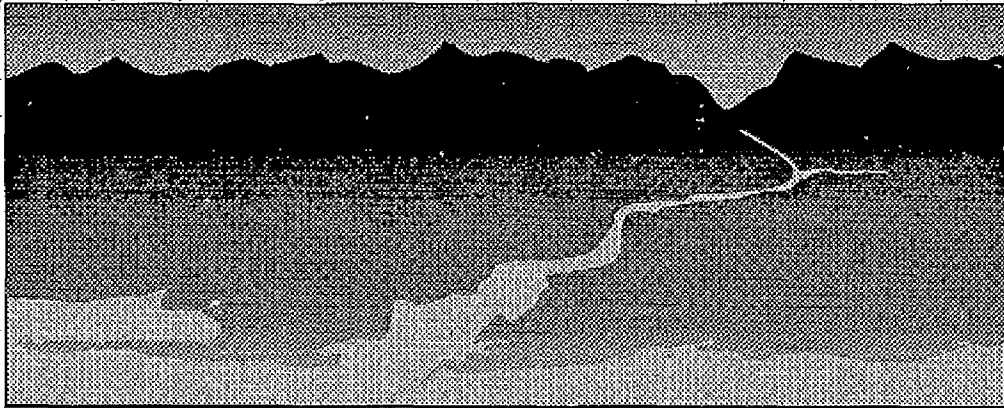FINAL REPORT
TC 9161-02

LOWER COLUMBIA RIVER

BI-STATE PROGRAM

DATA MANAGEMENT
NEEDS ASSESSMENT

FEBRUARY 10, 1993

Prepared By:

TETRA TECH

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ACKNOWLEDGEMENTS

1.0 INTRODUCTION

This report is the first in a series of tasks designed to evaluate data management needs and systems for the Bi-State Lower Columbia River Water Quality Program (Bi-State Program). A more detailed discussion of the overall project process and schedule is available in the Data Management Work Plan (Tetra Tech 1992). The purpose of this Data Management Needs Assessment Report is to:

1)   Identify key programmatic and technical issues of importance to effectively manage data for the Bi-State Program

2)   Develop a list of elements (based upon an integration of programmatic and technical issues) that can be used to evaluate the ability of existing data management systems to meet the needs of the Bi-State Program.

An evaluation of existing data management systems by these elements is a later task in the data management project.

Data management is a particularly important issue to the Bi-State Program for several reasons. First of all, the Bi-State Program has already generated a considerable amount of original field investigation data to help address some key program objectives, and is planning to collect additional information in the future. However, those data are not currently being managed. They reside as electronic files stored in an ARC/INFO Geographic Information System (GIS). Some data are also stored by the contractor in EXCEL spreadsheets, however, these data are not very accessible. The Bi-State Program committee is currently responsible for maintaining and distributing these data. The establishment of a data management system could facilitate broader uses of these data in program decision making simply by making the data more accessible to program managers, permit writers, and technical staffs at several agencies (e.g., Corps of Engineers, ODEQ, Ecology, Wildlife, Shellfish, Fisheries). Other users may include Bi-State Program committee members, consultants, and the general public. Secondly, the Bi-State Program is just one

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entity among many organizations with overlapping jurisdictions and interests in the lower Columbia River. A properly implemented long-term data management system will facilitate inter-organizational data sharing which will allow for more informed decision making, better interagency coordination, and lessening redundancy in data collection efforts by individual agencies. These issues will be presented in more detail later in this report.

Prior to the discussion of Bi-State Program data management needs, however, it is important to have an understanding of the goals and objectives of this program. This information is important to understanding the geographical and informational boundaries underlying both the Bi-State Program and its associated data management needs. The following provides a brief summary of the Bi-State Program history and objectives. A more detailed discussion of Bi-State Program structure and direction is available in the Four Year Program Plan, 1990-1994 (Bi-State Steering Committee, 1990). Programmatic issues with direct data management implications will be discussed in more detail in Section 3.0 of this report.

1.1 BACKGROUND

The Bi-State Program was formed in 1990 through an Interstate Agreement between the states of Washington and Oregon. The Bi-State Program is comprised of representatives from the Washington Dept. of Ecology (WDOE), Oregon Department of Environmental Quality (ODEQ), and a Steering Committee which consists of 15 members representing diverse interests. The Program's study area encompasses the lower 146 miles of the Columbia River, which spans from the Bonneville Dam to the Pacific Ocean.

The Bi-State Program was formed to accomplish several tasks during its first four years. These plans were broadly stated as the following (Bi-State Steering Committee, 1990):

- To identify water quality problems;
- To determine if beneficial/characteristic uses are impaired;
- To develop solutions to problems; and
- To make recommendations on a long-term Bi-State framework.

In order to meet these broad objectives, the Bi-State Program set out to conduct a series of six more discrete activities, which are:

- Involve the public through education and inviting public participation.

- Develop work plans that identify the studies needed to characterize the river's water quality.

- Evaluate existing data and conducting reconnaissance surveys.

- Carry out baseline studies.

- Conduct advanced studies and recommending long-term monitoring.

- Make recommendations to regulatory agencies.

To accomplish these tasks, the Bi-State Program is charged with meeting and integrating both short- and long-term objectives in a sequential manner. Short-term objectives include identifying existing data, conducting reconnaissance surveys, advanced field investigations, and baseline studies. Results from these short-term studies will be synthesized into plans for longer-term activities, which will include making recommendations on a long-term Bi-State institutional framework and a long-term monitoring strategy for the river.

The Bi-State Program's sequential problem-solving approach is an important factor in assessing its data management needs. For example, identifying criteria that will adequately manage existing or planned Bi-State Program field data (e.g., collected from reconnaissance, advanced, or baseline studies) may not be sufficient when considering longer-term program needs, existing data beyond the Bi-State Program data, or monitoring activities. This distinction that short- and long-term goals may be different is an important one and should not be overlooked in a needs assessment. The purpose of this needs assessment is to evaluate both short- and long-term data management needs. When recommendations vary between the two time-lines, both short- and long-term recommendations will be discussed. During later phases of this ongoing project (i.e., the system evaluation and recommendation phases), certain short-term

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assumptions may have to be weighed more heavily because they represent a more immediate need for the Bi-State Program.

In addition to collecting new information on the data management needs for the Bi-State Program, this report will incorporate information on data management needs compiled previously for the Bi-State Program as part of a Programmatic Needs Assessment (Webster 1992). These recommendations were based upon interviews with 57 individuals representing key users groups including federal, state, regional, and local agencies, as well as environmental and public interest groups, industry, and the general public. Recommendations from these individuals represent mostly longer-term data management objectives.

1.2 DEFINITIONS

Throughout this report several terms are utilized in discussing data management needs. These terms are assigned the following definitions:

■ *Data:* measured values or information about measured values; includes a data dictionary.

■ *Database:* a set of structured computer files, designed for storing and managing data.

■ *Database Application:* a set of programs, menus or commands used to organize, manage, retrieve and manipulate data in the database.

■ *Data(base) Management System:* the overall framework for managing information. A system includes data, the database or databases, the database applications, and the organizational framework for managing these. The system may also include coordination/connections to several databases and different data regardless of where the data resides.

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2.0 METHODS

This needs assessment report was compiled using information from numerous sources, including technical interviews with Bi-State Program staff, interviews with other agency representatives, and review of pertinent reports and documentation. This report incorporates ideas compiled from a total of 68 interviews conducted either as a part of this study or for the programmatic needs assessment (Webster 1992). A complete list of the individuals consulted both for this needs assessment and the programmatic needs assessment is presented in Appendix A.

It was generally felt that the programmatic needs assessment report (Webster 1992) provided a good summary of the types of data issues and data management roles many agencies and individuals from outside the program felt were appropriate for the Bi-State Program. Additional interviews and sources consulted for this report were designed to complement, not ignore, this previous work. Therefore, attempts to gather additional information focused mainly on issues that were not discussed in Webster (1992). These issues include Bi-State Program institutional considerations and data management activities, guidelines, restrictions, and needs of the two respective state governments.

The Bi-State Program Coordinators were interviewed for guidance on programmatic goals and limitations. The following questions were asked to help clarify programmatic issues of concern for an effective data management strategy:

■ What are the immediate (e.g., next 2 years) versus long-term objectives of the Bi-State Program in terms of programmatic goals? Do you think a Bi-State Program or a program with similar responsibilities will exist with funding over the long-term?

- What are the immediate (e.g., next 2 years) versus long-term objectives of the Bi-State Program in terms of data management issues? What types of data are of interest to the Bi-State Program?

- Who will be the likely users of this data (e.g., policy makers, scientists, public)? If the public is to use the data, how do you view their access to the data (e.g. via summary reports, handouts/fact sheets, data atlases, or through direct computer access)?

- How often or rapid is data access anticipated?

- Is data security, access, or control an important issue to the Bi-State Program?

Representatives from various Oregon and Washington state agencies and divisions were interviewed about data management system activities, guidelines, restrictions, and needs. The following eight sets of questions were asked of these individuals to help identify issues of concern:

- Are state or agency standards for data management systems (including Geographic Information Systems) in existence or under development? If they are under development, how long do you anticipate until their completion?

- What are your Agency's system and data management capabilities? Specifically, are there hardware and software standards or requirements? Are data management tasks generally handled in a centralized manner, such as by a single information management department, or are they handled more on an as-needed basis by individual groups or projects?

- What is your experience with coordinating data management issues between ODEQ and DOE? What do you view as major opportunities and obstacles?

- What do you view as options for system maintenance and administration for the Bi-State Program. Are there existing systems within your agency that might function adequately to store and manage data from the Bi-State Program?

- What other existing databases are you aware of that contain information relevant to the Bi-State Program? Who are they managed by?

- How can the Bi-State Program make data most accessible to your agency or division? What types of data are of most interest? Are digital data formats or hard-copy reports more preferable as a media for data sharing with your existing/planned data management process?

- If your agency/division has data relevant to the Bi-State Program, how is it available (e.g., though ASCII files or hard-copy)?

- Are there any other issues or suggestions you have to promote an effective data management strategy for the Bi-State Program?

The purpose of interviewing representatives from within and outside of the Bi-State Program was to provide different short- and long-term views on what an optimal data management strategy would be for the Bi-State Program. Bi-State Program representatives provided insight into goals and directions, in addition to institutional limitations. It was hoped that individuals from outside the Bi-State Program might provide a broader perspective as to how data management activities of the Bi-State Program might best accommodate the data needs of other agencies and interests operating in the region. These internal and external perspectives on a potential Bi-State data management strategy were compared in order to provide the checks and balances necessary to evaluate a creative but realistic role for the Bi-State Program.

The purpose of this section is to discuss two separate, but equally important, groups of considerations necessary to address an effective Bi-State Program data management strategy. The first group encompasses the programmatic or institutional issues of the Bi-State Program that are relevant to data management. For example, should information evaluated be limited to only data collected by the Bi-State Program, data collected by other agencies, or only data from below Bonneville Dam. Another issue might be the types of products that must be generated by the program (e.g., a Columbia River environmental atlas). These issues will have a direct influence on what type of data management system will best address the program's needs. The second group of considerations include the technical issues pertaining to an effective Bi-State data management system, database application, or database. These technical issues include hardware and software constraints, as well as other system compatibility, accessibility, and design issues that may prove critical or desirable to a Bi-State data management approach.

3.1 PROGRAMMATIC ISSUES

Key programmatic issues affecting data management needs were compiled from interviews with the Bi-State Program Coordinators from WDOE and ODEQ. The following discussion indicates the main issues identified in these interviews. In some cases, Program Coordinators from Oregon and Washington expressed different opinions or weighted the value of an outcome differently; in these cases, both ideas were consolidated. Three main programmatic issues were used to group the considerations which will have direct influence over data management systems:

- Program Objectives and Institutional Requirements
- Program Longevity
- Economic Constraints and Long-Term Funding Options.

3.1.1 Program Objectives and Institutional Requirements

Program objectives and institutional requirements are important considerations in evaluating a data management strategy for several reasons. First, they help define the geographic and informational boundaries for the information of interest to the program. In addition, these considerations define the types of information that may be collected and stored in a data management system. Second, by defining the types of questions that the program was initiated to address or answer, assists in clarifying the types of data that must be collected and managed within that program. As stated in Section 1.1 earlier, the Bi-State Program was formed to accomplish several tasks during its first four years.

Whereas the initial focus of the Bi-State Program was primarily water-quality oriented, the program has evolved into one with a broader focus that also includes sediment, benthos, fish, wildlife and human health concerns. This expanded interest will likely continue over the longer-term. Therefore, data relevant to these topics will be of interest to the program coordinators.

The four Bi-State program goals (Section 1.1) help define programmatic short-term and long-term data management needs. The short-term data management objectives are to manage the data that have been produced or collected through the activities of the program. This includes reconnaissance survey data and any future field monitoring data (water/sediment/ benthos/fish tissue), point source pollutant loading data, land use data, and information on river beneficial uses. It is imperative that this information is managed adequately to help address the Bi-State Program goals. Longer-term objectives are to support agency decision making; problem identification; interagency coordination; development, implementation, and enforcement of a management plan; and any additional mechanisms to support a long-term Bi-State framework. To help plan for this long-term vision, WDOE, ODEQ, and the U.S. Geological Survey (USGS) are just beginning to examine what form long-term monitoring should take in the river.

Specific questions that test hypotheses about water or environmental quality have not been officially formulated within the program. However, through discussions, it was apparent that several main categories of data are of interest to assist in future queries:

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- Environmental monitoring data: reconnaissance survey data and additional monitoring data as they become available.

- Point sources and loadings.

- Geographic data: including locations of resources, land uses, etc.

- Fish and Wildlife data.

- Nonpoint sources and loadings by pollutants.

More specific information about data elements identified as important to the Bi-State Program is presented in Section 3.2.3.

3.1.2 Program Longevity

How long the Bi-State Program will exist as an entity is also important to data management concerns. Its most direct implications are to where data might best be stored and managed and what kind of role the program might play in interagency data coordination. For example, if the Bi-State Program does continue to exist beyond four years, designing a database system that requires coordination by Program Coordinators or the Bi-State Committee might make sense. However, if the expectation is that the Bi-State Program will end, this proposal would be ineffective and even counter-productive.

The future of the Bi-State Program, after its initial four years, is uncertain. One Program Coordinator did anticipate that the Program would remain in existence in some capacity beyond four years. However, this existence may be with a small or limited staffing and funding level. Because the longevity of the Bi-State Program is uncertain, it is felt that assessment of data management needs should consider the Bi-State Program in a centralized data management coordination or an archive role at this time. Of course, another approach that could adapt to a change in program status may be desirable.

3.1.3 Economic Constraints and Long-Term Funding Options

Economic considerations are important in assessing an appropriate data management strategy for a program. A system must not only be assessed for its ability to manage the information of interest, but

also for its ability to be managed over the short- and long-term by the program. Therefore, it is important to identify what the limitations are in terms of economic expenditures on acquisition and maintenance of a data management system.

The Bi-State Program currently operates on an annual budget of approximately $600,000. There are two more years of this level of funding left until the initial four year period is over. These funds are allocated to a variety of projects and activities intended to help address questions identified in the goals and objectives section of this report. There are more potential projects and activities than there are funds for the Bi-State Program, so project funding has been based upon priorities recommended by the Program's Steering Committee. It is possible that some funds could be made available for data management during the remaining two years, since data management has already been identified as a priority area by the Steering Committee. It is also likely, however, that these funds would be limited, due to the competing need to sponsor other projects. Funding options over the longer-term are uncertain.

All of these factors combine to indicate that funding for a Bi-State Program data management system is an important concern for both the short- and long-term. Therefore, relying upon a system with long-term, program-specific funding requirements is not recommended. If a system with program-specific funding requirements is evaluated, it is recommended that its ability either to function as a stand-alone product if the program terminates or to integrate its results into an existing system with longer-term, more stable non-program ties be considered as a selection criteria.

3.2 TECHNICAL ISSUES

Key technical issues affecting data management directions were compiled from interviews with individuals and organizations from both inside and outside of the Bi-State Program. A number of new interviews were conducted in addition to the 57 summarized in the Programmatic Needs Assessment (Webster 1992). The following discussion is a synopsis of the key issues identified from all interviews. In circumstances where internal programmatic concerns about a technical issue were inconsistent with viewpoints expressed from individuals from outside of the program, both points of views are expressed, but emphasis is given to the viewpoint most consistent with the Bi-State Program's goals. Four technical issue categories were used to group the considerations which will have direct influence over data management system needs:

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- System Location, Operation, and Maintenance
- System Compatibility
- Database Design
- Data Accessibility.

3.2.1 System Location, Operation, and Maintenance

A fundamental logistical concern of initiating a data management program is location and management. These are the basic physical issues of who has the system, who operates the system, and who manages or maintains the system. The purpose of this section is to briefly describe views and options for locating and managing a data management system.

There are four fundamentally different scenarios for system location, operation, and maintenance:

- A data management system controlled by a single state (i.e., Washington or Oregon).

- A data management system controlled by a single regional entity (e.g., the Bi-State Program).

- A data management system controlled by a federal entity (e.g., EPA's STORET database or USGS's NWIS database).

- A coordinated system with data located in all places mentioned above with links/definitions shared among users.

Each of these scenarios have differing trade-offs in terms of the ability of the Bi-State Program to control the access, queries, distribution, and sharing of data. For example, locally-controlled systems generally offer more flexibility in terms of changing database or database application functions in comparison to nationally-controlled systems. Nationally-controlled systems, however, often offer the benefit of a wider potential user base for data.

No predominant preferences were found in interviews regarding system location, operation, and maintenance. There appears to be good candidate systems from state, regional, and federal programs that may satisfy the needs of the Bi-State Program. Therefore, all options should be considered viable as long as their relative potential to address the control, access, query, distribution, and data sharing concerns are compared.

Both Oregon and Washington have existing networks in place that have been used for other data management projects and have the capacity to house a system for the Bi-State Program. Representatives from both states shared an enthusiasm and optimism for the possibility of data exchange and coordination. No abnormal obstacles (i.e., other than funding and staffing commitments) were mentioned for potential inter-state coordination of Bi-State Program data.

Although no preferences on system location and maintenance were dominant in interviews, some individual concerns regarding specific aspects of system location, operation, and maintenance were expressed. For example, the programmatic needs assessment reported that interviewees do not want just another isolated database. This places a high value on data-sharing and distributing capacity. One program coordinator also identified data access and control as an issue, as well. In a single state-ownership scenario, they said that their state might feel uncomfortable in either giving their data to another state for management or in having the responsibility and costs of maintaining another state's information. They maintained that duplicate systems containing combined data sets may be necessary. All of these opinions help to recognize the perceived importance of data access, sharing, and control in an appropriate data management system for the Bi-State Program.

3.2.2 System Compatibility

This section briefly discusses compatibility issues confronting a data management system that must cater to the needs of two state governments and multiple other interests. It is particularly important that the data management system developed by the Bi-State Program be consistent with each states' hardware and software requirements, as well as any current or developing state data standards or formats.

Hardware and Software Requirements or Preferences. WDOE has no formal hardware or software requirements. Data management projects are frequently decentralized and produced or managed by single programs or individuals. In general, however, systems should be DOS-compatible and structured query

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language (SQL)-compliant. Several of WDOE's higher end database management systems are being constructed using Oracle software on a network. For example, currently WDOE is developing their Water Permit Life Cycle System (WPLCS) to store and manage data from the State's National Pollution Discharge Elimination System (NPDES) permit program in Oracle. This is, by far, WDOE's most ambitious database development effort, to date. WDOE uses ARC/INFO as its Geographic Information System (GIS) software.

ODEQ's agency data management software standard is Oracle. ODEQ's data management process is generally considered to be more centralized and coordinated than is WDOE's process. Data management applications are designed and run on a UNIX system with access to DOS-compatible machines through use of a LAM-Manager network. In the past, much of the agency's water-quality related data has been submitted and stored in the U.S. EPA's STORET database. ODEQ is currently developing their own in-house system as an alternative to STORET, so they can add additional flexibility to the system. This system is being developed with the IEF CASE (Integrated Computer Aided Software Engineering) tool, which is the future development standard for ODEQ. ODEQ uses ARC/INFO as its GIS software.

For the purposes of the Bi-State Program's data management needs assessment, both Oregon and Washington's software and hardware uses and preferences have similar compatibilities. Any system that either runs on, or can communicate with, a DOS-compatible system is sufficient to meet the minimum state requirements for compatibility. ARC/INFO is the preferred GIS software.

Data Management Standards or Formats. WDOE currently has no universal agency standards for data management systems. However, several efforts are in progress and likely to be ongoing. For example, the Water Resources Data Management Task Force is working on efforts to develop state-wide water quality standards. A draft of these standards is expected in the Fall of 1993, and the final should be available in approximately one to two years. A similar group within WDOE is also being formed, which is called the Information Systems Council Data Architecture Work Group. In addition, the Information Resources Management Plan prepared for WDOE in 1991/1992 called for the formation of the Information Systems Council, which will implement recommendations for moving to agency-wide data architecture and tool selection (e.g., CASE). WDOE has no GIS standards.

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Oregon has no adopted data management standards or formats. However, projects are generally coordinated through a centralized Information Services Group, which helps promote some consistency. In contrast to data management issues, the State does have adopted standards for GIS (Oregon State Map Advisory Council, 1990). These standards offer considerable guidance to managing cartographic data, but only broad guidelines on data management systems. Namely, it states that individual agencies should develop data element dictionaries for each database collected and circulate a draft of this dictionary to the GIS Data Administrator and other prospective users for review.

As stated earlier, compliance with individual state data management standards is important for an effective Bi-State Program data management system. Due to the likely ongoing development of these standards by both states, it will be important for the Bi-State Program to maintain open lines of communication during the selection of an appropriate data management system. The Bi-State Program will have to adopt some data management system at least over the short-term prior to the establishment of many of these standards, however, in order to meet its program goals. The selection of this system should attempt to be as consistent as current knowledge allows with the anticipated standards, but also have the flexibility to adapt over the longer-term once standards are developed. It is not the intent of the Bi-State Program to set *de facto* standards independent of efforts by both states.

3.2.3 Database Design

This section addresses the issues of data output and input. Addressing the question of what is the type of product/information desired from by a data management system (i.e., data output) can be especially important in determining what types of data are stored in such a system (i.e., data input). Both input and output are inter-related and equally important considerations to the ultimate success of a data management system.

Data Output. Some general concerns and interests regarding data output and uses were expressed in the interviews conducted. Authorities from inside and outside of the Bi-State Program identified the following general uses of program data:

- Research and Assessment
- Planning and Policy Development
- Education

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- ■ Regulatory and Enforcement
- ■ Review and Advisory
- ■ Land Management.

The first three use categories are most important in meeting the short term (four year) objectives of the program. The latter three use categories represent longer-term beneficial uses of a Bi-State data management system.

In all of these categories, users may want to view the data either in summary or detailed formats. Summary data can be most easily viewed through use of summary reports or maps. Detailed data interests usually require access to raw data, preferably in defined digital and hard formats.

Data Input. Interviewees from outside and inside the program were relatively consistent in identifying the specific types of data that should be the subject of a useful Bi-State data management system. These elements include (modified from Webster 1992):

- ■ Fish health and mortality related to water and sediment quality

- ■ Dioxin levels in sediment, water column, and biota

- ■ Dredging and Disposal Activities and Impacts

- ■ Toxics - sources, fates, and effects

- ■ Radionuclide levels

- ■ Hydrologic data

- ■ Wetland habitat trends

- ■ Conventional water quality pollutants (e.g., bacteria, total suspended solids, dissolved oxygen, and ammonia)

- Total dissolved gases

- Nearshore habitat trends

- Invertebrates

- Point and nonpoint sources

- Land use types

- Beneficial use locations

- Riparian areas

- Habitat types.

Data Quality. Identification, assurance, and maintenance of data quality was an important issue identified regardless of input or output requirements. The main emphasis is to make database users aware of the quality of or confidence in the data that they are using. The following data quality issues should be considered for ensuring the utility of a Bi-State data management system:

- Using standard station positioning and sampling protocols

- Using standard analytical protocols to ensure data compatibility

- Documenting analytical protocols, units, data qualifiers, etc.

- Predefining minimum reporting data for each sampling survey (e.g., sampling intervals, sampling equipment, unusual circumstances)

- Using data quality qualifiers

- Using procedures to verify and check data entry accuracy in the database

- Using procedures to verify and check data transfer accuracy and completeness

- Documenting accuracy of positioning of points or boundaries (for use in GIS)

- Complying with appropriate digital spatial data standards (for use in GIS).

3.2.4 Data Accessibility

Data accessibility pertains to the ability and timing of various parties to use data in the database system. There was agreement at the programmatic level that data appending and editing privileges should be controlled to insure data integrity. Therefore, most database users would have "read-only" privileges, which would allow them to view and download data, but not actually change the contents of the database, itself. There were mixed opinions as to whether the general public should have direct or indirect access to the data, but strong agreement that the data be available to the public in some form. Some segments of the public may want detailed data in electronic form, while others would be content with maps summarizing results. There was no agreement on what format (e.g., hard copy, electronic files) the data for the public should be available or how the information would be shared. There was also strong agreement at all levels that data be made available from the system in both digital and hard (i.e., printout) formats. There were mixed opinions as to whether the system should necessarily have remote dial-up capabilities that would allow anyone with a modem and the correct procedures to have electronic access to the data. There were also mixed opinions as to the importance of the frequency of data updating. The frequency of data updating refers to how often newly available data is input to the database management system.

These data access elements influence the needs of a Bi-State Program data management system in several ways. An appropriate system should be able to assign access privileges to different users depending on their program status (this assumes that non-program parties are allowed to directly access the system). The system must be able to generate both digital and hard-copy reports of data in defined formats. In addition, two desirable aspects of a system include its capacity for remote dial-up and its frequency of data updating.

4.0 DATA MANAGEMENT CRITERIA

This section offers an analysis and synthesis of issues discussed in Section 3.0 to yield a useful list of criteria by which various data management systems can be ranked according to their ability to meet the short- and long-term needs identified by the Bi-State Program. The immediate data management objectives of the program are to manage the data that have been collected and produced by the Bi-State Program itself. Criteria addressing these short-term needs have been divided into two categories: required elements and preferred elements. Required elements are those that are fundamental to the utility of the proposed data management system. Preferred elements are those that enhance, but are not fundamental to, the utility of the proposed data management system. Over the longer term, the Bi-State Program data management objectives are to assist in or provide a means of accessing, transferring, or managing all data from the lower Columbia River region (including data collected by other agencies). Criteria addressing these longer-term needs have also been divided into required and preferred categories. An itemization of both the short- and long-term criteria, by category, follows.

4.1 SHORT-TERM NEEDS

4.1.1 Required Elements

- Utilize an existing database or database application.

- Capacity to store and report environmental monitoring data, including:
    - Fish health and mortality related to water and sediment quality
    - Dioxin and other toxic contaminant levels in sediment, water column, and biota
    - Wildlife and fish community data
    - Radionuclide levels in sediments

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- Conventional water quality pollutants (e.g., bacteria, total suspended solids, dissolved oxygen, ammonia, nutrients, total dissolved gases)
- Invertebrate community data.

■ Capacity to store and report point source and pollutant loading data.

■ Capacity to store and report geographic data (including locations of resources, land uses, etc.).

■ Inexpensive to the Bi-State Program to develop and maintain. [Note: The Bi-State Program will have to pay something for data input and output, but the development, modification, and maintenance costs should be minimized.]

■ Consistency or compatibility with existing or developing state data management or GIS standards.

■ Assurance of data quality and integrity.

■ Immediate availability of system to manage data for short-term purposes.

■ Capacity to facilitate data exchange through import/export features.

■ Ability to communicate with DOS-compatible computers.

4.1.2 Preferred Elements

■ Ability to provide results in various forms (e.g., maps) to diverse audiences.

■ Capacity to generate both summary and detailed data lists.

■ Easy access to data for non-computer experts.

- Mapping capabilities.

- Provide coordinated data sharing between various agencies and individuals interested in the lower Columbia River.

- Capacity to store and report the following types of information:
    - Dredging and Disposal Activities and Impacts
    - Hydrologic data
    - Changes in wetland resources over time
    - Changes in nearshore habitats over time.

- Monitoring data can be frequently updated.

- Most recent resource data are available for use.

4.2 LONG-TERM NEEDS

4.2.1 Required Elements

- Inexpensive to the Bi-State Program to develop and maintain. [Note: The Bi-State Program will have to pay something for data input and output, but the development, modification, and maintenance costs should be minimized.]

- Capacity to store and report environmental monitoring data, including:
    - Fish health and mortality related to water and sediment quality
    - Dioxin and other toxic contaminant levels in sediment, water column, and biota
    - Wildlife and fish community data
    - Radionuclide levels in sediments

- Conventional water quality pollutants (e.g., bacteria, total suspended solids, dissolved oxygen, ammonia, nutrients, total dissolved gases)
- Invertebrate community data.

■ Capacity to store and report point source and pollutant loading data.

■ Capacity to store and report geographic data (including locations of resources, land uses, etc.).

■ Continued utility independent of Bi-State Program's existence.

■ Consistency or compatibility with existing or developing state data management or GIS standards.

■ Assurance of data quality and integrity (e.g., through data qualifiers, data entry protocols, and controlling database access privileges).

■ Capacity to facilitate data exchange through import/export features.

■ Ability to communicate with DOS-compatible computers.

■ Ability to provide results in various forms (e.g., maps) to diverse audiences.

■ Mapping capabilities.

■ Provide coordinated data sharing between various agencies and individuals interested in the lower Columbia River.

4.2.2 Preferred Elements

■   Flexibility to modify database or application.

■   Capacity to generate both summary and detailed data.

■   Easy access to data for non-computer experts.

■   Capacity to store and report the following types of information:
-       Dredging and Disposal Activities and Impacts
-       Hydrologic data
-       Changes in wetland resources over time
-       Changes in nearshore habitats over time.

■   Monitoring data can be frequently updated.

■   Most recent resource data are available for use.

5.0 SUMMARY

This report has summarized the programmatic and technical issues relevant to the needs of a Bi-State Program data management system. From these issues, a list of required and preferred elements were derived as criteria for evaluating the ability of various existing data management systems to meet the identified needs of the Bi-State Program. The next step is to evaluate and compare how well existing systems meet the needs of a Bi-State Program data management system. The results of this evaluation will be provided in a future report titled: *Evaluation and Recommendation Report.*

6.0 REFERENCES

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Interviews conducted as part of this Study (1)
and
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