A SURVEY OF USER NEEDS FOR DATA RELATING TO ENVIRONMENTAL AND WATER QUALITY IN THE SAN FRANCISCO ESTUARY

K. S. Kramer and David J.H. Phillips

AQUATIC HABITAT INSTITUTE
180 Richmond Field Station
1301 South 46th Street
Richmond, CA 94804
415 231-9539

November 1, 1988

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Acknowledgements

Jerry Oglesby and staff of SCI Data Systems Inc. contributed to the development of the survey questionnaire. Partial financial support for Kathy Kramer is provided by the Heller Foundation under the Project Assistant Fund of the Environmental Intern Program of California, and by Chevron USA. Thanks are due to Jay Davis and Andy Gunther of AHI for their contributions, and to Susan Prather of AHI for administrative help and general support. Thanks are also due to Renee Ragucci for providing transcription and word processing services.

The Project Officer, Mike Monroe of EPA Region IX, provided much useful input, for which we are grateful. Financial support for the survey and report production was provided by EPA.

Finally, we are grateful to the survey respondents listed in Appendix A of the report for their contributions of time, help and ideas.

I. INTRODUCTION

The five year workplan for the San Francisco Estuary Project of the U.S. Environmental Protection Agency (EPA) calls for the establishment of a Data Information and Management System (DIMS). This system should optimize the availability of data relating to environmental management and water quality-related issues in the San Francisco estuary and its catchment. Using DIMS, individuals should ideally be able to simply and efficiently access all needed information on historical and ongoing studies which contribute to the overall characterization of the estuary. Such a system would clearly be of considerable use to environmental managers, consultants, and researchers, both in the Bay area and elsewhere. It is possible that DIMS will also contain sufficiently non-technical material to be of use to the general public; however, other options may be preferable in this respect, and no decision has yet been made on the need for DIMS to service the public as well as the technical community.

The Aquatic Habitat Institute is contracted to the EPA to undertake initial studies needed for the development of DIMS in the San Francisco Estuary Project. These initial studies comprise a survey of user needs for data relevant to the estuary. This report describes the results of such a survey, and considers a variety of options for the establishment of a data management system in the estuary. Firm recommendations on the most appropriate type of data management system are presented, based upon the consensus derived from the survey of user needs.

II. THE USER NEEDS SURVEY

(a) Contact Points.

Several options were considered as the basis for the data user needs survey. Principal among these were:

- The use of a mailed questionnaire, sent to a large number of contact points and individuals in the Bay area and elsewhere.

- The selection of key contact organizations and individuals, and use of face-to-face interviews.

After discussion with the Project Officer, the second of these approaches was selected. It was felt that return rates for mailed questionnaires were likely to be poor, and returns would not be likely to represent a true cross-section of opinion concerning data user needs in the Bay area.

A list of key contact points and individuals was thus drawn up, with the help of the Project Officer and certain members of the EPA committees. Every attempt was made to generate a balanced list of contact points, including organizations and individuals representing all of the various sectors of environmental management and water-quality related topics in the estuary. In addition, certain organizations not actually sited in the Bay area, but with an interest in environmental quality of the estuary, were included. The final list of contact points to be surveyed was agreed by the Project Officer in late October

1987. A few minor amendments, deletions or additions were made in the course of the survey, reflecting suggestions of individuals surveyed or the unavailability of previously-selected contact points. The organizations and individuals surveyed included State and Federal regulatory agencies, public interest groups, dischargers and private industrial organizations, consulting firms, representatives of Universities, research scientists, and local government and management agencies. The total number of organizations contacted was 46; some 80 individuals from these organizations provided responses to the survey. These contacts are listed in Appendix A to this report. It is believed that the careful selection of the contact points permitted the generation of a balanced cross-section of viewpoints on the data user needs of the Bay community.

(b) The Questionnaire

The data user needs survey was conducted by use of a questionnaire, developed by AHI staff, with help from the Project Officer and staff of SCI Data Systems Inc. (the contracted data management organization responsible for setting up and maintaining the EPA national estuarine database at the North Carolina National Computer Center).

The questionnaire used is shown at Appendix B to this report. It was designed with a view to attempting to cover all areas of interest related to environmental quality in the San Francisco estuary and its catchment, with emphasis on items shown to be of particular concern. The latter were generated using the AHI

report entitled "Screening of Problems Relating to the San Francisco Bay-Delta", produced in draft by the Institute under contract to EPA in mid-1987. Areas relating to water quality (especially toxic contaminants), biological resources (wetlands, endangered species, fisheries, birds), land use, and other topics of environmental concern were included in the questionnaire.

The questionnaire was mailed to all contact points in early November 1987, and face-to-face interviews were scheduled through November and December of that year. The typical interview lasted between 30 minutes and 3 hours. Respondents were requested to complete the questionnaire either before or during the interview. The interviewer was Ms. Kathy Kramer in all cases; it was thought that the same AHI staff member should be used throughout all interviews to maintain consistency of the questions asked and approach taken.

In this fashion, information was gathered from each contact point in detail on the following generic areas represented in the questionnaire:

- Topic(s) of interest, for which access to data would be required. (Examples: water quality, terrestrial biota, pollution).

- Variable(s) of interest. (Examples: pollutants, biological statistics, physical statistics).

- Region of interest (entire Bay and Delta, parts of the system only, or comparative areas).

- Time period of interest (historical data, ongoing studies, or future planned work).
- Format in which data could be effectively used.
- Willingness to pay for use of a database retrieval service.

In addition, the second portion of the questionnaire requested information on data which respondents, or the organizations they represented, had collected or were presently gathering. This information is relevant to later phases of data management in the estuary and to production of an inventory of available data; however, it is not strictly relevant to data user needs. Information from this portion of the survey will therefore be presented in other AHI reports, and is not included here.

In most cases, it was found that respondents were helpful, and fully understood the need for the survey. Indeed, most respondents expressed frustration over their inability to efficiently access needed data on the estuary. The use of the questionnaire format permitted a consistent approach, and clear patterns emerged through the interviewing process in terms of the needs of respondents for information, or for data per se, on the estuary. This permitted conclusions on the adequacy of the present regional and national databases on environmental quality of the San Francisco estuary, on priority datasets (required by many respondents), on the desire for a centralized database on

the estuary, and on the required format for data (such that the data accessed may be most easily used by respondents). These topics are covered more fully in the following sections of this report.

III. ADEQUACY OF DATA MANAGEMENT AT PRESENT

(a) Regional Data Management

At present, there is no coordinated system for the regional management of data relating to the environmental quality of the San Francisco estuary. Many research programs exist, gathering data on diverse aspects of water quality, biological resources, land use, estuarine hydrology, and other topics. These programs are conducted by a wide variety of State, Federal, and other organizations. Additional data on specific topics are reported in such documents as Environmental Impact Statements and Reports. Much of the published material can be classified as "gray literature"; relatively little information on the estuary has been published in open peer-reviewed journals.

The large number of research programs and organizations involved in such programs implies the existence of multiple sources of data, and their storage in different formats is common. Individual researchers may make their own unconstrained decisions as to data formatting and storage. For data stored on computers, this results in the use of many different hardware/software combinations, and in problems with system compatibility if the data are required by others. Some organizations conducting research on the estuary possess a centralized data management group, in which case most data are generally stored in similar format, using consistent combinations of hardware and software. However, there has apparently been no attempt to standardize data management techniques between the various organizations conducting research on the estuary.

As a result of this lack of coordination to date of data management in the estuary, great confusion exists at present as to the existence of information or data on any given topic, and as to its availability. This confusion was reflected universally by respondents to the AHI survey. Many individuals expressed great frustration over their previous attempts to access needed data; in several cases, the task was considered hopeless and was discontinued, despite the known existence of the needed data. In many cases, differences between existing and desired or end-usable data formats required end-users to completely manually re-enter raw data onto the hardware/software combination of choice, before any analysis of the data could be commenced.

In conclusion, the regional management of data on the estuary at present is exceptionally poor, reflecting a total lack of previous coordination and generating a multiplicity of datasets which are either difficult to access, or can be accessed only very inefficiently.

(b) National Data Management.

SCI Data Systems Inc. are contracted through Battelle to the EPA as the data managers for the national estuary programs. SCI compile data from the various ongoing estuary programs being conducted under the Clean Water Act, and store these at the National Computer Center (NCC) in North Carolina. Data storage involves the compilation of large data sets, considered to be of high priority, in STORET and BIOS; the Statistical Analysis System (SAS) software package is employed to access and format data.

To date, considerable amounts of data relating to the San Francisco estuary project have already been stored on the NCC facility. These data include information from the Interagency Studies on various aspects of estuarine quality, and information compiled by AHI (point source discharge quality, from NPDES self-monitoring; spills data; and State Mussel Watch results). These databases are described in full in the AHI report entitled "Inventory of Priority Datasets Relating to the San Francisco Estuary."

Some of the larger organizations collecting data on the estuary (and contributing data to the NCC, through the Interagency Studies Program) are satisfied with this national system, finding that it fulfills their needs. In most cases, these organizations possess a centralized data management group comprised of several staff, who are sufficiently trained and knowledgeable on SAS to be able to complete any required data manipulation or management tasks.

However, many of the respondents to the AHI survey did not feel that the NCC database was of use to them. This was due to the difficulty and expenditure of time involved in becoming familiar with the use of STORET and SAS. One data management coordinator working for a large agency stated that it had taken her six months to become used to working with SAS, and that she was still making mistakes and still learning. Users with less frequent requirements found the system too cumbersome and too difficult or time-consuming to learn; the following comments were typical:

"You must be an expert with computers to use the NCC system, and this is too much for most researchers. First you have the hassle of signing on, then you have to deal with TSO, then you have to learn SAS."

"SAS - it's a maze. There's not enough time to learn it, and that data is unavailable to me until I do. Once you solve one problem you have another one."

"STORET and SAS are complicated. The user manual is a mountain of paper. It's not easy to get the data out."

It is notable here that the State Water Resources Control Board provides a data retrieval service which is available to the general public in addition to staff of State agencies. This service includes the retrieval of data in the NCC facility; six programmers exist on staff, and data from the NCC can be converted to ASCII files for down-loading into other computer systems. However, most respondents to the AHI survey were not aware of the existence of this service. Those respondents who were aware of the service felt that the time taken to access and convert data was too long (the SWRCB staff stated that turn-around times vary from a day to several months, depending on the complexity of the request and other workload).

(c) Conclusions

Very few of the respondents to the AHI survey were satisfied with the existing system for managing information or data on the

estuary. While the NCC national database satisfied the requirements of a few users, this was by no means common, as noted above. The difficulty of learning STORET and SAS was a frequently-cited problem.

In addition, many databases which are required by users are not presently stored on the NCC facility. In these cases, end-users must:

(i) become aware of the existence of the data of interest;
(ii) find the correct contact organization and individual;
and (iii) convince that contact individual to provide the data in the needed format, in a timely fashion.

In many instances, no fruitful outcome of such a scenario existed. The following comment was typical:

> "I spent a year and a half trying to beat data out of [agency] and it was the most frustrating experience of my life. Eighteen months later we were still coming up with data that we didn't know existed. That information was virtually impossible to access."

The respondents to the AHI survey were almost unanimous in their opinion that data management in the estuary should receive more attention and funding, and that the lack of a coordinated regional data management system at present constrains progress in water quality and environmental management in the estuary. There is clearly an almost universal need for improved communication on

the existence of data, and for a service providing such data to end-users in the appropriate formats. The last section of this report provides recommendations on how such improvements should be introduced.

IV. PRIORITY DATASETS

The questionnaire used by AHI in the data user needs survey (Appendix B) includes a number of generic areas of study, in which data are available. Assuming that the organizations and individuals responding to the survey represent a cross-section of data user needs in the Bay community, it is possible to identify priority datasets, i.e. those which are most frequently needed by respondents.

Table 1 indicates the responses of individuals contacted in the survey, in terms of their interest in accessing the various types of data covered by the survey. It is clear from this Table that certain types of data were of interest to a large number of respondents. These topics of greatest interest, and the principal databases existing on them, are discussed briefly below.

- Water Quality

Data on water quality are collected principally by the Department of Water Resources (DWR) and the U.S. Bureau of Reclamation (USBR), and include information on the levels of contaminants in the estuary, salinity levels, position of the null zone, nutrient loading, chlorophyll, and plankton. These data have been (or are being) entered onto an IBM mainframe in STORET at the National Computer Center (NCC) in Research Triangle Park, North Carolina.

Many other programs also exist which collect data relating to water quality in the estuary. These include Environmental

Impact Assessments, specific studies on waste discharges, and various other studies. Databases from such studies are in scattered locations, in many different formats.

- Contaminant Loading to the Estuary

The AHI report entitled "An Assessment of the Loading of Toxic Contaminants to the San Francisco Bay-Delta" discussed this topic in detail. For many sources (e.g. urban and nonurban runoff, atmospheric deposition, hazardous waste sites), the available local information is very poor. However, contaminant loads from point sources and from riverine inputs (the Sacramento and San Joaquin Rivers) are reasonably well-characterized. Point-source loading data on the NCC cover the years 1984 to 1986 inclusive; AHI is presently adding 1987 data to this database and will convert it to a PC-compatible format by mid-1988, for use by the Regional Water Quality Control Boards. Riverine loading can be computed from data on WATSTORE, the data storage system employed by USGS.

It is also notable that the National Oceanic and Atmospheric Administration have compiled a National Coastal Pollutant Discharge Inventory, which attempts to define contaminant loading to coastal areas of the USA, using generic (national) assumptions on the magnitude of various sources of contaminants. These data are on a PRIME computer in Rockville, Maryland.

With respect to hazardous waste sites, the recent passage of the Tanner bill now requires each county to formulate a manage-

ment plan for hazardous material and toxic contaminants. Data collected include potential sources of hazardous waste, the storage of toxic contaminants, and plans for the disposal of wastes.

The Coast Guard Office of Marine Safety stores data on oil and hazardous material spills at Battelle Labs in Columbus, Ohio. Data are virtually unavailable for retrieval due to the computer system design. At present, only spill data for the San Francisco estuary entered onto the NCC system by the Aquatic Habitat Institute for the years 1984 to 1986 inclusive can be accessed.

- Fisheries

Fisheries data collected by the Interagency Ecological Studies Program include studies on striped bass, chinook salmon and Dungeness crab. Species distributions, abundance and fecundity information, and various other parameters, are collected from studies using otter trawls, midwater sampling stations, and beach seining. The California Department of Fish and Game has conducted surveys of fish in the Bay and Delta, employing monthly sampling at a total of 70 sites since 1980. This study is part of the Regional Effects Monitoring component of the Aquatic Habitat Program Plan. Data are stored on the NCC system.

- Hydrology/Hydrodynamics

The U.S. Geological Survey collects an enormous amount of data on hydrodynamics of the San Francisco estuary. Studies

conducted include surveys of tidal currents, and water levels. This information is on a PRIME computer.

Data on Delta outflows are discussed below.

- Benthic Infauna

Long-term benthic studies are carried out by a variety of organizations. DWR collects baseline data on benthic community structure in the Delta, which have been entered into the NCC System. Data collected by the U.S. Geological Survey on trace metal accumulation in bivalves and sediments are stored on a PRIME computer in the software packages Minitab and Telegraph. Data from USGS species composition and abundance studies are stored on a VAX, using the software ORDANA.

- Sediment; Dredging and Disposal

Studies of contaminants in sediments of the estuary have been undertaken by various organizations, including USGS, the Army Corps of Engineers, the Lawrence Livermore National Laboratory, and the National Oceanic and Atmospheric Administration (NOAA).

NOAA has comprehensively reviewed historical data on sediment contamination in the estuary, as part of a draft report (final version due out in March 1988) on the Bay and Delta. The data are in Microsoft Excel spreadsheets on a MacIntosh computer in Seattle, Washington.

The National Status and Trends data of NOAA are entered on a PRIME computer in Rockville, MD (which is linked to a similar computer in the NOAA Seattle offices) and can be downloaded for manipulation to a MacIntosh computer. Most such data are offered to end-users in Microsoft Excel.

Data from the Lawrence Livermore National Laboratory on PCBs and PAHs in sediments and fish in the estuary are also on a MacIntosh.

The Army Corps of Engineers has conducted various studies for specific dredging projects; little of this information is computerized. Historical data on dredging are notable as a high-priority database, frequently of interest to survey respondents; however, these data are difficult to access and not yet compiled in a usable format. There appears to be a case for compilation of these data to improve access to them. Monitoring data on present disposal projects are summarized in Lotus in an IBM-compatible computer. The database is due for expansion during 1988 to allow more detailed tracking of dredging activities and permits.

- Wetlands

Studies involving the monitoring and mapping of wetlands are undertaken by several organizations. The Bay Area Conservation and Development Commission has recently implemented a computerized Project Tracking System on a Wang VS 15 which contains detailed and current information on wetlands and

shoreline development. The US Fish and Wildlife Service National Wetlands Inventory has mapped historical and current data on wetlands for the Bay-Delta region. These data have been entered onto a computerized Geographic Information System in Slidell, Louisiana. USFWS has also instituted studies on the use of salt ponds and diked baylands by wildlife. Data from both ground and aerial surveys were entered onto IBM-compatible computers.

- Delta Inflows

Delta hydrology is monitored by the DWR computer program, DAYFLOW, which estimates mean daily flows at Chipps Island, as well as at other locations in the Delta. These data have been entered into STORET on the NCC system.

- Rare and Endangered Species

The Natural Diversity Database of the California Department of Fish and Game is an inventory of State and Federally listed rare and endangered species. This information is stored in Intergraph on a DEC computer.

The above databases and many others are inventoried and described in detail in the AHI report entitled "Inventory of Priority Datasets Relating to the San Francisco Estuary." They are listed and briefly described here because of their frequent demand by data users surveyed, and to emphasize the diversity of hardware/software combinations employed at present to store important data on the estuary.

V. CENTRALIZATION OF DATABASES

Individuals surveyed were asked for their comments on the need for a centralized database, storing all priority datasets relevant to the San Francisco estuary. In general, the response to this suggestion was negative. The following comments were received:

- Large centralized data-bases were thought to be expensive to set up and maintain.
- Concern was expressed over experience elsewhere (e.g. Chesapeake Bay), where centralized databases have not been successfully introduced, and are infrequently used.
- The use of data from centralized databases was problematical; comments in this area reflected similar concerns to those voiced on the use of the NCC database. Data formatting was a major concern.
- Some respondents felt that data in centralized databases were not accompanied by sufficient explanatory or background material, and often were of doubtful QA/QC.

Most of those interviewed stated that they would prefer to access data from the original source, rather than through a centralized database. This was preferred because it permitted discussions on background topics, on QA/QC concerns, and on

whether the originator wished to include disclaimers on the interpretation of any data. It was also noted that datasets are often not included in centralized databases by the originator unless exhaustive QA/QC checks or interpretive analysis had already been completed. As a result, centralized databases tended to include only data from older surveys, more recent data being withheld by the originator. This was thought to constrain the progress of studies of the estuary, as the most recent data were often unavailable.

Most respondents to the survey considered that the principal requirement was for coordination and enhanced communication on the existence of data on topics of interest. The concept of an on-line information system on historical, ongoing and planned studies of environmental aspects of the estuary received almost unanimous support. It was generally felt that such a system should include not only information on the existence of data on the estuary, but also a keyworded bibliography of reports and published literature which interpret previous studies. All respondents to the survey considered it vital that such a system be on-line, accessible to remote users through any PC and modem.

It should be noted here that the frequent lack of support for the establishment of a centralized database on the estuary (covering many different types of data) does not imply that information on particular individual topics should not be summarized and available in a single database. An example of the latter is the National Diversity Database on rare and endangered

species noted in section IV above, which summarizes all available information on this topic. There is clearly a need for the preparation of such summarizing databases on individual topics; this is particularly the case when such information is amenable to mapping (e.g. wetland areas; land use).

VI. DATA FORMATS

Changes in computer technology over the past decade allow information which was once solely in the realm of mainframes to be loaded onto and analyzed on personal computers. It was an almost universal requirement from everyone interviewed that any information retrieved had to be called up via modem and be capable of loading onto a desk-top computer, for convenient manipulation on familiar software. Respondents felt that the inefficiency of contending with data in unfamiliar software made the data undesirable. IBM-compatible equipment and Macintosh computers were most commonly used, by respondents to the survey, with various software packages.

VII. CONCLUSIONS FROM THE DATA USER NEEDS SURVEY

The following conclusions are possible in relation to the survey and to the needs of users of data on the estuary:

- It is believed that the organizations and individuals contacted represent a reasonable cross-section of opinion and user needs in the Bay community, covering both technical and non-technical aspects.

- The present system of regional data management is inadequate. Databases exist in scattered locations in many different formats and are very difficult to access, even if their existence is known of by potential end-users.

- The national database set up on the NCC system by SCI Data Systems, under contract to EPA, satisfies the needs of only some individuals and organizations in the Bay community (mostly those large agencies with data management sections, staff of which are familiar with the use of STORET and SAS).

- Many other individuals surveyed considered that the difficulty or time taken to learn SAS effectively denied them access to the national database. Problems with data formatting and QA/QC were mentioned by respondents.

- The existence of the SWRCB service for accessing data in the NCC was not widely known; a few respondents to the survey knew of this service, but considered it to be of little use to them because of turn-around times (even though these appear quite short).

- Potential end-users of data had frequently experienced great problems in accessing information directly from the originating agency or individual.

- Priority datasets, of interest to many users, have been enumerated and are briefly described in section IV of this report; additional detail is available in other AHI reports.

- There was little support for the setting up of a centralized database for the estuary. Concerns expressed were similar to those encountered in using the existing NCC database. Most respondents stated that they would prefer to access data from the original source.

- Survey respondents were almost unanimous on the need for improved coordination of data management in the estuary and for enhanced communication on the existence of databases of various types.

- Most of those surveyed considered that an on-line system, accessed through any PC and modem,

incorporating information on the existence of data (from historical or ongoing studies) and a bibliography of available reports, would best serve their needs.

- Individual respondents were concerned that any data management or informational system set up for the estuary be sufficiently flexible to allow them access to the information using their own PC and familiar software. IBM-compatible and MacIntosh computers were most frequently used by survey respondents, with a variety of software packages.

VIII. RECOMMENDATIONS

It is recommended that EPA consider the following course of action in relation to the establishment of a Data Information and Management System (DIMS) in the San Francisco Estuary Project:

- Designate data management activities as an item of the highest priority in the EPA San Francisco estuary project.

- Continue maintaining the national NCC database and loading priority datasets on to the NCC system, to serve the needs of groups such as the Interagency Studies groups.

- Design and set up a regional information system, which should provide on-line information on the existence and scope of individual databases of importance on the estuary, and a complete bibliography. Details of this system are given below.

- Link the hardware employed for the national database at NCC to that used for the regional data indexing system, such that both sets of data may be accessed by an end-user in the Bay community.

- Consider how the national and regional databases and informational networks may be interfaced with data submitted as part of the State Hearing process.

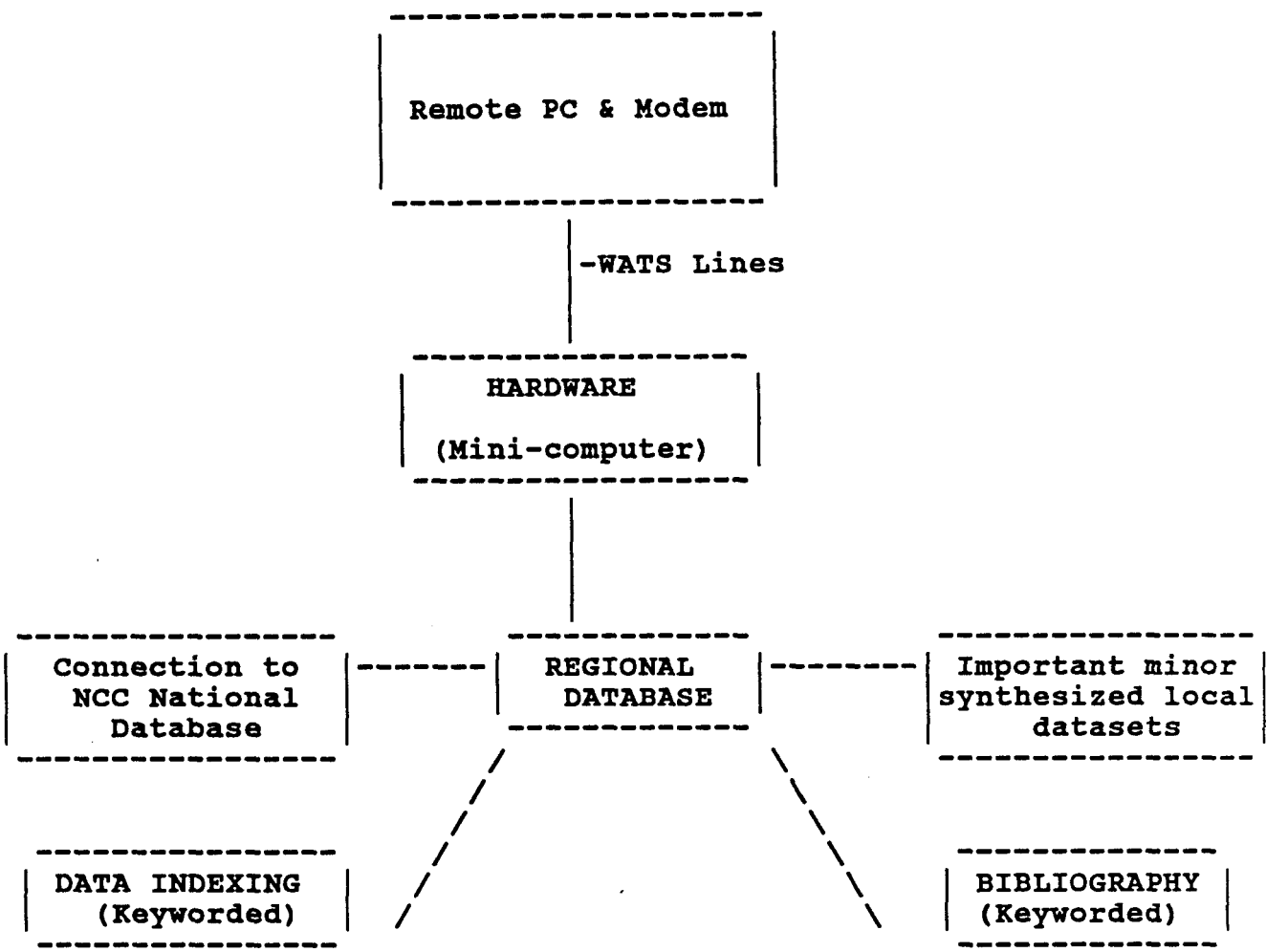
IX. THE PROPOSED REGIONAL DATA INDEXING SYSTEM

Brief details of the proposed regional data indexing system are provided here as a basis for further discussion by EPA committees.

As noted previously, the system should be accessible on-line through any PC and modem. Sufficient programming effort should be made to ensure a highly user-friendly interface to end-users (who may vary considerably in computer-literacy). The menu-driven system would be accessed through the use of keywords and would incorporate both information on the existence of data from historical and ongoing studies (including such items as relevant geographic locations, parameters studied, time period of study, relevant species, etc.) and a bibliography of available hard copy reports and publications. Up-to-date contact points should be included, such that an end-user may contact the data originator or manager for additional details or for hard copy or electronic copies of the data of interest. In the bibliographic section, availability of publications at libraries and other organizations in the Bay area should be noted. In certain cases, frequently required sets of synthesized data (e.g. simple estimates of Delta outflow) may also be loaded into the system. However, no large or complex datasets will be included; if of sufficient priority, these should be loaded onto the NCC system.

The proposed data indexing/bibliography system as described above is shown in schematic form in Figure 1. Additional details on this system are available from AHI staff.

Figure 1. Schematic of the proposed data indexing/bibliographic system, to act as the principal component of data management for the San Francisco estuary.



Includes for each database:

- o Name of study/generic description
- o Period covered
- o Locations/areas of study
- o Parameters measured
- o Frequency of measurements
- o Update frequency
- o QA/QC details
- o Principal hardcopy documentation
- o Contact point (name, address, telephone no.)

Includes:

- o Reports
- o Published papers
- o Unpublished manuscripts
- o Locations of availability

APPENDIX A: ORGANIZATIONS AND INDIVIDUALS CONTACTED FOR THE SURVEY

1) Assocation of Bay Area Governments
P.O. Box 2050
Oakland CA 94604
(415) 464-7941

Ms. Emy Meiorin
Senior Environmental Engineer
Water Quality

2) Audubon Society
590 Texas Street
San Francisco CA 94107
(415) 282-5937

Mr. Arthur Feinstein
President - Golden Gate

Ms. Lynn Tennefoss
Managing Director - Santa Clara

Ms. Barbara Salzman
Conservation - Marin County

3) Bay Area Dischargers Association
P.O. Box 24055
Oakland CA 94623
(415) 465-3700 x 121

Mr. James McCarthy
Wastewater Control

Mr. Archie Greenburg
Manager - Laboratory Services

4) Bay Area League of Industrial Assns.
P.O. Box 7924
San Francisco CA 94120-7924
(415) 894-4609

Dr. Audrey Goins
Environment/Consumer
Affairs Representative

5) The Bay Institute
Schoonmaker Building #120
10 Liberty Ship Way
Sausalito CA 94965
(415) 331-2303

Mr. Bill Davoren
Executive Director

6) California Academy of Science
Golden Gate Park
San Francisco CA 94118
(415) 750-7087

Mr. Dusty Chivers
Senior Curatorial Assistant

Mr. Bob Van Syoc
Collections Manager

7) California Department of Fish and Game
Bay-Delta Project
4001 N. Wilson Way
Stockton CA 95205
(209) 466-4421

Mr. Charles Armor
Associate Fishery Biologist

8) California Department of Fish and Game
State Mussel Watch
Coast Route 1, Granite Canyon
Monterey CA 93940
(408) 624-0864

Dr. Michael Martin
Laboratory Director

Mr. Mark Stephenson
Associate Water Quality Biologist

9) Calif. Department of Water Resources
3251 "S" Street
Sacramento CA 95816-7017
(916) 445-4640

Ms. Bellory Fong
Environmental Specialist

10) CH_2M Hill
2200 Powell Street
Emeryville CA 94608
(415) 652-2426

Mr. Davis Smith
Project Manager

11) Citizens for a Better Environment
942 Market Street #505
San Francisco CA 94102
(415) 788-0690

Mr. Mike Belliveau
Research Director

Mr. Greg Karras
Research Associate

12) Dames and Moore
221 Main Street #600
San Francisco CA 94105-1917
(415) 896-5858

Mr. Robert Mott
Senior Economist

Mr. Dale Shileikis
Environmental Scientist

13) East Bay Dischargers Association
2651 Grant Avenue
San Lorenzo CA 94580
(415) 278-5910

Mr. Oscarlee Fenton
Manager

14) East Bay Municipal Utilities District
P.O. Box 24055
Oakland CA 94623
(415) 465-3700

Mr. Ken Osborne
Operations Studies Supervisor

15) Environmental Defense Fund
5655 College Avenue #304
Berkeley CA 94704
(415) 658-8008

Dr. Terry Young
Consulting Scientist

16) Environmental Protection Agency
215 Fremont Street
San Francisco CA 94105
(415) 974-8264

Mr. Dave Jones
Head - Informational Resources
Management Task Force

17) K. P. Lindstrom & Associates
1177 Brownwyk Drive
Sacramento CA 95822
(916) 429-8140

Dr. Kris Lindstrom
President

18) Lawrence Livermore Laboratory
P.O. Box 507 - L453
Livermore CA 94550
(415) 422-5792

Dr. Bob Spies
Environmental Scientist

19) League of Women Voters - Bay Area
477 15th Street #200
Oakland CA 94612
(415) 834-7640

Mr. Paul DeFalco
Treasurer

20) Metropolitan Water District
P.O. Box 54153
Los Angeles CA 90054
(213) 250-6666

Mr. Dick Clemmer
Principal Engineer
Bay-Delta Branch

21) National Marine Fisheries Service
Southwest Fisheries Center
3150 Paradise Drive
Tiburon CA 94920
(415) 435-3140

Dr. Jeannette Whipple
Fisheries Biologist

22) Natural Resources Defense Council
90 New Montgomery
San Francisco CA 94108
(415) 777-0220

Ms. Laura King
Senior Scientist

23) National Oceanic and Atmospheric Adm.
N/OMA 32 x 2
7600 Sand Point Way N.E.
Seattle WA 98115
(206) 526-6338

Mr. Ed Long
Marine Biologist

24) Oceanic Society
Building E-Fort Mason
San Francisco CA 94123
(415) 441-5970

Ms. Joan Patton
Conservation Director

25) Old Dominion University
Dept. of Oceanography
Norfolk VA 23508
(804) 440-4929

Dr. Greg Cutter
Associate Professor
of Oceanography

26) Pacific Coast Federation
of Fishermen's Association
P.O. Box 1626
Sausalito CA 94965
(415) 332-5080

Mr. Zeke Grader
Executive Director

27) Regional Water Quality Control Board
Central Valley
3433 Routier Road
Sacramento CA 95827-3098
(916) 361-5694

Mr. Jerry Bruns
Chief - Standards Policies
and Special Studies

28) Regional Water Quality Control Board
San Francisco
1111 Jackson Street #6040
Oakland CA 94607
(415) 464-1346

Dr. Susan Anderson
Environmental Specialist

Mr. Richard Whitsel
Chief - Planning Division

Mr. Dan Tempelis
Water Resources Control Engineer

Mr. Ken Tyson
Environmental Specialist

29) San Francisco Bay Conservation
and Development Commission
30 Van Ness Avenue
San Francisco CA 94102
(415) 557-3686

Mr. Alan Pendleton
Executive Director

Mr. Steve Goldbeck
Planner

30) San Francisco State University
Paul Romberg Centre
Tiburon CA 94920
(415) 435-1717

Dr. Mike Josselyn
Director

31) Santa Clara Valley Water District
5750 Almaden Expressway
San Jose CA 95118
(408) 265-2600 x 328

Mr. Dan Kriege
Manager - Operations
and Maintenance

Mr. Richard Gates
Basic Data Group - Operations

32) Save San Francisco Bay Assn.
P.O. Box 925
Berkeley CA 94701
(415) 849-3044

Mr. Barry Nelson
Program Director

33) Science Applications Int. Corp.
3 Choke Cherry Road
Rockville MD 20852
(301) 977-4480

Dr. Mike Champ
Project Manager
Ocean Science Division

34) Sierra Club
6014 College
Oakland CA 94618
(415) 653-6127

Ms. Dana Kokubun
Conservation Representative

35) South Delta Water Agency
23443 South Hays Road
Manteca CA 95336
(209) 823-4166

Mr. Alex Hildebrand

36) Stanford University
Department of Civil Engineering
Terman Engineering Center
Stanford CA 94305-4020
(415) 723-1073

Dr. Paul Roberts
Professor of
Civil Engineering

Dr. Steve Monismoth
Assistant Professor
Civil Engineering

37) State Water Resources Control Board
P.O. Box 100
Sacramento CA 95801
(916) 324-5727

Mr. Leo Winternitz
Environmental Specialist

Mr. Doug Stewart
Water Resources Control Engineer

Mr. Phil Daniels
Supervisor - Data Processing Analyst
(916) 322-4514

38) Tetra Tech
3746 Mt. Diablo Blvd. #300
Lafayette CA 94549
(415) 283-3771

Tom Grieb
Principal Scientist

39) University of California/Berkeley
SEEHRL
1301 S. 46th Street #112
Richmond CA 94804
(415) 231-9585

Dr. Robert Cooper
Director

Dr. Alex Horne
Research Ecologist

40) University of California/Berkeley
Bodega Marine Laboratory
P.O. Box 247
Bodega Bay CA 94923
(707) 875-2211

Dr. Jon Shenker
Assistant Research
Oceanographer

41) University of California/Davis
Wildlife and Fisheries Biology
Davis CA 95616
(916) 752-8414

Dr. Harry Ohlendorf
Research Station Leader

42) U.S. Army Corps of Engineers
211 Main Street
San Francisco CA 94105

Mr. Tom Wakeman
Bay Model Director
(415) 332-5485

Mr. Rod Chisholm
Chief - Environmental Branch

Mr. Dave Hodges
Permit Analyst

Ms. Vicki Reynolds
Chief - Compliance Section

Mr. Dean Smith
Dredging Inspector

43) U.S. Bureau of Reclamation
2800 Cottage Way Rm W-2137
Sacramento CA 95825-1898
(916) 978-4923

Mr. Jim Arthur
Aquatic Biologist

Ms. Sheryl Baughman
Aquatic Biologist
(916) 978-5260

44) U.S. Coast Guard Pollution Response
Bldg. 14, Coast Guard Island
Alameda CA 94501
(415) 437-3781

Lt. Mike Moore
Chief - Marine Environmental Response Division

Lt. Steve Boyle
Assistant Chief - Marine Environmental Response Division

45) U.S. Fish and Wildlife Service
Division of Ecological Services
2800 Cottage Way Rm E-1803
Sacramento CA 95825
(916) 978-4613

Dr. Don Palawski
Environmental Contaminant Specialist

Mr. Jim Mckevitt
Field Supervisor

Ms. Ruth Pratt
Fish and Wildlife Biologist

Ms. Kay Goude
Fish and Wildlife Biologist

Ms. Terry Pencovic
Fish and Wildlife Biologist

46) U.S. Fish and Wildlife Service
National Wetlands Research Center
1010 Gause Boulevard
Slidell LA 70458
(504) 646-7359

Mr. Larry Handley
Geographer

47) U.S. Geological Survey
345 Middlefield Road
Menlo Park CA 94025

Dr. Fred Nichols
Project Chief
(415) 354-3218

Dr. Sam Luoma
Project Chief

Mr. Larry Schemel
Oceanographer
(415) 354-3335

Mr. Ray Herndon
Computer Specialist

Mr. Jeff Gartner
Oceanographer

Mr. John Bureu
Civil Engineer

Mr. Larry Smith
Hydrologist

48) Wesco
14 Galli Drive
Novato CA 94949
(415) 883-6425

Mr. Scott Cressey
Senior Fisheries Biologist

APPENDIX B: SURVEY QUESTIONNAIRE

DATA USER NEEDS SURVEY

General

1. Organization

2. Person Contacted
   a. title
   b. address
   c. phone

Data Needs

3. Areas of interest (select only the most relevant; can be more than one)
   a. water quality ____
   b. aquatic biota ____
      1. fisheries ____
      2. benthos ____
      3. plankton ____
      4. other ____
   c. terrestrial biota
      1. birds ____
      2. other ____
   d. endangered species ____
   e. hydrology/hydrodynamics ____
   f. pollution ____
      1. point sources ____
      2. nonpoint sources ____
      3. in-place pollutants ____
   g. wetlands ____
   h. land use ____
   i. dredging ____
   j. human health ____
   k. regulatory/political ____
      1. water management ____
   l. other (specify)

4. Variables of Interest
   a. pollutants in general ____
      1. trace metals ____
      2. synthetic organics ____
      3. hydrocarbons
      4. in:
         sediments ____
         water column ____
         organisms ____
         discharges ____
      5. nutrients ____
      6. coliform/other biological pollutants ____

b. biological statistics
    1. organism(s) of interest
    2. population data
        a. size
        b. distribution
    3. response to pollutants
    4. productivity

c. physical statistics
    1. hydrologic (including tides/circulation)
    2. climatic
    3. land use data (including habitat acreages)

d. loading statistics
    1. municipal discharges
    2. industrial discharges
    3. dredging and spoil disposal

e. other

5. Region of interest
    a. Entire Bay-Delta system
    b. San Francisco Bay
        1. South Bay
        2. Central Bay
        3. San Pablo Bay
        4. Suisun Bay
    c. Delta
        1. Sacramento River
        2. San Joaquin River
    d. other (specify)

6. Time period of interest
    a. pre 1970
    b. 1970-1975
    c. 1975-1980
    d. 1980-1985
    e. 1985-present
    f. future
        1. frequency of updates desired

7. Format desired:
    a. hard copy
    b. electronic
        1. tape
        2. disc
            i. 5.25"
            ii. 3.5"
        3. on-line

8. Would you be willing to pay for the use of a database retrieval service?

Available Data

9. Does your organization collect data on the Bay-Delta? If so, please describe subject:

   A. Spatial scale

   B. Temporal scale and update frequency

   C. Location of Sites
      (same sites over time?)

   D. Time span over which data exists

10. Format of data collected:
    a. hard copy
    b. electronic
       1. tape
       2. disc
          i. 5.25"
          ii. 3.5"
       3. on-line
    c. software in use for data analysis

11. Location of Data

12. QA/QC procedures in force

13. Availability and description of documentation regarding data

13. Person to contact for more information

Name:
Organization:
Address:
Phone: