

STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION
TECHNICAL REPORT DOCUMENTATION PAGE
 TR0003 (REV. 10/98)

1. REPORT NUMBER CA13-1232	2. GOVERNMENT ASSOCIATION NUMBER N/A	3. RECIPIENT'S CATALOG NUMBER N/A
4. TITLE AND SUBTITLE Final Report: Implementing and Deploying Data Management Tools within Geotechnical Services	5. REPORT DATE March 29, 2013	6. PERFORMING ORGANIZATION CODE N/A
	7. AUTHOR(S) Loren Turner, Xing Liu	8. PERFORMING ORGANIZATION REPORT NO. CA13-1232
9. PERFORMING ORGANIZATION NAME AND ADDRESS California Department of Transportation Division of Research, Innovation and System Information Sacramento, CA 95814	10. WORK UNIT NUMBER N/A	11. CONTRACT OR GRANT NUMBER Task ID 1232
	12. SPONSORING AGENCY AND ADDRESS California Department of Transportation Division of Research, Innovation and System Information Sacramento, CA 95814	13. TYPE OF REPORT AND PERIOD COVERED Final Report
14. SPONSORING AGENCY CODE N/A	15. SUPPLEMENTAL NOTES N/A	
16. ABSTRACT <p>The objective of this task was to develop and deliver a central web-based data and document repository for use by staff in Caltrans' Geotechnical Services that integrates key elements of geotechnical information management. This research task produced the Digital Archive of Geotechnical Data (GeoDOG), an internal Caltrans web-based tool for managing the Department's geotechnical documents and data. GeoDOG allows users to upload, search, and download geotechnical documents and data. Its primary web page centers around a map interface, displaying the locations of project files and data, and providing a boundary tool for refining search areas. Search results are presented in a table with sortable columns, mouse-over information, document preview, and a shopping-cart style document download feature. GeoDOG incorporates a project creation and document upload form that Caltrans staff can use to archive project documents upon completion.</p>		
17. KEY WORDS GeoDOG, geotechnical data management, data interchange standards, borehole logs	18. DISTRIBUTION STATEMENT No restrictions. This document is available to the public through the National Technical Information Service, Springfield, VA 22161	
19. SECURITY CLASSIFICATION (of this report) Unclassified	20. NUMBER OF PAGES 90	21. PRICE

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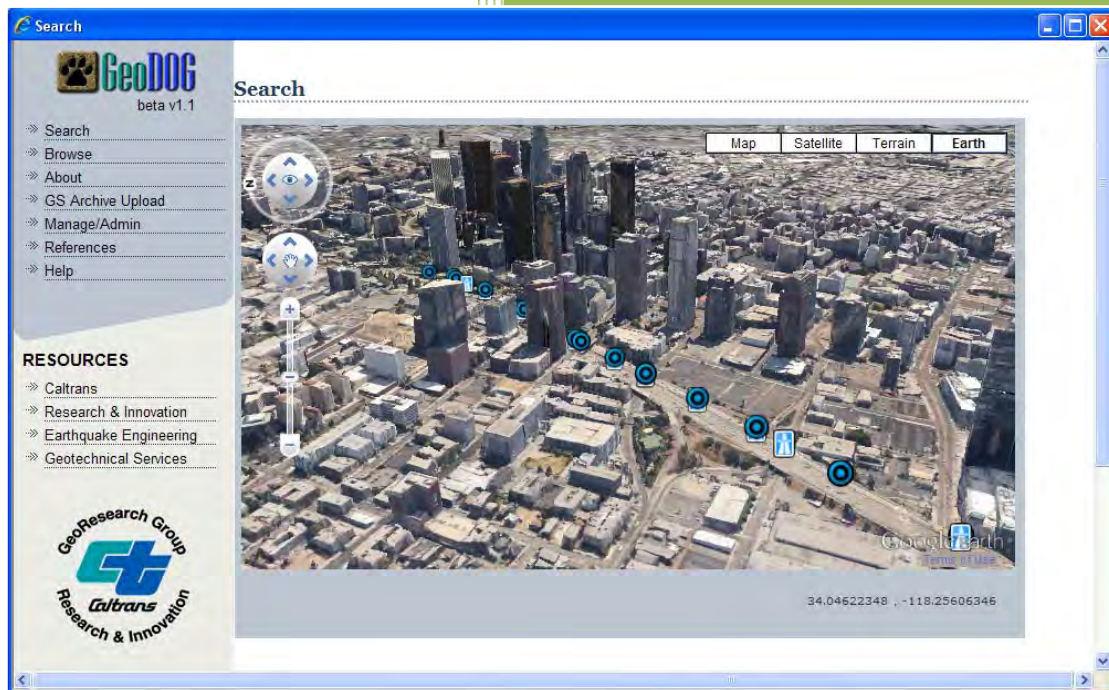
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Final Report: Implementing and Deploying Data Management Tools within Geotechnical Services



Caltrans Division of Research,
Innovation and System Information

Report CA13-1232
March 2013

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Final Report: Implementing and Deploying Data Management Tools within Geotechnical Services

Final Report No. CA13-1232

March 2013

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Acknowledgements

The authors would like to acknowledge the significant technical and developmental contributions by former Caltrans Student Assistants, Janki Patel and Keun-Lung Yeh. Furthermore, the guidance and feedback provided by key end-users in Caltrans Geotechnical Services, in particular Craig Hannenian and Natalie Cornell, were critical to the overall success of GeoDOG.

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1 Introduction

In the design and construction of bridge foundations, retaining walls, and other highway facilities, subsurface explorations are needed in order to determine engineering properties of foundation materials. These geotechnical site investigations typically result in large volumes of subsurface information and associated test data being generated. Up until a few years ago, Caltrans practice has relied on paper-based document filing systems that have been difficult to maintain and cumbersome to access by geo-professionals. Misplaced files, deteriorating paper medium, incomplete documentation, and a lack of awareness that certain data even exists have all contributed to inefficient or incomplete utilization of existing data. As subsurface data remains relevant long after the specific project for which the data was originally generated, a change in perception of the value of this data to the Department was needed. The research was carried out to identify and develop pilot tools to initiate change in the management of this important data asset.

The overarching research project was initiated in early 2000 to begin to address these data management challenges, titled *Innovative Geotechnical Data Management Tools and Methods* (Project ID P190). The project's focus was on a combination of elements to realize internal operational efficiencies and enable more convenient discovery of data. These include a series of research tasks to address: (1) geo-data standards and data models that underpin subsequent systems development; (2) improved geo-data collection practices and feasibility of automation in field and laboratory processes; and (3) new tools and technologies to facilitate rapid data archiving, dissemination, discovery, and exchange. The first task, *End-User Interest in Geotechnical Data Management* (Task ID 0057), was completed in November 2008 and touched on many elements of the data management problem. The final report can be found on the Caltrans research website (<http://www.dot.ca.gov/research/researchreports/reports/2008/07-0057.pdf>). The task described in this report, *Implementing and Deploying Data Management Tools within Geotechnical Services* (Task ID 1232), is the second in a series of tasks under this project.

2 Task Objectives and Deliverables

The objective of this task was to develop and deliver a central web-based data and document repository for use by staff in Caltrans' Geotechnical Services that integrates key elements of geotechnical information management. These include:

- A web-based data and document management tool on the Caltrans intranet with QA/QC process controls and tools to assure integrity of the collection.
- A functional user interface that presents data availability using maps and spatial referencing.
- A data interoperability mechanism to exchange data between the soils lab, engineers/geologists, drafting services, and the data repository.
- Support for data files generated by commercial geotechnical software used by Caltrans for borehole logs and laboratory test data.
- Integration with the Department's document management system.

This research task produced the *Digital Archive of Geotechnical Data (GeoDOG)*, an internal Caltrans web-based tool for managing the Department's geotechnical documents and data. GeoDOG allows users to upload, search, and download geotechnical documents and data. Its primary web page centers around a map interface, displaying the locations of project files and data, and providing a boundary tool for refining search areas. Search results are presented in a table with sortable columns, mouse-over information, document preview, and a shopping-cart style document download feature. GeoDOG incorporates a project creation and document upload form that Caltrans staff can use to archive project documents upon completion. This part of the tool incorporates automated notification emails to submitter and archive managers and means for tracking and approval. Screenshots are shown in Figure 2-1.

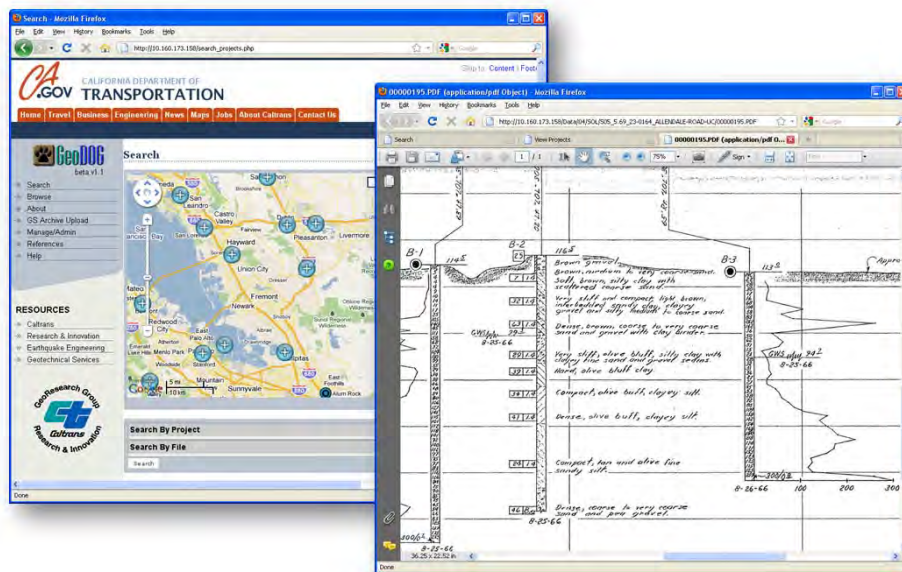


Figure 2-1 – Screenshots from GeoDOG

Over the course of this task, web coding work on GeoDOG was carried out in-house by a student assistant under the direction of the principal investigator. Regular interaction with end-users in Geotechnical Services assured that the end product met the fundamental requirements for a functional and deployable system. A pilot web-based repository was launched mid-term in the task. This allowed ample time for end-users to utilize various tools, and provide feedback to the development team.

Concurrent with the development of GeoDOG, Geotechnical Services initiated a separate contract with a document scanning company to convert over 1 million existing Caltrans geotechnical documents, spanning a period of over 80 years, to a digital format. These documents had been stored in an archive at the Caltrans TransLab facility in Sacramento, California, as shown in Figure 2-2. Additional software tools were developed by the research team to facilitate the bulk uploading of scanned documents into GeoDOG. The creation of this new collection of digitized documents provided an opportunity for end-users to immediately experience the advantages of the new tool.



Figure 2-2 – Former Document Archive Used by Geotechnical Services

Two key deployment milestones were achieved over the course of the research work:

- In March 2010 management in Geotechnical Services established a new policy requiring that all geotechnical products produced after April 2010 be archived using GeoDOG. The paper-based filing system was decommissioned.
- In August 2012 Caltrans Information Technology (IT) migrated GeoDOG from a locally hosted development server within research offices to an operational IT intranet web server. Subsequent maintenance and operations of GeoDOG are carried out by IT.

3 Deployment and Benefits

This research resulted in a deployed product. Implementation of GeoDOG was carried out on Caltrans intranet servers in August 2012, and long-term operations and maintenance activities were assumed by the Caltrans Information Technology Solutions Division. Policies were developed and implemented by the management in Geotechnical Services to establish GeoDOG as an integral component of their product delivery system.

Although the cost-savings have yet to be quantified, similar document management system implementation efforts at the Ohio DOT resulted in 10-20% less drilling and at a savings of \$12 to \$24 million per year. This reduction in costs can be attributed to reusing existing data rather than carrying out new drilling operations in locations where older data could not be found. At Caltrans approximately 300 geotechnical site investigations are conducted annually, each having multiple boreholes. If a savings due to 10% reduction in drilling is realized (as in the Ohio DOT experience), millions could likely be saved annually as well as a result of utilization of existing data.

Other benefits have been realized as a result of GeoDOG implementation, both within Caltrans and by externals:

- Public records requests for geotechnical information are now handled entirely via digital means, and there has been a significant reduction in staff time required to respond to requests.
- Massachusetts DOT is currently evaluating the use of GeoDOG for their document management tool.
- GeoDOG was a key resource in a recent investigative effort into the integrity of foundation testing data.

A follow-up research task is being planned to carry out work that could not be completed within the time and resource constraints of this task.

4 GeoDOG

4.1 Overview

The *Digital Archive of Geotechnical Data (GeoDOG)* is an internal Caltrans web-based tool for managing the Department's geotechnical documents and data. GeoDOG allows users to upload, search, and download geotechnical documents and data. The main web page centers around a map interface, displaying the locations of project files and data. Search tools are provided that use a combination of key attributes (e.g. date range, district, etc.) as well as a map based boundary defining tool. Search results are presented in tables, and a "shopping-cart" style document selection and download function is provided. GeoDOG incorporates a project creation and document upload form that staff can use to submit project documents to the archive upon completion. As part of this feature, GeoDOG sends automated notification emails to submitter and archive managers and means for tracking and approval. Highlights of various GeoDOG webpage features are presented in Figure 4-1 through Figure 4-4.

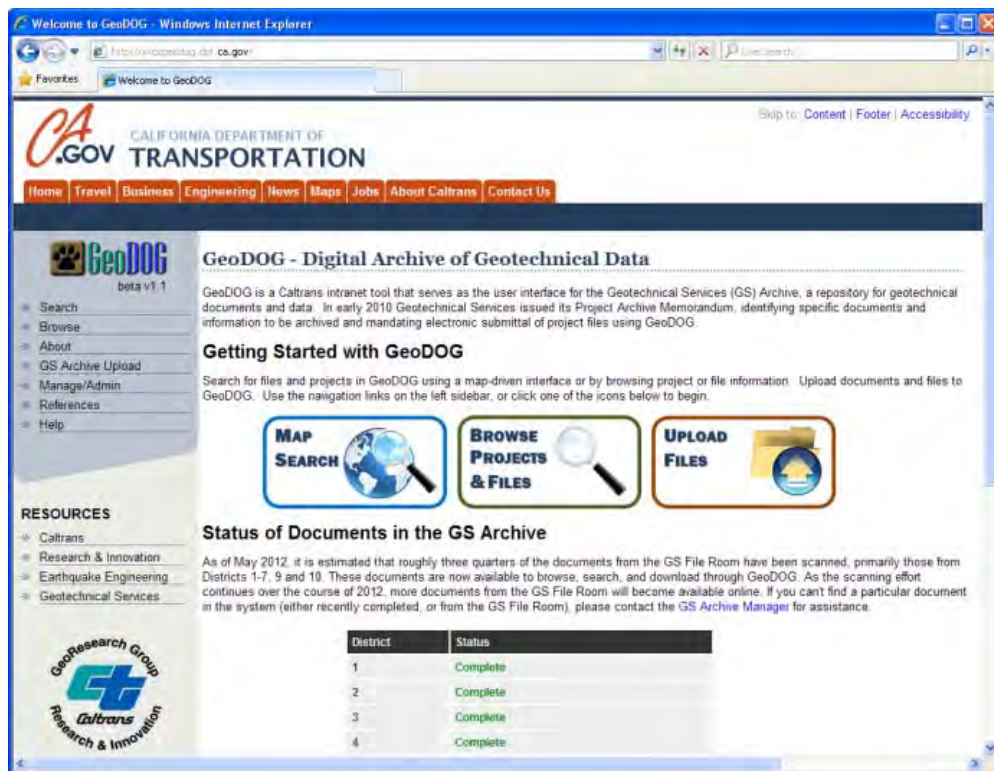


Figure 4-1 – Landing Page for GeoDOG



Figure 4-2 – GoogleMaps Used to Display Locations of Projects and Data



Figure 4-3 – Bounding Box Defined Spatial Limits for Search

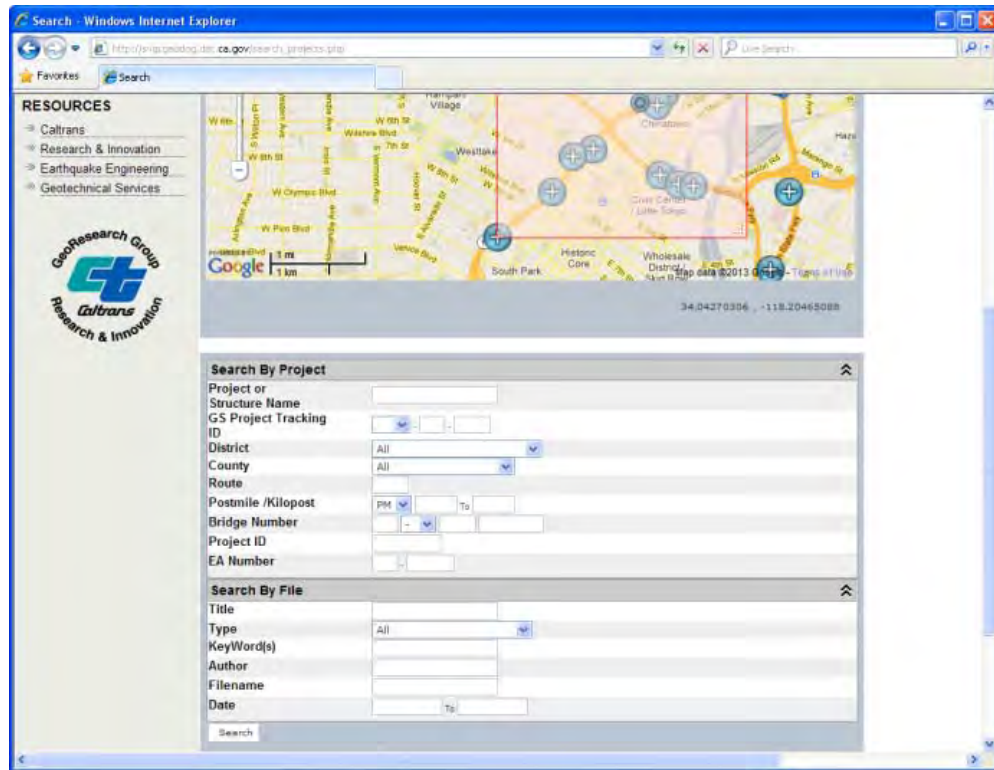


Figure 4-4 – Search Form Provides a Means to Narrow Search Results

4.2 Types of Information Captured in GeoDOG

The primary assets captured in GeoDOG are digital documents or files. GeoDOG can store any file type (e.g. PDF, Word, Excel, etc.) up to a maximum single file size of 50 MB per file. Information about files is captured in two tiers – *project*-specific metadata and *file*-specific metadata. This logical organization of data was setup to mimic the legacy filing systems used for paper-based files (shown in Figure 4-5) where a folder for a *project* contained multiple document *files* within. The project to file relationship and key metadata attributes are illustrated in Figure 4-6.



Figure 4-5 – Paper-based Files Used by Geotechnical Services Prior to GeoDOG

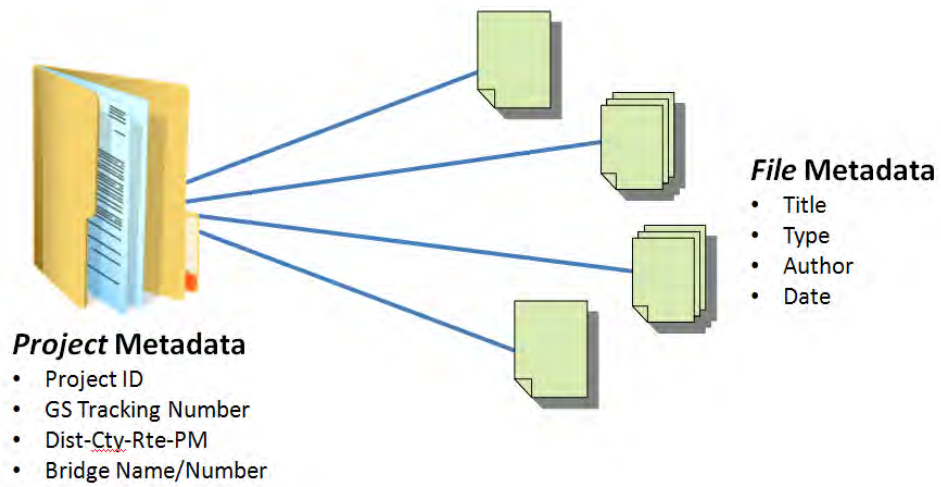


Figure 4-6 – Relationship Between Projects and Files and Key Metadata

5 Technology Architecture

5.1 Core Web Server Software

GeoDOG (<http://svgcgeodog.dot.ca.gov/>) is built upon a suite of integrated web server technologies, including *Windows*, *Apache*, *MySQL*, and *PHP*, commonly referred to as a *WAMP package* or *WAMP stack*. The WAMP package is configured to run on an intranet web server. *Windows* is the operating system running on the server (<http://windows.microsoft.com/>). *Apache* is the web server software (<http://httpd.apache.org/>). *MySQL* is an open-source database (<http://www.mysql.com/>). *PHP* is a scripting language used to carry out transactions between the client's browser and the database in addition to dynamic web page generation (<http://php.net/>). On the client's end a web browser, such as *Explorer*, is used to interface with the *GeoDOG* web application. The interaction of these components is illustrated in Figure 5-1.

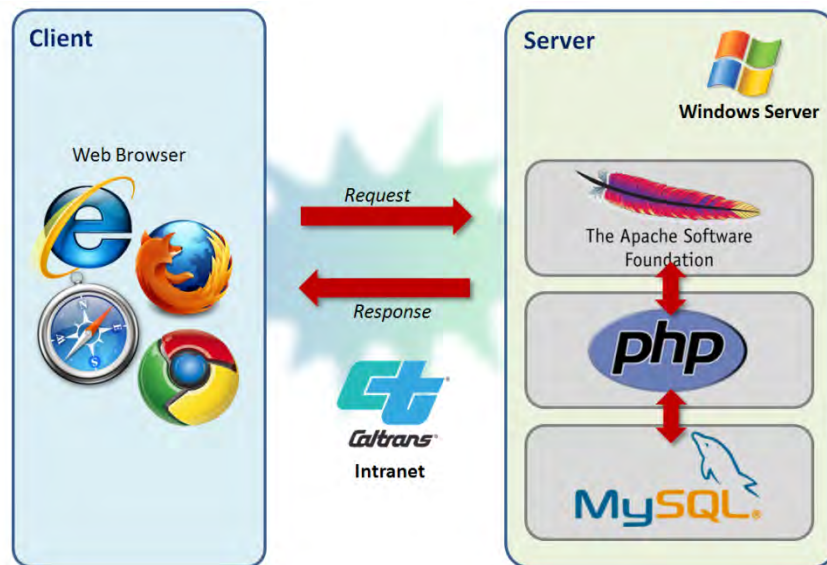


Figure 5-1 – GeoDOG Client-Server Architecture

Specific versions of the suite of software used during the development and testing of *GeoDOG* are presented in Table 5-1.

Server Software	Version
Windows Server	2003 R2
Apache	2.2.17.0
MySQL	5.5.8.0
PHP	5.3.5.0

Table 5-1 – Versions of Software Used During Development and Testing

This core suite of web technologies was carefully selected to conform to software standards established by the Caltrans IT Division. Using standard department-approved technologies greatly reduced

problems during the migration transition of the tool from research to operations. Furthermore, the use of open-source technologies eliminated recurring licensing costs.

5.2 Web Server Hardware

Development and testing of GeoDOG was carried out on server grade computer with the following specifications:

Type	Specification
Make	Dell
Model	PE 2850
Form Factor	Rackmount
Processor	Dual Xeon
Speed	3.6 GHz
Memory	4 GB
Storage	800 GB, RAID-5

Table 5-2 – Development Server Specifications

Although this particular machine is several years old, it likely represents performance of a typical web server.

6 Organization of Web Pages

6.1 Sitemap

The web pages in GeoDOG are organized as shown in the sitemaps in Figure 6-1 and Figure 6-2 below. The most commonly used pages for searching, browsing, viewing, downloading and uploading are available to all users (indicated by the light blue shaded boxes). Management of the file collections and system-level functions are restricted to a smaller set of select users (indicated by the light green and red shaded boxes).

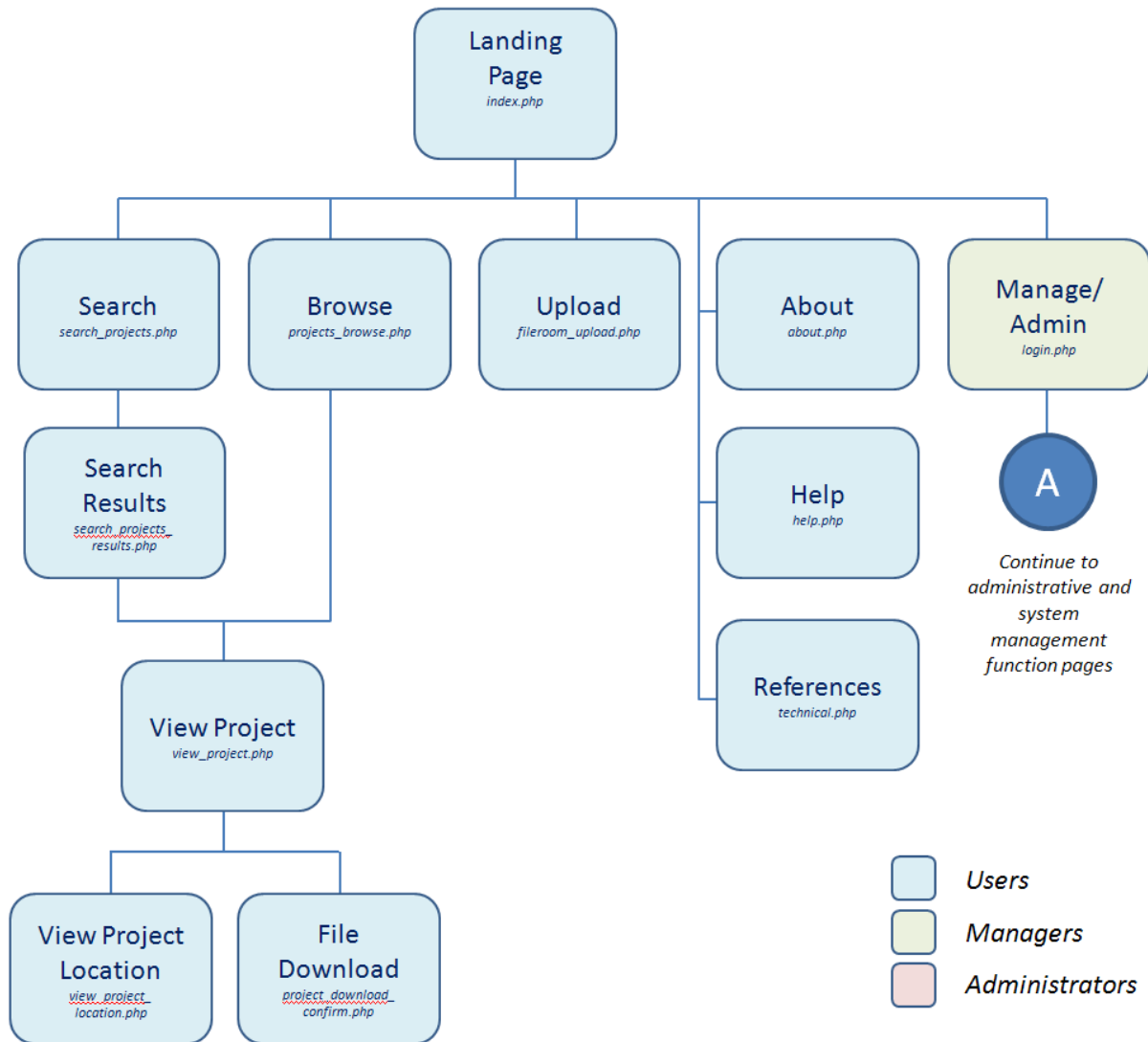


Figure 6-1 – Organization of Main Web Pages in GeoDOG

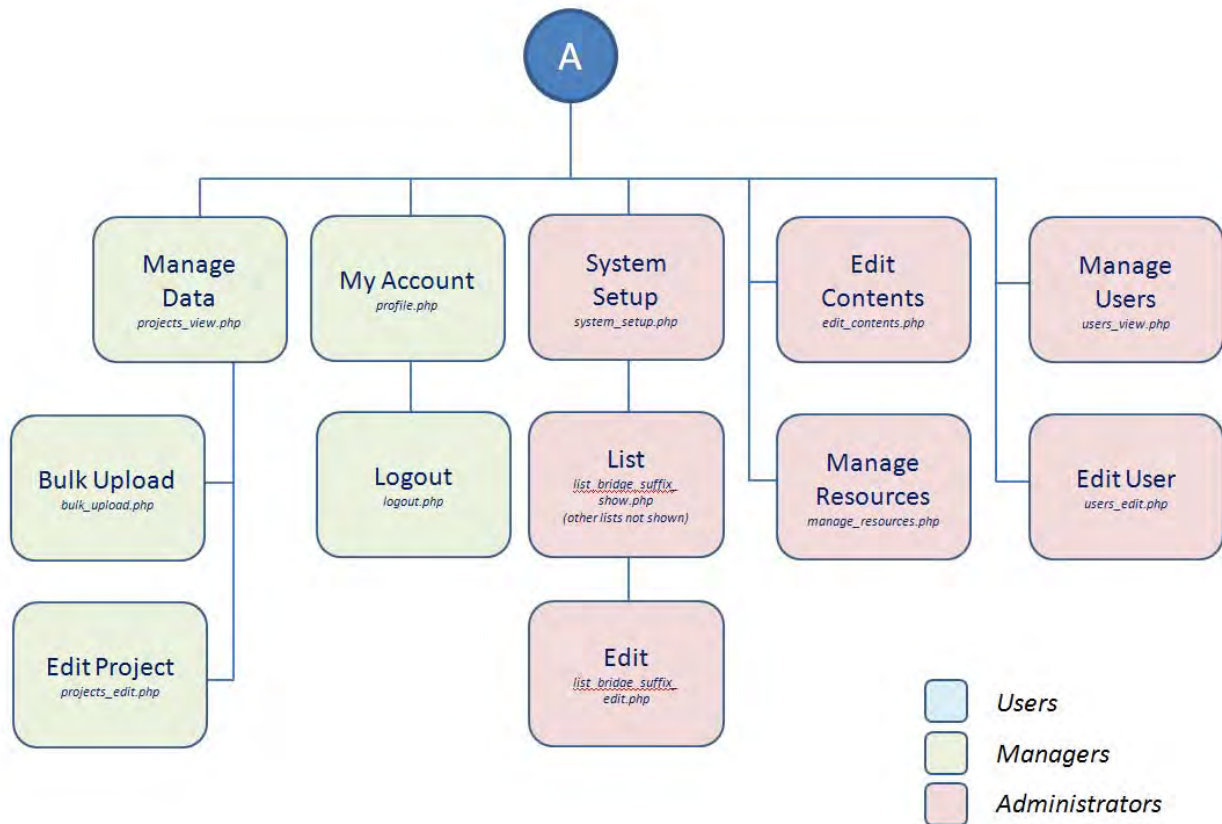


Figure 6-2 – Organization of Web Pages for System Managers and Administrators in GeoDOG

The name of the PHP file for each page is also shown in the figures. A more thorough explanation of each webpage and its corresponding file is presented in later sections of this report.

6.2 User Types and Permissions

Three types of users are defined in the GeoDOG system – *User*, *Manager*, and *Administrator*. Roles for these three types of users and typical interactions with GeoDOG are summarized in Table 6-1.

User Type	Description	Typical Interactions with GeoDOG
User	Caltrans geo-professional working in Geotechnical Services or Structure Design offices.	<ul style="list-style-type: none"> • Search for documents and data during initial design phase. • Download documents. • Upload completed reports and other geotechnical products upon completion of geotechnical work.
Manager	Person(s) with Geotechnical Services that is responsible for reviewing and approving newly submitted documents.	<ul style="list-style-type: none"> • Receive email notifications when documents are uploaded. • Interact with person who submitted documents to resolve issues if needed. • Review uploaded documents for consistency with document submittal policies. • Use GeoDOG approval tools to make documents appear in GeoDOG or delete from the collection. • Use the bulk upload tool to load large collections of scanned documents into the system.
Administrator	Person(s) with Geotechnical Services that is responsible for maintaining the overall operation of GeoDOG.	<ul style="list-style-type: none"> • Manage the creation/deletion of new Manager accounts. • Edit the informational web pages using integrated content management tools. • Edit lookup lists used throughout the system in various forms.

Table 6-1 – User Types in GeoDOG

7 GeoDOG Web Interface

7.1 Webpages Accessible to All Users

7.1.1 Landing Page

The *Landing* page is shown in Figure 7-1 and presents an overview of GeoDOG, information about the status of the document scanning and conversion process, and links for the most commonly accessed features (i.e. *Search*, *Browse*, and *Upload*).

Furthermore, in all pages throughout GeoDOG, a standard set of links appear in the left navigation bar that include:

- *Search* – opens the “Search” page to find documents and/or projects.
- *Browse* – opens the “Browse” page to browse and filter lists of projects.
- *About* – more information about the development of GeoDOG
- *GS Archive Upload* – opens the page to allow users to submit documents from completed projects to the system.
- *Manage/Admin* – login page for “Manager” or “Admin” account holders.
- *References* – opens page with GS policy documents
- *Help* – provides guide for users on how to use the system.



Figure 7-1 – Main Landing Page

7.1.2 Search Page

The *Search* page is shown in Figure 7-2 and is comprised of an interactive map tool in the upper half section and a project/file search form in the lower half section. The combination of user-entered information in both the map and the form fields is used to execute a focused search request.

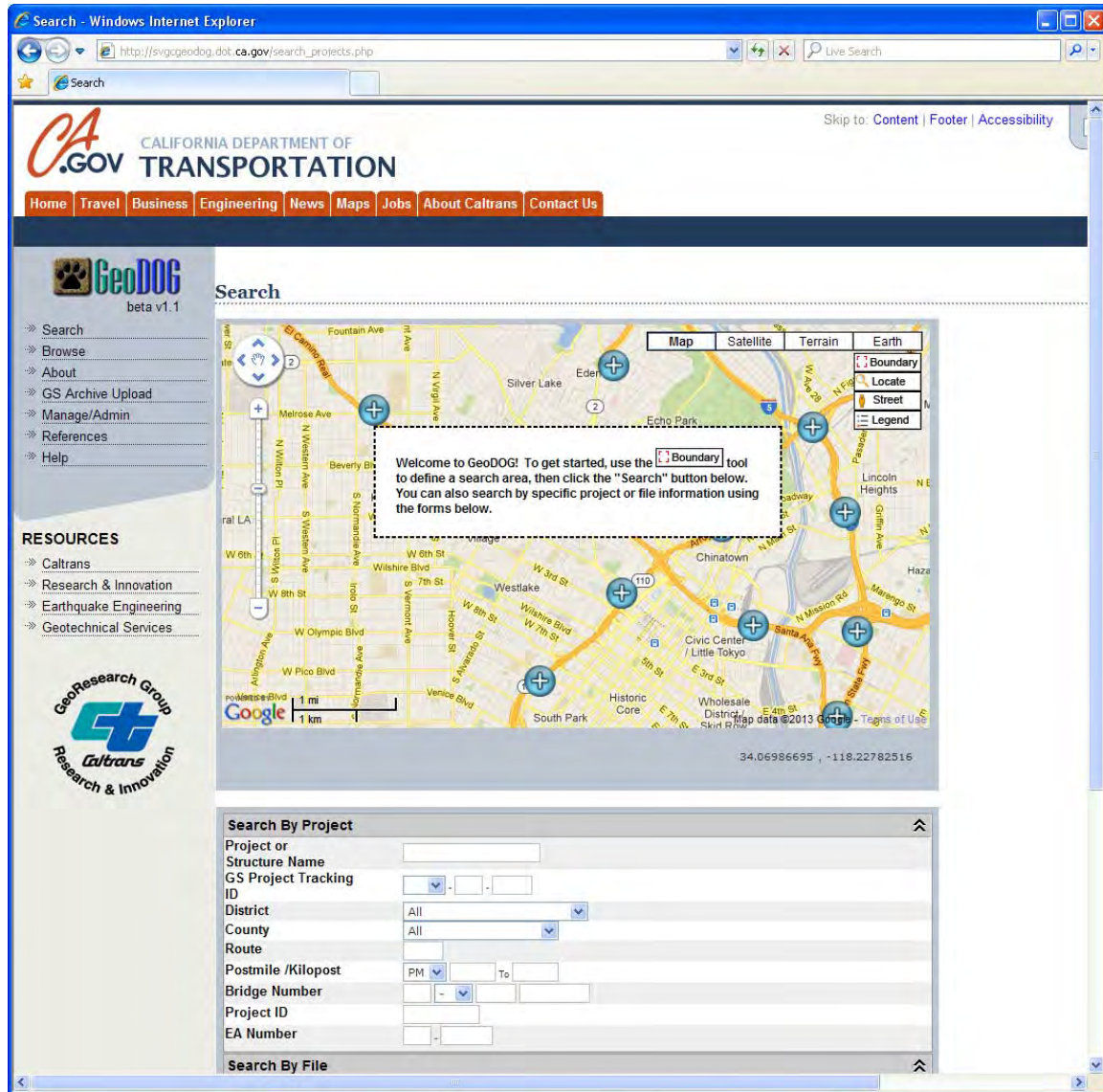


Figure 7-2 – Search Page

7.1.2.1 Features and Tools within the Map

A number of useful tools have been implemented within the map interface using the *GoogleMaps* API (<https://developers.google.com/maps/>).

For instance, the base map layer can be displayed in one of four formats, *Map*, *Satellite*, *Terrain*, and *Earth*, as shown in Figure 7-3 through Figure 7-7. Each type of map introduces different contextual

information in relation to available geotechnical data which can be particularly useful to a site investigation. For example, the terrain maps can provide regional slope information in landslide investigations.

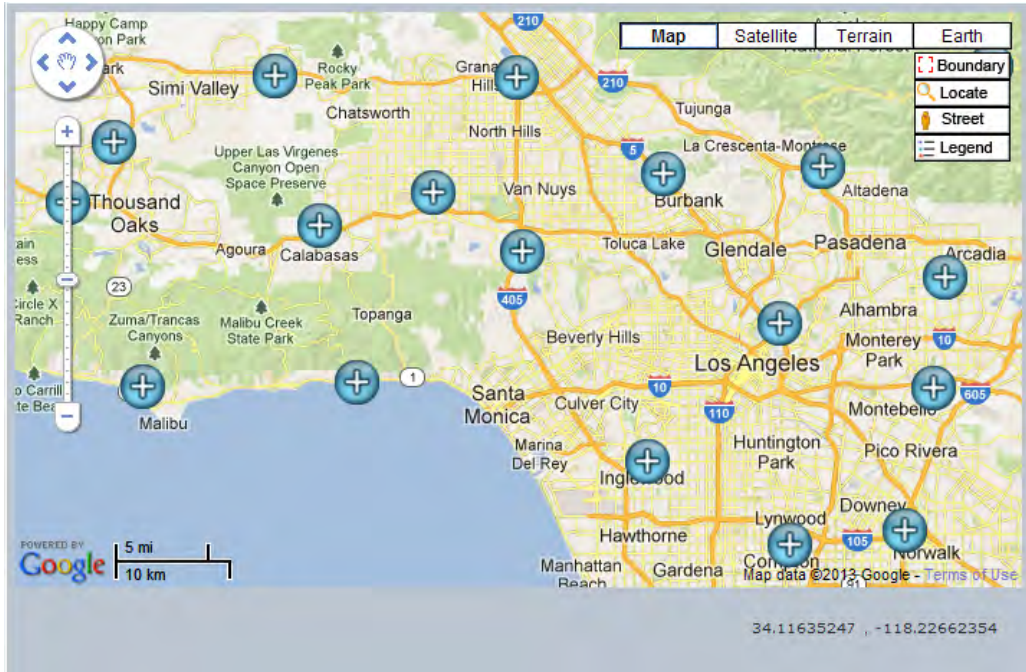


Figure 7-3 – Map View in GoogleMaps

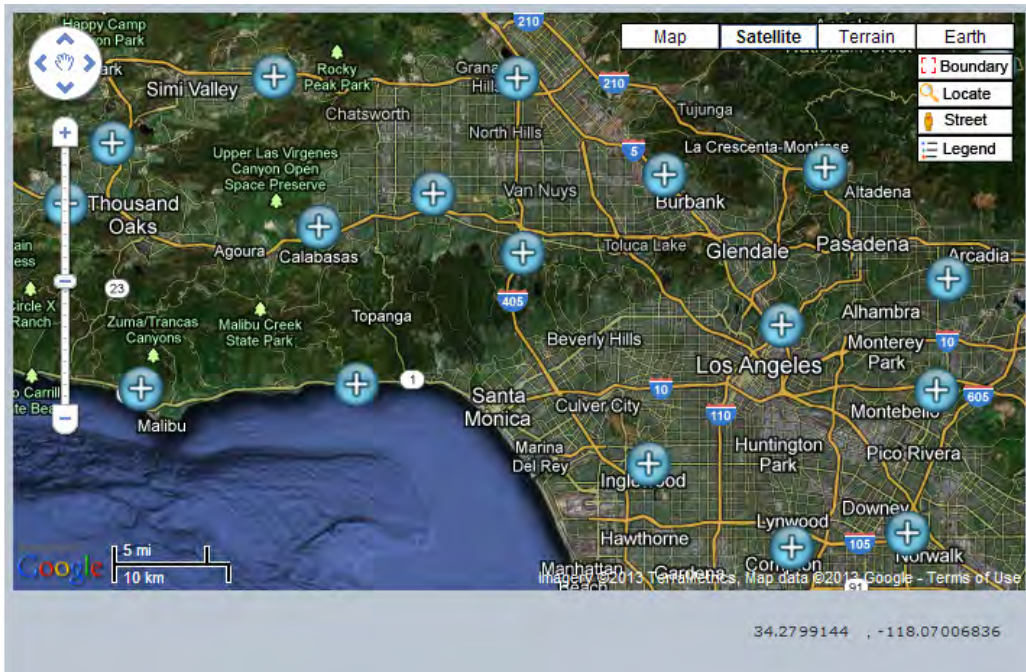


Figure 7-4 – Satellite View in GoogleMaps

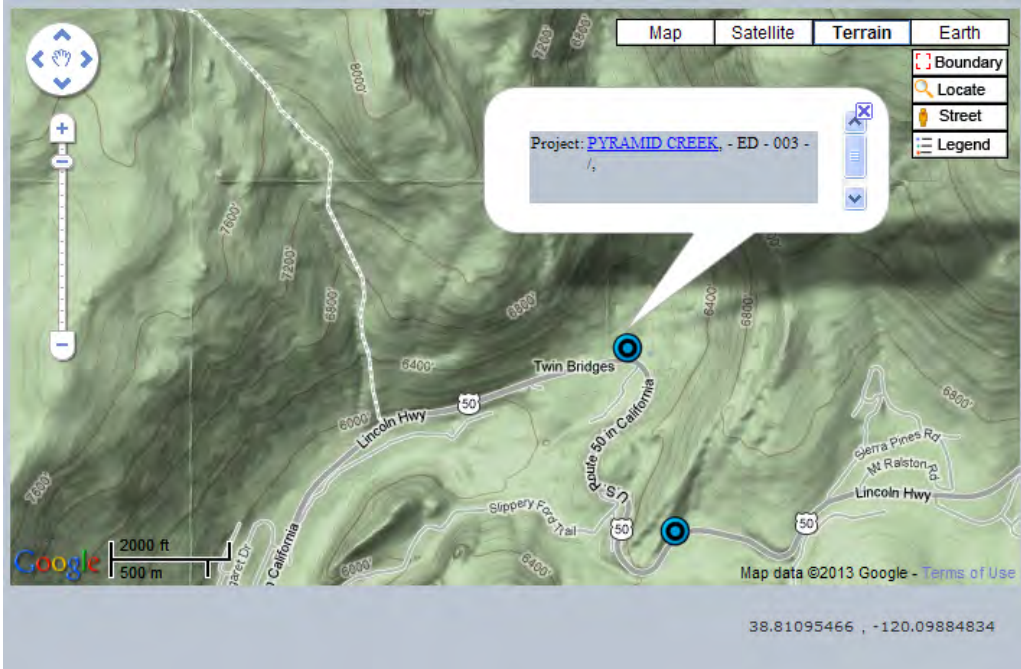


Figure 7-5 – Terrain View in GoogleMaps

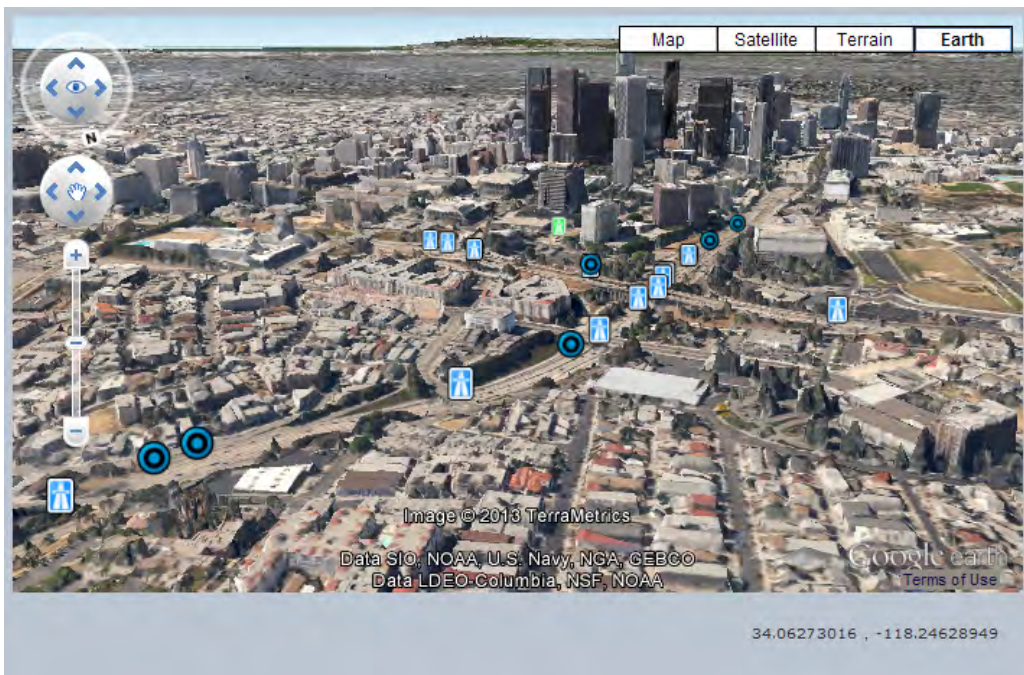


Figure 7-6 – Earth View in GoogleMaps

The earth view can be helpful in the early planning stages of a site investigation where access to drilling locations is a key consideration. Google’s *street view* tool can be helpful in these instances as well, as shown in Figure 7-7.



Figure 7-7 – Street View in GoogleMaps

Within the map interface users can click on project points to view information about the project, as shown in Figure 7-8. Within the informational balloons the name of the project provides a hyperlink directly to the project page where users can easily browse available documents for download. This feature is described in more detail in a later section of this report.



Figure 7-8 – Viewing Project Information

7.1.2.2 Search Using Project, File, and Spatial Boundary Filters

Users can choose to search for files or projects within the search page. The page is divided into three sections to facilitate searching, as shown in Figure 7-9.

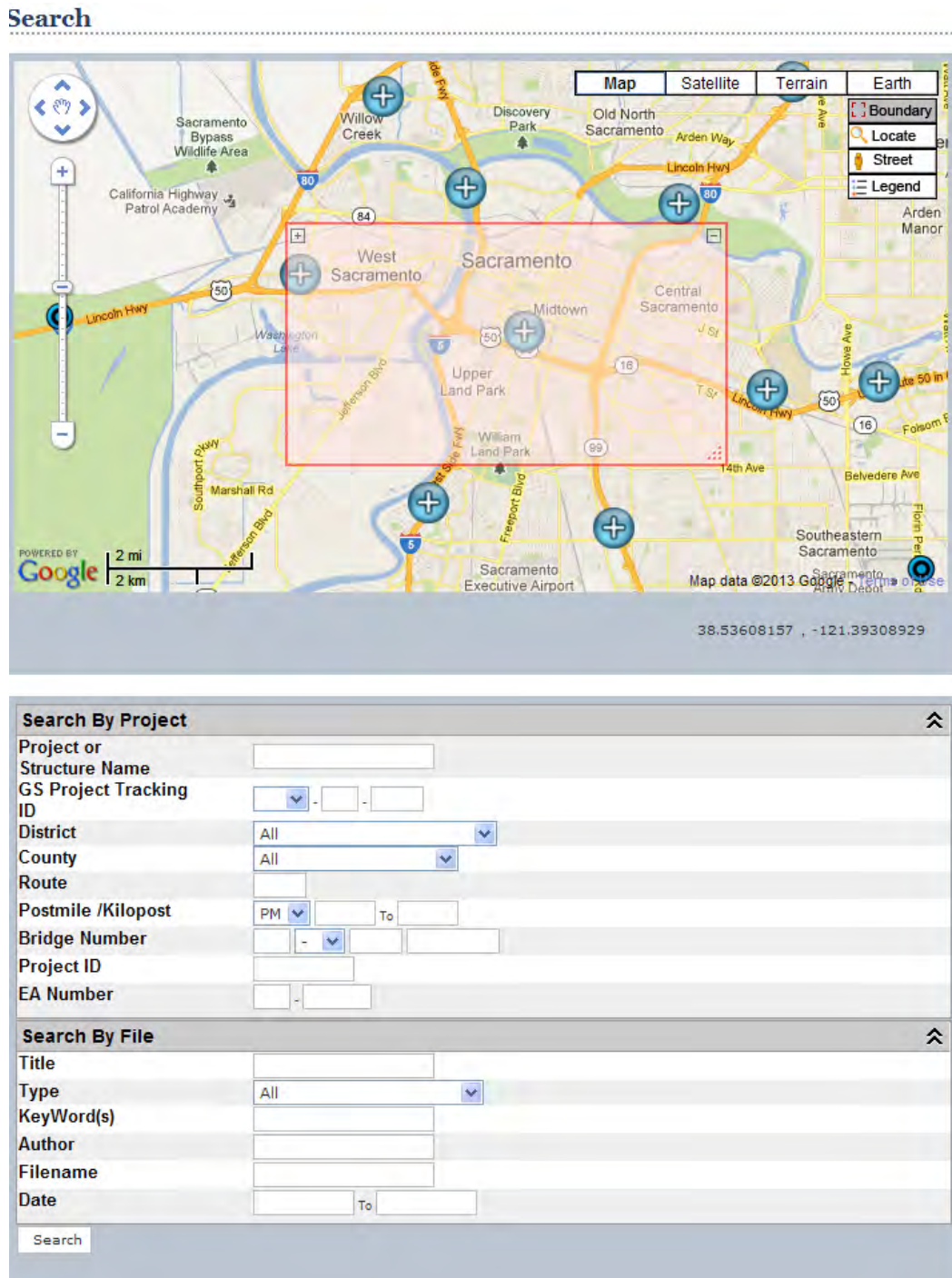


Figure 7-9 – Search Interface

Within the map, the user can optionally choose to define a spatial bounding box. The box can be moved and resized by clicking and dragging the corners of the box. In the form fields in the lower half, the user

can enter parameters to limit their search. If only *project* parameters are entered, search results will be returned showing projects meeting search criteria. If *file* parameters are entered, with or without project parameters, search results will be returned showing files meeting search criteria.

7.1.3 Search Results

Search results are presented as a series of tables, as shown in Figure 7-10, in the *Search Results* page. For project-based search results, the table shows the project name and the district-county-route-postmile information.

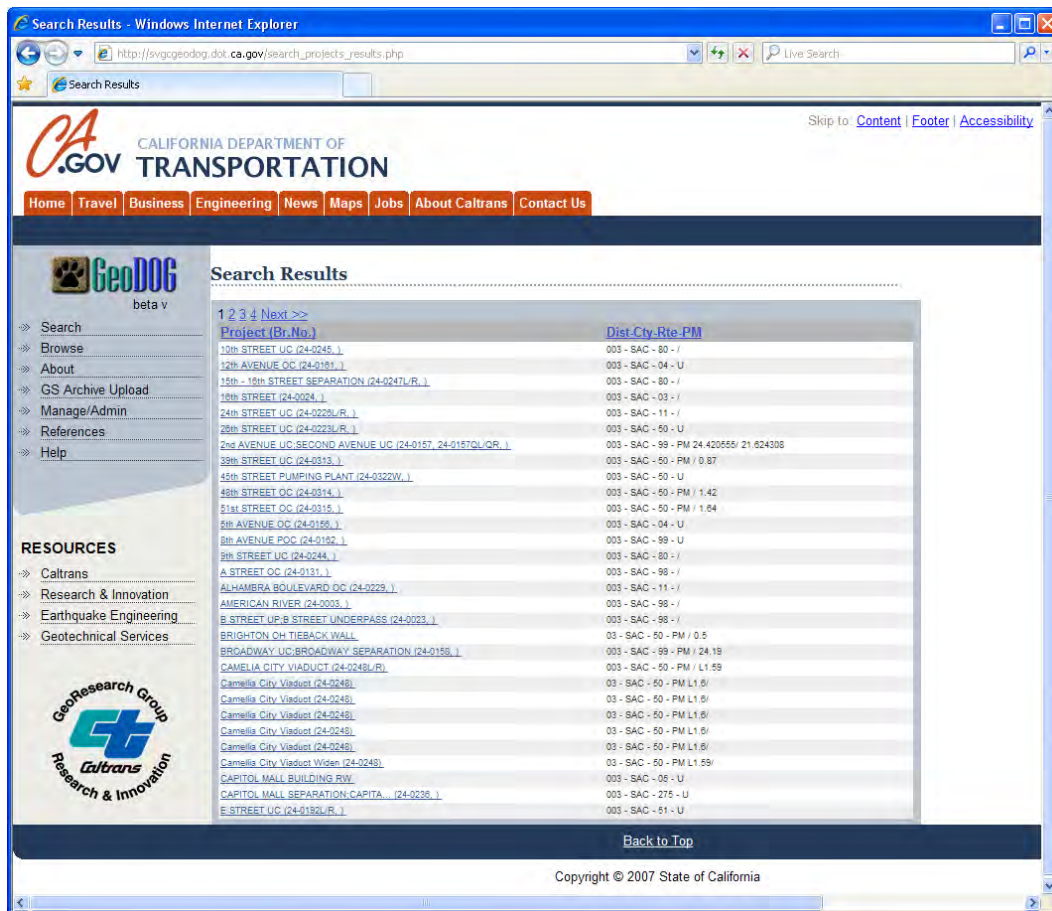


Figure 7-10 – Search Results for Projects

Additional information for each project can be found by positioning the cursor over the row of interest (i.e. “mouse over”). If the row in the table is clicked, a floating map window pops up, showing the location of the project relative to other projects. Both of these features are shown in Figure 7-11.

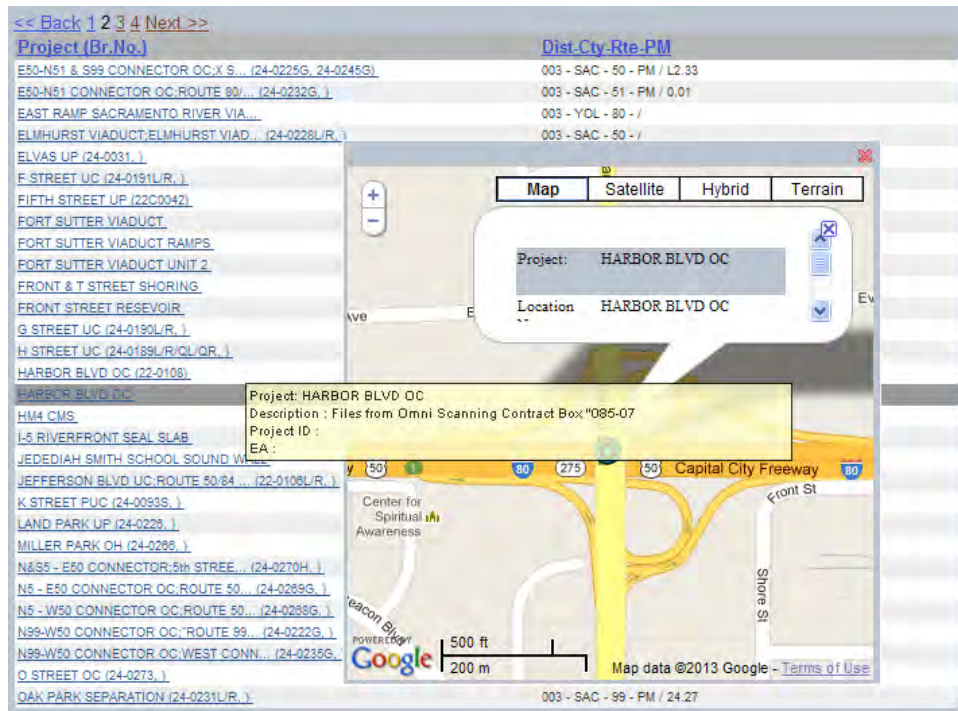


Figure 7-11 – Mouse Over and Map Information in Search Results

Clicking the hyperlinked name of the project will open a new browser window, displaying all project information (i.e. “project view”).

7.1.4 View Project

Detailed information about projects are presented in a single *View Project* page, as shown in Figure 7-12. This page is comprised of four key sub-sections:

- *Project Information* – Shows all relevant project related metadata such as the name, county, route, postmile, and description.
- *Files* – Lists all files associated with the project.
- *Location* – The geographic coordinates for the location of the project.
- *Possible Related Projects* – Displays other projects (as hyperlinks) in close spatial proximity to the subject project.

From this page the user can directly click the filename for any document in the list to view.

Alternatively, the user can click the checkbox associated with the file (or group of files) to download one or more files in a single step, as described in the next section of this report.

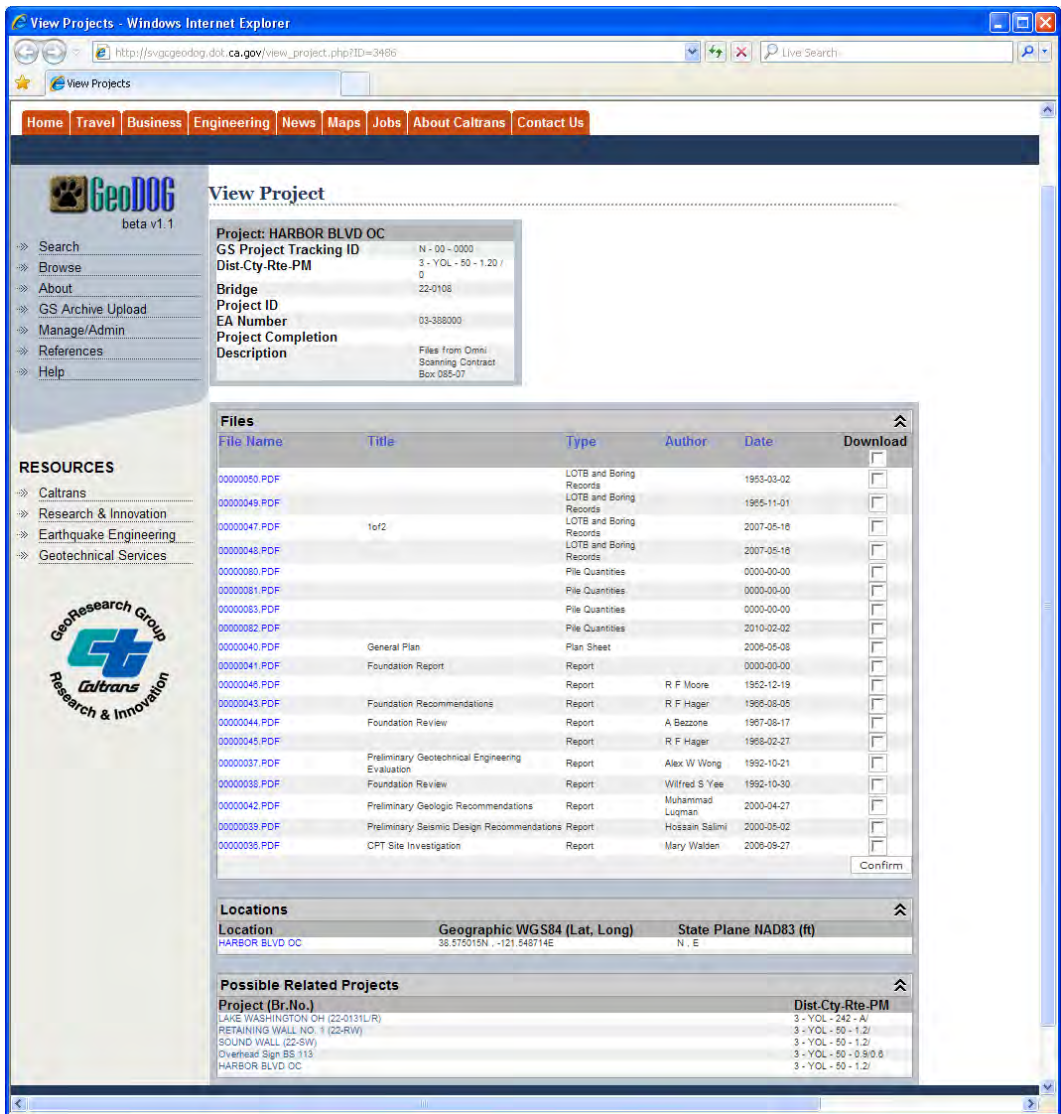


Figure 7-12 – View Project Page

7.1.5 File Download

If the user selects one or more files to download in the View Project page and clicks the “confirm” button, the user is directed to a new *Download Confirmation* page, as shown in Figure 7-13. A table in the page displays a summary of the files the user had selected, and provides the option to go “back” or “download” the files.

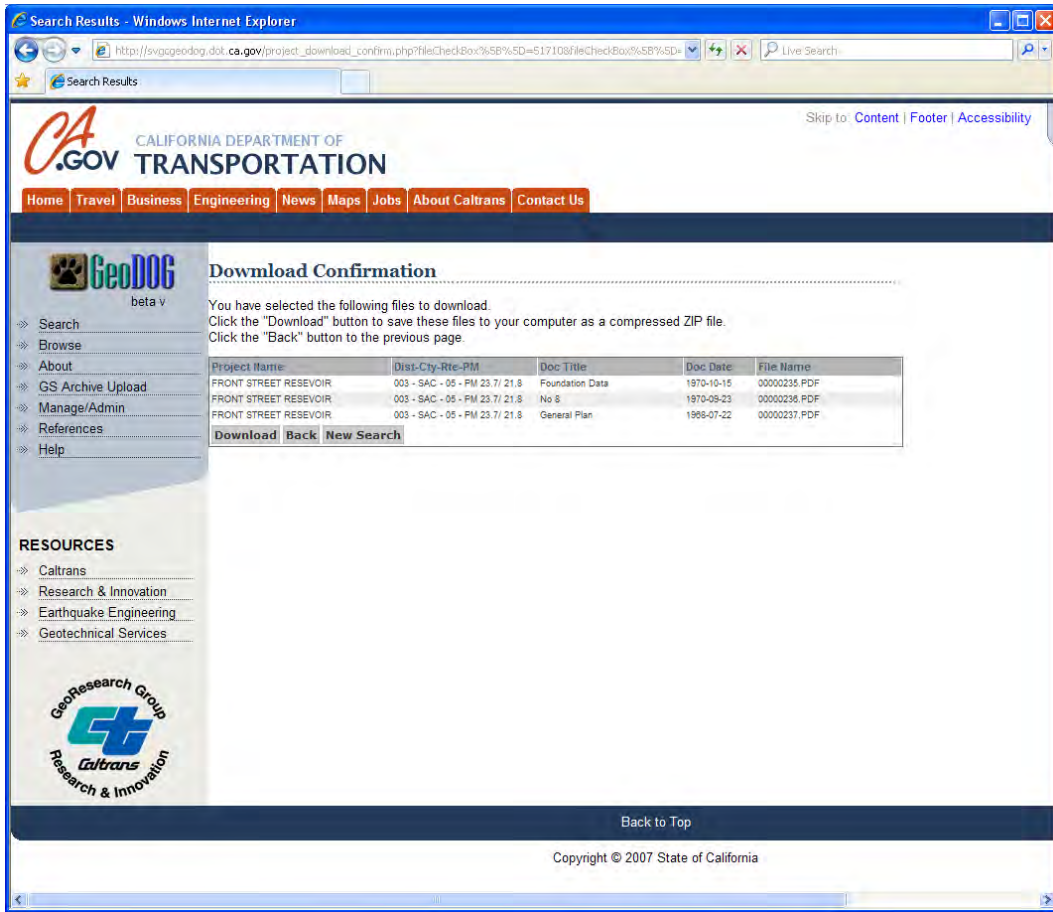


Figure 7-13 – Download Confirmation Page

If the “download” button is clicked, a zipped file is created and the user is prompted to save the file on their local computer, as shown in Figure 7-14.

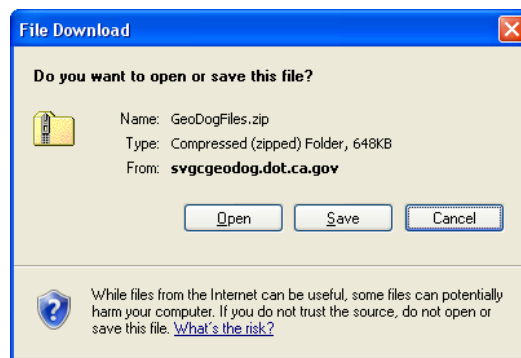


Figure 7-14 – File Save Prompt

7.1.6 Browse Projects

As an alternative to searching by project and/or file information, the user can use the *Browse Projects* page to interactively narrow down a list of projects, as shown in Figure 7-15. The upper section of this

page provides a series of form fields and drop-down menus to refine the list of results. As the user types in the form fields, the list of projects in the lower section is dynamically reduced to match the user entries.

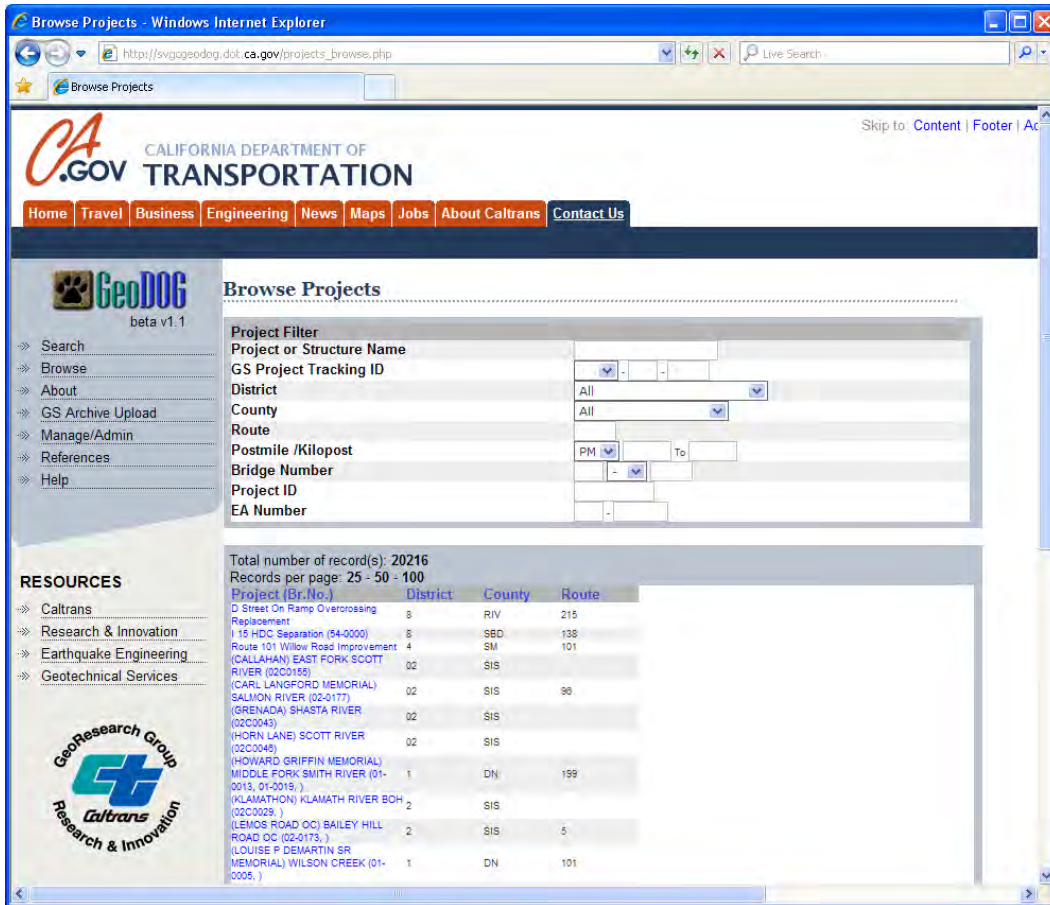


Figure 7-15 – Browse Projects Page

Similar to other pages in GeoDOG, any row in the results table can be clicked to bring up a floating map window showing the location of the project. A mouse-over showing relevant project metadata is also provided, as shown in Figure 7-16. Clicking the project name opens the *View Project* page.

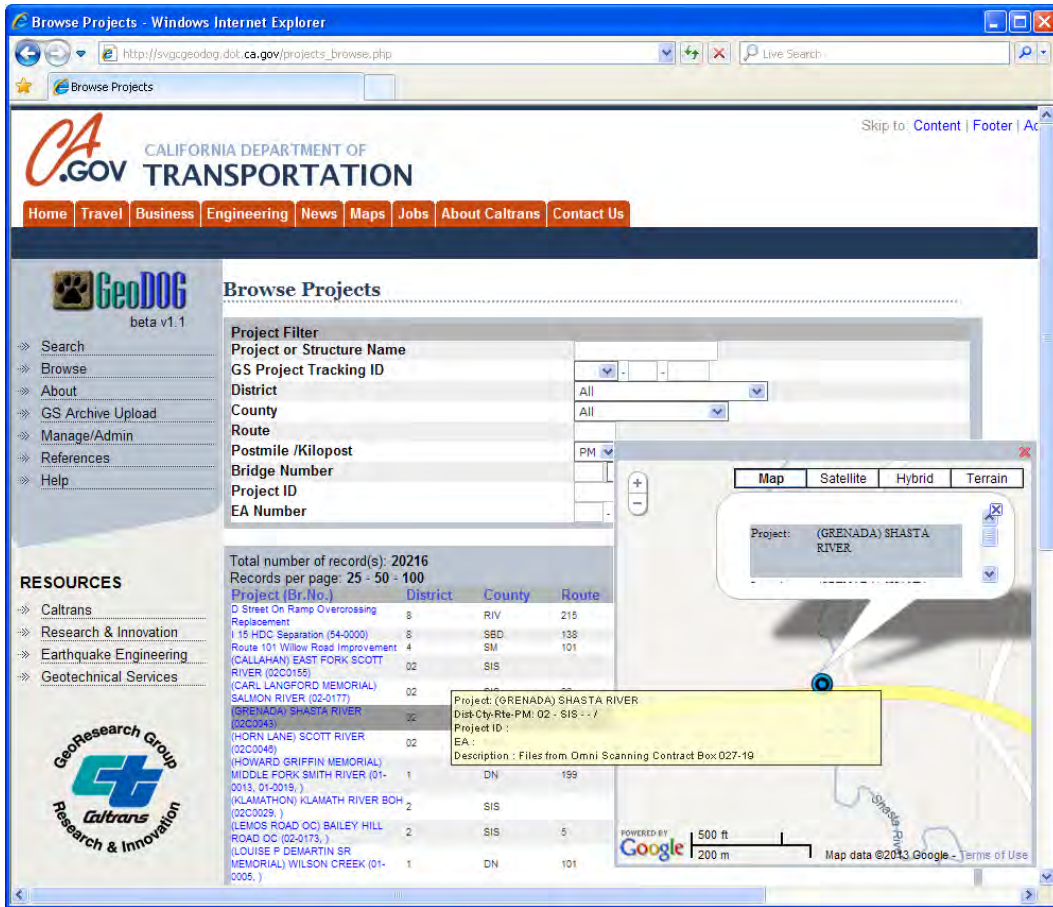


Figure 7-16 – Map Palette and Mouse-Over Project Metadata

7.1.7 Upload Files

The *Upload* page provides a controlled mechanism within GeoDOG for users to create new projects and upload new documents.

7.1.7.1 Requestor and Project Information

Four sets of information are submitted using the forms and drop-down menu items provided in the interface:

- **Requestor Info** – Name and contact information for the user.
- **Project Information** – Project related metadata such as the name, county, route, postmile, and description.
- **Files** – Files associated with the project and relevant metadata.
- **Location** – The geographic coordinates for the location of the project. This is automatically determined by GeoDOG based on the county, route, and postmile, but can be modified during the upload process.

Figure 7-17 and Figure 7-18 show the upload page and forms.

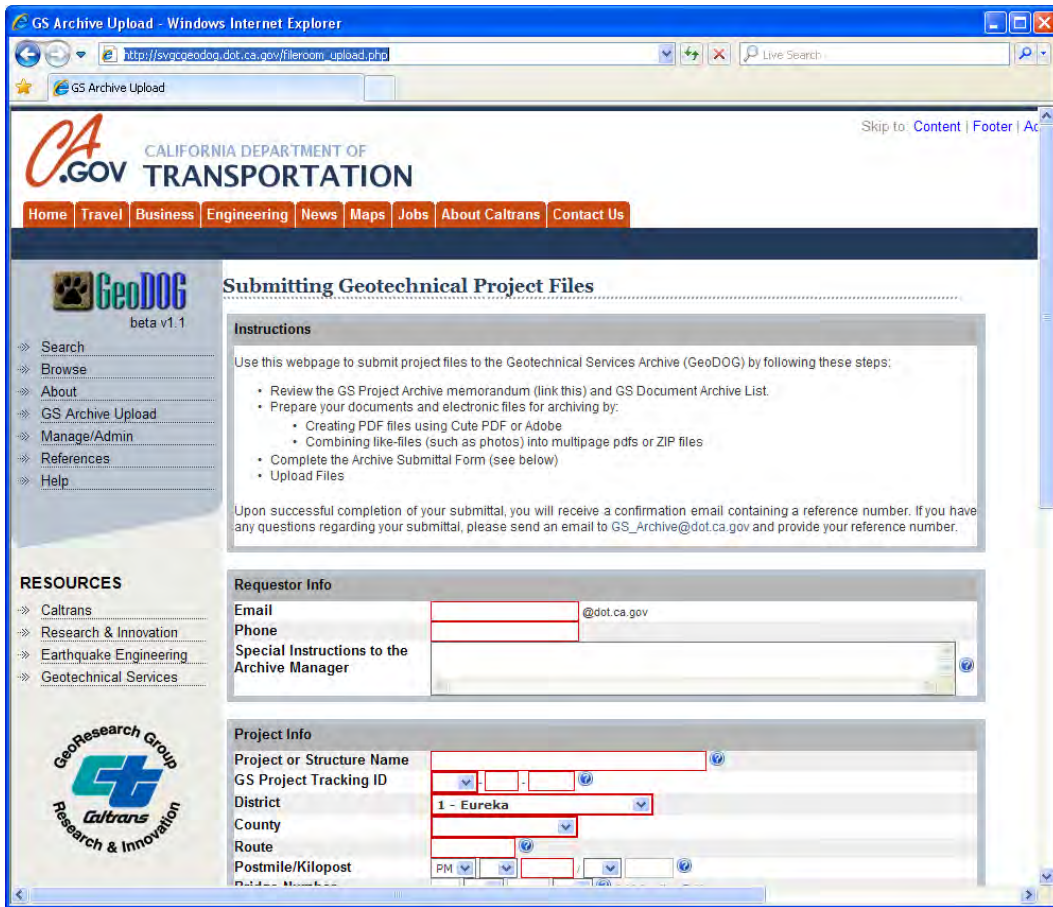


Figure 7-17 – Upload Page

The screenshot shows a web browser window titled "GS Archive Upload - Windows Internet Explorer" with the URL "http://svhgeodog1.dot.ca.gov/filercom_upload.php". The page features a sidebar with "RESOURCES" (Caltrans, Research & Innovation, Earthquake Engineering, Geotechnical Services) and a "GeoResearch Group" logo. The main content area contains a form with the following sections:

- Requester Info:** Email (with "@dot.ca.gov" suffix), Phone, and Special instructions to the Archive Manager.
- Project Info:** Project or Structure Name, GS Project Tracking ID, District (1 - Eureka), County, Route, Postmile/Kilopost (with "PM" dropdown), Bridge Number, Project ID, EA Number, and Description.
- Location:** A section that is currently collapsed.
- File Info:** Title, Type (Report), Author, Date, Keyword(s), and File (with "Browse..." button).

A "Next" button is located at the bottom of the form.

Figure 7-18 – Upload Page (continued)

7.1.7.2 Assignment of Project Location

The location of the project is automatically determined by GeoDOG once the user enters the county, route, and postmile parameters. GeoDOG uses a web service hosted by the Caltrans Office of Data Analysis and GIS (ODAGIS) under the Division of Research, Innovation, and System Information (<http://svhggisapp1.dot.ca.gov/postmilewebclient/PostmileQueryTool.html>). The web service uses the county-route-postmile data as input and returns the geographic latitude and longitude associated with that point.

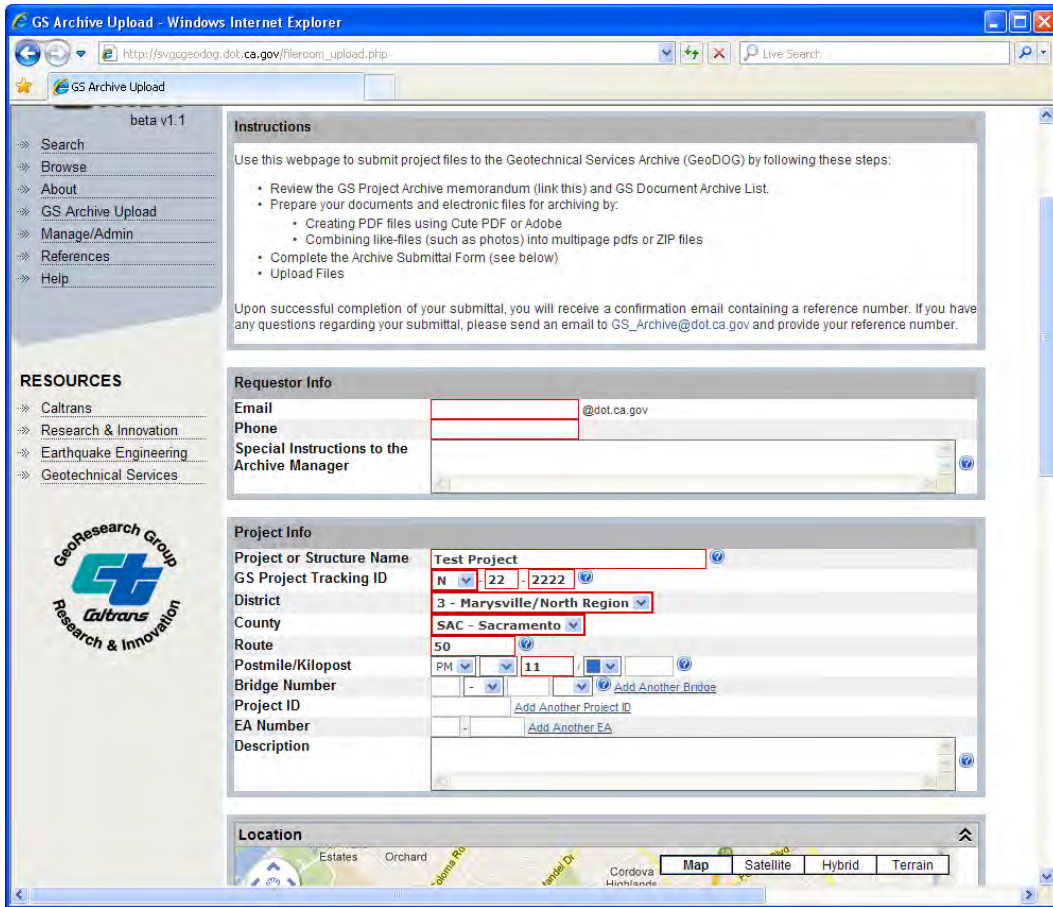


Figure 7-19 – Project Location Automatically Assigns Coordinates

7.1.7.3 Automated Conversion Between Geographic and State Plane Coordinate Systems

An additional coordinate conversion function is provided that allows automatic conversion between geographic latitude and longitude and corresponding California State Plane coordinate systems. The backend tool, *PROJ.4*, operates as a library within the Apache-MySQL-PHP technology platform. Additional information about the PROJ.4 tool can be found on the website (<http://trac.osgeo.org/proj/>).

With the postmile webservice and the PROJ.4 library, the user can easily enter and edit either coordinates. Upon entry, corresponding coordinates in the other projection are updated dynamically. This feature is shown in the screenshot in Figure 7-20.

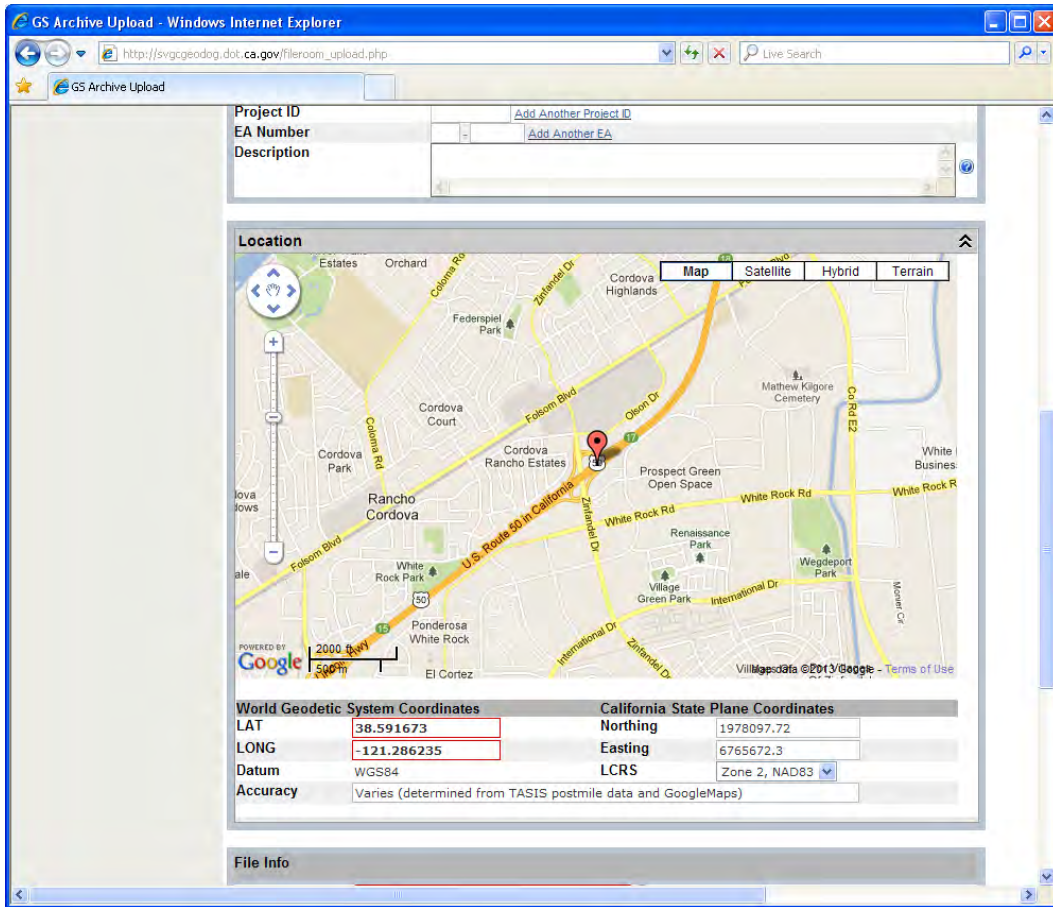


Figure 7-20 – Automated Location Assignment and Coordinate Conversion

7.1.7.4 Selecting Files for Upload

The bottom section of the *Upload* page provides several form fields to capture information about the file being uploaded. A predefined list of file types is presented in drop-down selection box as shown in Figure 7-21. The “browse” button allows users to navigate through local file directories to identify the file to be associated with the metadata entered, as shown in Figure 7-22. Additional files can be uploaded, each with unique file metadata, using the “Add Another File” link.

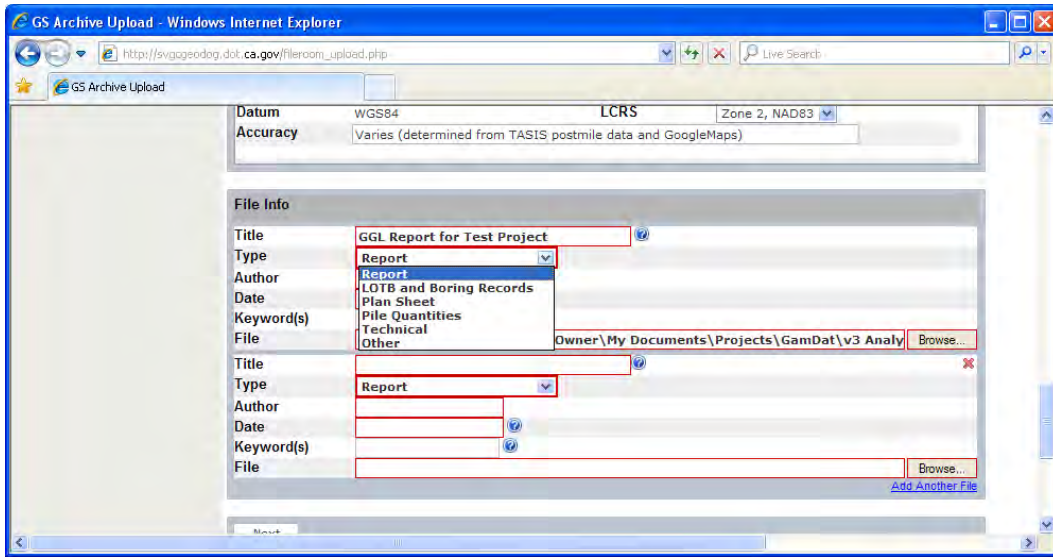


Figure 7-21 – Selecting File Type in the Upload Page

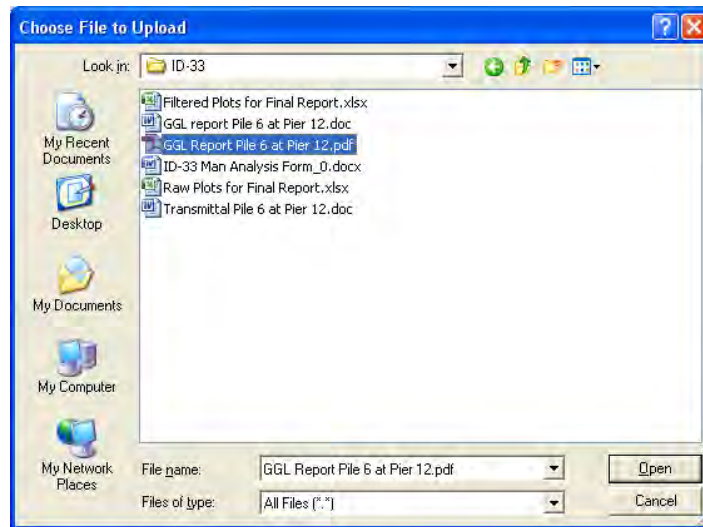


Figure 7-22 – Identifying File to Upload

7.1.7.5 Submission of Project to GeoDOG

Upon completion of file upload selection, the “Next” button is clicked and a confirmation page is presented, as shown in Figure 7-23. The “Submit” button is then clicked and the project is submitted for review by a GeoDOG system manager for approval.

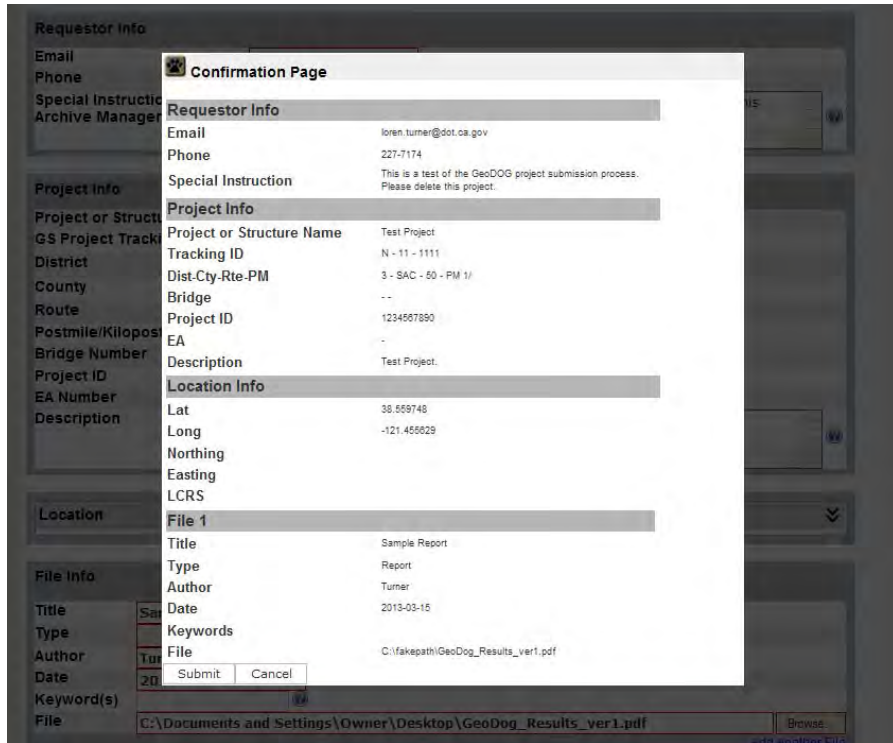


Figure 7-23 – Project Submittal Confirmation Page

When new projects and files are submitted to GeoDOG, both the *User* and the *Manager* are sent emails with details of the submission, as shown in Figure 7-24. A unique reference number is assigned to each submission to facilitate tracking

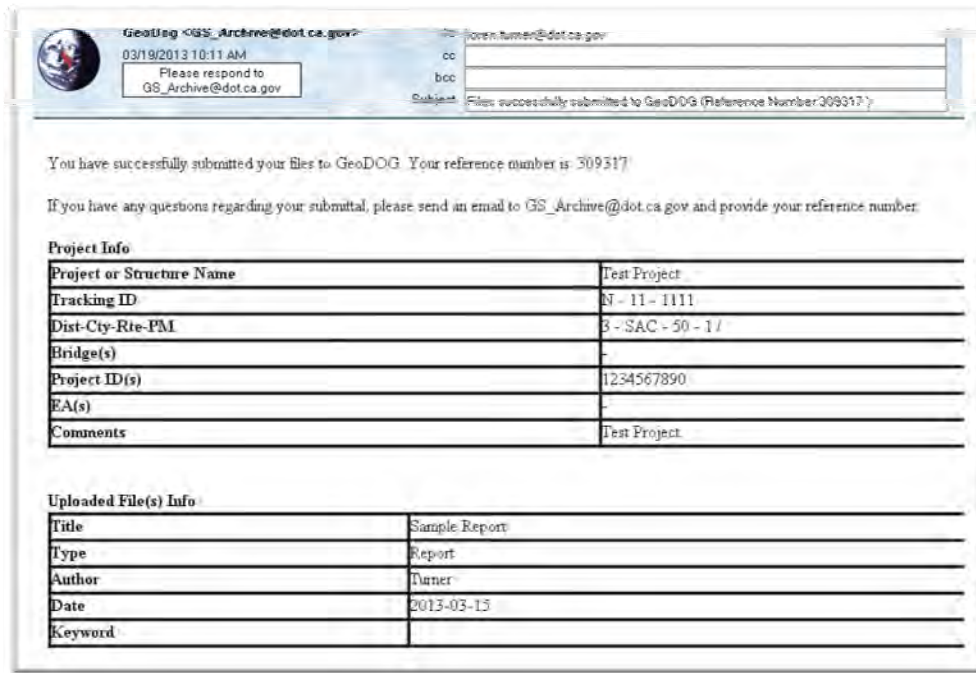


Figure 7-24 – Confirmation Email Sent to User

7.2 Manager/Admin Login Page

Managers and *Administrators* can access unique functions to maintain the GeoDOG system. A login page is accessed by clicking the “Manage/Admin” link on the left side navigation bar, as shown in Figure 7-25.

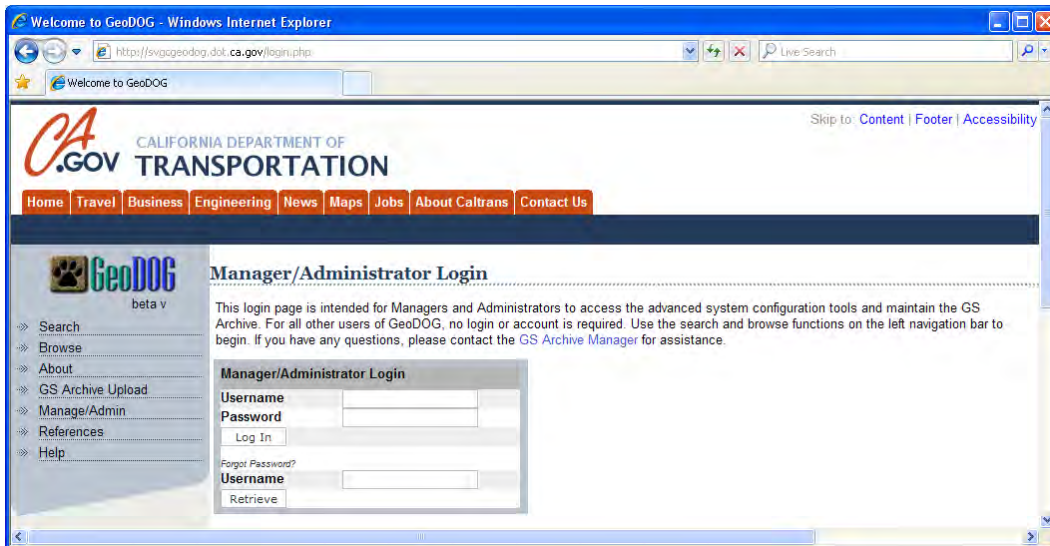


Figure 7-25 – Login Page for Managers and Administrators

7.3 Tools for Both Managers and Administrators

Both *Managers* and *Administrators* have access to three primary features in GeoDOG – *Edit Profile*, *Manage Data*, and *Bulk Upload*.

7.3.1 Edit Profile

The *Edit Profile* page, shown in Figure 7-26, provides a form for the *Manager* or *Administrator* to enter and/or modify various contact and login related information. A *Manager* can only change details of their specific account. An *Administrator* can change details of their account or the account of other *Managers* in the system.

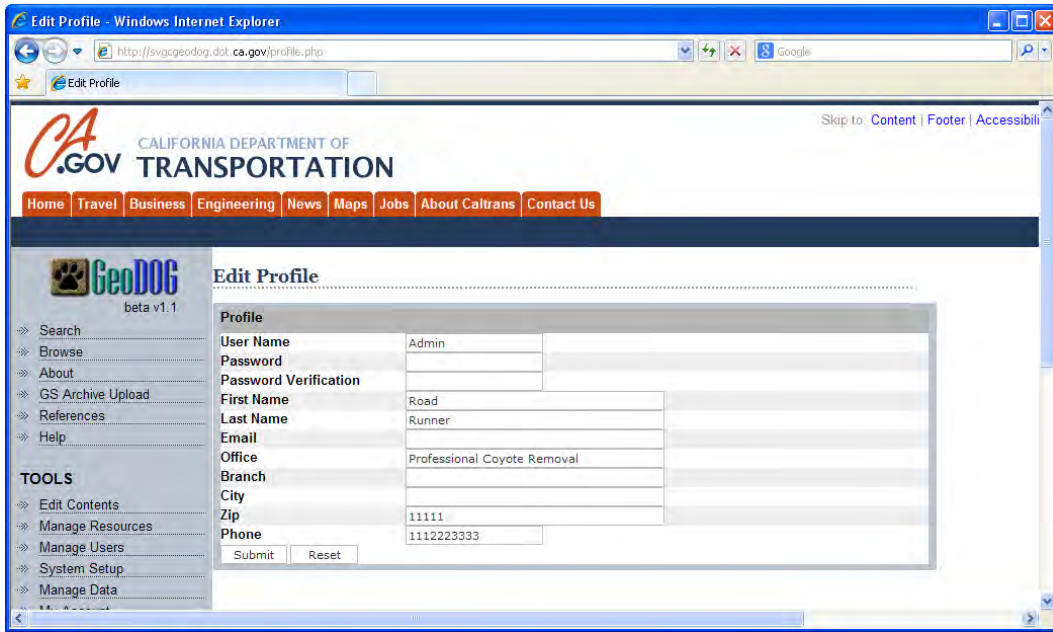


Figure 7-26 – Edit Profile Page

7.3.2 Manage Data

The *Manage Data* page, shown in Figure 7-27 and Figure 7-28, is the primary interface for approving submittals.

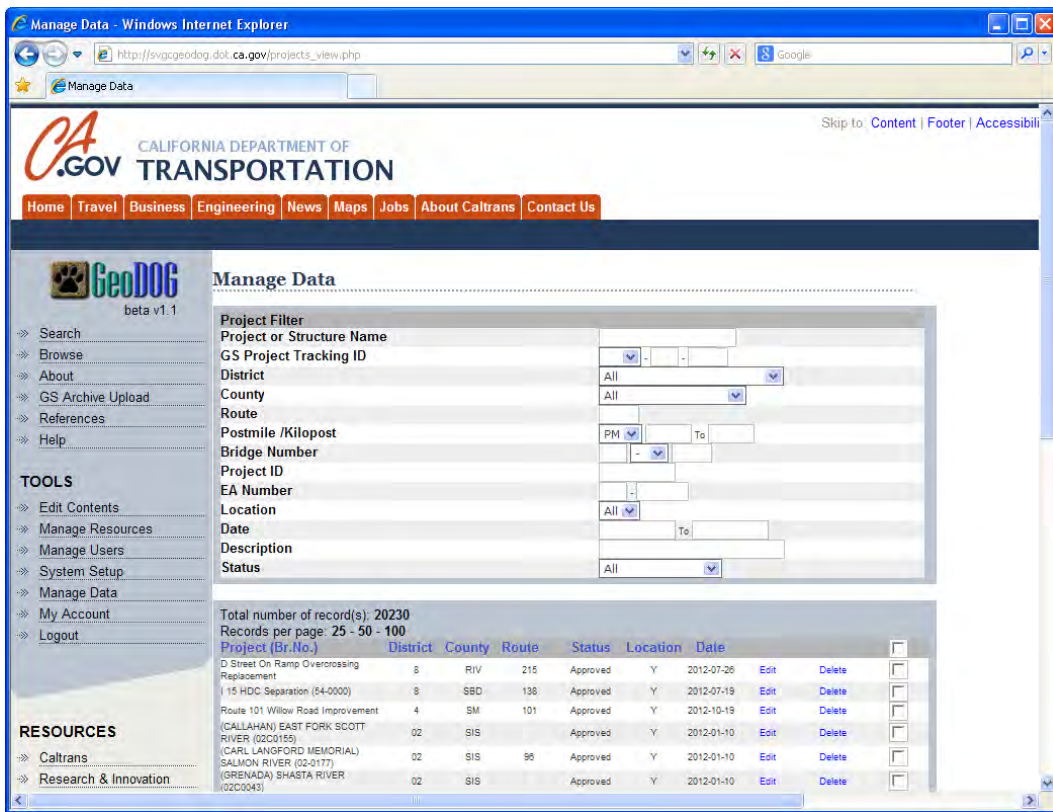


Figure 7-27 – Manage Data Page

Project Name	Quantity	Status	Date	Actions	
(HORN LANE) SCOTT RIVER (02C0046)	02	SIS	Approved	Y 2012-01-10 Edit Delete	
(HOWARD GRIFFIN MEMORIAL) MIDDLE FORK SMITH RIVER (01-0013, 01-0015,)	1	DN	199	Approved	Y Edit Delete
(KALAMATHON) KLAMATH RIVER BOH (02C0023,)	2	SIS	Approved	Y Edit Delete	
(LEMOS ROAD OC) BAILEY HILL ROAD OC (02-0173,)	2	SIS	5	Approved	Y Edit Delete
(LOUISE P DEMARTIN SR MEMORIAL) WILSON CREEK (01-0006,)	1	DN	101	Approved	Y Edit Delete
(MARY ADAMS PEACOCK MEMORIAL) SMITH RIVER (01-0009,)	1	DN	199	Approved	Y Edit Delete
(MCBRIDE RANCH OC) RUSS RANCH OC (04-0167,)	1	HUM	101 OR 254 (OLD RTE 1)	Approved	N Edit Delete
(WINER STREET) YREKA CREEK (02C0022,)	2	SIS	Approved	Y Edit Delete	
(MONTAGUE - GRENADA ROAD) SHASTA RIVER (02C0055,)	2	SIS	Approved	Y Edit Delete	
(MOONLIT OAKS AVENUE UC) SOUTH YREKA SEPARATION (02-0155LR,)	2	SIS	5	Approved	Y Edit Delete
(MOONSTONE ROAD UC) WESTHAVEN DRIVE UC (04-0056,)	1	HUM	101	Approved	Y Edit Delete
(NORTH WEED UC) (02-0164LR,)	2	SIS	5	Approved	Y Edit Delete
(OLD ROUTE 83/3 CONNECTOR SEPARATION) ROUTE 83/5 CONNECTOR SEPARATION,(OLD ROUTE 83-03 CONNECTOR SEPARATION) ROUTE 89-05 CONNECTOR SEPARATION (02-0127, 02-0127E,)	2	SIS	89	Approved	Y Edit Delete
(PANORAMA PT. RETAINING BEAM) PANORAMA UC TIEBACK RETAINING WALL (02-RW)	2	SIS	5	Approved	Y Edit Delete
(PROSPECT AVENUE UC) DUSNMUIR AVENUE UC (02-0171,)	2	SIS	5	Approved	Y Edit Delete
(ROHNERVILLE OC) KENMAR ROAD UC (04-0128,)	1	HUM	101	Approved	Y Edit Delete
(ROHNERVILLE OH) NORTH ALTON GRADE CROSSING (04-0051,)	1	HUM	101 OR 254 (OLD RTE 1)	Approved	N Edit Delete
(ROUTE 148 SEPARATION) ROUTE 101/189 SEPARATION,(ROUTE 1-48 SEPARATION) ROUTE 101-189 SEPARATION (01-0028,)	1	DN	101	Approved	Y Edit Delete
(ROUTE 110 SEPARATION) ROUTE 132-590 SEPARATION,(ROUTE 110 SEPARATION) ROUTE 132-590 SEPARATION (29-0161,)	10	SJ	(110) 132	Approved	Y Edit Delete

Figure 7-28 – Manage Data Page (continued)

When the *Manager* receives an email that a *User* has uploaded new files for project, the new upload appears on this page. The page shows each project submittal on a separate line in the table along with the date of submission, the status of the upload (i.e. “Approved” or “Pending”), and whether or not a location was assigned.

The *Manager* can click the “Edit” link for any given project to open an *Edit Project* page for the submission, as shown in Figure 7-29. Details of the submission can be edited from this page prior to approval.

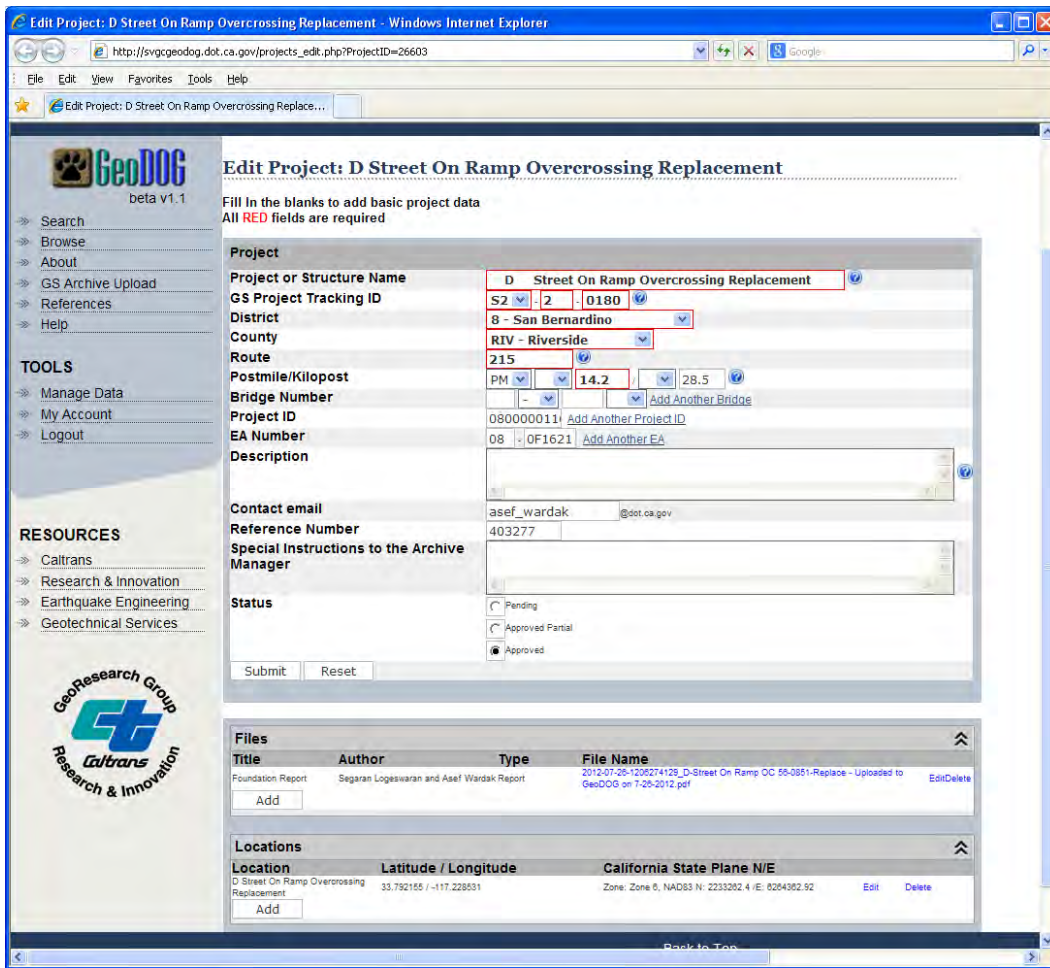


Figure 7-29 – Edit Project Page

7.3.3 Bulk Upload

The *Bulk Upload* page provides a tool for *Managers* to upload large numbers of projects and files into GeoDOG in a single step. This uploading function bypasses the standard file uploading function found when creating individual projects. The tool was primarily developed to support a large scale document scanning effort that was being carried out concurrent with the research. Under that effort large numbers of files were generated from scanning tens of thousands of archival documents. The *Bulk Upload* page provided a convenient means to upload the scanned documents and metadata into GeoDOG. The upload tool is shown in Figure 7-30.

The tool is implemented as an embedded Java Applet.

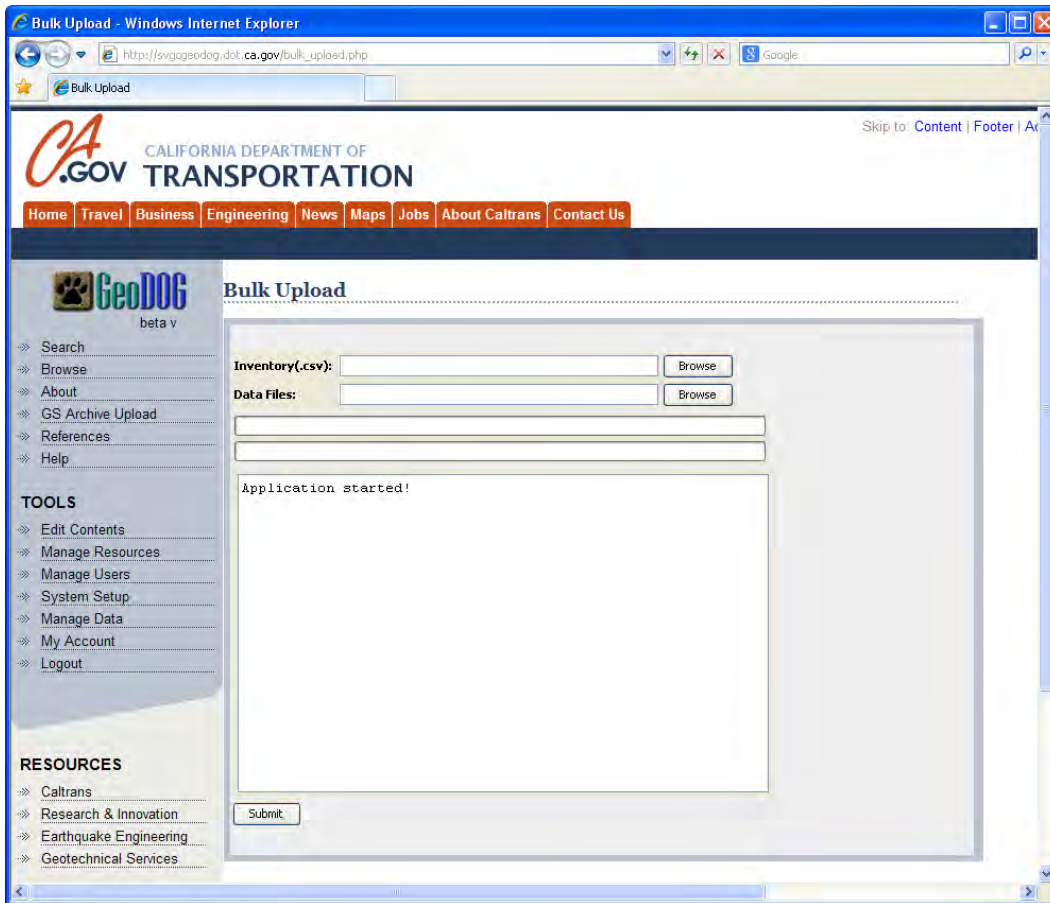


Figure 7-30 – Bulk Upload Tool

7.3.3.1 Requirements

In order to use this function, the Manager needs three things:

- *Project Index File* – Excel spreadsheet saved in a CSV format)
- *File Index File* – Excel file in XLS format)
- *Upload Directory* containing all the files to be uploaded

7.3.3.2 Project Index File

The *Project Index* is a comma-separated-value (CSV) formatted file containing project specific attributes, separated by comma delimiters, with data on one project on each line. The complete list of attributes, in order, is shown in Table 7-1.

Attribute	Example	Notes
Project ID	021-10	Required; assigned by Manager
Name	MIDDLE FORK SMITH RIVER	Required
Facility Designation	B	
County Number	1	
County Number Suffix	-	Default is “-“
Facility Number	12	
Facility Number Suffix		
District	1	Required
County	DN	Required
Route	199	Required
PM, KP, or U	PM	Required
Beginning PM, KP, or U Prefix		
Beginning PM, KP, or U	16.8	Required
Ending PM, KP, or U Prefix		
Ending PM, KP, or U	20.1	
EA Funding District	01 01	For multiple EAs, use spaces
EA	126001 076714	For multiple EAs, use spaces
Box Number	21	Assigned when scanned
Lat	38.87654	Latitude, WGS84 geographic, decimal degrees
Lon	-122.45677	Longitude, WGS84 geographic, decimal degrees

Table 7-1 – Attributes for Project Index File

If the attribute is not needed or available, a space character separated by commas should be used. A valid Project Index file viewed in a text editor (e.g. Notepad) would appear as shown in Figure 7-31.

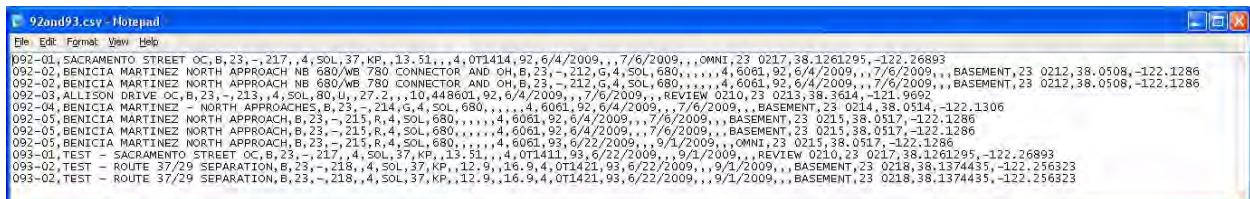


Figure 7-31 – Project Index File Viewed in Notepad

Alternatively, the resulting CSV would appear as shown in Figure 7-32 if opened in Excel.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	021-01	KLAMATH B		1 -		28		1 DN		101 PM			5.7		10 01 01	043961 4	21	
2	021-02	MINOT CR B		1 -		2		1 DN		101 PM			8.15			1 225201	21	
3	021-03	HUNTER C B		1 -		3		1 DN		101 PM			8.51			1 3634U0	21	
4	021-04	HIGH PRAI B		1 -		4		1 DN		101 PM			9.39				21	
5	021-05	(LOUISE P B		1 -		5		1 DN		101 PM			12.64			1 32870K	21	
6	021-06	SMITH RIV B		1 -		6		1 DN		199 PM			4.22			1 200801	21	
7	021-07	MYRTLE CI B		1 -		7		1 DN		199 PM			6.7	7.5	1 194521	21		
8	021-08	(VIGGO "V B		1 -		40		1 DN		199 PM			10.5	11.5	1 293100	21		
9	021-08	(VIGGO "V B		1 -		8		1 DN		199 PM			10.5	11.5	1 293100	21		
10	021-09	(MARY AD B		1 -		9		1 DN		199 PM			11.6	12.4	1 194491	21		
11	021-10	MIDDLE FC B		1 -		12		1 DN		199 PM			16.8	20.1 01 01	126001 07	21		
12	021-11	PATRICK C B		1 -		14		1 DN		199 PM			21.6	22.5	1 74500	21		
13	021-12	MIDDLE FC B		1 -		15		1 DN		199 PM			24.08		1 132301	21		
14	021-13	(ALLEN F L B		1 -		16		1 DN		199 PM	R		24.88		1 194471	21		
15	021-14	JORDAN C C		1 C		17		1 DN							1 101414	21		
16	021-14	JORDAN C B		1 -		18		1 DN		101							21	
17	021-15	ELK CREEK C		1 C		18		1 DN									21	
18	021-15	ELK CREEK B		1 -		17		1 DN		199							21	
19	021-16	(HOWARD B		1 -		19		1 DN		199 PM			19.99				21	
20	021-16	SMITH RIV B		1 -		13		1 DN		199							21	
21	021-17	(DR ERNE B		1 -		20		1 DN		101 PM			36.06		1 305501	21		
22	021-18	ELK CREEK B		1 -		21		1 DN		101 PM			26.15		1 182101	21		
23	021-19	ROWDY CI B		1 -		23		1 DN		101 PM			39.63	01 01	197141 39	21		
24	021-20	GILBERT C B		1 -		24		1 DN		101 PM			45.3		1 293130	21		

Figure 7-32 – Project Index File Viewed in Excel

Important notes regarding the preparation of the Project Index file:

- Only include the rows that correspond to the projects to be uploaded.
- Postmiles should only include numeric values. Otherwise the postmile-to-location web service will not convert it properly.
- Include latitude and longitude values, if known. If blank the postmile-to-location web service will attempt to identify the location for display on the map.
- For project names, avoid using special characters (e.g. /<+*&%\$#@.).

7.3.3.3 File Index

The *File Index* is an Excel spreadsheet (XLS format) containing file-specific attributes in the columns with each row representing a different file. The attributes in the spreadsheet are as shown in Table 7-2.

Attribute	Example	Notes
Document Type	Report	Must match type list in GeoDOG
Document Title	Foundation Investigation	
Date	08-15-1985	
Author	Sharon Narmore	
Project ID	001-01	Must match a Project ID in the <i>Project Index</i> CSV file
Filename	00000002.PDF	

Table 7-2 – Attributes for Project Index File

The *File Index* as viewed in Excel will look like the example in Figure 7-33, and will typically be a file provided by a document scanning company.

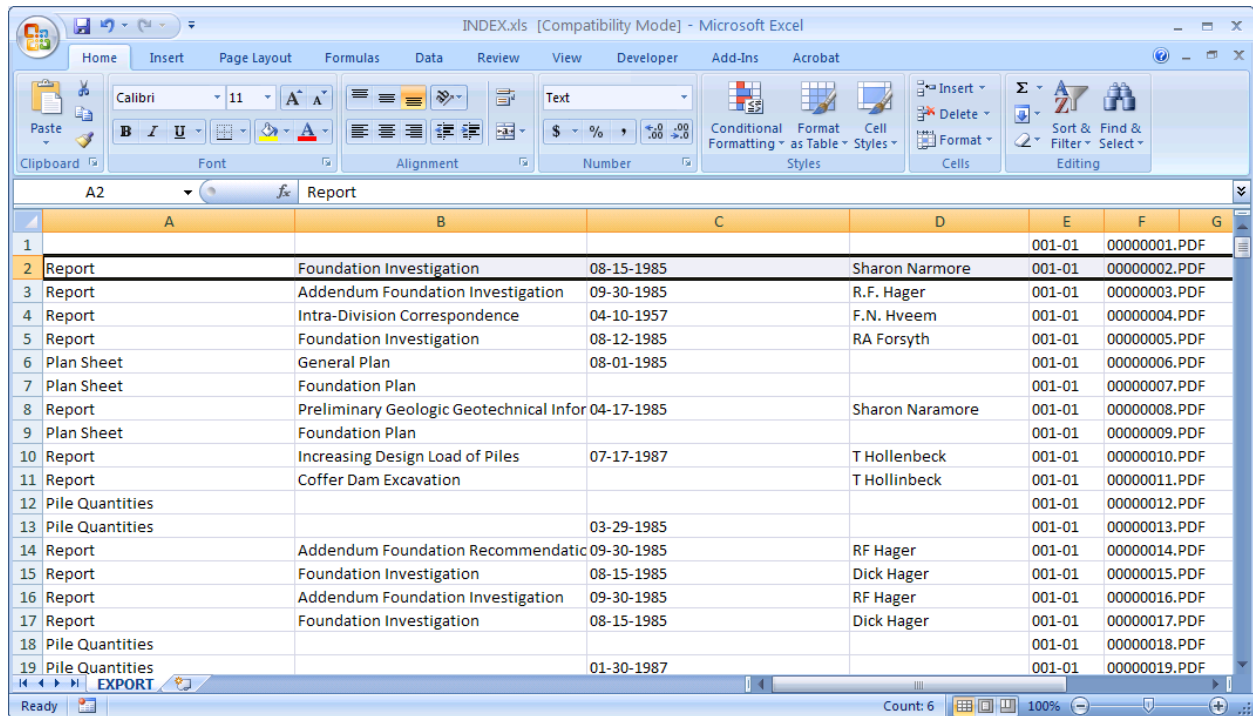


Figure 7-33 – File Index Viewed in Excel

The *File Index* itself needs to reside in the same directory as all the files to be uploaded. Also, the File Index must be named *INDEX.xls* in order to be properly identified.

7.3.3.4 Upload Directory

All of the files to be uploaded should be placed under a single directory, referred to as the *Upload Directory*. The *File Index* should be in the same directory as the files and named *INDEX.xls* as shown in Figure 7-34. The name of the directory needs to begin with the word “Approved.”

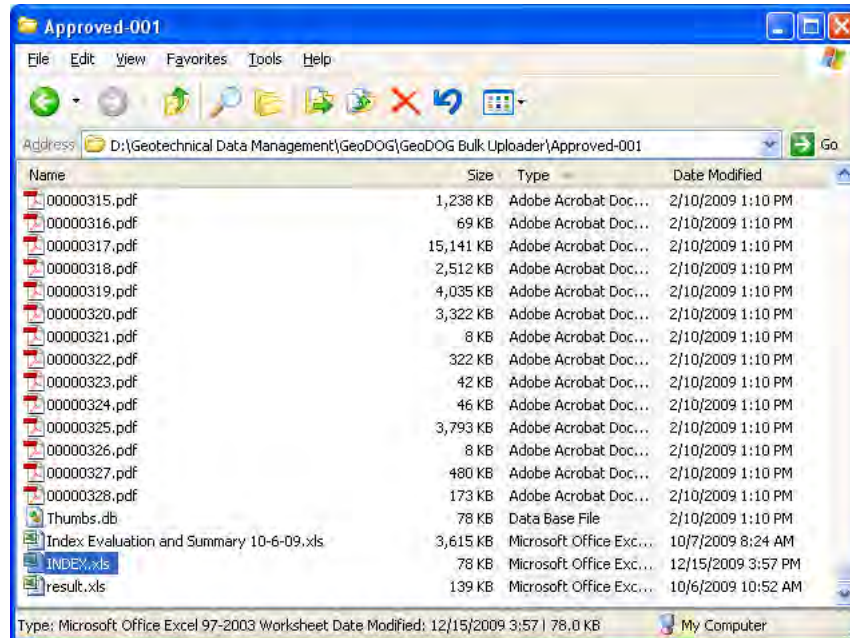


Figure 7-34 – Upload Directory

7.3.3.5 Bulk Upload Process

With the *Upload Directory*, *Project Index*, and *File Index* prepared, the bulk upload feature in GeoDOG can then be used to load the documents and data into the system. Use the first “Browse” button to identify the *Project Index* file, as was shown in Figure 7-30 in an earlier section. Then use the next “Browse” button to locate the directory containing the *File Index* (named “INDEX.xls”) and all the files to be uploaded. Once ready, click the “Submit” button to begin the process. Depending upon the number and size of the files being uploaded, the process can take several minutes to several hours to complete. A status bar in the interface will display progress during the upload.

7.4 Tools for Administrators

The *Administrator* account type provides access to three core system level functions:

- *System Setup* – Maintain lookup lists used throughout the website in forms.
- *Manage Users* – Setup and administer accounts for *Managers* and *Administrators*
- *Edit Content* – Maintain and edit the content of the *Landing Page*, *Help Page*, and other informational web pages in the system.

7.4.1 System Setup

The *System Setup* page presents a listing of all lookup values used throughout GeoDOG in various forms, as shown in Figure 7-35. The “Edit List” link next to each attribute can be used to modify the list of values, as shown in Figure 7-36 and Figure 7-37.

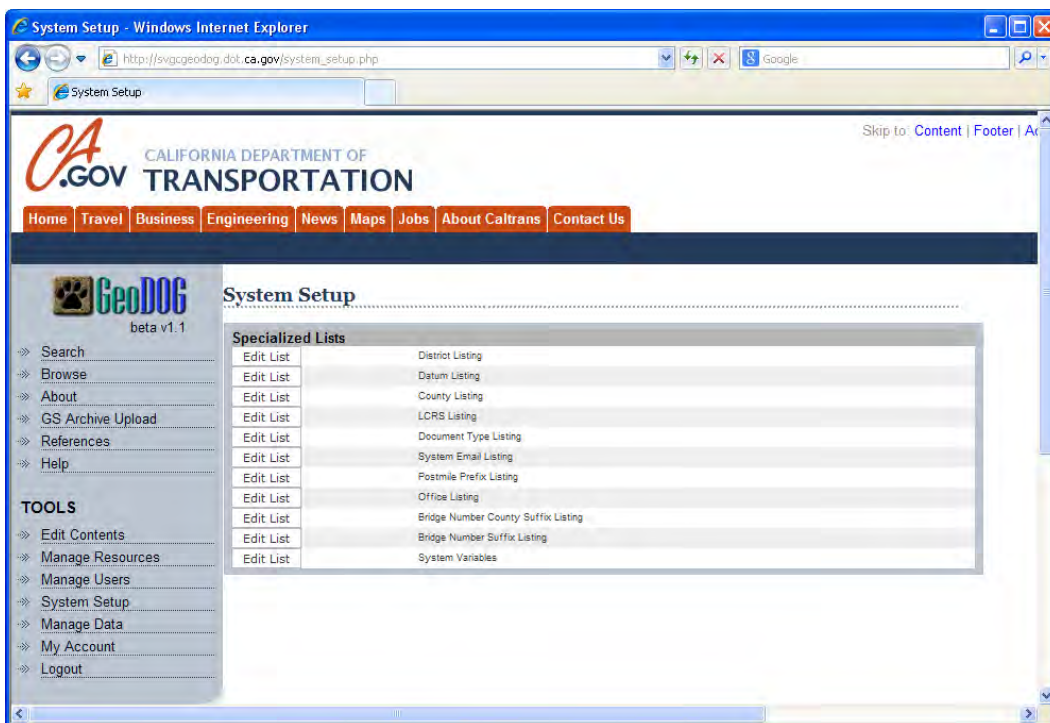


Figure 7-35 – System Setup Page

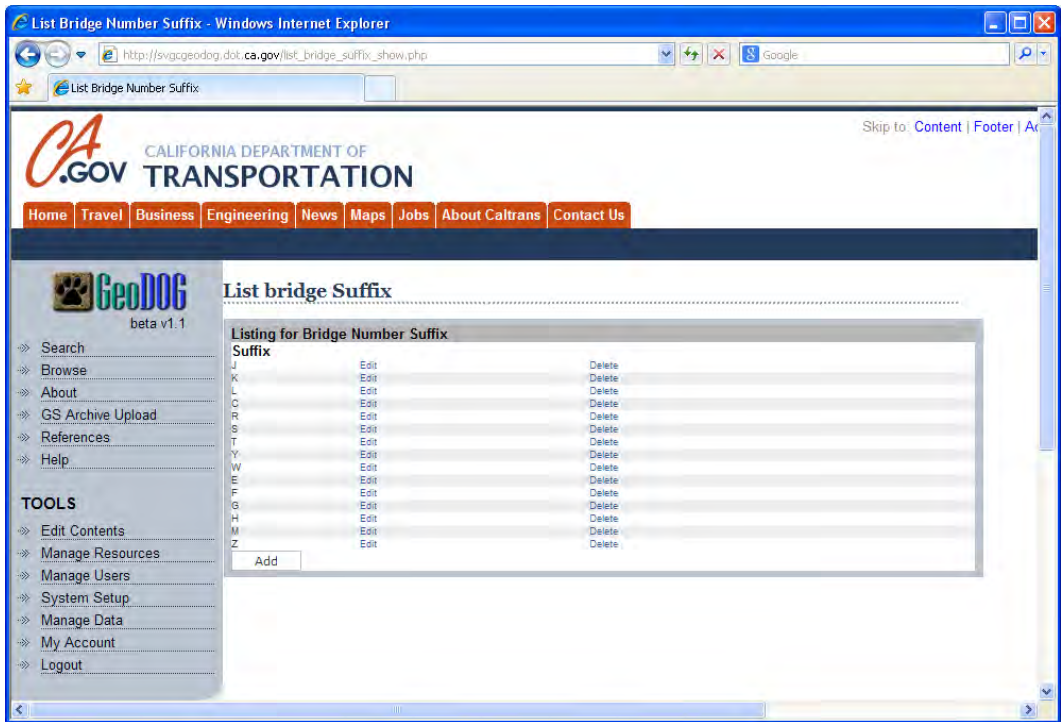


Figure 7-36 – Editing the Value List

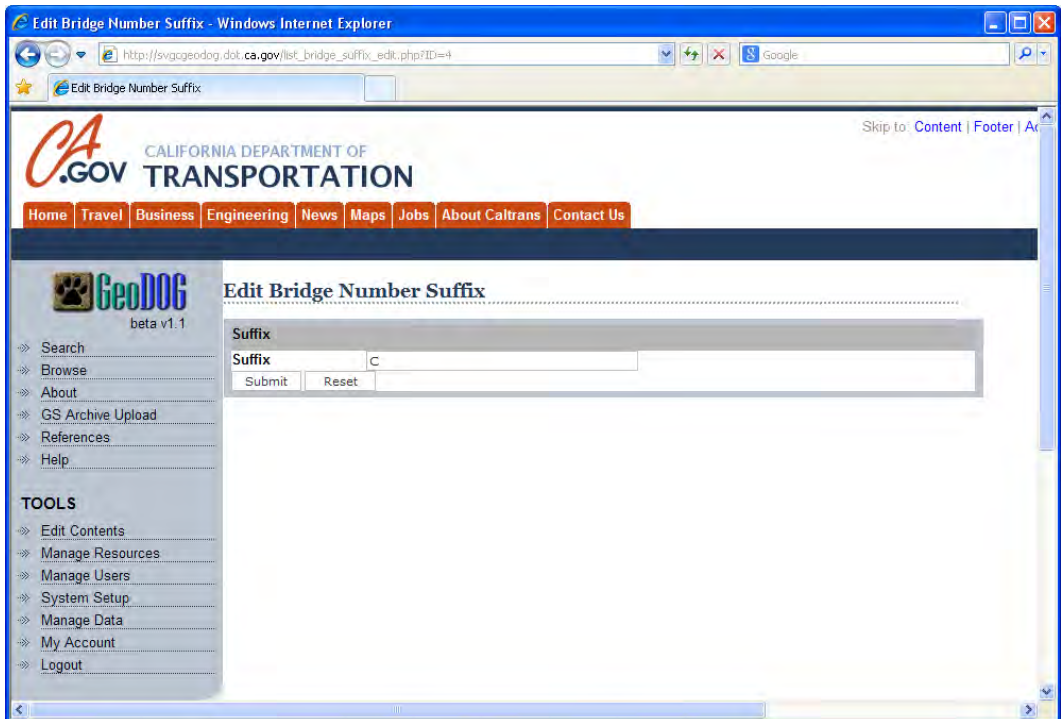


Figure 7-37 – Modifying and Entering Values in the List

7.4.2 Manage Users

The *Manage Users* page provides an interface to view, edit, and delete existing Manager and Administrator accounts, as shown in Figure 7-38 and Figure 7-39.

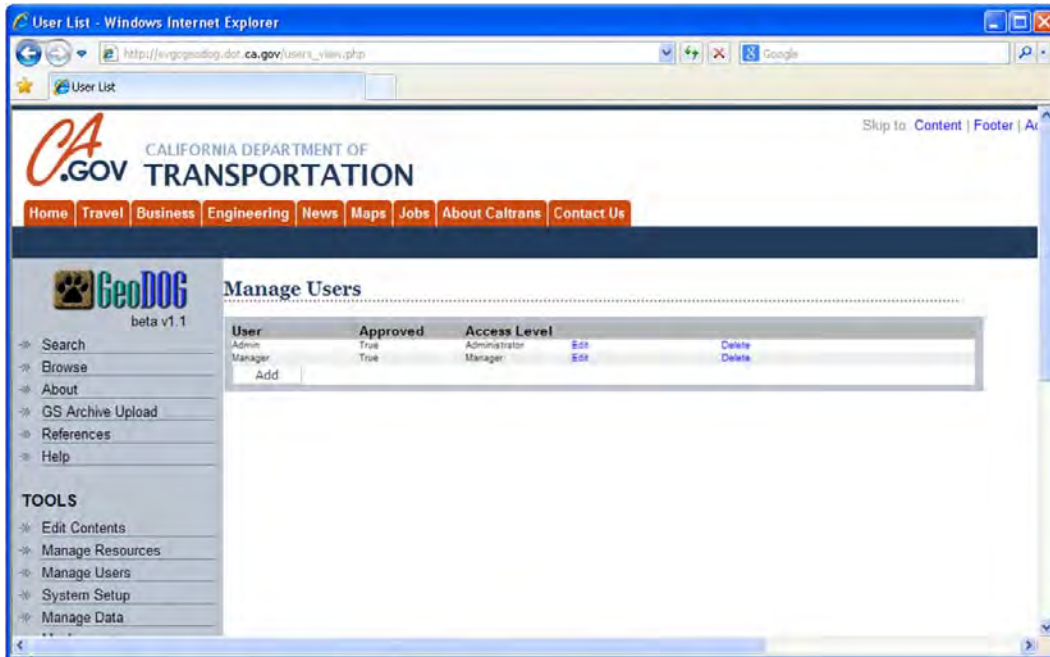


Figure 7-38 – Manage Users Page

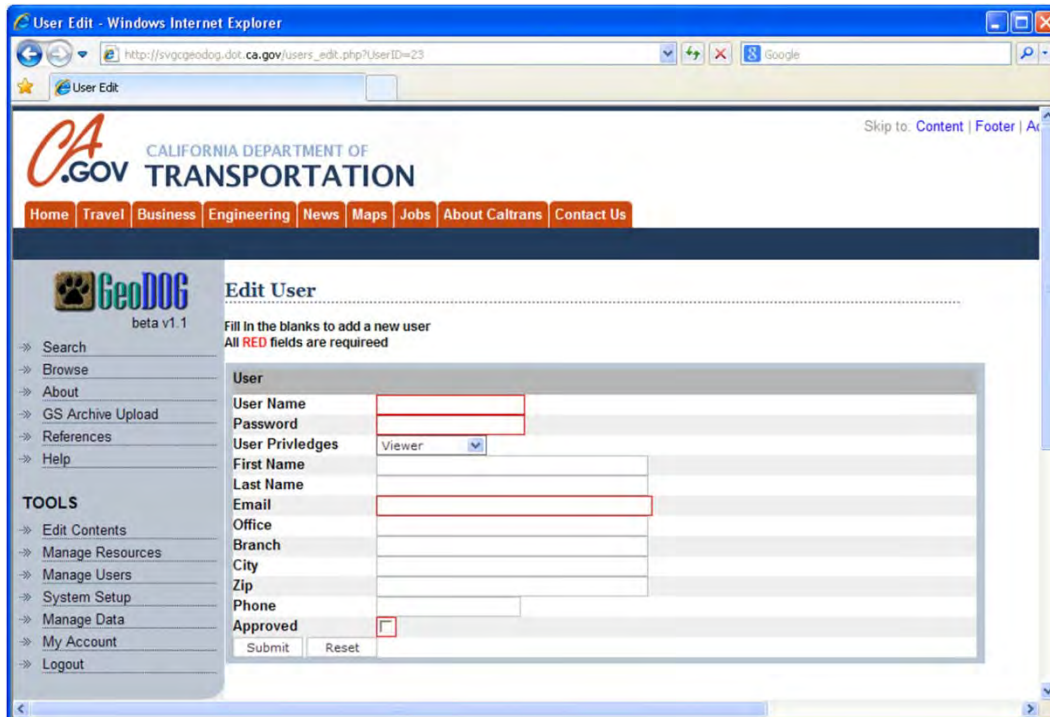


Figure 7-39 - Edit User Information

7.4.3 Edit Contents

Administrators can use the *Edit Contents* page to modify the page content presented in the body of four pages in GeoDOG:

- *Landing Page* – First page encounters by all users.
- *References* – Information about policies, procedures, and anything else related to GeoDOG.
- *About* – Background about the GeoDOG development effort.
- *Help* – Guidance on usage of GeoDOG.

The *Edit Contents* page is comprised of two sections, the upper section with a WYSIWYG editor, and a lower section with a listing of uploaded files that can be referenced. This is shown in Figure 7-40.

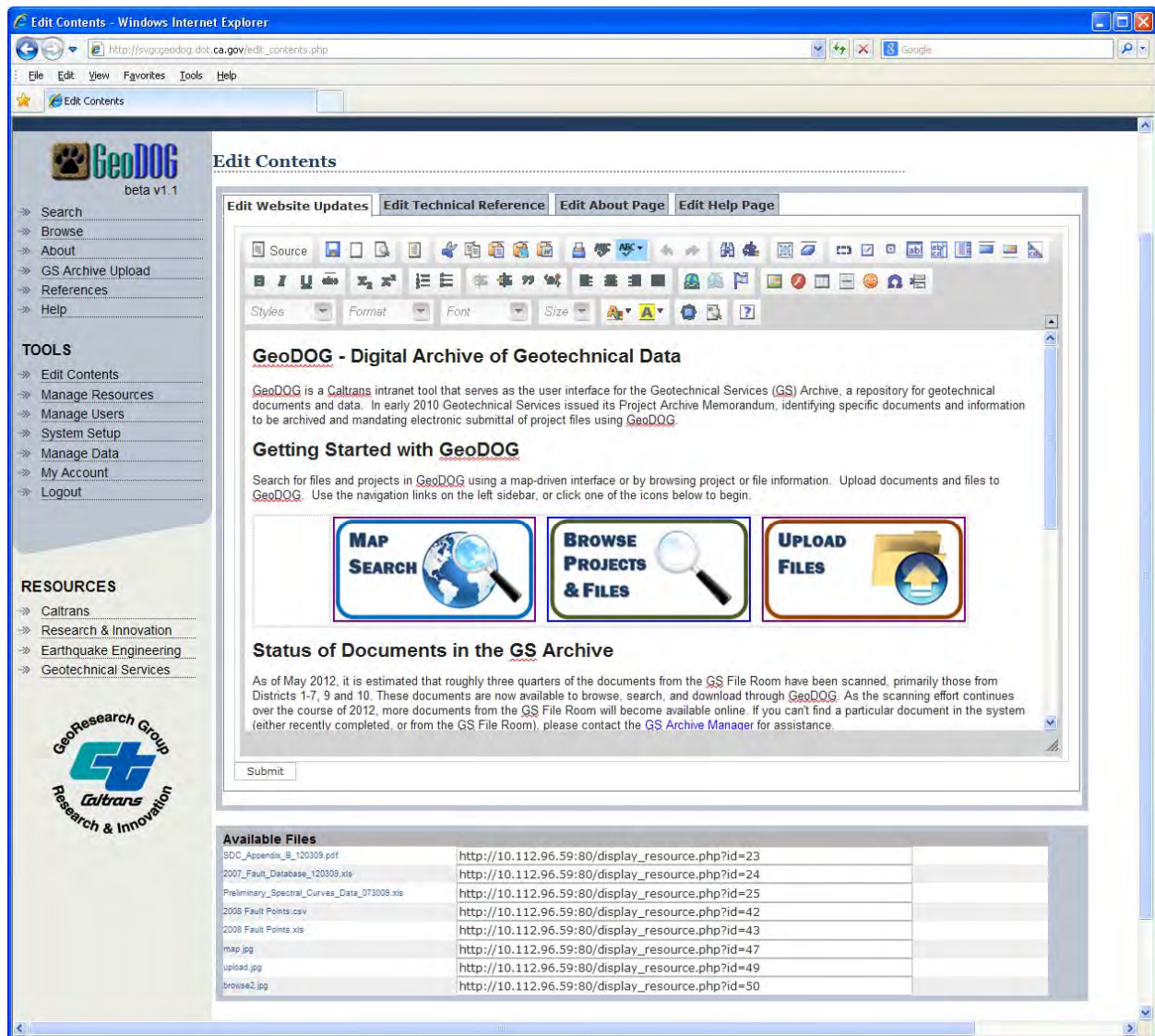


Figure 7-40 - Edit Contents Page

For each of the four pages where content can be edited, a series of tabs along the top of the editor is used to switch between pages. The editor is comprised of various text editing and formatting tools, similar in many ways to those found in common desktop word processing software, such as *Microsoft Word*. The Administrator can use these tools to craft fairly complex web page content that may include links to other pages, embedded images, tables, etc. Changes made in the editor are immediately viewable on the GeoDOG website, as shown in an example in Figure 7-41.

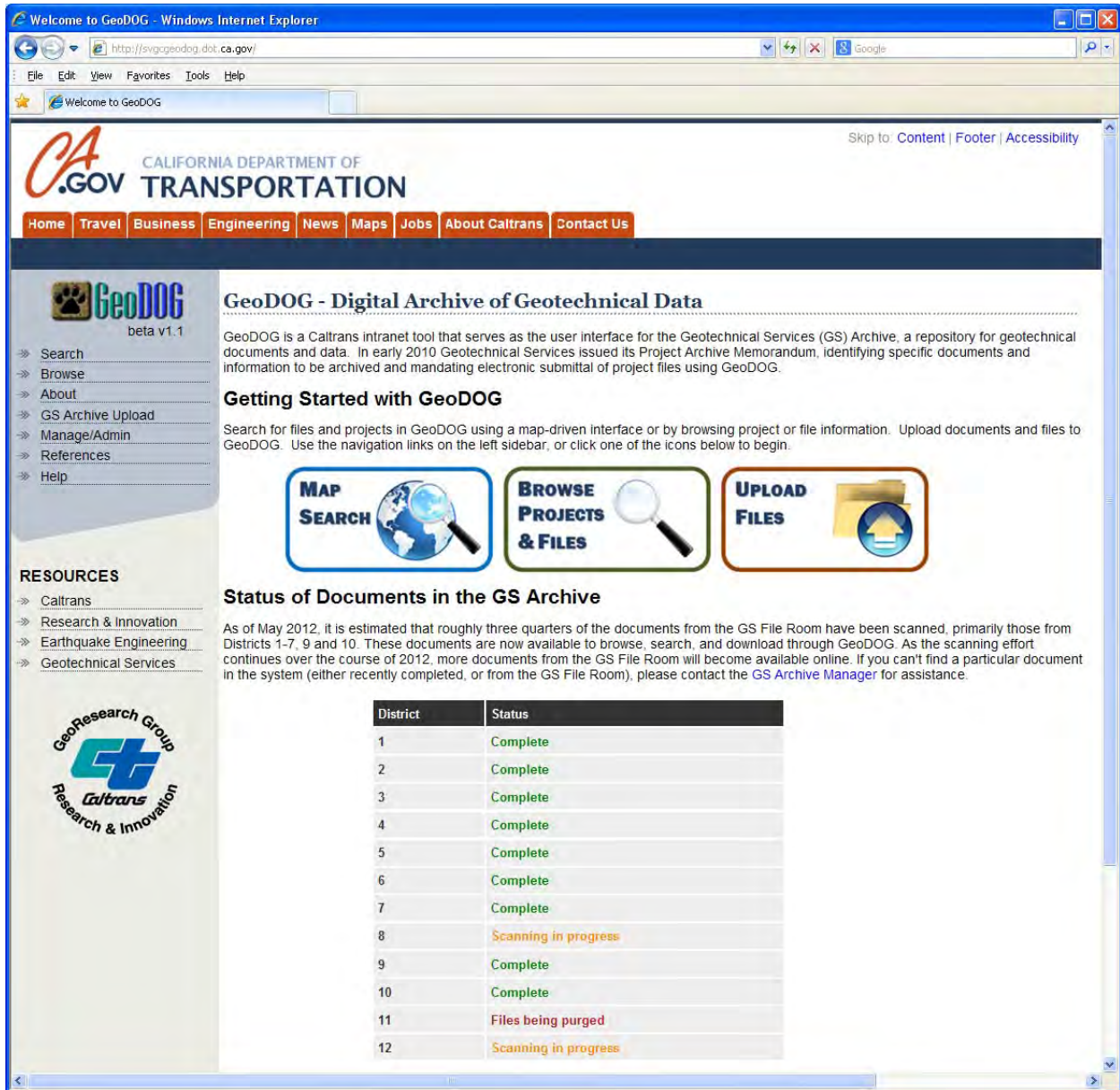


Figure 7-41 - Example of Edited Content Presented in GeoDOG

The editing tool, *CKEditor* (<http://ckeditor.com/>), is an open-source HTML web page editor that operates as a library within the PHP technology platform. Additional details are presented in a later section of this report.

7.4.4 Manage Resources

As described in the prior section, various documents, images, and other files can be used in the *Edit Contents* pages. For these files a special function is available to upload and manage these resources. The *Manage Resources* page, as shown in Figure 7-42, provides the interface.

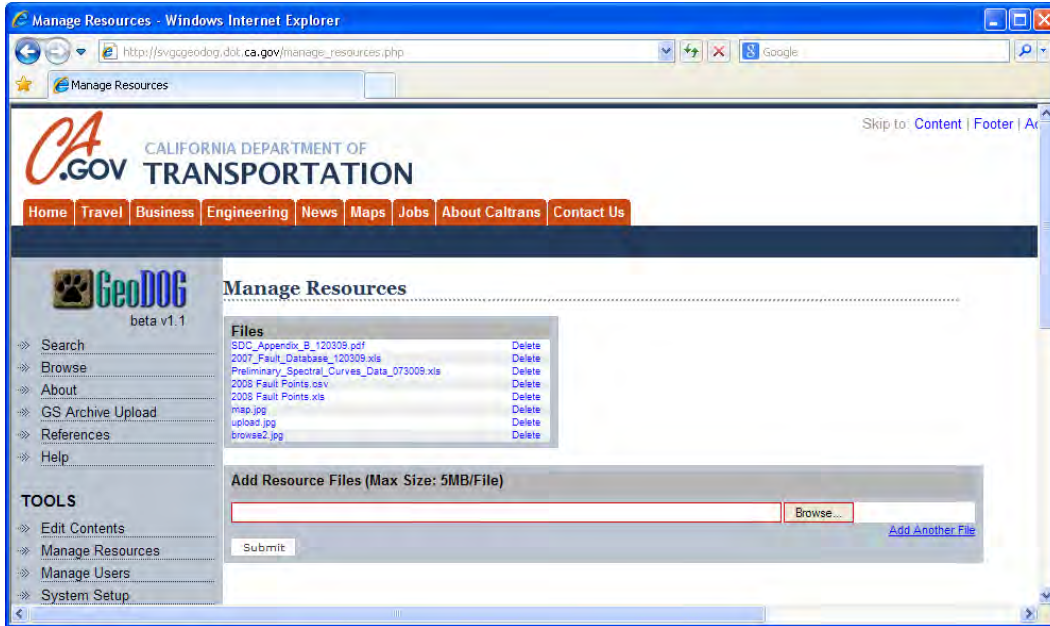


Figure 7-42 - Manage Resources Page

Once files are uploaded, they can be referenced in the *Edit Contents* page by using the appropriate URL.

8 Web Page Codes and Special Functions

Features and functions in the GeoDOG system are built primarily with PHP scripts. A few of the more specialized functions are implemented with Javascript, Java, and add-on PHP libraries.

8.1 PHP

Each web page in GeoDOG is built around PHP scripts. A complete listing of all PHP files and their organizational structure are described in detail in Appendix B.

8.2 CKEditor

The web-based tool, *CKEditor* (<http://ckeditor.com/>) allows *Administrators* to create and edit web page content for four specific informational pages on the GeoDOG website. CKEditor is a HTML text editor that brings familiar word processor features into a webpage to help site administrators edit content easily. CKEditor is an open source application distributed under the GPL, LGPL and MPL Open Source licenses.

As implemented in GeoDOG, CKEditor converts the WYSIWYG formatted content to equivalent HTML that is then stored as a string object in the MySQL database. This HTML is, in turn, embedded in the main body of one of the four specific informational web pages presented to users (e.g. Landing Page, Help Page, About Page, References Page). This tool provides a convenient means for system *Administrators* to update frequently changing website content.

Installation of CKEditor involves placing a directory of the CKEditor files at the root directory of the website, as shown in Figure 8-1. The PHP-based CKEditor libraries can then be called from any page within the site.

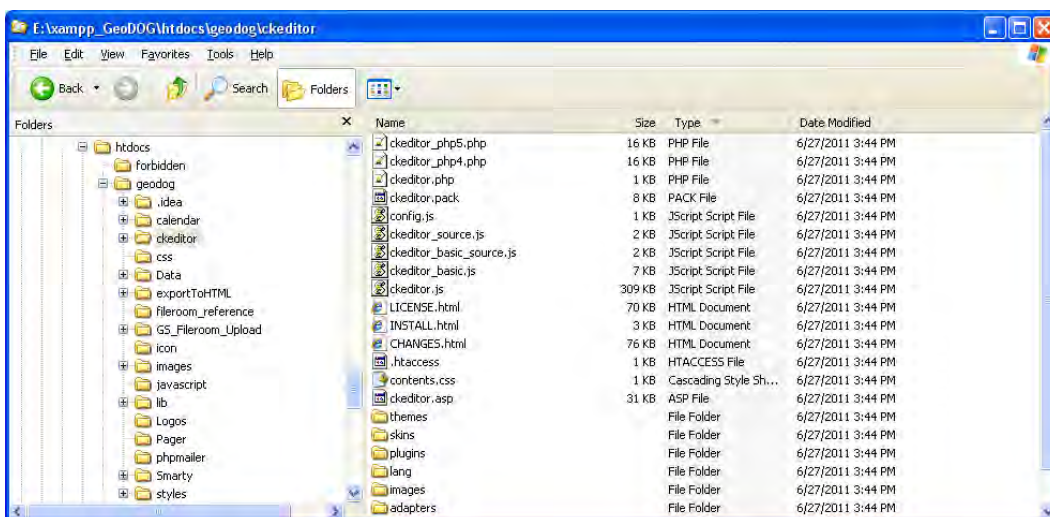


Figure 8-1 - CKEditor Files

8.3 PROJ.4

The *PROJ4JS* module (<http://trac.osgeo.org/proj4js/>) is a JavaScript library implementation of *PROJ.4* (<http://trac.osgeo.org/proj/>) that transforms point coordinates from one coordinate system to another, including datum transformations. In the GeoDOG implementation, this function is used to convert back and forth between *WGS84 Geographic Coordinate Systems* (e.g. latitude and longitude in units of degrees as displayed in Google Maps and Google Earth products) and the *California State Plane Coordinate System* (e.g. Cartesian x-y coordinates in units of feet or meters as typically displayed on printed maps and reported by Caltrans Survey Crews).

Installation of PROJ4JS involves placement of the JavaScript supporting files in the `../lib` directory at the root directory of the website, as shown in Figure 8-2.

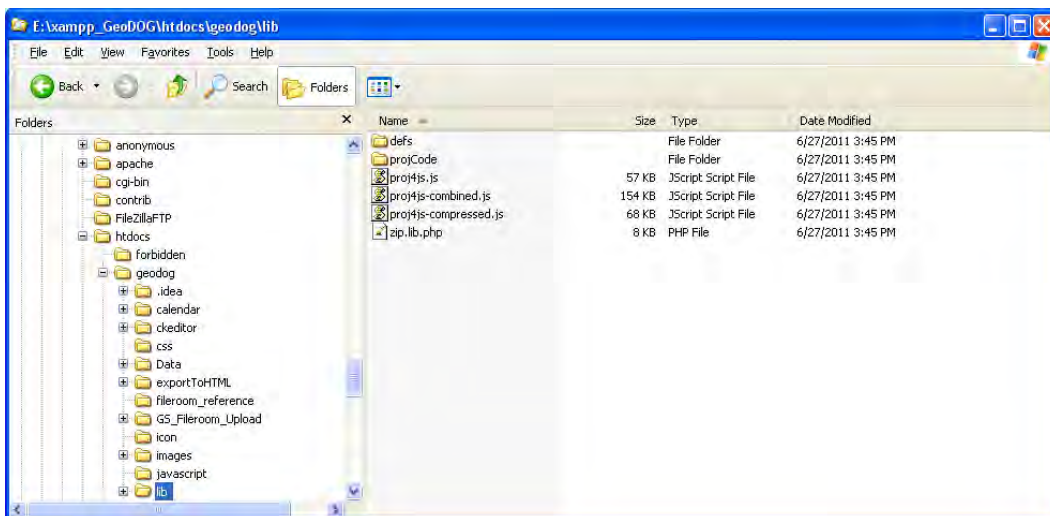


Figure 8-2 – PROJ4JS Files

8.4 Caltrans Postmile Query Tool Web Service

The Office of Data Analysis and Geospatial Information Systems (ODAGIS) in the Division of Research, Innovation and System Information (DRISI) currently hosts a web service that provides a conversion from postmiles to WGS84 geographic latitude and longitude coordinates. The *Postmile Query Tool* is hosted on a Caltrans intranet website

(<http://svhqgisapp1.dot.ca.gov/postmilewebclient/PostmileQueryTool.html#>) with a GoogleMaps interface, as shown in Figure 8-3. Access to the web service is accomplished through use of the *Simple Object Access Protocol (SOAP)* and the ODAGIS web service module (<http://svhqgisapp1.dot.ca.gov/postmilewebservice/services/GISWebServiceSoapImpl>).

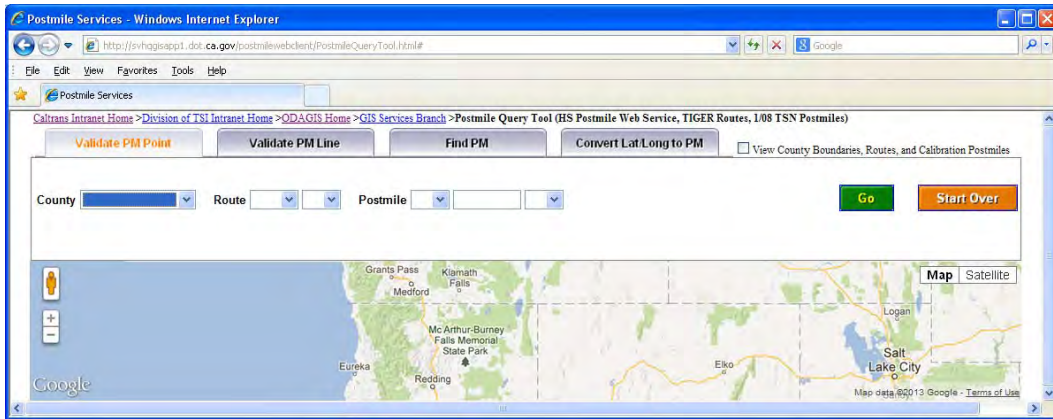


Figure 8-3 - ODAGIS Postmile Web Service

8.5 Prototype Support Functions for Commercial Geotechnical Software

Although the primary assets captured in GeoDOG are the digital documents, the feasibility of capturing subsurface soil and rock data was also explored. Geo-professionals at Caltrans currently use a commercial software package called *gINT* (<http://www.gintsoftware.com/>) to organize and prepare boring logs, fence diagrams, geotechnical soil and rock laboratory testing and other professional engineering reports. Although boring logs, as shown in an example in Figure 8-4, are typically included within PDF documents and reports archived in GeoDOG, the core data that underlies these boring logs are lost if not extracted and stored explicitly.

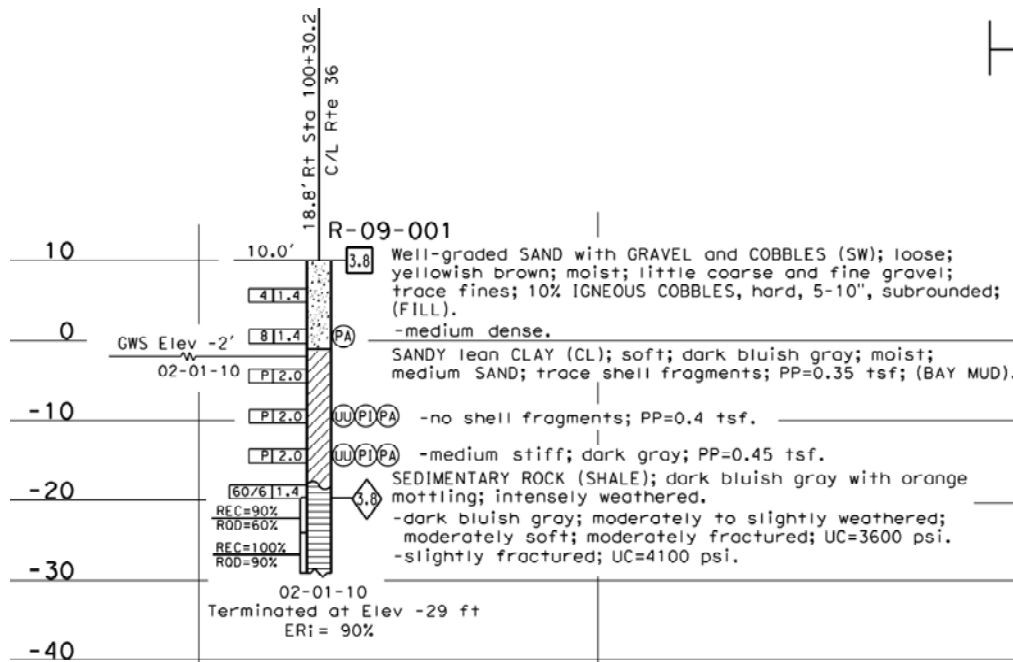


Figure 8-4 - Typical Boring Log

A prototype set of functions for data extraction and storage were developed and tested within the GeoDOG system and demonstrated to work. These functions, however, were not implemented into the operational system as the international geo-data interchange standard, DIGGS (<http://diggsml.org/>), was not finalized at the time of GeoDOG deployment.

This suite of prototype functions took uploaded gINT project files (identified by the file extension .GPJ), extracted the data contents, and populated a table in the backend database. Locations of the gINT data would appear in the user interface in the map as a different icon. When users chose to download gINT files, GeoDOG would pull data from the database and generate Excel-based spreadsheets of the boring logs. These Excel spreadsheets were formatted for direct import into the gINT software. The Excel formatted files were used only to demonstrate feasibility, and would be replaced with DIGGS when ready.

9 File Storage Approach

GeoDOG implements a *filesystem* storage approach, whereby uploaded files are stored in their original format in a hierarchy of directories and sub-directories on a server accessible over the internet.

9.1 Alternatives Considered

Two alternative approaches were considered for file storage during the design phase of GeoDOG:

- *Filesystem* – Files are stored on a server, and the links (or “pointers”) to the files are stored in a database.
- *Database Binary Large Objects (BLOB)* – Files are stored directly within a database as objects.

Both approaches have their merits and downsides as is documented in numerous studies in technical literature. For example, a 2006 Microsoft study suggests that filesystem based approach tends to result in better performance especially with larger files (<http://research.microsoft.com/pubs/64525/tr-2006-45.pdf>). By contrast, security for access to files can be more easily managed when the files are stored within the database.

For purposes of GeoDOG, a filesystem approach was taken. The driving consideration behind this design decision was “future-proofing” the system moving into the future. Using the filesystem approach assures that an organized collection of files in GeoDOG would be accessible into the future, mitigating scenarios where the technology underpinning GeoDOG becomes obsolete or department support for the GeoDOG system is lost.

9.2 Filesystem Implementation in GeoDOG

When files are uploaded by users to GeoDOG, new directories are created to store the files. A directory creation and naming convention was adopted to store the files based on key project and file metadata. High level directories are created automatically on the server in a “data” directory using the project’s district and county information. A project-specific sub-directory is created within these directories using a concatenation of the route, postmile, bridge number, and a fixed number of characters of the project name. During the directory naming spaces and special characters are replaced with underscores (i.e. “_”).

As an example, consider a document with the following properties:

- Filename: “33-1234_FoundRec.pdf”
- District: 4
- County: ALA
- Route: 680
- Postmile: 11.2

- Bridge Number: 33-1234
- Project Name: Fifth St OC Widening

When a file having these properties is uploaded into GeoDOG, three new folders are created in the filesystem, as shown in Figure 9-1. If the district and the county directory already exist, only the new project directory is created.

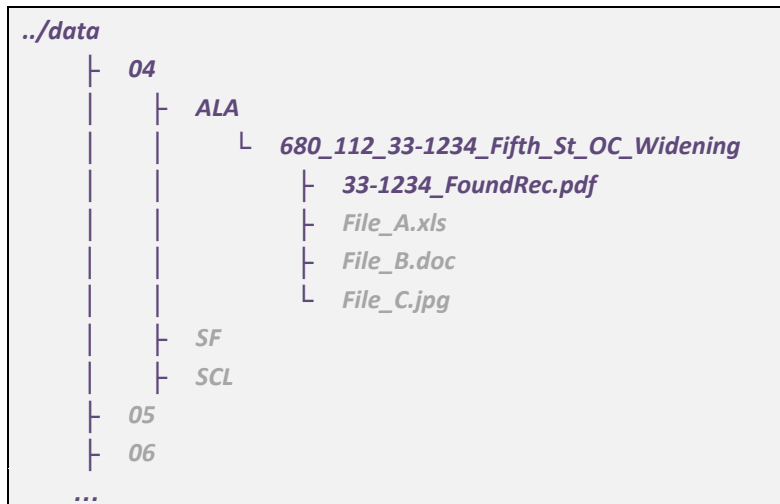


Figure 9-1 - Creation of Filesystem

The collection of files in this hierarchy of directories under the *.../data* directory represents a standalone, non-proprietary, and partially indexed collection of files that could be used in the absence of the GeoDOG system. This collection of files can be independently stored and backed up, thereby providing an additional degree of archival redundancy. If a new document management system were to be adopted at some point in the future, this collection of files is organized in a way that would facilitate streamlined migration.

10 Deployment

Early alpha and beta versions of GeoDOG were tested by focus groups in Geotechnical Services beginning in early 2009. By early 2010 a large number of paper files from the GS document fileroom had been scanned and were loaded into GeoDOG. In March 2010 GeoDOG was deemed sufficiently mature and GS management directed staff to begin archiving documents into the system (see Appendix C).

In early 2012 a number of state and federal investigations into foundation testing practices , initiated as a result of incidents of foundation test data falsification (<http://www.dot.ca.gov/hq/paffairs/gamma/>). A key finding from these investigations suggest that more rigorous data and document management practices be adopted by the Caltrans Foundation Testing Branch, including the use of GeoDOG. As a result, in September 2012 the GeoDOG system was migrated from intranet development servers within the Division of Research, Innovation and System Information (DRISI) to operational intranet servers maintained by the Caltrans Information Technology (IT) group. All future maintenance and operational aspects of GeoDOG are managed by IT.

11 Summary

This research, the second task under the multi-phase research project *Innovative Geotechnical Data Management Tools and Methods* (Project ID P190), resulted in the delivery of the *Digital Archive of Geotechnical Data (GeoDOG)*, an internal Caltrans web-based tool for managing the Department's geotechnical documents and data. GeoDOG allows users to upload, search, and download geotechnical documents and data. GeoDOG was implemented by Geotechnical Services in March 2010, and the technology migrated and implemented as an intranet application by Caltrans Information Technology in September 2012.

The implementation of GeoDOG marks a major milestone in data and document management practices for Caltrans Geotechnical Services. Moving forward, the digital archive is expected to drastically cut the time required to locate historical design documents and data. Furthermore, access to and discovery of historical boring logs will likely lead to more reuse of previously developed boring logs. The net effect of both of these factors could result in millions of dollars in savings based on experiences at other State Departments of Transportation that have pursued similar document management efforts.

Subsequent research work under this project is needed to further leverage the benefits introduced with GeoDOG. These include:

- **Expand GeoDOG to capture and store subsurface data.** GeoDOG currently supports the storage of documents. Although the feasibility of storing subsurface data from gINT files was successfully demonstrated, additional development work is needed to fully support this functionality.
- **Implement data interchange tools based on the DIGGS standard.** Use of the DIGGS standard would facilitate the exchange of underlying borehole and lab test data (not just the graphical elements embedded in PDF documents) between the geo-professionals, soil and rock testing labs, and other stakeholders in the design process. DIGGS implementation would also facilitate software interoperability between commercial software and the GeoDOG data repository.
- **Expand features and functions in GeoDOG.** A number of user and administrative interface enhancements are needed to improve workflow and reporting capabilities in the system.

Appendix A – Database

Organization of Database

The screenshot displays the schema for a database named 'Project'. The tables and their fields are as follows:

- geo_projects**
 - Project_ID VARCHAR(45)
 - Project_Name VARCHAR(560)
 - County VARCHAR(20)
 - District VARCHAR(20)
 - Route VARCHAR(60)
 - Project_Date DATE
 - Back_Prefix VARCHAR(50)
 - Back VARCHAR(50)
 - Ahead_Prefix VARCHAR(50)
 - Ahead VARCHAR(50)
 - PM_KP_U VARCHAR(5)
 - Comments MEDIUMTEXT
 - ModifiedBY VARCHAR(255)
 - CreatedBY VARCHAR(255)
 - Modified DATETIME
 - ProjectKey INT(10)
 - tracking_office VARCHAR(45)
 - tracking_year VARCHAR(45)
 - tracking_record VARCHAR(45)
 - status VARCHAR(50)
 - reference_number VARCHAR(45)
 - contact_email VARCHAR(255)
 - special_instructions VARCHAR(500)
 - uploaded_date DATE
 - Loc VARCHAR(45)
- geo_project_id**
 - projectID INT(10)
 - number VARCHAR(45)
 - ProjectKey INT(10)
- list_district**
 - District_ID INT(11)
 - Name TEXT
 - District INT(11)
- geo_bridges**
 - bridge_ID INT(10)
 - County_Prefix INT(10)
 - County_Suffix VARCHAR(45)
 - Bridge_Number VARCHAR(45)
 - Bridge_suffix VARCHAR(45)
 - ProjectKey INT(10)
- geo_ea**
 - EA_ID INT(10)
 - EA_District VARCHAR(45)
 - EA_Number VARCHAR(45)
 - ProjectKey INT(10)
- list_county_suffix**
 - id INT(10)
 - suffix VARCHAR(45)
- list_post_prefix**
 - ID INT(10)
 - prefix VARCHAR(100)
- list_tracking_office**
 - ID INT(10)
 - office VARCHAR(45)
- list_county**
 - County_ID INT(11)
 - Name VARCHAR(255)
 - Abbrv VARCHAR(3)
 - District_Num INT(11)
 - StatePlaneCoordinateZone I...

File

geo_files

- File_ID BIGINT(20)
- ProjectKey INT(10)
- Document_Author VARCHAR(255)
- Document_Title VARCHAR(255)
- Document_Type VARCHAR(255)
- Document_Sub_Type VARCHAR(255)
- Document_Date DATE
- Document_Keywords VARCHAR(6000)
- Filepath VARCHAR(255)
- Filename VARCHAR(255)

list_file_type

- ID INT(10)
- Name VARCHAR(100)

list_file_sub_type

- ID INT(10)
- Name VARCHAR(200)
- Main_Type_ID INT(10)

Location

geo_location

- Location_ID BIGINT(20)
- ProjectKey BIGINT(20)
- Location_Description MEDIUMTEXT
- Latitude DOUBLE
- Longitude DOUBLE
- Datum VARCHAR(255)
- Northing DOUBLE
- Easting DOUBLE
- LCRS VARCHAR(255)
- Accuracy VARCHAR(255)
- Location_Type VARCHAR(255)

list_location_type

- type_id INT(11)
- type VARCHAR(255)

list_datum_type

- Datum_ID INT(11)
- Code VARCHAR(255)

list_survey_type

- Survey_ID INT(11)
- Name VARCHAR(255)

list_vdatum_type

- VDatum_ID INT(11)
- Code VARCHAR(255)

list_accuracy_type

- Accuracy_ID INT(11)
- Name VARCHAR(255)

list_lcrs

- LCRS_ID INT(10)
- Name VARCHAR(255)

System

- admin_contents**
 - id INT(10)
 - type VARCHAR(60)
 - content LONGBLOB
 - Indexes
- resource_files**
 - File_ID INT(10)
 - content LONGBLOB
 - type VARCHAR(45)
 - name VARCHAR(255)
 - file_group VARCHAR(45)
 - size VARCHAR(45)
 - Indexes
- system_variables**
 - id INT(10)
 - version VARCHAR(45)
 - Indexes
- geo_users**
 - User_ID BIGINT(20)
 - Username CHAR(255)
 - User_Rights INT(11)
 - Password CHAR(255)
 - First_Name CHAR(255)
 - Last_Name CHAR(255)
 - Email CHAR(255)
 - Office CHAR(255)
 - Branch CHAR(255)
 - City CHAR(255)
 - Zip CHAR(10)
 - Phone CHAR(15)
 - Approved TINYINT(4)
 - Approval_Code CHAR(255)
 - Indexes
- list_email**
 - ID INT(10)
 - email VARCHAR(200)
 - Indexes

BIRIS Data

- biris_bridge**
 - id INT(10)
 - name VARCHAR(100)
 - number VARCHAR(45)
 - DCRP VARCHAR(60)
 - lat DOUBLE
 - lon DOUBLE
 - struct_type VARCHAR(200)
 - owner VARCHAR(45)
 - nbi VARCHAR(45)
 - hazus VARCHAR(45)
 - year_built VARCHAR(45)
 - year_improved VARCHAR(45)
 - max_span VARCHAR(45)
 - skew VARCHAR(45)
 - design_II VARCHAR(50)
 - Indexes
- biris_links**
 - id INT(10)
 - br_num VARCHAR(100)
 - path VARCHAR(350)
 - type VARCHAR(200)
 - Indexes

gINT Test Data (Beta)

- gint_atlb_readings**
 - Project_ID INT(11)
 - File_ID INT(11)
 - PointID VARCHAR(255)
 - Depth DOUBLE
 - Reading DOUBLE
 - WC_Wt_Wet FLOAT
 - WC_Wt_Dry FLOAT
 - WC_Wt_Tare FLOAT
 - Water_Content FLOAT
 - Number_Blows INT(11)
 - Cone_Pen_Initial FLOAT
 - Cone_Pen_Final FLOAT
 - Indexes

Data Dictionary

Database Table: admin_contents

Field	Type	Null	Default	Comments	MIME
<u>id</u>	int(10)	No			
type	varchar(60)	No			
content	longblob	No			

Database Table: biris_bridge

Field	Type	Null	Default	Comments	MIME
<u>id</u>	int(10)	No			
name	varchar(100)	No			
number	varchar(45)	No			
DCRP	varchar(60)	No			
lat	double	No			
lon	double	No			
struct_type	varchar(200)	No			
owner	varchar(45)	No			
nbi	varchar(45)	Yes	NULL		
hazus	varchar(45)	Yes	NULL		
year_built	varchar(45)	Yes	NULL		
year_improved	varchar(45)	Yes	NULL		
max_span	varchar(45)	Yes	NULL		
skew	varchar(45)	Yes	NULL		
design_ll	varchar(50)	Yes	NULL		

Database Table: biris_links

Field	Type	Null	Default	Comments	MIME
<u>id</u>	int(10)	No			
br_num	varchar(100)	No			
path	varchar(350)	No			
type	varchar(200)	No			

Database Table: geo_bridges

Field	Type	Null	Default	Comments	MIME
<u>bridge ID</u>	int(10)	No			

County_Prefix	int(10)	No
County_Suffix	varchar(45)	No
Bridge_Number	varchar(45)	No
Bridge_suffix	varchar(45)	No
ProjectKey	int(10)	No

Database Table: geo_ea

Field	Type	Null	Default	Comments	MIME
<u>EA_ID</u>	int(10)	No			
EA_District	varchar(45)	No			
EA_Number	varchar(45)	No			
ProjectKey	int(10)	No			

Database Table: geo_files

Field	Type	Null	Default	Comments	MIME
<u>File_ID</u>	bigint(20)	No			
ProjectKey	int(10)	Yes	NULL		
Document_Author	varchar(255)	Yes	NULL		
Document_Title	varchar(255)	Yes	NULL		
Document_Type	varchar(255)	Yes	NULL		
Document_Sub_Type	varchar(255)	Yes	NULL		
Document_Date	date	Yes	NULL		
Document_Keywords	varchar(6000)	Yes	NULL		
Filepath	varchar(255)	Yes	NULL		
Filename	varchar(255)	Yes	NULL		

Database Table: geo_location

Field	Type	Null	Default	Comments	MIME
<u>Location_ID</u>	bigint(20)	No			
ProjectKey	bigint(20)	Yes	NULL		
Location_Description	mediumtext	Yes	NULL		
Latitude	double	Yes	NULL		
Longitude	double	Yes	NULL		
Datum	varchar(255)	Yes	NULL		
Northing	double	Yes	NULL		
Easting	double	Yes	NULL		
LCRS	varchar(255)	Yes	NULL		

Accuracy	varchar(255)	Yes	NULL
Location_Type	varchar(255)	Yes	NULL

Database Table: **geo_project_id**

Field	Type	Null	Default	Comments	MIME
projectID	int(10)	No			
number	varchar(45)	No			
ProjectKey	int(10)	No			

Database Table: **geo_projects**

Field	Type	Null	Default	Comments	MIME
Project_ID	varchar(45)	Yes	NULL		
Project_Name	varchar(560)	Yes	NULL		
County	varchar(20)	Yes	NULL		
District	varchar(20)	Yes	NULL		
Route	varchar(60)	Yes	NULL		
Project_Date	date	Yes	NULL		
Back_Prefix	varchar(50)	Yes	NULL		
Back	varchar(50)	Yes	NULL		
Ahead_Prefix	varchar(50)	Yes	NULL		
Ahead	varchar(50)	Yes	NULL		
PM_KP_U	varchar(5)	Yes	NULL		
Comments	mediumtext	Yes	NULL		
ModifiedBY	varchar(255)	Yes	NULL		
CreatedBY	varchar(255)	Yes	NULL		
Modified	datetime	Yes	NULL		
ProjectKey	int(10)	No			
tracking_office	varchar(45)	Yes	NULL		
tracking_year	varchar(45)	Yes	NULL		
tracking_record	varchar(45)	Yes	NULL		
status	varchar(50)	No			
reference_number	varchar(45)	Yes	NULL		
contact_email	varchar(255)	Yes	NULL		
special_instructions	varchar(500)	Yes	NULL		
uploaded_date	date	Yes	NULL		
Loc	varchar(45)	Yes	NULL		

Database Table: geo_users

Field	Type	Null	Default	Comments	MIME
<u>User_ID</u>	bigint(20)	No			
Username	char(255)	Yes	NULL		
User_Rights	int(11)	Yes	NULL		
Password	char(255)	Yes	NULL		
First_Name	char(255)	Yes	NULL		
Last_Name	char(255)	Yes	NULL		
Email	char(255)	Yes	NULL		
Office	char(255)	Yes	NULL		
Branch	char(255)	Yes	NULL		
City	char(255)	Yes	NULL		
Zip	char(10)	Yes	NULL		
Phone	char(15)	Yes	NULL		
Approved	tinyint(4)	Yes	NULL		
Approval_Code	char(255)	Yes	NULL		

Database Table: list_accuracy_type

Field	Type	Null	Default	Comments	MIME
<u>Accuracy_ID</u>	int(11)	No			
Name	varchar(255)	Yes	NULL		

Database Table: list_bridge_suffix

Field	Type	Null	Default	Comments	MIME
<u>id</u>	int(10)	No			
suffix	varchar(45)	No			

Database Table: list_county

Field	Type	Null	Default	Comments	MIME
<u>County_ID</u>	int(11)	No			
Name	varchar(255)	Yes	NULL		
Abbrv	varchar(3)	Yes	NULL		
District_Num	int(11)	No			
StatePlaneCoordinateZone	int(11)	Yes	NULL		

Database Table: list_county_city

Field	Type	Null	Default	Comments	MIME
<u>county</u>	varchar(60)	No			
<u>city</u>	varchar(60)	No			

Database Table: list_county_suffix

Field	Type	Null	Default	Comments	MIME
<u>id</u>	int(10)	No			
suffix	varchar(45)	No			

Database Table: list_datum_type

Field	Type	Null	Default	Comments	MIME
<u>Datum ID</u>	int(11)	No			
Code	varchar(255)	Yes	NULL		

Database Table: list_district

Field	Type	Null	Default	Comments	MIME
<u>District ID</u>	int(11)	No			
Name	text	No			
District	int(11)	Yes	NULL		

Database Table: list_email

Field	Type	Null	Default	Comments	MIME
<u>ID</u>	int(10)	No			
email	varchar(200)	No			

Database Table: list_file_type

Field	Type	Null	Default	Comments	MIME
<u>ID</u>	int(10)	No			
Name	varchar(100)	No			

Database Table: list_lcrs

Field	Type	Null	Default	Comments	MIME
<u>LCRS ID</u>	int(10)	No			
Name	varchar(255)	Yes	NULL		

Database Table: list_location_type

Field	Type	Null	Default	Comments	MIME
type_id	int(11)	No			
type	varchar(255)	Yes	NULL		

Database Table: list_post_prefix

Field	Type	Null	Default	Comments	MIME
ID	int(10)	No			
prefix	varchar(100)	No			

Database Table: list_tracking_office

Field	Type	Null	Default	Comments	MIME
ID	int(10)	No			
office	varchar(45)	No			

Database Table: list_zip_county

Field	Type	Null	Default	Comments	MIME
zip	varchar(10)	No			
county	varchar(100)	No			

Database Table: resource_files

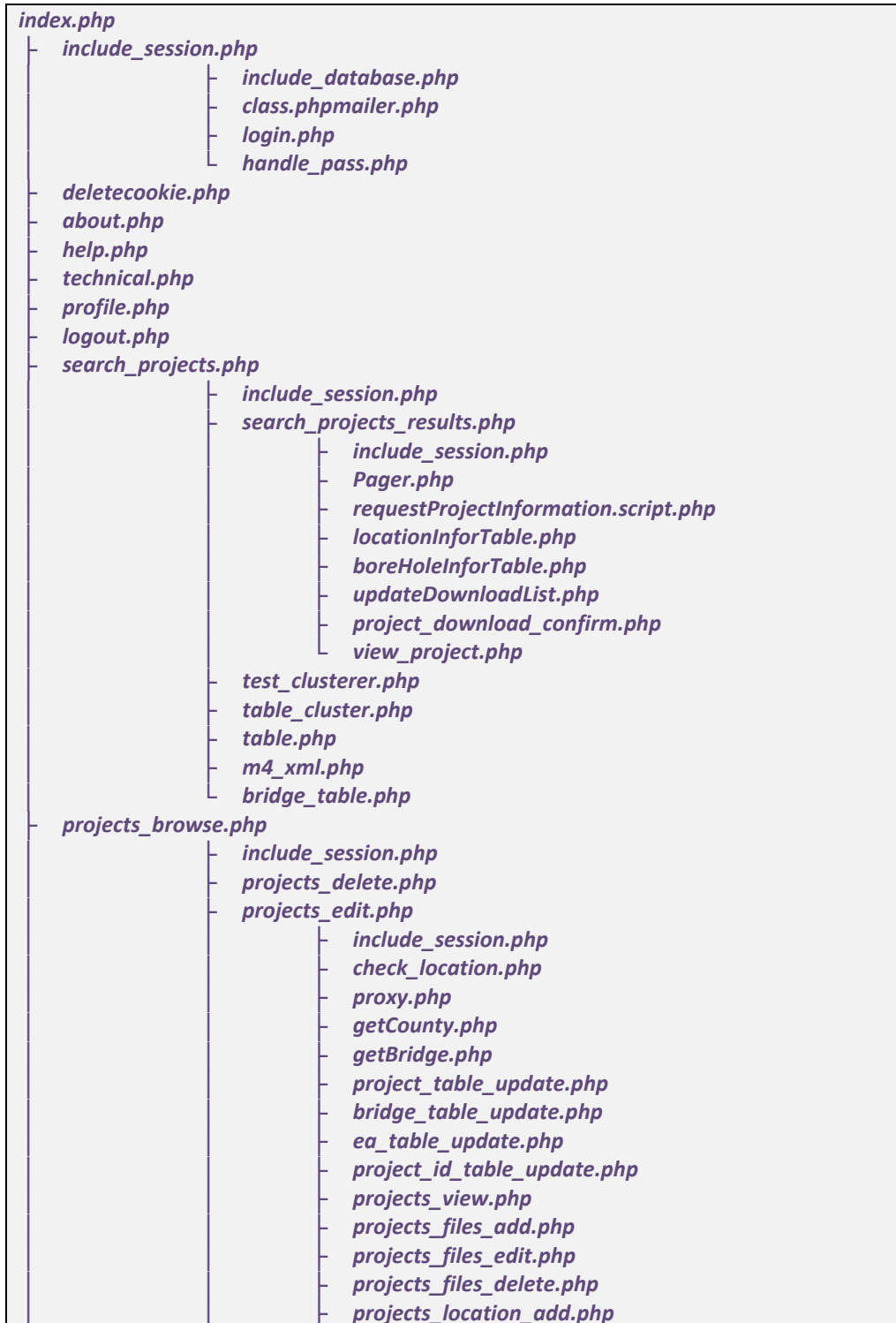
Field	Type	Null	Default	Comments	MIME
File ID	int(10)	No			
content	longblob	No			
type	varchar(45)	No			
name	varchar(255)	No			
file_group	varchar(45)	No			
size	varchar(45)	No			

Database Table: system_variables

Field	Type	Null	Default	Comments	MIME
id	int(10)	No			
version	varchar(45)	No			

Appendix B – PHP Codes

Each page in GeoDOG has a corresponding PHP file. These PHP files are structured ,as shown below, with hierarchical relationships represented in the tree structure. This structure closely follows the simplified website map presented in an earlier section of this report.



	<ul style="list-style-type: none"> <ul style="list-style-type: none"> projects_location_delete.php projects_location_edit.php user_project_search.php getCounty.php requestProjectInformation.script.php locationInforTable.php boreHoleInforTable.php view_project.php <ul style="list-style-type: none"> include_session.php updateDownloadList.php project_download_confirm.php view_project_location.php
fileroom_upload.php	<ul style="list-style-type: none"> include_session.php fileroom_upload_confirm.php projects_location_add_gs.php getTable.php getCounty.php getBridge.php getEA.php getProjectID.php proxy.php projects_location_add.php projects_Coordinate_Conversion.php
projects_view.php	<ul style="list-style-type: none"> include_session.php ApproveProjectList.php DeleteProjectList.php updateProjectList.php getCounty.php projects_delete.php projects_edit.php admin_project_search.php requestProjectInformation.script.php locationInforTable.php boreHoleInforTable.php projects_add.php bulk_upload.php export_table.php
edit_contents.php	<ul style="list-style-type: none"> include_session.php ckeditor.php edit_help.php edit_about.php edit_technical_references.php edit_website_updates.php display_resource.php
manage_resources.php	<ul style="list-style-type: none"> include_session.php resource_files_add.php resource_files_delete.php getResourceTable.php
users_view.php	

Appendix C – Geotechnical Services Document Management Policy

The documents in this appendix were issued by Caltrans Division of Engineering Services (DES) Geotechnical Services (GS) in March 2010 implementing the use of GeoDOG.

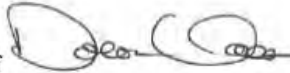
Memorandum

*Flex your power!
Be energy efficient!*

To: ALL STAFF
Geotechnical Services
Division of Engineering Services

Date: March 10, 2010

From: DOLORES VALLS
Deputy Division Chief
Geotechnical Services



Subject: Geotechnical Services Project Archive

Archiving of project-related information preserves the Department's investment in data acquisition, provides a valuable resource for future investigators, and helps to achieve the Department's strategic goals of Delivery and Stewardship. Geotechnical Services (GS) recognizes the advantages of a robust project archive and is implementing a geotechnical project archiving policy to assure that project information is retained and available for others to use. This memo supersedes the Geotechnical Services Project Filing memo signed by James Davis dated November 30, 2007.

Effective April 5, 2010, all Geotechnical Services staff must adhere to the attached *GS Procedure for Archiving GS Documents and Files* to archive project-related documents and information, whether generated in-house or by consultants. The geotechnical professional in responsible charge of the project is responsible for ensuring proper archiving occurs in accordance with this memorandum. Managers and supervisors must ensure that their staff are aware of this policy, are properly trained, and fulfill all archiving requirements.

A project archive must be created or augmented whenever a work product (e.g. geotechnical report, memorandum, boring log, consultant report review) is completed. The types of documents and information to be archived are listed in the *GS Document Archive List*. Items marked "Required" must be archived if they were developed during the course of project investigation, design, reporting, or construction. Working documents not archived, such as drilling requests, USA clearances, original work requests etc., must be maintained by the geotechnical professional throughout the life of the project. These documents may be destroyed upon completion of construction (including litigation).

Project archiving should occur as soon as possible after completion of the final work product and no later than 30 days after marking the GS project tracking "Status" field as "Complete".

Time for project filing shall be charged to the appropriate project EA and activity code for the final work product.

Training on the implementation of these procedures will be made available to all staff. Additionally, GS Data Management Committee members are available to assist staff in the

"Caltrans improves mobility across California"

proper implementation of this procedure. Please work with your Office's representative as necessary. Committee members are listed below:

Chris Koepke (GDN)
Tung Nguyen (GDW)
Shawn Wei (GDS2)
Yung Chung (GS)
Natalie Cornell (GS)
John Bowman (GS)
Craig Hannenian (GS)

Attachment

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Geotechnical Services

Procedure for Archiving GS Documents and Files

March 2010

Page 1 of 19

This document presents the procedures that GS staff must follow to comply with the GS project archive memo dated March 4, 2010. Per the memorandum, the types of documents and information to be archived are listed below.

GS Document Archive List

Document Type	Required (R) or Optional (O)	Native Format	Archive Format *
Relevant historical data from literature search	O	Paper, PDF	PDF
Relevant site reconnaissance results (notes, photos, sketches, geology field maps)	O	Paper	PDF
Reports (e.g., Preliminary Foundation Report)	R	DOC, PDF, XLS, other	Single PDF of entire report
Laboratory test results	R	PDF	PDF
Rock core photos	O	JPG, GIF, BMP	PDF
LOTB, As-Built LOTB, Boring Records	R	PDF, TIF, DGN, gINT	Archive all as PDF, also archive the original format
Existing As-Built Plans not available in BIRIS	R	Paper, PDF	PDF
Field instrumentation measurements or results	R	PDF, XLS, CSV, TXT, and proprietary	Retain relevant file format
Reports (e.g., Foundation, Geotechnical, Geophysical, Geological)	R	DOC, PDF, XLS, other	Single PDF of entire report
Copy of geotechnically relevant plans (GP, FP, Abut/Bent Details)	R	PDF, DGN, TIF	PDF
Peer Review Documents	R	DOC	PDF
QC/QA signature page(s)	R	Paper	PDF
Foundation Review	R	Paper	PDF
Bidder Core View Log	R	Paper	PDF
Borehole Backfill Data Sheet	R	Paper	PDF
Notes or correspondence confirming field verification of geotechnical conditions	R	Paper, email	PDF
Recommendations relating to change orders, claims, or pile mitigation	R	DOC, PDF, XLS, other	Single PDF of entire report
Pile driving records/ logs	R	Paper	PDF
Foundation testing reports (PDA, PLT, GGL, CSL)	R	DOC, PDF, XLS, other	Single PDF of entire report
Field instrumentation measurements or results (e.g. soil nail tests, ground anchor tests, shop drawings)	R	PDF, XLS, CSV, TXT, and proprietary	Retain relevant file format

* ZIP as appropriate

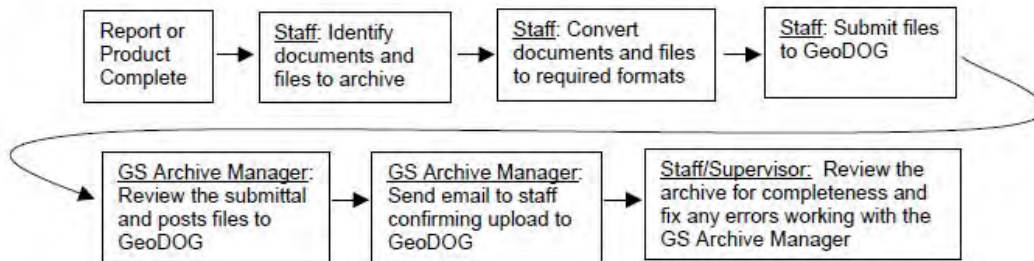
The archiving procedure is as follows:

1. Identify the project documents and/or electronic files to archive by referring to the *GS Document Archive List*.
2. Convert paper documents and electronic files to the proper archive format(s).
3. Go to the archive website (GeoDOG) at <http://10.160.173.178/geodog> and follow the directions to submit your electronic files.

Once submitted to GeoDOG, the project information and archive files are reviewed for completeness and then posted to the GS Project Archive (GeoDOG). The geotechnical designer will receive an email confirming that the file(s) has been posted and is available on the GeoDOG server.

4. Upon receipt of the confirmation email, the geotechnical designer is encouraged to review the archive for completeness and resolve any errors by working with the GS Archive Manager (Natalie Cornell).

Archive Procedure:



The goal of this process is to create a project archive that is complete, comprehensive, well organized, and is a useful resource for current and future GS staff. To achieve that end geoprofessionals must properly prepare and organize all archive documents and electronic files so they are easy to search, view, and use. The following additional information is provided to aid staff in their archiving:

Archive File Formats

The required archive file formats are presented on the *GS Document Archive List*. The PDF file format is preferred for archiving of most documents. However, it is recognized that other file formats such as XLS, DGN, or other proprietary formats may be appropriate for archiving.

PDF files can be created and read using Cute PDF, which is available to all GS employees, or Adobe Acrobat Professional. Contact IT and request that they install Cute PDF on your computer if needed. Appendix A provides guidance on how to create a PDF file using either of these programs. Adobe Acrobat Reader (<http://www.adobe.com>) is a free software program that can read PDF files and is typically installed on all Department computers.

In all cases where PDF file format is required for archiving, electronic conversion is preferred in lieu of digital scanning. In cases where documents cannot be converted electronically, they should be scanned at a minimum resolution of 300 dpi.

Combining similar documents, such as photos or pile driving records, into one multi-page PDF file or the ZIP format is desirable to create a neatly organized and easily searchable archive. The WinZip program is available on most staff computers and should be used to zip similar files. Appendix B provides guidance on how to create a ZIP file.

Reports

Reports are typically created using MS Word. Reports must be archived in PDF format, which must be done electronically using Acrobat, Cute PDF or other program.

It is required to insert your electronic signature and stamp into a document prior to converting the document to a PDF format. Appendix C provides guidance on how to insert a scanned electronic signature and stamp into an electronic file.

LOTB and Boring Records

Log of Test Borings (LOTB) and Boring Records are prepared in DGN and gINT file formats. It is required that these documents be converted to PDF and both the original file format and the PDF be archived. The Engineering Graphics Unit can provide PDF files of any LOTB they create.

Plan Sheets

Structures Design and the District Design Offices provide plans in DGN formats but also have the ability to create PDF files. Plan sheets submitted for archiving should be in a PDF format. Any plan sheets that are archived should be the plan(s) associated with the geotechnical recommendations.

Pile Quantities

Pile quantities (e.g. pile driving records, pile drilling records, etc) should be scanned (300 dpi resolution) or preferably electronically converted to a PDF file format and zipped if appropriate.

Technical Documents

Technical documents consist of the many types of documents and electronic files produced during the geotechnical investigation such as laboratory data, geophysical test results, settlement curves, cross-sections, etc. These documents and electronic files should be organized as orderly as possible for the next user. An example might be settlement data, which were measured at several locations. In this case, it is requested that these files be combined into one multi-page PDF file titled "settlement data". Proprietary files should be archived in their original formats and should be zipped as appropriate.

Other Documents

Other documents consist of many types of documents and electronic files such as emails, historical/construction observations, QC/QA documents, site photos, core photos, etc. Documents must be converted to PDF and should be combined or zipped as appropriate. Electronic files not converted into PDF should be combined as appropriate into one ZIP file. An example might be numerous core photos, which were taken during a field investigation. In this case, it is recommended that these files be combined into one ZIP file titled "*Boring R-2-09 core photos*".