

## **Oak Ridge Environmental Information System (OREIS) Enhancements - 13109**

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### **ABSTRACT**

Significant cleanup has been accomplished on the Oak Ridge (OR) site since it was placed on the National Priorities List (NPL) in 1989, and a final evaluation of Zone 1 at the East Tennessee Technology Park (ETTP) under the Comprehensive Environmental Response, Compensation, and Liability Act of 1988 (CERCLA) has been initiated. The Oak Ridge Environmental Information System (OREIS) is the database for storing OR site environmental characterization and monitoring data. Consideration of a final decision under CERCLA prompted several enhancements to OREIS that were designed to provide future users a clear picture of remediation progression across the OR site. The enhancements to OREIS are ongoing and fall into four categories:

- Geographic Information System Interface
- Document Association
- Remediation Status
- Geospatial Data

### **INTRODUCTION**

OREIS was initiated by the U.S. Department of Energy (DOE) Oak Ridge Operations Office in 1991 to fulfill the Federal Facility Agreement (FFA) [1] requirement for storing environmental characterization and monitoring data related to cleanup of the OR site, which includes ETTP, Oak Ridge National Laboratory (ORNL), the Y-12 National Security Complex (Y-12 NSC), and surrounding areas that are within the Oak Ridge NPL site. Clean-up activities are being conducted under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). As a stated requirement of the FFA, the purpose of OREIS is to support the Administrative Record requirement to store environmental data utilized in making remediation decisions and track post-remediation effectiveness. The charter for OREIS states its purpose to be:

*“The efficient retrievability and long-term retention of ORO environmental data.”<sup>1</sup>*

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<sup>1</sup>ORO refers to Oak Ridge Operations the extent of which, for all practical purposes, is the Oak Ridge site.

Consequently, OREIS is the designated system that serves as the repository for current, future, and legacy environmental characterization, monitoring, and remediation information. The system is used to capture and maintain geographic information system (GIS) and environmental sampling data that includes chemical, biological, ecological, radiological, and geophysical information. OREIS serves as the central location for stakeholders (public, corporations, and regulatory parties) to access verified and validated environmental measurement, monitoring, and spatial data across the entire site.

Significant cleanup has been accomplished on the OR site since it was placed on the NPL in 1989. Because of the high annual rainfall, groundwater levels, and multitude of streams and creeks, cleanup is being performed on a watershed basis with soil and sediment contamination sources addressed first under watershed interim RODs. Final ROD groundwater and ecological decisions have been assumed to follow the completion of all source control watershed activities. Currently, there are seven approved interim watershed RODs for the cleanup of contaminated slabs, soils, and sediments on the OR site:

- ETTP Zone 1 Interim ROD [2]
- ETTP Zone 2 Interim ROD [3]
- Bethel Valley Interim ROD (ORNL campus and surrounding areas within the Bethel Valley watershed) [4]
- Upper East Fork Poplar Creek (UEFPC) Phase 1 Interim ROD (Y-12 NSC and surrounding areas within the UEFPC watershed) [5]
- UEFPC Phase 2 Interim ROD (Y-12 NSC and surrounding areas within the UEFPC watershed) [6]
- Bear Creek Valley Interim ROD (waste management area west of the Y-12 NSC) [7]
- Melton Valley Watershed Interim ROD (waste management area south of ORNL) [8]

### **OREIS Challenge**

There has been a change recently in the OR site cleanup emphasis with the budget shortfalls and the drive to decommission extremely large, Manhattan Project-era buildings that have deteriorated to the point of being hazardous to site workers and, potentially, to the public health and environment. Additionally, there is a growing concern that contaminated groundwater from the OR site may be moving under the river that surrounds half the site and showing up in the well waters of residents across the river. Efforts to supply these residents with bottled water and connect them to city/county water systems have begun. These changes have resulted in DOE's Oak Ridge Environmental Management Program to prioritize budgets for the demolition of some of the worst deteriorated buildings and to begin addressing groundwater prior to completing work on watershed contamination sources. The challenge to the OREIS staff is to ensure the data in OREIS that was gathered in support of interim ROD decisions, to define and support post-ROD activities, and to characterize post-remediation conditions can be easily accessed to support ecological, stream, and groundwater decisions in the same watershed areas.

## **Test Case: ETTP Zone 1**

Soils characterization in Zone 1 at ETTP under the Zone 1 Interim ROD [2] has been completed and all identified remediation has been completed in all the areas except for two. Zone 1 was determined to be the perfect test case for addressing OR site groundwater and determining what obstacles there may be in reaching a groundwater decision within the U.S. Environmental Protection Agency's (EPA's) Region 4, where no federal site groundwater decisions have been reached.

With the FFA parties (DOE, EPA, and the Tennessee Department of Environment and Conservation) agreeing to proceed in this direction in Zone 1 where groundwater use controls, waivers, and monitored natural attenuation agreements will all be necessary and tested, the interim Zone 1 activities were halted and the FFA parties project team began to look at the issues to be addressed. Following data quality objective (DQO) meetings to discuss potential data gaps, the Zone 1 Final Remedial Investigation/Feasibility Study (RI/FS) [9] was prepared in the spring 2012 to document the accomplished soils cleanup under the Zone 1 Interim ROD [2], address groundwater and ecological data gaps, and propose alternatives for remaining remediation needs.

With submission of the Zone 1 Final RI/FS [9], it was recognized that the purpose and use of OREIS is subtly changing. Comments received from the regulatory parties pointed out that their review of the RI/FS had been slowed and impaired significantly by not being able to track back and verify the characterization/completion data from the Zone 1 Interim ROD [2]. Thus, whereas OREIS has historically been a tool primarily for data storage and retrieval, it has become apparent that current and future users of OREIS will also need to use OREIS to document, verify, and establish the data basis of the final decisions on the OR site.

Changes are presently being implemented that enhance the utility of OREIS by strengthening interim and final data informational ties. These ties will meet the needs of the three FFA parties in making final end-state decisions and provide future users a clear picture of remediation progression. Currently, these changes to OREIS are being tested and verified for accuracy and efficiencies by using the ETTP Zone 1 Interim ROD [2] and Zone 1 Final RI/FS [9] data as the test case. However, the changes being made to OREIS will be broadly applicable to data collected across the entire OR site. The OREIS enhancements described below are aimed specifically at soils data. As final RODs are developed across the OR site, the enhancements described below will be evaluated for their applicability to other media and updated, as necessary, to support final decisions, annual monitoring, and CERCLA 5-year reviews.

## **ETTP ZONE 1 CERCLA BACKGROUND SUMMARY**

This section provides a summary of activities that have been conducted under CERCLA in ETTP Zone 1. Because ETTP Zone 1 data are the prototypes for the OREIS enhancements, this summary provides background information that supports the enhancements described below. The Zone 1 Interim ROD [2] documents the process by which ETTP Zone 1 soils will be addressed and end-use goals reached. The ROD [2] established the future land use for Zone 1 as unrestricted industrial to a depth of 10 feet and presents the compositional criteria that soils must meet to be acceptable under the specified land use.

In order to bring Zone 1 soils in line with the stated remediation goals, the Zone 1 Interim ROD [2] specifies several remedial actions that must be conducted and presents a broad outline of a soils characterization program to use in determining whether additional remedial actions are necessary. Guidelines for the soils characterization program include risk-based compositional characteristics to use in making remediation decisions within 80 Zone 1 exposure units (EUs), which are subdivisions of Zone 1 and are used in determining the need for remediation based on characterization results. The decision-making program for soils characterization was called the Dynamic Verification Strategy (DVS) in the Zone 1 Remedial Action Work Plan [10]. The DVS presents the methodology for collecting new soils data and sets quality-related standards for using existing data for decision-making. All ETP Zone 1 DVS and the historical data used in this process currently reside in OREIS.

## **OREIS ENHANCEMENTS**

The enhancements to OREIS are ongoing and fall into four categories:

- GIS Interface
- Document Association
- Remediation Status
- Geospatial Data

### **GIS Interface**

The OREIS Spatial Query Tool (SQT) is the front-end GIS tool for viewing spatial information and accessing data in OREIS. The SQT provides a spatial component to an existing web interface for selecting records from a database that contains over 12 million records. Because the SQT is the tool most users will use to obtain data from OREIS, the descriptions of OREIS enhancements begins with a description of the SQT.

The SQT as it appears in its current form when accessed by a user is shown on Figure 1. There are four main parts to the SQT from which users can obtain information and data contained in the OREIS database; particular attention is paid to the tools selection menu as that is the interface for running data queries. The following descriptions reference the numbered areas on Figure 1:

1. The GIS map of the OR site dominates the SQT because this is where important information for accessing data is displayed. This is a dynamic map based on the user's commands. The default view when the SQT is first accessed is shown on Figure 1. The dark blue dots shown on the GIS map on Figure 1 represent sample stations.
2. The Map Layer selection menu located on the right side of the SQT in Figure 1 allows the user the capability to turn map layers on and off.

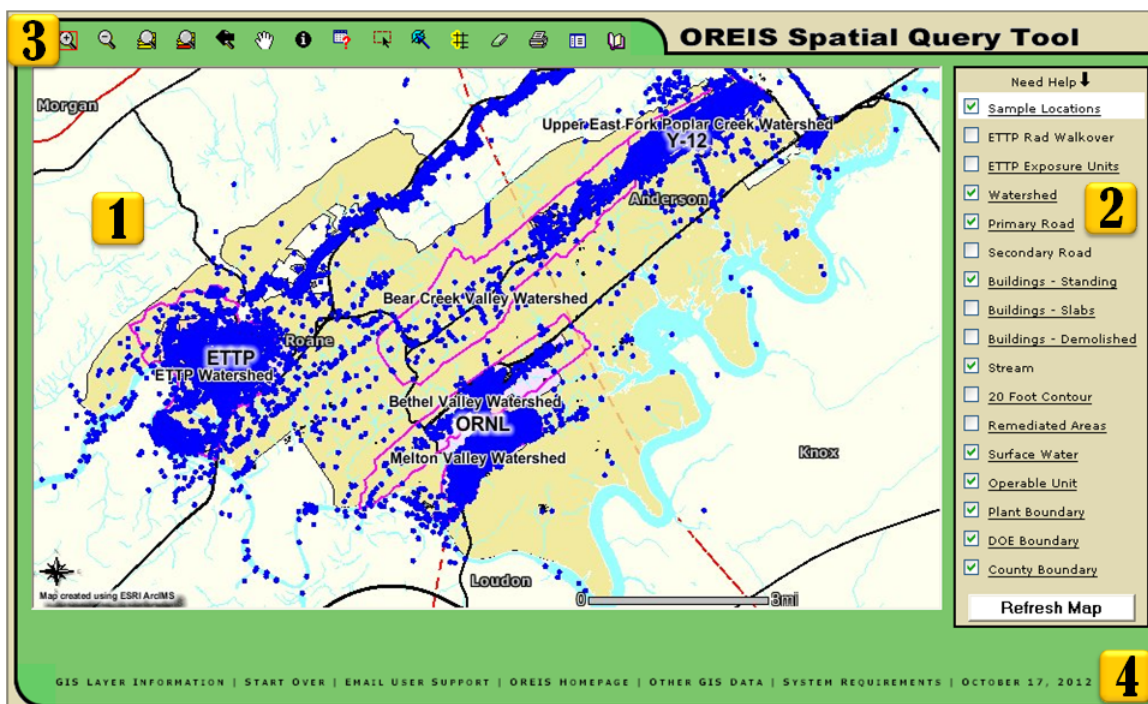


Figure 1. OREIS Spatial Query Tool (SQT) opening page. Numbered areas include (1) Geographic Information System map, (2) Map Layer selection menu, (3) Tools selection menu, and (4) SQT support features menu.

3. The Tools selection menu is located in the green field in the upper left of the SQT in Figure 1. SQT Tools are grouped into navigation tools, data tools, and other tools. Data tools are the key tools for accessing data. In particular, the Identify tool (① in Figure 1) allows the user to identify information about features shown on the GIS map (e.g., sample stations, roads, buildings, exposure units), and the Query tool (🔍 in Figure 1) provides the capability to create customized queries that allow the user to extract and download data from OREIS.
4. The SQT support features menu is located in the green field at the bottom of the SQT in Figure 1.

Because of the interrelationship between information and spatial representation in a GIS platform, most of the enhancements to the SQT GIS interface of OREIS result from Document Association, Remediation Status, and Geospatial Data enhancements, which are described in the following sections. The resulting SQT enhancements will provide the user with enhanced visual information that includes delineation of area(s) being addressed and color coding of sample stations to reflect their remediation status.

## **Document Association**

Although OREIS contains the data with which decisions are made under CERCLA, it does not contain the rationale for the decisions. Instead, the rationale for the decisions made are contained in various decision and other documents. An important enhancement to OREIS is the capability that allows the user to query data in OREIS and identify the document(s) in which the data are referenced.

Due to the size and number of remediation activities needed within each watershed, the watershed interim remediation activities have resulted in several Phased Construction Completion Reports (PCCRs) being prepared prior to generation of the Remedial Action Report, which will document the completion of all ROD requirements. For example, there are five Zone 1 PCCRs documenting remediation activities and 70 no further action decisions in the 80 Zone 1 Interim ROD [2] EUs.

Using the Query tool in the SQT Tools selection menu, the user can select a particular document from a list of available documents and all of the sample stations referenced in the selected document will be highlighted on the SQT GIS map. An example of such a query result is shown on Figure 2. In the foreground on Figure 2, the Query tool dialog box shows that a specific ETTP Zone 1 PCCR [11] has been selected as the document of interest and added to the query string. The background on Figure 2 is the SQT GIS map. The red dots on the GIS map are all of the sample stations referenced in the selected document [11]. The user can choose to download the data referenced in the selected document by clicking on “Download Data” in the Query tool dialog box (Figure 2).

Another alternative for obtaining document/data information is selecting “Station Names” from the “Field” menu in the Query tool dialog box (Figure 2), adding one or more station names to the query string by clicking on “Get Values,” and selecting from a list of all station names in OREIS. The user can then opt to include the associated document(s) when downloading data for the selected station names.

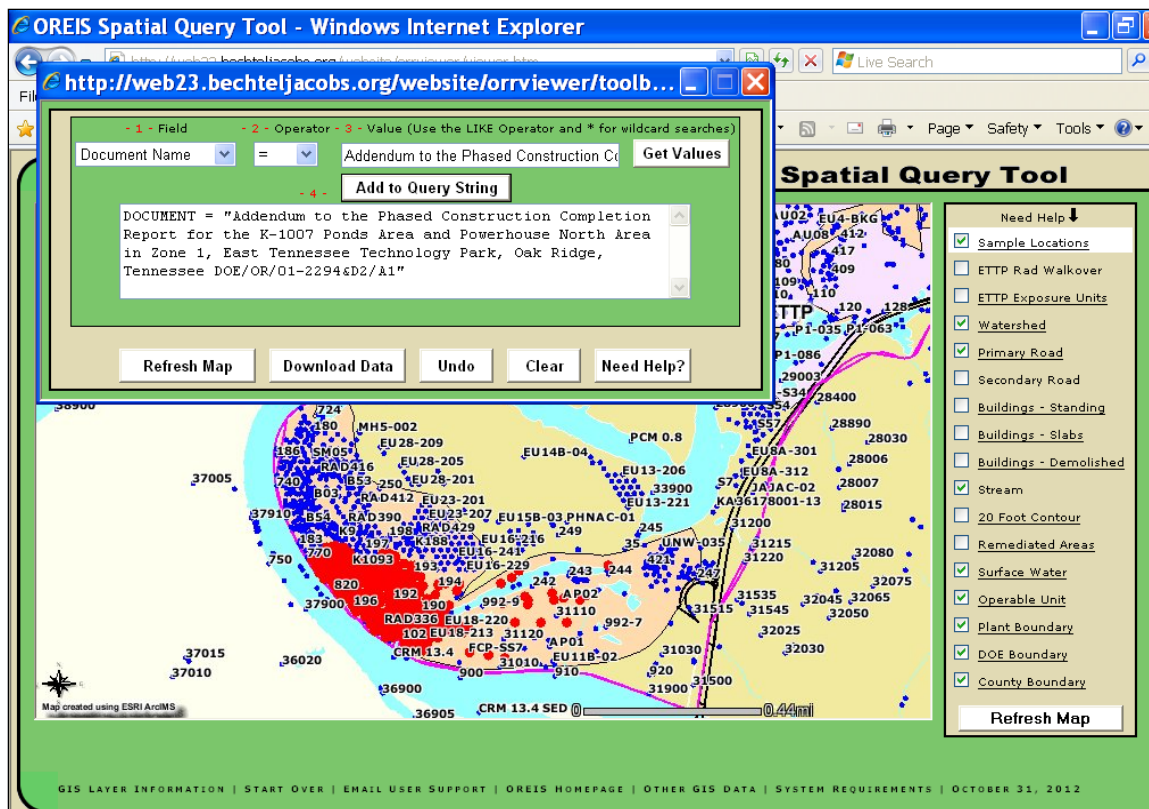


Fig. 2. OREIS Spatial Query Tool showing a document query in the foreground and the sample stations referenced in the document as red dots on the GIS map in the background.

## Remediation Status

OREIS contains all of the analytical data from across the OR site. Currently, there are 2268 soil sample stations across ETPP Zone 1 alone. The remediation status at each sample station is an important piece of information to the future OREIS user interested in documenting the progression of cleanup on the OR site. The remediation status is now associated with the data for each ETPP Zone 1 soil sample station. Adding the remediation status to the OREIS database provides the user a relatively simple means of identifying data that represent past and current conditions, general descriptions of the type of remedial action conducted at a location, whether current conditions data designate the location for no further action, and whether data representing current conditions are awaiting a decision.

The soils data remediation status that have been added to the ETPP Zone 1 data tables in OREIS and their definitions are presented in Table I.

The “EX” status documents data that are no longer representative of current conditions because the soil or other media represented by the data have been removed by excavation. However, the data are retained in OREIS as a metric of progress under CERCLA by documenting remedial action locations and pre-remediation conditions.

The “IP” status documents sample stations where remedial actions were conducted to stabilize contamination, but because the sample stations were not excavated, the data still represent current conditions. In the case of capping, sample depths will change by the thickness of the cap and sample depths recorded in OREIS must be updated following placement of a cap.

**Table I. OREIS Remediation Statuses and Definitions**

<b>OREIS Remediation Status<sup>a</sup></b>	<b>Definition</b>
EX	Remediation by excavation: remediation of the contaminant source has been completed to the required remediation level and/or defined area scope; sample media have been removed by excavation and no longer represent current conditions.
IP	Remediation in place: remediation has been completed to stabilize an area in place (e.g., grouting, vitrification, capping, French drains) to greatly reduce or prevent rain and groundwater from percolating through and spreading contamination; media sampled remain in place.
NR	No remediation required: characterization sampling has been performed and, based on the results of data analysis, no remediation is required; media sampled remain in place.
ND	No remediation/no decision: characterization sampling has been conducted to support a decision document, but no decision has been reached; media sampled remain in place.
<sup>a</sup> REMEDICATION_STATUS = name of the remediation status field in OREIS	

The “NR” status also documents current conditions data. These data come from samples that either did not require a remedial action or were collected as post-remedial action confirmation samples.

The “ND” status documents data from sample stations where no decision has been made. Data with the “ND” remediation status highlight the fact that OREIS is a living database (i.e., it is necessary to continually update OREIS as decisions are made across the OR site).

Conceptually, all data from the OR site would initially have been flagged with the “ND” status, then as work under interim RODs progressed, remediation decisions made, and remedial actions conducted, the data status would be revised to reflect the remediation/location status referenced in the CERCLA document. For ETP Zone 1, the “ND” remediation status data constitute the smallest proportion of Zone 1 data in the OREIS database. These data represent sample stations in Zone 1 for which a decision under the Zone 1 Interim ROD [2] has not been reached and are a primary focus of the Zone 1 Final RI/FS [9].

In addition to the remediation status enhancements, the requirements for information input to the remediation comment field, an existing field in OREIS, have been changed so that the information is standardized to maximize the information about remedial actions that have been conducted. For data from locations on the OR site watersheds that have been remediated, the following information is now required for the remediation comment field when data are submitted to OREIS:



- Descriptive name of the remedial action
- Date of the completed remedial action
- Other information that will support the user’s understanding of what has occurred

Information in the remediation comment fields for ETTP Zone 1 data with a remediation status of either “EX” or “IP” (Table I) (i.e., the data representing sample stations that have been remediated) has been updated to be consistent with the new requirements. Two examples of remediation comments for ETTP Zone 1 data are shown in Table II, one for an “EX” remediation status and one for an “IP” remediation status.

**Table II. Remediation Comment Examples from ETTP Zone 1 Data**

<b>Remediation_Status<sup>a</sup></b>	<b>Remediation_Comments<sup>b</sup></b>
EX	Sample excavated during the 2009 K-722 Area remedial action
IP	2-foot soil cover added during the 2011 ecological remedial action; sample depth includes cover
<sup>a</sup> Remediation_Status = name of the remediation status field in OREIS <sup>b</sup> Remediation_Comments = name of the remediation comments field in OREIS	

The remediation status at any sample station can be accessed in OREIS by two different processes. First, the user can query the data for the sample station of interest by using the Query Tool in the SQT Tools Menu (Figure 1). The user will be given the option of including the remediation status and remediation comments with the data being accessed. Second, sample stations on the SQT GIS map will be color coded to reflect the remediation status. Figure 3 is a prototype example of this enhancement for an ETTP Zone 1 EU containing sample stations with all four remediation statuses.

Combined with the new document association capabilities in OREIS, the user is now able to relate data contained in OREIS to descriptive remediation information and access reference to the decision document(s) in which the details of the remediation are documented.

### **Geospatial Data**

An important criterion in decision-making under a ROD or other decision document is the spatial distribution of the data being used to make the decisions. For example, as described above, the action/no further action decision under the Zone 1 Interim ROD [2] pertains to EUs. Since there are 80 EUs in Zone 1, there are potentially 80 separate action/no further action decisions. It is critical to be certain the data used to make each decision are located in the EU for which the decision is being made. Two enhancements have been made to OREIS to address geospatial decision-making needs.

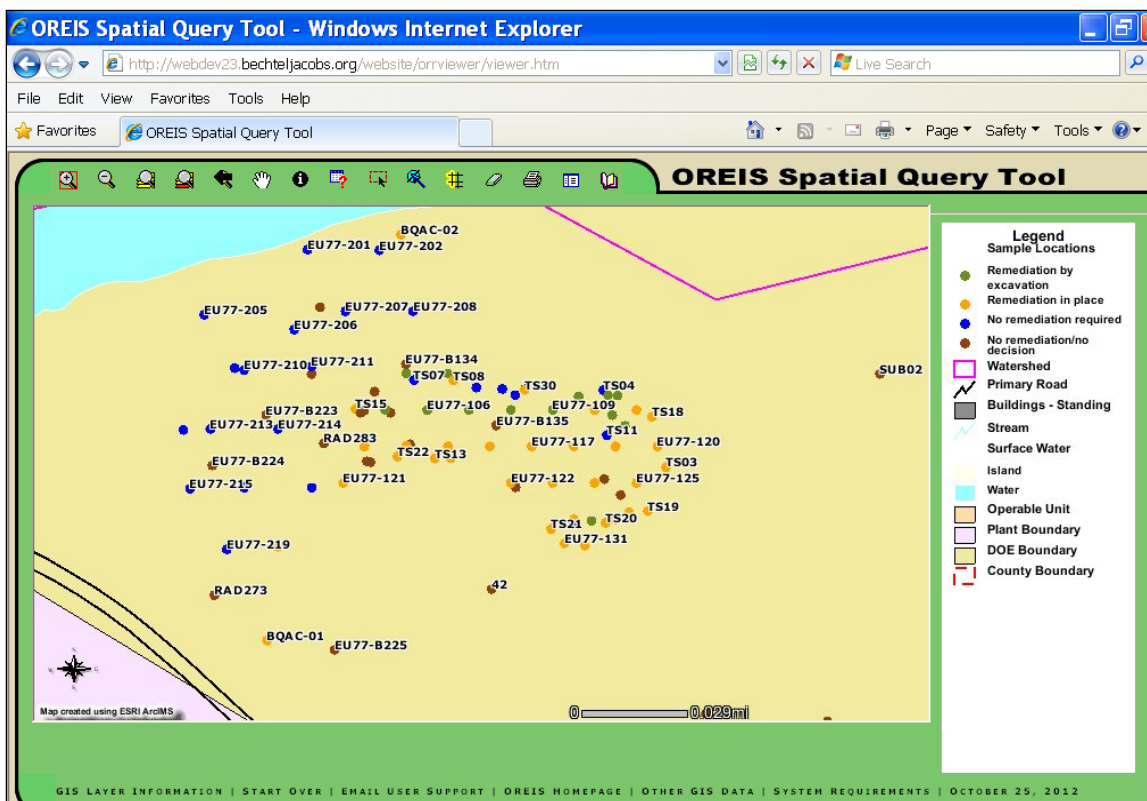


Fig. 3. OREIS Spatial Query Tool showing a portion of Zone 1 with sample stations color coded by remediation status.

First, Zone 1 sample station coordinates existing in OREIS have been evaluated for accuracy, adding a higher level of assurance that OREIS contains an accurate representation of the spatial distribution of existing data for each EU. Because there are 2268 soil sample stations in Zone 1, there are limitations to the practicality of verifying each location's coordinates. For example, resurveying the coordinates of each station was not considered as an option. Instead, DVS sample station coordinates in OREIS were compared to the coordinates provided in their source files, and coordinates for sample stations whose data existed in OREIS prior to DVS were verified by researching historical documents to ensure that the sample stations were located within the area they were intended to characterize. In addition to verifying sample stations coordinates already existing in OREIS, new OREIS process steps have been added to ensure future sampling stations are captured accurately. A protocol for obtaining coordinates using global positioning system equipment has been developed and verification of coordinates by two project personnel is now required prior to entering any sampling coordinates into OREIS.

Second, a new field has been added to the OREIS database that assigns data to their correct EUs. Addition of this EU field supports the objective of making Zone 1 Interim ROD [2] action/no further action decisions transparent. Furthermore, combining the new capability of associating data with documents, the addition of an EU field to OREIS thereby links EU-specific data to the documents presenting the rationale for the EU decisions. For example, an additional capability of the OREIS SQT afforded by addition of the EU field is shown on Figure 4, which is

essentially the result of the same query as in Figure 2, except that ETPP Zone 1 EU Z1-20 has been added to the query string. With this addition to the query string, the GIS map in the background of Figure 4 shows in red only the stations in EU Z1-20 that are referenced in [11]. With the query string set up as shown in Figure 4, the user can download the data associated with the selected EU Z1-20 stations. The OREIS user is also able to obtain EU information by using the Query tool to select one or more station names and adding the EU field to the list of field names to be downloaded.

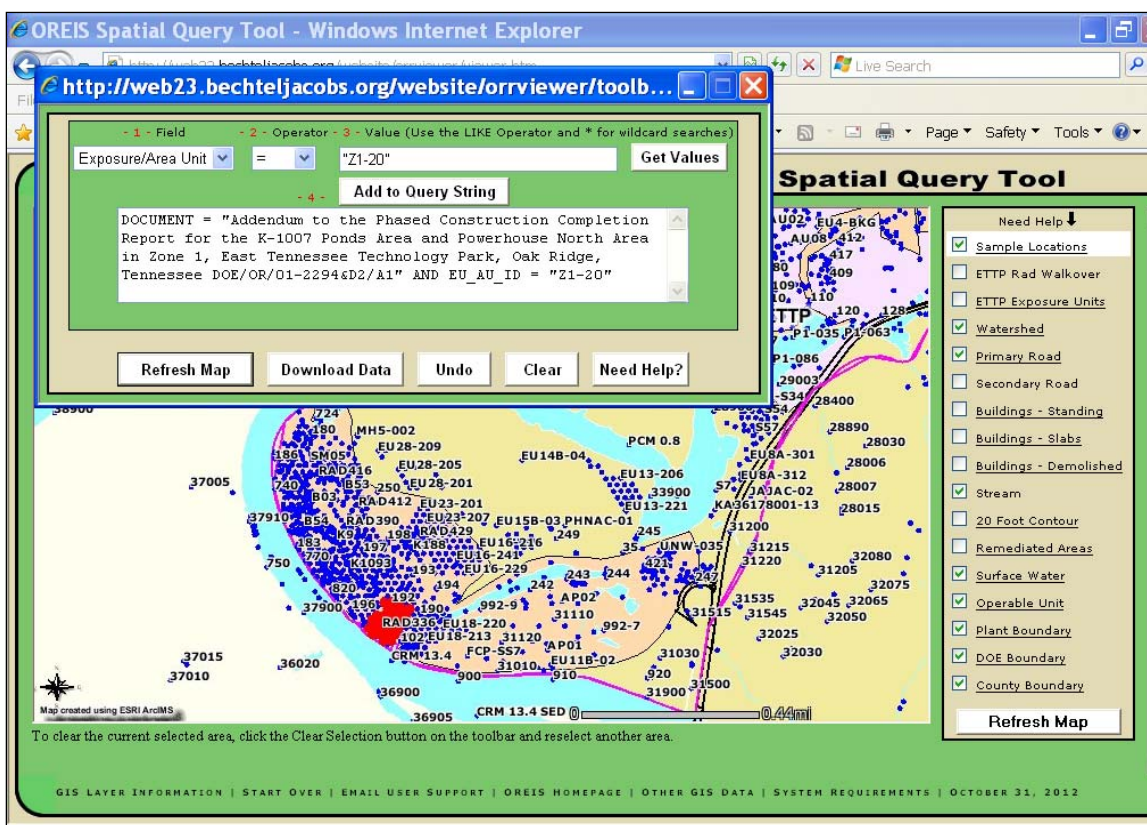


Fig. 4. OREIS Spatial Query Tool showing sample stations in EU Z1-20 as red dots on the GIS map in the background. In this case the query in the foreground is the same as in Figure 2 except that EU Z1-20 was added to the query. EU queries can be run by themselves or with other queries as shown on this figure.

## CONCLUSION

The changes outlined above make significant improvements to OREIS that have been clearly shown in the use of Zone 1 Interim ROD data to support DQO sessions and to capture data needed for development of the Zone 1 Final RI/FS [9]. The OREIS enhancement effort to make supportive changes was intense, but has proven effective to the project team and to the regulatory review of the RI/FS document [9]. Moving forward, it is key that OREIS analytical data and location information are verified prior to initiating final ROD efforts and that OREIS is updated

as new data are generated for use in primary documents as remedial actions are conducted and closeout data collected.

The changes being made to OREIS to support the transparency of ETTP Zone 1 decisions are broadly applicable to the rest of the OR site. Environmental restoration across the OR site is currently being conducted under interim watershed RODs that subdivide the watersheds into EUs. Decisions made and remediation efforts conducted based upon the data maintained within OREIS under the interim and final watershed RODs are well documented in CERCLA primary documents. The OREIS enhancement efforts will allow for ease of access, understanding, and use of the data for maintaining effectiveness monitoring/trending data necessary to ensure the health of the environment and the surrounding residents.

## REFERENCES

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