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Description and Evaluation of a Prototype Coastal Information System as a Tool for the Ocean Pollution Data and Information Network

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NOTICE

BACKGROUND

In May of 1981, the Central Coordination and Referral Office (CCRO) was designated to manage the Ocean Pollution Data and Information Network (OPDIN). The Network was one result of Public Law 95-273 (The National Ocean Pollution Planning Act) which states, under Section 8 of the Act, a need to disseminate in a more timely manner and useful form, data and information resulting from Federal marine pollution activities. The National Oceanic and Atmospheric Administration (NOAA) was delegated the responsibility as lead agency to implement the Act: the CCRO was established within NOAA's National Oceanographic Data Center (NODC) to fulfill the data and information dissemination task.

With private contractor assistance and guidance from Federal pollution-related agencies, the CCRO staff developed Network goals and objectives (Appendix A) using guidelines and requirements that were approved by potential Federal Network participants and users (1 - 4). Among the tasks initiated by the CCRO to meet those objectives was the investigation of developmental and state-of-the-art hardware and software systems that could improve marine pollution data and information dissemination within the Network (5).

With annual funding for Network developmental tasks limited to approximately $50,000 during the initial years, the potential use of relatively inexpensive personal computers for generating and distributing data and information products (via diskette, hardcopy or PC communications) was particularly attractive. Several proposals and on-going projects were reviewed by the CCRO that might address this area.

COASTAL INFORMATION SYSTEM (CIS) PROPOSAL

Among the projects considered by the CCRO was a proposal to investigate the use of micro-computers as an information system to support coastal decision-making. Dr. Peter Weyl and Dr. Jerry Schubel from the Marine Sciences Research Center (MSRC) of the State University of New York at Stony Brook submitted the proposal under a NOAA/SUNY cooperative agreement. The two-year task was proposed at a cost of $100,000 a year (Appendix B).

After several discussions and meetings, it was agreed that NODC, through the Ocean Pollution Data and Information Network and the William H. Donner Foundation, would jointly provide the necessary funding for this two-year effort. It was further agreed that a prototype system for the port of New York/New

Jersey, one of the most complex estuarine areas in the United States, would be used to demonstrate the utility of this approach. The project was initiated in June 1982, and named the Hudson-Raritan Coastal Information System.

PROTOTYPE SYSTEM WORK PLAN

Prior to the actual initiation and resource assignments for the task, a detailed work plan was formulated by MSRC and CCRO staffs. The work plan identified four successive phases to be completed during the two year period (Appendix C). Although there was some overlap among the four phases, each phase was relatively distinct and involved the following tasks:

I. Procure hardware and develop index systems.

II. Identify information requirements, sources and products, and link index systems.

III. Acquire and enter data and information into automated files, and develop output programs and products.

IV. Complete system documentation, and transfer the system to clients.

Review meetings and demonstrations of the system to potential regional users were important components of the work plan schedule. Major workshops and demonstrations conducted throughout this task are listed in Appendix D. Samples and copies of the developing system were provided by MSRC personnel to the CCRO and other interested agencies throughout the project to permit detailed, hands-on evaluation of the system by users.

During the first phase, the IBM PC (personal computer) was selected as the project hardware. It offered the most promising long-term and broad use potential among Federal and regional agency users of micro-computers. It is the system most likely to become an industry standard for PCs. As part of this phase, a single one-dimensional indexing system for the coasts and the navigation channels was completed using detailed U.S. Geological Survey and NOAA maps. Depending on chart scales and map details, specific sites and objects were located along the axis with an accuracy of 100-meter or better.

During the second phase, MSRC concentrated on determining information requirements for regional issues, identifying primary sources of data, and developing the necessary software to link the indexing systems. Desirable products and priority data types were identified initially through discussions with potential users. However, as the MSRC staff was developing the software packages to generate menu-driven and file selection capabilities, industry-developed spreadsheets for personal computers began to appear on the market. The Lotus 1-2-3 spreadsheet, in particular, was a promising alternative to MSRC-developed user-tailored software for the prototype system. Lotus 1-2-3 consists of large matrix worksheets, graphics capabilities, and information management programs as well as auxiliary utilities for file handling and disk operations. It is compatible with IBM PCs as well as many other personal computers. By early 1983, Lotus 1-2-3 replaced most software previously developed by MSRC personnel for the Hudson-Raritan CIS.

More advanced software packages such as Lotus Symphony are now available. Symphony is currently being investigated by MSRC for selected modification and CIS enhancement. In addition to 1-2-3 capabilities, Symphony has word processing, data base management, and communications capabilities.

The third phase involved the selection of appropriate data and information, and development of specific worksheet files and output products. Since the MSRC staff was familiar with the Hudson-Raritan and New York Bight areas, the choice of data and information sources for incorporation in the CIS was primarily left to their staff. The CCRO reviewed their progress, and provided comments on their file choices as the prototype system was developed. The data files currently in the prototype system are described in more detail in the system characteristics section of this report.

A task extension, to May 1985, allowed newly-identified files to be incorporated into the CIS and a Users Guide to be completed. Several problems still remained at the conclusion of the initial phases of the project:

- No interested government agency (other than the CCRO) had IBM PCs or compatible hardware, which limited hands-on evaluation and use of the system by other interested activities.
- Most agencies awaited review and acceptance by other agencies in their region before committing themselves to hardware purchase or development of similar systems and identification of additional files useful to their agency mission.
- Some sources of data, particularly those concerned with both temporal and areal distributions (e.g., water quality), did not work well with the established, one-dimensional index system.

DEMONSTRATION OF THE PROTOTYPE SYSTEM

By May 1985, an extensive audience of potential users had seen presentations and demonstrations of CIS capabilities (Appendices D and E). Diskette copies of the prototype system and the 'Users Guide' had been provided to a number of individuals associated with Federal, state and regional interests in the New York-New Jersey area and also in the broader area of regional coastal zone management.

Major discussion topics among demonstration participants included the need to identify of overall system management and maintenance of the system under operational conditions. The consensus of the demonstration participants was that maintenance efforts and computer hardware support must be kept to a minimum while products for decision making and evaluation must represent the most current data and information, if the system was to be useful for individual decision making and planning agencies. It was noted that computer software expertise and data entry resources were not always available at regional agency facilities to support such systems.

SYSTEM DESCRIPTION AND SAMPLE PRODUCTS

The characteristics of the prototype system are discussed in detail in the documentation and user manual prepared by SUNY/MSRC (6). The following is a brief summary of the major characteristics of the system.

The coordinate system used in the prototype is a one-dimensional system consisting of a series of connected line segments drawn to approximate shorelines and major channels in the estuary. Starting points were arbitrarily selected and one kilometer increments marked along each segment (Figure 1). Coordinate systems were developed for five different coastal areas (Manhattan and Staten Islands and the eastern, western and northern coasts of the estuary) and three channel systems (the Hudson River and the river systems for the New Jersey area).

Two types of spatial information have been indexed on the linear system:

- individual features, such as port facilities or navigational hazards located along the shore or waterway are identified by single coordinate points.

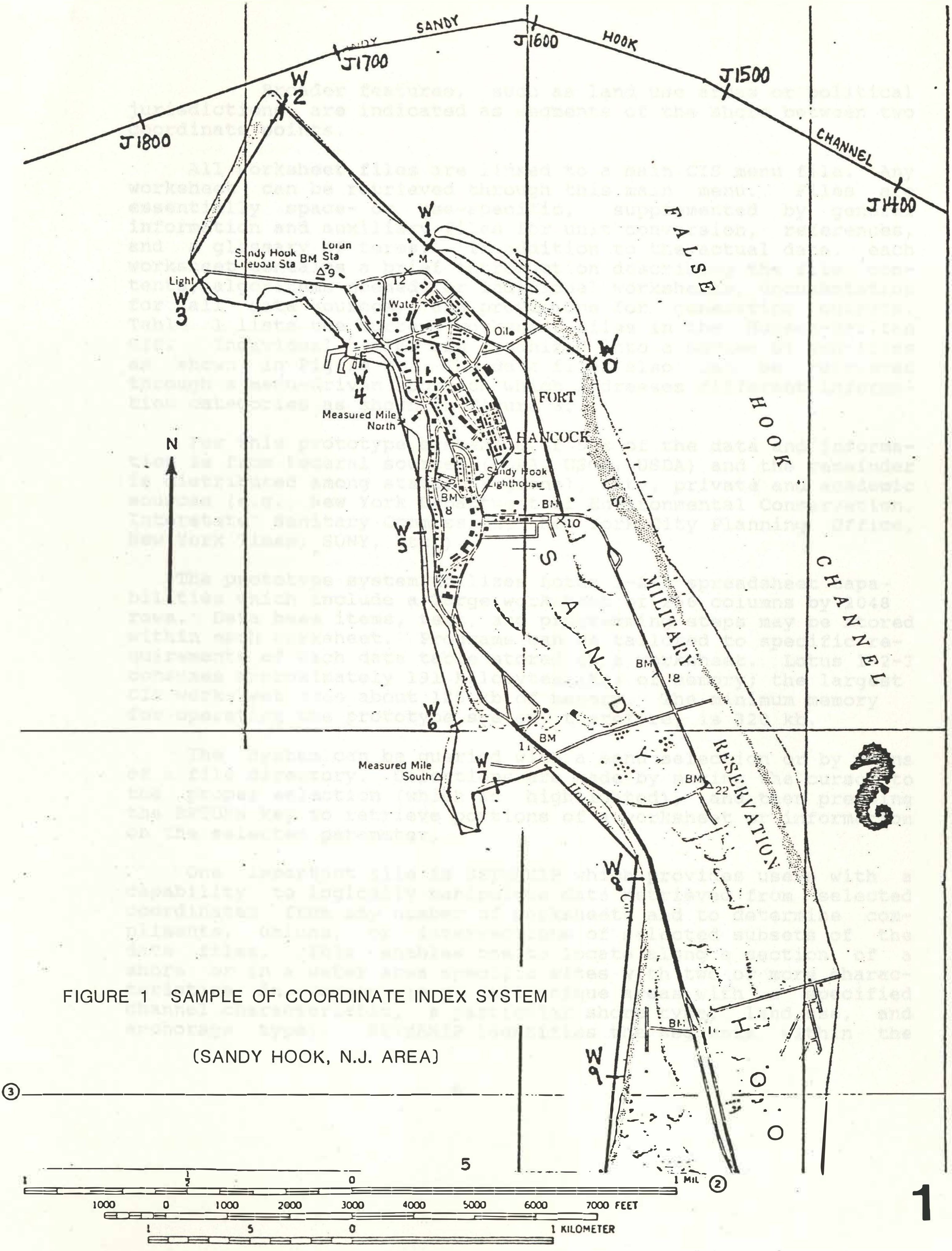

FIGURE 1 SAMPLE OF COORDINATE INDEX SYSTEM

(SANDY HOOK, N.J. AREA)

- Broader features, such as land use areas or political jurisdictions, are indicated as segments of the shore between two coordinate points.

All worksheet files are linked to a main CIS menu file. Any worksheet can be retrieved through this main menu. Files are essentially space- or use-specific, supplemented by general information and auxiliary files for unit conversion, references, and a glossary of terms. In addition to the actual data, each worksheet contains a brief introduction describing the file contents, algorithms needed for individual worksheets, documentation for all data sources, and provisions for generating outputs. Table 1 lists the current worksheet files in the Hudson-Raritan CIS. Individual files are organized into a series of sub-files as shown in Figure 2. The data files also can be retrieved through a menu-driven approach which addresses different information categories as shown in Figure 3.

For this prototype system, over 50% of the data and information is from Federal sources (NOAA, USGS, USDA) and the remainder is distributed among state, regional, city, private and academic sources (e.g., New York Department of Environmental Conservation, Interstate Sanitary Commission, New York City Planning Office, New York Times, SUNY, etc.).

The prototype system utilizes Lotus 1-2-3 spreadsheet capabilities which include a large worksheet of 256 columns by 2048 rows. Data base items, text, and programming steps may be stored within each worksheet. Programs can be tailored to specific requirements of each data table stored on a worksheet. Lotus 1-2-3 consumes approximately 191 kilobytes (kb) of memory; the largest CIS worksheet uses about 125 kb of memory. The minimum memory for operating the prototype system, therefore, is 320 kb.

The system can be queried with a menu selection or by means of a file directory. Selections are made by moving the cursor to the proper selection (which is highlighted), and then pressing the RETURN key to retrieve portions of a worksheet or information on the selected parameter.

One important file is SETMANIP which provides users with a capability to logically manipulate data retrieved from selected coordinates from any number of worksheets and to determine compliments, unions, or intersections of selected subsets of the data files. This enables one to locate along a section of a shore or in a water area specific sites with two or more characteristics in common (e.g. all unique areas with a specified channel characteristic, a particular shore type, land use, and anchorage type). SETMANIP identifies the segments within the

TABLE 1. ALPHABETICAL LIST OF WORKSHEET FILES FOR THE PROTOTYPE HUDSON-RARITAN CIS

File	Description
ACCESS	Access to shoreline from landward side
ANCHOR	Anchorages
BATHYM	Nearshore bathymetry
BAYCHAR	Bottom characteristics and special features
BRIDGE	Bridges
CHANAME	Names of waterways
CHANCHAR	Waterway characteristics (incl. dredging)
CLNDEPTH	Channel centerline depth profile
DREGDATA	Federal dredging project data file
FISHDATA	Summary information on fish species
GEONAME	List of geographic names with coordinates
GLOSSARY	Glossary of technical terms
HISTDATE	Important historical events
HUD_GID	Hudson River discharge at Green Island
INDUSTR	Location and discharges for industrial facilities
ISLAND	Information about small islands
LANDUSE	Land use for shoreline segments
LATLONGS	Shoreline latitude/longitude index
LATLONGW	Waterway latitude/longitude index
LW_CORR	Correlation between land and water coordinates
MAPCHART	Map/Chart index
MENU	Main PNYNJ Information System menu
MENU PT2	Second part of main menu
NAVAID	Aids to navigation
NAVHAZ	Hazards to navigation
POLJUR	Political jurisdictions for shoreline segments
POL_MOD	Pollution dispersal hydrologic model
POPULTN	Population by counties during census years
PORTFAC	Access file to port facility information files
RAINCP	Rainfall data for New York City's Central Park
REFFILE	References
SAL_MOD	Salinity distribution hydrologic model
SETMANIP	Logical manipulation of line segment subsets
SHORTYPE	Type of shoreline
SOILTYPE	Soil type classification
TIDECUR	Tidal currents
TIDEELEV	Tidal elevation data at the shoreline
TOPOGRPH	Access file for topography within 1 km of shore
TRUEDIST	Distance between a pair of coordination
UNITS	Unit conversions
WATCLASS	Water classification along shore segments
WWDISCHG	Quality of sewage treatment plant discharges
WWTALL	Major changes in waste treatment plants
WWTHIST	Annual data on major treatment plants
WWTPLANT	Wastewater treatment plant name, location & flow rate

F I G U R E   2

WORKSHEET FILE AND SUBDIRECTORY STRUCTURE

MAIN FILE MENU -------------> EXIT SYSTEM

S U B D I R E C T O R Y / F I L E   N A M E S

- WATER
  - ANCHOR
  - BAYCHAR
  - CHANAME
  - CHANCHAR
  - CLNDEPTH
  - DREGDATA
  - LATLONGW
  - NAVAID
  - NAVHAZ
  - TIDECUR
  - WATCLASS
- RIVER
  - HUD-GID
- SHORE
  - ACCESS
  - BATHYM
  - LANDUSE
  - LATLONGS
  - POLJUR
  - SHORTYPE
  - SOILTYPE
  - TOPOGRPH
  - TIDEELEV
- POINT
  - BRIDGE
  - INDUSTR
  - PORTFAC
  - WWDISCHG
  - WWTPLANT
- HISTORY
  - HISTDATE
  - POPULTN
  - WWTALL
  - WWTHIST
- GENERAL
  - FISHDATA
  - RAINCP
- MODEL
  - POL_MOD
  - SAL_MOD
- AUXILIARY
  - GEONAME
  - GLOSSARY
  - ISLAND
  - LW_CORR
  - MAPCHART
  - REFFILE
  - TRUEDIST
  - UNITS
- OUTPUT
  - SETMANIP

F I G U R E   3

M E N U - D R I V E N   W O R K S H E E T   C A T E G O R I E S & F I L E S

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                         C       A       T       E       G       O       R       I       E       S
 ______________   ______________   ______________   __________________   ______________   ______________
|              | |              | |              | |                  | |              | |              |
|    SPACE     | |     USE      | |   HISTORY    | |   METEOROLOGY    | |  AUXILIARY   | |    OUTPUT    |
|______________| |______________| |______________| |__________________| |______________| |______________|
     |               |                                                         |                |
     |               |     S    U    B    J    E    C    T    S                |                |
     |               |                                     |                   |                |
S E L E C T I O N S                       |   W    O    R    K    S    H    E    E    T    S     |
     |               |                                                                          |
     v               v                    v                                    v                v
 |>Shore         |>Recreation         |>General----|  |>Precipitation-|  |>Glossary----|  |>Files----|
 |   National--| |   Parks---------|  |            |  |               |  |             |  |          |
 |   Political-| |   Boating-------|  |>Population-|  |>Temperature---|  |>References--|  |>Setmanip-|
 |   Cultural--| |   Fishing-------|  |            |  |               |  |             |  |          |
 |             | |>Transportation  |  |>Waste      |  |>River         |  |>Maps--------|  |>Print----|
 |>Water       | |   Water---------|      treatment      discharge       |             |  |          |
 |   Channels--| |   Land----------|      History--|      Hudson-----|  |>Units-------|  |>Graph----|
 |   Bays------| |   Bridges-------|      All------|                  |  |             |  |          |
 |   Rivers----| |>Fishing          |               |                  |  |>Names-------|             |
 |   Names-----| |   Recreation----|               |                  |  |             |             |
 |   General---| |   Commercial----|               |                  |  |>Atlas-------|             |
 |             | |   Species-------|               |                  |  |             |             |
 |>Islands-----| |>Waste disposal  |               |                  |  |>Lat-Long----|             |
 |             | |   Municipal-----|               |                  |  |             |             |
 |>Bridges-----| |   Industrial----|               |                  |  |>Correlation-|             |
               | |   Dredging------|               |                  |  |             |             |
               | |>Commerce--------|               |                  |  |>Distance----|             |
               | |   Water---------|               |                  |  |             |             |
               | |   Land----------|               |                  |  |             |             |
               | |   Bridges-------|               |                  |  |             |             |
               | |>Residential-----|               |                  |  |             |             |
               | |>Undeveloped-----|               |                  |  |             |             |
               |                   |               |                  |                |             |
 ______________V___________________V_______________V__________________V________________V_____________V__
|                                                                                                        |
|                     I n d i v i d u a l    W o r k s h e e t    F i l e s                              |
|________________________________________________________________________________________________________|
```

specified range that have all (or none) of the characteristics selected during individual worksheet searches. This provides a user with a relatively quick means of identifying sites within the study area that should be investigated further. A more detailed discussion of this process is included in a paper by Weyl (7).

Several simple hydrodynamic models have been included in the CIS using Lotus 1-2-3 capabilities. These models (salinity and pollutant dispersions) are not intended to replace more sophisticated models such as those developed by NOAA, EPA, MMS, USGS, and other agencies. They are however, intended to provide managers with some preliminary indications of where and when problems concerning chemical spills or similar events may occur within a given estuary or port area.

A box model approach was used to divide the estuary into a number of different water areas, each with its own volume and discharge characteristics (Figure 4). Algorithms were developed by MSRC personnel to compute the dispersion from a specific site over any number of tidal cycles. In contrast, the hydrology of the Mississippi River made it possible to use actual results from several spill tests for the New Orleans CIS. Arrival times, concentration and extent of surface plume are computed for points downstream from any spill site for different river stages for this system.

Another regional delineation for the prototype system uses areas of similar marine sediment characteristics (Figure 5). Each area is described in terms of sediment type, mean depth, aerial boundaries, significant features, and other information for each area.

A variety of data presentations and graphic products can be generated from the system. Figures 6 through 11 display some of these products. Presentations may range from lists of the data or subsets of data as stored on a worksheet (Figure 6), to products which present formatted outputs for different sites (Figure 7), or other more general information such as data on a particular fish species common to the area (Figure 8).

CIS graphic product types are limited to Lotus 1-2-3 capabilities with examples shown in Figures 9 through 11. Figure 9 is an x-y plot of population changes over time. Figure 10 shows mean monthly discharge characteristics for a site on the Hudson River (plotted from a PC printer). Figure 11 is a histogram summarizing selected metals from municipal discharges for New York and New Jersey sites stored in the prototype system.

FIGURE 4. HYDRODYNAMIC MODEL AREAS

This map depicts the parts into which the study area and adjacent external regions were divided for the hydrologic model of New York Harbor.

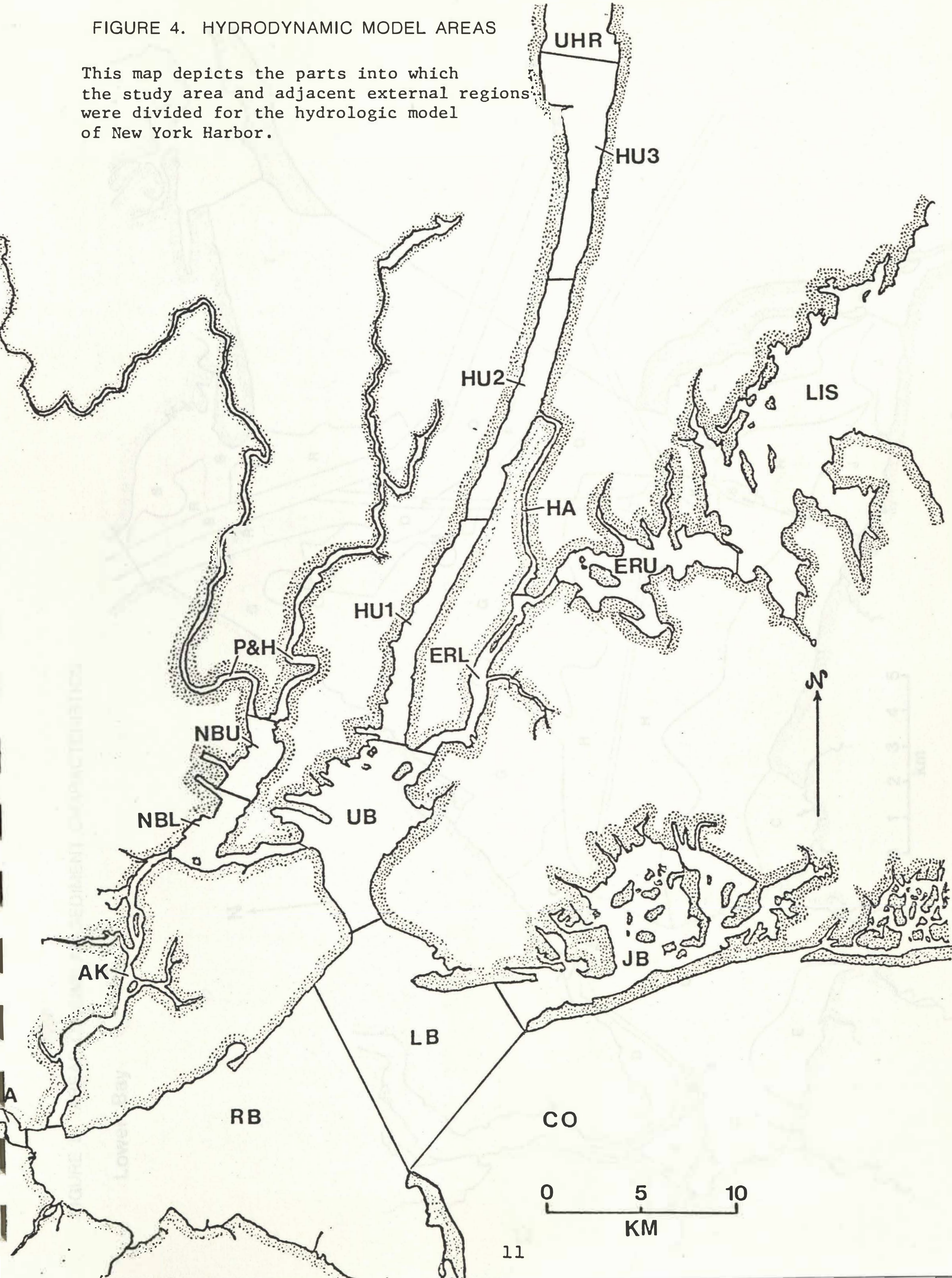

FIGURE 5. AREAS OF SIMILAR SEDIMENT CHARACTERISTICS

Lower Bay

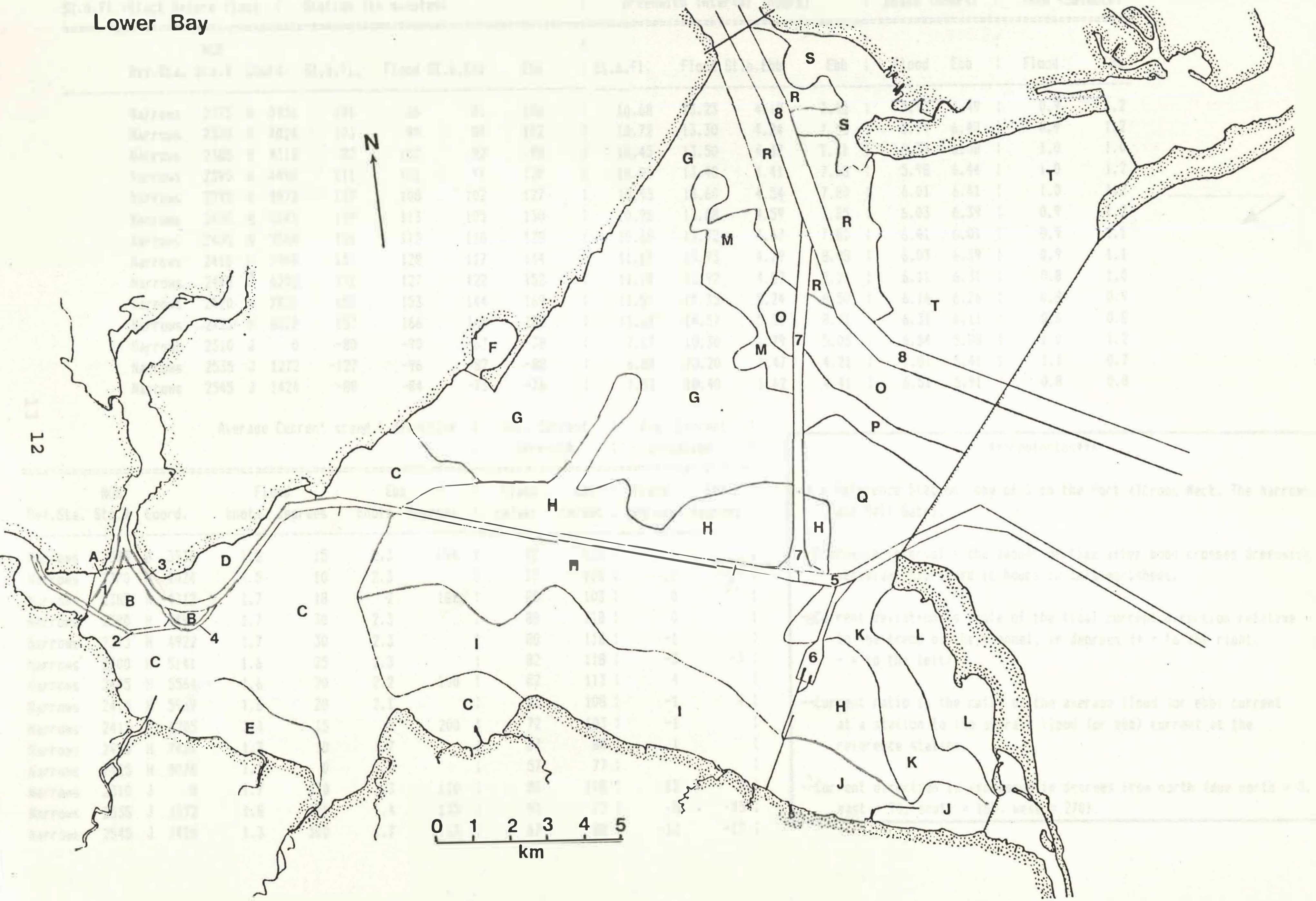

FIGURE 6. SAMPLE DATA TABLE (TIDAL DATA)

TIDAL CURRENT DATA Sl.b.Fl.=Slack before flood				Time difference relative to Reference Station (in minutes)				Greenwich Interval (hours)				Duration of phase (hours)		Current Ratio (see footnote)	
Ref.Sta.	NOS Sta.#	Coord:		Sl.b.Fl.	Flood	Sl.b.Ebb	Ebb	Sl.b.Fl.	Flood	Sl.b.Ebb	Ebb	Flood	Ebb	Flood	Ebb
Narrows	2375	H	3936	101	86	81	106	10.68	13.23	4.19	7.45	5.93	6.49	0.9	1.2
Narrows	2380	H	4024	103	90	84	112	10.72	13.30	4.24	7.55	5.94	6.48	0.9	1.2
Narrows	2385	H	4312	87	102	92	98	10.45	13.50	4.37	7.31	6.34	6.08	1.0	1.0
Narrows	2390	H	4490	111	101	94	120	10.85	13.48	4.41	7.68	5.98	6.44	1.0	1.2
Narrows	2395	H	4922	117	108	102	127	10.95	13.60	4.54	7.80	6.01	6.41	1.0	1.2
Narrows	2400	H	5141	119	113	105	130	10.98	13.68	4.59	7.85	6.03	6.39	0.9	1.2
Narrows	2405	H	5564	101	115	110	128	10.68	13.72	4.67	7.81	6.41	6.01	0.9	1.1
Narrows	2410	H	5969	131	128	117	144	11.18	13.93	4.79	8.08	6.03	6.39	0.9	1.1
Narrows	2415	H	6205	131	127	122	152	11.18	13.92	4.87	8.21	6.11	6.31	0.8	1.0
Narrows	2420	H	7426	150	153	144	169	11.50	14.35	5.24	8.50	6.16	6.26	0.8	0.9
Narrows	2425	H	8078	157	166	160	182	11.62	14.57	5.51	8.71	6.31	6.11	0.6	0.8
Narrows	2310	J	0	-80	-90	-63	-38	7.67	10.30	1.79	5.05	6.54	5.88	1.0	1.2
Narrows	2535	J	1272	-127	-96	-82	-88	6.88	10.20	1.47	4.21	7.01	5.41	1.1	0.7
Narrows	2545	J	1424	-88	-84	-73	-76	7.53	10.40	1.62	4.41	6.51	5.91	0.8	0.8

				Average Current speed & direction				Avg. Current Strength		Avg. Current Deviation	
	NOS			Flood		Ebb		Flood	Ebb	Flood	Ebb
Ref.Sta.	Sta.#	Coord.		knots	degrees	knots	degrees	cm/sec	cm/sec	degrees	degrees
Narrows	2375	H	3936	1.5	15	2.3	194	77	118	0	
Narrows	2380	H	4024	1.5	10	2.3		77	118	-12	-23
Narrows	2385	H	4312	1.7	18	2	187	88	103	0	
Narrows	2390	H	4490	1.7	30	2.3		88	118	0	
Narrows	2395	H	4922	1.7	30	2.3		88	118	-1	
Narrows	2400	H	5141	1.6	25	2.3		82	118	-3	-3
Narrows	2405	H	5564	1.6	20	2.2	200	82	113	4	
Narrows	2410	H	5969	1.6	20	2.1		82	108	-1	4
Narrows	2415	H	6205	1.4	15	2	200	72	103	-1	
Narrows	2420	H	7426	1.3	10	1.7		67	88	1	
Narrows	2425	H	8078	1.1	0	1.5		57	77		
Narrows	2310	J	0	1.7	310	2.3	110	88	118	12	7
Narrows	2535	J	1272	1.8	320	1.4	135	93	72	-8	-15
Narrows	2545	J	1424	1.3	300	1.7	113	67	88	-12	-17

Footnotes

** = Reference Station. one of 3 in the Port (Throgs Neck. The Narrows. and Hell Gate).

--Greenwich interval = the amount of time after moon crosses Greenwich meridian. expressed in hours in this worksheet.

--Current deviation is angle of the tidal current direction relative to the trend of the channel. in degrees (+ = to the right. - = to the left).

--Current ratio is the ratio of the average flood (or ebb) current at a station to the average flood (or ebb) current at the reference station.

--Current direction is expressed in degrees from north (due north = 0. east = 90. south = 180. west = 270).

FIGURE 7. SAMPLE SUMMARY DATA (MUNICIPAL DISCHARGES)

County Code	AREA	TREATMENT PLANT	TREATMENT PLANT DISCHARGE REF 1 MGD	TYPE	REF 2 MGD	TYPE	DATA TO BE USED FOR OUTPUT * Copy into this column MGD	TYPE	E+3 m^3/Tc	
36119		(maximum value)	345		281.53		281.53		551.4585	
34003		(minimum value)	0		0.1		0		0	
								TYPE	FLOW	AREA
36047	JB	26TH WARD	90.0	SEC	64.0	SEC AS	64.0	SEC AS	125.4	JB
	LB3	ABERDEEN TWNSHP	0.5	SEC			0.5	SEC	1.0	LB3
34025	LB2	ATLANTIC HIGHLAN	0.5	PRIM	0.5	PRIM	0.5	PRIM	1.0	LB2
34017	NBL	BAYONNE	13.0	PRIM	12.3	PRIM	12.3	PRIM	24.1	NBL
36081	ERU	BOWERY BAY	151.0	SEC3AS	129.0	SEC AS	129.0	SEC AS	252.7	ERU
34023	AK	CARTERET	3.2	PRIM3	3.2	PRIM	3.2	PRIM	6.3	AK
36059	JB	CEDERHURST	1.0	SEC TF	1.1	SEC TF	1.1	SEC TF	2.2	JB
36047	JB	CONEY ISLAND	98.0	SEC3	85.6	SEC AS	85.6	SEC AS	167.7	JB
34003	HU1	EDGEWATER	2.8	PRIM3	2.8	PRIM	2.8	PRIM	5.5	HU1
36085	AK	ELMWOOD HOMES	0.5	SEC3		SEC XA		SEC XA	0.0	AK
36085	AK	HEARTLAND VILLAG	0.5	SEC	0.6	SEC XA	0.6	SEC XA	1.2	AK
34025	LB2	HIGHLANDS	0.4	PRIM	0.6	PRIM	0.6	PRIM	1.2	LB23
34017	HU1	HOBOKEN	15.0	PRIM3	7.2	PRIM	7.2	PRIM	14.1	HU1
36005	ERU	HUNTS POINT	146.0	SEC AS	111.4	SEC AS	111.4	SEC AS	218.2	ERU
36059	JB	INWOOD	1.8	SEC TF	1.3	SEC TF	1.3	SEC TF	2.5	JB
36081	JB	JAMAICA	1[illegible]1.[illegible]	SEC	96.0	SEC AS	96.0	SEC AS	188.1	JB
34017	UB	JERSEY CITY (EAS	35.0	PRIM	25.5	PRIM	25.5	PRIM	50.0	UB
34017	NBU	JERSEY CITY (WES	21.0	PRIM	24.1	PRIM	24.1	PRIM	47.2	NBU
34039	AK	JOINT MTNG ESSEX	65.0	SEC AS	60.0	SEC AS3	60.0	SEC AS	117.5	AK
34017	NBU	KEARNY		PRIM	2.0	PRIM	2.0	PRIM	3.9	NBU
34039	AK	LINDEN ROSELLE	10.0	SEC	9.0	SEC AS	9.0	SEC AS3	17.6	AK
36061	HU2	MANHATTAN WEST U	87.5	RAW			87.5	RAW	171.4	HU2
36061	HU1	MANHATTAN WEST U	87.5	RAW			87.5	RAW	171.4	HU1
36061	XXX	MANHATTAN WEST U	175.0	RAW					0.0	XXX
34023	LB3	MIDDLESEX S A	92.0	SEC	82.1	SEC AS	82.1	SEC AS3	160.8	LB3
36047	ERL	NEWTOWN CREEK	289.0		270.0	SEC AS	270.0	SEC AS	528.9	ERL
36061	HU2	NORTH RIVER (under construction)							0.0	
36085	LB2	OAKWOOD BEACH3	24.0	SEC	23.0	SEC AS	23.0	SEC AS3	45.1	LB2
34023	LB3	OLDBRIDGE TOWNSH	0.8	PRIM	0.8	PRIM	0.8	PRIM3	1.6	LB3
36047	UB	OWLS HEAD	98.0	SEC	85.0	SEC AS	85.0	SEC AS	166.5	UB
36087	HU3	ORANGETOWN SEWER	6.9	SEC			6.9	SEC TF	13.5	HU3
34013	UB	PASSAIC VALLEY S	260.0	PRIM	228.0	SEC AS	228.0	SEC AS	446.7	UB
34023	LB3	PERTH AMBOY3	4.7	PRIM	4.0	PRIM	4.0	PRIM	7.8	LB33
36085	NBL	PORT RICHMOND	42.0	SEC AS	39.0	SEC AS	39.0	SEC AS	76.4	NBL
36047	ERL	REDHOOK	0.0	RAW			0.0	RAW	0.0	ERL3
36047	UB	REDHOOK	18.4	RAW			18.4	RAW	36.0	UB
36047	XXX	REDHOOK UNSEWERE	45.0	RAW					0.0	XXX
36081	JB	ROCKAWAY	23.0	SEC	21.0	SEC AS	21.0	SEC3AS3	41.1	JB
36087	HU3	ROCKLAND COUNTY	15.0	SEC AS#1	18.2	SEC AS	18.2	SEC AS	35.7	HU3
34023	LB3	SAYREVILLE - MEL OSE			0.1	PRIM	0.1	PRIM	0.2	LB3
34023	LB33	SAYREV3LLE - MORGAN			0.2	PRIM	0.2	PRIM	0.4	LB3
34023	LB3	SOUTH AMBOY	0.6	PRIM	0.9	PRIM	0.9	PRIM	1.8	LB3
36085	AK	STATEN ISLAND	30.0	RAW			30.0	RAW	58.8	AK
36081	ERU	TALLMAN ISLAND	67.0	SEC AS	61.0	SEC AS	61.0	SEC AS	119.5	ERU
36061	ERL	WARDS ISLAND	345.0	SEC AS	281.5	SEC AS	281.5	SEC AS	551.5	ERL

FIGURE 8. SAMPLE FORMATTED OUTPUT (SELECTED FISH SPECIES)

```
Species Name           Morone saxatilis
                (common name_= Striped Bass)
Usu. max. length (inches)      ----------------------------    72
Usu. max. weight (lbs.)        ----------------------------   100
Usu. summertime location of adults   -------      NEARSH ESTBAY
Usu. wintertime location of adults   -------      NEARSH ESTBAY
Schooling behavior      -----------------------------------VASCHL
Feeding behavior        ----------------------------       PLAGIC
Commercial importance   ----------------------------COMMER SPORTF_
Usual Food Items        --------------              INVERT FISHES_

Usu. spawning location ----------------------------UPRIVR ESTBAY
Breeding season (starting & ending months)  -------     3_    6
Egg size (mm)           -----------------------------------   3.2
Usu. egg location       -----------------------------------WATCOL-
Nursery areas (if not = usu. adult locatns.) -----
Special notes   -----------------------------------
References:
    (1)p79_     (2)p389       (3)V3.p86
-------------------------------------------------------------------------
```

------------------------------- References -----------------------------

(1) Grosslein. M.D.: and T.R. Azarovitz. 1982. Fish Distribution. MESA New York Bight Atlas Monograph 15. 182 pp.

(2) Bigelow, H.B.; and W.C. Schroeder. 1953. Fishes of the Gulf of Maine. Fishery Bulletin of the U.S. Fish and Wildlife Service. Fishery Bulletin 74. Volume 53. 577 pp.

(3) Drewry, G.E.; R.A. Fritzche; J.D. Hardy, Jr.; G.D. Johnson; P.W. Jones; and F.D. Martin._ 1979. Development of Fishes of the Mid-Atlantic Bight: An Atlas of Egg, Larval and Juvenile Stages._ U.S. Fish and Wildlife Service, U.S. Department of the Interior.

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Volume 2 458 pp.	Volume 5 340 pp.
Volume 3 394 pp.	Volume 6 416 pp.

FIGURE 9. SAMPLE X-Y PLOT (POPULATION GROWTH)

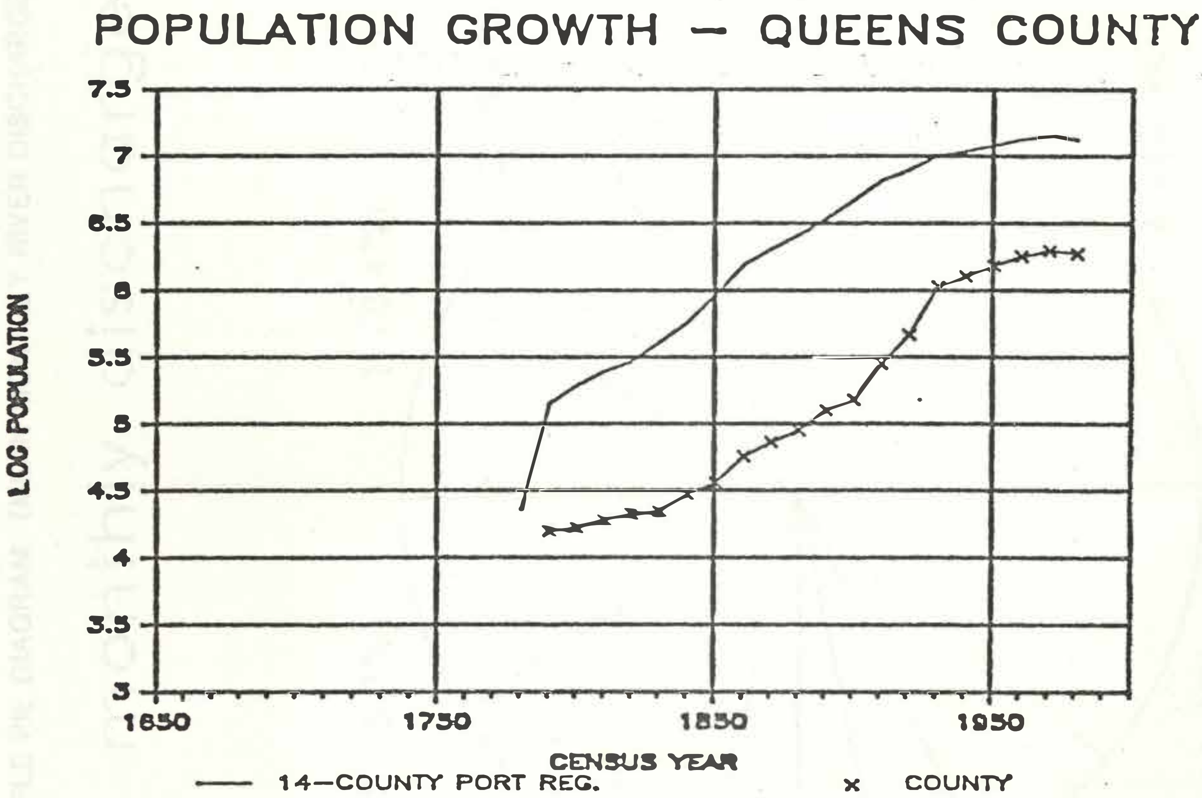


FIGURE 10. SAMPLE PIE DIAGRAM (MEAN MONTHLY RIVER DISCHARGE)

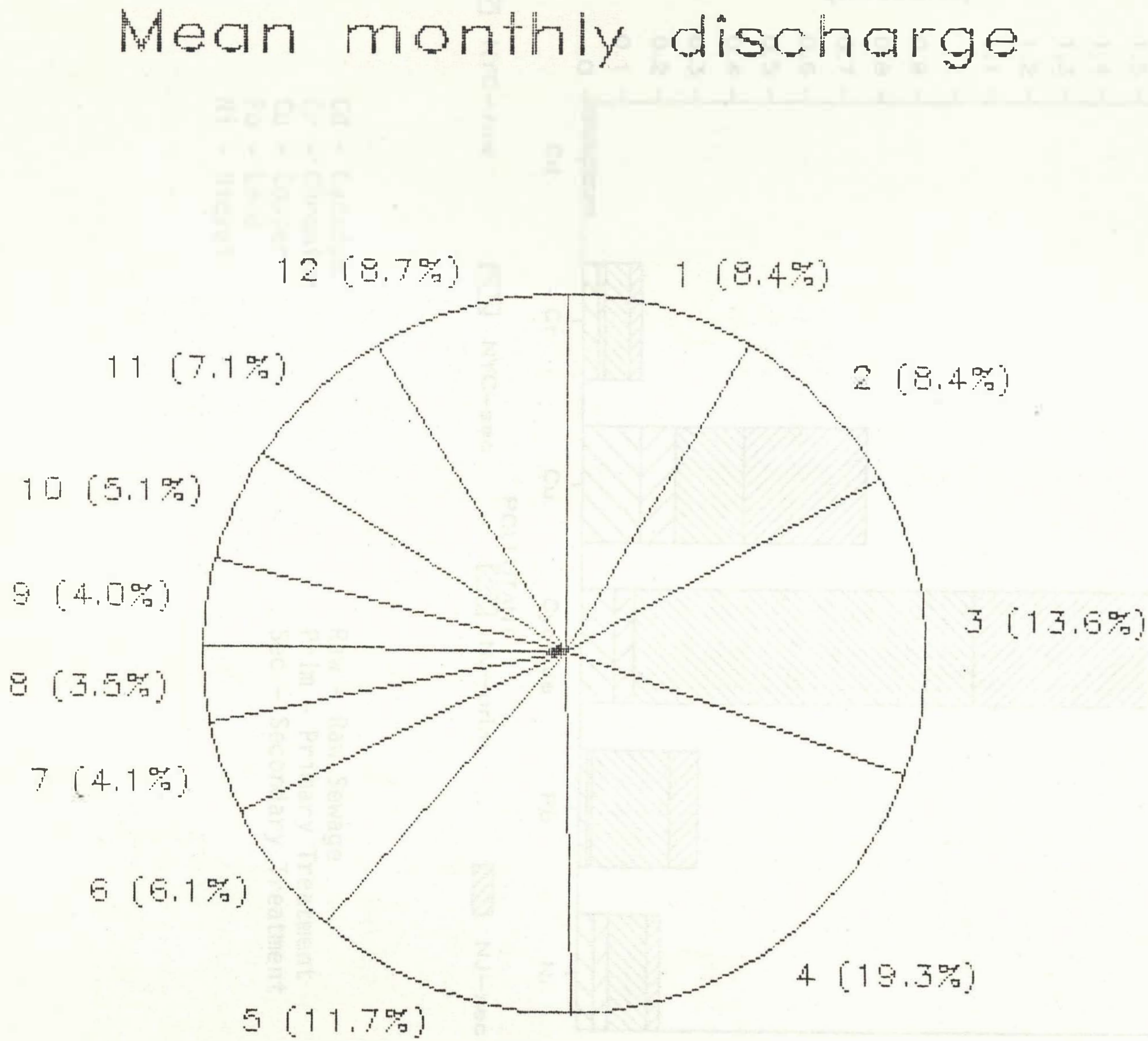
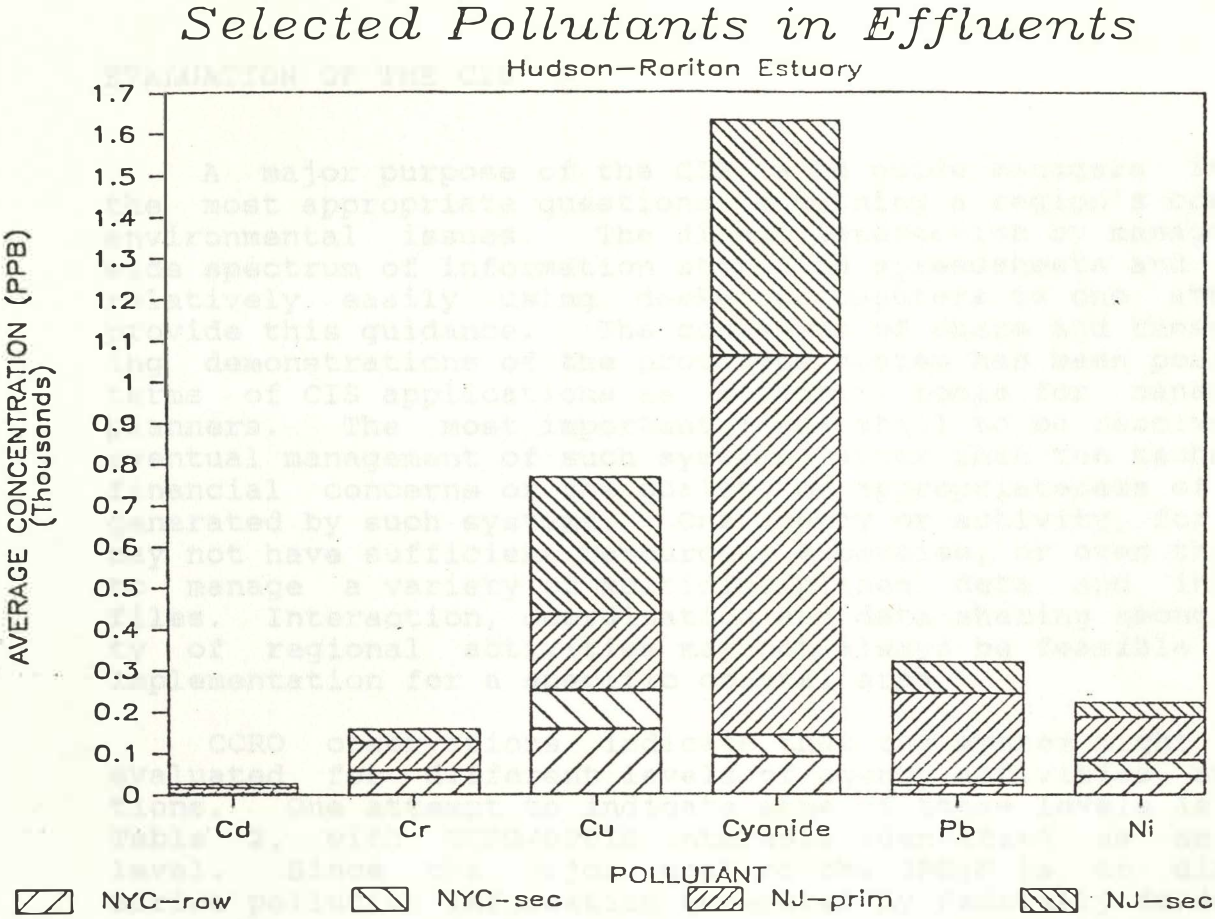


FIGURE 11. SAMPLE HISTOGRAM (SELECTED POLLUTANTS IN EFFLUENTS)



Cd - Cadmium
Cr - Chromium
Cu - Copper
Pb - Lead
Ni - Nickel

Raw - Raw Sewage
Prim - Primary Treatment
Sec - Secondary Treatment

EVALUATION OF THE CIS

A major purpose of the CIS is to guide managers in asking the most appropriate questions concerning a region's coastal and environmental issues. The direct interaction by managers to a wide spectrum of information stored on spreadsheets and accessed relatively easily using desk-top computers is one attempt to provide this guidance. The consensus of users and those attending demonstrations of the prototype system has been positive in terms of CIS applications as potential tools for managers and planners. The most important issue still to be resolved is the eventual management of such systems rather than the technical or financial concerns or the quality or appropriateness of products generated by such systems. One agency or activity, for example, may not have sufficient resources, expertise, or even the mission to manage a variety of multidisciplined data and information files. Interaction, coordination and data sharing among a variety of regional activities may not always be feasible for CIS implementation for a specific coastal area.

CCRO observations indicate that the system might best be evaluated for different levels of agency activities and functions. One attempt to indicate some of these levels is shown in Table 2, with CCRO/OPDIN interests identified as an initial level. Since the major goal of the OPDIN is to disseminate marine pollution information generated by Federally funded activities in a more timely manner and in more useful forms, the use of the CIS approach with relatively inexpensive personal computers to help accomplish this task is a favorable option for an activity that has limited staff and funding resources.

Potential uses and applications by the CCRO are discussed in some detail. Other possible applications for broader agency or discipline interests, such as those required by other NOAA facilities and other Federal or regional activities also are discussed. Evaluations for other than OPDIN needs will be based primarily on comments and observations resulting from the workshops and demonstrations noted earlier in this report.

TABLE 2

SELECTED CIS EVALUATION LEVELS FOR THE PROTOTYPE SYSTEM

Agency/Activity	Potential CIS Interests
CCRO/OPDIN	*Regional marine pollution data/info products *Response to special interests or pollution issue requests (i.e., Dredging effects, estuary concerns, etc.)
NODC/NESDIS	*Regional environmental data/info products *Response to special interest or data discipline requests *Tool for NODC Liaison Office services *Tailored catalogs, summaries, and analyses
NOAA	*Regional Ocean Service Center applications *NOS support: Estuarine atlas, marine sanctuary, status & trends products *NMFS support: Estuarine Program Office and regional fisheries issues *OAR support: state and NOAA Sea Grant activities
Other Federal Agencies	*USCG: oil & hazardous substance spills support; navigation hazards, environmental summaries; site specific issues *MARAD: port planning/development; environmental characterization; shipping hazards; emergency spill response; research priorities; and information gaps *US FWS: Identification of endangered species, wetlands and habitat areas and types *EPA: site-specific effluent characteristics, land use practices, environmental assessment *US Army Corps of Engineers: regional activities in dredging, dumping, sediment properties; permit application screening
Regional Applications (State & local governments, academic and private institutions	*Coordination of regional activities' data/info needs (Port Authorities, etc.) *Support for interagency data gathering & assessment, i.e., Chesapeake Bay Program, Puget Sound Action Office, etc. *Screening for state and local environmental permit activities *Supplemental analyses tools and information support for regional studies

CIS APPLICATIONS FOR CCRO/OPDIN NEEDS

The prototype CIS has been evaluated with respect to CCRO/OPDIN uses for convenience and cost as well as technical content and appropriateness for providing OPDIN products and services. Since the MSRC staff acquired data and information perceived to be useful to a variety of Hudson-Raritan issues, some of the prototype worksheets are of limited use to specific users including the CCRO. Table 3 is one example of ranking current system files in terms of estuarine pollution issues (vs. marine transportation, land use, etc.) For other Federal or regional interests, the list would certainly be modified to meet individual agency priorities. For regional interagency needs, each agency's priority worksheets might complement other agency worksheets, while all agencies utilize similar auxiliary files, worksheet structures, coordinate systems, and operating manuals.

The CCRO regional expertise is available primarily through Network participants and the five NODC Liaison Offices located at Woods Hole, MA, Miami, FL, La Jolla, CA, Seattle, WA, and Anchorage, AK. The Liaison Offices maintain extensive regional Federal and non-Federal contacts and provide regional coordinating functions for OPDIN. As personal computers become available at these sites, the generation of worksheets that address marine pollution issues for their regions could be a major task within the Network. Current regional tasks could be supplemented by coastal information systems that address local pollution issues using one or two-dimensional coordinate index systems with auxiliary files similar to those developed for the prototype system.

Even for this rather limited approach to improvement of Network services and products, the availability of resources to develop such local or regional systems may be a major problem. As currently staffed, the Liaison Offices are essentially one-person offices responding to a variety of environmental data and information needs within their region. Because of daily requirements and other priority NODC/NESDIS tasks, an additional person (most likely a temporary employee or student assistant) would be required to help generate and maintain appropriate CIS files, to support system software, and to service requests. This, of course, implies that such employees are somewhat proficient with PCs and the CIS concept. One alternative would be to provide this level of technical support through cooperative agreements or contracts with academic or private industry sources located within each region under the purview of each Liaison Office.

TABLE 3

RELATIVE IMPORTANCE OF PROTOTYPE FILES FOR CCRO APPLICATIONS

(MARINE POLLUTION INTERESTS)

Environmentally Important	System Important	Potentially Useful	Limited use to CCRO
BAYCHAR	CHANAME	ANCHOR	ACCESS
CHANCHAR	GEONAME	BATHYM	BRIDGE
DREGDATA	GLOSSARY	CHADEPTH	NAVAID
FISHDATA	LATLONGS	ISLAND	NAVAAZ
HUD_GID	LATLONGW	LANDUSE	HISDATE
INDUSTR	LW-CORR	POLJUR	
POL_MOD	MAPCHART	POPULTN	
SAL_MOD	MENU	PORTFAC	
SOILTYPE	MENU-PT2	RAINCP	
TIDECUR	REFFILE	SHORTYPE	
WWDISCHG	SETMANIP	TIDEELEV	
WWTALL	UNITS	TOPOGRPH	
WWTHIST		TRUEDIST	
WWPLANT			
WATCLASS			

Even though the Network is of national scope, the ability to generate similar regional information systems for all major U.S. harbors and estuaries is clearly beyond the present level of Network and Liaison Office resources. Not only do such systems involve significant effort and expertise for data identification, acquisition, conversion and entry, but maintenance, updating and enhancement of such systems is essential if the Network is to continue to provide timely products for specific regions or issues. Several scenarios will be discussed in the next section of this report to address this critical task of management for such systems.

Other CIS applications for CCRO/OPDIN products are being investigated. These include systems that consider specific marine pollution issues or disciplines for a number of sites not necessarily in the same region. A subset of important marine pollution-related files for major United States ports or for the National Estuarine Sanctuaries located in fifteen different States and Puerto Rico are two examples that are being considered. Extensive coordination with NOAA and other Federal and non-Federal activities is anticipated if such multi-area systems are implemented.

Another CCRO-related application involves the analysis and summary of NODC digital data relevant to marine pollution interests. Appropriate summaries of these data may be developed as worksheets and generated for regional areas and subareas or for specific data disciplines. Since current NODC data holdings are not distributed uniformly along the U.S. coastal areas or in offshore waters, only those regions with a sufficient quantity of well-documented and quality-controlled data would be used for CIS inputs. For this application, the present one-dimensional coordinate system would most likely be replaced with some form of two-dimensional system to define relatively small areas of similar marine pollution-related properties.

CIS APPLICATIONS FOR OTHER FEDERAL AND NON-FEDERAL INTERESTS

As an application for NODC use, the CIS can probably best be utilized as an extension of present Center capabilities for generating information products not easily retrieved from the UNIVAC mainframe computer. Downloading summarized or analyzed data sets from the UNIVAC or the NODC DEC VAX computer to PC system spreadsheets may at times provide a more flexible capability for preparing data products and graphics for requesters. This introduces a task not totally operational within the Data

Center and NESDIS. The options available at the present time using NESDIS systems are manual key entry supplemented by selected down-line loading and data transmission to floppy diskettes (indirectly through the VAX). Similar downloading could be made available to the NODC Liaison Offices with the acquisition of appropriate PC hardware and software. Communication capabilities would facilitate timely products; exchanging diskettes through the mail could initially satisfy many regional manager needs.

The CIS approach may be of most immediate use to NODC as a tool for the Liaison Offices, who need to address a variety of environmental issues in their regions and have access to significant regional information sources (grey literature, data summaries, etc.) that are not always available in NODC or NESDIS digital data archives. Acquisition of PC systems and related hardware may represent a relatively inexpensive investment for the five Liaison Offices if more comprehensive and professional products can be delivered to customers.

The Alaskan Liaison Office already has an extensive micro computer system in operation at the Anchorage site. This system, a Hewlett-Packard 1000, was purchased with OPDIN funds to support a variety of marine pollution-related activities in the Alaskan area. The system operates in concert with other hardware acquired earlier to support the Alaskan OCS Environmental Assessment Program (OCSEAP) and other regional activities. The CIS approach could provide a useful tool for MMS OCS lease area activities in Alaska and other coastal environmental issues. (Copies of the prototype system for the Port of New Orleans have recently been sent to both the Seattle and the Anchorage offices to better evaluate local applications of the CIS approach.)

At the NOAA level, the CIS has been evaluated as a tool for the Northwest Regional Ocean Service Center in Seattle, Washington. The types of products, particularly those generated by the Weather Service, often pertain to near real-time environmental conditions and do not appear to be appropriate for current CIS applications. The NOAA Ports Program also was investigated as to its use of a CIS. Its focus on real-time circulation and tide information and environmental prediction needs also indicate a limited use of current CIS capabilities at the present time.

Other NOAA activities, however, suggest several applications that may supplement or possibly replace current methods of manipulating data and generating products. Although their efforts will not be discussed in detail in this report, some of the work of the National Ocean Service's Estuarine Sanctuary Program, the Office of Oceanography and Marine Assessment's Estuarine Atlas task, as well as some aspects of NOAA's Status and Trends Program suggest applications of CIS systems for packaging selected information in forms that can be more easily manipulated by those program managers and regional decision-makers who have access to personal computers.

Specific applications depend in a large part on the issues to be addressed by these programs and the options required for looking at information for a variety of management and scientific needs. The CIS approach provides a capability to easily update information not always possible through publication of atlases, maps, and other hard copy materials. It also provides broad capabilities for merging and selecting subsets of information from different disciplines and packaging these tailored products in more meaningful forms. Although spreadsheets provide a relatively large matrix for storing data or information elements, the CIS is not intended to serve the needs of investigators for storing and analyzing large amounts of field or laboratory measurements; other PC database management systems and mainframe systems can better support this need.

RELATED CIS DEVELOPMENTAL EFFORTS

Some of the other potential Federal and non-Federal applications of the CIS are briefly noted in Table 2. Several of these applications are already being investigated. The Maritime Administration Port of New Orleans system, noted earlier, is focused on port planning and management activities. A final report on this system was recently completed by Weyl and Gulbransen for MARAD's Office of Research and Development (8). An extension of this New Orleans CIS effort by Dillard University is serving as one element for a Department of Transportation task to facilitate on-scene multi-agency coordination of spill response for selected U.S. ports using computer-based planning and information management systems. Agencies involved include the Coast Guard, EPA, NOAA, the Army Corps of Engineers, U.S. Geological Survey, U.S. Fish and Wildlife Service, as well as the Louisiana State University Center for Wetlands Research, and state and local environmental agencies and port authorities.

Another developmental effort, prompted somewhat by the above noted CIS involvement, is the development of a U.S. Army Corps of Engineers video disc prototype system that incorporates micro-computer technology for interagency applications concerning emergency operations (9). Video disc map data are accessed through micro-computer by geographic location, proper name or Corps product. The map images are used as background maps for graphic overlay information to be transmitted between disc work stations. Prototype work stations are planned to be networked among activities including the Corps, the Federal Emergency Management Agency (FEMA), NOAA, U.S. Geological Survey, and the State of Louisiana.

An effort using an Apple Mackintosh PC system is being developed with off-the-shelf software to investigate rapid access to both textual information and graphic images to support NOAA's Hazardous Materials Response Branch (10). The prototype system provides quick data entry as well as retrieval; the system uses PC 'mouse' capabilities to retrieve detailed information about individual symbols or sites located on each display. The maps displayed are essentially tracings of areas at levels of detail similar to the source maps; specific sites and symbols are located in relation to the precision of the maps rather than by geographic coordinates.

Another private firm, Applied Research Associates, has evaluated the Hudson-Raritan CIS for several application uses. At the present time, some of the CIS prototype capabilities (including the glossary and index systems) are being incorporated into their approach for responding to spill cleanups for local areas. Their specific efforts currently are focused on several European sites. Copies of the data and system diskettes also have been provided to the New York City Department of Environmental Protection for their evaluation and possible modification.

These are some examples of the growing trend to use PCs and the CIS approach to support decision-making for local regions, such as ports or estuaries. The consensus of nearly all reviewers and demonstration participants is that a PC system such as the prototype Hudson-Raritan CIS can provide useful and timely information if managed and maintained responsibly and inexpensively. The remainder of this evaluation, therefore, will examine several management strategies for such a system, noting major advantages and disadvantages of each management scenario.

POTENTIAL CIS MANAGEMENT STRATEGIES

Throughout the demonstrations and discussions of the prototype CIS, one of the prevailing questions has been the management of the operational CIS system. Although a rather extensive array of management strategies can be discussed, four strategies are presented in this report (Figure 12) that appear to be the most realistic and that could provide maximum benefit to the mutual users of a CIS.

Because of the multi-disciplinary nature of the CIS, the use of multiple agencies with different data and information collection responsibilities is considered to be one of the most effective CIS management strategies. For simplification, the diagrams presented in Figure 12 include five information types for each scenario (physical, chemical, biological, cultural and commercial information). Similar configurations could reflect functional or agency activities rather than information types. For example, the Army Corps of Engineers, NOAA, and EPA could all have interests in some aspect of marine chemistry for a region. Discipline-related activities were chosen for this presentation simply for illustration purposes, Obviously, some regional issues may be much simpler than those of the prototype area, requiring fewer data disciplines and information sources and more limited agency participation.

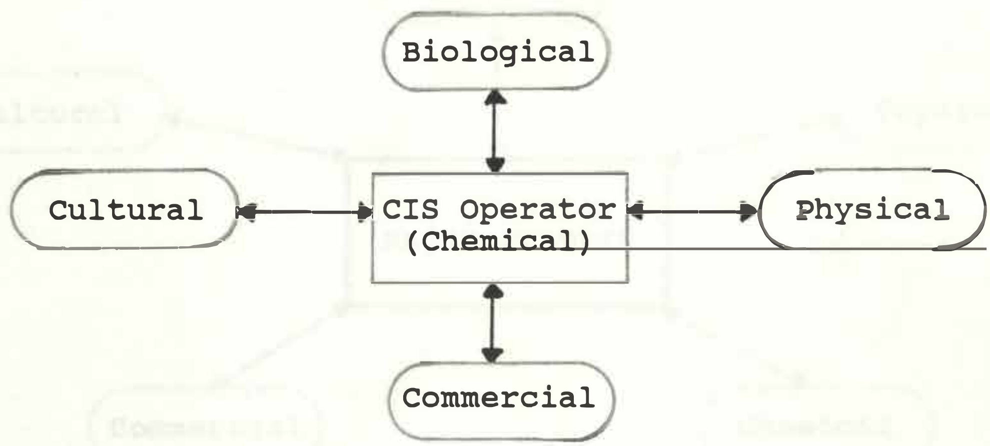
One on-going example of a single activity system is a Padilla Bay Research Data Management System being investigated by the Washington State Department of Ecology for NOAA's National Estuarine Sanctuary Program (11). This system uses an IBM-PC and Lotus 1-2-3 to link a variety of management and scientific data concerning the Bay. The issues for this estuarine sanctuary are more limited than the complex issues for the Hudson-Raritan region, and include a primary interest in manipulating recent survey results rather than summary or historical data. Consequently, the need for multi-agency cooperation may be limited to assistance in data identification, data tracking, or providing the necessary data and information from individual studies to the sanctuary manager, who maintains the entire system and generates the necessary products for various sanctuary management needs.

At the other extreme are complex systems such as the New York harbor, the Chesapeake Bay, or Puget Sound areas that require information and coordination from multiple state, regional, and Federal activities. Due to the complex nature of issues and problems, no single activity is capable of providing the

FIGURE 12

POTENTIAL CIS MANAGEMENT STRATEGIES

a) Operator as a CIS Participant



b) Operator Not a CIS Participant (Minor Support)

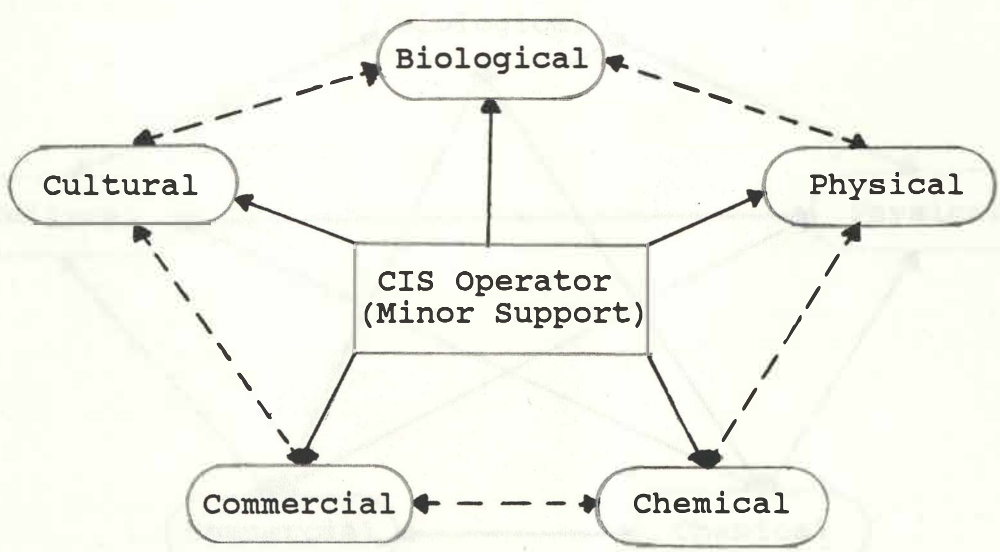
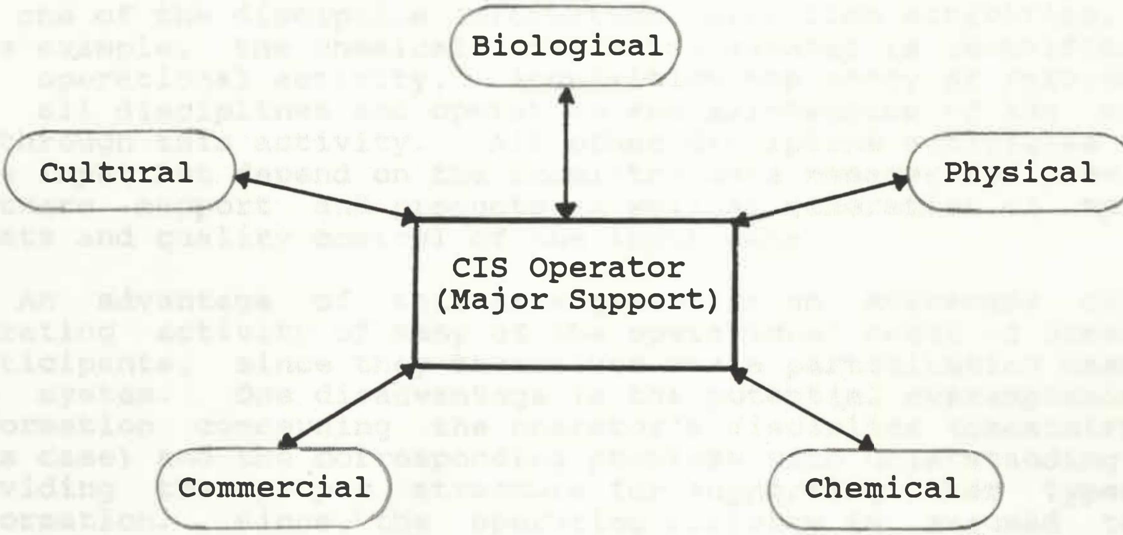
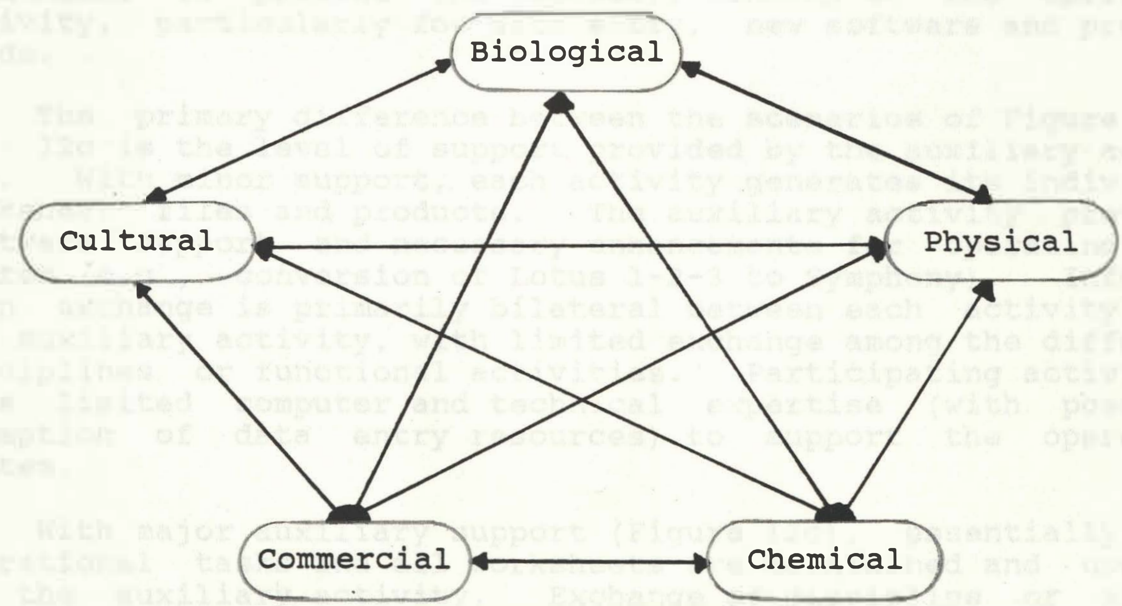


FIGURE 12 (continued)

c) Operator Not a CIS Participant (Major Support)



d) Shared Technical and Analytical Resources



information needs for all activities involved (transportation interests vs. environmental concerns vs. industry development vs. permit procedures, etc.).

The scenarios in Figure 12 describe four rather simplified CIS configurations for regional interagency information support. The first scenario (Figure 12a) assumes the manager of the CIS to be one of the discipline information collection activities. In this example, the chemical information manager is identified as the operational activity. Acquisition and entry of information for all disciplines and operation and maintenance of the system is through this activity. All other discipline activities provide input but depend on the chemistry data manager for providing software support and products as well as generation of spreadsheets and quality control of the input data.

An advantage of this arrangement is an awareness by the operating activity of many of the operational needs of other CIS participants, since they themselves are a participating user of the system. One disadvantage is the potential overemphasis on information concerning the operator's discipline (chemistry in this case) and the corresponding problems with understanding and providing the proper structure for supporting other types of information. Since the operating activity is assumed to be comparable to other discipline activities, this arrangement could be the most cost-effective but would most likely require cooperative agreements, interagency memos of understanding, or other mechanisms to provide the necessary funding to the operation activity, particularly for data entry, new software and product needs.

The primary difference between the scenarios of Figure 12b and 12c is the level of support provided by the auxiliary activity. With minor support, each activity generates its individual worksheet files and products. The auxiliary activity provides software support and necessary enhancements for operating the system (e.g., conversion of Lotus 1-2-3 to Symphony). Information exchange is primarily bilateral between each activity and the auxiliary activity, with limited exchange among the different disciplines or functional activities. Participating activities have limited computer and technical expertise (with possible exception of data entry resources) to support the operating system.

With major auxiliary support (Figure 12c), essentially all operational tasks and all worksheets are maintained and updated by the auxiliary activity. Exchange of discipline or agency files is conducted through the support activity to improve coordination. All hardware and software support including data entry is concentrated at the auxiliary activity. Dissemination of information on system enhancements as well as new worksheets and products also would be carried out by the auxiliary activity. This arrangement obviously requires more funding support for the auxiliary activity by each participating agency, but frees the other managers and technical staff to carry out their decision-making, interagency coordination, and evaluation of potential new products to meet their needs.

The last scenario (Figure 12d) assumes that all participating activities have essentially similar levels of technical expertise for supporting the hardware and software needs for the CIS. Each activity maintains worksheets for their areas of interest and conducts extensive data and information exchange with the other participants. With no central coordinator, this configuration is highly dependent on coordination and cooperation among participants to keep the system up-to-date and to disseminate information on new worksheets, products, etc. This approach would require more technical resources and expertise from each activity but would eliminate potential private contractor and other auxiliary operation costs. In regions where different government structures would be involved (Federal, state, local, etc.), coordination on a timely basis may be difficult to accomplish.

One of these four scenarios, or simpler or more complex versions, may be the 'best' CIS management approach for a specific region. For some areas, major activities and issues may already be well coordinated and configurations similar to that shown in Figure 12d may simply provide an additional tool for decision-making. In other areas, complex management levels and interactions may suggest a private contractor or other 'non-participant' (Figure 12b or 12c) to provide the most timely and useful information for decision-making at the different levels. For regions of simpler issues and limited data and information needs, management of the CIS by a single participating activity (Figure 12a) may suffice.

FUTURE CIS EFFORTS AND CONCLUSIONS

The prototype PC-based CIS (and its counterpart for the Port of New Orleans) has proven to be a useful and relatively easy tool for regional managers and decision makers, including those concerned primarily with environmental and pollutant effects. CIS applications suggest much broader uses than coastal impact or pollution-related activities. A wide spectrum of information types not generally interrelated can be addressed for any geographic area or regional issue. The benefits and ease in using such a system are difficult to describe without hands-on demonstrations of system capabilities. A number of system demonstrations have been provided to regional interests; there is no substitute for such on-site demonstrations and hands-on experience for the individual users to evaluate the system and how it can best meet their needs.

The prototype effort has not been a static one; conclusions as to system utility, resource requirements, and ability to meet user needs have evolved as time brought improvements and advances to personal computer technology. To evaluate the system strictly on the merits or weaknesses of the Hudson-Raritan estuary system likewise does not take into account the continued rapid growth potential of micro-computer applications. Improved communications, laser discs, and advanced mapping techniques are some of the PC enhancements that can be applied to future CIS development.

Several potential system improvements were suggested by system demonstration attendants. The technical aspects of each are addressed below. The SUNY/MSRC staff is currently investigating solutions to some of these concerns.

One of the major limitations of the prototype system is the one-dimensional coordinate system. For some information sources and products derived from maps and charts, two-dimensional coordinate systems are more appropriate for determining features with similar properties (wetland areas, sediment types, etc.). Other coastal regions, particularly those involving river systems such as the New Orleans area, can employ one-dimensional systems by identifying the limits of such areas as they occur along the river and canal system. Two-dimensional coordinate systems are being investigated by the Marine Sciences Research Center for future CIS applications.

There also is a perceived need for the CIS to provide display maps of local areas with features, problems, etc. highlighted as they are identified by the user selection criteria.

The current need to refer to both a map atlas and a computer monitor does create, as one reviewer commented, 'a media mix' for the user. Sophisticated map packages now available for PCs (12) currently are being reviewed by the CCRO, NODC and MSRC for potential application with PC software such as Lotus 1-2-3 or similar software packages.

Another concern is the sometimes tedious operation required to generate new graphic products once a subset of information has been selected for review and displayed. To operate the CIS most efficiently, users must first understand Lotus 1-2-3. As one reviewer stated, "Most harbor and estuary users are map literate, but they are not computer literate." With available tutorial programs, software enhancement files such as the CIS 'SETMANIP', and improved spreadsheet capabilities such as Symphony, many of these concerns are being resolved. There are situations, however, where managers and decision-makers still need to rely on other operators on their staff or external sources to provide the necessary support and information products, even from such 'user-friendly' systems.

The question of ultimate management and resources needed (human, hardware, and dollars) to manage a system containing diverse information types, agency interests, user needs, etc. is perhaps the major item of concern from the various demonstrations. The four management scenarios are intended by the author to address this concern.

Because of changing interests and software modifications that took place during the prototype development, the prototype system is not necessarily a good model for determining the total cost of developing a CIS for another region. With PCs and their software continuing to drop in price and expand in capabilities, agencies can now purchase all equipment to support a CIS including printer, plotter, communications package, spreadsheets and other software for between $5,000 and $10,000.

Scientific and technical support will depend on the types and amount of information being loaded and sophistication of information products needed. Programming personnel may be required where large amounts of digital data are downloaded to diskettes. Technicians or student aids may be sufficient for retrieving most information from maps, atlases or other publications.

A major expense, therefore, is the cost of setting up specific coordinate systems and entering data in file structures similar to those used in the prototype system. About 35% of the SUNY/MSRC effort was expended on data entry for the prototype system. Developmental costs for the prototype included software development that eventually was replaced by Lotus 1-2-3 when it appeared on the market. With design and developmental efforts now essentially in place for future CIS tasks, data entry could be as much as 75% of the total effort for completing a future system for a specific region.

The combined investment by the Ocean Pollution Data and Information Network and the Donner Foundation amounted to $240,000 over a three-year period. In addition to SUNY/MSRC staff salaries, this included procurement of several complete PC systems, hardware, repairs and supplies, funds for demonstrations, workshops and conference presentations and associated travel, purchase of maps and other source materials, publications of manuals, and generation of many diskette copies of the system for on-hand user review and evaluation.

For a CIS to address a limited number of space-specific information issues, such as the New Orleans CIS with 27 spreadsheets using a one-dimensional coordinate system, development of a CIS is estimated to cost between $50,000 and $75,000. This includes two technical/scientific personnel for a one-year period using technology, methods, and information sources similar to that used to develop the two prototype systems.

SUMMARY

To summarize, the focus of an efficient CIS should not be to generate files of everything known about an area, but rather to identify and store, in a timely way and a readily accessible form, the most important information related to regional issues. The spreadsheet format permits the user to extend summary information products beyond the rather static atlas source or data report form, and pursue an almost unlimited array of 'what if?' situations.

To quote a recent Washington Post article (13) concerning personal computer users, "There are two kinds of information users: People who like exploring a variety of answers to question and those who want the answers now .... The functional user is interested in using the PC for very specific and clearly defined tasks. Time is money and the functional user doesn't want to spend much of either on a machine that will be used for a fairly narrow task domain." With proper focus on these concerns, the CIS can provide a satisfactory and relatively inexpensive tool for functional users to help resolve specific issues pertaining to regional environmental concerns.

Although it generally does not provide in-depth analyses or sophisticated model results, the system, using site specific information and natural resource distributions, may serve managers for a variety of needs. The CCRO, through the Ocean Pollution Data and Information Network, plans to pursue the use of such PC-based systems as one means of providing timely and useful marine pollution-related information at a regional level. High priority areas, such as Puget Sound and the Chesapeake Bay, are initial areas to be investigated. The task remains for regional Federal, state, and local activities to coordinate their resources, perhaps in forms similar to scenarios described in this report, so that they can use this tool to help resolve their local and regional environmental and planning problems.

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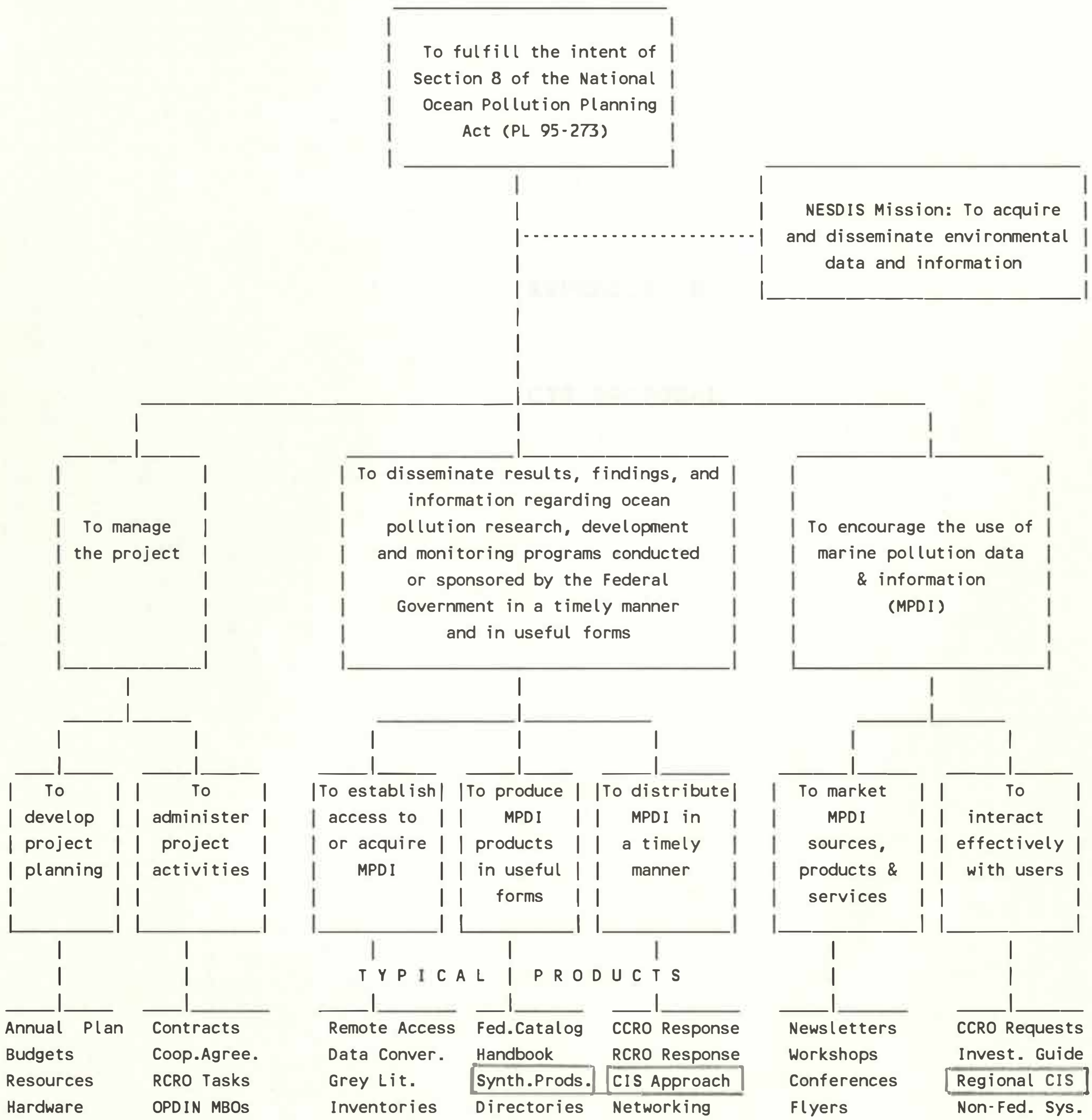
APPENDIX A.

OBJECTIVES TREE FOR THE OCEAN POLLUTION

DATA AND INFORMAION NETWORK

APPENDIX A

OBJECTIVES TREE FOR THE OCEAN POLLUTION DATA AND INFORMATION NETWORK



APPENDIX B.

CIS PROPOSAL

Title: Development of a microcomputer assisted information system for coastal decision making in the Hudson - Raritan Estuary.

Investigators: P. K. Weyl and J. R. Schubel, MSRC

Amount Requested: 100,000 FY 82 ($100,000 FY 83)

Justification and Approach: To make decisions about the utilization of the waters of the Hudson-Raritan Estuary system and the coastal lands bordering it requires space specific information. Providing a decision maker with copies of all documents that contain information that might be relevant to the decision at hand might be useful if a competent staff is available and if a well-financed staff study is programmed, but will be of little assistance if the decision must be taken rapidly. The development of inexpensive personal computers has provided a new tool for dealing with the problem of information overload. MSRC scientists have explored the use of that tool for coastal zone management decision making (Weyl 1981) and detailed software for this purpose has been developed (Schaefer 1981).

The information problem in the Hudson-Raritan Estuary is more complex than that of an open coastline. In the Estuary, one is concerned with the management of major waterways and the interacting land use of the adjacent shores. The waterways form a complex network and water quality depends on the hydrology and on waste water sources from the land. The sediments of the waterways contain a historical record of past uses of the estuary. These uses have undergone many changes and the future will see further alterations as a result of the development of coastal real estate and highways, changes in marine transportation, the construction of waste water treatment facilities, and the shift in fossil fuel usage from oil to coal.

We propose to develop a personal computer based information system for the Hudson-Raritan Estuary to assist decision makers. The output of this effort will not be another printed report that would rapidly become outdated but rather a documented operational information system that is kept up to date and whose output capabilities can be adapted to meet the changing needs of decision makers.

*We anticipate cost sharing 50/50 between the NODC and the USACE.

The system to be developed will be space specific to the Hudson-Raritan Estuary and will be designed to meet the needs of two agencies, the New York office of the Army Corps of Engineers and one other agency to be selected after consultation with NODC. Our aim is to develop a general methodology. To do so, however, one must develop a specific system. Further, the utility of such systems can only be evaluated for an operational system.

Appropriate microcomputer hardware is currently in a state of flux since a number of new and upgraded systems are being introduced. The system used for this project will be selected after consultation with the clients and should be usable by personnel with a minimum of specialized training. We will require hardware to develop the system and the clients should have a compatible system, once appropriate preliminary programs and information files have been developed. The initial phase should be completed within about one year. Next, we will work with the clients to improve the responsiveness of the system to their needs.

It is difficult to anticipate detailed system specifications. However, the following list indicates some of the probable requirements:

1. Space specific indexed data files for the following:

    a. Navigation Channels.

    b. Shorelines.

    c. Water areas.

2. Means for editing the data files.

3. Means for correlating the spatial indexes, for example between navigation channel locations and port facilities on shore.

4. Means for rapidly extracting particular space specific information in a form useful to the client. This may involve any of the following:

    a. Computation of specific parameters in customary units.

    b. Documentation for the data.

    c. Explanatory text to define technical terms and put quantitative answers in perspective.

5. The data files may contain descriptive parameters that are generated from primary data gathered by the client. In that case we will provide a means for entering the primary data into source files and generating the descriptive parameters.

6. Means for generating appropriate parameters from data obtained from data centers. We will explore means for the direct data transmission between the information system and the data centers.

In the past, developers of computerized information systems have primarily focussed on problems of data processing. The resultant progress in hardware and software makes the present proposal possible. Our focus will be on how one provides data to facilitate the comprehension of complex systems to permit better decision making. We wish to optimize the complex information output of the system for the user rather than to improve the efficiency of internal data handling.

This proposal was developed in response to a request from Mr. Edward Ridley and Dr. Kent Hughes of NODC. It has been revised following suggestions of Dr. Kent Hughes and Mr. James Audet of NODC.

Duration: 2 years

References: Weyl, P.K. 1981 Simple Information Systems for Coastal Zone Management. Coastal Zone Management Journal in press.

Schaefer, Jeff, 1981. CZMIS: A Microcomputer Information System for Coastal Zone Management. MSRC M Sc. Thesis.

APPENDIX C.

WORKPLAN FOR CIS DEVELOPMENT

marine sciences research center

STATE UNIVERSITY OF NEW YORK AT STONY BROOK
LONG ISLAND, NY 11794
516-246-7710

February 23, 1982

Mr. John J. Audet
U.S. Dept. of Commerce
NOAA Environmental Data and Information
Service
National Oceanographic Data Center
Washington, D.C. 20235

Dear Jim:

The following is a detailed workplan to supplement our proposal entitled "Development of a Personal Computer based Information System for Coastal Zone Decision Making". The work will be carried out in four successive phases. During each phase, a number of tasks will be carried out in parallel. The tasks in a phase must generally be completed, before the next phase can begin. The phases and the probable timetables are as follows:

PHASE I

Task 1. Decide on hardware to be used, order it and obtain delivery.

Task 2. Develop three indexing systems for information in the Estuary. Linear systems for the shoreline and the navigation channels and a box system for the water areas.

Task 3. Outline the structure and scope of the programming effort.

Phase I will be completed by the sixth month.

PHASE II

Task 1. Develop specific programs to link the 3 indexing systems.

Task 2. Identify the types of information required, sources for the information and appropriate parameters. Assign each parameter to one of the threee indexing systems and establish a classification system.

Task 3. Develop programs for entering and editing information in the data files.

Task 4. Determine with client agencies the types of outputs desired.

Phase II will be completed before the end of the first year.

PHASE III

Task 1. Enter information into data files.

Task 2. Create information source files for the entries in the data files.

Task 3. Develop programs for generating user and problem specific outputs.

Phase III should be completed 18 months after the start of the project.

PHASE IV

Task 1. Transfer files and programs to client agencies and instruct them in the use of the system.

Task 2. Develop detailed documentation and instructions for use of the system. This involves preparing reports as well as incorporating explanatory material into the system outputs and programs.

Task 3. Prepare final report.

Phase IV should be completed two years after the start of the project.

At the conclusion of each phase we will distribute a brief report. This will be followed by a review meeting with the clients and other interested parties. The purpose of these meetings is to inform the clients and to provide feedback to the project in order to maximize the utility of the system to the clients.

The phases and the milestones are indicated on the attached chart.

Once the project has been completed, we expect to continue to interact with the clients to assist with the continued improvement of the systems. Arrangements for such interactions will be made directly with the clients. Within one year after the systems have become operational, we will prepare journal articles to evaluate the utility of the systems. These articles will be prepared in collaboration with the clients.

Sincerely yours,

Peter K. Weyl

PKW/ml
Enclosure
xc: J. R. Schubel

MILESTONE CHART

Month

Phase		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	36
		6/82				10/82						4/83								12/83					5/84	
I	hardware procurement	x	x	x	x	x																				
	indexing system development	x	x	x	x	x																				
	scope programming effort	x	x	x	x	x																				
II	link indexing systems					x	x	x	x	x	x	x														
	determine information requirements and sources					x	x	x	x	x	x	x														
	develop data file programs					x	x	x	x	x	x	x														
	identify desired outputs					x	x	x	x	x	x	x														
III	enter information in files										x	x	x	x	x	x	x	x	x							
	create information source files										x	x	x	x	x	x	x	x	x							
	develop programs for output										x	x	x	x	x	x	x	x	x							
IV	transfer systems to clients																			x	x	x	x	x	x	
	prepare detailed documentation																			x	x	x	x	x	x	
							10/82							5/83					11/83						5/84	
	short reports						x							x					x							
	review meetings							x						x						x					x	
	final report and documentation																								x	
	prepare paper evaluating system																									x

APPENDIX D.

CIS DEMONSTRATIONS, MEETINGS, AND WORKSHOPS

APPENDIX D

CIS DEMONSTRATIONS, MEETINGS, AND WORKSHOPS

-- Chronological List through April 1985 --

Phase	Date	Place	Purpose
I	Feb 82	Stony Brook, NY	NOAA/SUNY Coop Agreement Review
	Apr 82	New York City	NY/NJ Port Authority Meeting
	Jul 82	New York City	MSRC/CCRO Mtg. Potential CIS Users
	Aug 82	New York City	MSRC/CCRO Mtg. Potential CIS Users
	Oct 82	Stony Brook, NY	Multi-agency Demo (State & Fed)
II	Nov 82	Asilomar, CA	Paper by Weyl @ CZM Conference
	Apr 83	Trenton, NJ	NJ Dept. of Envir. Protection Demo
III	Jun 83	Stony Brook, NY	MSRC Progress Review
	Jun 83	Newark, DE	CCRO Paper @ NOAA Estuarine Wkshp.
	Oct 83	Virginia Beach, VA	MSRC Demo @ Fed. Estuarine Confer.
	Nov 83	New Orleans, LA	CCRO Info @ DOI/MMS Info.Trans.Mtg
IV	Jan 84	Stony Brook, NY	Multi-agency Demo (State & Fed)
	Feb 84	New Orleans, LA	MSRC Demo - New Orleans CIS Users
	May 84	Washington, DC	NODC/NESDIS/NOAA Demo
	May 84	Washington, DC	NOAA Sea Grant Intern Demo
	May 84	Washington, DC	Foreign Visitor Demo @ CCRO
	May 84	Nantes, France	MSRC Presentation @ ICES Meeting
E	Jun 84	Washington, DC	Private Industry Demo @ CCRO
x	Aug 84	Stony Brook, NY	MSRC Progress Review
t	Sep 84	Washington, DC	NESDIS Ctr Directors Demo @ CCRO
e	Sep 84	Washington, DC	Foreign Visitor Demo @ CCRO
n	Sep 84	Washington, DC	NODC Information Booth @ Oceans 84
s	Oct 84	Stony Brook, NY	NY Dept. of Env. Con. Demo @ MSRC
i	Oct 84	New Orleans, LA	MSRC Demo of New Orleans CIS
o	Nov 84	Boston, MA	MSRC Demo for Mass. Port Authority
n	Nov 84	Washington, DC	CCRO Paper&Demo @ National Estuarine Sanctuaries Workshop
	Dec 84	Seattle, WA	Multi-agency (Fed, State & Univ.) Demo/CCRO & MSRC
	Jan 85	New York City	MSRC Demo @ Save Our Ports Wkshp.
	Jan 85	Washington, DC	MARAD/USGS Demo @ CCRO
	Jan 85	Stony Brook, NY	Tugboat Association Demo @ MSRC
	Feb 85	Washington, DC	NMFS/NEFC demo @ CCRO
	Mar 85	Washington, DC	NMFS Hqtrs & NOAA Estuarine Programs Office Demo @ CCRO

APPENDIX D (continued)

CIS DEMONSTRATIONS, MEETINGS, AND WORKSHOPS

-- Chronological List through April 1985 --

Phase	Date	Place	Purpose
Ext.	Apr 85	Washington, DC	Foreign Visitor Demo @ CCRO
	Apr 85	Washington, DC	American Assoc of Port Authorities
	Jun 85	Washington, DC	New York City Planning Department

APPENDIX E.

FEDERAL, STATE AND REGIONAL CIS INTERACTIOINS

APPENDIX E

FEDERAL, STATE and REGIONAL CIS INTERACTIONS (1982-1985)

Federal Agencies

- NOAA
  - National Estuarine Sanctuary Programs Office
  - Estuarine Programs Office
  - National Ocean Pollution Program Office
  - Ocean Assessment Division-Rockville, Stony Brook & Seattle
  - Seattle Regional Ocean Service Center
  - Ocean Services Division - Rockville, MD
  - National Ocean Service - Superfund Office
  - Sea Grant - Hqtrs, Maryland & New Jersey Offices
  - NMFS Headquarters Staff
  - Northeast Fisheries Center - Woods Hole
  - Assessment and Information Services Center
  - National Oceanographic Data Center
  - NESDIS Center Directors
- U.S. Army Corps of Engineers
  - New York, Seattle and Portland Districts
- U.S. Navy, Office of Chief of Naval Operations
- Environmental Protection Agency
  - EPA Headquarters - Ocean Programs
    - Estuarine and Criteria Offices
  - Region 2 - Technical Research Branch
  - Environmental Services Division - Edison, NJ
  - Region 10 - Seattle - Superfund Office
- U.S. Maritime Administration
  - New York and Washington, DC offices
- U.S. Coast Guard
  - New York City and Washington, DC districts
- U.S. Merchant Marine Academy
- Minerals Management Service - Metairie, LA office

State Agencies and Other Regional Activities

- Port Authority of New York and New Jersey
- Delaware River Port Authority
- State of New Jersey
  - Department of Environmental Protection
  - Marine Advisory Service
- State of New York
  - Department of Natural Resources
  - Department of State Coastal Zone Management
  - Department of Environmental Conservation

APPENDIX E (CONTINUED)

State Agencies and Other Regional Activities (continued)

- New York City
  - New York City Planning Office
  - New York City Parks Council
  - Office of Coastal Zone Management
  - Office of Ports and Terminals
- Long Island Regional Planning Board
- New York Tugboat Association
- Massachusetts Port Authority
- State of Washington
  - Department of Natural Resources
  - Department of Ecology
  - Columbia River Estuary Data Development Program (CREDDP)
- Puget Sound Action Program
- Port of Seattle Office
- Los Angeles City Sanitation District
- State Resource and Estuarine Sanctuary Managers
- Port of New Orleans - Board of Port Commissioners

Academic, Private Industry and Foreign

- Academic
  - University of Washington
  - Western Washington State University
  - University of South Alabama
  - Georgia University
  - Dillard University
  - State University of New York
  - William and Mary College
  - Louisiana State University
- Private Industry
  - William H. Donner Foundation - New York
  - Shapiro and Associates - Seattle, WA
  - JRB Associates - McLean, VA
  - Tetra Tech - Bellevue, WA
  - Applied Research Associates - Forest Hills, NY
  - American Management Systems, Inc., Arlington, VA
  - RCI Consultants, McLean, VA
  - Microscience, Inc., Williamsburg, VA
  - EG&G, Riverdale, MD and Boston, MA offices
  - Battelle New England Research Lab, Duxbury, MA
- Foreign
  - Marine Environmental Data Service - Ottawa, Canada
  - People's Republic of China - Visiting Scientists
  - Canadian Department of Fisheries and Oceans-Ottawa, Canada