Regional Geology Interactive Web Based Mapping Application: Javascript v2.0

Mid-FY2018 Milestone Report

Fuel Cycle Research & Development

SUMMARY

This is a milestone report for the FY2018 continuation of support, maintenance, development and hosting of the Spent Fuel, Storage, and Waste, Technology program (formerly Used Fuel Disposal program) 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 Flash technology. It is designed to facilitate informed decision making regarding geology of continental US relevant to the SFSWT program.

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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

SFWST – Spent Fuel, Waste, and Storage Technology

UFD – Used Fuel Disposal

URL – Uniform Resource Locator (a web address)

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, Waste, and Storage Technology Program (SFWST) (formerly the Used Fuels Deposition (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 FY2018 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 FY2018 project requirements were a continuation of support, maintenance, development, and hosting a new version of the application in Javascript (JS) while maintaining and hosting the older Adobe Flash (FLEX) based application, which resides on INL's external GIS server. FY2016 report summarized the functionality and spatial data of the Flex version and the FY2017 report focused on the migration to JS version 2.0 of the application whereas this report summarizes the activities related to support maintenance, and hosting of the application.

Both applications will take advantage of current GIS application hosting software licenses (ArcGIS for Server). The JS application is accessed at https://gis.inl.gov/RegionalGeology. The application was built using JS in 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 (2019) by web browsers such as Internet Explorer (IE), Google Chrome, Mozilla Firefox, and Apple's Safari. The solution has been to migrate the applications to JS, an Esri's 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. INL's experience developing web map applications with this platform is new. However, INL has now produce multiple web map applications for internal and external use for purposes of emergency management, facilities management, subsurface investigations, cultural resources, and homeland security.   For our developers, a learning curve has been overcome and additional customization of applications is developed and tested.

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 RGWM can be viewed in Figure 1. The application can be utilized on Windows and Macintosh based desktops and laptops, surfaces and iPads, as well as mobile devices. Screen size of device may or may not be an impediment to usage because of the data-rich content of the applications.

1.1   FY2018 Continued Resolution Appropriations

Through May of FY2018, the web map application development and enhancements were limited and a focus of support, maintenance, administration, and hosting of the application were the primary tasks performed.   Enhancements are anticipated for the remainder of FY2018.   As well, a proof of concept for interactive 3D web visualization of regional geology data will be developed. 3D interactive tasks is in collaboration with LANL and their development of 3D geologic framework data and models associated with GDSA framework.

1.2   Spatial Data

The Regional Geology Application includes various spatial base reference and geological layers specifically identified and provided by LANL for the Geologic Framework Models. 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
- **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 from Sims et al. (2005)
    - 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)
  - Seismic Risk
    - Raster layer showing peak ground acceleration
    - GeoRSS Feed – USGS Earthquake map service showing active earthquakes at various magnitudes
  - Granitic/Gneissic Rock
- **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
- **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

- o Hybrid (Streets and Imagery)
- o Terrain Hybrid Streets and Shaded Relief

1.3 Tools

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 giving the scale distance information. Tool automatically updates information while user interacts with 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** - Tools allows user to see the symbology of visible layers
- **Regional Extents** – This provides the ability to navigate through the map by saved map extents and allow users to add/create new extents.
- **Salt, Shale, & Basement Depths Tool** – This tools designed to provide the user with name of and depths of subsurface formations (Salt Deposits, Shale Formations, Crystalline Basement Rock)
- **Analyze Tools**
  - o **Draw** – Tools allows users to draw graphics on the map.
  - o **Measure Tool** – This tool allows for a user to draw graphics on the map and get specific units of measure (area, distance, location) of those graphics.
- **Print Tool** - Allows a user to save or print the current visible map within RGWM.
- **About Tool** – This tool provides the users with the simple directions on how to use tools within the application.

1.4   What's New

The new version 2.0 RGWM has a new look and feel from the FLEX version. Below is a list of what to expect that is new (FY2018) and different from the previous version:

- **Basemaps** - Additional Basemaps have been added from previous version. This includes Landsat imagery and additional hybrid

- **Legend Tool** – Tools provides symbology for current visible layers in the map. Basemaps are excluded from Legend tool.

- **iPads and Surfaces Usage** – The new JS version allows for easier (without a mouse) use and navigation on iPads, Surfaces and other touch screen technology.   With the rich data provided in this application, it is not recommended for use with cell phones.

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 configurations changes, performance of the ArcGIS for Server on the host server has been improved. In FY2016, ArcGIS for Desktop was also installed to improve the efficiency of publishing mapservices used in the RGWM. The older FLEX RGWM version is still operational and supported. FLEX application support will expired in 2019.

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/RegionalGeology

Previously used URL address https://gis.inl.gov/JSregionalgeology is now redirected to the updated URL.

1.7   Maintenance

Maintenance of the RGWM is anticipated to continue through FY2017 and performed by the INL developers. 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 FY2018.

2.   REFERENCES

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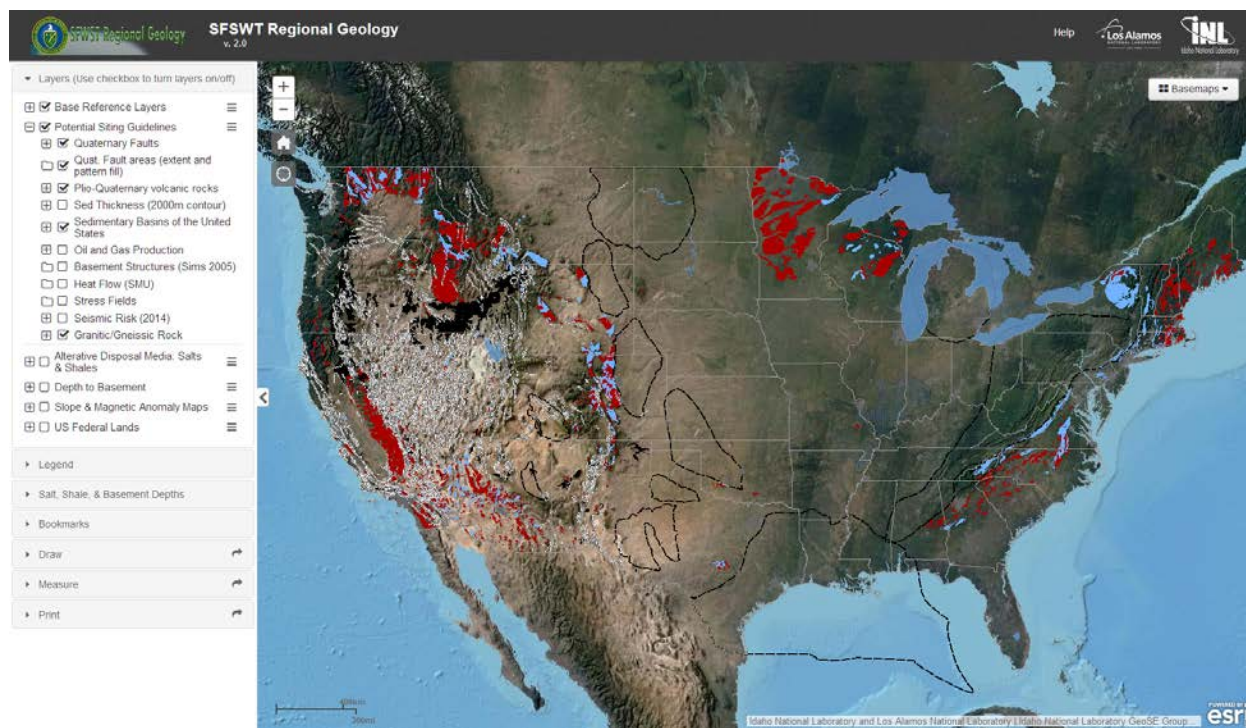
3. FIGURES

Figure 1. Version 2.0 Regional Geology Interactive Web Mapping Application
(https://gis.inl.gov/RegionalGeology)

4.   USER'S GUIDE TO THE REGIONAL GEOLOGY WEB MAP APPLICATION

http://gis.inl.gov/RegionalGeology/

Note: It may be better to use browser Google Chrome or Mozilla Firefox when accessing this site.

Go to http://gis.inl.gov/RegionalGeology/

- Map with sites appears.
- To change the zoom scale, zoom tools are in upper left corner of map. Panning the map can be accomplished by left mouse click and holding and moving the map.   Also, mouse rollers can be used to zoom in and out.

To the left side of the window, see grey panel with application tools: *Layers, Legend, Salt, Shale, & Basement Depths, Bookmarks*, etc., each with open/close button (a triangle) to the left of the word (Figure A2-1).

Basemaps:

In the upper right corner of the map window, see a grey rectangle containing word "Basemaps". Select or click the rectangle to choose a basemap you find of value in your exploration of the tool. You are presented with ~7 choices for basemap to use including imagery, streets, topographic, hillshade and hybrids (i.e. streets and hillshade). It is recommended that the "satellite" view is used for the basemap but other basemaps may be a better orientation reference at different scales depending on user preference.

Layers:

Click triangle to the left of word "Layers".   Two boxes appear next to the facility title and each layer title for the list of all 5 mapservices. Each mapservices has multiple map layers that can be turn on and off the checkbox. Make sure you place a check mark in each box just to left of layer name, and if you select or click the small box to the far left of the map and layer titles, the layer features symbols appear on the map and equivalent of a legend is visible for symbols on map. Click the plus sign and make sure a check mark is in the right box next to each layer name or next to "all Layers". This activates database for each of the layers.

Salts, Shales & Basement Depths:

Click the triangle to left of title "Salt, Shale, & Basement Depths". In the Layers tool, click the checkbox to the left of *Alternative Disposal Media: Salts and Shale* and/or *Depth to Basement* mapservices depending on user preference. In the Salt, Shale, & Basement Depths tool, you may

select one layer or all layers on the map for activation. You may also Right Click with your mouse on the color assigned features on the map to get subsurface depth in meters to the feature at the location selected. Identify features on the map is available to you at any time. When you right click on the feature a pop-up window appears showing depth (meters) and name of formation for specific location. When clicking on a feature that is in close proximity to other features, you may get popup results for multiple features. When this is the case, you will see a ratio (i.e. "(1 of 3)") in the upper left corner of the popup indicating multiple features have been identified. Use triangle on upper right side to navigate to the other identified features. This tool cannot be used if the layers are not visible in the map.

Links to Report:

Through the hyperlinks in this tool, you may access the full report and key sections of the report in pdf format. Click on the link and the document should open in a new tab. If the document auto-downloads, a setting in your web browser will need to be changed. To make that change in Google Chrome:

1. Open *Google Chrome*.
2. Click on the *Menu* icon ( ) in the top-right corner of the Window.
3. Click *Settings*.
4. Scroll down to the bottom of the Settings window and click *Advanced*.
5. In the *Privacy and security* section, click *Content Settings*.
6. Scroll down and click the *PDF* documents option.

To change in Mozilla Firefox:

1. Go to *Tools > Options* (or *Firefox > Options*).
2. In the Options window, scroll down and select the *Applications* tab.
3. In the *Search* field, type *PDF*. You should find *Portable Document Format (PDF)*.
4. On the right-hand side you should find an *Action* column. Use that to select your favorite PDF reader. In order to view PDF files in Firefox, choose *Preview in Firefox*.

To change in Internet Explorer:

Make sure that the Adobe PDF browser add-on, AdobePDF.dll, is enabled.
1. Open *Internet Explorer*.
2. Select *Tools > Internet Options*.
3. Click the *Programs* tab.
4. Click the *Manage Add-ons* button.
5. Set the Show menu to "*Add-ons that have been used by Internet Explorer*."
6. Find and select *Adobe PDF Reader*.

7. Find and select *Adobe PDF Reader* and click *OK*.

Regional Extents:

Click the triangle to left of word "Regional Extents". A list of preset regional extents is now visible and you may select an extent that will change the extent of the map. You may also pan and zoom to a new extent and click Add Bookmark. This will save a new extent for use in a later session.

Draw:

Click the triangle to left of word "Draw". You may select from five options to draw on map: Point, Circle, Polyline, Freehand Polyline, Polygon, Freehand Polygon, Area, Distance, and Location. Use the Stop Drawing button to stop drawing in during drawing. Use the Clear Drawing button to delete all drawing on map.

Measure:

Click the triangle to left of word "Measure". You may select from three options: Area, Distance, and Location. Once you select an option the units will appear to the right, and you may click on the units to change to the desired unit. After making your selections you can draw a polygon, line or points on the map. The units will appear in the left panel. Click on map at start point; double click to terminate drawing a line or polygon.

Print:

Click the triangle to left of word "Print". This tool allows you to print or save a copy of the current map extent, i.e., this prints or saves view of map area on screen, not the entire map.

Legend:

Click the triangle to left side of the word legend, and the layer symbols appear. Each map layer / facility type is assigned a color coded symbol; Deep mines layer has multiple colors assigned for infill of hexagonal symbol representing mine or shaft depth for the facilities in Table 1, Deep Mines and Shafts. You may leave the Legend open, or click the triangle to close it.

About:

To the right side of the top banner of the map, you can click on the *About* tool. This opens a stationary window on the map that provides helpful information about the site.   Information is organized in tabular pages (Welcome (Abstract), Navigation, Tools, What's New).   Hover the mouse over the name on the tabs and click. When finished, click X in upper right corner and you will return to the map.
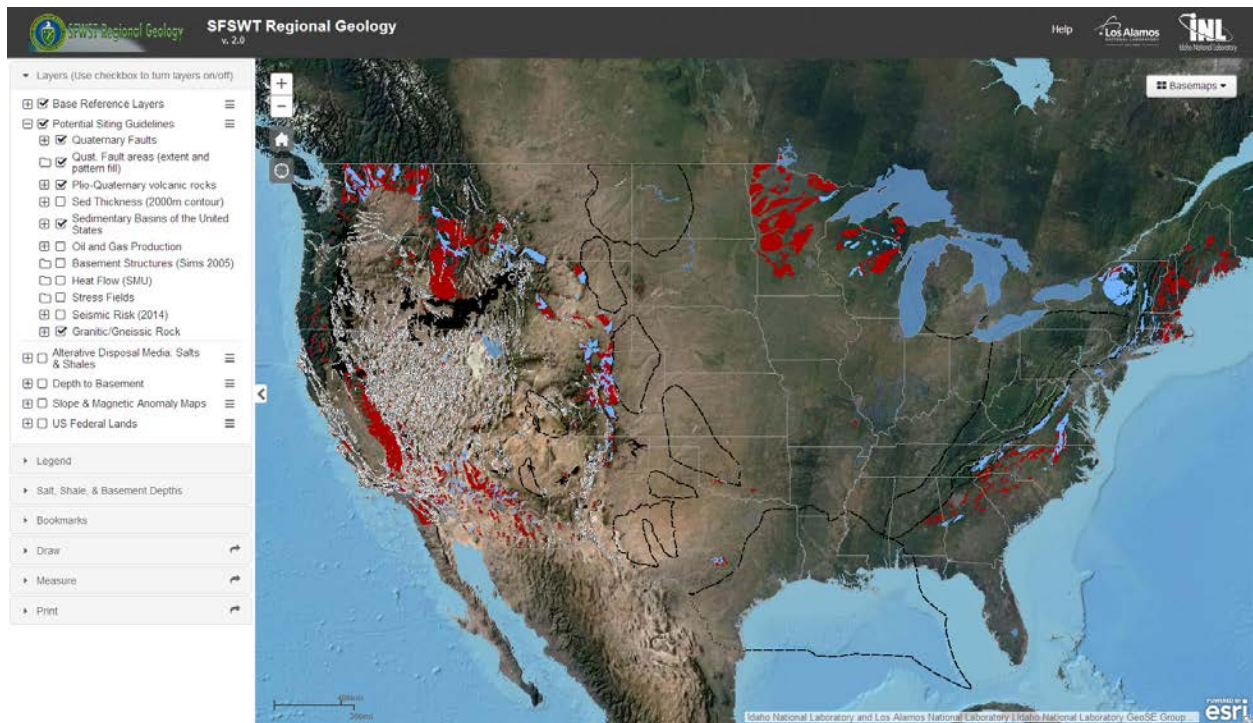
Figure 2: Main page for http://gis.inl.gov/RegionalGeology/.

Not all layers for the mapservices are activated or visualized in the map on start up. Tools to manipulate maps, layers, and information on found on left panel or top banner.