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AWARD NUMBER: G16AC00073

SPONSORING ORGANIZATION: Utah Geological Survey

PROJECT TITLE: Request of Maintenance Funding from the Utah Geological Survey to Provide Data to the National Groundwater Monitoring Network via the Utah Water Quality Database of Wells and Springs

CONTACT PERSON: Janae Wallace **TITLE:** Senior Geologist

ADDRESS: 1594 West Temple, Suite 3110 Salt Lake City, UT 84116
PHONE: (801)537-3387 **FAX:** (801)537-3400
EMAIL: janaewallace@utah.gov

CONTACT PERSON 2: Jodi Patterson **TITLE:** UGS Financial Manager
ADDRESS: 1594 West Temple, Suite 3110 Salt Lake City, UT 84116
PHONE: (801)537-3310 **FAX:** (801)537-3400
EMAIL: jpatters@utah.gov

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MAJOR GOALS: Continue the flow of data to the National Groundwater Monitoring Network (Objective 2- support persistent data services); adding lithologic data to the Portal (Objective 3-Filling gaps in information).

PROJECT SUMMARY: The Utah Geological Survey (UGS) continued the flow of data from the UGS Water-Quality Network to the National Ground-Water Monitoring Network (NGWMN). This project establishes a long-term goal to continue integrating our state-level data with a national-level database.

OVERVIEW OF WORK

The Utah Geological Survey (UGS) cooperated with the USGS to provide a continued connection between the UGS Water-Quality Network and the NGWMN, providing the NGWMN with selected sites and related quality-controlled data. The UGS linked a database from our network for entry and integration of data to the NGWMN portal. The UGS provided ongoing maintenance by updating the list of UGS network sites, populating data elements for new sites acquired, substituting for a previous site that was not accessible at a later sampling date, and ensuring the NGWMN Portal connection to the databases stayed operational. Geologists and GIS Specialists in the Groundwater and Wetlands Program of the UGS performed all tasks in cooperation with the USGS, and provided web services for database integration.

Data flow maintenance by the UGS consisted of the following four tasks:

1. **Ongoing network maintenance (persistent data services)**

Janae Wallace, Paul Inkenbrandt, and Marshall Robinson:

a. administered and maintained the UGS database, connecting it to the NGWMN portal;
b. performed regular manual and automated quality assurance and quality control;
c. maintained a user interface (UI) application that allows for immediate upload of site and field chemistry information;

2. **Updating network site list (Objectives 2 and 3)**

Janae Wallace coordinated with other groundwater geologists at the UGS to check station data, and add data where necessary. The groundwater geologists inspected records related to their respective sample sites and verified the accuracy of the information of that location to ensure that

it is correct and current. Under the direction of Janae, the geologists entered new data related to the NGWMN sites into the UGS database, which allowed for the flow of that data to the NGWMN.

3. **Populating data elements (Objective 3)**

The UGS populated data elements for many of its sites, mostly well construction and lithology data. Because almost all of the sites in our network are existing, privately-owned wells, we use the Utah Division of Water Rights' records to populate our site data.

The extensive database offered by the Utah Division of Water Rights contains most data elements as outlined in the NGWMN framework document. Drillers' logs may provide inaccurate or inadequate lithologic reporting; such deficiencies can be verified using local geologic maps, cross sections, and published stratigraphic columns (available statewide [Hintze, 1988]; and through our Utah Geological Survey website map products for various locations throughout the state through http://geology.utah.gov/apps/intgeomap/index.html).

Paul Inkenbrandt compiled water-quality laboratory results returned from the EPA laboratory related to NGWMN sites and submitted those data through the CDX (Central Data Exchange) into the EPA WQX. The WQX data flow to the NGWMN.

4. **Ensured an operational connection between the UGS and the NGWMN Portal (Objectives 2 and 3)**

Working closely with the USGS, the UGS continued to provide data to the NGWMN. The UGS:

a. ensured that the data is flowing from UGS to WQX to NGWMN;

b. maintained data integrity and proper flow of results data;

c. established best practices for data transfer and upkeep;

d. maintained a schema/field mapping and conversion in cooperation with USGS;

e. maintained REST service to serve data via web service in cooperation with USGS.

WEB SERVICES

The UGS uses an ESRI-based ArcGIS SDE (spatial database) to store data collected for the UGS networks. The ArcGIS platform allows us to serve data via REST-based public web services. The schema of the database was modeled after the EPA's WQX database under the guidance of the USGS, where the primary tables are a Results table that holds measured data and a Stations table that holds monitoring location/site information. Many of the field names are different than those of the WQX to meet field name limitations of the SDE and some fields have been added to comply with the minimum data requirements (Subcommittee on Ground Water, 2013) of the NGWMN. We also have well owner information, well construction information, and lithology information tables. Well owner information is not made publicly available by the UGS.

All of the data we transmit and services we provide follow existing federal schemas, specifically the WQX schema. The UGS provides services that contain the following tables:

1. Stations
    a. unique identification is the station identification number
    b. contains minimum data requirements for sites
2. Results
    a. many to one relationship with stations

    b. joined to stations using station identification number
    c. parameter per row format
    d. contains results returned by the U.S. EPA laboratory
    e. contains measured field parameters
3. Lithology
    a. lithology describes the geology from the well driller's record
    b. this information is connected to the station table via the station identification number
4. Well Information
    a. this table includes completion and well construction
    b. it is derived from the Utah Division of Water Rights database

The current UGS services can be found at the following web addresses:

- https://webmaps.geology.utah.gov/arcgis/services/Groundwater/NGWMN_USGS/MapServer/WFSServer?request=GetCapabilities&service=WFS
- https://webmaps.geology.utah.gov/arcgis/rest/services/Groundwater/NGWMN_USGS/MapServer

The state of Utah provides technical assistance to various state agencies through its Department of Technology Services (DTS). The UGS has acquired state funding to hire a data manager to maintain and build our databases that feed our website. The UGS also has many technically experienced staff that maintain databases and web pages. We are currently working with the EPA on an Exchange Network grant to enhance the flow of water chemistry and

wetland data from Utah to the EPA. With the Exchange Network support the UGS is actively developing an ESRI Collector based application to interface with the database, allowing UGS staff to enter station and field data anywhere that internet is available. The interface is still being beta-tested, but will be the main platform for entering data into the UGS database. Data entry on the application limits users to specific domains for each field, to ensure that the entered data follows the schema required by the EPA WQX and NGWMN.

PROBLEMS ENCOUNTERED

No significant issues were encountered during this project. Paul Inkenbrandt and Nathan Payne experienced difficulty in developing a workflow for data to go from the UGS to the WQX, but efforts on Exchange Network grants allow for a more efficient flow of UGS chemistry data.

EXPECTED CHANGES

Within the next year, the UGS expects to migrate from a Microsoft SQL database for its SDE to a Postgresql database. The UGS may also explore using alternative agencies to host its data, like CUAHSI, as they meet the XML delivery requirements that the USGS currently maintains. The UGS will host its stable isotope data with the University of Utah. A new data manager is starting at the UGS, which will allow for better organization of our data.

REFERENCES

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