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**ENVIRONMENTAL
RESTORATION
PROGRAM**

**Results of the User Survey
of Functional Requirements for the
Oak Ridge Environmental
Information System**

MANAGED BY
MARTIN MARIETTA ENERGY SYSTEMS, INC.
FOR THE UNITED STATES
DEPARTMENT OF ENERGY

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ENERGY SYSTEMS

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Results of the User Survey
of Functional Requirements for the
Oak Ridge Environmental
Information System

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PREFACE

This report, *Results of the User Survey of Functional Requirements for the Oak Ridge Environmental Information System*, was prepared to document the results of a user survey conducted in early 1994. The user survey was conducted in partial fulfillment of the requirement stated in Phase 3, Step 7, of the ADP Systems Development Methodology of Martin Marietta Energy Systems, Inc., to "validate with user and requester that the [OREIS] system meets design specifications." This work was performed under Work Breakdown Structure Number 1.4.12.2.3.04 (Activity Data Sheet 8304). An additional report, now in preparation, will provide results from an evaluation of OREIS functionality by hands-on users of the system during a beta testing period.

EXECUTIVE SUMMARY

The Oak Ridge Environmental Information System (OREIS) user survey of functional requirements was conducted in the spring and summer of 1994 to allow representatives of the OREIS user community to review and confirm the functionality of the OREIS system and to provide a method to document user acceptance of the system. The results of the survey confirm that the OREIS system meets data and functional requirements of the users. It further emphasizes that the user community is quite diverse, with many different needs for and perspectives about OREIS, and with varying needs for access and use of software tools. To meet the needs of a diverse and potentially changing user community, OREIS staff will survey the user community periodically to obtain input on changes to user requirements for future versions of the system.

1. INTRODUCTION

1.1 PURPOSE OF THE USER SURVEY

In the spring and summer of 1994, the Oak Ridge Environmental Information System (OREIS) program conducted two surveys of the potential OREIS user community. The first survey was part of the Beta Users' Evaluation and was given to a group of beta test volunteers who had completed an intensive 8-week evaluation of the system that included hands-on use. The second survey was called the User Survey and was given to a wider audience of potential OREIS users, many of whom had no hands-on experience with OREIS. This report documents the results of the second survey. Results from the Beta Users' Evaluation survey will be reported in a future document.

An additional purpose of the User Survey was to confirm user requirements and document user acceptance of OREIS by a wide representation of OREIS users.

1.2 USER SURVEY PARTICIPANTS

An attempt was made to survey representatives from all OREIS user groups. Meetings were held with various groups to present an overview of OREIS and to conduct the survey. Ten meetings were held with the following groups: the Department of Energy (DOE); the Environmental Protection Agency (EPA); the Martin Marietta Energy Systems, Inc., Environmental Restoration (ER) Program; environmental coordinators; compliance groups; risk assessors; and ER subcontractors. Survey instruments also were distributed to other potential users who were unable to attend the meetings. Survey instruments were sent to ER contacts at Portsmouth and Paducah for distribution. A total of 62 people attended the meetings; 57 survey instruments were completed, including those completed by individuals who did not attend the meetings. A copy of the survey instrument is included as Appendix A.

The participants were asked to answer four demographic questions:

- Which organization do you work for directly? (*company*)
- Which DOE site is most closely associated with your work? (*site*)
- Which organization most closely describes your work affiliation? (*organization*)
- How would you best describe your work? (*position*)

The results of these questions are presented in Table 1. Although the groups are not equally represented, there is a good mix of representatives from the various user groups of OREIS.

Table 1. User survey demographics

Company	Number of respondents
Energy Systems	35
Subcontractor	11
DOE-ORO	7
EPA	2
Other (ATSDR)	2
Site	
Not site-specific	18
Y-12	16
K-25 (ERWM)	9
X-10	8
ORR Off-site	2
Paducah	2
Portsmouth	2
Organization	
Environmental Restoration	29
Environmental Compliance	18
Other	10
Position	
Other	20
Group manager	16
Data manager or programmer	12
Report investigator or preparer	9

The remaining items dealt with rating (on a scale of 1 to 5) the importance of, or concurrence with, various statements about OREIS functionality. A response of "NA" was available for all questions to handle all "not able to answer," "don't know," and "not applicable" responses. The questions fall into the following categories:

- Rate the importance of current measurement data.
- Rate the importance of historical measurement data.
- Rate the importance of loading historic data from different time frames.
- Rate the importance of spatial data coverages.
- Rate the importance of data management functions.
- How strongly do you agree/disagree with assumptions about the OREIS user interface?
- Rate the importance of statistical analysis functions.
- Rate the importance of graphical analysis functions.
- Rate the importance of spatial analysis functions.
- Rate the importance of other OREIS functions.

For items rating importance, 1 was equal to "not important" and 5 was equal to "very important." For the question rating concurrence (i.e., level of agreement or disagreement with stated assumptions), 1 was equal to "disagree" and 5 was equal to "agree." Section 2 on user survey results devotes a subsection to discussion of the answers given for each of the items listed above.

2. USER SURVEY RESULTS

2.1 IMPORTANCE OF CURRENT MEASUREMENT DATA

Survey participants were asked to rate the importance of having current measurement data in the OREIS consolidated data base. Current measurement data were divided into various types based on different collection methods and applications. Graphs representing the actual number of responses for each question appear in Appendix B. The rating by users of the importance of each current measurement data type, as determined from the average response of survey participants, is given in Table 2.

Table 2. User rating of importance of each current measurement data type to be consolidated in the OREIS data base

Rating	Current measurement data type	Average response
1	Surface water data	4.4
2	Background data	4.2
3	Groundwater/well construction	4.0
	USGS data (surface water flow)	4.0
4	Air emissions	3.9
	Ambient air data	3.9
	Biological data	3.9
5	Lithology	3.8
6	Off-site data	3.7
7	Climate data	3.6
	TDEC sampling	3.6
8	Risk analysis screening values	3.5
	Other	^a

^a Soils data (n=6), sediment data (n=2), and one response each for off-site, asbestos, burial sites, soil sample depths, and ORR surveillance data.

2.2 IMPORTANCE OF HISTORICAL MEASUREMENT DATA

Participants were asked to rate the importance of having historical measurement data in the OREIS consolidated data base. The historical measurement data were divided into various types based on different collection methods and applications. Graphs representing the actual number of responses for each question appear in Appendix B. The rating by users of the importance of each historical measurement data type is given in Table 3.

Table 3. User rating of importance of each historical measurement data type to be consolidated in the OREIS data base

Rating	Historical measurement data type	Average response
1	Surface water data	4.2
2	Background data	4.0
	Groundwater/well construction	4.0
	USGS data (surface water flow)	4.0
3	TDEC sampling	3.9
4	Lithology	3.8
5	Biological data	3.7
	Climate data	3.7
6	Air emissions	3.6
	Ambient air data	3.6
7	Off-site data	3.5
8	Risk analysis screening values	3.3
	Other	^a

^a Soils data (n=6), sediment data (n=2), and one response each for off-site data, old disposal sites, asbestos, and ORR surveillance data.

Although not prompted for feedback, three participants commented on the importance of historical measurement data:

- *Lithology doesn't change over "people time" so current and historical would have to be the same.*
- *Please limit historical data requirements. Many compliance programs would be uncomfortable supplying this information to a generic user.*
- *For historical data, it is not as important for a consistent, standardized form as long as users are aware of this when accessing the data.*

2.3 IMPORTANCE OF HISTORICAL DATA FROM VARIOUS TIME FRAMES

Survey participants were asked to rate the importance of consolidating historical data from seven different time frames. Graphs representing the actual number of responses for each question appear in Appendix B. The rating by users of the importance of consolidating historical data from various time frames is given in Table 4.

Table 4. User rating of importance of consolidating historical data from various time frames

Rating	Time frame	Average response
1	1993	4.5
2	1992	4.3
3	1991	4.0
4	1990	3.8
5	1985-1989	3.3
6	1975-1984	3.0
7	pre-1975	2.5

2.4 IMPORTANCE OF SPATIAL DATA COVERAGES

Survey participants were asked to rate the importance of spatial data coverages for 2-ft contours (in floodplains), 5-ft contours, 20-ft contours, 100-ft contours, environmentally sensitive areas, floodplain areas, gamma surveys, land use, new ortho images (1-in.=200-ft scale; current, covers entire reservation), Operable Unit/Waste Area Grouping (OU/WAG) boundaries, private wells, wildlife habitat, and other. Graphs representing the actual number of responses for each question appear in Appendix B. The rating by users of the importance of each spatial data coverage is given in Table 5.

Table 5. User rating of importance of each spatial data coverage

Rating	Spatial data coverage	Average response
1	Floodplain areas	4.3
2	Environmentally sensitive areas	4.2
3	Land use	4.1
	OU/WAG boundaries	4.1
4	Gamma surveys	3.9
5	20-ft contours	3.8
6	New ortho images (1-in.=200-ft scale)	3.7
	Wildlife habitat	3.7
7	2-ft contours (in floodplains)	3.6
	5-ft contours	3.6
	Private wells	3.6
8	100-ft contours	3.2
	Other	^a

^aVegetation, historical ortho images, burial sites (locations and materials types), recent airborne geophysical survey, sampling locations, historic site/archaeological sites, and wildlife management areas, ownership (DOE, private, TVA, state).

2.5 IMPORTANCE OF DATA MANAGEMENT FUNCTIONS

Survey participants were asked to rank the importance of eight data management functions: access to metadata, data import, data export, data retrieval without requiring data structure knowledge, data retrieval via tools that are simplified and easy-to-use, data retrieval via tools that are comprehensive and complex, standardization of fields and codes, and cataloging of historical data even if not standardized. Graphs representing the actual number of responses for each question appear in Appendix B. The rating by users of the importance of each data management function is given in Table 6.

Table 6. User rating of importance of each data management function

Rating	Data management function	Average response
1	Retrieval tool without data structure knowledge	4.6
	Standardized fields and codes	4.6
2	Data export	4.5
3	Data import	4.4
	Simplified retrieval tool	4.4
4	Metadata	4.3
5	Catalog of available historic data	3.8
6	Comprehensive retrieval tool	3.7

Eleven of the 57 participants provided feedback and comments on the data management functions. The need for standardization and mandatory fields elicited the most comments:

- *Standardize parameters (for example, have a list of "valid" units of measure that **must** be on the list to be accepted. Same for analyte names, CAS #s, qualifiers [BJ and JB should not both appear on the same data set])*
- *It is important for a user not familiar with data to know that the codes, flags, parameter names, etc., are consistent across and within project. Implementation of standard codes must occur at the site/data generator level since, in my opinion, it is very difficult to apply them consistently after the fact.*
- *Need **all** data to be in a **standard** format (e.g., analyte names, Cesium-137 (not Cs-137 or Cs 137 or Cesium 137)).*
- *Must have CAS #s for each analyte.*
- *Must have data in standard units of measure (e.g., groundwater in mg/l [not ug/l]; soil in mg/kg [not mg/g]).*
- *If it is not in consistent, standardized form, then the flagged quality descriptors are of no value.*
- *Our needs are to have quality data—thorough and complete.*

There were also comments on the "easy-to-use" versus the complex retrieval tools:

- *The more experienced the user, the more valuable the user becomes as a data manager/analyst. Project management at the site level may not require the sophistication that advanced tools offer. Advanced tools are appropriate for cost/benefit of various remedial action options.*
- *Data retrieval and manipulation should be easy for beginner users as well as comprehensive for experienced users.*
- *Easy to use is important to me.*

Other comments about the data management functions included:

- *It is important to have as much data as possible with the appropriate caveats (metadata), especially historical data and historical thematic mapping. In my opinion, in order to know where we're going, we have to understand where we came from. It's important for restorative activities, risk management, and risk communication.*
- *Without the import and export capabilities, OREIS will not be used effectively.*
- *Output must be in "English"—not in codes or using excessive abbreviations!*

2.6 CONCURRENCE WITH ASSUMPTIONS ABOUT THE OREIS USER INTERFACE

Participants were asked to rate their level of concurrence (i.e., agree/disagree) with 11 assumptions about the OREIS user interface. Graphs representing the actual number of responses for each question appear in Appendix B. The rating by users of concurrence with each assumption about the OREIS user interface is given in Table 7.

Table 7. User rating of concurrence with stated assumptions about the OREIS user interface

Rating	Stated assumption	Average response
1	OREIS should provide both an easy-to-use retrieval mechanism and the means for more advanced users to work with the complex tools.	4.7
2	OREIS needs to have tools which will accommodate users with a variety of computing and technical backgrounds.	4.5
	The OREIS user interface, the look and feel of the OREIS computer system as it is presented to the user, should be "user friendly."	4.5
3	Some OREIS users will prefer extensive retrieval capabilities, even if they are more complex to use.	4.4
4	Some OREIS users will prefer retrieval capabilities that are simplified, even if it means limited capabilities.	4.3
	It is important that OREIS data retrieval, statistical analysis, graphical analysis, and spatial analysis be integrated.	4.3
5	OREIS should be useable by users with minimal computer experience.	4.1
	It is important that users be able to use combinations of spatial, statistical, and data query tools as a means of defining the data of interest.	4.1
6	OREIS should provide users with more than SQL as a data retrieval language.	4.0
7	Some users will prefer to take advantage of the power and speed of software on an OREIS workstation rather than do all analysis on their local PCs.	3.8
8	OREIS should primarily be for users with computer programming skills.	1.9

Thirteen of the 57 participants (approximately one-fourth) provided feedback in the form of comments on the integration and ease of use of the OREIS user interface. They were:

- *Use the KISS principle! (Keep It Simple Stupid.)*
- *Most certainly it's to be user friendly and to allow for easy access and retrieval.*
- *I believe that if the system appears complex or difficult to use, people will not use it. Therefore it is important that the system is simple enough, even for the novice.*
- *It needs to be integrated and easy-to-use. It is not yet what a non-expert user would be comfortable with.*
- *I feel that the strength of the user interface is the ability to perform a "high level" interactive query and subsequent data retrieval by the novice user or the user unfamiliar with a product.*
- *Integration of the various tool sets is one of the real strong points of this type of system.*
- *It would be nice to have a variety of types of user interface ranking from less powerful/easy to use to very powerful/difficult to use.*
- *The separation of users seems to fall into categories: project level (simple user), cost analysis (advanced user), and risk modeling. However, if an advanced user is a project level manager, he or she may not need to access advanced functionality.*
- *I think the data interface should have some controls over how the data are reused to minimize misuse (e.g., correct significant digits, making sure all metadata is displayed for disclaimer purposes).*

The other comments about the user interface are:

- *Provisions need to be made to track access to data. Our program has a lot of publishable data and it would be important to know who has accessed the files.*
- *Education, training, and opportunities to grow with the system are highly encouraged.*
- *Would be helpful to have PC GUI under windows.*
- *Consider both hardware and software components.*
- *TEST--TEST--TEST--PROVE before saying "It's ready."*

2.7 IMPORTANCE OF STATISTICAL ANALYSIS FUNCTIONS

Survey participants were asked if they performed statistical analysis. If they answered "no" to this question, they were instructed to skip that section. Thirty-four participants responded affirmatively. Those participants were asked to rate the importance of statistical analysis functions as part of OREIS. Graphs representing the actual number of responses for each question appear in Appendix B. The rating by users of the importance of each statistical analysis function is given in Table 8.

Table 8. User rating of importance of each statistical analysis function

Rating	Statistical analysis function	Average response
1	Ability to generate general statistics for data exploration.	4.2
2	Having statistical software as part of OREIS or as an integrated part of OREIS.	4.1
3	Ability to access advanced statistical functions through an easy-to-use interface for users new to the software.	3.4
	Having a programming language available for experienced users for complex data and statistical analysis.	3.4
4	Ability to generate advanced statistics needed for scientific analyses and hypothesis testing.	3.3

Eleven of the 34 participants provided comments. The seven comments below were about who should be doing statistical analysis and where analysis should be conducted:

- *Complex statistical analyses should be performed by the "experts" on that data. These methods could be misused. The user should have to download the data and use his/her own tools.*
- *I don't see inexperienced users doing "in depth" statistical work. That would probably be too dangerous. But I do see the need for experienced statisticians to use OREIS for statistical manipulation of data.*
- *OREIS should not be the place to perform complex statistical work. Data should be easily downloaded so it can be used in other existing statistical systems.*
- *OREIS should not try to be all things for all people. With a functional export capability, the user should provide the necessary data evaluation tools.*
- *Good export capabilities are important so individuals can use their preferred statistical programs.*
- *Would likely export data to own system for analysis.*
- *Folks expecting to do advanced statistics ought to be willing to put some effort into learning about tools. The really advanced folks will probably be able to pull the needed data to their own platform and work with it there. The less general the application, the less vital it is that it be easy for beginners to use.*
- *Complex to be done off-line in project data base.*

There also were comments about the statistical software itself and the data available for analysis. These comments are provided below:

- *SAS is the preferred software.*
- *Need a user support staff/group to help with running the available statistical programs.*
- *Depends on how the data are in the data base. We use data that have already been analyzed, summarized, and determined if significant or not. These are the data of most interest.*
- *We are interested in applying uncertainty/statistics to the data and that the statistics are applied in a potentially standardized manner.*

2.8 IMPORTANCE OF GRAPHICAL ANALYSIS FUNCTIONS

Survey participants were asked if they performed graphical analysis. If they answered "no," they were instructed to skip that section of the survey. Thirty-five participants responded affirmatively. Those participants were asked to rate the importance of graphical analysis functions as part of OREIS. Graphs representing the actual number of responses for each question appear in Appendix B. The rating by users of the importance of each graphical analysis function is given in Table 9.

Table 9. User rating of importance of each graphical analysis function

Rating	Graphical analysis function	Average response
1	Having graphical software for data presentation as part of OREIS.	3.9
2	Ability to generate complex and well documented graphics for inclusion in reports as part of OREIS.	3.7
3	Ability to access advanced graphical functions through an easy to use interface for users new to the software.	3.6
4	Having a computerized graphics editor to improve technical graphics for presentation.	3.5
5	Having a programming language available for experienced users for complex data and graphical analysis.	3.3

Nine of the 35 participants provided comments on graphical analysis functions:

- *People would use graphical analysis if it were available.*
- *Need fate & transport modeling and graphics capabilities.*
- *This should be done by the "experts." OREIS should be a repository only, with view, import/export functions, and query capabilities.*
- *The graphical software doesn't actually need to be a part of OREIS, as long as it is capable of accessing the OREIS data base and pre-defined views of the data. The user should export the data. (n=3)*
- *There are a number of good graphics programs. Why not interface with a good graphics editor via export facility? By closely integrating or nesting the graphics package it would be almost part of OREIS. That may be a route to save time and money.*
- *Rather than a single "hard-wired" graphics package, various export functions should allow use of different systems.*
- *Typically, "fine-tuning" of graphical products for reports/presentations is performed by a graphics specialist. Therefore export of a graphic produced by the OREIS would be cost effective (e.g., DXF file).*

2.9 IMPORTANCE OF SPATIAL ANALYSIS FUNCTIONS

Survey participants were asked if they performed or planned to perform spatial analysis. If they answered "no" to both of these functions, they were instructed to skip that section of the survey. Thirty-six participants responded affirmatively. Those participants were asked to rate the importance of spatial analysis functions as part of OREIS. Graphs representing the actual number of responses for each question appear in Appendix B. The rating by users of the importance of each spatial analysis function is given in Table 10.

Table 10. User rating of importance of each spatial analysis function

Rating	Spatial analysis function	Average response
1	Having the S-16A (ORR 1:24000 topo maps) base maps available for analysis with the measurement data in OREIS.	4.2
	Having a simplified and easy to use interface for spatial analysis available for users that are learning about spatial data.	4.2
	Ability to produce "real maps" with OREIS data.	4.2
	Having an easily accessible coordinate conversion routine as part of OREIS.	4.2

Table 10 (continued)

Rating	Spatial analysis function	Average response
2	Having spatial processing capabilities and analysis of geographic data as part of your work.	4.1
	Having spatial data import capabilities as a part of OREIS.	4.1
	Having spatial data export capabilities as a part of OREIS.	4.1
3	Having image data (i.e., from aerial photos) available for spatial analysis of data in OREIS.	3.9
4	OREIS having color plotting hardware, in either large or small format, that can be accessed by anyone using the OREIS system.	3.7
5	Having complete and robust spatial analysis tools available for experienced users, even if they appear to be more complex.	3.5

Eight of the 36 participants provided the following feedback:

- *This is a real need that OREIS can fill. This type of tool is not readily available to the data user. Put the effort here and let the other functions remain with the user.*
- *OREIS is primarily a data repository but, I'd expect to utilize the GIS capabilities.*
- *Need to have spatial data export and use my own system for analysis. (n=4)*
- *All data in OREIS should be under one grid system. (n=2)*
- *The harder it is for folks to export color graphics files in standard form (e.g., postscript) to print on their own equipment, the more important it is for OREIS to provide the plotting hardware.*

2.10 IMPORTANCE OF OTHER OREIS FUNCTIONS

The participants were asked to rate the importance of other OREIS functions. Graphs representing the actual number of responses for each question appear in Appendix B. The rating by users of the importance of each function is given in Table 11.

Table 11. User rating of importance of other OREIS functions

Rating	OREIS function	Average response
1	Ability of OREIS to use the application of a view throughout the entire data analysis environment (statistical, graphical, and spatial).	4.1
	Ability of OREIS to generate reports.	4.1
2	Ability of OREIS to produce standardized reports.	4.0
	OREIS having the capability to allow users to create their own views that can be reused from one OREIS session to another.	4.0
	OREIS having the capability to allow users to create their own views, copy existing views, and edit views.	4.0
3	OREIS having views that are QA-tested and documented by the OREIS staff and made available to all OREIS users.	3.9
4	OREIS having macros that are QA-tested and documented by the OREIS staff and made available to all OREIS users.	3.7
5	OREIS having the capability to allow users to create their own macros, copy existing macros, and edit macros.	3.6

Nine of the 57 participants provided general comments about OREIS at the conclusion of the survey:

- *Of primary importance is the availability of accessing data in a timely manner (for example, we need to access data prior to performing a risk assessment. If it is not available until a year after the risk assessment, then it is of no (or little) use to the risk assessor.*
- *Will first be used by specific technical disciplines then mid-level management (non-technical possible). Will be used by TDEC in public meetings.*
- *Formal reports should be generated by the organization which generated the data contained in them. These organizations should have their own systems in place containing more relevant data than OREIS will have. OREIS should only be a repository and not a tool for compliance reporting or complex manipulation of these data. The "experts" in the various organizations should be performing these tasks. OREIS should only allow viewing or exporting of data.*

- *Standardized reports are **extremely** important.*
- *Standardized reports are probably more efficient than having each individual generator try to do it themselves.*
- *I do not think OREIS is the place for complex data manipulation. The FFA and TOA require only a "storehouse" data base. If a regulator or other non MMES user needs to perform some manipulation of the data—he or she needs to be able to export the data to some other system to do so. As for reports, the organization collecting the data should be the only one producing formal reports. It is that organization's responsibility and liability to ensure the data are presented accurately and meet the intent of any formal report based on the data it collects.*
- *OREIS should also be focused on being the best integrated environmental data management and analysis system in the world. You should be participating in scientific conferences now, and should be organizing conferences and providing leadership in the future.*
- *As a data supplier to MMES, I feel that information concerning the data (metadata) is not being forwarded in a complete and consistent manner. I think OREIS should evaluate the need for some mechanism, whether it be a form or questionnaire, that captures critical information concerning the data set that you have received. Bechtel is currently trying to capture relevant information concerning any given measurement data by the use of archive comment field.*
- *It would be nice to have more 3-D modeling tools like Dynamic Graphics, Earthvision.*
- *Make printing more user friendly.*
- *Shared views should be QA-audited and documented. User views should at least be documented in order to provide a measure of data integrity. Improperly constrained views can lead to erroneous data operating in reports.*
- *For macros to be effective requires excellent coordination with end users.*
- *Allowing users to create their own views that can be reused from one OREIS session to another is absolutely fundamental to OREIS!*

3. SUMMARY AND DISCUSSION

This section is a summary and discussion of the results presented in the previous section. It contains OREIS' responses to participant responses and, in some cases, provides an explanation or rationale for the functional design, the intended use of OREIS, or clarification on the survey instrument itself.

3.1 CURRENT MEASUREMENT DATA

The average responses indicate that the user community supports all of the data areas surveyed. The most support was for surface water data (4.4), and the least support was for risk analysis screening values (3.5). Additional data types were indicated by ten participants in the "other" category; the primary addition was soil data. Based on the number of responses, soil data should have been listed as a separate data type on the survey instrument to enable all participants to rate its importance.

The current OREIS data model can accommodate surface water data, background data, groundwater data, well construction data, USGS data, lithology, soils data, sediment data, and National Pollutant Discharge Elimination System data. Data modeling efforts are under way to incorporate air and biological data into the data structure. Some of the data types specifically mentioned by users on the survey, such as TDEC sampling and ORR surveillance data, may fit into this structure depending on agreements reached with the data generators. Other data areas mentioned by users—climate data, risk analysis data, and asbestos data—currently are not part of the data structure.

3.2 HISTORICAL MEASUREMENT DATA

The average responses for the importance of consolidating historical measurement data in OREIS ranged from 4.2 for historical surface water data to 3.3 for risk analysis screening values. The responses were about the same or lower than the responses for current measurement data except for climate data and TDEC sampling data; the importance of having historical data for these data types was rated slightly higher.

The user comment about lithology not changing over "people time" is correct; however, it indicates that the survey's questions on historical data were misleading by implying that the primary use of historical data in OREIS is for trending analyses. The actual intent of the questions was to determine what environmental data collected *before* the establishment of OREIS are *needed now by users to conduct studies driven by the Comprehensive Environmental Response, Compensation, and Liability Act*.

Two comments by survey participants dealt with access to and availability of historical data. These comments highlight the expected differences in perspectives of historical data *suppliers* and historical data *users*. Suppliers often emphasize the burdens placed on them to retrieve and review "old" data and are concerned about the ways the data potentially could be misinterpreted. Users, on the other hand, need data to begin an investigation and often emphasize the need to access any available data regardless of their form as long as the

limitations of the data are known. Users may stress that even data of unknown quality can be used for a qualitative evaluation of an area.

OREIS initially is focusing on loading *current* measurements data that are being collected by the ER Program and the ORR compliance and surveillance programs. As a component of the submissions by ER projects, however, OREIS is receiving historical data used by these projects in making decisions about remedial actions. DOE-ORO ER has recently directed the Energy Systems ER Program to collect historical data based on the *priority needs of the ER site programs*. As these data are collected, it is expected that they will be included in OREIS. The priority for loading historical compliance and surveillance data into OREIS has not been determined.

3.3 TIME FRAMES FOR HISTORICAL DATA

The average response for consolidating historical data from various time frames ranged from 4.5 for the year 1993 to 2.5 for data dated pre-1975. The average responses indicate that the user community readily sees the need for consolidating data back through 1990 (3.8), but support starts to dramatically drop off after that point. The graphs in Appendix B show that the distribution of the results begins to flatten out with the 1985-1989 interval (3.3) and that direction from the user community is in less agreement. The statistics also show that some users would like to have access to data as far back as 1975 and beyond if it were available, but it is not as high a priority as more recent data. Interestingly, however, a few participants ranked older data with a higher priority than more recent data.

3.4 SPATIAL DATA COVERAGES

The questions with the largest average responses concern floodplain areas (4.3) and environmentally sensitive areas (4.2), which are coverages driven by regulatory need. The least average response was 3.2 for 100-ft contours. However, the graphs in Appendix B show that 27 of the 57 participants chose not to answer the question about the importance of having 100-ft contours. The contour coverage with the most support was the 20-ft contour (3.8).

Spatial coverages in OREIS include S-16A data (e.g., buildings, roads, utilities, 20-ft contours, 100-ft contours, shore lines, the DOE boundary), OU boundaries, gamma surveys data, environmentally sensitive areas, and floodplains for the East Fork Poplar Creek area. The new orthophoto images and more detailed contour coverages, including floodplains, are under development and will be available from OREIS.

3.5 DATA MANAGEMENT FUNCTIONS

The average responses indicate strong support from the user community for all of the data management functions surveyed. Five of the eight functions surveyed received very strong support, with average responses ranging from 4.6 to 4.4. These functions include a retrieval tool without data structure knowledge, standardized fields and codes, data export, simplified retrieval tool, and data import. The least average response was 3.8 for a comprehensive retrieval tool. The comments from survey participants added emphasis to the need

for standardized fields and codes. The OREIS project took an early lead in the need for standard fields and codes for environmental data and will continue to do so.

OREIS has incorporated data import/export tools as part of the user interface and has taken into consideration the need for both simplified retrieval tools and comprehensive retrieval tools. One of the main features of OREIS is the storage of metadata to give secondary users of data some perspective on the collection and original intent of the data. OREIS currently does not have a catalog of available historic data but is investigating methods for accomplishing this task.

3.6 USER INTERFACE ASSUMPTIONS

The average responses for the stated assumptions about the OREIS user interface ranged from a high of 4.7 for strong concurrence with the statement, "OREIS should provide both an easy-to-use retrieval mechanism and the means for more advanced users to work with the complex tools," to a low of 1.9 for a strong nonconcurrence with the statement, "OREIS should primarily be for users with computer programming skills." The high and low ratings of these two statements, along with the high ratings of the other user interface assumptions, provide validation for a user interface that will accommodate users with many different levels and types of computer experience. The responses also indicate the need for both easy-to-use and integrated software tools as well as access to complex tools for advanced users. Several user comments focused on the easy-to-use versus the complex options for the user interface and on the level of control the user interface should have over the use of the software.

These views highlight the two perspectives that users bring to OREIS: give us an easy-to-use interface to the tools and give us the full functionality of the tools. A system with an easy-to-use interface seldom can give users access to full functionality of the system. Adding capabilities to the system which allow advanced users access to full functionality and which integrate more software adds complexity. The approach the OREIS team has taken is to provide an easy-to-use interface that integrates the basic functionality of the software that make up the OREIS system *and* give advanced users the option of using the full functionality of the software without benefit of a user interface.

OREIS has not yet addressed the issue of tracking access to data. Until recently, OREIS has only processed data that have already been published in some form and are therefore considered public domain. This issue will probably surface again in the coming months as data are transmitted to OREIS before appearing in a published report.

3.7 STATISTICAL FUNCTIONS

The average of the responses in the section on statistical analysis was ≥ 3.3 . The average responses indicate that participants support statistical analysis functions in OREIS. There was, however, stronger support for integration of general statistics than for inclusion of advanced statistics and a programming language. Seven of the 34 participants answering these questions indicated that the advanced statistical functions should be left to the "experts" and that many experts would prefer to work on their own systems. These comments add support to the need for the data export capability that was mentioned in the Data Requirements section. The data

export capability will enable the experts to take advantage of the systems and software they already have in place.

One survey participant commented that statistical analysis should be left to the experts. The OREIS staff agrees that statistics is a discipline that often necessitates consultation with experts. OREIS statistical tools are provided as an integral part of OREIS to provide statistical analysis capabilities to users who do not have access to other tools and to provide statistical analysis capabilities to OREIS staff. OREIS staff consists of applications specialists who have expertise in environmental data and statistical analysis and can conduct statistical analysis for OREIS users.

3.8 GRAPHICAL ANALYSIS FUNCTIONS

The average responses for the section on graphical analysis functions ranged from 3.9 to 3.3. The responses indicate support for a graphical package to be a part of OREIS (3.9) but less support for having more advanced graphics functions (a programming language, 3.3; a graphics editor, 3.5) included in the OREIS user interface. Based on the number of similar comments, the ability to export data and/or preliminary graphics would be greatly supported by the user community. A question on graphical export should have been on the survey instrument so more participants could have rated its importance. Based on the comments, it is possible that some of the participants did not understand the difference between having a good graphics package (e.g., Freelance, Corel Draw, or Harvard Graphics) and having a software tool to perform graphical analysis. The advantage of a graphical analysis tool is its ability to produce a large number of graphs directly from a data base without a lot of manual manipulation (e.g., the graphs shown in Appendix A were produced using the SAS tool in OREIS).

3.9 SPATIAL ANALYSIS FUNCTIONS

The average responses for the section on spatial analysis ranged from 4.2 to 3.5. The average responses indicate that the participants support spatial analysis functions in OREIS. The user comments indicate less access to spatial analysis tools and experts than to statistical and graphical tools and experts. Therefore, it is expected that users would have more reliance on OREIS for spatial analysis tools and expertise. Based on other comments, a question on the importance of spatial data export should have been added to the survey instrument. The topic was important enough that four of the 36 participants commented on its need.

3.10 OTHER FUNCTIONS

The average responses for the section on other functions ranged from 4.1 to 3.6, which indicates that the participants support other OREIS functions that were surveyed. The participant comments indicate that there continue to be differences of opinion about the roles and responsibilities of OREIS. The OREIS staff agrees that the collectors of data should have the responsibility to analyze, interpret, and report the data they collect.

One participant commented that "OREIS should not be a tool for reporting." Although generators or custodians of data for remedial or other regulatory reports currently use their

own tools for reporting, the OREIS report-generating tools have been provided to assist all users (e.g., data generators, those accessing the data for secondary uses) to analyze and report the data as meaningful information. The existence of report-generating tools in OREIS is essential to users who do not have access to report-generating tools from other sources. OREIS users having other options for report generation may download data from OREIS to other tools using the export functions.

4. CONCLUSIONS

The goals of this survey were to collect information needed to confirm user requirements and to serve as a means to document user acceptance of OREIS. The survey participants have accepted the functions of OREIS by rating each of them above an average of 3 with the exception of very old historical data (pre-1975) and the creation of a user interface that is for computer experts only. The comments of survey participants indicated that some functions such as advanced statistical and advanced graphical analysis are not as strongly supported as others. However, these functions were still supported by the majority of users. Participants confirmed that the potential user community continues to have diverse opinions concerning the role of OREIS in data management for various programs. There were suggestions for more software tools, fewer software tools, and inclusion of personal-favorite software tools. The participants also confirmed the diversity of user backgrounds and expectations about the system. Participants commented that export of both measurement and spatial data will be an important function of OREIS.

As a result of this survey, OREIS will recommend that information exchange and interaction between representatives of different user groups be facilitated and encouraged throughout the life cycle of OREIS as an operable system. OREIS staff will prioritize the inclusion of historical data and focus most of the consolidation effort on more recent data. OREIS staff will also closely monitor the need for advanced statistical and graphical analysis as directed by the user community.

APPENDIX A
USER SURVEY INSTRUMENT

OREIS USER SURVEY

Givens and Assumptions:

1. OREIS was designed to satisfy the FFA and TOA requirements for a consolidated environmental data base.
2. Applications from commercial software products were preferred over project-developed software for managing, displaying, analyzing, and retrieving data.
3. The complexity of the data requires that a relational data base language be used to store the data and the anticipated volume requires a workstation configuration.
4. Measurement data from completed environmental restoration projects are currently the only data loaded into OREIS because of FFA deliverables and current funding sources. Additional data, including compliance data, needed to meet the FFA and TOA requirements will be prioritized by the users of the system and the sponsors and may be included in the near future.
5. Spatial data from the TVA S-16A are available through OREIS for the creation of maps and spatial analysis.
6. Data within OREIS will primarily be available for secondary uses, i.e., for use by someone other than the data collector. Examples are by regulators, DOE, and others.
7. Users may be required at some time in the future to use the system to generate reports.
8. A broad range survey of OREIS users is being conducted to validate that the system meets design requirements and to obtain requestor acceptance of the system.

If you have any questions about this survey, you can call or e-mail Miriam Land at (615) 241-4775 or ml3@ornl.gov. Send completed surveys to:

Miriam Land
Martin Marietta Energy Systems
P.O. Box 2003, Building K-1007, MS 7056
Oak Ridge, TN 37831-7056

OREIS USER SURVEY

For OREIS to be a useful tool, it must meet the expectations of its users for both computer systems and data. We appreciate you taking the time to answer the following questions about OREIS which will help us document the expectations of the OREIS user community.

Which of the following organizations do you work for directly (pick one)?

- ☐ Martin Marietta Energy Systems
- ☐ A subcontractor to either Martin Marietta or DOE
- ☐ DOE
- ☐ Tennessee Department of Environment and Conservation
- ☐ EPA

Which DOE site is most closely associated with your work (pick one)?

- ☐ K-25
- ☐ ORR Offsite
- ☐ Paducah
- ☐ Portsmouth
- ☐ X-10
- ☐ Y-12
- ☐ Not site-specific or involves multiple sites

Which organization most closely describes your work affiliation (pick one)?

- ☐ Environmental Restoration
- ☐ Groundwater
- ☐ Environmental Compliance
- ☐ Other

How would you best describe yourself?

- ☐ A Data Manager or programmer
- ☐ Responsible for report investigation or preparation
- ☐ A manager of a group that does one or both of the above
- ☐ Other

For all of the following rankings use the following scale:

1 = Not important 5 = Very important NA = Not able to answer

DATA REQUIREMENTS

1. Rate the importance of having the following types of **current** measurement data in OREIS (historical data will be addressed in the next question):

1	2	3	4	5	NA	Ambient air data
1	2	3	4	5	NA	Background data
1	2	3	4	5	NA	Biological data
1	2	3	4	5	NA	Climate data
1	2	3	4	5	NA	Air emissions
1	2	3	4	5	NA	Groundwater/well construction
1	2	3	4	5	NA	Lithology
1	2	3	4	5	NA	Off-site data
1	2	3	4	5	NA	Risk analysis screening values
1	2	3	4	5	NA	Surface water data
1	2	3	4	5	NA	TDEC sampling
1	2	3	4	5	NA	USGS data (surface water flow)
1	2	3	4	5	NA	Other (specify)

2. Rate the importance of having the following types of **historic** measurement data in OREIS:

1	2	3	4	5	NA	Ambient air data
1	2	3	4	5	NA	Background data
1	2	3	4	5	NA	Biological data
1	2	3	4	5	NA	Climate data
1	2	3	4	5	NA	Air emissions
1	2	3	4	5	NA	Groundwater/well construction
1	2	3	4	5	NA	Lithology
1	2	3	4	5	NA	Off-site data
1	2	3	4	5	NA	Risk analysis screening values
1	2	3	4	5	NA	Surface water data
1	2	3	4	5	NA	TDEC sampling
1	2	3	4	5	NA	USGS data (surface water flow)
1	2	3	4	5	NA	Other (specify)

3. How important is the loading of historic data into OREIS from the following years:

1	2	3	4	5	NA	1993
1	2	3	4	5	NA	1992
1	2	3	4	5	NA	1991
1	2	3	4	5	NA	1990
1	2	3	4	5	NA	1985-1989
1	2	3	4	5	NA	1975-1984
1	2	3	4	5	NA	pre 1975

4. How important are the following types of spatial data:

1	2	3	4	5	NA	2 foot contours (in floodplains)
1	2	3	4	5	NA	5 foot contours
1	2	3	4	5	NA	20 foot contours
1	2	3	4	5	NA	100 foot contours
1	2	3	4	5	NA	Environmentally sensitive areas
1	2	3	4	5	NA	Floodplain areas
1	2	3	4	5	NA	Gamma surveys
1	2	3	4	5	NA	Land use
1	2	3	4	5	NA	New ortho images (1"=200' scale - current, covers entire reservation)
1	2	3	4	5	NA	OU/WAG boundaries
1	2	3	4	5	NA	Private wells
1	2	3	4	5	NA	Wildlife habitat
1	2	3	4	5	NA	Other (specify)

-
5. 1 2 3 4 5 NA Metadata is defined as data about data. Metadata can include information about the source of the data, when it was collected, circumstances about the data collections, and how the data were processed. Given this definition of metadata, rank the importance of having metadata in OREIS and available for secondary use of the data.
6. 1 2 3 4 5 NA Data import is the ability to bring data from one computing environment (e.g., Lotus, FoxPro, SAS, etc.) into the OREIS environment and use it in combination with OREIS tools and analysis capabilities. Given this definition of data import, rank the importance of having data import capabilities as a part of OREIS.

7.	1	2	3	4	5	NA	Data export is the ability to take subsets of data from the OREIS system and convert it for use in another computing/data analysis environment (e.g., Lotus, FoxPro, SAS, etc.). Given this definition of data export, rank the importance of having data export capabilities as a part of OREIS.
8.	1	2	3	4	5	NA	Once data are in OREIS, users will need a data retrieval tool to subset the data for data analysis applications. Rank the importance of providing users with a data retrieval tool that does not require them to be intimate with the data structure and coded fields.
9.	1	2	3	4	5	NA	Rank the importance of providing beginning users with a data retrieval tool that may be somewhat simplified, but is easy-to-use.
10.	1	2	3	4	5	NA	Rank the importance of providing experienced users with a data retrieval tool that is very comprehensive but somewhat complex.
11.	1	2	3	4	5	NA	Rank the importance of having OREIS data available in a consistent, standardized form with clearly defined fields and codes.
12.	1	2	3	4	5	NA	Rank the importance of having historical data available, cataloged, and flagged with quality descriptors even if it is not in consistent, standardized form.
13.	Do you have any comments on the Data Requirements?						

USER INTERFACE

Once data are stored in a data base repository such as OREIS, there are many options for providing users with data retrieval tools. Deciding which options to implement depends on the backgrounds and expectations of the users. Rank how well you agree with the following descriptions about OREIS and its users:

1 = Disagree 5 = Agree

14.	1 2 3 4 5 NA	OREIS should primarily be developed for users with computer programming skills
15.	1 2 3 4 5 NA	OREIS should be useable by users with minimal computer experience.
16.	1 2 3 4 5 NA	OREIS should provide users with more than SQL as a data retrieval language.
17.	1 2 3 4 5 NA	Some OREIS users will prefer retrieval capabilities that are simplified, even if it means limited capabilities.
18.	1 2 3 4 5 NA	Some OREIS users will prefer extensive retrieval capabilities, even if they are more complex to use.
19.	1 2 3 4 5 NA	OREIS needs to have tools which will accommodate users with a variety of computing and technical backgrounds.
20.	1 2 3 4 5 NA	Some users will prefer to take advantage of the power and speed of software on an OREIS workstation rather than do all analysis on their local PCs.
21.	1 2 3 4 5 NA	OREIS should provide both an easy-to-use retrieval mechanism and the means for more advanced users to work with the complex tools.
22.	1 2 3 4 5 NA	The OREIS user interface is the look and feel of the OREIS computer system as it is presented to the user. Rank the importance of having a "user friendly" interface for the OREIS system.
23.	1 2 3 4 5 NA	Integrated analysis tools allow users to link data retrieval capabilities to statistical analysis tools, graphical analysis capabilities, and spatial analysis tools with a minimum of effort and hand manipulation. Rank the importance of having all available tools integrated.

24. 1 2 3 4 5 NA Secondary use of data often involves data exploration because of the lack of familiarity with the specific area and the history of data collection efforts. Given this need for data exploration, rank the importance of being able to use combinations of spatial, statistical, and data query tools as a means of defining the data of interest.
25. Do you have any comments on the User Interface?

STATISTICAL ANALYSIS

26. Do you or those in your group perform statistical analysis or summarizations?
_____ Yes _____ No

If No, then skip to **GRAPHICAL ANALYSIS**.

27. 1 2 3 4 5 NA Rank the importance of having statistical software as part of OREIS or as an integrated part of OREIS.
28. 1 2 3 4 5 NA Rank the importance of being able to access advanced statistical functions through an easy to use interface for users new to the software.
29. 1 2 3 4 5 NA Rank the importance of being able to generate advanced statistics needed for scientific analyses and hypothesis testing.
30. 1 2 3 4 5 NA Rank the importance of having a programming language available for experienced users for complex data and statistical analysis.
31. 1 2 3 4 5 NA Rank the importance of being able to generate general statistics for data exploration.
32. Do you have any comments on Statistical Analysis?

GRAPHICAL ANALYSIS

Graphical analysis is the presentation of data in a graphical form such as bar charts, pie charts, and line graphs to assist in summarizing data or making decisions.

33. Do you or those in your group perform graphical analysis?
 _____ Yes _____ No

If No, then skip to SPATIAL ANALYSIS.

34.	1	2	3	4	5	NA	Rank the importance of having graphical software for data presentation as part of OREIS.
35.	1	2	3	4	5	NA	Rank the importance of being able to access advanced graphical functions through an easy to use interface for users new to the software.
36.	1	2	3	4	5	NA	Rank the importance of being able to generate complex and well documented graphics for inclusion in reports as part of OREIS.
37.	1	2	3	4	5	NA	Rank the importance of having a programming language available for experienced users for complex data and graphical analysis.
38.	1	2	3	4	5	NA	Rank the importance of a computerized graphics editor to improve technical graphics for presentation.
39.	Do you have any comments on Graphical Analysis?						

SPATIAL ANALYSIS

Spatial data analysis is the examination of geographic patterns of environmental measurements and the proximity of geographic objects to one another.

40. Do you or those in your group perform spatial analysis?
 _____ Yes _____ No
41. If No, do you anticipate that spatial analysis will be added to the job requirements of the people you work with in the near future?
 _____ Yes _____ No

If No to both, then skip to OTHER FUNCTIONS.

42.	1	2	3	4	5	NA	Rank the importance of spatial processing capabilities and analysis of geographic data to your work.
43.	1	2	3	4	5	NA	Rank the importance of having the S-16A (ORR 1:24000 topo maps) base maps available for analysis with the measurement data in OREIS.
44.	1	2	3	4	5	NA	Rank the importance of having image data (i.e., from aerial photos) available for spatial analysis of data in OREIS.
45.	1	2	3	4	5	NA	Rank the importance of having a simplified and easy to use interface for spatial analysis available for users that are learning about spatial data.
46.	1	2	3	4	5	NA	Rank the importance of having complete and robust spatial analysis tools available for experienced users, even if they appear to be more complex.
47.	1	2	3	4	5	NA	"Real" maps have legends, scale bars, and north arrows to give the map a qualitative relationship to the earth and the data. Rank the importance of being able to produce "real maps" with OREIS data.
48.	1	2	3	4	5	NA	Several software products are currently in use on the Oak Ridge Reservation for viewing and analyzing spatial data. Spatial data import is the ability to bring spatial data from a one of these products into the GIS spatial data product selected for OREIS and use the data in combination with OREIS tools and analysis capabilities. Given this definition of spatial data import, rank the importance of having spatial data import capabilities as a part of OREIS.

49. 1 2 3 4 5 NA Spatial data export is the ability to convert OREIS spatial data for use with other spatial data products. Given this definition of spatial data export, rank the importance of having spatial data export capabilities as a part of OREIS.
50. 1 2 3 4 5 NA Coordinate conversion routines allow users to convert spatial data from one grid system in use on the Oak Ridge Reservation (e.g., X-10, lat/long, state plane, etc.) to any other system in use here. Rank the importance of having an easily accessible coordinate conversion routine as part of OREIS.
51. 1 2 3 4 5 NA Rank the importance of OREIS having color plotting hardware, in either large or small format, that can be accessed by anyone using the OREIS system.
52. Do you have any comments on Spatial Analysis?

OTHER FUNCTIONS

53. 1 2 3 4 5 NA Data repositories can either supply users with simple data records that must be manipulated on their own machines or supply them with data in a report format with titling, documentation, summaries, calculated fields, and totals. Reports could also include statistical output and graphics. Given this definition of reports, rank the importance of including reporting capabilities in OREIS.
54. 1 2 3 4 5 NA Standardized reports are those that are intended to be generated several times, either over time by the same person, or by a group of several people at the same time. Standardized reports can have input parameters for information that changes from one execution of the report to the next (e.g., new project, new range of dates, new distance). Given this definition, rank the importance of having the capability to produce standardized reports as part of OREIS.
55. 1 2 3 4 5 NA Macros are sections of programming code that perform repetitive tasks. Standardized reports are one application of using macros. Rank the importance of having macros that are QA tested and documented by the OREIS staff and made available to all OREIS users.
56. 1 2 3 4 5 NA Rank the importance of allowing users to create their own macros, copy existing macros, and edit macros.

Views are combinations of column and record subsets. For example, one view might be the sampling and lab measurement data for K-1407 B & C Pond subset by soil and sorted by sampling data. Another view could be well construction data for WAG1 for wells drilled by a specified date. These views do not contain a second copy of the original data but instead they are the specifications for the data of interest. Views have relatively small storage requirements and can include extremely complex specifications.

57. 1 2 3 4 5 NA Rank the importance of allowing users to create their own views that can be reused from one OREIS session to another.
58. 1 2 3 4 5 NA Rank the importance of having views that are QA tested and documented by the OREIS staff and made available to all OREIS users.
59. 1 2 3 4 5 NA Rank the importance of allowing users to create their own views, copy existing views, and edit views.

60. 1 2 3 4 5 NA Rank the importance of OREIS being able to use the application of a view throughout the entire data analysis environment (statistical, graphical, and spatial).
61. Do you have other comments on OREIS?

APPENDIX B
GRAPHICAL REPRESENTATION
OF PARTICIPANT RESPONSES

Number of Responses vs the Importance of Current Measurement Data

1=Not Important ... 5=Very Important

1-57

1-57

1-57

1-57

1-57

1-57

1-57

1-57

Number of Responses vs the Importance of Current Measurement Data

1 = Not Important ... 5 = Very Important

1-57

1-57

1-57

1-57

1-57

Number of Responses vs the Importance of Historic Measurement Data

1=Not Important ... 5=Very Important

1-5

1-5

1-5

1-5

1-5

1-5

1-5

1-5

Number of Responses vs the Importance of Historic Measurement Data

1 = Not Important ... 5 = Very Important

1-5

1-5

1-5

1-5

Number of Responses vs the Importance of Historic Timeframes

1=Not Important ... 5=Very Important

1-5

1-5

1-5

1-5

1-5

1-5

1-5

Number of Responses vs the Importance of Spatial Data Coverages

1=Not Important ... 5=Very Important

Number of Responses vs the Importance of Spatial Data Coverages

1=Not Important ... 5=Very Important

1-5

1-5

1-5

1-5

1-5

Number of Responses vs the Importance of Data Management Functions

1 = Not Important ... 5 = Very Important

1-5

1-5

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1-5

Number of Responses vs Agreement With User Interface Assumptions

1 = Disagree ... 5 = Agree

1-57

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1-57

Number of Responses vs Agreement With User Interface Assumptions

1 = Disagree ... 5 = Agree

1=5

1=5

1=5

Number of Responses vs the Importance of Statistical Analysis Functions

1 = Not Important ... 5 = Very Important

1-17

1-17

1-17

1-17

1-17

Number of Responses vs the Importance of Graphical Analysis Functions

1 = Not Important ... 5 = Very Important

1-Q

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1-Q

Number of Responses vs the Importance of Spatial Analysis Functions

1 = Not Important ... 5 = Very Important

1-2

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1-2

Number of Responses vs the Importance of Spatial Analysis Functions

1 = Not Important ... 5 = Very Important

Number of Responses vs the Importance of Other Functions

1 = Not Important ... 5 = Very Important

1-5

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1-5

1-5

1-5

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