USACE RESERVOIR SEDIMENTATION SURVEY DATABASE (RESSED) ORACLE CONVERSION

Deborah Cooper, Research Hydraulic Engineer, US Army Engineer Research and Development Center, Vicksburg, MS, Deborah.R.Cooper@usace.army.mil

Abstract

Reservoirs are vital for providing flood risk reduction, water supply, energy generation, navigation, irrigation, recreation, and other services. Sediment deposition reduces the useful life of reservoirs, affecting their authorized function. Reservoir Sedimentation Survey Database (RESSED), a database in FileMaker Pro© (FMP) maintained by the U.S. Geological Survey (USGS), contains reservoir information from U.S. Army Corps of Engineers (USACE) districts and other federal agencies for updating and verifying data and creating reports concerning reservoir sedimentation. The data in RESSED can be used to calculate and track changes in reservoir storage characteristics, track and report current and future impacts of sedimentation, quantify sediment budgets, estimate erosion rates in a reservoir's watershed, and export data into other databases. Data captured from FMP to Oracle© provides a basic interface to view RESSED data in the CorpsMap©, an enterprise geospatial platform for USACE that is capable of communication with other data platforms. This paper will discuss the USACE-RESSED data conversion application.

INTRODUCTION

USACE manages more than 700 locks and dams that provide flood risk reduction, water supply, energy generation, navigation, irrigation, recreation, and other services. Sediment deposition (Figure 1) reduces the useful life of the reservoirs these dams produce, affecting their authorized function. More than 50% of USACE reservoirs report moderate to severe impacts of performance within their authorized function before 25% of storage capacity is lost due to reservoir sedimentation. Increasing deposition of sediment in reservoirs is recognized as a growing problem in the United States, with implications for impacts on water supply, water quality, and navigation. The 1996 National Water Quality Inventory (Section 305(b) Report to Congress) indicates that sediments are ranked as a leading cause of water quality impairment in assessed rivers and lakes (Kuhnle and Simon 2000). Quantifying the rate that sediment moves through or is deposited in a reservoir is vital to managing the nation's water resources. Reservoir sedimentation data is essential to assessing changes in reservoir capacity and future reservoir sustainability.

Locating and comparing datasets is challenging because reservoir sedimentation records are scarce, various methods of measuring can be incompatible, and the procedures may have high rates of measurement uncertainty. A *High Country News (HCN)* analysis of US Bureau of Reclamation (USBR) data provides a good example of why locating and comparing datasets is challenging. This analysis, which offers the most recent publicly accessible surveys for eight of

11 Western states, reveals that 35 USBR reservoirs have lost approximately 4.6 million acre-ft of storage capacity to sedimentation.

Figure 1 Sediment Deposition in Matilija Reservoir, CA (USBR 2010)

That's about 8% of total storage in USBR reservoirs, or enough water to serve at least nine million households. The surveys examined by *HCN* cover less than 10% of the dams managed by USBR. Other challenges are that many of USBR's surveys are two decades old and Utah was only able to locate data for 18 of its 133 reservoirs larger than 1,000 acre-ft (Weiser 2011). The lack of reservoir sedimentation data is not a state or regional issue rather it is a national issue. A standardized, web accessible database may provide more accurate data sets for analysis of the effects of sedimentation on reservoir sustainability.

The USGS manages the nation's largest reservoir sedimentation database, RESSED. RESSED, a database in FileMaker Pro© (FMP), is a comprehensive reservoir sedimentation database for U.S. reservoirs (http://water.usgs.gov/osw/ressed) containing data compiled by the Soil Conservation Service, now the Natural Resources Conservation Service (NRCS). Version 1.0 of this interactive and enhanced reservoir sedimentation survey database consists of a comprehensive compilation of reservoir information related to wet and dry surveys, storage, elevation, area capacity, reservoir operations, and other reservoir information for 1,824 large and small USACE, USBR, Tennessee Valley Authority (TVA), NRCS, and other federal, municipal, and utility agency reservoirs and lakes. The data in RESSED can be used to calculate and track changes in reservoir storage characteristics, track and report current and future impacts of sedimentation, quantify sediment budgets, estimate erosion rates in a reservoir's watershed, and can be exported into other databases.

To date, USACE districts have performed quality assurance and quality control on RESSED data. The Institute for Water Resources (IWR) is conducting ongoing research of reservoir sedimentation and the impacts of climate change on reservoir sedimentation through the Reservoir Sediment Information (RSI) research work unit and the USACE Response to Climate

Change Program. Data capture of reservoir survey and area capacity data from the USGS RESSED FMP platform became necessary to store and display reservoir information consistent with established USACE enterprise databases, such as the Corps Water Management System (CWMS) and the National Inventory of Dams (NID). Once the RESSED data was captured in CorpsMap©, USACE developed the Reservoir Sedimentation Information system production site for entering basic reservoir survey and capacity data for uploading data to RESSED. While the production site was developed with references to NID and CWMS databases, the data capture from RESSED established a platform for uploading data to RESSED. This paper will discuss the USACE-RESSED data conversion application.

RESERVOIR SEDIMENTATION INFORMATION SYSTEM PRODUCTION SITE

The Reservoir Sedimentation Information (RSI) system production site was developed by USACE to provide a comprehensive summary of USACE reservoir conditions. The overarching intent of this system is to store and display reservoir information to assist with evaluation of sedimentation trends and reservoir life expectancy with respect to a changing climate. The initial iteration of this dynamic system focuses on input and display of reservoir metadata. Reservoir information is available for viewing by all users. To edit or upload data requires the acquisition of permissions provided by an administrator.

To access the RSI production site users must:

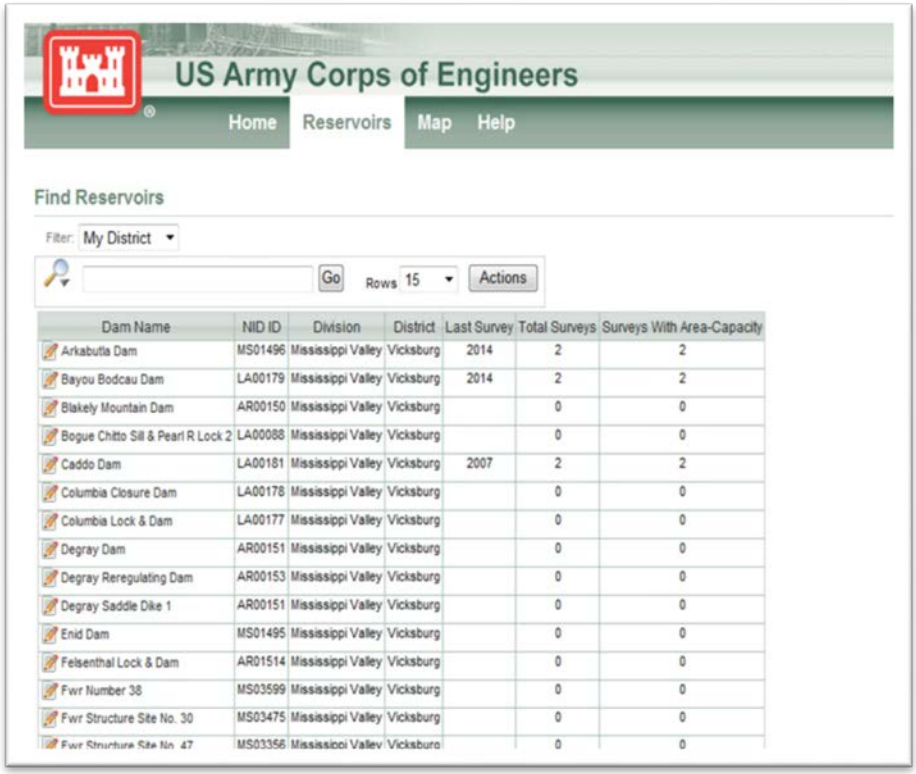
1. Log on to https://maps.crrel.usace.army.mil/apex/f?p=303
2. Click the CAC Login button
3. Enter the 4-digit PIN

Upon logging into the system, the user will be able to view everything in the application as the read-only role of Data Reviewer. To obtain additional privileges of editing or uploading data, the user should email one of the points of contact (POC) listed on the Help tab. After emailing a RSI POC, if the user is eligible for additional privileges, the RSI Production Site team will grant the user District Data Manager (DDM) privileges based on the corresponding district. After the Production Site team grants privileges, the user will receive an email notifying him or her of a role change in RSI. The District Data Manager privilege will allow users to edit data for their specific district only, while still allowing them to view data from other districts as they did with the Data Reviewer role, i.e., the District Data Manager for the Vicksburg District can view any district's data but can only edit data for the Vicksburg District.

The RSI system production site consists of four main tabs: Home, Reservoirs, Map, and Help. Descriptions and graphic illustrations of each tab are provided below.

Home Tab

The Home tab provides introductory information on the RSI Production Site and describes each of the successive tabs (see Figure 2 below).



Dam Name	NID ID	Division	District	Last Survey	Total Surveys	Surveys With Area-Capacity
Arkabutla Dam	MS01496	Mississippi Valley	Vicksburg	2014	2	2
Bayou Bodcau Dam	LA00179	Mississippi Valley	Vicksburg	2014	2	2
Blakely Mountain Dam	AR00150	Mississippi Valley	Vicksburg		0	0
Bogue Chitto Sill & Pearl R Lock 2	LA00088	Mississippi Valley	Vicksburg		0	0
Caddo Dam	LA00181	Mississippi Valley	Vicksburg	2007	2	2
Columbia Closure Dam	LA00178	Mississippi Valley	Vicksburg		0	0
Columbia Lock & Dam	LA00177	Mississippi Valley	Vicksburg		0	0
Degray Dam	AR00151	Mississippi Valley	Vicksburg		0	0
Degray Reregulating Dam	AR00153	Mississippi Valley	Vicksburg		0	0
Degray Saddle Dike 1	AR00151	Mississippi Valley	Vicksburg		0	0
Enid Dam	MS01495	Mississippi Valley	Vicksburg		0	0
Felsenthal Lock & Dam	AR01514	Mississippi Valley	Vicksburg		0	0
Fwr Number 38	MS03599	Mississippi Valley	Vicksburg		0	0
Fwr Structure Site No. 30	MS03475	Mississippi Valley	Vicksburg		0	0
Fwr Structure Site No. 47	MS03356	Mississippi Valley	Vicksburg		0	0

Figure 2 Reservoirs Tab

Reservoirs Tab

The Reservoirs tab allows a user to view detailed information about all USACE reservoirs listed in the NID database. The dam name, NID ID, division, and district are directly linked to the NID database and cannot be modified or edited within the RSI production site. Data associated with a particular reservoir, found in the last survey, total surveys, and surveys with area-capacity fields on the production site, can be viewed and, with special permissions, edited by the District Data Manager aligned to that particular reservoir. The dams can be filtered by an individual district or all districts. A reservoir can be located by typing the name of the reservoir in the search window and clicking "Go." The user can then click the pencil icon to view detailed information and/or enter data for the specific dam that was searched for. Five sub-tabs will appear under the Reservoirs tab: Detail, Surveys, Storage Allocation, Documents, and Graphs.

Detail Sub-Tab

The Detail sub-tab allows a user to view detailed information about a particular USACE reservoir. Information on this sub-tab is still directly linked to the NID database. A map showing the reservoir location and NID information is also displayed (shown in Figure 3 below).

Figure 3 Reservoirs Detail Sub-tab

Surveys Sub-Tab

Survey data is entered by clicking the "Add New Survey" button on the Surveys sub-tab and entering data under the Survey Detail tab (see Figure 4a below). Values with asterisks indicate mandatory fields. Clicking the "Add" button after entering all the required information displays the survey data in a table at the top of the page. Clicking the pencil icon next to an added survey and clicking a red "Upload Area-Capacity" arrow (Figure 4b) allows the user to upload Area-Capacity data for the corresponding survey. After uploading the Area-Capacity data, data can be edited in this window by clicking the pencil icon next to the row to be edited. Note that the Area-Capacity data can also be downloaded by clicking on a green "Download Area-Capacity" arrow.

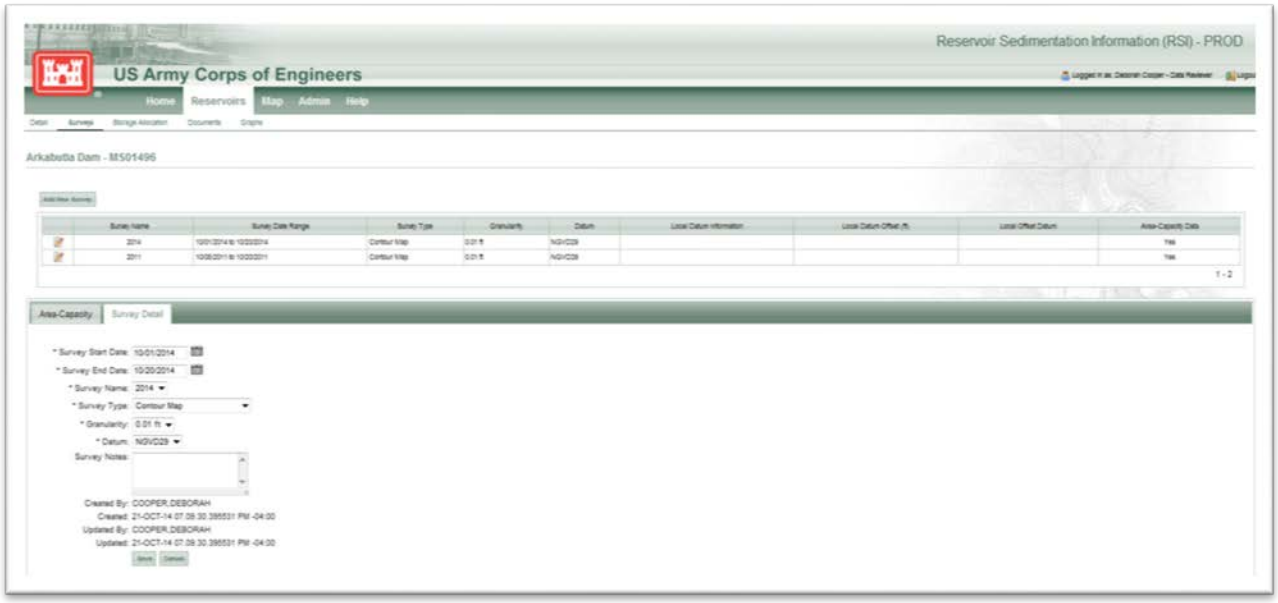


Figure 4a Reservoirs Surveys sub-tab and Survey Detail tab

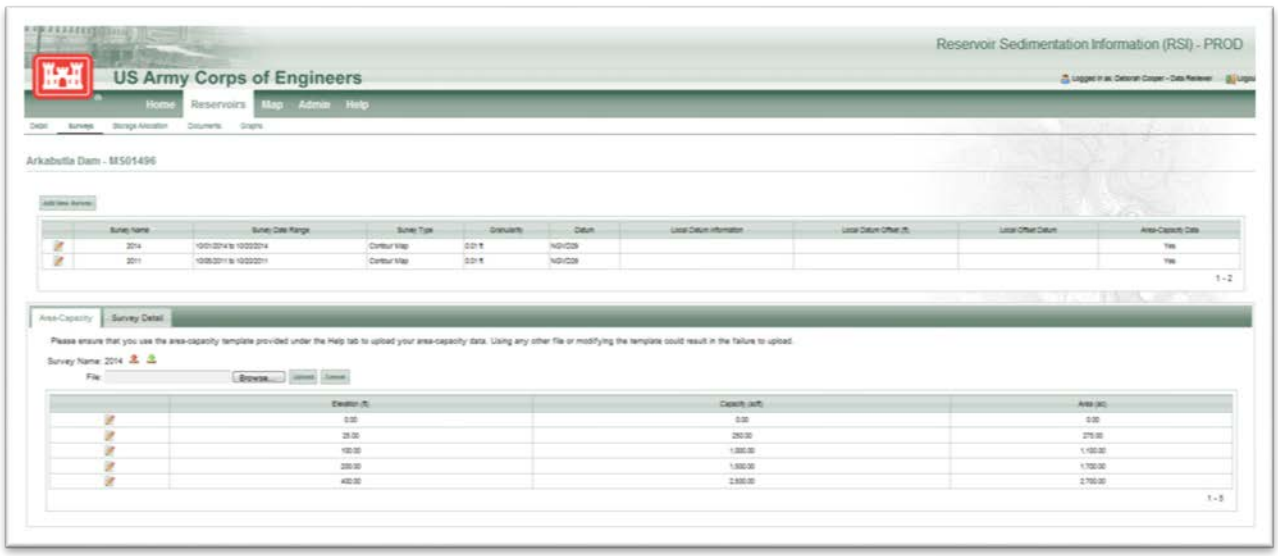


Figure 4b Reservoirs Surveys sub-tab and Area-Capacity tab

Storage Allocation Sub-Tab

Data from the Corps Water Management System (CWMS) is displayed under the Storage Allocation Tab. If reservoir data is not found in CWMS, no data will be displayed.

Documents Sub-Tab

The user can upload documents for storage under the Documents sub-tab. Area-Capacity spreadsheets, documents, images, maps, presentations, reports, videos, and other files can all be stored for retrieval on this site (shown in Figure 5 below).

Figure 5 Reservoirs Documents Sub-tab

Graphs Sub-Tab

Capacity data is plotted under the Graphs tab (shown in Figure 6 below). If the reservoir elevation data is entered in CWMS, data from the CWMS site can be plotted here as well.

Map Tab

The Map tab displays active reservoir survey data sites.

Help Tab

Technical assistance information, a RSI Quick Guide, and an Area-Capacity spreadsheet template (that must be used for uploading area-capacity data to the RSI System Production Site) are all found under the Help tab. Users must use the provided Area-Capacity template to ensure that data is properly uploaded and displayed in the Reservoirs Surveys window. To enter data for additional reservoirs, the user must begin the process again by navigating to the Reservoirs tab. On the Reservoirs tab, the user can then search for and locate another reservoir to initiate survey data input.

Figure 6 Reservoirs Graphs Sub-tab

CONCLUSION

Testing of the RSI system production site will be initiated by district input of survey and area-capacity data in FY15. The plan is to expand the site to include additional reservoir data as it becomes available, enhance the input tools, and standardize the reservoir data analysis across USACE. T he RSI production site will ensure that districts can maintain the most currently available and consistent data from databases such as RESSED, CWMS, and NID. It does this by using the provided Oracle© interface to view RESSED data in CorpsMap© and as a mechanism for the USACE data platform to communicate with RESSED as well as other data platforms.

REFERENCES

Kuhnle, R.A. and Simon, A. (2000) "Evaluation of Sediment Transport Data for Clean Sediment TMDLs" National Sedimentation Laboratory, USDA Agricultural Research Service, p 3.

Morris, G. L. and Fan, J. (2010). ***Reservoir Sedimentation Handbook,*** p 10.1.

Strand, R.I., and E.L. Pemberton (1982). **Reservoir Sedimentation**, U.S. Bureau of Reclamation, Sedimentation and River Hydraulics Group, p 48

Weiser, M., (2011). "Sedimentation is a Building Problem in the West's Reservoirs", *High Country News*, April 20, 2011, http://www.hcn.org/issues/43.6/muddy-waters-silt-and-the-slow-demise-of-glen-canyon-dam/sedimentation-a-building-problem-in-the-wests-reservoirs