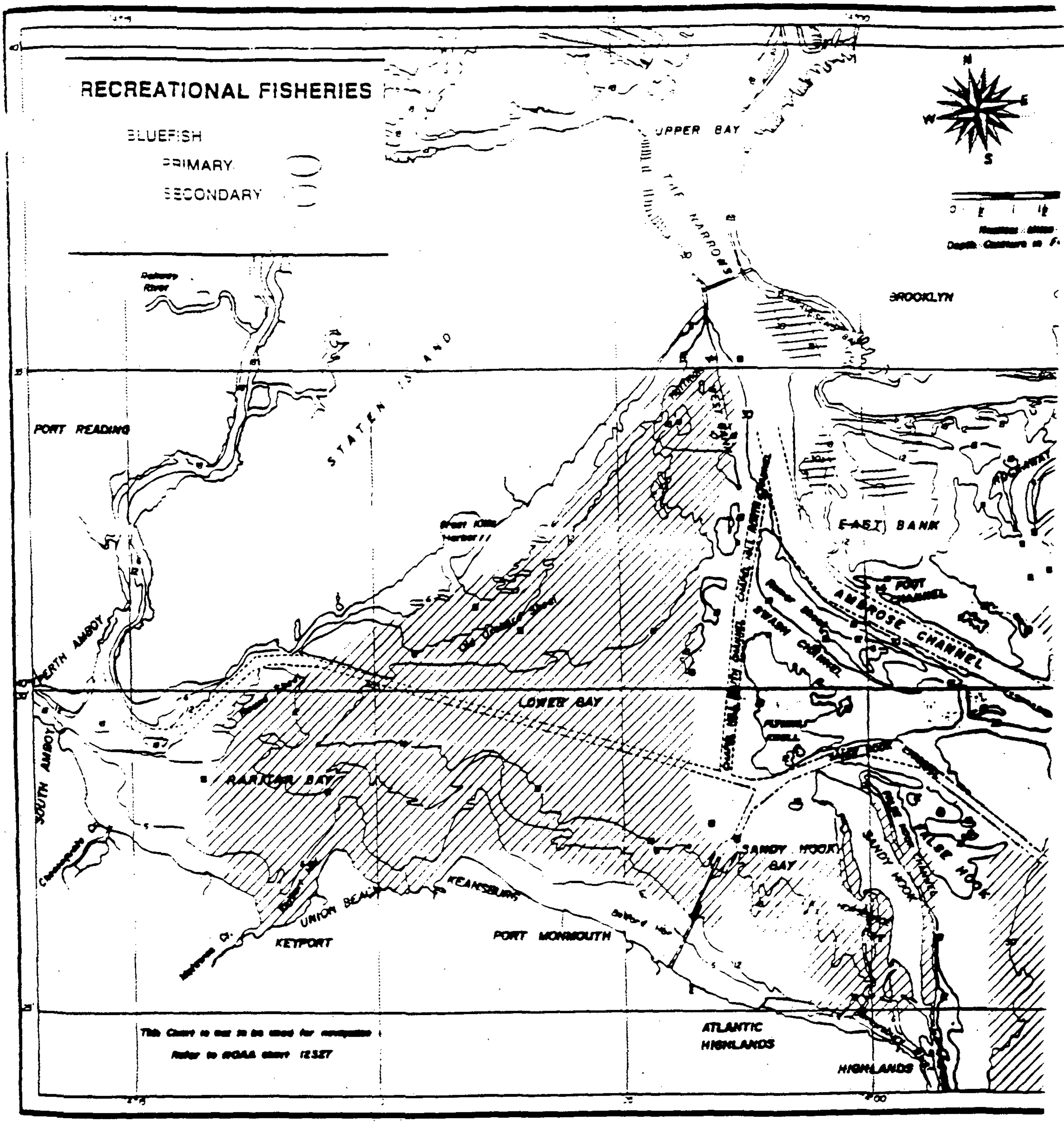
RECREATIONAL FISHERIES
BLUEFISH
PRIMARY
SECONDARY
N
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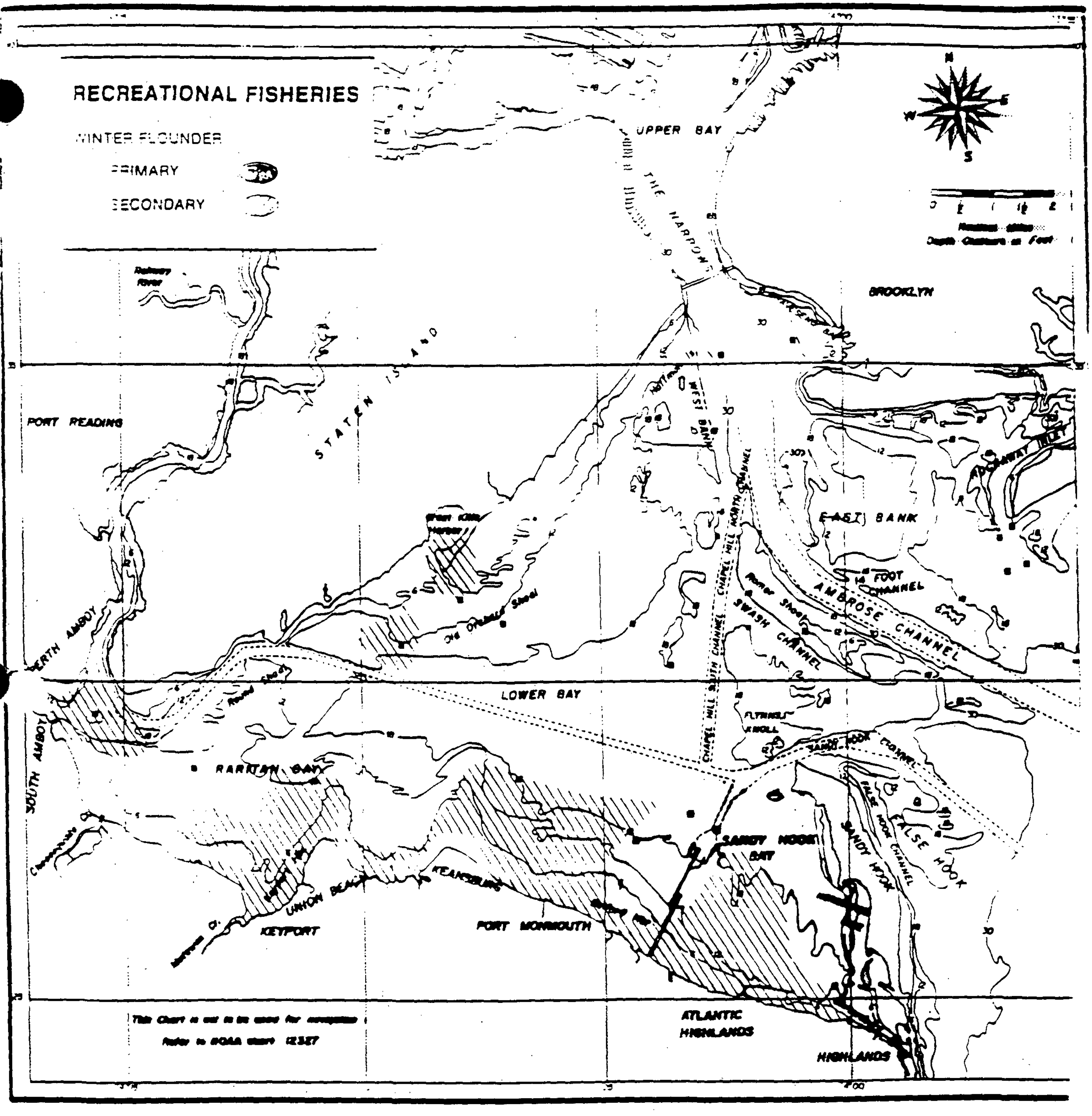
UPPER BAY
THE NARROWS
BROOKLYN
Rahway River
STATEN ISLAND
PORT READING
Great Kills Harbor
EAST BANK
AMBROSE CHANNEL
SWASH CHANNEL
PERTH AMBOY
SOUTH AMBOY
LOWER BAY
RARITAN BAY
SANDY HOOK BAY
SANDY HOOK
FALSE HOOK
KEANSBURG
UNION BEACH
KEYPORT
PORT MONMOUTH
ATLANTIC HIGHLANDS
HIGHLANDS
This Chart is not to be used for navigation
Refer to NOAA chart 12327



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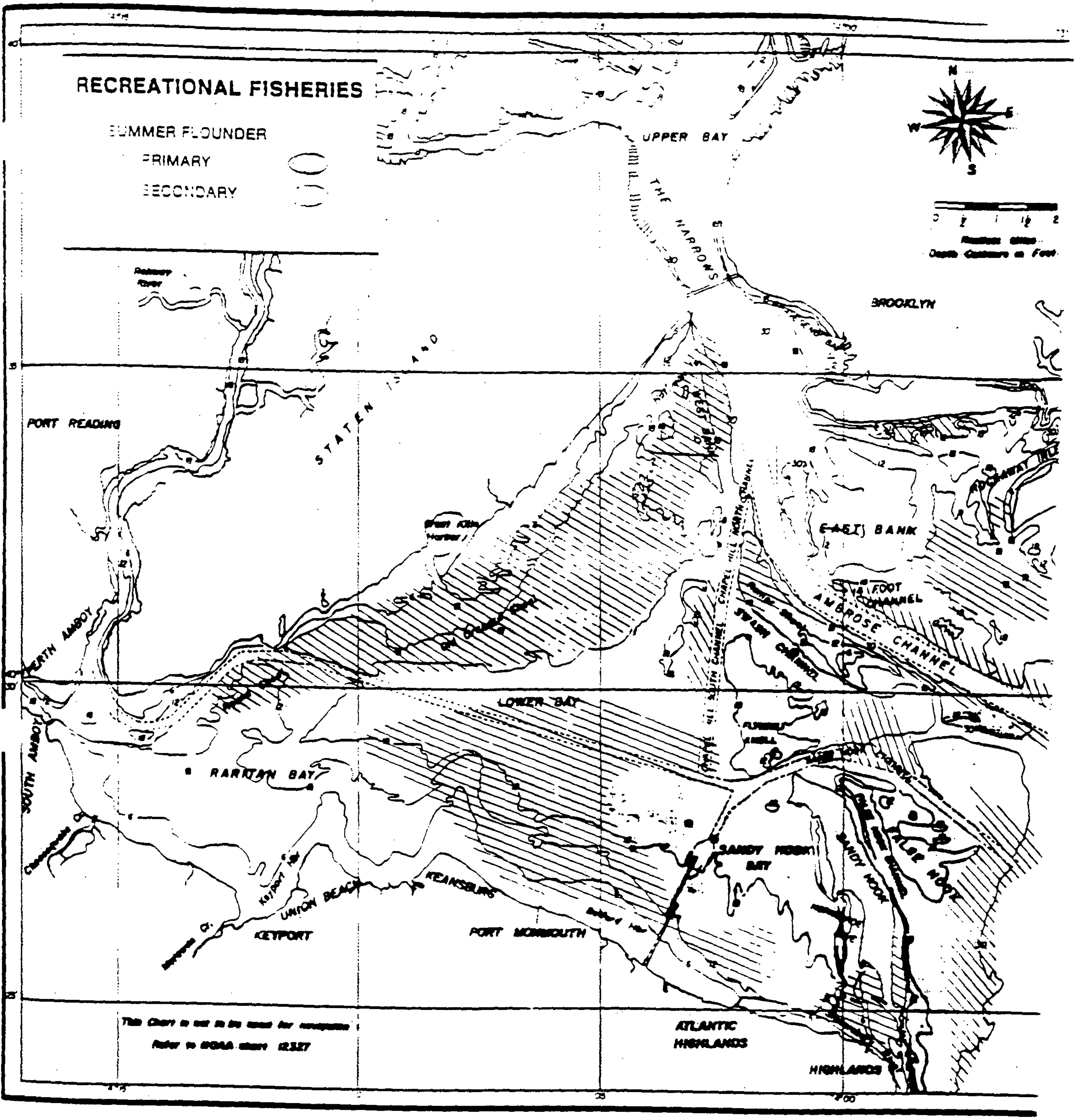
RECREATIONAL FISHERIES
SUMMER FLOUNDER
PRIMARY
SECONDARY
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2
Nautical Miles
Depth Contours in Feet
UPPER BAY
THE NARROWS
BROOKLYN
Rahway River
STATEN ISLAND
PORT READING
Great Kills Harbor
EAST BANK
FOOT CHANNEL
AMBROSE CHANNEL
SWASH CHANNEL
CHAPEL HILL NORTH CHANNEL
CHAPEL HILL SOUTH CHANNEL
PERTH AMBOY
SOUTH AMBOY
LOWER BAY
RARITAN BAY
ROMER SHOAL
ROCKAWAY INLET
SANDY HOOK BAY
SANDY HOOK
FALSE HOOK
Cheesequake Cr.
Keyport Hbr
UNION BEACH
KEANSBURG
KEYPORT
PORT MONMOUTH
Belford Hbr
ATLANTIC HIGHLANDS
HIGHLANDS
This Chart is not to be used for navigation
Refer to NOAA chart 12327

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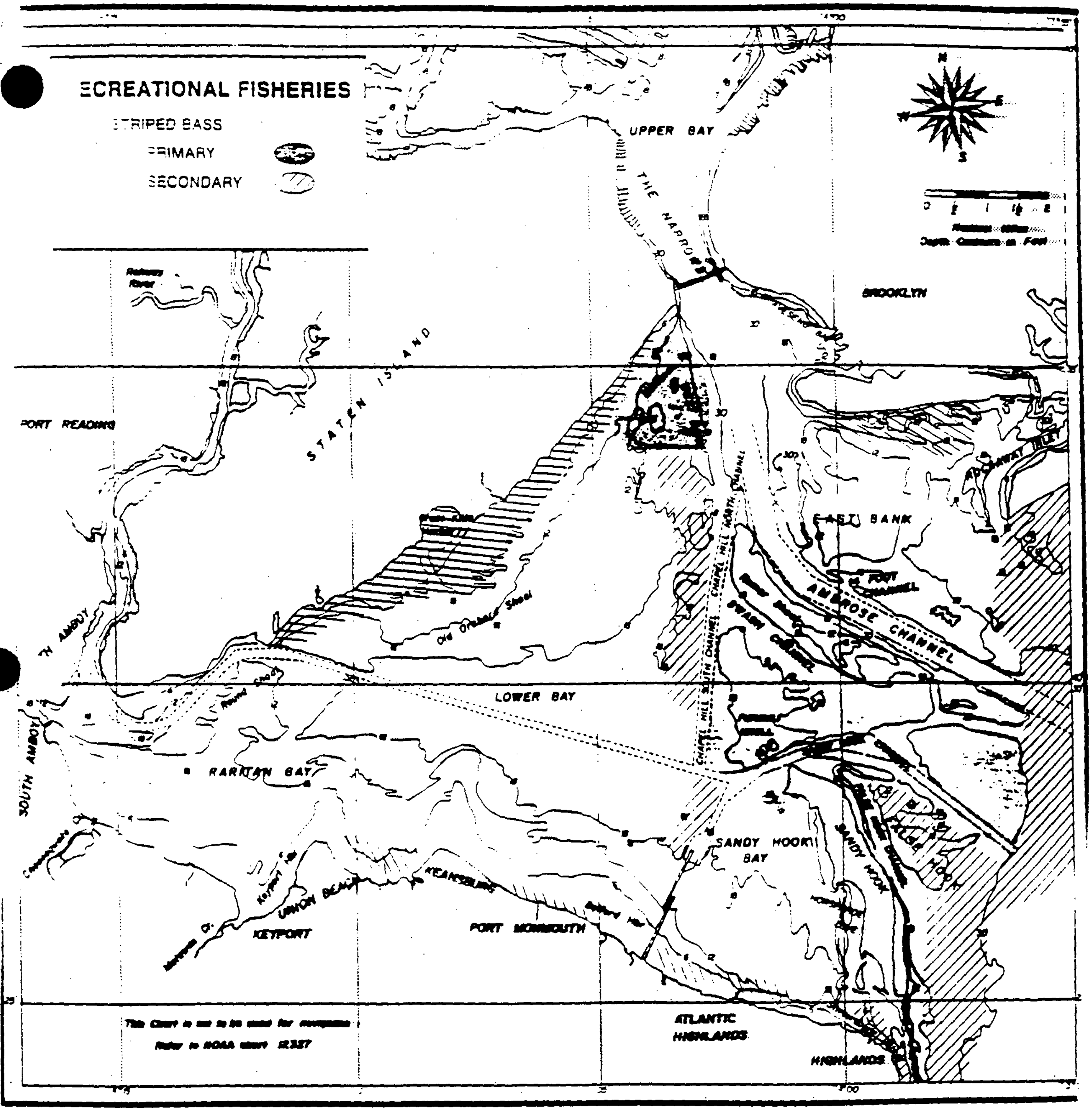
ECREATIONAL FISHERIES
TRIPED BASS
PRIMARY
SECONDARY
UPPER BAY
THE NARROWS
BROOKLYN
STATEN ISLAND
PORT READING
EAST BANK
AMBROSE CHANNEL
SWASH CHANNEL
CHAPEL HILL SOUTH CHANNEL
CHAPEL HILL NORTH CHANNEL
Old Orchard Shoal
LOWER BAY
RARITAN BAY
SOUTH AMBOY
SANDY HOOK BAY
SANDY HOOK
UNION BEACH
KEANSBURG
KEYPORT
PORT MONMOUTH
ATLANTIC HIGHLANDS
HIGHLANDS
Romer Shoal
Rockaway Inlet
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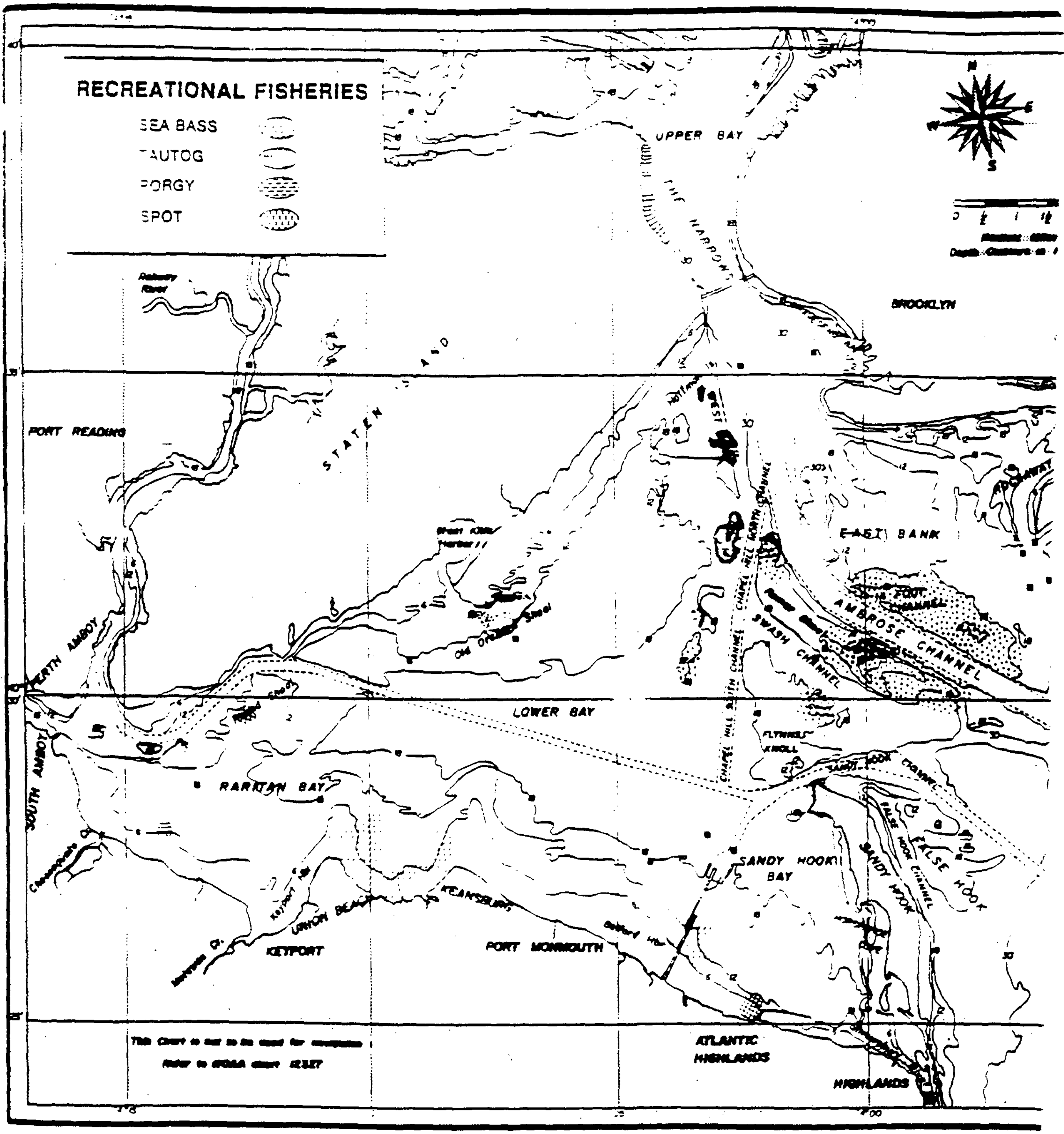
Refer to NOAA chart 12327

40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SEA BASS
TAUTOG
PORGY
SPOT
UPPER BAY
THE NARROWS
BROOKLYN
Rahway River
PORT READING
STATEN ISLAND
EAST BANK
AMBROSE CHANNEL
SWASH CHANNEL
CHAPEL HILL NORTH CHANNEL
CHAPEL HILL SOUTH CHANNEL
Great Kills Harbor
Old Orchard Shoal
PERTH AMBOY
SOUTH AMBOY
LOWER BAY
RARITAN BAY
FLYNNS KNOLL
SANDY HOOK CHANNEL
FALSE HOOK CHANNEL
FALSE HOOK
SANDY HOOK
SANDY HOOK BAY
Cheesequake Cr.
Keyport
UNION BEACH
KEANSBURG
KEYPORT
PORT MONMOUTH
ATLANTIC HIGHLANDS
HIGHLANDS
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Refer to NOAA chart 12327

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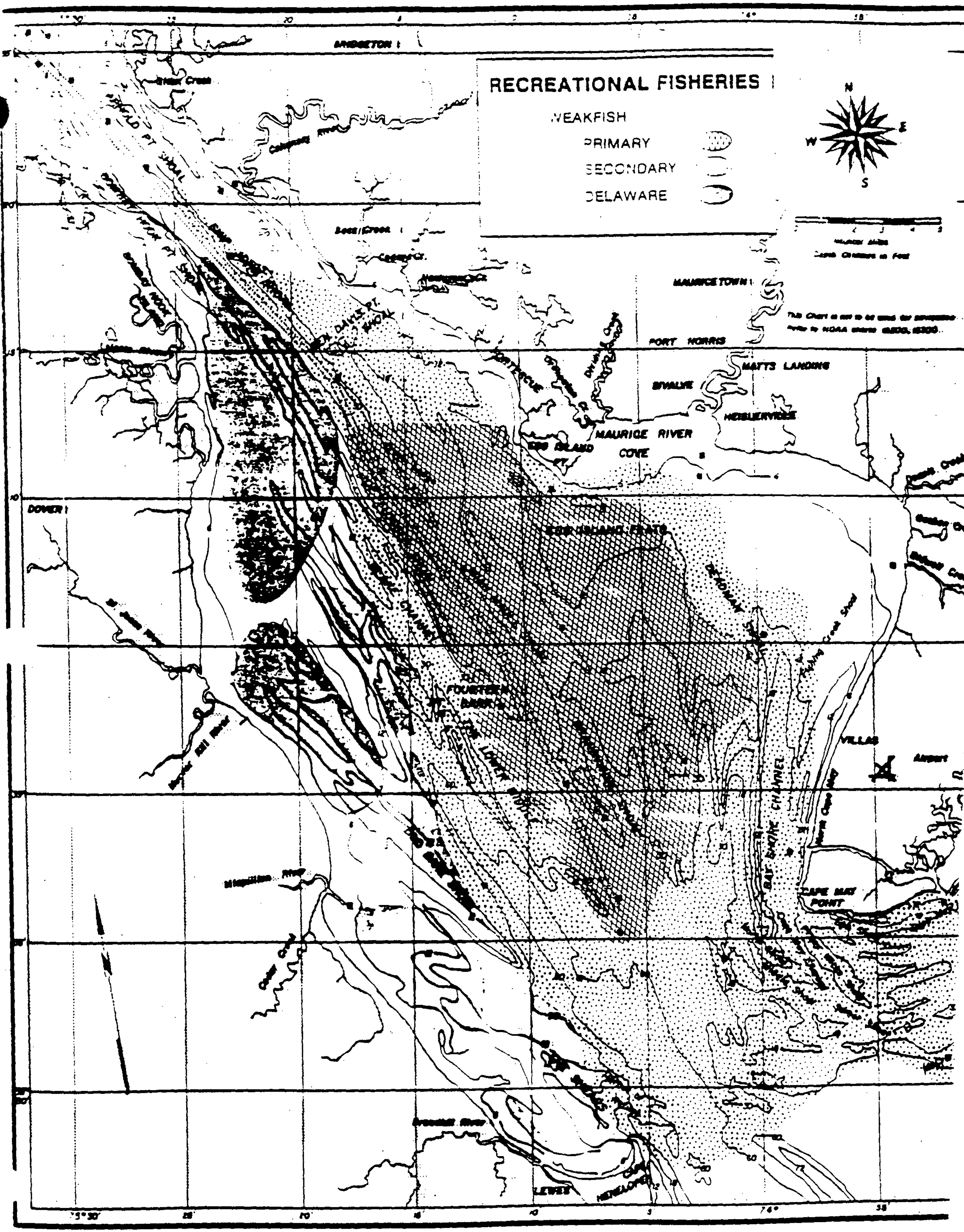

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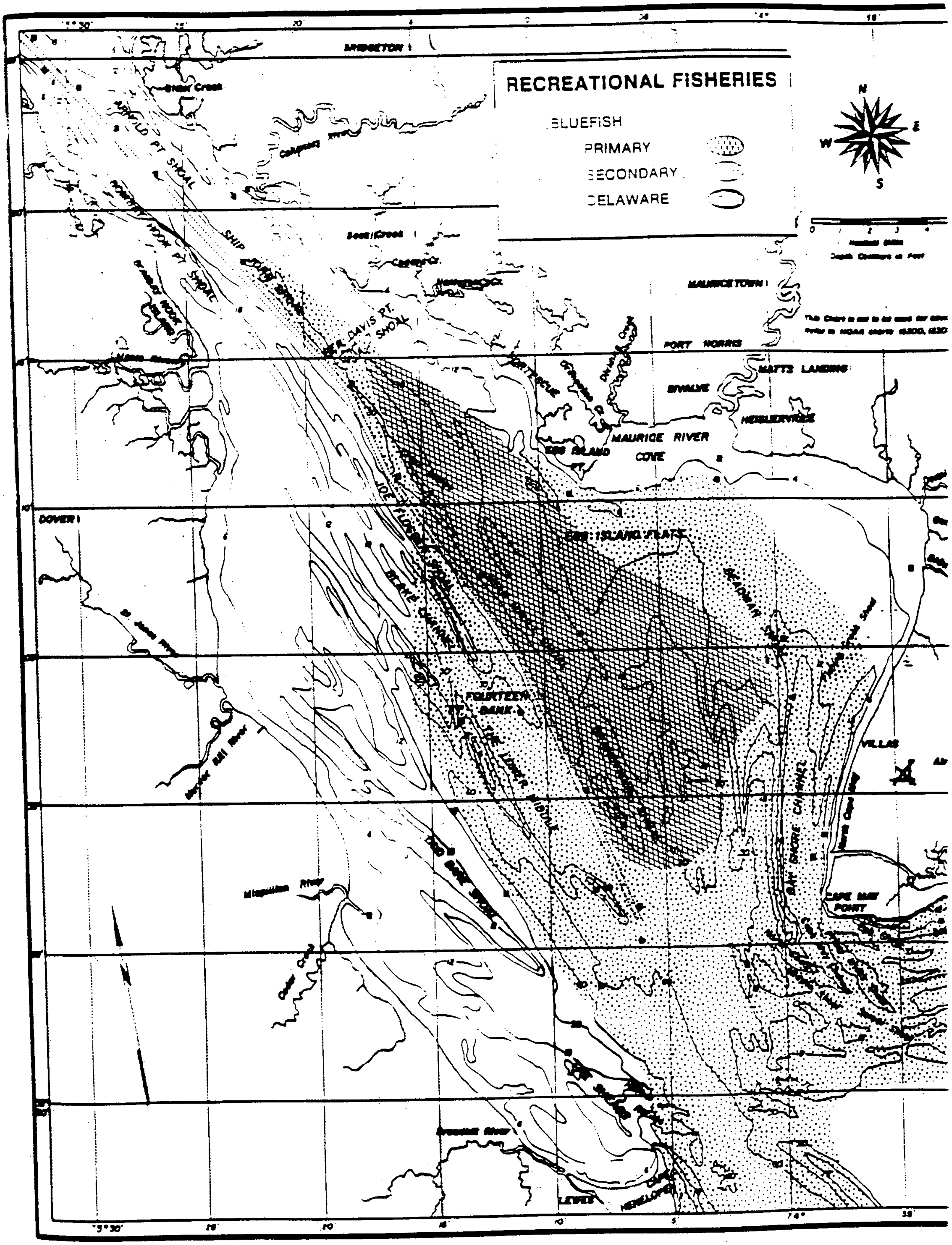
RECREATIONAL FISHERIES
BLUEFISH
PRIMARY
SECONDARY
DELAWARE
N
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0
1
2
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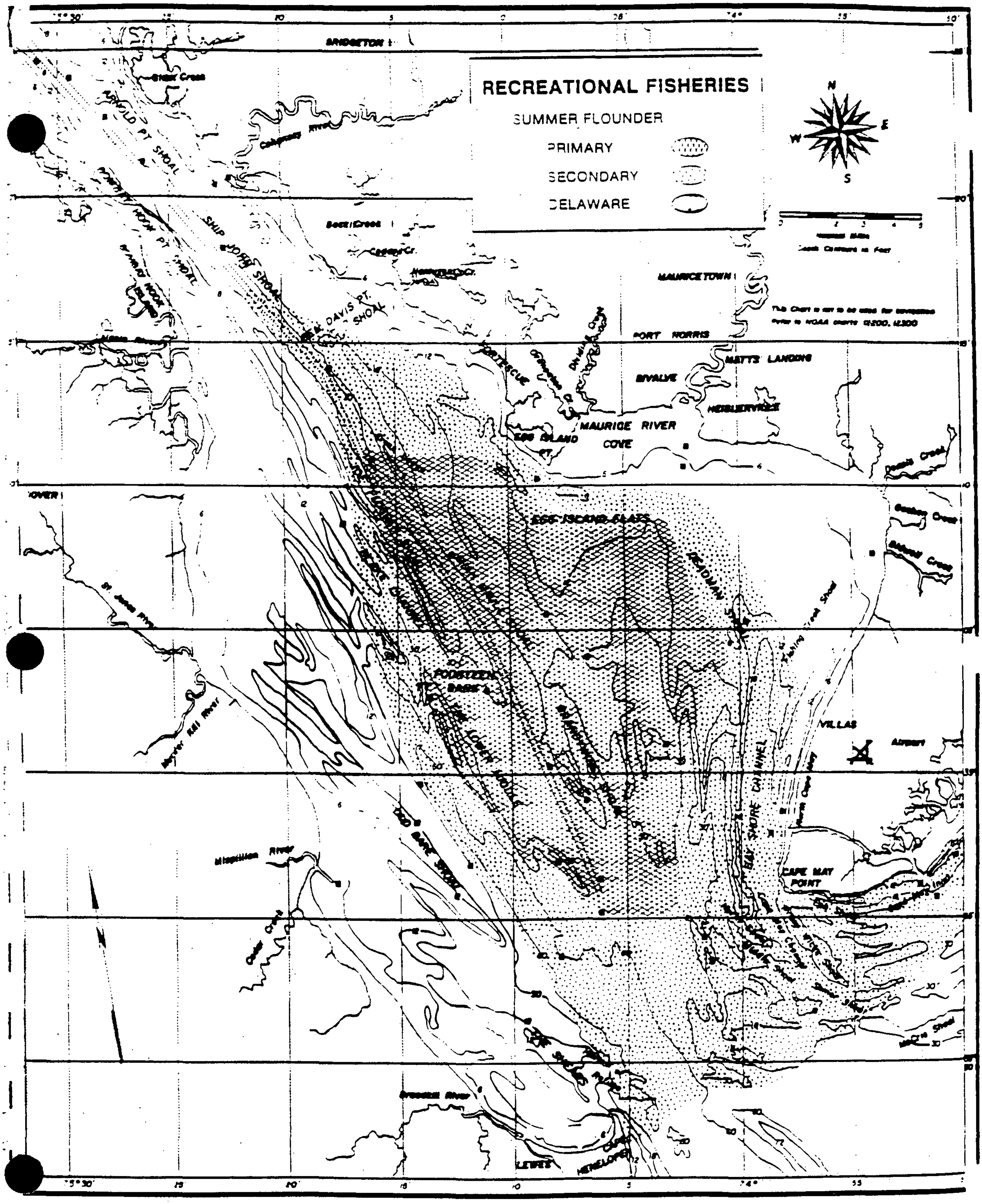
4
Depth Contours in Feet
75°30'
25'
20'
15'
10'
5'
74°
55'
BRIDGETON
Stow Creek
ARNOLD PT SHOAL
Cohansey River
SHIP JOHN SHOAL
FORTESCUE
Back Creek
Cedar Cr.
MAURICETOWN
BEN DAVIS PT. SHOAL
PORT NORRIS
MATTS LANDING
BIVALVE
HEISLERVILLE
MAURICE RIVER COVE
EGG ISLAND PT.
EGG ISLAND FLATS
DOVER
JOE FLOGGER SHOAL
BLAKE CHANNEL
St Jones River
FOURTEEN FT. BANK
Murderkill River
VILLAS
BAY SHORE CHANNEL
CAPE MAY POINT
Mispillion River
Cedar Creek
Broadkill River
LEWES
CAPE HENLOPEN


RECREATIONAL FISHERIES
SUMMER FLOUNDER
PRIMARY
SECONDARY
DELAWARE
N
S
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Nautical Miles
Depth Contours in Feet
This Chart is not to be used for navigation
Refer to NOAA charts 12200, 12300
75°30'
25'
20'
15'
10'
5'
74°
55'
50'
BRIDGETON
Stow Creek
Cohansey River
ARNOLD PT SHOAL
SHIP JOHN SHOAL
Back Creek
Cedar Cr.
Nantuxent Cr.
MAURICETOWN
E. DAVIS PT. SHOAL
FORTESCUE
PORT NORRIS
MATTS LANDING
BIVALVE
HEISLERVILLE
MAURICE RIVER COVE
EGG ISLAND PT.
Dennis Creek
DOVER
EGG ISLAND FLATS
DEADMAN SHOAL
Goshen Creek
Bidwell Creek
St. Jones River
FOURTEEN FT. BANK
LOWER MIDDLE
VILLAS
Airport
BAY SHORE CHANNEL
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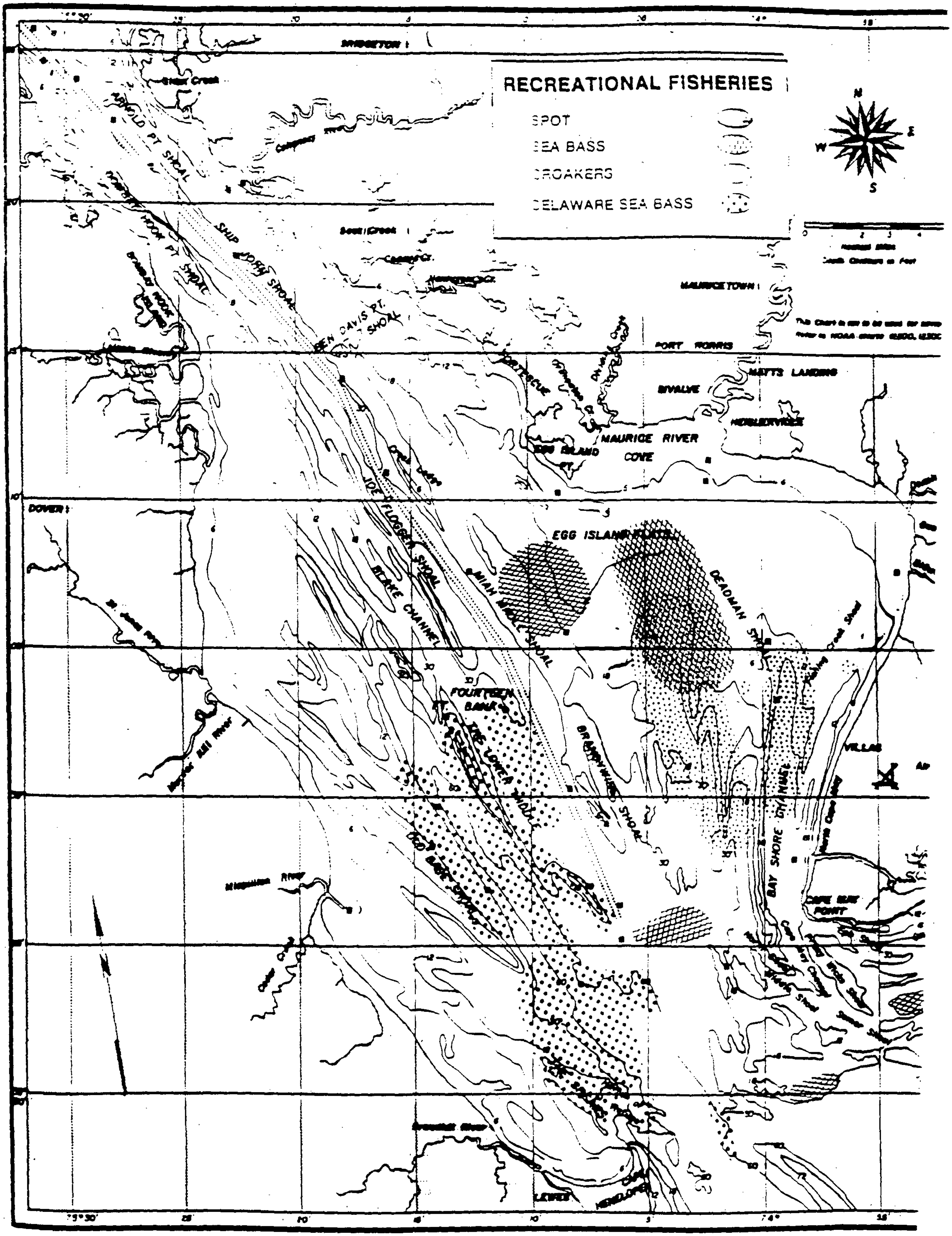
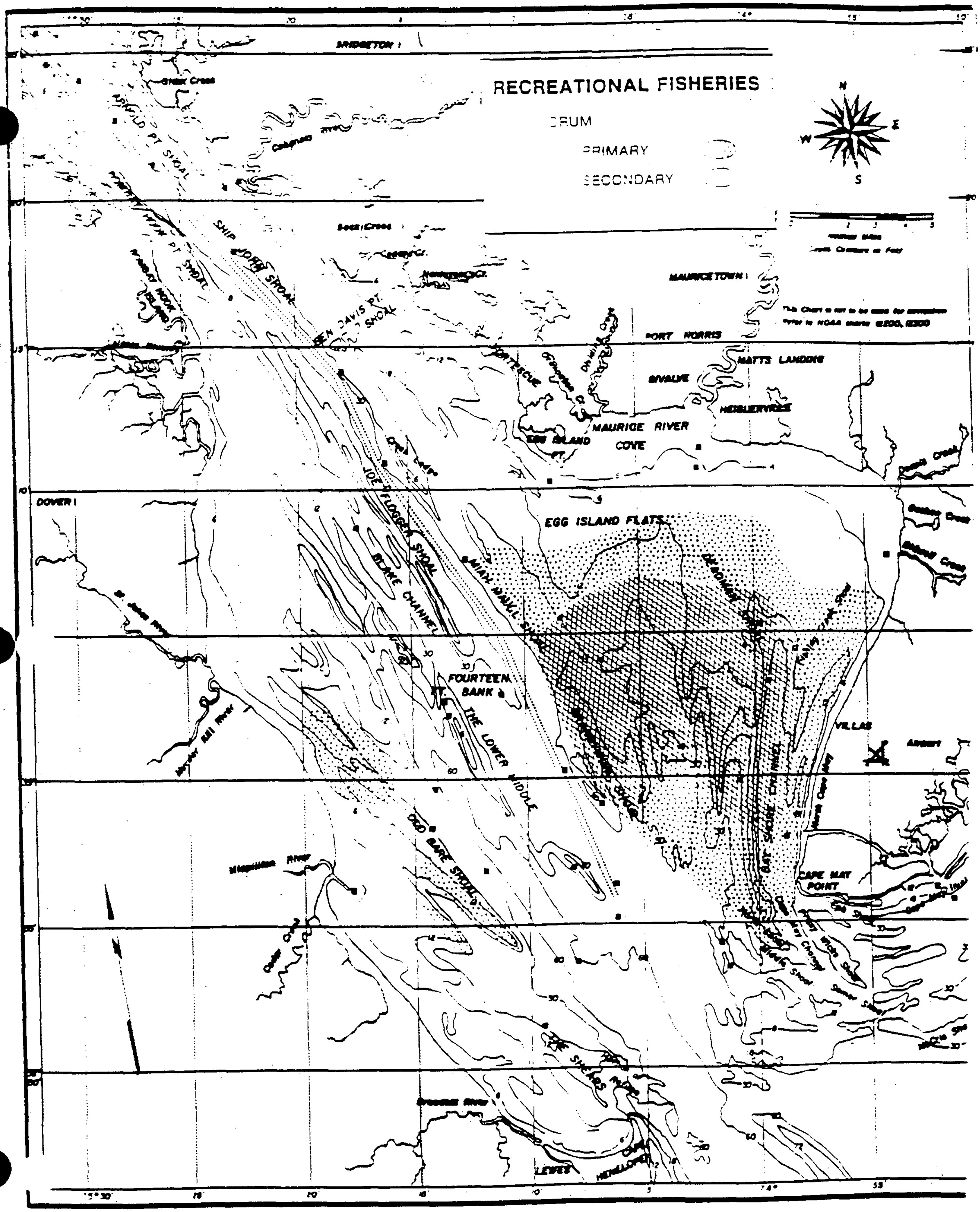
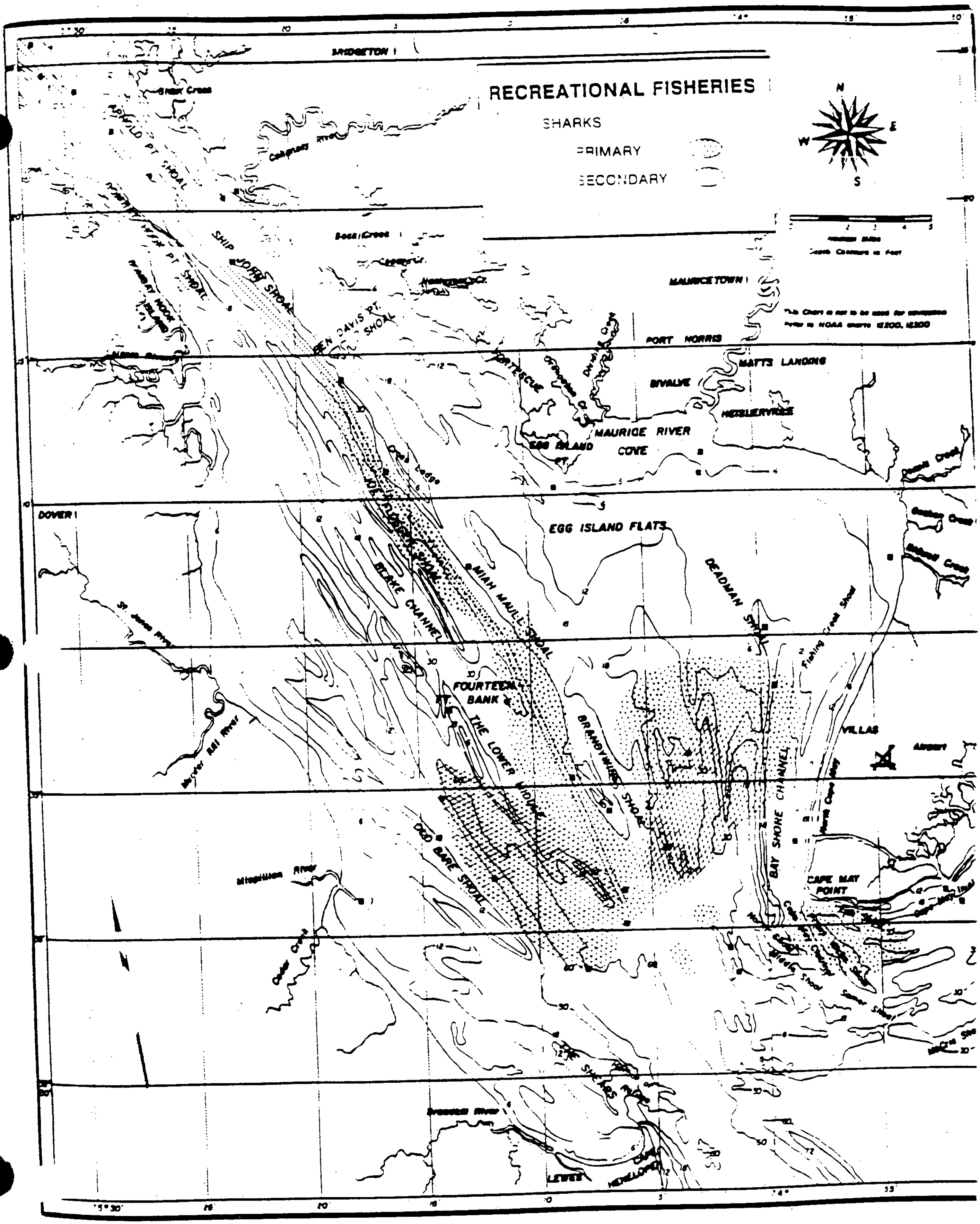
Mispillion River
OLD BARE SHOAL
CAPE MAY POINT
Cedar Creek
Broadkill River
LEWES
CAPE HENLOPEN


RECREATIONAL FISHERIES
SPOT
SEA BASS
CROAKERS
DELAWARE SEA BASS
N
E
S
W
Nautical Miles
Depth Contours in Feet
BRIDGETON
Stow Creek
ARNOLD PT SHOAL
Cohansey River
SHIP JOHN SHOAL
Back Creek
Cedar Cr.
Nantuxent Cr.
BEN DAVIS PT. SHOAL
FORTESCUE
MAURICETOWN
PORT NORRIS
BIVALVE
MATTS LANDING
HEISLERVILLE
MAURICE RIVER COVE
EGG ISLAND PT.
DOVER
St. Jones River
JOE FLOGGER SHOAL
BLAKE CHANNEL
MIAH MAULL SHOAL
EGG ISLAND FLATS
DEADMAN SHOAL
FOURTEEN FT. BANK
THE LOWER MIDDLE
BRANDYWINE SHOAL
BAY SHORE CHANNEL
VILLAS
CAPE MAY POINT
Murderkill River
Mispillion River
Cedar Creek
Broadkill River
THE SHEARS
LEWES
CAPE HENLOPEN
75°30'
25'
20'
15'
10'
5'
55'

RECREATIONAL FISHERIES
DRUM
PRIMARY
SECONDARY
N
E
S
W
Nautical Miles
Depth Contours in Feet
This Chart is not to be used for navigation. Refer to NOAA charts 12200, 12300
BRIDGETON
Cohansey River
ARNOLD PT SHOAL
SHIP JOHN SHOAL
BEN DAVIS PT.
BEN DAVIS PT SHOAL
MAURICETOWN
PORT NORRIS
MATTS LANDING
BIVALVE
HEISLERVILLE
MAURICE RIVER COVE
EGG ISLAND PT.
FORTESCUE
DOVER
EGG ISLAND FLATS
JOE FLOGGER SHOAL
BRANDYWINE SHOAL
BLAKE CHANNEL
MIAH MAULL SHOAL
FOURTEEN FT. BANK
THE LOWER MIDDLE
OVERFALLS SHOAL
BAY SHORE CHANNEL
VILLAS
Airport
CAPE MAY POINT
Mispillion River
Cedar Creek
OLD BARE SHOAL
THE SHEARS
Broadkill River
LEWES
CAPE HENLOPEN
74°
75°30'

46


RECREATIONAL FISHERIES

SHARKS

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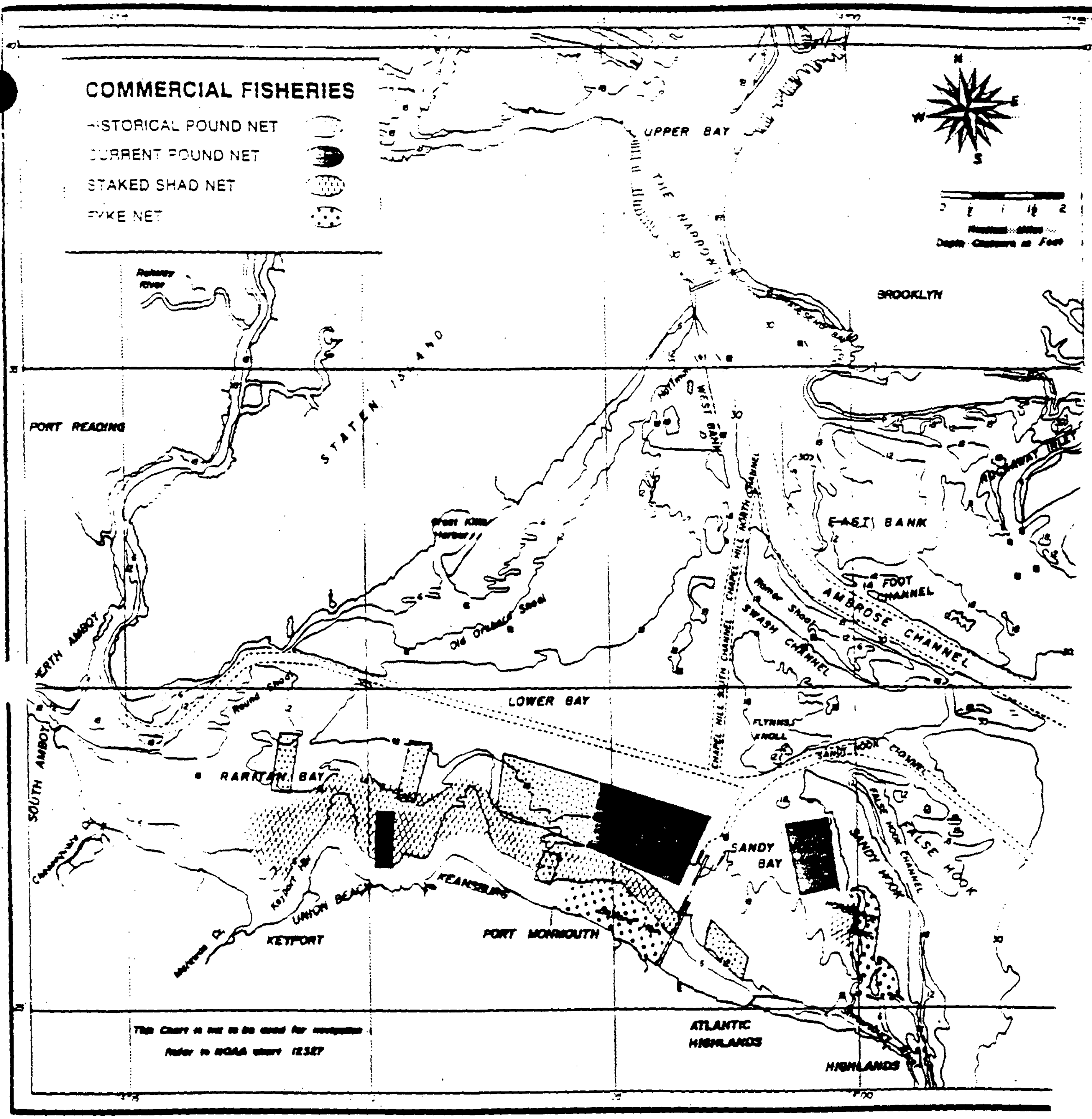
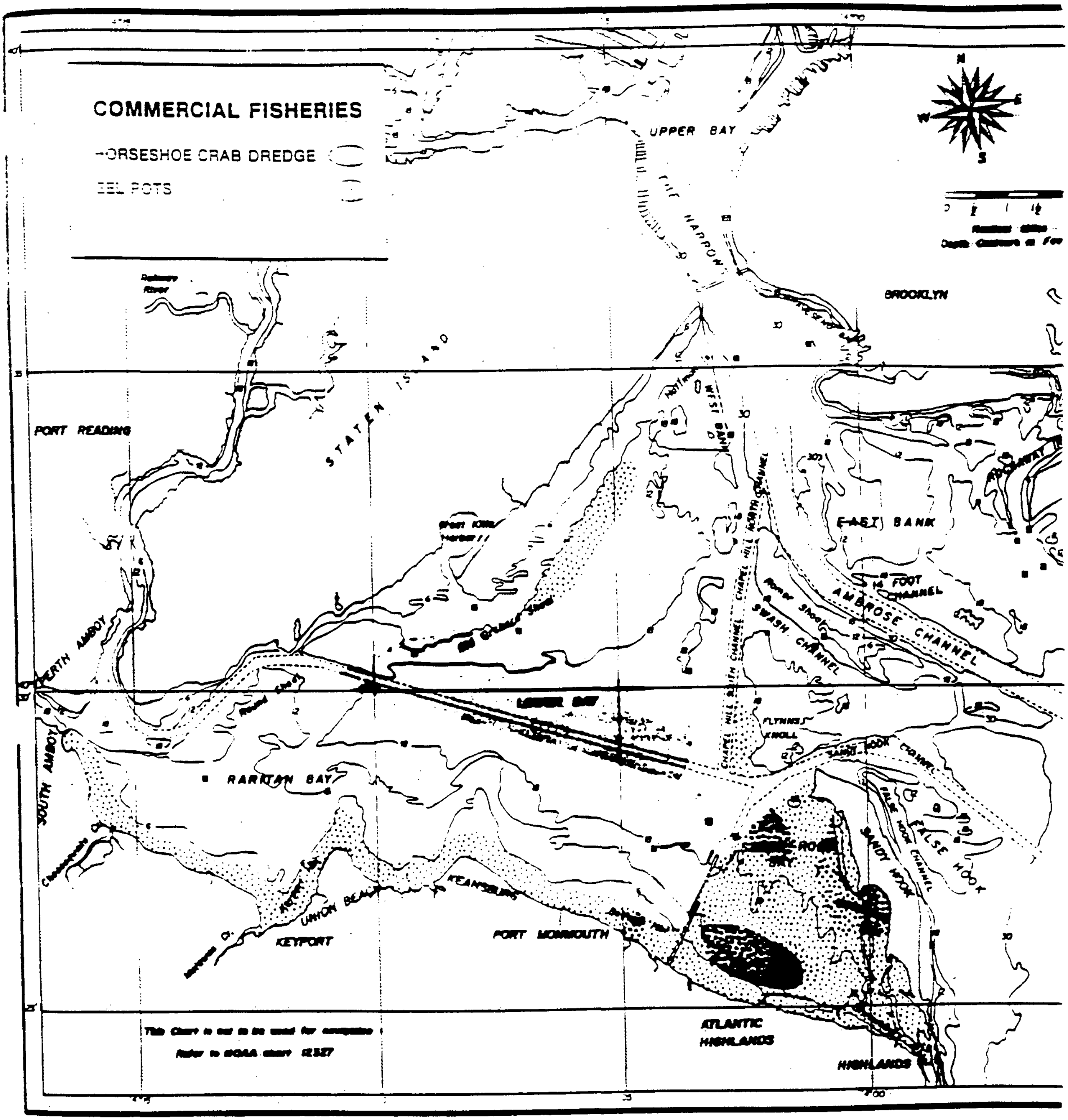

COMMERCIAL FISHERIES
HISTORICAL POUND NET
CURRENT POUND NET
STAKED SHAD NET
FYKE NET
UPPER BAY
THE NARROWS
BROOKLYN
Rahway River
PORT READING
STATEN ISLAND
West Bank
East Bank
Great Kills Harbor
Old Orchard Shoal
Chapel Hill North Channel
Chapel Hill South Channel
Romer Shoal
Swash Channel
Ambrose Channel
18 Foot Channel
Rockaway Inlet
PERTH AMBOY
SOUTH AMBOY
Round Shoal
LOWER BAY
RARITAN BAY
Flynns Knoll
Sandy Hook Channel
False Hook Channel
False Hook
Sandy Hook
SANDY BAY
Cheesequake
Keyport Harbor
Matawan Cr.
UNION BEACH
KEANSBURG
KEYPORT
PORT MONMOUTH
ATLANTIC HIGHLANDS
HIGHLANDS
Nautical Miles
Depth Contours in Feet
This Chart is not to be used for navigation
Refer to NOAA chart 12327

48


COMMERCIAL FISHERIES
HORSESHOE CRAB DREDGE
EEL POTS
UPPER BAY
THE NARROWS
BROOKLYN
Rahway River
STATEN ISLAND
PORT READING
WEST BANK
EAST BANK
ROCKAWAY
Great Kills Harbor
CHAPEL HILL NORTH CHANNEL
CHAPEL HILL SOUTH CHANNEL
Romer Shoal
SWASH CHANNEL
AMBROSE CHANNEL
14 FOOT CHANNEL
PERTH AMBOY
SOUTH AMBOY
LOWER BAY
FLYNNS KNOLL
SANDY HOOK CHANNEL
RARITAN BAY
FALSE HOOK CHANNEL
FALSE HOOK
SANDY HOOK
SANDY HOOK BAY
Cheesequake Cr.
Matawan Cr.
UNION BEACH
KEANSBURG
KEYPORT
PORT MONMOUTH
ATLANTIC HIGHLANDS
HIGHLANDS
Nautical Miles
Depth Contours in Feet
N
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30
12
6
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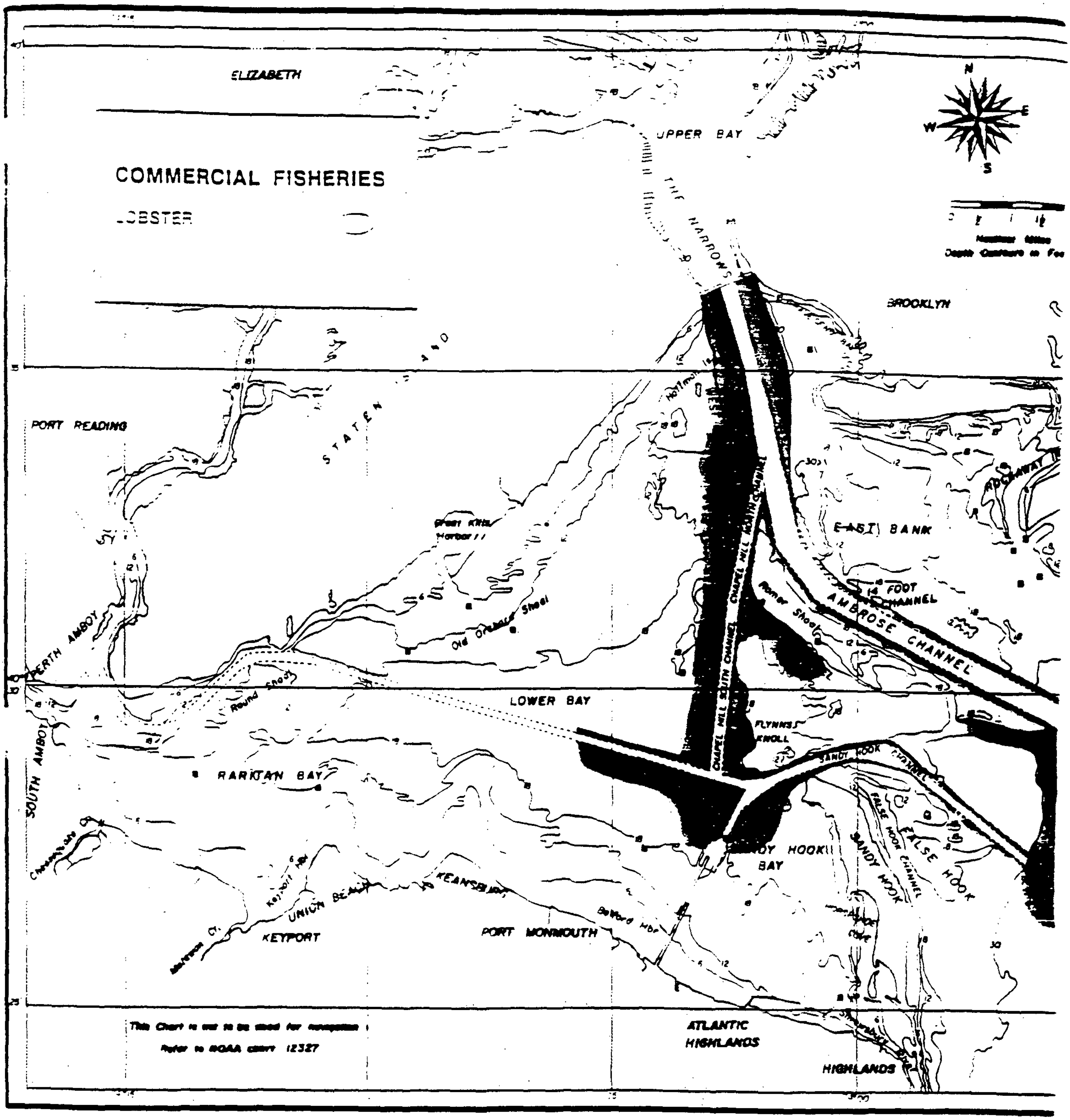
49

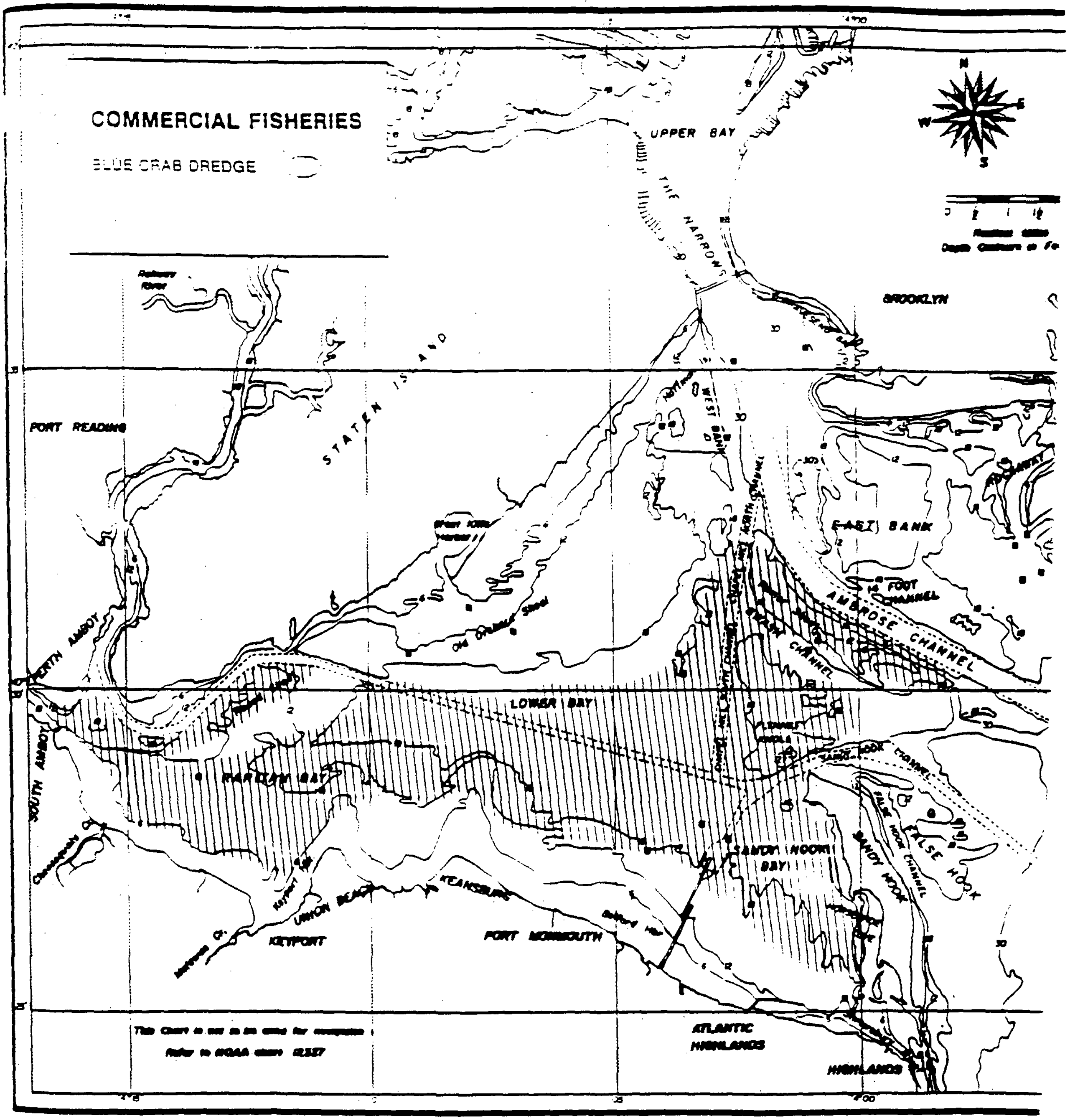


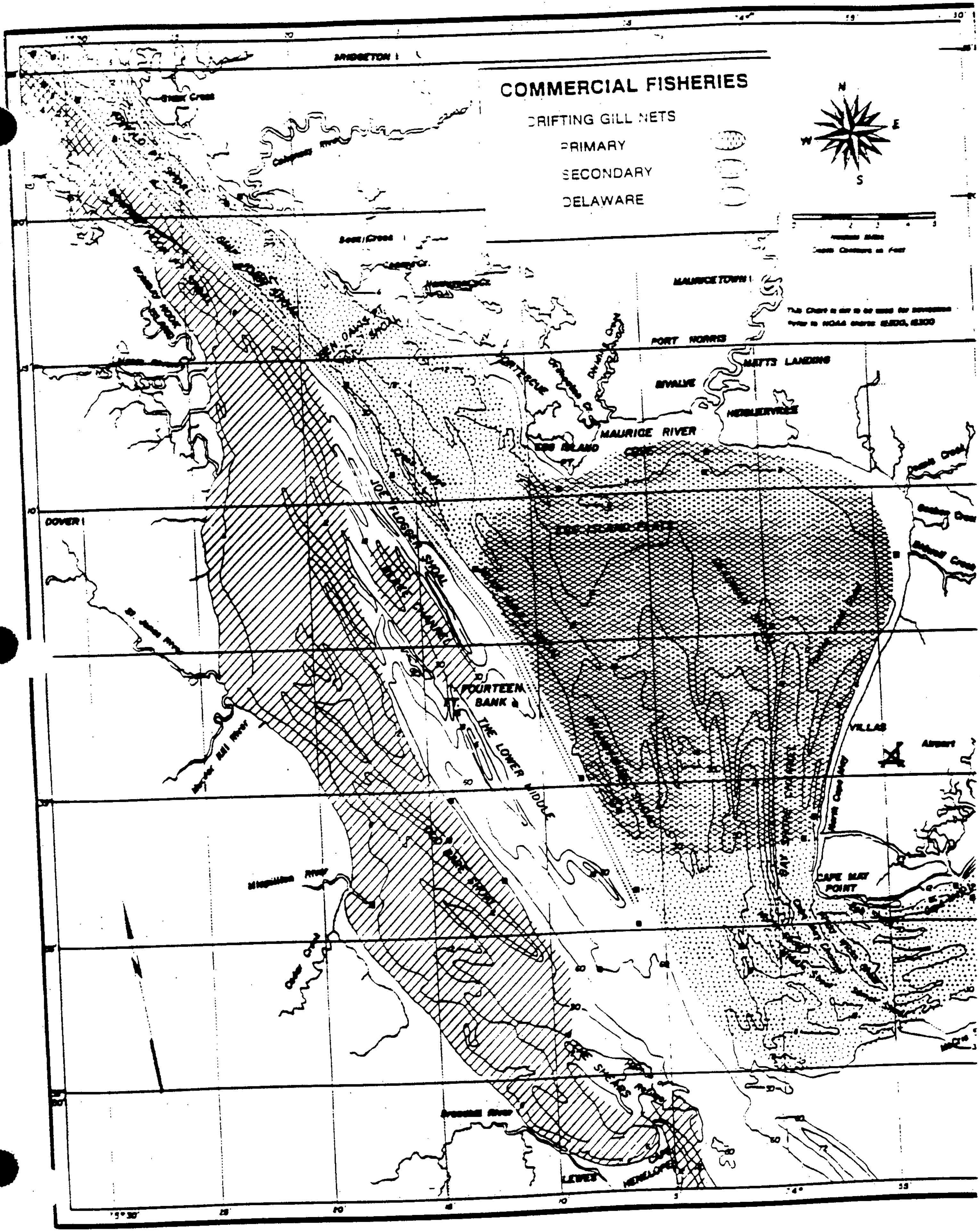
COMMERCIAL FISHERIES

LOBSTER

COMMERCIAL FISHERIES

BLUE CRAB DREDGE




COMMERCIAL FISHERIES
DRIFTING GILL NETS
PRIMARY
SECONDARY
DELAWARE
N
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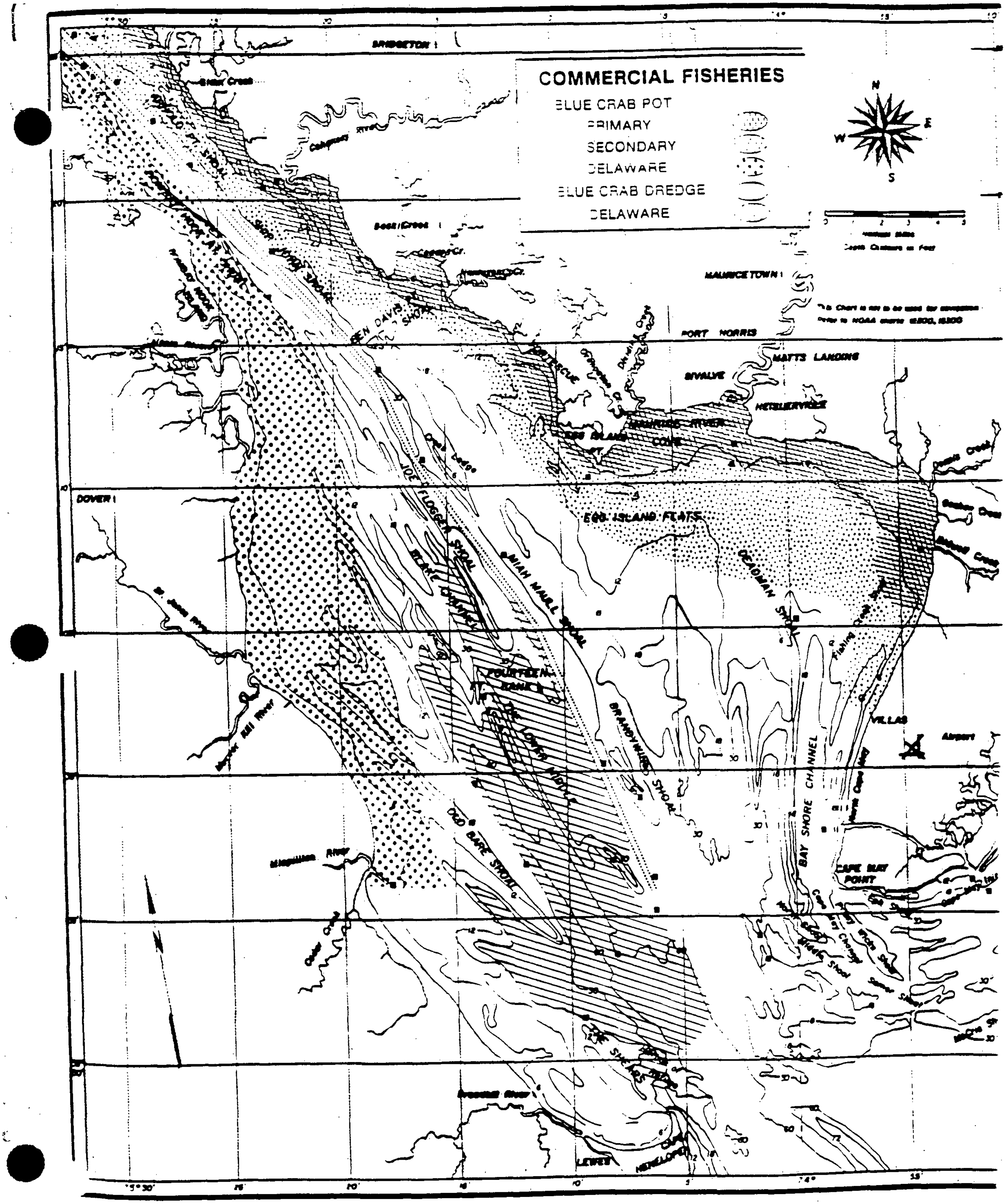
BRIDGETON
MAURICETOWN
PORT NORRIS
MATTS LANDING
BIVALVE
HEISLERVILLE
MAURICE RIVER
EGG ISLAND PT.
FORTESCUE
DOVER
JOE FLOGGER SHOAL
FOURTEEN FT. BANK
THE LOWER MIDDLE
BAY SHORE CHANNEL
VILLAS
Airport
CAPE MAY POINT
LEWES
HENLOPEN
Mispillion River
Broadkill River
Cohansey River
Murderkill River
St Jones River
Cedar Creek
Stow Creek


COMMERCIAL FISHERIES
BLUE CRAB POT
PRIMARY
SECONDARY
DELAWARE
BLUE CRAB DREDGE
DELAWARE
N
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S
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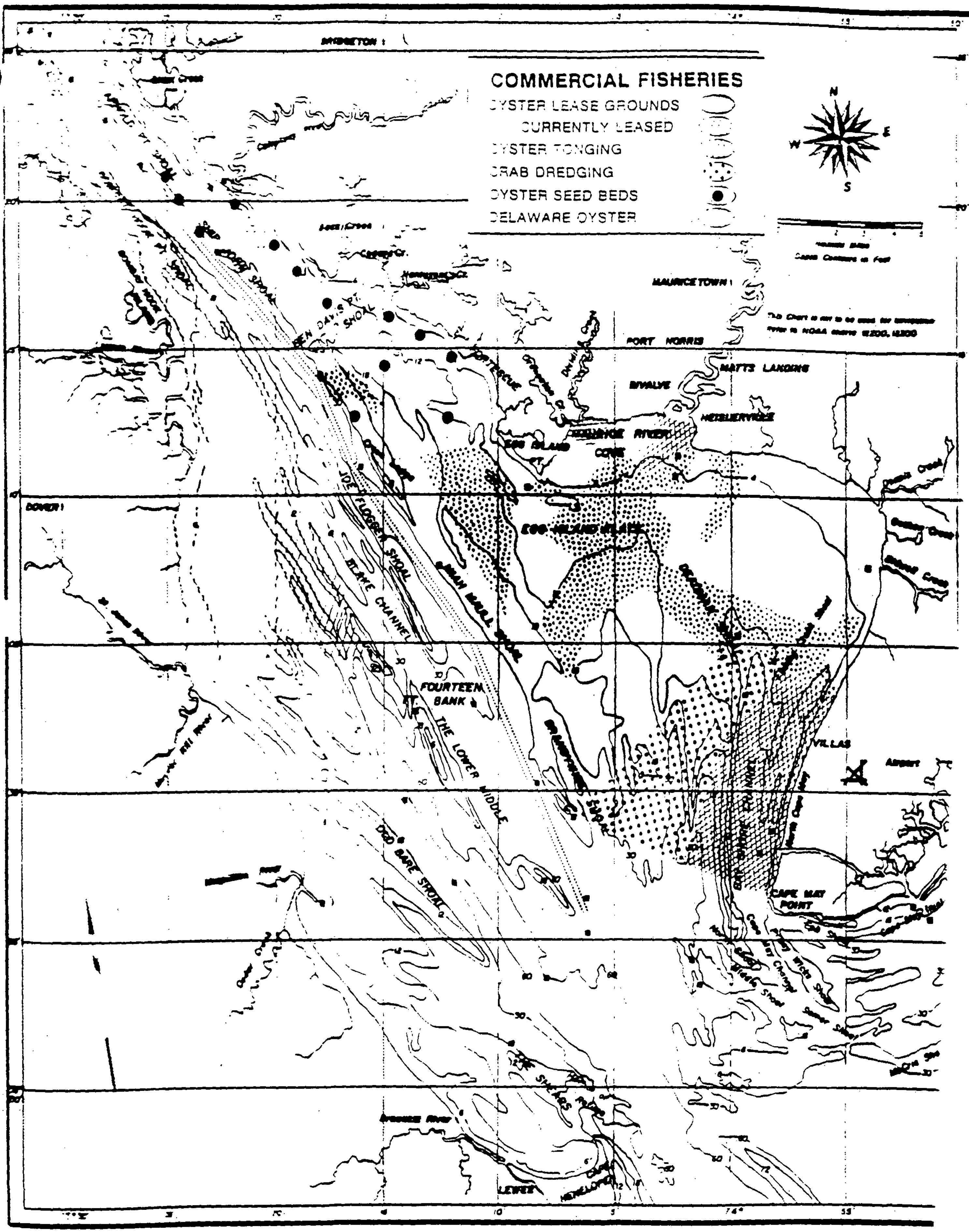
BRIDGETON
Cohansey River
Back Creek
MAURICETOWN
PORT NORRIS
MATTS LANDING
BIVALVE
HEISLERVILLE
MAURICE RIVER COVE
EGG ISLAND PT.
EGG ISLAND FLATS
FORTESCUE
BEN DAVIS PT. SHOAL
DEADMAN SHOAL
JOE FLOGGER SHOAL
BLAKE CHANNEL
MIAH MAULL SHOAL
FOURTEEN FT. BANK
THE LOWER MIDDLE
BRANDYWINE SHOAL
OLD BARE SHOAL
BAY SHORE CHANNEL
Fishing Creek
Dennis Creek
Goshen Creek
VILLAS
Airport
CAPE MAY POINT
DOVER
St. Jones River
Murderkill River
Mispillion River
Cedar Creek
Broadkill River
THE SHEARS
LEWES
CAPE HENLOPEN
75°30'
25'
20'
15'
10'
5'
74°
55'


COMMERCIAL FISHERIES
OYSTER LEASE GROUNDS
CURRENTLY LEASED
OYSTER TONGING
CRAB DREDGING
OYSTER SEED BEDS
DELAWARE OYSTER
N
E
S
W
BRIDGETON
MAURICETOWN
PORT NORRIS
MATTS LANDING
BIVALVE
HEISLERVILLE
MAURICE RIVER
COVE
EGG ISLAND PT.
EGG ISLAND FLATS
DOVER
BEN DAVIS PT. SHOAL
FORTESCUE
JOE FLOGGER SHOAL
BLAKE CHANNEL
FOURTEEN BANK
THE LOWER MIDDLE
BRANDYWINE SHOAL
BRANDYWINE
VILLAS
Airport
CAPE MAY POINT
DEEP BARE SHOAL
LEWES
CAPE HENELOPEN
SHEARS
74°
55'
5'
10'

41

INTRODUCTION

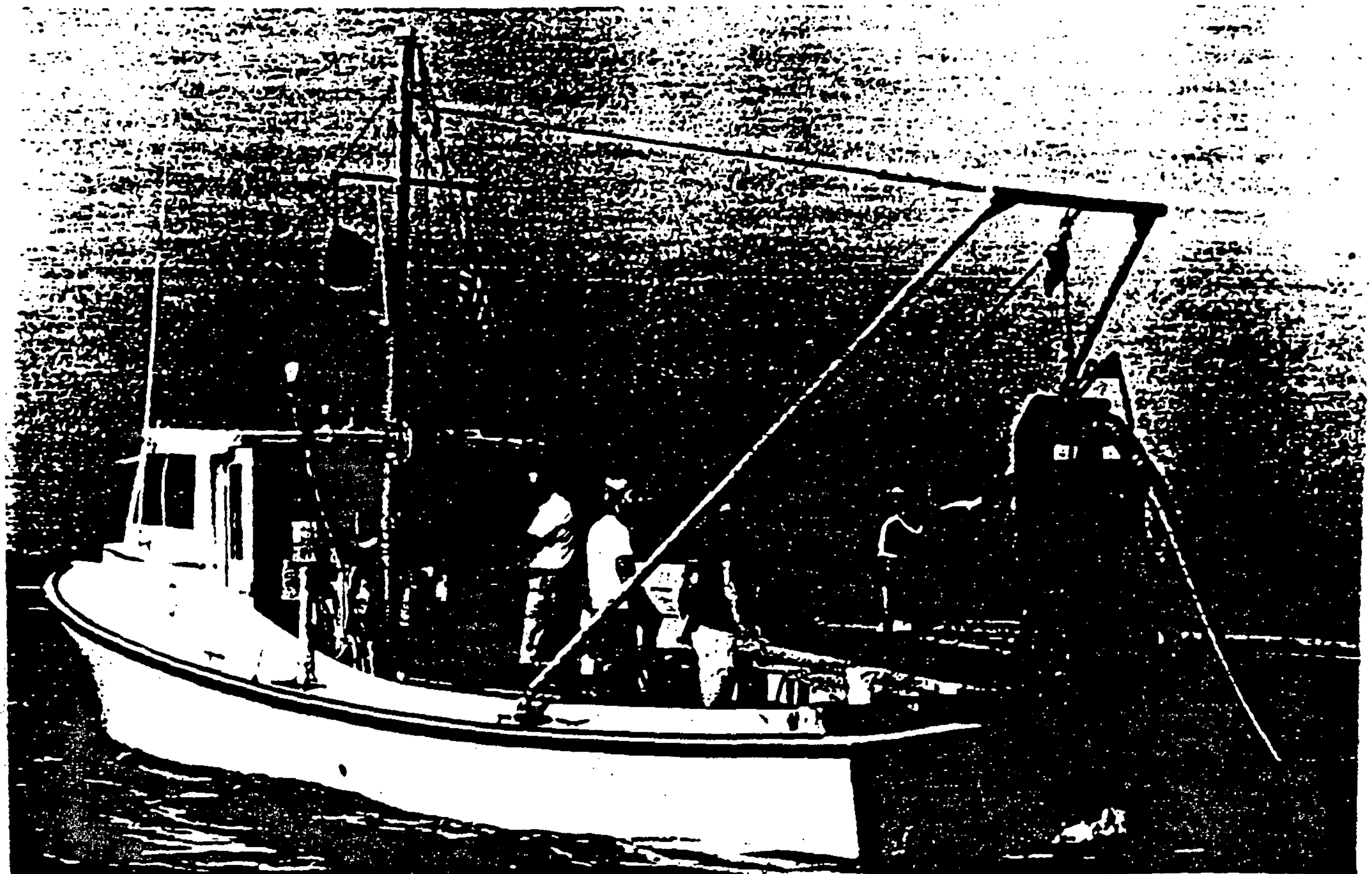
Since the harvest of shellfish has been prohibited in Raritan Bay and Sandy Hook Bay in 1964, it was not possible to delineate current fishing areas through the process of fisherman interview. Instead, the Bureau of Shellfisheries initiated a shellfish inventory of these areas in 1983.

The primary purpose for conducting an inventory was to provide current information on the distribution and abundance of the various shellfish species. The data collected forms the basis on which management programs are developed. Before a resource can be effectively managed information on resource abundance, location and its well-being must be known.

The inventory data also provide an additional benefit when conducting assessments of coastal development projects. Activities such as dredging, spoil disposal, pipeline or cable routing, discharge of sewage effluent, marina construction as well as residential and commercial development along the coast have the potential to adversely affect the shellfish resources by contamination or destruction of shellfish populations, as well as the destruction of its habitat. The information derived from the inventory program is extremely useful in the development review process and serves t protect important shellfish beds from the negative impacts associated with these activities.

The shellfish inventory program was designed primarily to sample hard clam populations because the most current historical information indicated that thi species was the most abundant and widely distributed The sampling technique employed was also capable o collecting other shellfish species such as oysters, so clams, surf clams and blue mussels.

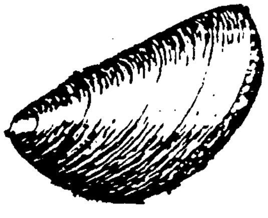
The inventory of Raritan Bay and Sandy Hook Ba has been the first systematic shellfish survey conducted of New Jersey estauries in over twenty year The Bureau of Shellfisheries is continuing this progra throughout all of the state's estauries.

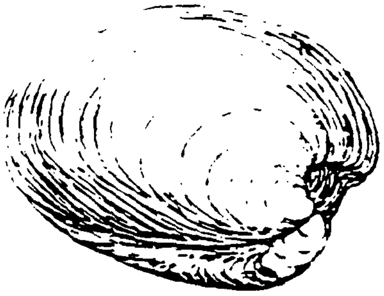


The Bureau of Shellfisheries research vessel, Notata, uses a hydraulic dredge to delineate shellfish groun


Oyster


Soft Clam


Blue Mussel


Hard Clam

METHODS

The sampling device was a miniature hydraulic clam dredge with a knife width of one foot that was towed from a research vessel. Water is pumped from a pump onboard the vessel down to the dredge manifold which has a series of nozzles. Water pumped through the nward directed nozzles loosens the sediment ahead of the knife while the rear facing nozzles wash sediment from the basket. The dredge basket is designed to retain all hard clams 1-3/16 inches or greater in length.

Sampling stations were established at regular intervals throughout Raritan Bay and Sandy Hook Bay. Over two hundred stations were sampled throughout the course of this program. Two tows of approximately 100 feet each were sampled at each station and the density of hard clams was determined by averaging the catch of the two tows. For the purpose of delineating the general abundance pattern of the hard clam resource four classifications of abundance were established-none, occurrence, moderate density and high density. Adjacent stations within the same density classification were grouped together thus giving the general abundance distributions.

Quantitative results for other shellfish species collected (oysters, soft clams, surf clams, mussels) were not deemed as useful because the sampling gear was not specifically designed for their capture. However, the information collected on these other species was sufficient to permit delineation of the significant beds.

HARVEST METHODS

Soft clams are harvested by a method known as "hoe and net" which is rather unique to New Jersey. All harvesting is conducted in shoal areas with the harvester in the water. The harvester works the hoe up and down creating a depression in the bottom. As the clams are dislodged from the sediment they become buoyant and are scooped up with the net. No mechanical gear is allowed for harvest.

Hard clams are harvested by a variety of methods. wever, laws in New Jersey restrict the harvest to nd employed gear only. No mechanical harvest or dredging is permitted. Three commonly used harvest methods in New Jersey include treading, tonging and raking. In treading, the clammer, proceeding backwards, shuffles his feet through the mud. When the hard edge of a clam is encountered, the clammer takes a breath, ducks under and pulls the clam out of the bottom. The equipment required for treading includes an intertube and basket to hold clams and thin rubber boots and gloves to protect feet and hands.

Tonging is done from an anchored boat. The tong handles are opened and closed, forcing the tong's teeth to scrape the upper two or three inches of substrate and pick up loosened clams. The area around the entire boat is worked before the anchor is moved.

n raking, the third method, the boat is allowed to drift while the rake is dragged across the bottom. The handle is worked up and down by hand to insure a smooth and continuous drag. The long teeth of the rake ft the clams out of the bottom and the mesh bask at the back of the rake holds the clams until the ra s lifted into the boat.

FISHERY

All of Raritan Bay and Sandy Hook Bay is moderately polluted and is classified as condemned for the direct market harvest of shellfish. Consequently, there is no recreational fishery and, prior to 1983, only a small commercial soft clam fishery existed. Following the shellfish inventory of 1983 a commercial fishery for hard clams was initiated under closely controlled conditions. At present, the only shellfish species for which a commercial fishery exists are hard and soft clams.

Because the water of these areas is moderately polluted, the shellfish must be cleansed prior to consumption. When polluted clams are placed in a clean water environment they have the ability to flush bacterial and viral contaminants out of their digestive system through a natural cleansing mechanism. This cleansing process is accomplished through three State supervised programs known as soft clam depuration, hard clam depuration and hard clam relay.

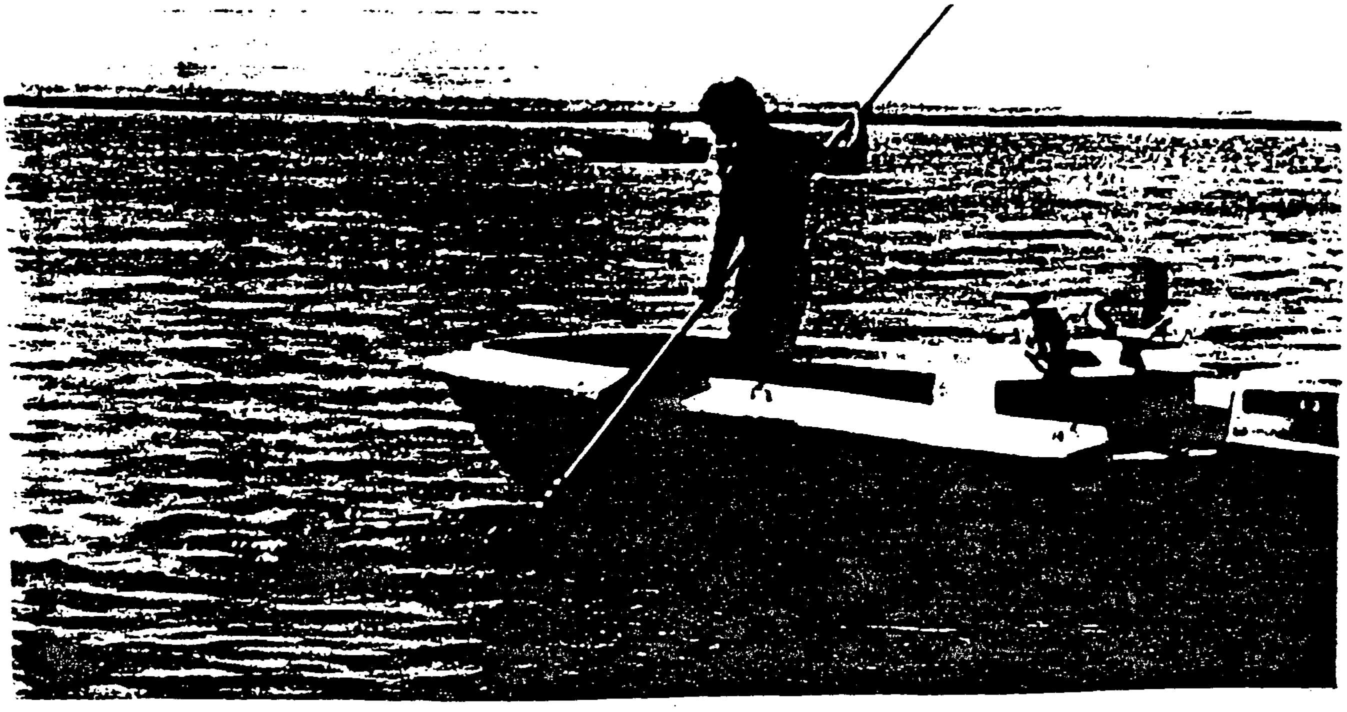
Soft clam and hard clam depuration are similar processes with slightly different operating requirements because of the physiological differences between the two species. Both operations start with the harvest of the clams from moderately polluted areas. The clams are then transported to a depuration plant. Once in the plant the clams are placed in tanks and flooded with purified water for 48 hours. Through their natural feeding activity they eliminate harmful contaminants from their system and are acceptable for marketing a consumption.

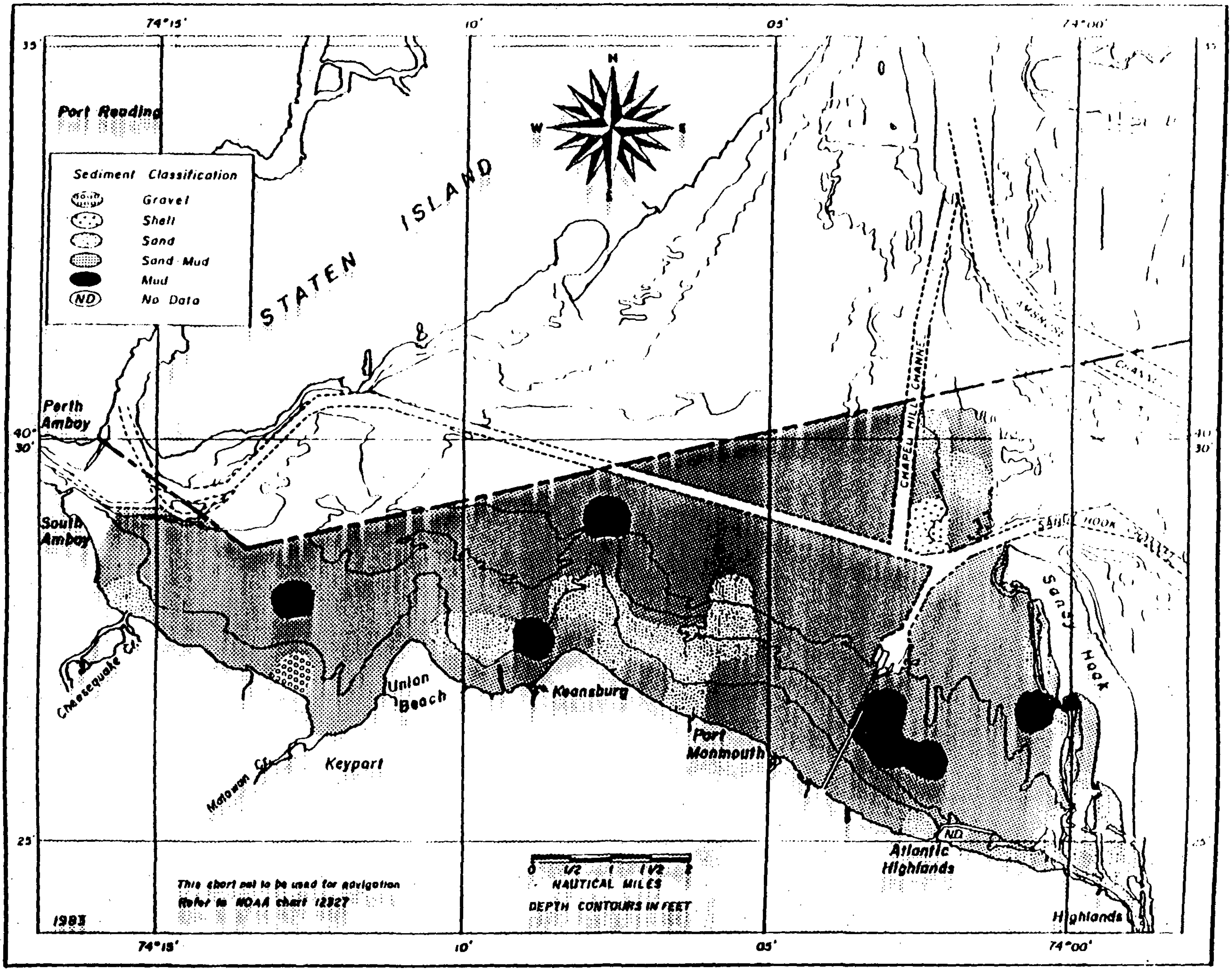
The hard clam relay also begins with the harvest clams from moderately polluted waters. The clams a then transplanted to "relay lots", leased from the St by shellfishermen, which are in areas of good wa quality. Following a thirty day cleansing period clams are tested and available for harvesting a subsequent marketing.

There are no conservation associated seasonal strictions on the harvest of hard or soft clams. For most part they are harvested year round subjec weather and market conditions.

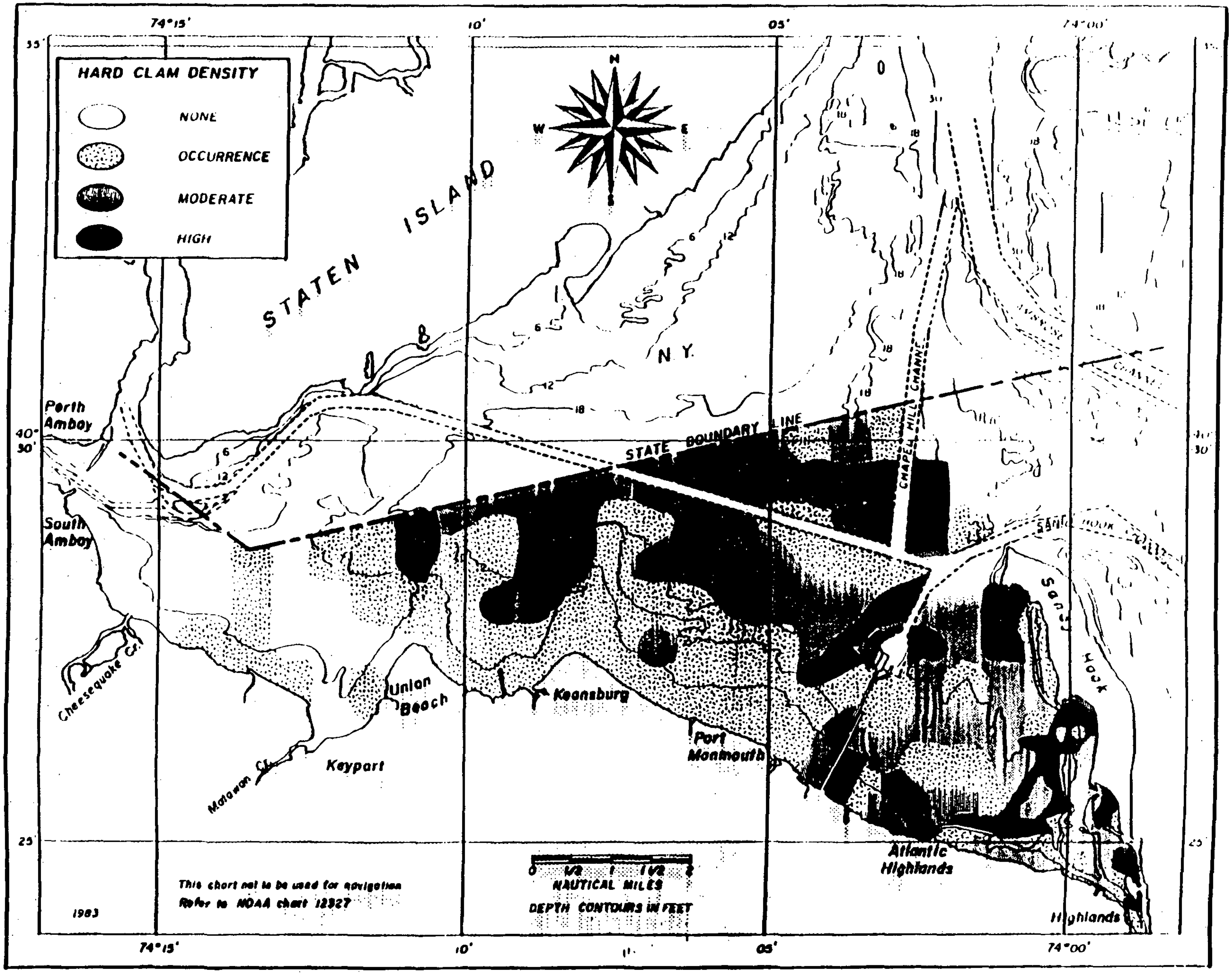
The soft clam depuration program is responsible practically all of the commercial landings of soft cla in New Jersey. The primary reason is that the sig cant soft clam resource is located in northern M mouth County waters all of which are closed to di market harvest of shellfish.

The hard clam relay and depuration program counted for 25 percent of the total commercial h clam landings in New Jersey in 1984-86. The remair of the landings were from waters of the State wi harvesting for direct marketing is approved. Althc there is increasing interest and activity in aquaculture of hard clams in New Jersey the maj of the landings come from natural stock.





Ref. No. 16, p. 39 of 42 PR



Ref. No. 16, p. 40 of 42

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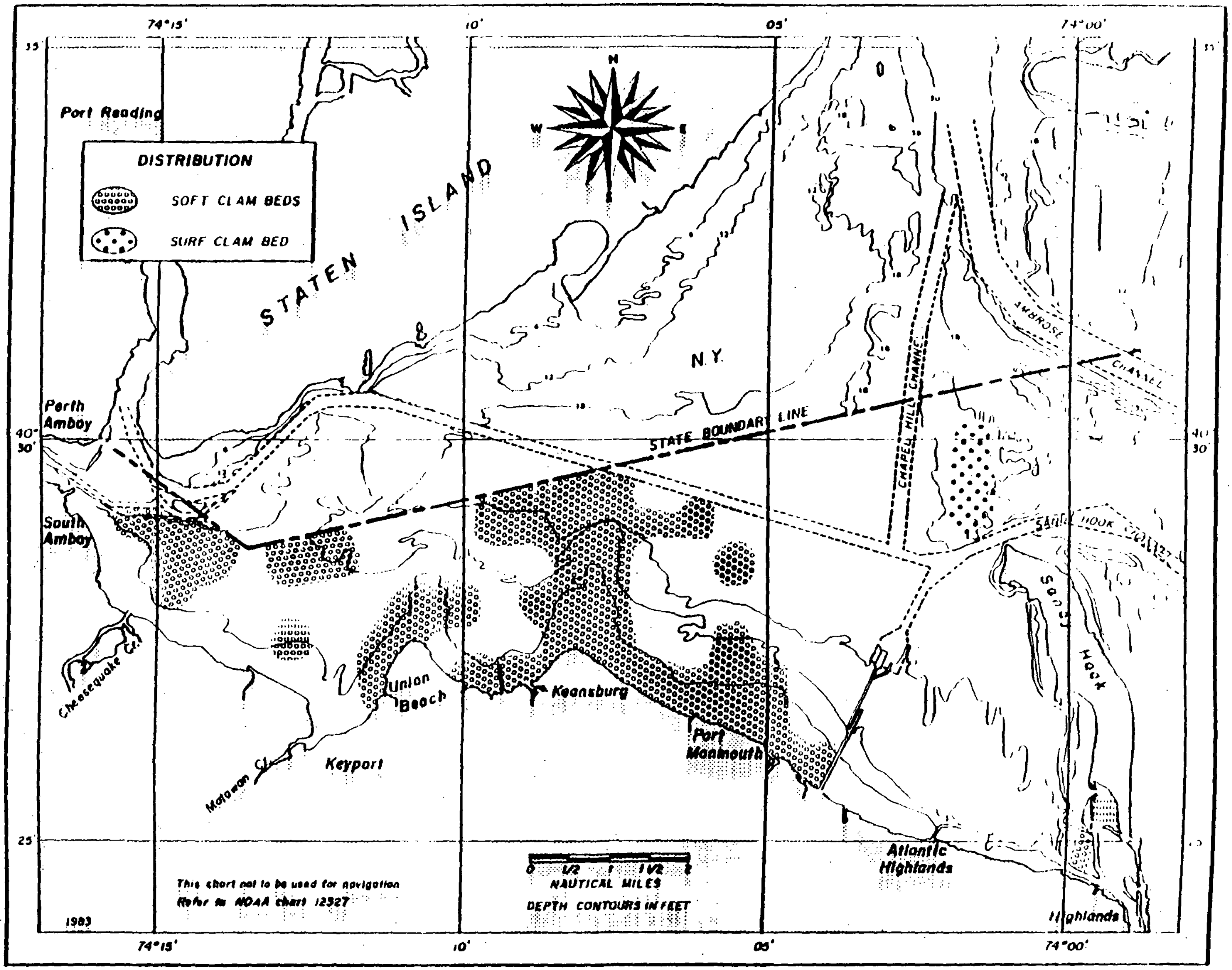
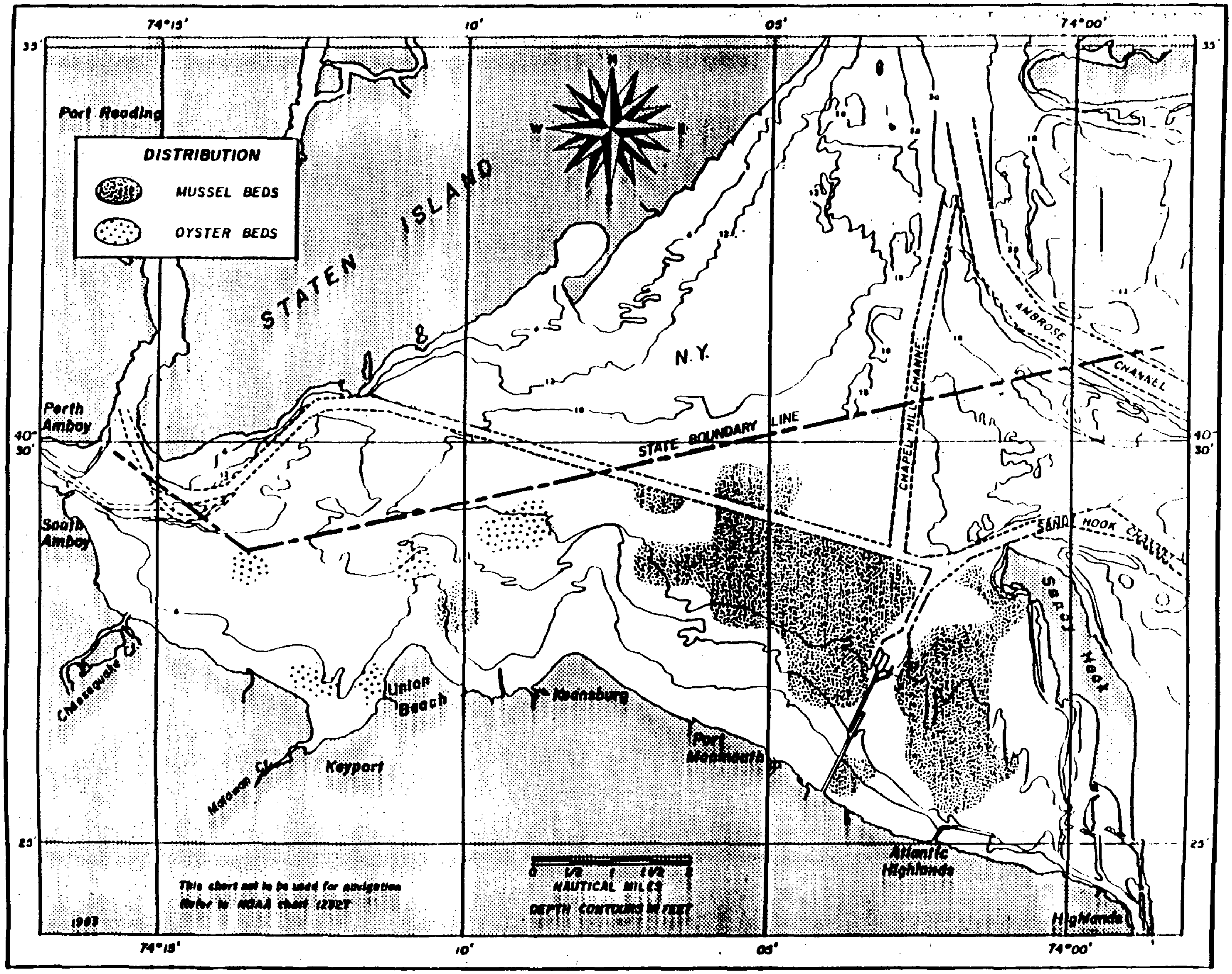

DISTRIBUTION
SOFT CLAM BEDS
SURF CLAM BED
74°15'
10'
05'
74°00'
40°
30'
25'
Port Reading
STATEN ISLAND
N.Y.
N
W
E
STATE BOUNDARY LINE
CHAPEL HILL CHANNEL
AMBROSE CHANNEL
SANDY HOOK CHANNEL
Perth Amboy
South Amboy
Cheesequake Cr.
Union Beach
Keansburg
Keyport
Matawan Cr.
Port Monmouth
Sandy Hook
Atlantic Highlands
Highlands
0 1/2 1 1 1/2 2
NAUTICAL MILES
DEPTH CONTOURS IN FEET
This chart not to be used for navigation
Refer to NOAA chart 12327
1983



Ref. No. 16, p. 42 of 42

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102094 9

REFERENCE NUMBER 17

ARCS II CONTRACT 68-W9-0051
MALCOLM PIRNIE, INC.
RECORD OF TELEPHONE CONVERSATION/AGREEMENT

File No. 8003-337

Date: July 27, 1995 Time: 2:00 AM ☐ PM ☑

Outgoing Call

To: Hanif Sheikh (908)-906-6169
Telephone No.

Affiliation: USEPA Region II - Edison Facility, MMB

Malcolm Pirnie Staff: Lisa Greco Lisa Greco (609) 860-0100
Telephone No.

Summary of Conversation:

The correct formula to use to calculate SQL's for inorganic data is the following:

{C X V X F) / ((1,000 X W) X (% solids/100))}

where:
C = CRDL in ug/l
V = final volume (200 mL for all analytes except Hg. Hg final volume = 100 mL)
F = dilution factor
W = wet weight of sample in grams

This will result in a value given in mg/kg.

Ref 267, p. 1 of 1

REFERENCE NUMBER 18

ARCS II CONTRACT 68-W9-0051
MALCOLM PIRNIE, INC.
RECORD OF TELEPHONE CONVERSATION/AGREEMENT

File No. 8002-123

Date: November 9, 1994 Time: 9:30 AM ☒ PM ☐

Outgoing Call

To: Hanif Sheikh 908-906-6169
Telephone No.

Affiliation: USEPA Region 2 - Edison Facility, MMB

Malcolm Pirnie Staff: Valerie Smith (609) 860-0100
Telephone No.

Summary of Conversation:

When soil/sediment sample data is qualified as estimated 'J' due to percent moisture content greater than 50% is the associated result considered to be of low, high, or unknown bias? According to Hanif, the result would be considered high bias based on the fact that when the soil/sediment fraction result is divided by a low percent solids content versus a high percent solids content, the result as well as the associated instrument detection limit will go up.

Ref No 18, p 1 of 1

REFERENCE NUMBER 19

USEPA CONTRACT LABORATORY PROGRAM

STATEMENT OF WORK
FOR
INORGANICS ANALYSIS

Multi-Media
Multi-Concentration

Document Number ILM01.0

Ref No 19, p. 1 of 5

RHS

EXHIBIT C

INORGANIC TARGET ANALYTE LIST

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INORGANIC TARGET ANALYTE LIST (TAL)

Analyte	Contract Required Detection Limit (1,2) (ug/L)
Aluminum	200
Antimony	60
Arsenic	10
Barium	200
Beryllium	5
Cadmium	5
Calcium	5000
Chromium	10
Cobalt	50
Copper	25
Iron	100
Lead	3
Magnesium	5000
Manganese	15
Mercury	0.2
Nickel	40
Potassium	5000
Selenium	5
Silver	10
Sodium	5000
Thallium	10
Vanadium	50
Zinc	20
Cyanide	10

(1) Subject to the restrictions specified in the first page of Part G, Section IV of Exhibit D (Alternate Methods - Catastrophic Failure) any analytical method specified in SOW Exhibit D may be utilized as long as the documented instrument or method detection limits meet the Contract Required Detection Limit (CRDL) requirements. Higher detection limits may only be used in the following circumstance:

> If the sample concentration exceeds five times the detection limit of the instrument or method in use, the value may be reported even though the instrument or method detection limit may not equal the Contract Required Detection Limit. This is illustrated in the example below:
>
> For lead:
>
> Method in use - ICP
> Instrument Detection Limit (IDL) - 40
> Sample concentration - 220
> Contract Required Detection Limit (CRDL) - 3

Ref No 19, p. 4 of 5

The value of 220 may be reported even though instrument detection limit is greater than CRDL. The instrument or method detection limit must be documented as described in Exhibit E.

(2) The CRDL are the instrument detection limits obtained in pure water that must be met using the procedure in Exhibit E. The detection limits for samples may be considerably higher depending on the sample matrix.

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FORM I-IN includes fields for three types of result qualifiers. These qualifiers must be completed as follows:

- C (Concentration) qualifier -- Enter "B" if the reported value was obtained from a reading that was less than the Contract Required Detection Limit (CRDL) but greater than or equal to the Instrument Detection Limit (IDL). If the analyte was analyzed for but not detected, a "U" must be entered.

- Q qualifier -- Specified entries and their meanings are as follows:

  E - The reported value is estimated because of the presence of interference. An explanatory note must be included under Comments on the Cover Page (if the problem applies to all samples) or on the specific FORM I-IN (if it is an isolated problem).

  M - Duplicate injection precision not met.

  N - Spiked sample recovery not within control limits.

  S - The reported value was determined by the Method of Standard Additions (MSA).

  W - Post-digestion spike for Furnace AA analysis is out of control limits (85-115%), while sample absorbance is less than 50% of spike absorbance. (See Exhibit E.)

  * - Duplicate analysis not within control limits.

  \+ - Correlation coefficient for the MSA is less than 0.995.

  Entering "S", "W", or "+" is mutually exclusive. No combination of these qualifiers can appear in the same field for an analyte.

- M (Method) qualifier -- Enter:

  - "P" for ICP
  - "A" for Flame AA
  - "F" for Furnace AA
  - "PM" for ICP when Microwave Digestion is used
  - "AM" for flame AA when Microwave Digestion is used
  - "FM" for Furnace AA when Microwave Digestion is used
  - "CV" for Manual Cold Vapor AA
  - "AV" for Automated Cold Vapor AA
  - "CA" for Midi-Distillation spectrophotometric.
  - "AS" for Semi-Automated Spectrophotometric
  - "C" for Manual Spectrophotometric
  - "T" for Titrimetric
  - " " where no data has been entered.
  - "NR" if the analyte is not required to be analyzed.

A brief physical description of the sample, both before and after digestion, must be reported in the fields for color (before and after), clarity (before and after), texture and artifacts. For water samples, report color and clarity. For soil samples, report color, texture and artifacts.

Ref No 19, p. 2 of 5

REFERENCE NUMBER 20

[illegible] copies to
Juan He
Elain B
Cathy M. A.
Arthur
Walter
Buddy
Rob Koesecker
Tapan Basu
Dennis
Ayannah
Joe
Diane C.
Amy
Edison-Punch

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
SOLID WASTE AND EMERGENCY
RESPONSE

AUG 4 1994

MEMORANDUM

SUBJECT: Distribution of the "Using Qualified Data to Document an Observed Release" Factsheet

FROM: Steve Caldwell, Acting Chief
Site Assessment Branch
Steve Caldwell

TO: Site Assessment Section Chiefs
Regions I - X

Please find enclosed the draft factsheet "Using Qualified Data to Document an Observed Release". The factsheet provides guidance and methodology on how to use J-qualified data for documenting an observed release with the HRS.

This factsheet is being distributed to you as interim guidance. The approach presented in the factsheet is effective immediately and can be cited in HRS documentation records. We will be evaluating the data usability methodology after a year and will adjust as necessary.

If you have any questions or issues concerning the factsheet, please call Yolanda Ting of my staff at (703) 603-8835.

Attachment

cc: Regional NPL Coordinator
Headquarters Regional Coordinator
DynCorp Viar

Ref No. 20 p. 1 of 15

United States
Environmental Protection
Agency

Office of
Solid Waste and
Emergency Response

Directive 9285.7-14FS
PB94-963311
EPA/540/F-94/028
July 1994

EPA

Using Qualified Data to Document an Observed Release

Office of Emergency and Remedial Response
Hazardous Site Evaluation Division (5204G)

Quick Reference Fact Sheet

Abstract

Data validation checks the accuracy of analytical data, and qualifies results that fall outside performance criteria of the Contract Laboratory Program (CLP). Results qualified with a "J" are estimated concentrations that may be biased, but may be used to determine an observed release in Hazard Ranking System (HRS) evaluation. This fact sheet explains the conditions for use of "J"-qualified data, and introduces factors which compensate for variability and enable their use in HRS evaluation.

Why Qualify Data?

Chemical concentration data for environmental decision-making are generated using analytical methods. EPA analytical chemistry methods are designed to provide the definitive analyte identification and quantitation needed to establish an observed release under the Hazard Ranking System (HRS). Routine operational variations in sampling and analysis inevitably introduce a degree of error into the analytical data. Data validation checks the usability of the analytical data for HRS evaluation and identifies the error (bias) present. The validation process qualifies the biased data. Certain types of qualified data for release and background samples may be used to determine an observed release.

EPA Data Qualifiers

EPA analytical methods (e.g., SW-846 and Contract Laboratory Program [CLP]) introduce a number of Quality Assurance/Quality Control (QA/QC) mechanisms during the course of sample analysis to measure qualitative and quantitative accuracy.[3,4,8,9] Such mechanisms include matrix spikes, matrix spike duplicates, laboratory control samples, surrogates, blanks, laboratory duplicates, and quarterly blind performance evaluation (PE) samples. Surrogates and spikes are chemically similar to the analytes of interest and thus behave similarly during the analytical process. They are introduced or "spiked" at a known concentration into the field samples before analysis. Comparison of the known concentrations of the surrogates and spikes with their analytical results measures accuracy, and may indicate bias caused by interferences from the sample medium (matrix effect).[1,2,9] Laboratory control samples contain known concentrations of target analytes and are analyzed in the same batch as field samples. Their results are used to measure laboratory accuracy. Blanks are analyzed to detect any extraneous contamination introduced either in the field or in the laboratory. Laboratory duplicates consist of one sample that undergoes two separate analyses; the results are compared to determine laboratory precision. Quarterly blind PE samples also evaluate lab precision.

CLP and other EPA analytical methods include specifications for acceptable identification, and minimum and maximum percent recovery of the target analytes and QA/QC compounds. Data are validated according to guidelines which set performance criteria for instrument calibration, analyte identification, and identification and recovery of the QA/QC compounds.[3,4,9] The *National Functional Guidelines for Data Review* used in EPA validation were designed for data generated under the CLP organic and inorganic analytical protocols.[1,2,3,4] The guidelines do not preclude the validation of field and non-CLP data; many EPA Regions have adapted the *National Functional Guidelines for Data Review* to validate non-CLP data. Data which do not meet the

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guidelines' performance criteria are qualified to indicate bias or QC deficiencies. The data validation report usually explains why the data were qualified and indicates the direction of bias when it can be determined. Most EPA validation guidelines use the data qualifiers presented below. [illegible] (Other data qualifiers besides these are in use: always check the validation report for the exact list of qualifiers and their meanings.)

- **"U" qualifier** -- the analyte was analyzed for, but was not detected above the reported sample quantitation limit. For practical purposes, "U" means "not detected"; the result is usable for characterizing background concentrations for HRS evaluation. [5]
- **"J" qualifier** -- the analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample. "J" data are biased, but provide definitive analyte identification, and are usually reliable. They may be used to determine an observed release under conditions specified later in this fact sheet. [5]
- **"N" qualifier** -- the analysis indicates the presence of an analyte for which there is presumptive evidence to make a "tentative identification." "N" data are not sufficiently definitive for HRS evaluation.
- **"NJ" qualifier** -- the analysis indicates the presence of an analyte that has been "tentatively identified" and the associated numerical value represents its approximate concentration. "NJ" data are not sufficiently definitive for HRS evaluation.
- **"UJ" qualifier** -- the analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample. "UJ" non-detects are not definite; the analyte may be present. The result can be used to document non-detects in background samples under certain conditions.
- **"R" qualifier** -- the sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified. EPA does not use "R" data because they are considered unreliable. [5]

Validated data that are not qualified are unbiased and can be used at their reported values for HRS evaluation.

Criteria for Determining an Observed Release with Chemical Data

Chemical data demonstrate an observed release when all of the following are true:

1. The release of a hazardous substance is at least partially attributable to the site under investigation.
2. The release sample concentration is greater than or equal to the appropriate detection limit (e.g., sample quantitation limit [SQL]).
3. If background levels are below detection limits, the release sample concentration must be greater than its detection limit, or, if background levels are greater than or equal to detection limits, the release sample concentration must be at least three times the background concentration. [7]

Direction of Bias in "J"-Qualified Data

It is important to understand the bias associated with "J"-qualified data when using them for HRS evaluation. "J" data may have high, low, or indeterminate bias. A low bias means that the reported concentration is most likely an underestimate of the true concentration. For example, data may be biased low when sample holding times for volatile organic compounds (VOCs) are exceeded or when the recovery of QA/QC compounds is significantly less than the true amount originally introduced into the sample. A high bias means that the reported concentration is most likely an overestimate of the true concentration. A bias is indeterminate when it is impossible to ascertain whether the concentration is an overestimate or an underestimate. For example, an indeterminate bias could result when matrix effects obscure QA/QC compounds.

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Qualified Data and Direction of Bias

Qualified data may be used when it can be demonstrated that the data meet the HRS rule for determining an observed release despite the bias in the reported concentrations. This condition depends on the direction of bias: low bias data may be used for release samples, and high bias data may be used for background samples. Low bias release samples are underestimates of true concentration. Underestimated release concentrations that still meet the HRS criteria (e.g., they are still three times background level) clearly establish an observed release. High bias background samples are overestimates of background level. If the concentration of unbiased release samples still significantly exceeds an overestimated background level according to HRS criteria, an observed release is clearly established. Similarly, an observed release is established when low bias release concentrations significantly exceed high bias background concentrations according to the HRS criteria.

These scenarios show that low bias "J-"qualified data may be used for release samples at their reported concentrations, and that high bias "J-"qualified data may be used for background samples at their reported concentrations.

High bias release samples may not be used at their reported concentrations because they are an overestimate of true concentration; the true concentration might be less than the HRS criteria for an observed release. The reported concentration for low bias background concentrations may not be compared to release samples because it is most likely an underestimate of background level; the release sample concentration might not significantly exceed the background concentration. However, high bias release data and low bias background data may be used with factors which compensate for the variability in the data. The factors will enable these types of biased data to meet HRS criteria for determining an observed release.

Factors for Biased Data: Tables 1 through 4 (pages 6-13) present analyte-specific factors to address the uncertainty when determining an observed release using high bias release data and low bias background data. The factors are derived from percent recoveries of matrix spikes, surrogates, and laboratory control samples in the CLP Analytical Results Database (CARD) from January 1993 to March 1994. The range of CARD data for each analyte includes 95 percent of all percent recoveries. Discarding outliers left 95 percent of the CARD data available for calculating factors. The factors are ratios of percent recovery values at the 97.5 and 2.5 percentiles. The ratios generally show a consistent pattern.

An attempt to "convert" a biased value to its true concentration is not recommended because the CARD data do not differentiate and quantify individual sources of variation. The factors are applied as "safety factors" to ensure that biased data can be used to meet HRS criteria for determining an observed release. Dividing a high bias value by a factor effectively deflates it from the high end of the range to the low end (low bias value). Multiplying a low bias value by the factor effectively inflates it to a high bias value. Use of the ratio of percentiles is a "worst-case" assumption that the data are biased by the extent of the range of CARD data considered. The factors either inflate the values to the high end of the range, or deflate the data to the low end, and thus compensate for the apparent variability when comparing a high bias value to a low bias value (see Exhibit 1).

Factors have been selected for all analytes in the CLP Target Compound List (organic analytes) and Target Analyte List (inorganic analytes). Some organic factors were derived from matrix spike percent recoveries, and some from surrogate percent recoveries, depending on availability of data. When both matrix spike and surrogate data were available for the same compound, the larger value (representing more extreme high and low percent recoveries) was used. Laboratory control samples were used to calculate some of the inorganic factors. A default factor of 10 was used for analytes when percent recovery data were unavailable.

Application of the Factors: Exhibit 1 shows how to apply the factors to "J" qualified data. High bias background data, low bias release data, and unbiased data may be used at their reported concentrations. Multiply low bias background sample data by the analyte-specific factor to bring them to their new value. The new background value effectively becomes a high bias value that may be used to determine an observed release. Divide high bias release sample data by the analyte-specific factor to bring them to their new value. The new release sample value effectively becomes a low bias result that may be used

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Exhibit 1: Use of Factors for "J"-Qualified Data

Type of Sample	Type of Bias	Action Required
Background Sample	No Bias	None: Use concentration without factor
	Low Bias	Multiply concentration by factor
	High Bias	None: Use concentration without factor
	Unknown Bias	Multiply concentration by factor
Release Sample	No Bias	None: Use concentration without factor
	Low Bias	None: Use concentration without factor
	High Bias	Divide concentration by factor
	Unknown Bias	Divide concentration by factor

to determine an observed release. *Note: Adjusted release and background values must still meet HRS criteria (e.g., release concentration must be at least three times background level) to determine an observed release.*

Examples Using Trichloroethene in Soil:

1. *Release sample data biased low, background sample data biased high.*

Release sample value: 30 μg/kg (J) *low bias*
Background sample value: 10 μg/kg (J) *high bias*

In this instance, the direction of the bias indicates that the release sample concentration exceeds background by more than three times, so an observed release is established (provided all other HRS criteria are met). Use of the factors is not needed.

2. *Release sample data unbiased, background sample data biased low.*

Release sample value: 30 μg/kg *no bias*
Background sample value: 10 μg/kg (J) *low bias*

To use the data to establish an observed release, multiply the background sample value by factor given for trichloroethene (1.8). No factor is needed for the release sample.

New background sample value:
(10 μg/kg) x (1.8) = 18 μg/kg (J) *high bias*

The release sample concentration does not exceed the new background level by a factor of three, so an observed release is not established.

3. *Release sample data biased high, background sample data unbiased.*

Release sample value: 75 μg/kg (J) ***high bias***
Background sample value: 15 μg/kg *no bias*

To use the data to establish an observed release, divide the release sample value by the factor for trichloroethene (1.8). No factor is needed for the background sample.

New release sample value:
(75 μg/kg) ÷ (1.8) = 42 μg/kg (J) *low bias*

The new release sample concentration does not exceed background concentration by a factor of three, so an observed release is not established.

4. *Release sample data biased high, background sample data biased low.*

Release sample value: 100 μg/kg (J) *high bias*
Background sample value: 10 μg/kg (J) *low bias*

To use the data to establish an observed release, divide the release sample value and multiply the background sample value by the factor given for trichloroethene in soil (1.8).

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New release sample value:
(100 μg/kg) ÷ (1.8) = 56 μg/kg (J) *low bias*

New background sample value:
(10 μg/kg) x (1.8) = 18 μg/kg (J) *high bias*

The new release sample concentration is three times the new background concentration, so an observed release is established, provided all other HRS criteria are met.

Documentation Requirements for Use of Qualified Data: When using "J"-qualified data to determine an observed release, include the "J"-qualifier commentary from the data validation report in the HRS package. This step will ensure that the direction of bias is documented.

Use of Other Factors: EPA Regions may substitute higher factor values other than the ones in this fact sheet on a case-by-case basis when technically justified. For example, other factors may be applied to conform with site-specific Data Quality Objectives (DQOs) or with Regional Standard Operating Procedures (SOPs).[10]

Detection Limit Restrictions: Factors may only be applied to "J" data with concentrations above the CLP Contract Required Quantitation Limit (CRQL) or Contract Required Detection Limit (CRDL). "J"-qualified data with concentrations below CLP detection limits cannot be used to document an observed release.

Use of "UJ"-Qualified Data

A combination of the "U" and "J" qualifiers indicates that the reported value may not accurately represent the concentration necessary to detect the analyte in the sample. Under limited conditions, "UJ" data can be used to represent background when determining an observed release. These conditions include instances when there is confidence that the background concentration has not been detected and the sample measurement that establishes the observed release equals or exceeds the SQL or other appropriate detection limit. This reasoning is based on the presence of a high bias in the background sample. Thus, UJ data can be used only when all of the following conditions apply:

- The "UJ" value applies to the background sample and represents the detection limit,
- The "UJ" value is biased high, and
- The release sample concentration exceeds the SQL (or applicable detection limit) and is unbiased or biased low.

Summary

Data validation checks the usability of analytical data and identifies certain errors (bias). "J"-qualified data identify that analytes are present, but the reported values represent estimated concentrations associated with bias. Low bias release data and high bias background data may be used at the reported values. High bias release data and low bias background data may not be used at their reported concentrations because they do not establish an observed release with certainty. Application of factors introduced in this fact sheet compensate for this uncertainty, and enable "J" data to be used to determine an observed release.

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Table 1: Factors for Volatile Organic Analytes				
VOLATILE ORGANIC ANALYTES	SOIL MATRIX		WATER MATRIX	
	Number of CARD Samples Reviewed	Factor	Number of CARD Samples Reviewed	Factor
1,1,1-TRICHLOROETHANE	--	10.0	–	10.0
1,1,2,2-TETRACHLOROETHANE	11144	1.5	9180	1.2
1,1,2-TRICHLOROETHANE	–	10.0	–	10.0
1,1-DICHLOROETHANE	11144	1.4	9179	1.3
1,1-DICHLOROETHENE	2064	2.4	1484	2.0
1,2-DICHLOROETHANE	11144	1.4	9179	1.3
1,2-DICHLOROETHENE (TOTAL)	11144	1.4	9179	1.3
1,2-DICHLOROPROPANE	--	10.0	–	10.0
2-BUTANONE	11144	1.4	9179	1.3
2-HEXANONE	11144	1.5	9180	1.2
4-METHYL-2-PENTANONE	11144	1.5	9180	1.2
ACETONE	11144	1.4	9179	1.3
BENZENE	2060	1.7	1482	1.5
BROMODICHLOROMETHANE	–	10.0	–	10.0
BROMOFORM	--	10.0	--	10.0
BROMOMETHANE	11144	1.4	9179	1.3
CARBON DISULFIDE	11144	1.4	9179	1.3

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Table 1: Factors for Volatile Organic Analytes (continued)

VOLATILE ORGANIC ANALYTES	SOIL MATRIX		WATER MATRIX	
	Number of CARD Samples Reviewed	Factor	Number of CARD Samples Reviewed	Factor
CARBON TETRACHLORIDE	–	10.0	–	10.0
CHLOROBENZENE	2058	1.6	1480	1.4
CHLOROETHANE	11144	1.4	9179	1.3
CHLOROFORM	11144	1.4	9179	1.3
CHLOROMETHANE	11144	1.4	9179	1.3
CIS-1,3-DICHLOROPROPENE	–	10.0	–	10.0
DIBROMOCHLOROMETHANE	–	10.0	–	10.0
ETHYLBENZENE	11144	1.5	9180	1.2
METHYLENE CHLORIDE	11144	1.4	9179	1.3
STYRENE	11144	1.5	9180	1.3
TETRACHLOROETHENE	11144	1.5	9180	1.2
TOLUENE	2029	2.0	1468	1.4
TRANS-1,3-DICHLOROPROPENE	–	10.0	–	10.0
TRICHLOROETHENE	2046	1.8	1452	1.5
VINYL CHLORIDE	11144	1.4	9179	1.3
XYLENE (TOTAL)	11144	1.5	9180	1.2

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Table 2: Factors for Semivolatile Organic Analytes

SEMIVOLATILE ORGANIC ANALYTES	SOIL MATRIX		WATER MATRIX	
	Number of CARD Samples Reviewed	Factor	Number of CARD Samples Reviewed	Factor
1,2,4-TRICHLOROBENZENE	1978	3.5	1375	2.9
1,2-DICHLOROBENZENE	11899	3.8	7951	4.0
1,3-DICHLOROBENZENE	11899	3.8	7951	4.0
1,4-DICHLOROBENZENE	1980	3.8	1373	3.0
2,2'-OXYBIS(1-CHLOROPROPANE)	11899	3.8	7951	4.0
2,4,5-TRICHLOROPHENOL	11889	8.9	7952	3.6
2,4,6-TRICHLOROPHENOL	11889	8.9	7952	3.6
2,4-DICHLOROPHENOL	11896	4.0	7949	2.5
2,4-DIMETHYLPHENOL	11896	4.0	7949	2.5
2,4-DINITROPHENOL	11889	8.9	7952	3.6
2,4-DINITROTOLUENE	1979	3.4	1375	2.6
2,6-DINITROTOLUENE	11889	8.9	7952	3.6
2-CHLORONAPHTHALENE	11889	8.9	7952	3.6
2-CHLOROPHENOL	1930	3.2	1376	2.9
2-METHYLNAPHTHALENE	11896	4.0	7949	2.5
2-METHYLPHENOL	11899	3.8	7951	4.0
2-NITROANILINE	11889	8.9	7952	3.6
2-NITROPHENOL	11896	4.0	7949	2.5
3,3'-DICHLOROBENZIDINE	11898	4.3	7951	6.0
3-NITROANILINE	--	10.0	--	10.0
4,6-DINITRO-2-METHYLPHENOL	--	10.0	--	10.0
4-BROMOPHENYL-PHENYL ETHER	--	10.0	--	10.0
4-CHLORO-3-METHYLPHENOL	1927	3.6	1375	3.5
4-CHLOROANILINE	11896	4.0	7949	2.5
4-CHLOROPHENYL-PHENYL ETHER	11899	8.9	7952	3.6
4-METHYLPHENOL	11899	3.8	7951	4.0

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Table 2: Factors for Semivolatile Organic Analytes (continued)

SEMIVOLATILE ORGANIC ANALYTES	SOIL MATRIX		WATER MATRIX	
	Number of CARD Samples Reviewed	Factor	Number of CARD Samples Reviewed	Factor
4-NITROANILINE	11889	8.9	7952	3.6
4-NITROPHENOL	1905	4.8	1368	4.5
ACENAPHTHENE	1965	3.1	1361	3.0
ACENAPHTHYLENE	11889	8.9	7952	3.6
ANTHRACENE	--	10.0	--	10.0
BENZO(A)ANTHRACENE	11898	4.3	7951	6.0
BENZO(A)PYRENE	--	10.0	--	10.0
BENZO(B)FLUORANTHENE	--	10.0	--	10.0
BENZO(G,H,I)PERYLENE	--	10.0	--	10.0
BENZO(K)FLUORANTHENE	--	10.0	--	10.0
BIS(2-CHLOROETHOXY)METHANE	11896	4.0	7949	2.5
BIS(2-CHLOROETHYL)ETHER	11899	3.8	7951	4.0
BIS(2-ETHYLHEXYL)PHTHALATE	11898	4.3	7951	6.0
BUTYLBENZYLPHTHALATE	11898	4.3	7951	6.0
CARBAZOLE	--	10.0	--	10.0
CHRYSENE	11898	4.3	7951	6.0
DI-N-BUTYLPHTHALATE	--	10.0	--	10.0
DI-N-OCTYLPHTHALATE	--	10.0	--	10.0
DIBENZ(A,H)ANTHRACENE	11889	8.9	7952	3.6
DIBENZOFURAN	11889	8.9	7952	3.6
DIETHYLPHTHALATE	11889	8.9	7952	3.6
DIMETHYLPHTHALATE	11889	8.9	7952	3.6
FLUORANTHENE	--	10.0	--	10.0
FLUORENE	11889	8.9	7952	3.6
HEXACHLOROBENZENE	--	10.0	--	10.0
HEXACHLOROBUTADIENE	11896	4.0	7949	2.5
HEXACHLOROCYCLOPENTADIENE	11889	8.9	7952	3.6

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Table 2: Factors for Semivolatile Organic Analytes (continued)

SEMIVOLATILE ORGANIC ANALYTES	SOIL MATRIX		WATER MATRIX	
	Number of CARD Samples Reviewed	Factor	Number of CARD Samples Reviewed	Factor
HEXACHLOROETHANE	11899	3.8	7951	4.0
4-NITROPHENOLINDENO(1,2,3-CD)PYRENE	–	10.0	–	10.0
ISOPHORONE	11896	4.0	7949	2.5
N-NITROSO-DI-N-PROPYLAMINE	1966	3.7	1345	3.7
N-NITROSODIPHENYLAMINE (1)	--	10.0	--	10.0
NAPHTHALENE	11896	4.0	7949	2.5
NITROBENZENE	11896	4.0	7949	2.5
PENTACHLOROPHENOL	1895	18.8	1359	3.7
PHENANTHRENE	–	10.0	–	10.0
PHENOL	1924	3.2	1368	3.5
PYRENE	1901	8.3	1369	4.9

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Table 3: Factors for Pesticide/PCB Analytes

PESTICIDE/PCB ANALYTES	SOIL MATRIX		WATER MATRIX	
	Number of CARD Samples Reviewed	Factor	Number of CARD Samples Reviewed	Factor
4,4'-DDD	--	10.0	--	10.0
4,4'-DDE	--	10.0	--	10.0
4,4'-DDT	1801	7.4	1353	4.6
ALDRIN	1870	7.9	1350	4.8
ALPHA-BHC	--	10.0	--	10.0
ALPHA-CHLORDANE	--	10.0	--	10.0
AROCLOR-1016	--	10.0	23305	8.7
AROCLOR-1221	--	10.0	23305	8.7
AROCLOR-1232	--	10.0	23305	8.7
AROCLOR-1242	--	10.0	23305	8.7
AROCLOR-1248	--	10.0	23305	8.7
AROCLOR-1254	--	10.0	23305	8.7
AROCLOR-1260	--	10.0	23305	8.7
BETA-BHC	--	10.0	--	10.0
DELTA-BHC	--	10.0	--	10.0
DIELDRIN	1886	6.2	1350	2.8

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Table 3: Factors for Pesticide/PCB Analytes (continued)

PESTICIDE/PCB ANALYTES	SOIL MATRIX		WATER MATRIX	
	Number of CARD Samples Reviewed	Factor	Number of CARD Samples Reviewed	Factor
ENDOSULFAN I	--	10.0	--	**10.0**
ENDOSULFAN II	--	10.0	--	**10.0**
ENDOSULFAN SULFATE	--	10.0	--	**10.0**
ENDRIN	1866	8.5	1348	**3.4**
ENDRIN ALDEHYDE	--	10.0	--	**10.0**
ENDRIN KETONE	--	10.0	--	**10.0**
GAMMA-BHC (LINDANE)	1872	4.5	1350	**3.1**
GAMMA-CHLORDANE	--	10.0	--	**10.0**
HEPTACHLOR	1877	4.5	1351	**3.6**
HEPTACHLOR EPOXIDE	--	10.0	--	**10.0**
METHOXYCHLOR	--	10.0	--	**10.0**
TOXAPHENE	--	10.0	--	**10.0**

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Table 4: Factors for Inorganic Analytes

INORGANIC ANALYTES	SOIL MATRIX		WATER MATRIX	
	Number of CARD Samples Reviewed	Factor	Number of CARD Samples Reviewed	Factor
ALUMINUM	1147	1.5	1686	1.2
ANTIMONY	1153	1.8	1688	1.2
ARSENIC	1208	1.6	1701	1.2
BARIUM	1149	3.3	1686	1.1
BERYLLIUM	1150	1.2	1686	1.2
CADMIUM	1148	1.3	1685	1.2
CALCIUM	1163	1.2	1685	1.1
CHROMIUM	1148	1.2	1686	1.2
COBALT	1153	1.2	1685	1.2
COPPER	1154	1.1	1683	1.2
CYANIDE	884	1.4	–	10.0
IRON	1149	1.2	1687	1.2
LEAD	1331	1.3	1727	1.2
MAGNESIUM	1143	1.2	1686	1.1
MANGANESE	1151	1.2	1685	1.2
MERCURY	1563	1.7	–	10.0
NICKEL	1150	1.2	1685	1.2
POTASSIUM	–	10.0	–	10.0
SELENIUM	1190	2.3	1695	1.3
SILVER	1152	1.6	1684	1.3
SODIUM	–	10.0	–	10.0
THALLIUM	1197	1.7	1691	1.2
VANADIUM	1152	1.2	1685	1.1
ZINC	1154	1.3	1689	1.2

RefNo 20, p. 14 of 15

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References

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4. U.S. Environmental Protection Agency, 1991. *Contract Laboratory Program Statement of Work for Organics Analysis*. Office of Solid Waste and Emergency Response. Document No. OLM1.8

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REFERENCE NUMBER 21

United States
Environmental Protection
Agency

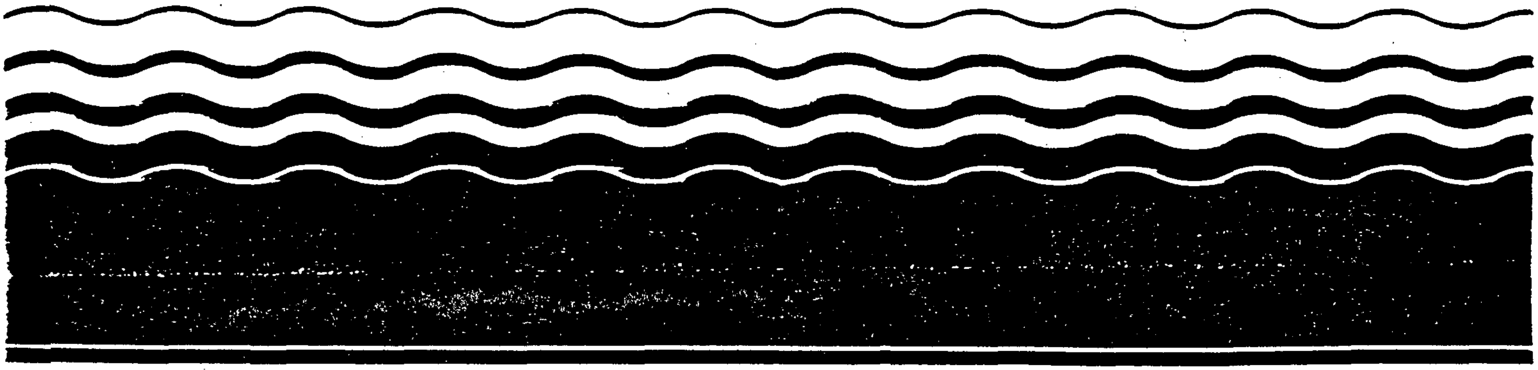
Office of Solid Waste
and Emergency
Response

Publication 9345.1-07
PB92-963377
EPA 540-R-92-026
November 1992

Superfund

EPA

Hazard Ranking System Guidance Manual



Ref. No. 21, p. 1 of 3

Three other categories do not meet the HRS definition of wetlands:

- Areas without hydrophytes but with hydric soils (e.g., flats where drastic fluctuation in water level, wave action, turbidity, or high concentration of salts may prevent the growth of hydrophytes);

- Areas with hydrophytes but without soils (e.g., seaweed-covered portions of rocky shores); and

- Areas without hydrophytes and soils (e.g., gravel beaches or rocky shores without vegetation).

Deepwater habitats that support submerged aquatic vegetation (SAV) but not emergent vegetation do not fall within either the HRS or the USFWS definition. Although SAV is hydrophytic, it is not "vegetation typically adapted for life in saturated soil conditions" because substrates that support SAV but not emergent vegetation are considered nonsoil.

USFWS divides wetlands (and deepwater systems) into five categories based on salinity, tidal influence, and wave action. Hydrophytes and hydric soils exist in each of these categories:

- The <u>marine</u> system includes all wetlands that occur along the high energy coastline of the open ocean overlying the continental shelf. Salinities exceed 30 parts per thousand (ppt), with little or no dilution except near the mouths of estuaries.

- The <u>estuarine</u> system includes all wetlands in areas, partially enclosed by land, with open, partly obstructed, or sporadic access to marine waters. Salinities are 0.5 ppt or greater and fluctuate due to evaporation and mixing of fresh water and seawater.

- The <u>riverine</u> system includes all wetlands within channels (i.e., open conduits which at least periodically contain moving water or which form a connection between two bodies of standing water). The riverine system also includes wetlands dominated by trees, shrubs, persistent emergents, and emergent mosses or lichens; and wetlands in areas with water containing ocean derived salts in concentrations exceeding 0.5 ppt.

- The <u>lacustrine</u> system includes all wetlands situated in topographic depressions or dammed river channels in areas where trees, shrubs, persistent emergents, and emergent mosses and lichens cover less than 30 percent of the total area. Lacustrine systems must be at least 8 hectares (ha) in size and are subdivided into two zones: limnetic (all deepwater habitats), and littoral (areas from the shoreward boundary to a depth of 2 meters below low water or to the maximum extent of non-persistent emergents). All wetlands fall into the littoral zone.

- The <u>palustrine</u> system includes all non-tidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses and lichens, and all such wetlands that occur in tidal areas where the salinity due to ocean derived salts is less than 0.5 ppt. A wetland lacking the above vegetation is also palustrine if: it is less than 8 ha in size; it does not have an active wave-formed or bedrock shoreline; water depth in the deepest part of the basin is less than 2 meters at low water; or salinity due to ocean derived salts is less than 0.5 ppt.

Note that salinity category does not affect whether or not an area qualifies as a wetland under either the HRS or the USFWS definition.

Highlight A-8 divides wetland and deepwater categories defined on NWI maps into three categories: those presumed to be eligible for HRS purposes, those that may under certain

Ref. No. 21, p. 2 of 3

circumstances be eligible for HRS purposes, and those that generally will not be eligible for HRS purposes.

HIGHLIGHT A-8
COMPARISON OF HRS WETLANDS DEFINITION AND WETLANDS CLASSIFICATION SYSTEM USED FOR NWI MAPS

Wetlands Category on NWI Maps	Eligible as HRS wetlands?		
	Yes[a]	Possibly[b]	Generally Not[c]
Marine System			
Subtidal			
Rock Bottom			✓
Unconsolidated Bottom			✓
Aquatic Bed			✓
Reef			✓
Intertidal			
Aquatic Bed			✓
Reef			✓
Rocky Shore		✓	
Unconsolidated Shore		✓	
Estuarine System			
Subtidal			
Rock Bottom			✓
Unconsolidated Bottom			✓
Aquatic Bed			✓
Reef			✓
Intertidal			
Aquatic Bed			✓
Reef			✓
Streambed		✓	
Rocky Shore		✓	
Unconsolidated Shore		✓	
Emergent Wetland	✓		
Scrub-Shrub Wetland	✓		
Forested Wetland	✓		
Palustrine System			
Rock Bottom			✓
Unconsolidated Bottom		✓	
Aquatic Bed			✓
Unconsolidated Shore		✓	
Moss-Lichen Wetland	✓		
Emergent Wetland	✓		
Scrub-Shrub Wetland	✓		
Forested Wetland	✓		

[a] Can be presumed to meet the 40 CFR 230.3 definition of a wetland.

[b] May meet the 40 CFR 230.3 definition of a wetland if emergent hydrophytes are present.

[c] Generally will not meet the 40 CFR 230.3 definition of a wetland, except for some unique types of wetlands (e.g., some shoals or reefs).

(continued on next page)

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REFERENCE NUMBER 22

ARCS II CONTRACT 68-W9-0051
MALCOLM PIRNIE, INC.
RECORD OF TELEPHONE CONVERSATION/AGREEMENT

File No. 8003-431

Date: May 12, 1995 Time: 1:24 AM [] PM [X]

Incoming Call

From: John Reiff (908) 862-5740 Telephone No.

Affiliation: Northville Industries, Inc.

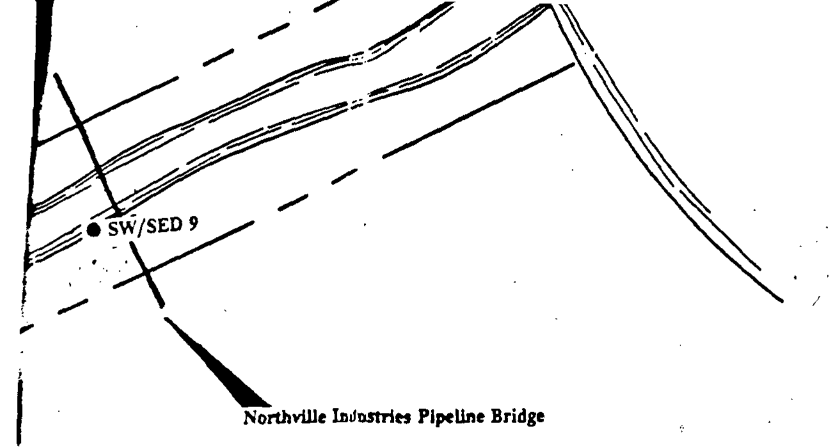
Malcolm Pirnie Staff: David Kahlenberg (609) 860-0100 Telephone No.

Summary of Conversation:

Mr. Reiff returned my earlier phone call. I spoke with Mr. Reiff in regards to the pipeline bridge which they operate and crosses the South Branch Creek in the vicinity of the Arthur Kill. More speciically I asked Mr. Reiff, how many feet the pipeline bridge is, along the South Branch Creek, from the Arthur Kill? Mr. Reiff told me that the pipeline bridge is located 400 feet due west of the Arthur Kill along the South Branch Creek. Mr. Reiff also informed me that Northville Industries is involved in the storage and distribution of petroleum products, varying from No. 6 Fuel Oil to gasoline and other petroleum blends.

Ref No 22, p. 1 of 1

REFERENCE NUMBER 23



THIS MAP IS LOCATED AT THE FOLLOWING LOCATION:
U.S. EPA, REGION 2, SUPERFUND RECORDS CENTER,
290 BROADWAY, 18TH FLOOR, NEW YORK, NY 10007

RCRA FACILITY INVESTIGAT

LCP CHEMICALS-NEW JERSEY, INC
A DIVISION OF HANLIN GROUP, INC
LINDEN, NEW JERSEY

eder associates consulting engi
NEW YORK MICHIGAN WISCONSIN

ple and pipeline bridge locations are to scale. This figure was adapted
A Facility Investigation prepared by EDER Associates Consulting
.C.

y 26, 1976 "Plot Plan" (Treadwell Corp. N.Y., N.Y.)
"Existing Conditions" Site Plan (AJV Engineering, Woodbridge, N.J.).

Figure 2

PROJECT
RCRA FACILITY INVESTIGATION
LCP CHEMICALS-NEW JERSEY, INC
A DIVISION OF HANLIN GROUP, INC
LINDEN, NEW JERSEY

TITLE
SITE PLAN

eder associates consulting engineers, p.c.
LOCUST VALLEY, NEW YORK • MADISON, WISCONSIN
ANN ARBOR, MICHIGAN • AUGUSTA, GEORGIA

DRAWN BY MSA	SCALE 1" = 100'-0"
DESIGNED BY KJP	PROJECT No. 625-3
APPROVED BY SJO	DWG. No. 1
DATE NOVEMBER, 1992	

625-3B
110392

Ref. No. 23, p. 1 of 1

REFERENCE NUMBER 24

code of federal regulations

Protection of Environment

40

PARTS 260 to 299

Revised as of July 1, 1994

CONTAINING
A CODIFICATION OF DOCUMENTS
OF GENERAL APPLICABILITY
AND FUTURE EFFECT

AS OF JULY 1, 1994

With Ancillaries

Published by
the Office of the Federal Register
National Archives and Records
Administration

as a Special Edition of
the Federal Register

1985

Ref No 24, p. 1 of 8

	Hazard code
ɿth process contami- nt formulations from eosote formulations. om the treatment of creosote and/or	(T)
ith process contami- nt formulations from rganic preservatives K001 bottom sedi- serving processes	(T)
ny sludge generated storage or treatment etroleum refineries. in: oil/water/solids ances; sumps; and in stormwater units non-contact once- ocess or oily cooling units as defined in dditional units after nt units) and K051	(T)
ration sludge—Any al separation of oil/ rs from petroleum es and floats gen- ndments, and all water units that do ntact once-through oily cooling waters, units as defined in ore additional tment units)	(T)
stes) resulting from ardous under sub- r more of the fol- e retains its EPA d/or F028.).	(T)

a receiving drippage of these
tent to upgrade or install drip
for drip pad upgrades or in-
February 6, 1992 for existing

F037 and F038 list-

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contactor for the
or high-rate aer-
or tanks, in which
stes, enhance bio-
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ime of the unit is
no longer than 30
ous waste by the

s have the burden
7 and F038 wastes
lisposal facilities
uments and data
l treatment unit
xempted from the

---

definitions of F037 and/or F038 were actually generated in the aggressive biological treatment unit.

(3) (i) For the purposes of the F037 listing, sludges are considered to be generated at the moment of deposition in the unit, where deposition is defined as at least a temporary cessation of lateral particle movement.

(ii) For the purposes of the F038 listing,

(A) sludges are considered to be generated at the moment of deposition in the unit, where deposition is defined as at least a temporary cessation of lateral particle movement and

(B) floats are considered to be generated at the moment they are formed in the top of the unit.

[46 FR 4617, Jan. 16, 1981]

EDITORIAL NOTE: For FEDERAL REGISTER citations affecting §261.31, see the List of CFR Sections Affected in the Finding Aids section of this volume.

§261.32 Hazardous wastes from specific sources.

The following solid wastes are listed hazardous wastes from specific sources unless they are excluded under §§260.20 and 260.22 and listed in appendix IX.

Industry and EPA hazardous waste No.	Hazardous waste	Hazard code
Wood preservation: K001	Bottom sediment sludge from the treatment of wastewaters from wood preserving processes that use creosote and/or pentachlorophenol.	(T)
Inorganic pigments:		
K002	Wastewater treatment sludge from the production of chrome yellow and orange pigments.	(T)
K003	Wastewater treatment sludge from the production of molybdate orange pigments	(T)
K004	Wastewater treatment sludge from the production of zinc yellow pigments	(T)
K005	Wastewater treatment sludge from the production of chrome green pigments	(T)
K006	Wastewater treatment sludge from the production of chrome oxide green pigments (anhydrous and hydrated).	(T)
K007	Wastewater treatment sludge from the production of iron blue pigments	(T)
K008	Oven residue from the production of chrome oxide green pigments	(T)
Organic chemicals:		
K009	Distillation bottoms from the production of acetaldehyde from ethylene	(T)
K010	Distillation side cuts from the production of acetaldehyde from ethylene	(T)
K011	Bottom stream from the wastewater stripper in the production of acrylonitrile	(R, T)
K013	Bottom stream from the acetonitrile column in the production of acrylonitrile	(R, T)
K014	Bottoms from the acetonitrile purification column in the production of acrylonitrile	(T)
K015	Still bottoms from the distillation of benzyl chloride	(T)
K016	Heavy ends or distillation residues from the production of carbon tetrachloride	(T)
K017	Heavy ends (still bottoms) from the purification column in the production of epichlorohydrin.	(T)
K018	Heavy ends from the fractionation column in ethyl chloride production	(T)
K019	Heavy ends from the distillation of ethylene dichloride in ethylene dichloride production.	(T)
K020	Heavy ends from the distillation of vinyl chloride in vinyl chloride monomer production.	(T)
K021	Aqueous spent antimony catalyst waste from fluoromethanes production	(T)
K022	Distillation bottom tars from the production of phenol/acetone from cumene	(T)
K023	Distillation light ends from the production of phthalic anhydride from naphthalene	(T)
K024	Distillation bottoms from the production of phthalic anhydride from naphthalene	(T)
K025	Distillation bottoms from the production of nitrobenzene by the nitration of benzene	(T)
K026	Stripping still tails from the production of methy ethyl pyridines	(T)
K027	Centrifuge and distillation residues from toluene diisocyanate production	(R, T)
K028	Spent catalyst from the hydrochlorinator reactor in the production of 1,1,1-trichloroethane.	(T)
K029	Waste from the product steam stripper in the production of 1,1,1-trichloroethane	(T)
K030	Column bottoms or heavy ends from the combined production of trichloroethylene and perchloroethylene.	(T)
K083	Distillation bottoms from aniline production	(T)
K085	Distillation or fractionation column bottoms from the production of chlorobenzenes	(T)
K093	Distillation light ends from the production of phthalic anhydride from ortho-xylene	(T)
K094	Distillation bottoms from the production of phthalic anhydride from ortho-xylene	(T)
K095	Distillation bottoms from the production of 1,1,1-trichloroethane	(T)
K096	Heavy ends from the heavy ends column from the production of 1,1,1-trichloroethane.	(T)
K103	Process residues from aniline extraction from the production of aniline	(T)
K104	Combined wastewater streams generated from nitrobenzene/aniline production	(T)

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Industry and EPA hazardous waste No.	Hazardous waste	Hazard code
K105	Separated aqueous stream from the reactor product washing step in the production of chlorobenzenes.	(T)
K107	Column bottoms from product separation from the production of 1,1-dimethyl-hydrazine (UDMH) from carboxylic acid hydrazines.	(C,T)
K108	Condensed column overheads from product separation and condensed reactor vent gases from the production of 1,1-dimethylhydrazine (UDMH) from carboxylic acid hydrazides.	(I,T)
K109	Spent filter cartridges from product purification from the production of 1,1-dimethylhydrazine (UDMH) from carboxylic acid hydrazides.	(T)
K110	Condensed column overheads from intermediate separation from the production of 1,1-dimethylhydrazine (UDMH) from carboxylic acid hydrazides.	(T)
K111	Product washwaters from the production of dinitrotoluene via nitration of toluene	(C,T)
K112	Reaction by-product water from the drying column in the production of toluenediamine via hydrogenation of dinitrotoluene.	(T)
K113	Condensed liquid light ends from the purification of toluenediamine in the production of toluenediamine via hydrogenation of dinitrotoluene.	(T)
K114	Vicinals from the purification of toluenediamine in the production of toluenediamine via hydrogenation of dinitrotoluene.	(T)
K115	Heavy ends from the purification of toluenediamine in the production of toluenediamine via hydrogenation of dinitrotoluene.	(T)
K116	Organic condensate from the solvent recovery column in the production of toluene diisocyanate via phosgenation of toluenediamine.	(T)
K117	Wastewater from the reactor vent gas scrubber in the production of ethylene dibromide via bromination of ethene.	(T)
K118	Spent adsorbent solids from purification of ethylene dibromide in the production of ethylene dibromide via bromination of ethene.	(T)
K136	Still bottoms from the purification of ethylene dibromide in the production of ethylene dibromide via bromination of ethene.	(T)
K149	Distillation bottoms from the production of alpha- (or methyl-) chlorinated toluenes, ring-chlorinated toluenes, benzoyl chlorides, and compounds with mixtures of these functional groups, (This waste does not include still bottoms from the distillation of benzyl chloride.).	(T)
K150	Organic residuals, excluding spent carbon adsorbent, from the spent chlorine gas and hydrochloric acid recovery processes associated with the production of alpha- (or methyl-) chlorinated toluenes, ring-chlorinated toluenes, benzoyl chlorides, and compounds with mixtures of these functional groups.	(T)
K151	Wastewater treatment sludges, excluding neutralization and biological sludges, generated during the treatment of wastewaters from the production of alpha- (or methyl-) chlorinated toluenes, ring-chlorinated toluenes, benzoyl chlorides, and compounds with mixtures of these functional groups.	(T)
Inorganic chemicals:		
K071	Brine purification muds from the mercury cell process in chlorine production, where separately prepurified brine is not used.	(T)
K073	Chlorinated hydrocarbon waste from the purification step of the diaphragm cell process using graphite anodes in chlorine production.	(T)
K106	Wastewater treatment sludge from the mercury cell process in chlorine production	(T)
Pesticides:		
K031	By-product salts generated in the production of MSMA and cacodylic acid	(T)
K032	Wastewater treatment sludge from the production of chlordane	(T)
K033	Wastewater and scrub water from the chlorination of cyclopentadiene in the production of chlordane.	(T)
K034	Filter solids from the filtration of hexachlorocyclopentadiene in the production of chlordane.	(T)
K035	Wastewater treatment sludges generated in the production of creosote	(T)
K036	Still bottoms from toluene reclamation distillation in the production of disulfoton	(T)
K037	Wastewater treatment sludges from the production of disulfoton	(T)
K038	Wastewater from the washing and stripping of phorate production	(T)
K039	Filter cake from the filtration of diethylphosphorodithioic acid in the production of phorate.	(T)
K040	Wastewater treatment sludge from the production of phorate	(T)
K041	Wastewater treatment sludge from the production of toxaphene	(T)
K042	Heavy ends or distillation residues from the distillation of tetrachlorobenzene in the production of 2,4,5-T.	(T)
K043	2,6-Dichlorophenol waste from the production of 2,4-D	(T)
K097	Vacuum stripper discharge from the chlordane chlorinator in the production of chlordane.	(T)
K098	Untreated process wastewater from the production of toxaphene	(T)
K099	Untreated wastewater from the production of 2,4-D	(T)
K123	Process wastewater (including supernates, filtrates, and washwaters) from the production of ethylenebisdithiocarbamic acid and its salt.	(T)
K124	Reactor vent scrubber water from the production of ethylenebisdithiocarbamic acid and its salts.	(C, T)

Industry and EPA hazardous waste No.	
K125	Filtration, ethylenebis
K126	Baghouse d production
K131	Wastewater production
K132	Spent absor mide.
Explosives:	
K044	Wastewater
K045	Spent carbo
K046	Wastewater lead-base
K047	Pink/red wa
Petroleum refining:	
K048	Dissolved a
K049	Slop oil emu
K050	Heat exchar
K051	API separa
K052	Tank botton
Iron and steel:	
K061	Emission co
K062	Spent pickl and steel
Primary copper:	
K064	Acid plant from prim
Primary lead:	
K065	Surface im at primar
Primary zinc:	
K066	Sludge fro mary zin
Primary aluminum:	
K088	Spent potli
Ferroalloys:	
K090	Emission c
K091	Emission c
Secondary lead:	
K069	Emission c stayed e tems. Th EPA tak in the Fe
K100	Waste lea ondary l
Veterinary pharmaceuticals:	
K084	Wastewat maceuti
K101	Distillation duction
K102	Residue f erinary
Ink formulation:	
K086	Solvent w sludges ments,
Coking:	
K060	Ammonia
K087	Decanter
K141	Process r ing sum by-prod tar slud
K142	Tar storag of coke
K143	Process r generat coke b
K144	Wastewa capting duced
K145	Residues coke b

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	Hazard code
step in the production	(T)
of 1,1-dimethyl-hydra-	(C,T)
ondensed reactor vent H) from carboxylic acid	(I,T)
production of 1,1-	(T)
from the production of des.	(T)
itration of toluene	(C,T)
the production of	(T)
nine in the production	(T)
tion of toluenediamine	(T)
the production of	(T)
production of toluene	(T)
roduction of ethylene	(T)
in the production of	(T)
roduction of ethylene	(T)
) chlorinated toluenes, with mixtures of from the distilla-	(T)
ent chlorine gas e production of alpha- benzoyl chlorides, and	(T)
logical sludges, gen- n of alpha- (or meth- chlorides, and com-	(T)
ne production, where	(T)
diaphragm cell proc-	(T)
chlorine production ...	(T)
dylic acid	(T)
....	(T)
diene in the produc-	(T)
in the production of	(T)
sote	(T)
n of disulfoton	(T)
....	(T)
ion	(T)
in the production of	(T)
....	(T)
....	(T)
hlorobenzene in the	(T)
....	(T)
the production of	(T)
....	(T)
....	(T)
waters) from the pro-	(T)
dithiocarbamic acid	(C, T)

Industry and EPA hazardous waste No.	Hazardous waste	Hazard code
K125	Filtration, evaporation, and centrifugation solids from the production of ethylenebisdithiocarbamic acid and its salts.	(T)
K126	Baghouse dust and floor sweepings in milling and packaging operations from the production or formulation of ethylenebisdithiocarbamic acid and its salts.	(T)
K131	Wastewater from the reactor and spent sulfuric acid from the acid dryer from the production of methyl bromide.	(C, T)
K132	Spent absorbent and wastewater separator solids from the production of methyl bromide.	(T)
Explosives:		
K044	Wastewater treatment sludges from the manufacturing and processing of explosives	(R)
K045	Spent carbon from the treatment of wastewater containing explosives	(R)
K046	Wastewater treatment sludges from the manufacturing, formulation and loading of lead-based initiating compounds.	(T)
K047	Pink/red water from TNT operations	(R)
Petroleum refining:		
K048	Dissolved air flotation (DAF) float from the petroleum refining industry	(T)
K049	Slop oil emulsion solids from the petroleum refining industry	(T)
K050	Heat exchanger bundle cleaning sludge from the petroleum refining industry	(T)
K051	API separator sludge from the petroleum refining industry	(T)
K052	Tank bottoms (leaded) from the petroleum refining industry	(T)
Iron and steel:		
K061	Emission control dust/sludge from the primary production of steel in electric furnaces	(T)
K062	Spent pickle liquor generated by steel finishing operations of facilities within the iron and steel industry (SIC Codes 331 and 332).	(C,T)
Primary copper:		
K064	Acid plant blowdown slurry/sludge resulting from the thickening of blowdown slurry from primary copper production.	(T)
Primary lead:		
K065	Surface impoundment solids contained in and dredged from surface impoundments at primary lead smelting facilities.	(T)
Primary zinc:		
K066	Sludge from treatment of process wastewater and/or acid plant blowdown from primary zinc production.	(T)
Primary aluminum:		
K088	Spent potliners from primary aluminum reduction	(T)
Ferroalloys:		
K090	Emission control dust or sludge from ferrochromiumsilicon production	(T)
K091	Emission control dust or sludge from ferrochromium production	(T)
Secondary lead:		
K069	Emission control dust/sludge from secondary lead smelting. (*Note*: This listing is stayed administratively for sludge generated from secondary acid scrubber systems. The stay will remain in effect until further administrative action is taken. If EPA takes further action effecting this stay, EPA will publish a notice of the action in the Federal Register.	(T)
K100	Waste leaching solution from acid leaching of emission control dust/sludge from secondary lead smelting.	(T)
Veterinary pharmaceuticals:		
K084	Wastewater treatment sludges generated during the production of veterinary pharmaceuticals from arsenic or organo-arsenic compounds.	(T)
K101	Distillation tar residues from the distillation of aniline-based compounds in the production of veterinary pharmaceuticals from arsenic or organo-arsenic compounds.	(T)
K102	Residue from the use of activated carbon for decolorization in the production of veterinary pharmaceuticals from arsenic or organo-arsenic compounds.	(T)
Ink formulation:		
K086	Solvent washes and sludges, caustic washes and sludges, or water washes and sludges from cleaning tubs and equipment used in the formulation of ink from pigments, driers, soaps, and stabilizers containing chromium and lead.	(T)
Coking:		
K060	Ammonia still lime sludge from coking operations	(T)
K087	Decanter tank tar sludge from coking operations	(T)
K141	Process residues from the recovery of coal tar, including, but not limited to, collecting sump residues from the production of coke from coal or the recovery of coke by-products produced from coal. This listing does not include K087 (decanter tank tar sludges from coking operations).	(T)
K142	Tar storage tank residues from the production of coke from coal or from the recovery of coke by-products produced from coal.	(T)
K143	Process residues from the recovery of light oil, including, but not limited to, those generated in stills, decanters, and wash oil recovery units from the recovery of coke by-products produced from coal.	(T)
K144	Wastewater sump residues from light oil refining, including, but not limited to, intercepting or contamination sump sludges from the recovery of coke by-products produced from coal.	(T)
K145	Residues from naphthalene collection and recovery operations from the recovery of coke by-products produced from coal.	(T)

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Industry and EPA hazardous waste No.	Hazardous waste	Hazard code
K147	Tar storage tank residues from coal tar refining	(T)
K148	Residues from coal tar distillation, including but not limited to, still bottoms	(T)

[46 FR 4618, Jan. 16, 1981]

EDITORIAL NOTE: For FEDERAL REGISTER citations affecting §261.32, see the List of CFR Sections Affected in the Finding Aids section of this volume.

§261.33 Discarded commercial chemical products, off-specification species, container residues, and spill residues thereof.

The following materials or items are hazardous wastes if and when they are discarded or intended to be discarded as described in §261.2(a)(2)(i), when they are mixed with waste oil or used oil or other material and applied to the land for dust suppression or road treatment, when they are otherwise applied to the land in lieu of their original intended use or when they are contained in products that are applied to the land in lieu of their original intended use, or when, in lieu of their original intended use, they are produced for use as (or as a component of) a fuel, distributed for use as a fuel, or burned as a fuel.

(a) Any commercial chemical product, or manufacturing chemical intermediate having the generic name listed in paragraph (e) or (f) of this section.

(b) Any off-specification commercial chemical product or manufacturing chemical intermediate which, if it met specifications, would have the generic name listed in paragraph (e) or (f) of this section.

(c) Any residue remaining in a container or in an inner liner removed from a container that has held any commercial chemical product or manufacturing chemical intermediate having the generic name listed in paragraphs (e) or (f) of this section, unless the container is empty as defined in §261.7(b) of this chapter.

[*Comment:* Unless the residue is being beneficially used or reused, or legitimately recycled or reclaimed; or being accumulated, stored, transported or treated prior to such use, re-use, recycling or reclamation, EPA considers the residue to be intended for discard, and thus, a hazardous waste. An example of a legitimate re-use of the residue would be where the residue remains in the container and the container is used to hold the same commercial chemical product or manufacturing chemical intermediate it previously held. An example of the discard of the residue would be where the drum is sent to a drum reconditioner who reconditions the drum but discards the residue.]

(d) Any residue or contaminated soil, water or other debris resulting from the cleanup of a spill into or on any land or water of any commercial chemical product or manufacturing chemical intermediate having the generic name listed in paragraph (e) or (f) of this section, or any residue or contaminated soil, water or other debris resulting from the cleanup of a spill, into or on any land or water, of any off-specification chemical product and manufacturing chemical intermediate which, if it met specifications, would

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have the generic nam
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[*Comment:* The phrase "co
product or manufacturin
mediate having the gener
. ." refers to a chemical
manufactured or formulat
or manufacturing use wh
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any technical grades of
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tions in which the chemic
ingredient. It does not re
such as a manufacturing
contains any of the substa
graph (e) or (f). Where a m
ous waste is deemed to be
because it contains a s
paragraph (e) or (f), such
in either §261.31 or §261.3
fied as a hazardous waste
ties set forth in subpart C

Hazardous waste No.	Chemical abstracts No.	
P023	107-20-0	Acetalde
P002	591-08-2	Acetamic
P057	640-19-7	Acetamic
P058	62-74-8	Acetic ac
P002	591-08-2	1-Acetyl-
P003	107-02-8	Acrolein
P070	116-06-3	Aldicarb
P004	309-00-2	Aldrin
P005	107-18-6	Allyl alco
P006	20859-73-8	Aluminun
P007	2763-96-4	5-(Amino
P008	504-24-5	4-Aminop
P009	131-74-8	Ammoniu
P119	7803-55-6	Ammoniu
P099	506-61-6	Argentat
P010	7778-39-4	Arsenic a
P012	1327-53-3	Arsenic o
P011	1303-28-2	Arsenic c
P011	1303-28-2	Arsenic p
P012	1327-53-3	Arsenic tr
P038	692-42-2	Arsine, d
P036	696-28-6	Arsonous
P054	151-56-4	Aziridine
P067	75-55-8	Aziridine,
P013	542-62-1	Barium cy
P024	106-47-8	Benzenar
P077	100-01-6	Benzenar
P028	100-44-7	Benzene,
P042	51-43-4	1,2-Benze
P046	122-09-8	Benzenee
P014	108-98-5	Benzenet
P001	81-81-2	2H-1-Ben greater
P028	100-44-7	Benzyl ch
P015	7440-41-7	Beryllium
P017	598-31-2	Bromoace
P018	357-57-3	Brucine
P045	39196-18-4	2-Butanor O-(meth
P021	592-01-8	Calcium c
P021	592-01-8	Calcium c
P022	75-15-0	Carbon di
P095	75-44-5	Carbonic
P023	107-20-0	Chloroace
P024	106-47-8	p-Chloroa

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PART 261

'ART 261—
'LING METHODS

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—ASTM Standard
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ASTM Standard D346-75 Soil or rock-like material—ASTM Standard D420-69 Soil-like material—ASTM Standard D1452-65

Fly Ash-like material—ASTM Standard D2234-76 [ASTM Standards are available from ASTM, 1916 Race St., Philadelphia, PA 19103]

Containerized liquid wastes—"COLIWASA" described in "Test Methods for the Evaluation of Solid Waste, Physical/Chemical Methods,"[1a] U.S. Environmental Protection Agency, Office of Solid Waste, Washington, D.C. 20460. [Copies may be obtained from Solid Waste Information, U.S. Environmental Protection Agency, 26 W. St. Clair St., Cincinnati, Ohio 45268]

Liquid waste in pits, ponds, lagoons, and similar reservoirs.—"Pond Sampler" described in "Test Methods for the Evaluation of Solid Waste, Physical/Chemical Methods."[1a]

This manual also contains additional information on application of these protocols.

APPENDIX II TO PART 261—METHOD 1311 TOXICITY CHARACTERISTIC LEACHING PROCEDURE (TCLP)

Note: The TCLP (Method 1311) is published in "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," EPA Publication SW-846, as incorporated by reference in § 260.11 of this chapter.

[58 FR 46049, Aug. 31, 1993]

APPENDIX III TO PART 261—CHEMICAL ANALYSIS TEST METHODS

Note: Appropriate analytical procedures to determine whether a sample contains a given toxic constituent are specified in Chapter Two, "Choosing the Correct Procedure" found in "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," EPA Publication SW-846, as incorporated by reference in § 260.11 of this chapter. Prior to final sampling and analysis method selection, the individual should consult the specific section or method described in SW-846 for additional guidance on which of the approved methods should be employed for a specific sample analysis situation.

[58 FR 46049, Aug. 31, 1993]

APPENDIX IV TO PART 261—[RESERVED FOR RADIOACTIVE WASTE TEST METHODS]

APPENDIX V TO PART 261—[RESERVED FOR INFECTIOUS WASTE TREATMENT SPECIFICATIONS]

APPENDIX VI TO PART 261—[RESERVED FOR ETIOLOGIC AGENTS]

APPENDIX VII TO PART 261—BASIS FOR LISTING HAZARDOUS WASTE

EPA hazardous waste No.	Hazardous constituents for which listed
F001	Tetrachloroethylene, methylene chloride trichloroethylene, 1,1,1-trichloroethane, carbon tetrachloride, chlorinated fluorocarbons.
F002	Tetrachloroethylene, methylene chloride, trichloroethylene, 1,1,1-trichloroethane, 1,1,2-trichloroethane, chlorobenzene, 1,1,2-trichloro-1,2,2-trichfluoroethane, ortho-dichlorobenzene, trichlorofluoromethane.
F003	N.A.
F004	Cresols and cresylic acid, nitrobenzene.
F005	Toluene, methyl ethyl ketone, carbon disulfide, isobutanol, pyridine, 2-ethoxyethanol, benzene, 2-nitropropane.
F006	Cadmium, hexavalent chromium, nickel, cyanide (complexed).
F007	Cyanide (salts).
F008	Cyanide (salts).
F009	Cyanide (salts).
F010	Cyanide (salts).
F011	Cyanide (salts).
F012	Cyanide (complexed).
F019	Hexavalent chromium, cyanide (complexed).
F020	Tetra- and pentachlorodibenzo-p-dioxins; tetra and pentachlorodi-benzofurans; tri- and tetrachlorophenols and their chlorophenoxy derivative acids, esters, ethers, amine and other salts.
F021	Penta- and hexachlorodibenzo-p-dioxins; penta- and hexachlorodibenzofurans; pentachlorophenol and its derivatives.
F022	Tetra-, penta-, and hexachlorodibenzo-p-dioxins; tetra-, penta-, and hexachlorodibenzofurans.
F023	Tetra-, and pentachlorodibenzo-p-dioxins; tetra- and pentachlorodibenzofurans; tri- and tetrachlorophenols and their chlorophenoxy derivative acids, esters, ethers, amine and other salts.

[1a] These methods are also described in "Samplers and Sampling Procedures for Hazardous Waste Streams," EPA 600/2-80-018, January 1980.

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EPA hazardous waste No.	Hazardous constituents for which listed
F024	Chloromethane, dichloromethane, trichloromethane, carbon tetrachloride, chloroethylene, 1,1-dichloroethane, 1,2-dichloroethane, trans-1-2-dichloroethylene, 1,1-dichloroethylene, 1,1,1-trichloroethane, 1,1,2-trichloroethane, trichloroethylene, 1,1,1,2-tetra-chloroethane, 1,1,2,2-tetrachloroethane, tetrachloroethylene, pentachloroethane, hexachloroethane, allyl chloride (3-chloropropene), dichloropropane, dichloropropene, 2-chloro-1,3-butadiene, hexachloro-1,3-butadiene, hexachlorocyclopentadiene, hexachlorocyclohexane, benzene, chlorbenzene, dichlorobenzenes, 1,2,4-trichlorobenzene, tetrachlorobenzene, pentachlorobenzene, hexachlorobenzene, toluene, naphthalene.
F025	Chloromethane; Dichloromethane; Trichloromethane; Carbon tetrachloride; Chloroethylene; 1,1-Dichloroethane; 1,2-Dichloroethane; trans-1,2-Dichloroethylene; 1,1-Dichloroethylene; 1,1,1-Trichloroethane; 1,1,2-Trichloroethane; Trichloroethylene; 1,1,1,2-Tetrachloroethane; 1,1,2,2-Tetrachloroethane; Tetrachloroethylene; Pentachloroethane; Hexachloroethane; Allyl chloride (3-Chloropropene); Dichloropropane; Dichloropropene; 2-Chloro-1,3-butadiene; Hexachloro-1,3-butadiene; Hexachlorocyclopentadiene; Benzene; Chlorobenzene; Dichlorobenzene; 1,2,4-Trichlorobenzene; Tetrachlorobenzene; Pentachlorobenzene; Hexachlorobenzene; Toluene; Naphthalene.
F026	Tetra-, penta-, and hexachlorodibenzo-*p*-dioxins; tetra-, penta-, and hexachlorodibenzofurans.
F027	Tetra-, penta-, and hexachlorodibenzo-*p*-dioxins; tetra-, penta-, and hexachlorodibenzofurans; tri-, tetra-, and pentachlorophenols and their chlorophenoxy derivative acids, esters, ethers, amine and other salts.
F028	Tetra-, penta-, and hexachlorodibenzo-*p*-dioxins; tetra-, penta-, and hexachlorodibenzofurans; tri-, tetra-, and pentachlorophenols and their chlorophenoxy derivative acids, esters, ethers, amine and other salts.
F032	Benz(a)anthracene, benzo(a)pyrene, dibenz(a,h)-anthracene, indeno(1,2,3-cd)pyrene, pentachlorophenol, arsenic, chromium, tetra-, penta-, hexa-, heptachlorodibenzo-p-dioxins, tetra-, penta-, hexa-, heptachlorodibenzofurans.
F034	Benz(a)anthracene, benzo(k)fluoranthene, benzo(a)pyrene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, naphthalene, arsenic, chromium.
F035	Arsenic, chromium, lead.
F037	Benzene, benzo(a)pyrene, chrysene, lead, chromium.
F038	Benzene, benzo(a)pyrene chrysene, lead, chromium.
F039	All constituents for which treatment standards are specified for multi-source leachate (wastewaters and nonwastewaters) under 40 CFR 268.43(a), Table CCW.

EPA hazardous waste No.	Hazardous constituents for which listed
K001	Pentachlorophenol, phenol, 2-chlorophenol, p-chloro-m-cresol, 2,4-dimethylphenyl, 2,4-dinitrophenol, trichlorophenols, tetrachlorophenols, 2,4-dinitrophenol, creosote, chrysene, naphthalene, fluoranthene, benzo(b)fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, benz(a)anthracene, dibenz(a)anthracene, acenaphthalene.
K002	Hexavalent chromium, lead
K003	Hexavalent chromium, lead.
K004	Hexavalent chromium.
K005	Hexavalent chromium, lead.
K006	Hexavalent chromium.
K007	Cyanide (complexed), hexavalent chromium.
K008	Hexavalent chromium.
K009	Chloroform, formaldehyde, methylene chloride, methyl chloride, paraldehyde, formic acid.
K010	Chloroform, formaldehyde, methylene chloride, methyl chloride, paraldehyde, formic acid, chloroacetaldehyde.
K011	Acrylonitrile, acetonitrile, hydrocyanic acid.
K013	Hydrocyanic acid, acrylonitrile, acetonitrile.
K014	Acetonitrile, acrylamide.
K015	Benzyl chloride, chlorobenzene, toluene, benzotrichloride.
K016	Hexachlorobenzene, hexachlorobutadiene, carbon tetrachloride, hexachloroethane, perchloroethylene.
K017	Epichlorohydrin, chloroethers [bis(chloromethyl) ether and bis (2-chloroethyl) ethers], trichloropropane, dichloropropanols.
K018	1,2-dichloroethane, trichloroethylene, hexachlorobutadiene, hexachlorobenzene.
K019	Ethylene dichloride, 1,1,1-trichloroethane, 1,1,2-trichloroethane, tetrachloroethanes (1,1,2,2-tetrachloroethane and 1,1,1,2-tetrachloroethane), trichloroethylene, tetrachloroethylene, carbon tetrachloride, chloroform, vinyl chloride, vinylidene chloride.
K020	Ethylene dichloride, 1,1,1-trichloroethane, 1,1,2-trichloroethane, tetrachloroethanes (1,1,2,2-tetrachloroethane and 1,1,1,2-tetrachloroethane), trichloroethylene, tetrachloroethylene, carbon tetrachloride, chloroform, vinyl chloride, vinylidene chloride.
K021	Antimony, carbon tetrachloride, chloroform.
K022	Phenol, tars (polycyclic aromatic hydrocarbons).
K023	Phthalic anhydride, maleic anhydride.
K024	Phthalic anhydride, 1,4-naphthoquinone.
K025	Meta-dinitrobenzene, 2,4-dinitrotoluene.
K026	Paraldehyde, pyridines, 2-picoline.
K027	Toluene diisocyanate, toluene-2, 4-diamine.
K028	1,1,1-trichloroethane, vinyl chloride.
K029	1,2-dichloroethane, 1,1,1-trichloroethane, vinyl chloride, vinylidene chloride, chloroform.
K030	Hexachlorobenzene, hexachlorobutadiene, hexachloroethane, 1,1,1,2-tetrachloroethane, 1,1,2,2-tetrachloroethane, ethylene dichloride.
K031	Arsenic.
K032	Hexachlorocyclopentadiene.
K033	Hexachlorocyclopentadiene.
K034	Hexachlorocyclopentadiene.
K035	Creosote, chrysene, naphthalene, fluoranthene benzo(b) fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd) pyrene, benzo(a)anthracene, dibenzo(a)anthracene, acenaphthalene.
K036	Toluene, phosphorodithioic and phosphorothioic acid esters.
K037	Toluene, phosphorodithioic and phosphorothioic acid esters.

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Hazardous constituents for which listed

ntachlorophenol, phenol, 2-chlorophenol, p-
chloro-m-cresol, 2,4-dimethylphenyl, 2,4-
dinitrophenol, trichlorophenols,
tetrachlorophenols, 2,4-dinitrophenol, creosote,
hrysene, naphthalene, fluoranthene,
enzo(b)fluoranthene, benzo(a)pyrene,
ndeno(1,2,3-cd)pyrene, benz(a)anthracene,
dibenz(a)anthracene, acenaphthalene.
xavalent chromium, lead
avalent chromium, lead.
avalent chromium.
avalent chromium, lead.
xavalent chromium.
anide (complexed), hexavalent chromium.
xavalent chromium.
roform, formaldehyde, methylene chloride,
ethyl chloride, paraldehyde, formic acid.
roform, formaldehyde, methylene chloride,
ethyl chloride, paraldehyde, formic acid,
hloroacetaldehyde.
ylonitrile, acetonitrile, hydrocyanic acid.
ocyanic acid, acrylonitrile, acetonitrile.
onitrile, acrylamide.
yl chloride, chlorobenzene, toluene,
enzotrichloride.
achlorobenzene, hexachlorobutadiene, carbon
rachloride, hexachloroethane,
chloroethylene.
lorohydrin, chloroethers [bis(chloromethyl)
r and bis (2-chloroethyl) ethers],
hloropropane, dichloropropanols.
ichloroethane, trichloroethylene,
achlorobutadiene, hexachlorobenzene.
chloride, 1,1,1-trichloroethane, 1,1,2-
hane, tetrachloroethanes (1,1,2,2-
oethane and 1,1,1,2-
achloroethane), trichloroethylene,
achloroethylene, carbon tetrachloride, chlo-
rm, vinyl chloride, vinylidene chloride.
e dichloride, 1,1,1-trichloroethane, 1,1,2-
oroethane, tetrachloroethanes (1,1,2,2-
hloroethane and 1,1,1,2-
achloroethane), trichloroethylene,
achloroethylene, carbon tetrachloride, chlo-
m, vinyl chloride, vinylidene chloride.
y, carbon tetrachloride, chloroform.
tars (polycyclic aromatic hydrocarbons).
anhydride, maleic anhydride.
c anhydride, 1,4-naphthoquinone.
nitrobenzene, 2,4-dinitrotoluene.
yde, pyridines, 2-picoline.
diisocyanate, toluene-2, 4-diamine.
hloroethane, vinyl chloride.
oroethane, 1,1,1-trichloroethane, vinyl
de, vinylidene chloride, chloroform.
lorobenzene, hexachlorobutadiene, hexa-
thane, 1,1,1,2-tetrachloroethane, 1,1,2,2-
loroethane, ethylene dichloride.

uorocyclopentadiene.
orocyclopentadiene.
orocyclopentadiene.
chrysene, naphthalene, fluoranthene
) fluoranthene, benzo(a)pyrene,
1,2,3-cd) pyrene, benzo(a)anthracene,
o(a)anthracene, acenaphthalene.
phosphorodithioic and phosphorothioic
sters.
phosphorodithioic and phosphorothioic
rs.

EPA hazardous waste No.	Hazardous constituents for which listed
K038	Phorate, formaldehyde, phosphorodithioic and phosphorothioic acid esters.
K039	Phosphorodithioic and phosphorothioic acid esters.
K040	Phorate, formaldehyde, phosphorodithioic and phosphorothioic acid esters.
K041	Toxaphene.
K042	Hexachlorobenzene, ortho-dichlorobenzene.
K043	2,4-dichlorophenol, 2,6-dichlorophenol, 2,4,6-trichlorophenol.
K044	N.A.
K045	N.A.
K046	Lead.
K047	N.A.
K048	Hexavalent chromium, lead.
K049	Hexavalent chromium, lead.
K050	Hexavalent chromium.
K051	Hexavalent chromium, lead.
K052	Lead.
K060	Cyanide, napthalene, phenolic compounds, arsenic.
K061	Hexavalent chromium, lead, cadmium.
K062	Hexavalent chromium, lead.
K064	Lead, cadmium.
K065	Do.
K066	Do.
K069	Hexavalent chromium, lead, cadmium.
K071	Mercury.
K073	Chloroform, carbon tetrachloride, hexachloroethane, trichloroethane, tetrachloroethylene, dichloroethylene, 1,1,2,2-tetrachloroethane.
K083	Aniline, diphenylamine, nitrobenzene, phenylenediamine.
K084	Arsenic.
K085	Benzene, dichlorobenzenes, trichlorobenzenes, tetrachlorobenzenes, pentachlorobenzene, hexachlorobenzene, benzyl chloride.
K086	Lead, hexavalent chromium.
K087	Phenol, naphthalene.
K088	Cyanide (complexes).
K090	Chromium.
K091	Do.
K093	Phthalic anhydride, maleic anhydride.
K094	Phthalic anhydride.
K095	1,1,2-trichloroethane, 1,1,1,2-tetrachloroethane, 1,1,2,2-tetrachloroethane.
K096	1,2-dichloroethane, 1,1,1-trichloroethane, 1,1,2-trichloroethane.
K097	Chlordane, heptachlor.
K098	Toxaphene.
K099	2,4-dichlorophenol, 2,4,6-trichlorophenol.
K100	Hexavalent chromium, lead, cadmium.
K101	Arsenic.
K102	Arsenic.
K103	Aniline, nitrobenzene, phenylenediamine.
K104	Aniline, benzene, diphenylamine, nitrobenzene, phenylenediamine.
K105	Benzene, monochlorobenzene, dichlorobenzenes, 2,4,6-trichlorophenol.
K106	Mercury.
K107	1,1-Dimethylhydrazine (UDMH).
K108	1,1-Dimethylhydrazine (UDMH).
K109	1,1-Dimethylhydrazine (UDMH).
K110	1,1-Dimethylhydrazine (UDMH).
K111	2,4-Dinitrotoluene.
K112	2,4-Toluenediamine, *o*-toluidine, *p*-toluidine, aniline.
K113	2,4-Toluenediamine, *o*-toluidine, *p*-toluidine, aniline.
K114	2,4-Toluenediamine, *o*-toluidine, *p*-toluidine.
K115	2,4-Toluenediamine.
K116	Carbon tetrachloride, tetrachloroethylene, chloroform, phosgene.
K117	Ethylene dibromide.
K118	Ethylene dibromide.
K123	Ethylene thiourea.
K124	Ethylene thiourea.
K125	Ethylene thiourea.
K126	Ethylene thiourea.
K131	Dimethyl sulfate, methyl bromide.
K132	Methyl bromide.
K136	Ethylene dibromide.
K141	Benzene, benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene.
K142	Benzene, benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene.
K143	Benzene, benz(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene.
K144	Benzene, benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenz(a,h)anthracene.
K145	Benzene, benz(a)anthracene, benzo(a)pyrene, dibenz(a,h)anthracene, naphthalene.
K147	Benzene, benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene.
K148	Benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene.
K149	Benzotrichloride, benzyl chloride, chloroform, chloromethane, chlorobenzene, 1,4-dichlorobenzene, hexachlorobenzene, pentachlorobenzene, 1,2,4,5-tetrachlorobenzene, toluene.
K150	Carbon tetrachloride, chloroform, chloromethane, 1,4-dichlorobenzene, hexachlorobenzene, pentachlorobenzene, 1,2,4,5-tetrachlorobenzene, 1,1,2,2-tetrachloroethane, tetrachloroethylene, 1,2,4-trichlorobenzene.
K151	Benzene, carbon tetrachloride, chloroform, hexachlorobenzene, pentachlorobenzene, toluene, 1,2,4,5-tetrachlorobenzene, tetrachloroethylene.

N.A.—Waste is hazardous because it fails the test for the characteristic of ignitability, corrosivity, or reactivity.

[46 FR 4619, Jan. 16, 1981]

EDITORIAL NOTE: For FEDERAL REGISTER citations affecting Appendix VII, part 261, see the List of CFR Sections Affected in the Finding Aids section of this volume.

Ref No 24
p. 8 of 8

REFERENCE NUMBER 25

MALCOLM PIRNIE

MEMORANDUM

To: LCP Chemical File **Date:** March 14, 1996

From: David Kahlenberg

Re: Site Inspection

As part of the January 1995 Site Inspection the following were noted during the field activities:

- There was no liner present at the site; no maintained, engineered cover; no functioning and maintained run-on control and runoff management system(s); and no leachate collection/removal system present at soil sample locations MBKW78 (SL2) or MBKW79 (SL3).

Ref. No. 25. p. 1 of 1