Regional Geology Web Map Application Development: Javascript v2.0

Mid-FY2017 M4 Milestone Report

Fuel Cycle Research & Development

Prepared for the
U.S. Department of Energy
Spent Fuel, Storage, and Waste
Technology Campaign

Glenn Russell
Idaho National Laboratory

June 19, 2017

DISCLAIMER

This information was prepared as an account of work sponsored by an agency of the U.S. Government. Neither the U.S. Government nor any agency thereof, nor any of their employees, makes any warranty, expressed or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness, of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. References herein to any specific commercial product, process, or service by trade name, trade mark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the U.S. Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the U.S. Government or any agency thereof.

SUMMARY

This is a milestone report for the FY2017 continuation of the Spent Fuel, Storage, and Waste, Technology (SFSWT) program (formerly Used Fuel Disposal (UFD) program) development of the Regional Geology Web Mapping Application by the Idaho National Laboratory Geospatial Science and Engineering group. This application was developed for general public use and is an interactive web-based application built in Javascript to visualize, reference, and analyze US pertinent geological features of the SFSWT program. This tool is a version upgrade from Adobe FLEX technology. It is designed to facilitate informed decision making of the geology of continental US relevant to the SFSWT program.

CONTENTS

SUMMARY iii

1. INTRODUCTION 1
   1.1 Spatial Data 1
   1.2 Tools 3
   1.3 What's New 4
   1.4 Export Control 4
   1.5 External Hosting of Application 4
   1.6 Software Development Testing and Migration 5
   1.7 Maintenance 5

2. REFERENCES 6

3. FIGURES 7

FIGURES

Figure 1. JavaScript version 1.0 Regional Geology Web Mapping Application 7

ACRONYMS

AOI – Area of Interest
ArcGIS – Suite of Esri's GIS software
DMZ – Demilitarized Zone
Esri - Environmental Systems Research Institute
FLEX – Open-source application framework for building and maintaining expressive web applications
FY2016 – Fiscal Year 2016
IE – Internet Explorer
INL – Idaho National Laboratory
JS – Javascript application development language
RGWM - Regional Geology Web Map
GeoSE – Geospatial Science and Engineering Group
GIS – Geographic Information System
LANL – Los Alamos National Laboratory
MXD – ArcGIS Map Document
NE - Office of Nuclear Energy
SFSWT – Spent Fuel, Storage, and Waste Technology
UFD – Used Fuel Disposal
URL – Uniform Resource Locator
US – United States
USGS – United States Geological Survey
UTM – Universal Transverse Mercator

REGIONAL GEOLOGY INTERACTIVE WEB BASED MAPPING APPLICATION MILESTONE REPORT

1. INTRODUCTION

As part of the US Department of Energy's Office of Nuclear Energy (NE) Spent Fuel, Storage, and Waste Technology Program (SFWST) (formerly the Used Fuels Disposition (UFD) Program), Los Alamos National Laboratory (LANL) has developed GIS (geographic information system) data for understanding the relationships between potential geologic host rocks for a high-level nuclear waste repository and potential siting guidelines that could influence the eventual siting of a repository. NE has employed Idaho National Laboratory (INL) to provide this information to the public through a web-based, interactive GIS application. This application will allow users to better understand potential siting issues for certain regions of the country including the presence or lack of potential host rocks, natural hazards, potential for future drilling of natural resources, and proximity to population centers.

This document serves as the FY2017 mid-year progress report for continuation of development of the SFSWT Regional Geology Web Map (RGWM) application. This document is presented at a high level; INL's FY2017 project requirements were to migrate, develop, and host a new version of the application in Javascript (JS) while maintaining and hosting the older FLEX based application, which resides on INL's external GIS server. The FY2016 report summarized the functionality and spatial data of the Flex version whereas this report will focus on the JS version 2.0 of the application.

Both applications will take advantage of current GIS application hosting software licenses (ArcGIS for Server). The new JS version can be accessed at https://gis.inl.gov/JSRegionalGeology. The JS application has been built using JS in the Visual Studio Code integrated development environment (IDE) platform for web development. The previous version of the application (FLEX) is built on Adobe Flash technology and Flash is anticipated by the information management community to be an unsupported format in the near future by web browsers such as Internet Explorer (IE), Google Chrome, Mozilla Firefox, and Apple Safari. The solution is to migrate the applications to JS; an Esri ArcGIS supported development language. Javascript based applications are the preferred method of web map application development. Overall, the international GIS community has embraced this development. As prior INL web map application development was primarily FLEX based, the JS language has presented a new learning curve for INL developers. The JS application is a server-side application that does not require users to download software. Rather, the application is provided on a web-enabled server to users via an internet browser such as IE, Chrome, Firefox, or Safari. The initial interface of the RGWM can be viewed in Figure 1.

1.1 Spatial Data

The Regional Geology Application includes various spatial base reference and geological layers specifically identified and provided by LANL (Perry et al., 2014). The data are organized in six

mapservices (e.g., published ArcGIS map documents (MXD)). Below is a list of those mapservices, associated layers and descriptions of the layers:

- **Base Reference Layers**
  - US Population Density - Only areas of greater than 1000 people per mile^2
  - State Boundaries and Labels
  - Major Lakes of the US
- **Alternative Disposal Media**
  - Bedded Salt Formations
    - Raster layer(s) for salt formations (depth only)
    - Vector layer (polygon) for accessing depth value of salt deposits
  - Shale Formations
    - Raster layer(s) for shale formations (depth only)
    - Vector layer (polygon) for accessing depth value of shale formations
- **Depth to Basement**
  - Sediment Thickness Contours
  - Depth to Basement
    - Raster layer(s) for depth to crystalline basement rock (depth only)
  - Basement Rock Depth
    - Vector layer (polygon) for accessing depth (m) to crystalline basement rock
- **Potential Siting Guideline Data Layer**
  - Quaternary Faulting
    - Vector layer (line) showing the distribution of Quaternary faults (USGS)
    - Vector polygon layer showing areas of Quaternary faulting
  - Plio-Quaternary Volcanic Rocks
    - Vector layer (polygon) showing the distribution of Pliocene and Quaternary volcanic rocks (USGS)
  - Sedimentary Rock Thickness (2000 meter contours)
  - Sedimentary Basins of the United States
  - Oil and Gas Production
    - Vector layer (polygon) 0.5 km polygons showing location of oil and gas drilling (USGS)
  - Crystalline Basement Structures (Sims et al., 2005; Sims, 2009)
    - Magnetic Derived Structures
      - Thrust Faults associated with suture zones
    - Structure Types
      - High Angle Faulting
      - Ductile Shear Zone
      - Boundary of Major Rift Zones
  - Subsurface Heat Flow
    - Raster layer from Southern Methodist University (SMU) (Blackwell et al., 2011)
  - Seismic Risk
    - Raster layer showing peak ground acceleration

        - GeoRSS Feed – USGS earthquake map service showing active earthquakes at various magnitudes
    - Granitic/Gneissic Rock
- **Slope and Magnetic Anomaly Maps**
    - Map service showing land administration for the US – (USGS Protected Areas Database map service)
- **Federal Lands**
    - Map Service showing land administration for the US – (USGS Protected Areas Database map service)
- **ArcGIS Online Base Layers**
    - Shaded Relief
    - Landsat
    - Streets
    - Satellite (Satellite and Aerial Imagery)
    - US Topographic (USGS)
    - Shaded Relief
    - Hybrid (Streets and Imagery)
    - Terrain Hybrid Streets and Shaded Relief

1.2 Tools

The RGWM application provides users with a robust set of tools for referencing pertinent geological features and siting potential. The specialized tools are designed to allow for greater usability, referencing of data, and specific layer targeting. Below is the list of tools provided in the application:

- **Navigation** – This standard map tool provides navigation of the map by zooming to scale, panning, front and back zoom, and directional pan.
- **Base Layer Toggling Tool** – Gives users the option to switch between base layers of imagery, streets layer, shaded relief, topographic, and hybrid layers depending on user background layer preference.
- **Scale Bar** – These are additional standard map tools providing scale information. The tool automatically updates information while a user interacts with the application.
- **Overview Map –** Provides users with an overview map of the location of the current extent in the main map window.
- **Layers** – This tool provides the user with the ability to interact with the data layers by turning them on and off, adjusting layer transparency, moving layers up and down in the table of contents, and provides descriptions of the data layers.
- **Legend** - Tool allows user to see the symbology of visible layers
- **Bookmarks** – This provides the ability to navigate through the map by saved map extents and allows users to add/create new extents.
- **Salt, Shale, & Basement Depths Tool** – This tool's designed to provide the user with name of and depths of subsurface formations (Salt Deposits, Shale Formations, Crystalline Basement Rock)

- **Analyze Tools**
  - **Draw** – Tool allows users to draw graphics on the map.
  - **Measure Tool** – This tool allows for a user to draw graphics on the map and obtain specific units of measure (area, distance, location) of those graphics.
- **Print Tool** - Allows a user to save or print the current visible map within the RGWM.
- **Help Tool** – This tool provides the users with the simple directions on how to use the tools within the application.

1.3 What's New

The new JS v2.0 RGWM has a new look and feel from the FLEX version. Below is a list of what to expect that is new and different from the previous version:

- **Tool Locations** – Tools are now located in a "fixed" tabular window to the left of the map.
- **Basemaps** - Additional basemaps have been added. This includes Landsat imagery and additional hybrid basemaps.
- **Legend Tool** – Provides symbology descriptions for current visible layers in the map. Basemaps are excluded from this tool.
- **Draw and Measure Tools** – These tools were once a single tool, now they function separately.
- **Print Tool** – A more user friendly Print tool is provided in the JS v2.0 application.
- **Touchscreen Technology Usage** – The new JS version should allow for easier (without a mouse) use and navigation on iPads, surfaces, and other touchscreen technology. With the rich data provided in this application, it is not recommended for use with cell phones.

1.4 Export Control

For the software to meet functionality and policy standards, an overview was performed by INL Scientific & Technical Information Management Systems (STIMS) team and review for Export Compliance was performed to gain approval for release for public use of the RGWM application. The review of the application did not find any security or functionality issues to address.

1.5 External Hosting of Application

To provide this application to the public, the INL has implemented a web-enabled server for GIS data and applications which provided web hosting of the RGWM. In FY2016 and through mid-FY2017, security issues were identified, addressed, and resolved with the server's capabilities. For better workflow, upgrades and installations of the Esri's ArcGIS suite of software were performed. Through software updates and server configuration changes, performance of ArcGIS for Server on the host server has been improved. In FY2016, ArcGIS for Desktop was also installed to improve the efficiency of publishing map services used in the RGWM.

1.6 Software Development, Testing, and Migration

Using INL's GeoSE development workstations, RGWM was tested for functionality of layers and tools. The application was then compiled and migrated to an application beta testing server within the INL internal network. The testing environment allowed for members of the GeoSE group to test functionality in a server environment similar to the host server. Once functionality was considered satisfactory, the application and data were migrated to the INL external ArcGIS for Server on the INL DMZ (demilitarized zone) network for use by the public. The RGWM is currently functional and publically accessible. It can be accessed via web browser by the following Uniform Resource Locator (URL) address:

https://gis.inl.gov/JSregionalgeology

1.7 Maintenance

Maintenance of the RGWM is anticipated to continue through FY2017 and to be performed by the INL developers. The JS v2.0 version of RGWM is yet to be deployed with the User Feedback tool that provides user feedback and reporting of software bugs. This tool sends the development group an email with the users' comments and contact information. As part of the maintenance, the RGWM, administrators and developers are expected to respond to the user feedback and resolve issues in a timely manner. This tool will be deployed by end of FY2017.

2. REFERENCES

Blackwell, D.D., Richards, M.C., Frone, Z.S., Batir, J.F., Williams, M.A., Ruzo, A.A., and Dingwall, R.K., 2011, "*SMU Geothermal Laboratory Heat Flow Map of the Conterminous United States, 2011*". Supported by Google.org. Available at http://www.smu.edu/geothermal.

Perry, Frank Vinton, Kelley, Richard E., Birdsell, Suzanne M., Lugo, Alexander Bryan, Dobson, Patrick, & Houseworth, James (Nov 2014). Database for Regional Geology, Phase 1: A Tool for Informing Regional Evaluations of Alternative Geologic Media and Decision Making (LA-UR--14-27389). United States

Sims, P.K., K. Lund, and E. Anderson, 2005. Precambrian Crystalline Basement Map of Idaho—An Interpretation Of Aeromagnetic Anomalies. Scientific Investigations Map 2884, U.S. Geological Survey.

Sims, P. K., 2009. *The Trans-Rocky Mountain Fault System: A Fundamental Precambrian Strike-Slip System*. Retrieved September 28, 2014, from http://pubs.usgs.gov/circ/1334/pdf/C1334.pdf

3. FIGURES

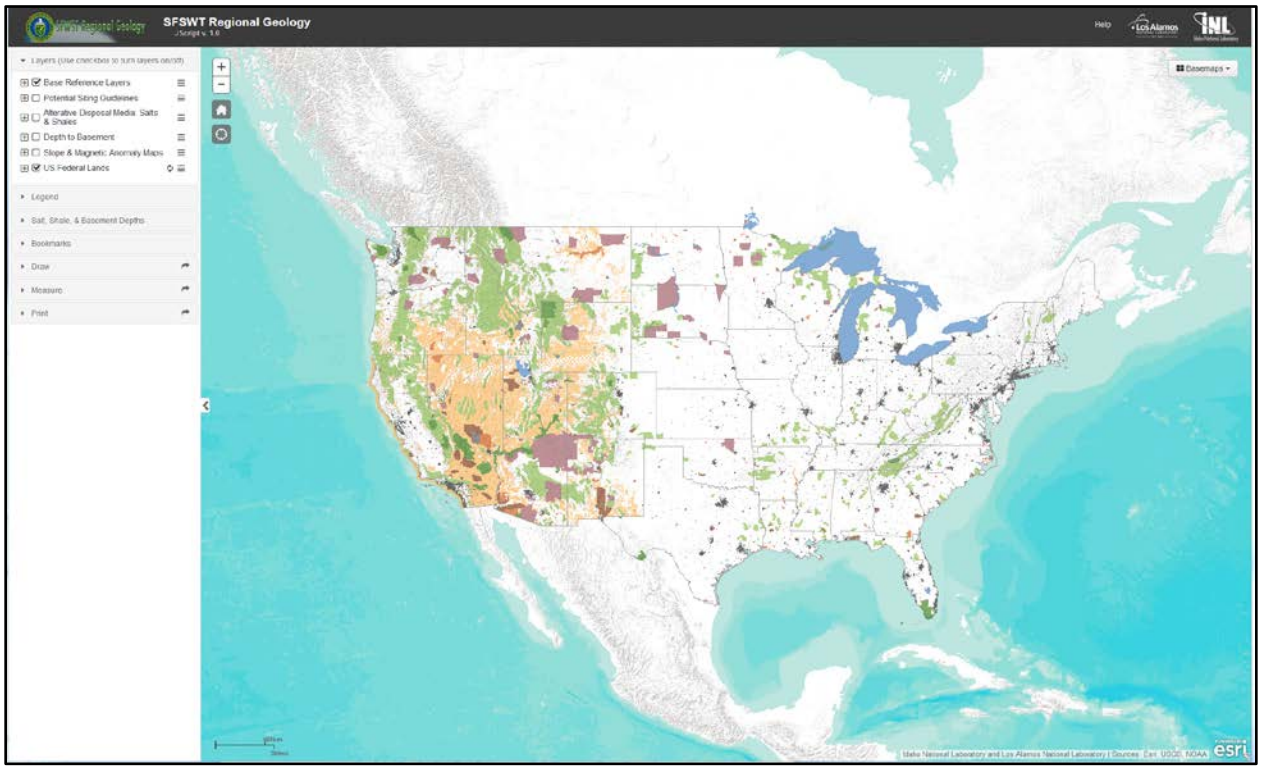

Figure 1. JavaScript version 2.0 Regional Geology Web Mapping Application. This figure shows the original extent of the application as a user would see when launching the web page using their web browser. Application starts with the Layer tool open for users to see layers available. Layers visible in the map upon start up include Base Reference Layers (US States, Large Lakes) and US Federal Lands.