

**GeoGIS**  
Phase III

Prepared for the

**Alabama Department of Transportation**

by

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<b>16. Abstract</b> GeoGIS is a web-based geotechnical database management system that is being developed for the Alabama Department of Transportation (ALDOT). The purpose of GeoGIS is to facilitate the efficient storage and retrieval of geotechnical documents for ALDOT. The website utilizes a web-based map to search for documents based on the location of the project to which the document is associated. Users can also search for documents based on document attributes. The website is equipped with a document upload page where users can add geotechnical data to GeoGIS. Access to the website is limited to only authorized users with one of four levels of classification: General User, Consultant, ALDOT Engineer, or Administrator, listed in order from lowest level of access to highest. General users are limited to only viewing the site and searching documents. Consultants have the ability to upload data to the GeoGIS database. ALDOT Engineers are charged with the task of approving the uploaded documents and initiating new projects, which allows new projects to be available to receive uploaded documents and be displayed on the GeoGIS map. Administrators have the additional responsibility of managing GeoGIS users. Each level of classification inherits the privileges of each previous level of classification. Currently over 1200 documents have been uploaded to GeoGIS for 103 projects across the state of Alabama. GeoGIS is improving daily to accommodate new features and improve the overall functionality of the website.					
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## Executive Summary

GeoGIS is a web-based geotechnical database management system that is being developed for the Alabama Department of Transportation (ALDOT). The purpose of GeoGIS is to facilitate the efficient storage and retrieval of geotechnical documents for ALDOT. The website utilizes a web-based map to search for documents based on the location of the project to which the document is associated. Users can also search for documents based on document attributes. The website is equipped with a document upload page where users can add geotechnical data to GeoGIS. Access to the website is limited to only authorized users with one of four levels of classification: General User, Consultant, ALDOT Engineer, or Administrator, listed in order from lowest level of access to highest. General users are limited to only viewing the site and searching documents. Consultants have the ability to upload data to the GeoGIS database. ALDOT Engineers are charged with the task of approving the uploaded documents and initiating new projects, which allows new projects to be available to receive uploaded documents and be displayed on the GeoGIS map. Administrators have the additional responsibility of managing GeoGIS users. Each level of classification inherits the privileges of each previous level of classification. Currently over 1200 documents have been uploaded to GeoGIS for 103 projects across the state of Alabama. GeoGIS is improving daily to accommodate new features and improve the overall functionality of the website.

# CHAPTER 1

## INTRODUCTION

### 1.1 Introduction

Roadway construction projects amass large amounts of preconstruction and construction documents that must be stored for future use. With state departments of transportation (DOTs) conducting numerous roadway projects at one time the amount of documentation needing to be stored quickly becomes overwhelming. Much of this data is generated from geotechnical investigations and contains soil information as well as its location on the earth. Storing this information based on the location could prevent redundant geotechnical investigations of areas that have been explored in the past.

Recently the use of geographic information systems (GISs) has become more prevalent in the engineering community. A GIS has the ability to store and retrieve vast amounts of data and represent that data spatially on a map. A point of strength in a GIS is the ability to perform spatial and non-spatial analysis on data. Spatial analysis is a very powerful tool when used in a system for storing construction documentation. In particular, the storage of geotechnical documents are ideally suited for a GIS. Roadway projects, soil borings, bridge foundations and other features can be represented on a map and all data associated with those features can be stored in a database. Storing data based on location allows for more efficient storage and retrieval of geotechnical data. Geographic information systems also have powerful tools for querying data in order to find information quickly and easily.

In the early 2000's the Alabama Department of Transportation (ALDOT) recognized the need to store geotechnical documents in a GIS. Phase I of GeoGIS was first developed on a

desktop computer at the University of Alabama. Information regarding projects from across the state of Alabama was collected and scanned in order to test the GeoGIS system. The information was collected from eight projects located in seven different counties. Included in these projects were 18 bridges. All projects were identified by a project number and the bridges were identified with a bridge identification number assigned by ALDOT. The GeoGIS map contained four different features: project lines, bridges, foundations and soil borings. Each of these features had spatial information, attributes, and scanned images. Features were then linked to GeoGIS from information that was entered into attribute tables. A basemap was created on which all map features were displayed. This map consisted of Alabama counties, roads, railways and water bodies and is shown in Figure 1.1.

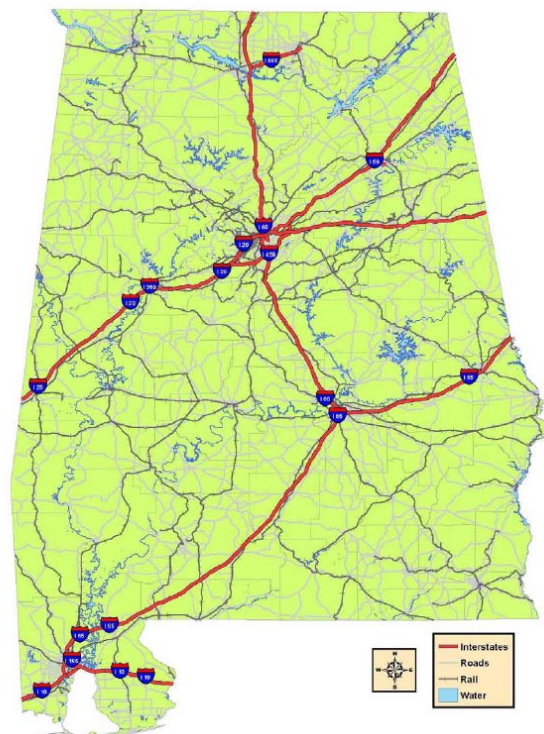


Figure 1.1 Phase I GeoGISBasemap (Karyamapudi 2005)

In this initial Phase of the GeoGIS development, attribute data was keyed into attribute tables for the features on the map such as project name, project description, etc. Part of this attribute data was a field called “image” which linked the feature to a scanned image associated with project features. The project documents were divided into preconstruction and construction documents and upon clicking a map feature, a user could view associated documentation via a hyperlink to an HTML page. During Phase I of the project, GeoGIS could only be accessed on a desktop computer on which the GIS was stored.

Phase II of GeoGIS consisted of moving the desktop GeoGIS to the web. A system was put in place to provide authorized users access to the GeoGIS website. Four types of users were developed: General, Consultant, ALDOT Engineer, and Administrator, listed from lowest level of access to highest. The website had the ability to access the GeoGIS map, search documents, upload documents, approve documents, and access a document database website at ALDOT called Hummingbird. Each user was assigned a user type that would allow access to certain parts of the website based on the user classification. All users had the ability to search documents. All users were also able to use the map to search for a project and access the Family Details Page. The family details page was very similar to the HTML page that users could hyperlink to in Phase I and listed all documents uploaded for a particular project. From the Family Details page users could download documents and save the documents to a computer. Users with the Consultant classification or higher could upload documents through the GeoGIS website. Once a document was uploaded, a user with ALDOT Engineer classification or higher could approve documents for use in the GeoGIS database. Administrators had the ability to add and manage users for the website. Although GeoGIS functionality and access was vastly improved in Phase II, the website still lacked some functionality. GeoGIS lacked the automated

ability to add projects to the map from the website. In addition, the process for searching projects to which documents would be uploaded was inadequate. Furthermore, only one document could be uploaded at a time, which made uploading extremely tedious. Documents awaiting approval showed very little information to check the accuracy of the uploaded document. The website lacked usability due to the fact that the amount of data stored in the GeoGIS database was minimal.

Due to the success of Phase II and the need for additional site functionality and data, a third Phase of the project was initiated. Phase III focused on improving the functionality of the website while at the same time increasing the amount of data stored. The development and implementation of Phase III of GeoGIS is covered in the report

## 1.2 Report Organization

Chapter 2 consists of the literature review, and discusses different aspects of database management systems. The literature review is broken into the following components: geotechnical databases, relational databases, web-based geographical information systems, and emerging standards for transfer of geotechnical data. Chapter 3, Methodology, is an in depth look at the different functionalities of the GeoGIS website and how the different website components work together. Chapter 4 shows the results of this research. In the Results chapter the various changes to GeoGIS that were made in Phase III are discussed, as well as the impact the changes have had on the website. Chapter 5 is made up of Conclusions and Future Work. This chapter discusses conclusions drawn from the GeoGIS Phase III project and changes that can be made in future phases of the project. Appendix A is a user's guide intended for ALDOT, consultants, and the University of Alabama staff that will work with GeoGIS in the future.

## CHAPTER 2

### LITERATURE REVIEW

#### 2.1 Background

Many state highway departments and other government and private agencies around the world have amassed large amounts of geotechnical data that should be stored for future use (Dasenbrock, 2008; Kunapo, et al., 2005). Systems for managing geotechnical data are necessary to ensure data availability for use on future construction projects. In many cases the engineering data comes from geotechnical investigations, scour data, hydrologic data, and the like (Chang and Park, 2004; Farrag and Morvant, 2001). Before computers were used, geological data such as borehole data and hydrological data were stored as physical documents. In order to facilitate the storage of physical documents a central location was usually chosen and the documents were stored in boxes. In many cases each box consisted of multiple projects and the boxes were organized with an index card system. These systems for document retrieval were inefficient and often index cards, which numbered in the tens of thousands, and boxes would be changed and not updated causing documents to be virtually impossible to find. Furthermore, depending on where the documents were stored, the documents may have been subject to extreme environmental elements and damaged. In addition, usually only one copy of a document was available; therefore, when multiple users were involved, the documents become increasingly difficult to manage (Chang and Park, 2004; Okunade, 2010; Descamps et al., 2006). In more extreme cases, large amounts of engineering data that was generated by engineers from highway and geotechnical projects was not well documented (Okunade, 2010).

The engineering profession quickly identified a need to improve document storage techniques. With the increase in computing power in the recent years, most organizations have

begun storing past engineering data on computers (Lefchik P.E. and Beach, 2006). Storing engineering data using an electronic management system has many advantages to storing physical documents. Electronic management systems can handle large quantities of engineering data with a high level of efficiency. The data is safe from the elements and access can be limited to provide a much more secure storage environment (Lefchik P.E. and Beach, 2006). Most civil engineering data has spatial attributes. In these cases a GIS is ideal to represent the information on a map. However, geotechnical data contains three dimensions, which is not typical for GIS data. Application designed for 3D data are available for GIS; however, they are usually not ideal for representing geotechnical data. In 3D cases, GIS incorporates a relational database to better represent the data (Kimmanceet al., 1999; Kunapo et al. 2005). With the recent increase in computer power, the ability of electronic management systems to handle large amounts of data efficiently, and the safety of electronic management versus physical document storage, electronic management systems incorporating GIS have become increasingly popular in civil engineering.

## 2.2 Geotechnical Databases

Geotechnical database software is not new, but due to the large amount of engineering data generated, the need for many different users to have access to the data, and improvements in computing power, geotechnical databases have become increasingly common (Chadwick et al., 2006; Descampset al., 2006). When developing a geotechnical database there are several fundamental functions that should be addressed. The geotechnical database should have the capability to capture vast quantities of data collected in the field and generated from various lab tests and engineering analyses. The database should be properly managed to ensure that the data stored is up to date, accurate, and protected from unauthorized access and both accidental and intentional corruption. Employees in an organization should have the ability to access the

geotechnical database quickly and easily whether in the field or in the office. If the geotechnical database is to have the functionality to analyze geotechnical data, it should perform calculations without being complex or difficult to learn, while at the same time allowing users to apply engineering judgment when making decisions. Furthermore all data used for the database should be stored in a form that can be easily exchanged within both an organization and to outside consultants and clients (Kimmance et al., 1999; Markovic and Lekic, 2006). In order to design the most efficient geotechnical database possible, all fundamental functions should be addressed.

### 2.3 Relational Databases

In order to use geotechnical data in GIS many organizations have established a relational database (Kimmance et al., 1999; Kunapo, et al. 2005). The data stored in a relational database can be either document data or field data. Document data can be scanned historical documents, reports, charts, etc. Many organizations still currently store data as document data, which is more of a document management approach than a database management approach (Farrag and Morvant, 2001; Markovic and Lekic, 2006; Kunapo, et al. 2005). Field data on the other hand can be imported into certain programs and used for engineering analysis. This data is typically stored using software such as Microsoft Access, Microsoft Excel, gINT, or Oracle; all of which integrate well with GIS. (Chang and Park, 2004; Dasenbrock, 2008; Chung, 2007; Kunapo, et al. 2005; Descamps et al., 2006). Geotechnical databases often benefit from incorporating both field and document data. In the case of GeoGIS, project and bridge information are stored as field data, and all documents associated with projects and bridges are stored as document data, both of which exist in a SQL Server database. Relational databases solve one of the fundamental problems to address when creating geotechnical databases by having the ability to handle the vast amount of data generated by engineering projects (Markovic and Lekic, 2006).



## 2.4 Web-Based GIS

A geographic information system is a very powerful tool that is becoming increasingly popular for managing geotechnical data (Chang and Park, 2004). The use of GIS is a good solution for data management due to the fact that GIS has the ability to store, manipulate, analyze and display graphical information that has been referenced to a location on the earth (Chang and Park, 2004; Chung, 2007). Querying of data is possible in GIS based both on attributes as well as the spatial location of the data (Chung, 2007). All of these capabilities make GIS a strong candidate to be used in conjunction with a geotechnical database.

Recently many organizations have moved GIS applications from the desktop to the web. This change was brought on by the many advantages of web-based GIS compared to the earlier desktop applications. Web-based GIS applications can be accessed by any number of users at any location where there is access to the web, while desktop applications are limited to the computer on which the GIS exists (Chang and Park, 2004). Web-based GIS solves one of the fundamental problems facing geotechnical databases; that is the ability to easily access the database from any location (Kimmance et al., 1999).

Web-based GIS applications provide users with GIS capabilities over the internet via a map server. A common map server used by many organizations is Arc Internet Map Server (ArcIMS) produced by Environment Systems Research institute (ESRI) (Chang and Park, 2004; Mathiyalagan et al., 2005; Dasenbrock, 2008). ArcIMS has four major components. The first is the client viewer which provides the user with map functions and the ability to perform spatial queries. The second component is the application server connector, which connects ArcIMS to a webserver. The application server component takes spatial data in the server and generates map images and functions. The final component of ArcIMS is the spatial server. This connects the

application server to the database management system (DBMS) by querying the DBMS and providing it to other GIS software (Chang and Park, 2004).

ArcServer is a product recently released by ESRI for developing Web applications. ArcServer's services provide advanced GIS performance over the internet including mapping functions such as zoom, pan, and measure along with, storage, and geoprocessing tools (Han et al., 2010; Fangli et al., 2010, Zhao et al., 2010). This is an improvement compared to ArcIMS; however, the spatial analysis provided by ArcServer is still much less powerful than that of desktop GIS (Zhao et al., 2010). In order to improve developer productivity and allow for application reuse FLEX was created by Adobe (Wei et al., 2010). FLEX creates a faster more effective application while balancing the workload between the client and the server. FLEX is a separate programming language which is used to create an Adobeswf file that is then loaded into the GeoGIS. The client's computer process non GIS data while the server only processes requests from the database and GIS functions (Wei et al., 2010; Xu, 2010). The only thing a client needs to do to run the FLEX software is install Adobe Flash Player (Wei et al., 2010). FLEX integrates particularly well with Arc Spatial Database Engine (ArcSDE), which stores spatial data and tables in one central database. Figure 2.1 shows an example of the structure of a FLEX application.

The RDBMS is where all of the information utilized in constructing the web map is stored. For the purposes of this project, this information is the CPMS table. Microsoft SQL Server is the RDBMS employed for this aspect of the project. SDE is in reference to ESRI's ArcSDE tool that allows you to store and manage *spatial* data in your chosen RDBMS. ArcSDE allows you to store and manage your data as tables. GIS Data is initially stored on the GIS Server. This data is then moved into the RDBMS with the help of ArcSDE. The GIS

Server refers to a server dedicated to hosting GIS related information utilized in the construction of our map for this project. GIS information is obtained from the RDBMS with the help of ArcSDE and utilized to create an initial representation of our map. The layers of this map such as project lines, county boundaries are then “published” and hosted by ArcGIS Server. The Flex Application refers to the actual map seen by the user of the system after clicking the map icon in the application. A Flex application is written in Action Script and MXML code and incorporates the published layers noted above into the program. After this program is constructed, it is utilized as an Adobe .swf file in the actual GeoGIS code.

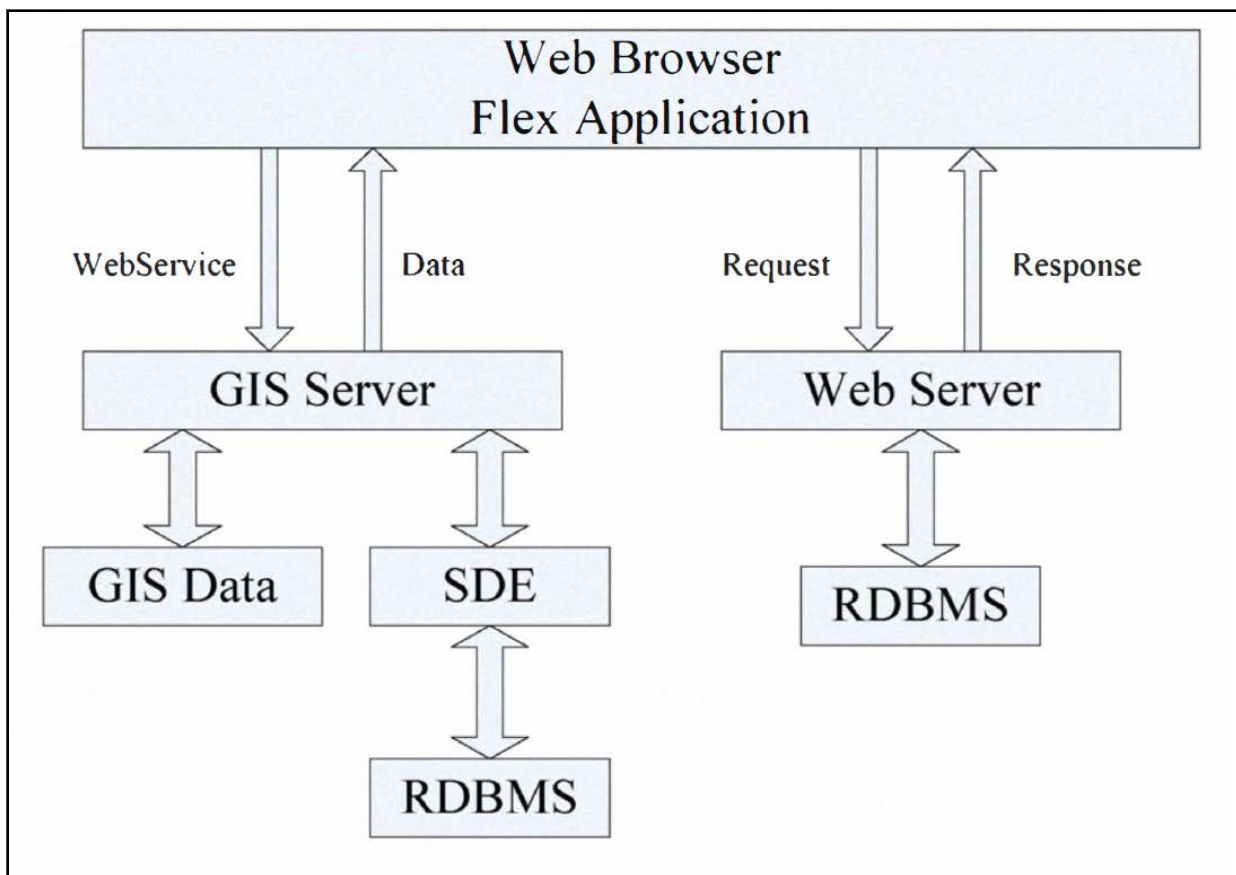


Figure 2.1 Flex Application Structure (Wei et al., 2010)

## 2.5 Standardization for Data Transfer

In order to efficiently share engineering data over the internet, it must be presented in a standard form that can easily be transferred to different users (Sen and Duffy, 2005; Lefchik P.E. and Beach, 2006; Chang and Park, 2004). The need for data standardization has been recognized around the world, and organizations have been quick to implement some form of standardization in data transfer applications (Chung, 2007; Chang and Park, 2004; Sen and Duffy, 2005). There are many different examples of standardization currently in use.

The Association of Geotechnical and Geoenvironmental Specialists (AGS) published its first version of a standard data transfer model in 1992 and since then has been accepted and implemented by many organizations around the world. In the AGS format all files are stored in ASCII form. ASCII format can be viewed as a text file and imported into spreadsheets and database systems, in order to facilitate the efficient exchange of engineering data between users. The AGS publication lists a set of rules and standards for ASCII files which serve as a guide to users (Toll and Cubitt, 2003; Kunapo et al., 2005; Chadwick et al., 2006).

Many new web-based data transfer systems have begun using Extensible Markup Language (XML)(Chadwick et al., 2006; Sen and Duffy, 2005). XML files are text files that include a tag that can be recognized by an XML compliant internet browser (Toll and Cubitt, 2003). For example if a bridge has an identification number of 1, an XML file would call the bridge out as an “element” as follows: <bridge Id> “1”<bridge Id>. Additionally each element can have associated attributes which are indicated by an indentation below an element. An example of XML data for core drilling is shown in Figure 2.2. An internet browser can then use these elements to build a database. Using this format, new elements can easily be added to a database without the need to restructure the database itself (Lefchik P.E. and Beach, 2006;

Turichshev 2002). Data Interchange for Geotechnical and Geoenvironmental Specialists (DIGGS) is a standard that utilizes XML schema with the addition of geographical tags, and was established in an effort to create a worldwide standard for geotechnical data (Chadwick et al., 2006; Dasenbrock, 2008; Lefchik P.E. and Beach, 2006). XML is currently not utilized in GeoGIS, but is a common method of exchanging data that could be used in the future.

```
<core>
  <origin>
    <latitude>50.6785N</latitude>
    <longitude>123.8967W</longitude>
    <depth>230</depth>
  </origin>
  <size>
    <length>90</length>
    <diameter>45</diameter>
  </size>
  <material>
    <rock_type>granite</rock_type>
  </material>
</core>
```

Figure 2.2 Example of XML Code (Turichshev, 2002)

## CHAPTER 3

### METHODOLOGY

The overall focus of the GeoGIS project is to assist in the storage and retrieval of preconstruction and construction documents related to geotechnical engineering for the Alabama Department of Transportation (ALDOT). Phase I and II of GeoGIS created a system for storage and retrieval, and made the system available on the web. Phase III focuses on improving the performance of the website, increasing functionality, and expanding the overall volume of geotechnical data stored.

#### 3.1 Overview of Phase III Progress

During Phase III several functions on the GeoGIS website were improved. In addition, features were added to the website to improve the functionality of GeoGIS. Functions that were added or improved are circled in red in Figure 3.1, which is an illustration showing the various functions of the website and how they are connected to each other. Squares in Figure 3.1 refer to buttons at the top of the website that allow users to access functions, parallelograms refer to pages of the website, and diamonds refer to the function that is performed. The color of the illustration refers to which user is able to access the function as indicated in the legend in Figure 3.1. For example, features in blue are accessible to all users. Changes to GeoGIS included changes to document type subcategories that are displayed at the Family Details page. The Family Details page is circled at the top of Figure 3.1. The new subcategory format is more accommodating for the various types of geotechnical documents that are typically uploaded. Multiple search fields were added to the Project Search page, shown beside the Document Upload button in Figure 3.1, to create a more robust tool for searching projects. At the Document Upload page, the last page in the connectivity of Document Upload in Figure 3.1, the ability to

simultaneously upload multiple documents, as well as the ability to add multiple document types at one time was added. This made uploading of documents much less time consuming. The Document Edit capability was added to the Document Approval page, shown to the right of the Document Approval button in Figure 3.1, to allow documents that were uploaded with incorrect information to be edited before approval. Project Initiation, shown below Document Approval in Figure 3.1, is a completely new function of the GeoGIS web page that was developed and programmed during Phase III. This allows a project to be added to the map and become available for upload without leaving the GeoGIS website. The remainder of this section will discuss the various features of the website.

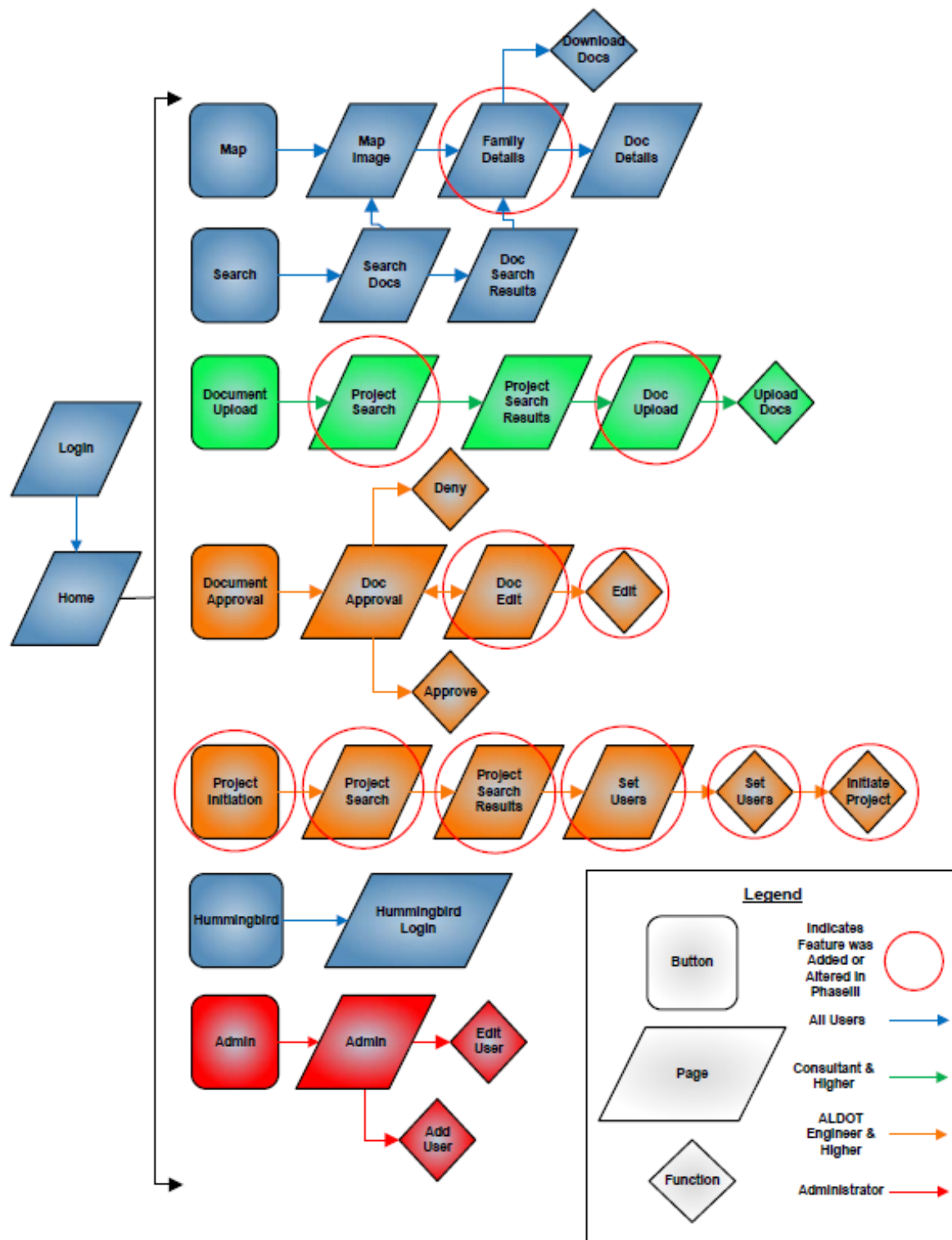


Figure 3.1 Feature Connectivity



### 3.2 CPMS Table

Connectivity between the various functions of the GeoGIS website is based on the Comprehensive Project Management System (CPMS) Projectsline Table. The primary fields used in this table are shown in Table 3.1. The unique identifier to each phase of a project is the PJ\_REF\_ID hereon referred to as the CPMS number. At ALDOT, the CPMS number is used for accounting purposes. For this reason, several different CPMS numbers can have the same project number. The FA\_PREFX\_I, FA\_RT\_ID, and FA\_AGRET\_N number all concatenate to create the project number. The project number is a three part number, i.e. BR-0120(320), that is used to identify all phases of a project as a whole. The rt\_id identifies the route on which the project is located. Beg\_mp and End\_mp refer to the beginning and ending milepost where the project is located. By using the route id and the beginning and ending milepost, linear events can be displayed for all projects in the CPMS table. These events are then shown on the GeoGIS map for projects that exist in GeoGIS. The family id refers to all projects along a given route, for example, Corridor X has a Family ID of 2225. In addition, each project has a scope, which is a two letter name referring to the project phase, such as CN for construction or PE for preliminary engineering. The PJ\_DS gives a short description of the project. A new addition to the CPMS table is the "Initiated" field. This field indicates whether or not a project has been initiated by an ALDOT Engineer so that documents can be uploaded. Different functions on the website rely on this table to display information about a project or document.

Table 3.1 CPMS Table Fields and Descriptions

Field Name	Common Name	Description
PJ_REF_ID	CPMS Number	Unique identifier of project phase
RT_ID	Route Id	Route on which a project is located
BEG_MP	Beginning Milepost	Beginning milepost of project
END_MP	Ending Milepost	Ending milepost of project
SCPE_ID	Scope	Phase of project
FA_PREFX_I	Prefix	Concatenate to create a project number
FA_RT_ID	Route Id	
FA_AGRET_N	Agreement Number	
PJ_FAMILY_I	Family Id	Number assigned to all projects on a route
PJ_DS	Project Description	Description of work performed
Initiated	Project initiation	Flag column for project initiation (0,1)

### 3.3 Website Functionality

GeoGIS has many functions that are available to users. The website is first accessed through the URL: <http://geogis.crdl.ua.edu> and users are prompted to login to the website. Once the user has logged in, the homepage is displayed. The homepage for a user varies depending on the level of authorization a user has. Only functions available to the user are shown at the top of the page. The homepage for an administrator, which has full access to the website, is shown in Figure 3.2.

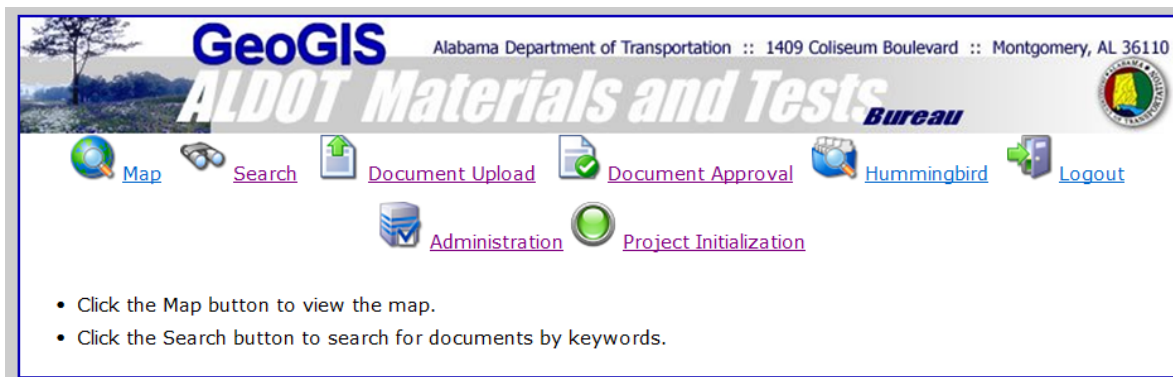


Figure 3.2 Administrator Homepage

The Homepage serves as a guide to the website where all website functions can be accessed. The most commonly used functions include viewing the GeoGIS map as well as searching, uploading, and approving documents. A link to Hummingbird, a document database at ALDOT, is provided, however, only users with authorized logins from ALDOT are able to access the database. Other functions include Project Initiation and Administration functions for managing users. Figure 3.1 shows the connectivity of the features in the website as well as which users are able to access the features. The color of the arrows connecting each feature in the figure indicates which users are able to access that particular part of the website. The following sections describe the functionality of the website; however, a more detailed GeoGIS User's Guide is included in Appendix A of this report.

### 3.3.1 GeoGIS User Classification

GeoGIS is accessible only to authorized users. Overall access to the website is limited by several different classes of users in a hierarchical form: General, Consultant, ALDOT Engineer, and Administrator (listed from lowest level of access to highest). This authorization is established through ASP.NET Login View. Each user has a unique set of privileges which allows the user to access different features in the website. All users have the ability to view the GeoGIS map as well as documents. However, access to more robust functions of the website is limited based on user type. A table listing the user types and privileges is shown in Table3.2.

Table 3.2 User Types and Associated Privileges

User Type	Privileges
General User	Search the Website, View Map, and View Documents
Consultant	Above privileges as well as upload documents
ALDOT Engineer	Above privileges as well as edit documents, approve documents, and initiate new projects
Administrator	Above privileges as well as manage user accounts

### 3.3.2 GeoGIS Map

A map is utilized by GeoGIS to allow users to search for documents based on a projects location. Clicking the map button displays a map centered on Alabama. The map can be viewed in street view, topographic view, and satellite imagery. The street view is the default map view. The street view contains streets, street names, water bodies, and other information about an area. The topographic view contains contours, streets and water bodies with fewer features labeled than the street view. The satellite imagery currently contains satellite images with no labeled features, but satellite images with labeled features are being considered for the future. The map consists of four feature layers: Projects are red lines, soil borings are yellow circles, foundations are green circles, and bridges are green stars. The different view options as well as the four layers are shown in Figure 3.3. The user can zoom and pan the map to find a project of interest. Once a project is found the user can click it and view all documents associated with the project. The map functionality for searching out projects is available to all users.



Figure 3.3 Map Views and Layers a) Street View b) Topographic View c) Satellite Imagery

### 3.3.3 Family Details Page

The Family details page collects all documents associated with a project in an organized form allowing the user to view documents efficiently and easily. When a line is clicked on the map all project documents that have been uploaded and approved for that project are displayed in the Family Details Page. A list of every project at the location that was clicked is shown at the top of the page. The family details page is compiled by searching SQL Server Database, where GeoGIS documents are stored, based on the CPMS number of the project clicked by the user.

All uploaded documents that match the CPMS number are compiled in the Family Details Page. Next to each project listed at the top of the Family Details page is a check box, a link to the project on the map, and a list of project information. Project information includes the CPMS number, Bridge Identification Numbers (BINs) associated with the project, project number, and description of the project. The list of BINs associated with the project is compiled from a table in the SQL Server Database that contains a field for projects and a field for BINs. This table was created by comparing the route and milepost where the bridge is located to the route and beginning and ending milepost of projects in the CPMS table. All documents associated with projects listed at the top of the page are initially displayed. Toggling the check boxes on and off allows the user to view documents from only the projects of interest. Documents shown on the Family Details Page are divided into preconstruction and construction documents. These categories are further divided into subcategories to allow the user to quickly access information. An example of the Family Details Page is shown below in Figure 3.4.

**GeoGIS** Alabama Department of Transportation :: 1409 Coliseum Boulevard :: Montgomery, AL 36110  
**ALDOT Materials and Tests Bureau**

Map Search Document Upload Document Approval Hummingbird Logout  
 Administration Project Initiation

**Family Details**  
**Family ID: 9000000002**

**CPMS# 9000000002 BIN 8520 8521 8522 8523 8526**  
 Project# STPAA -0275 I-10 OVERPASS BALDWIN COUNTY  
 Zoom to project on the map.

**Preconstruction Records**

- Soil Survey (3)
  - soil boring 1 BIN 8520 8521.JPG  
BIN 8520 8521
  - soil boring 2 BIN 8522 8523.JPG  
BIN 8522 8523
  - soil boring 3 BIN 8526.JPG  
BIN 8526
- Materials Report (0)
- Slope Study Report (0)
- Foundation Investigation Report (0)
- Retaining Wall Report (0)
- Coal Analysis Report (0)
- Culvert Report (0)
- Other Geotechnical Reports (0)
- Geohydrologic Report (0)
- Geotechnical Data (0)
- Soil Sample Test Request (0)
- Summary of Lab Tests (0)
- Foundation Recommendations (0)
- Foundation Analysis (0)
- Addenda (0)
- Correspondence (0)
- Photo (0)
- Other (0)
- Foundation Report (0)
- Landslide Report (0)
- Sinkhole Report (0)

**Construction Records**

- Bridge Card Image (0)
- Bridge Identification Information (0)
- Summer Submittal (0)
- Bridge Foundation Report (0)
- Soil Boring Curves (PDA Results) (0)
- Cast in Place Pile Driving Record (0)
- Precast Pile Driving Record (0)
- Shaft Excavation Log (0)
- Shaft Pouring Record (0)
- Load Test (0)
- Instrumentation (10)
- Correspondence (0)
- Photo (0)
- Field Monitoring (0)
- Other (0)

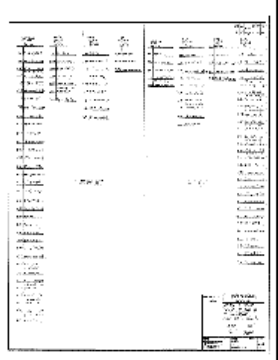


Figure 3.4 Family Details Page

Hovering over the document will bring up a thumbnail image to aid a user in finding a document of interest. Clicking the document name hyperlink will prompt the user to download the document. Next to each document is an information icon. Clicking this icon will take the user to a page showing the information associated with the document, as well as information about the project to which the document was uploaded. Also provided on the page is a low resolution image of the document.

### 3.3.4 Search Page

Another avenue of reaching the Family Details page that is available to all users is the Search function. When the search function is clicked the page shown in Figure 3.5 is displayed.



Figure 3.5 Search Page

On the search page the user can search for a specific document based on CPMS number or description keyword. Once the appropriate information has been entered into the search page clicking search will query the SQL Server Database for documents matching the search criteria. The search results page shown in Figure 3.6 shows a thumbnail image of the document, and indicates what field the search matches for the document. The user can view the document and



family details pages, or download the document from the search results page. The search results page is shown in Figure 3.6.

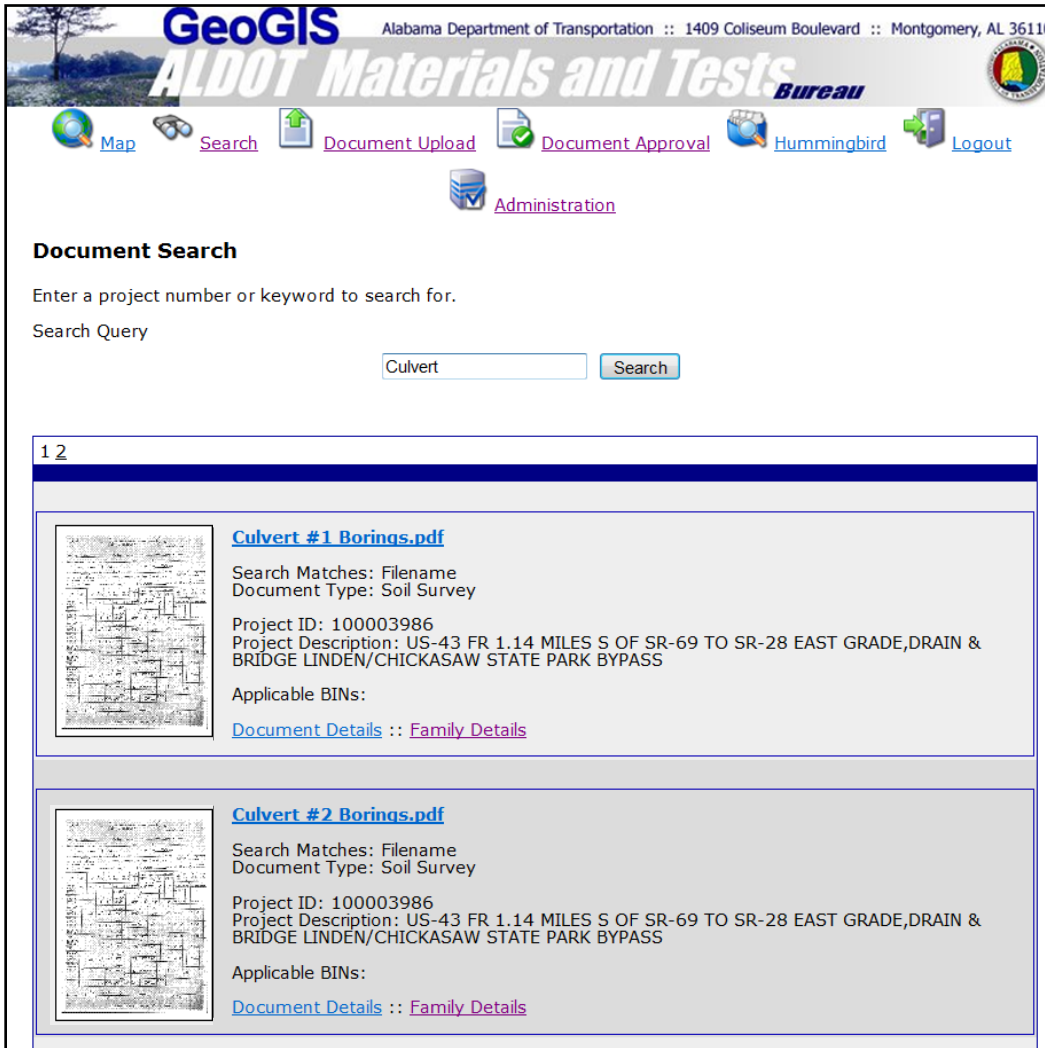


Figure 3.6 Search Results

### 3.3.5 Document Upload Page

Documents are entered into GeoGIS through the Document Upload function which is available to users with a Consultant classification or higher. The first step after the clicking the Document Upload button at the homepage is to fill out the appropriate information in the project search page shown in Figure 3.7.

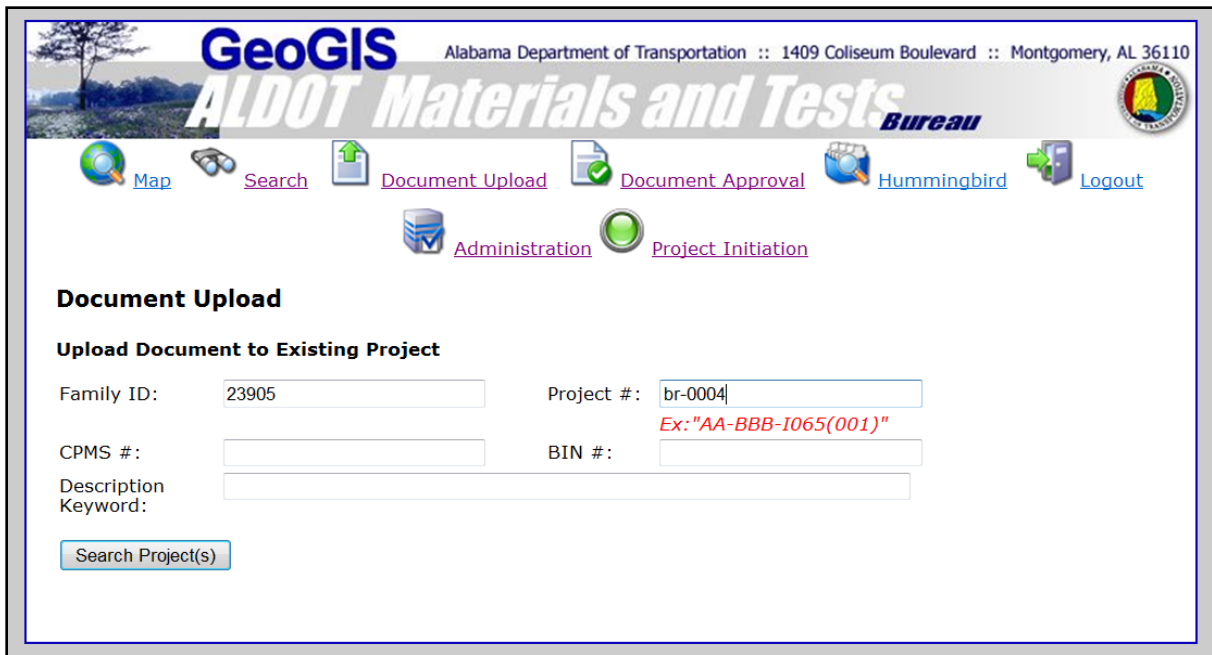


Figure 3.7 Document Upload Page

Once the user has entered in the search criteria and clicks search projects, the results of the search are listed on the page. Any project that matches the search criteria in the CPMS table is compiled in the list along with the project’s Family Id, Project number, CPMS number, Project Scope, applicable BINs and project description. The search results page is shown in Figure 3.8. The globe icon next to each project takes the user to the geographic location of that project on the map. Each project has an empty check box beside it when the search results are compiled. The user will select the project that is associated with the documents of interest and click “Begin Uploading”.

The screenshot shows the GeoGIS ALOD Materials and Tests Bureau web application interface. At the top, there is a header with the logo and text: "Alabama Department of Transportation :: 1409 Coliseum Boulevard :: Montgomery, AL 36110". Below the header, there are navigation links: "Map", "Search", "Document Upload", "Document Approval", "Hummingbird", and "Logout". A central "Administration" link is also visible.

The main section is titled "Document Upload" and contains a "Search Again" button. Below this is a table with the following data:

	Family ID	Project #	CPMS #	Scope	BIN #	Description
<input checked="" type="checkbox"/>	<a href="#">23905</a>	BR-0004	100042653	CN		REPL BIN 000476, SR-4 (US-78) OVER WOLF CREEK, SOUTH OF I-20 NW OF PELL CITY (SUFF=19.2, STAT=SD)
<input type="checkbox"/>	<a href="#">23905</a>	BR-0004	100046672	RW		SR-4 (US-78) BRG REPL BIN 000476 OVER WOLF CREEK, SOUTH OF I-20 NW OF PELL CITY (SUFF=19.2, STAT=SD)
<input type="checkbox"/>	<a href="#">23905</a>	BR-0004	100047967	UT		REPL BRG BIN 000476, SR-4 (US-78) OVER WOLF CREEK, SOUTH OF I-20 NW OF PELL CITY (SUFF=19.2, STAT=SD)
<input type="checkbox"/>	<a href="#">23905</a>	BR-0004(506)	100042652	PE		REPL BIN 000476, SR-4 (US-78) OVER WOLF CREEK, SOUTH OF I-20 NW OF PELL CITY (SUFF=19.2, STAT=SD)

At the bottom of the table area, there is a "Begin Uploading" button.

Figure 3.8 Project Search Results

After a user has selected a project for uploading documents, the user is prompted to browse for documents to upload. Documents are selected by clicking the browse button, selecting documents to be uploaded, and clicking add. All selected documents are then shown on the page with several uploading options shown in Figure 3.9, along with the browse function shown at the top of the page.

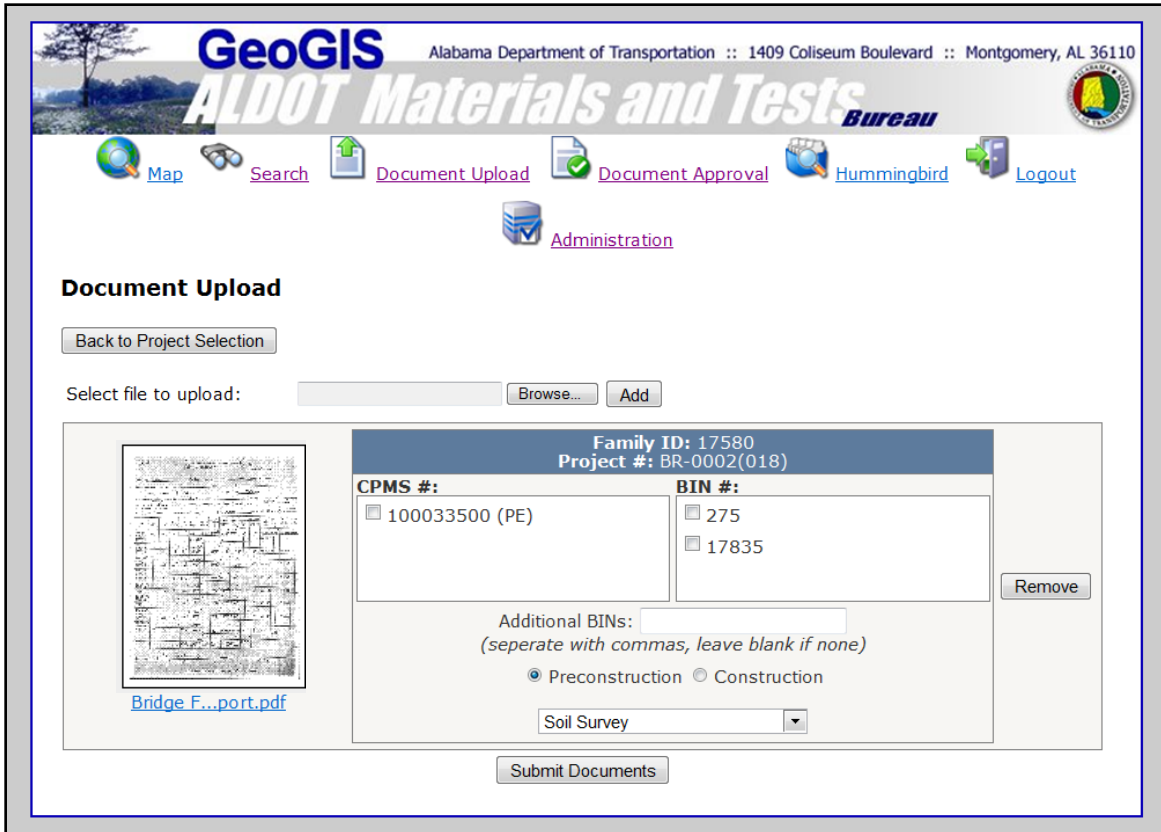


Figure 3.9 Assigning Document Attributes

Documents waiting to be uploaded are shown under the browse function. Each document has a thumbnail and a link to download the file. The user then selects the correct project number, the appropriate BINs, and the correct document type. Toggling between preconstruction and construction gives different options for the document type, shown in Table 3.3.

Table 3.3 Document Types

<b>Preconstruction</b>	<b>Construction</b>
Soil Survey	Bridge Card Image
Materials Report	Bridge Identification
Coal Analysis Report	Hammer Submittal
Culvert Report	Bearing Curves (PDA Results)
Other Geotechnical Reports	Test Pile Driving Record
Geohydrologic Report	Pile Driving Record
Geotechnical Data	Drilled Shaft Excavation Log
Soil Sample Test Request	Drilled Shaft Pouring Record
Summary of Lab Tests	Correspondence
Foundation Recommendations	Photo
Foundation Analysis	Other
Addenda	
Correspondence	
Photo	
Other	
Foundation Report	
Landslide Report	
Sinkhole Report	

Document types are correlated with the categories on the Family Details page. Documents may be assigned to multiple document types. In this situation the user would click the “add document type” button and select the correct additional document type. When the correct information is assigned to each document the user selects “submit documents”. The documents are then sent to Document Approval to be approved by an ALDOT Engineer.

### 3.3.6 Document Approval Page

The Document Approval function is available to ALDOT Engineers and Administrators, and allows engineers to review documents before the document is added to the GeoGIS database. Clicking the Document Approval button takes the user to the Documents Approval page an example of which is shown in Figure 3.10. All documents that have been uploaded and are awaiting approval are listed with the option to approve, deny, or edit an individual document.

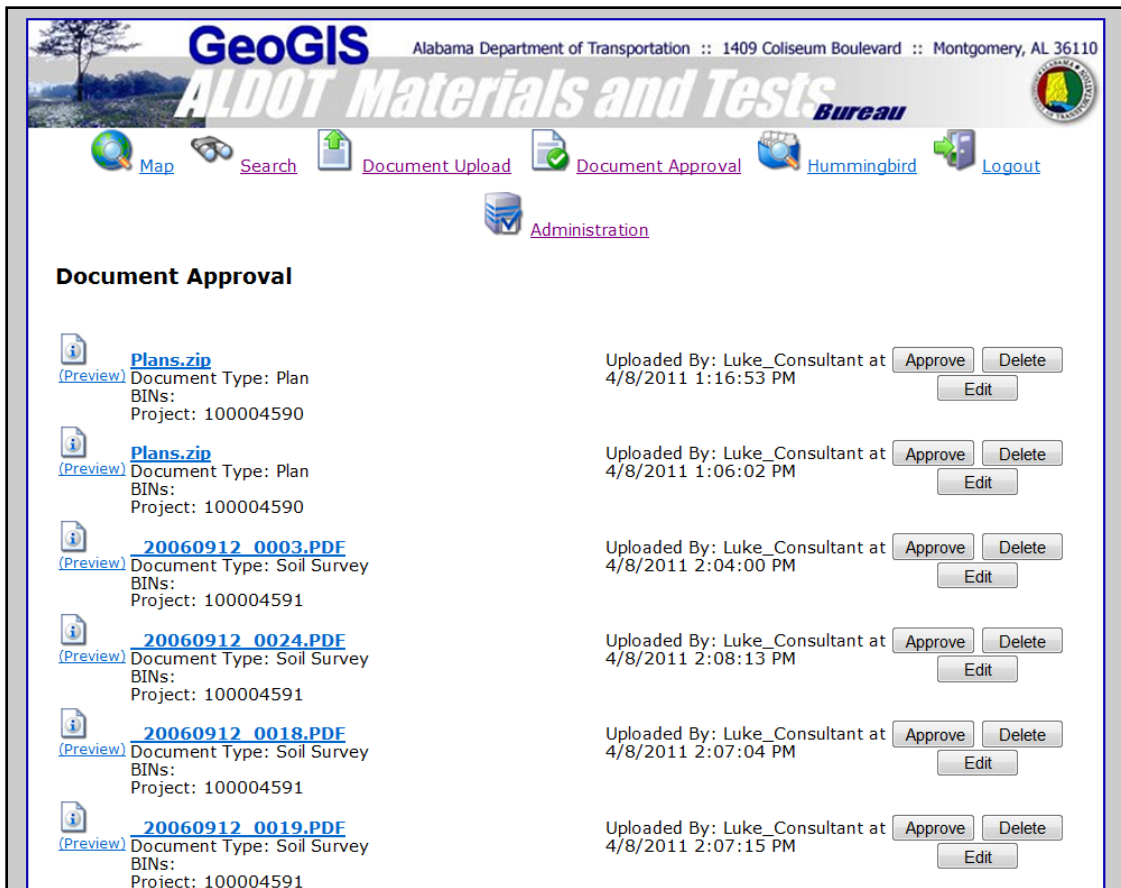


Figure 3.10 Document Approval Page

General information such as Document type, BINs, and CPMS number are listed alongside the document. Furthermore, the user that uploaded the document and the date and time of upload are provided. Deleting the document will remove the document from the Document Approval page and the system as a whole. Approving a document will send the document to SQL Server Database to be stored with all document information that was assigned in the document upload process. The Edit button allows the ALDOT Engineer to edit a document before approval. The document edit page is shown in Figure 3.11.

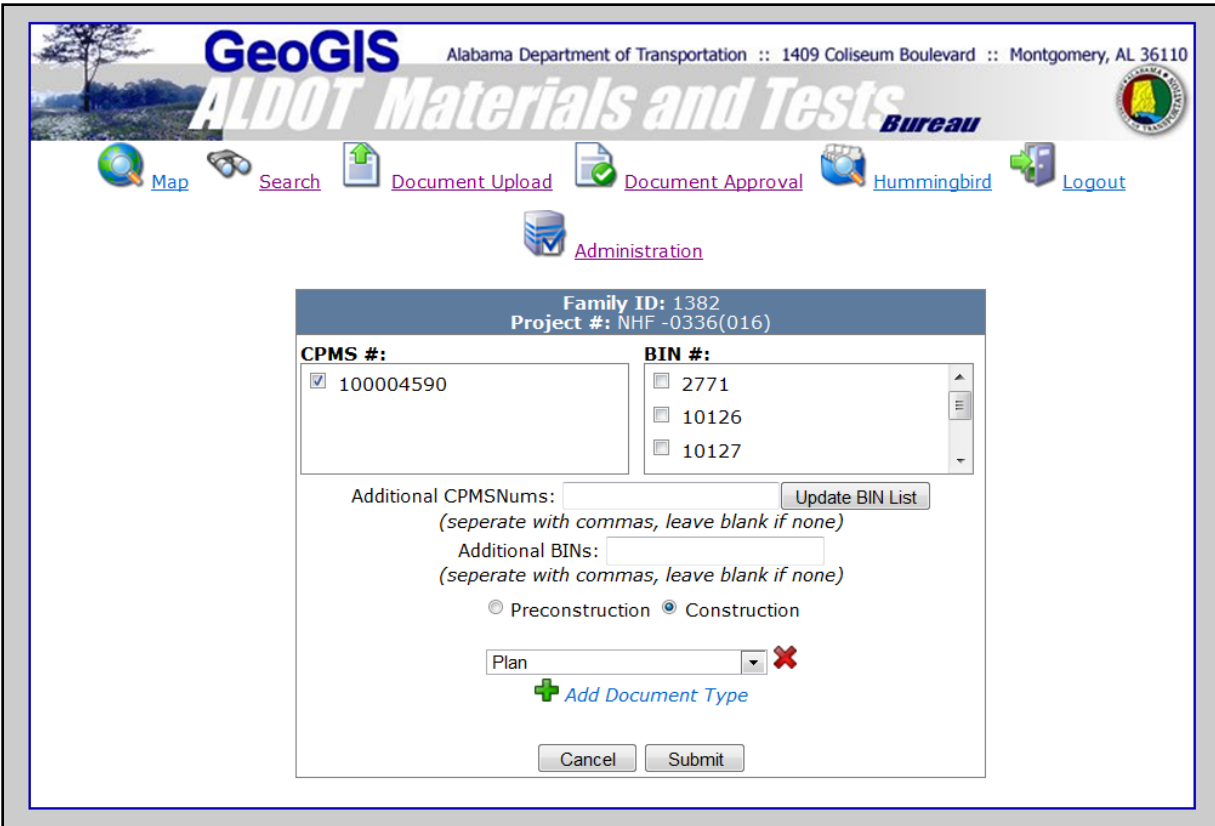


Figure 3.11 Document Edit Page

At the document edit page the user can edit the attributes of an uploaded document. The CPMS number, BIN numbers and document types can be changed to correct the document attributes. When the document has been corrected and submitted the document is returned to the Document Approval page. Now, in addition to which user uploaded the document and the date, there is an edit user and date timestamp. Approving the document will send the document to the SQL Server Database if the project in question has been initiated.

### 3.3.7 Project Initiation

In order to approve a document for a given project the project must first be initiated. The Project Initiation button is available to ALDOT Engineers and Administrators. When the button is clicked the user is prompted to enter project information in the form shown in Figure 3.12.

Once the appropriate information is entered the user can search projects in the CPMS table that match the search criteria. An example list of projects that meet search criteria is compiled in the page shown in Figure 3.13.

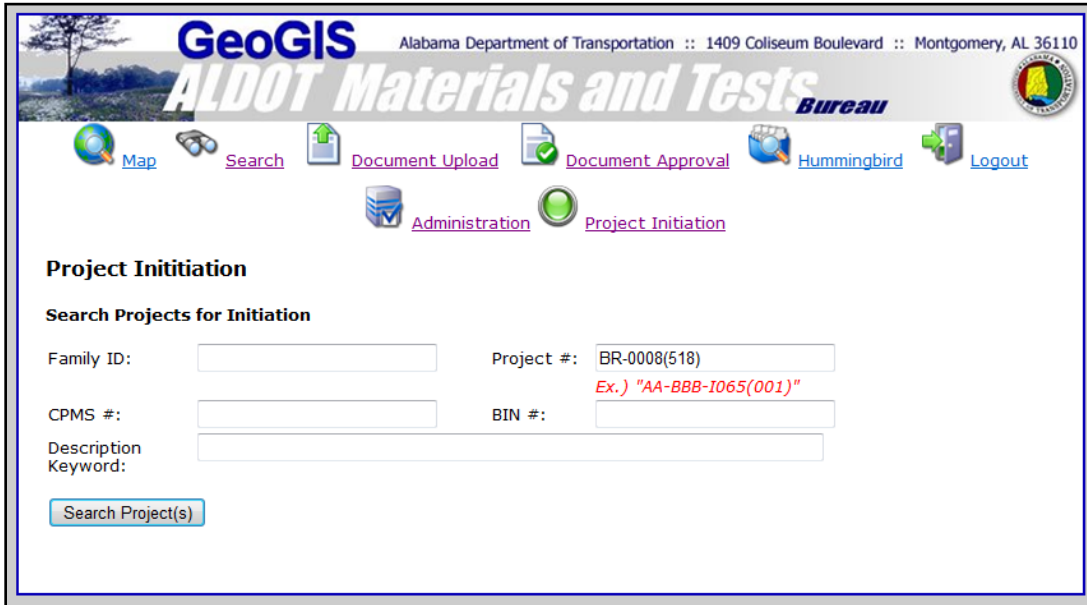


Figure 3.12 Project Initiation Page

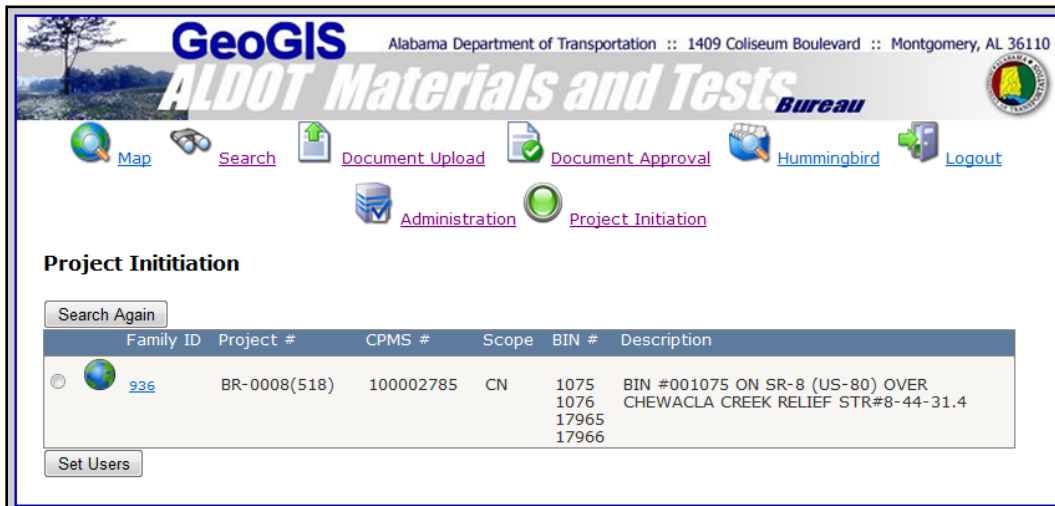


Figure 3.13 Project Search Results



The ALDOT Engineer then selects the project to be initiated and clicks “Set Users”. The following page shown in Figure 3.14 allows the ALDOT Engineer to set which consultants can upload and approve documents for the project. After the users have been selected the project can be initiated.



Figure 3.14 User Selection Page

A project is initiated in the relational database by changing the “Initiated” field in the CPMS table from a zero to a one. This change is performed automatically by the program. This provides the necessary “flag” so that a query can be performed and only projects with a one in the initiated column are put on the map, and only these projects can receive uploaded documents. A separate table in the relational database stores the consultant users name and the projects to which the consultant is assigned.

### 3.3.8 Administration Page

The Administration function is available to users with an Administrator classification. Currently, only an administrator can create and edit accounts including usernames, passwords, emails, and roles. The ability to delete an old username is not yet a function of the website. A user can only upload and approve documents if they have the correct classification and are assigned to that particular project. The Administration page is shown in Figure 3.15.

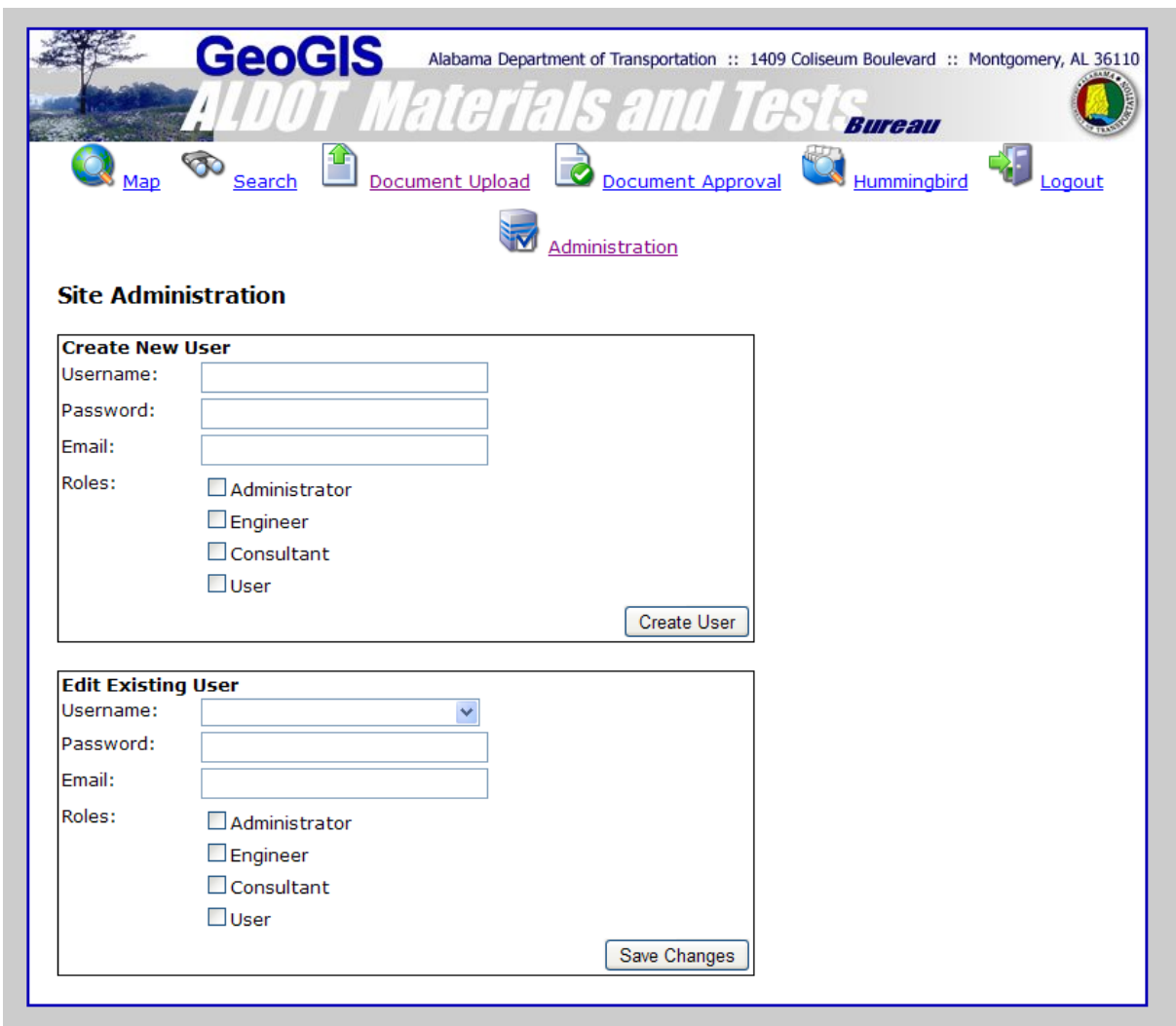


Figure 3.15 Administration Page

### 3.3.9 Hummingbird Link

Hummingbird is a database separate from GeoGIS where ALDOT business and engineering documents are stored. The Hummingbird button is a link to this database that requires a user name and password that is assigned and managed by ALDOT personnel. This link allows users to switch to the Hummingbird system.

### 3.4 GeoGIS Architecture

The GeoGIS website is constructed from several different entities acting together to efficiently store and retrieve data. GeoGIS consists of five major components: a relational database, a web client, an instance of ArcGIS Server by ESRI, a Flash map extension, and an instance of Arc Spatial Database Engine (ArcSDE) by ESRI. Each of these components is vital to providing a GeoGIS user with robust storage and retrieval functionality. The architecture used for GeoGIS is shown in Figure 3.16.

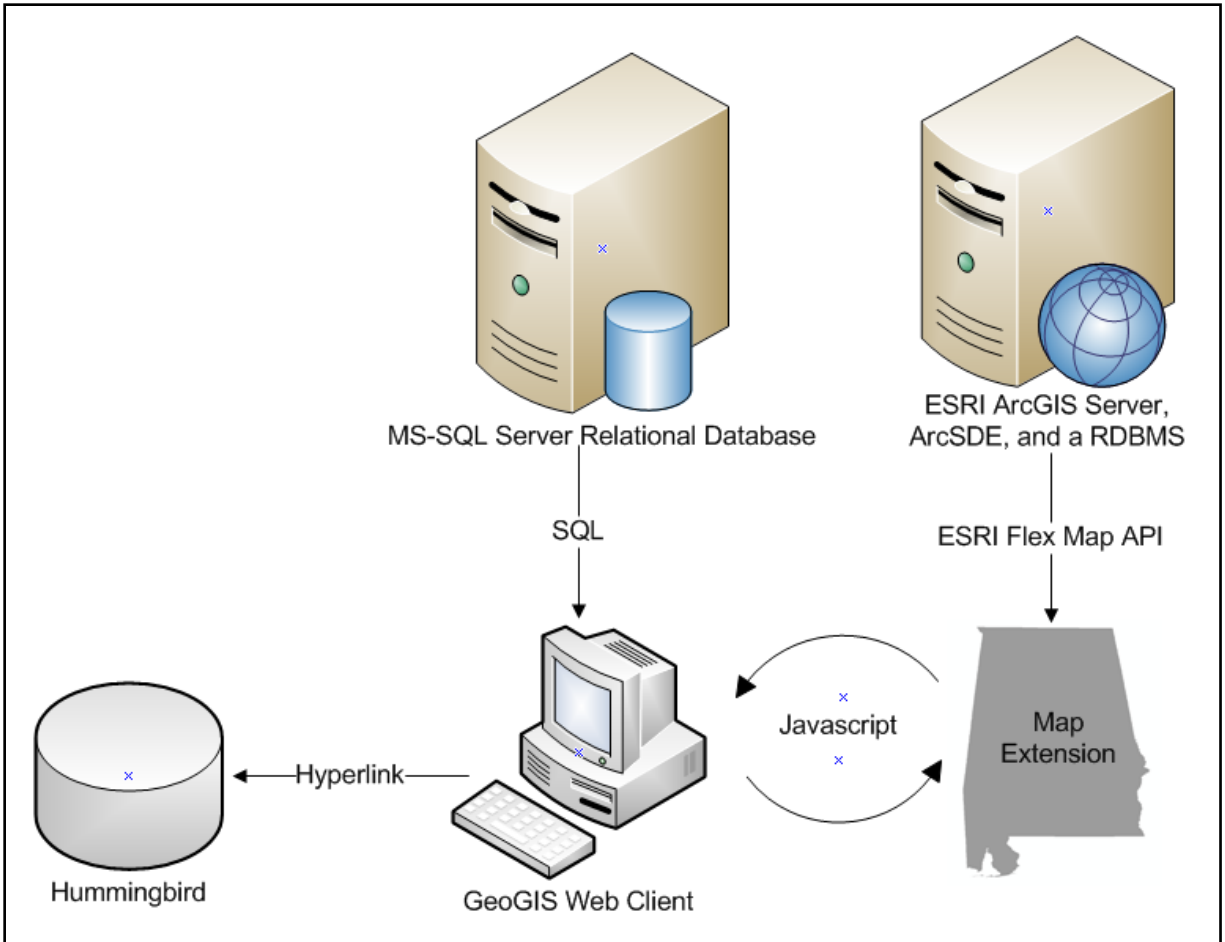


Figure 3.16 GeoGIS Architecture

The relational database is one of the most important components of the GeoGIS website. The relational database exists in Microsoft SQL Server 2008 and is located on a host server, which is a computer that runs the website client. This database stores information about projects, document attributes, information about GeoGIS users, and recent website activity. When a user makes a request from the website, the web client interacts with the relational database to provide the user with the information requested. Most requests from the website key off of the CPMS number.

The GeoGIS web client is the main front end accessed by all users of the website. The web client serves as the user interface for every aspect of the GeoGIS website. The relational database and the map extension are connected to the web client. The web client queries the relational database through the Structured Query Language (SQL) and communicates with the map through JavaScript. The GeoGIS web client provides a medium through which all components of the website can work together.

The Flash map extension was created with the Flex Builder integrated development environment created by Adobe. The Flash Map utilizes the ESRI Flex API to interface with map services published by ArcGIS server. The map communicates with an instance of ArcGIS Server to display features on a basemap furnished by ESRI. The ESRI Flex API provides the querying capability needed to make the “Project Initiation” function in GeoGIS possible.

ArcGIS Server, ArcSDE, and a relational database management system (RDBMS), separate from the relational database mentioned previously, reside on a host computer. ArcSDE provides the capability to store spatial information in the RDBMS. These components work together to publish map services utilized in the Flex application.

### 3.5 Conclusions

GeoGIS is designed to aid in the storage and retrieval of preconstruction and construction documents related to geotechnical engineering for ALDOT. The storage of documents is made possible by allowing users the ability to upload documents to GeoGIS efficiently through simple project search functions, uploading pages, and document approval pages. The retrieval of documents is accomplished by both spatial and attribute search functions combined with the organization of the Family details page which makes the retrieval of documents very efficient.

Chapter 4 describes the website enhancements from Phase II to Phase III as well as the progress made on increasing the amount of data stored in GeoGIS.

## CHAPTER 4.0

### RESULTS

The objective of Phase III of GeoGIS was to increase the amount of data stored in GeoGIS while at the same time increasing the functionality of the website. The amount of data stored has increased significantly and the website has many new functions that aid the user in website operations. This section describes the results of Phase III of GeoGIS.

#### 4.1 Documents Uploaded

At the completion of Phase II, documents had been uploaded for eight projects in seven different counties in Alabama. In November 2010, ALDOT submitted approximately 15,500 files to be reviewed for uploading. As of May 31, 2011, 8150 files have been reviewed and of those 1847 were loaded to the website. Documents were uploaded for 156 projects from 50 counties in Alabama. Figure 4.1 shows a thematic map of the number of projects received from ALDOT in each county, and the percent of projects that have been uploaded for each count. The amount of data stored in the GeoGIS increased significantly from the eight projects originally stored in the system.





## 4.2 Searching Projects

Many functions that are available in GeoGIS begin with a page to search for projects. During Phase II, projects were search based only on the project's CPMS number. This proved to be inadequate because in many cases the CPMS number was not provided on any documents. In order to rectify this problem, the project search page was enhanced drastically. A large amount of information about projects can be found in the CPMS Projectline table discussed in Section 3.1. Projects can now be searched based on Family ID, Project Number, CPMS Number, BINs on the project, and project description keywords. This addition to the website has greatly reduced the amount of time spent trying to find the CPMS number associated with a project.

## 4.3 Project Initiation

The process for loading project lines to the GeoGIS map in Phase II was a time consuming manual process. The shapefile was first created in ArcMap and published to ArcServer for all projects for which documents had been uploaded. The FLEX code was then adjusted to allow the GeoGIS map to display the shapefile. This process was automated in Phase III as described in Section 3.2.7. Automating the process eliminates the need to have a person competent in ArcGIS, ArcGIS Server, and Flex manually load new projects. This new functionality also offers control over which users can upload documents to a project, which is a feature that was not available in Phase II.

## 4.4 Uploading Multiple Documents Simultaneously

The ability to upload multiple documents at the same time has made the document upload process much less time consuming. In Phase II of GeoGIS only one document could be uploaded at a time. This was a very time consuming process that made uploading documents a very inefficient process. During Phase III, functionality was added to allow multiple documents

to be added to the document upload page. These documents are then assigned the correct attributes and upload simultaneously. Simultaneous uploading of multiple documents has increased the efficiency of the document upload process significantly.

#### 4.5 Multiple Document types

Documents such as foundation reports may fit into multiple document type categories. In Phase II, the only way to handle this situation would be to upload the document multiple times for different document types. From a database standpoint this is very inefficient due to the redundancy of the same document existing multiple times in the database. Documents in Phase III have the ability to be tagged with multiple document types. All instances of the document type in the database point at the same document. This eliminates any redundancy of the document in the database management system thus making the system more efficient.

#### 4.6 Editing Documents at Approval

Occasionally documents may be coded incorrectly at the document approval page, and require some form of correction. Prior to Phase III, the only option for correcting a document was to deny the document at the Document Approval Page, and then re-upload the document with the correct information. An “Edit” button was added to the Document Approval Page to eliminate the need to re-upload documents. The Edit button allows users to quickly edit document attributes at the Document Upload Page, and subsequently approve the document.

#### 4.7 Conclusions

The increase in documents stored combined with the boost in website functionality in Phase III has made GeoGIS a more robust user friendly system. Much of the painstaking procedural inefficiency that existed in Phase II has been enhanced to make GeoGIS easy to

operate. The vast increase in data stored has made the website more practical for everyday use at ALDOT.

## CHAPTER 5

### CONCLUSION AND FUTURE WORK

#### 5.1 Conclusion

Phase III of GeoGIS successfully increased the functionality of the GeoGIS website while at the same time increased the amount of data stored in the system. Various components of the website were enhanced to make the site more user friendly. The amount of data stored in GeoGIS increased by more than fifteen times what was in the system in Phase II. Phase III moved the GeoGIS project closer to being launched as a full working database management system for ALDOT.

GeoGIS users have two options for finding documents for a project of interest. The first option is to search for a project spatially on the GeoGIS map. The map function is efficient when the user knows the location of a project. The second option is to use the Search Page and find documents based on known attributes. The map and search functions provide users with the ability to efficiently search and retrieve project documents.

In order to increase the amount of data stored in GeoGIS, users need an avenue of uploading documents to the GeoGIS system. The document upload page provides consultants with a simple and efficient means of uploading documents to GeoGIS. The documents being uploaded are managed by an ALDOT engineer through the Document Approval page. Engineers can approve, deny, or edit documents based on the document attributes.

## 5.2 Future Work

The main goal of the next phase of this research is moving the GeoGIS to ALDOT. This will be accomplished by setting up a GeoGIS space on a Materials and Tests server, systematically moving aspects of GeoGIS to ALDOT, and linking GeoGIS to existing database management systems at ALDOT. Additional functionality will also be added to website as well as increasing the amount of geotechnical data stored in the system. The following section lists several tasks that will be involved in future work for GeoGIS.

### 5.2.1 Access to Plans Library

Access to the Plans Library would be beneficial to increasing the amount of data available to the GeoGIS. Pointing the GeoGIS to the Plans Library would allow users to access plans for many projects currently not in the GeoGIS. Undergraduate students will create links from the Family Details page to the Plans Library enabling GeoGIS to vastly increase the amount of data available to a GeoGIS user.

### 5.2.2 Soil Boring Upload Page

GeoGIS currently has a limited amount of soil boring data displayed on the GeoGIS map. The ability to locate soil boring data on a map will help to eliminate duplicate or unnecessary subsurface investigations. Providing ALDOT engineers and consultants with a user interface to upload and display soil boring data on the GeoGIS map will be a valuable addition to the website. The following steps outline an approach to add this enhancement to the GeoGIS.

- A “Soil Boring Upload” button will be added to the consultant GeoGIS homepage to access a soil boring upload function.

- When a consultant accesses the Soil Boring Upload page, the project for which the soil borings were collected will need to be indicated. This will be accomplished with a project search function much like the function that currently exists at the Document Upload page.
- Next, the consultant will select a soil boring location file to upload that contains the soil boring spatial attributes. This file will be a spreadsheet with key fields, including Soil Boring ID, Latitude, and Longitude. The consultant will specify which column in the uploaded spread sheet corresponds to the required location fields. The coordinate system of the soil boring locations needs to be indicated and will be selected from a drop down menu consisting of commonly used coordinate systems.
- After the required information is provided, the soil boring upload page will automatically map and link the soil borings to a project. When a user clicks a soil boring on the GeoGIS map, the Family Details page of the corresponding project will be displayed. In addition, when a user zooms to an appropriate level on the map, the soil borings will be labeled with the Soil Boring Id.

### 5.2.3 ALDOT PDF Documents

An ALDOT intern working in Materials and Tests will scan historic geotechnical documents and imbed key attribute information within each PDF. A Windows Desktop Application, created during a previous phase of this research, will mine the attribute information from each PDF and programmatically upload the document and attribute data to the GeoGIS website.

This task will also look at using PDF tabs to point at specific sections of PDF document from the GeoGIS Family Details page. Many geotechnical documents fit into multiple categories on the Family Details page. These documents are currently assigned multiple document types when the documents are uploaded. The ability to use PDF tabs associated with the Family Details page to point a user to the specific section of a PDF document would be advantageous to GeoGIS.

#### 5.2.4 Increase Map Functionality

Currently the GeoGIS map has pan and zoom capabilities combined with the ability to alternate between street, topographic, and satellite basemap imagery. Additional map functionality will be added in the form of spatial and attribute queries, as well as the ability to turn map layers on and off. Spatial queries will provide the ability to select every soil boring within a certain distance of a proposed project.

#### 5.2.5 Consultant Pilot Study

GeoGIS will be tested by several consultants. This pilot study is necessary to determine what parts of GeoGIS need to be fine tuned to increase the usability of the website. The consultants will test various features of the site and provide feedback on possible changes that could be beneficial the efficiency of GeoGIS.

#### 5.2.6 Transition GeoGIS to ALDOT

Transitioning GeoGIS to ALDOT will be a phased approach beginning with receiving access to needed ALDOT servers, systems, and data, followed by setting up GeoGIS components in appropriate locations at ALDOT, and finally bring individual components at ALDOT online in a

systematic approach to allow the GeoGIS site to remain active for the users. To accomplish the transition the following steps will be taken.

- Access to ALDOT servers and data will consist of: the Materials and Tests Hummingbird Library, a portion of a Materials and Tests server, a view to a CPMS projects table, and ALDOT basemap feature classes.
- A development site will be created at UA that mirrors the server and database arrangement at ALDOT. This site will have an instance of the Materials and Tests Hummingbird Library, a view to a CPMS SQL table at UA, and a UA ArcServer with a copy of the ALDOT basemap feature classes.
- After the development site is created, files will be transferred from the current GeoGIS site to the development site. This will include loading documents into the UA Hummingbird database and then redirecting the GeoGIS to point at the Hummingbird database at UA. Once successful, the GeoGIS documents will be transferred to the ALDOT Hummingbird database.
- A development GeoGIS site will be created at ALDOT by copying the UA GeoGIS to a Materials and Tests server. User permissions that follow ALDOT protocol will be established for the ALDOT development GeoGIS site. The ALDOT development GeoGIS site will be directed to point at the Materials and Tests Hummingbird library at ALDOT and a live view of the CPMS project table at ALDOT. This will allow users access to the newest projects in the CPMS project table.
- All GIS data will then be transferred to a spatial database engine at ALDOT, and published to an instance of ArcGIS server on an ALDOT host machine. The GeoGIS Flex code will then be redirected to this server to create the map on the development site.



- The development GeoGIS website will then be tested and when proven sound, the ALDOT GeoGIS site will take over as the live site. This will be seamless transition from a GeoGIS user standpoint.

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## APPENDIX A

### GEOGIS USERS GUIDE

#### 1.0 Introduction

This guide will describe the process of using the GeoGIS site, beginning with the privileges given to the general user, followed by consultant privileges, ALDOT engineer privileges, and finally administrative privileges. Each section of this Users Guide will explain the tasks that can be performed by each user type. This guide will also explain how to add and edit projects in the GeoGIS using SQL Server and ArcGIS. The User's Guide was originally written during Phase II of GeoGIS. The User's Guide has been updated to keep up with changes to the website during Phase III and included in this report.

#### 1.1 GeoGIS User Types

GeoGIS is a structured system that allows users of different classifications to perform different operations depending on their user type. There are four user types: general user, consultant, ALDOT engineer, and administrator. These are listed in order of increasing privileges. Each classification has privileges that allow users to perform certain tasks. Each higher classification can perform all the tasks of the lower classifications. The general user can view the map, view and retrieve documents and document details, and search for data. These are the only tasks the general user can perform. The purpose of the consultant user is to allow outside consulting firms the ability to upload documents to a temporary storage space where the data awaits approval. The consultant can also view the map, documents, and search the system. The purpose of the ALDOT engineer user is to approve documents. An ALDOT engineer can also upload documents and perform the other tasks related to the lower level users. In addition,

the ALDOT Engineer can initiate a project, which places the project on the map and allows documents to be uploaded to the project that has been initiated. The administrator can create or change user names, passwords, and privilege levels for GeoGIS users. The administrator can also initiate projects, as well as perform any action that can be performed by the lower level users.

## 2.0 General User Type

The GeoGIS website requires a valid login ID and password. Only a user with administrator status can create a login ID and password. Contact the administrator for a login ID and password. This section will discuss the privileges associated with the general user. A general GeoGIS user is restricted to a “view only” status and therefore cannot edit, add, or delete any information in the system.

### 2.1 Login Page

The GeoGIS website is located on a secure server. At the time of this Users Guide, the GeoGIS is located at the following link <http://geogis.crdl.ua.edu/>. Navigate to this address using a web browser to bring up the GeoGIS Login Page. Figure A1 below shows the Login Page. Before logging in, the buttons across the top of the page will not function.



Figure A1 - GeoGIS Login Page

As mentioned previously, a valid login ID and password must be created for each user of the GeoGIS. After a valid user name and password is entered, the user can click the Login button and the GeoGIS homepage will appear.

## 2.2 GeoGIS Homepage

The GeoGIS homepage is shown in Figure A2. This page is the starting point for a GeoGIS user. The page has several buttons including Map, Search, Document Upload, Document Approval, Hummingbird, and Logout. From this page, a user can select any function, but the user can only perform the functions that are within the privileges of the user type.

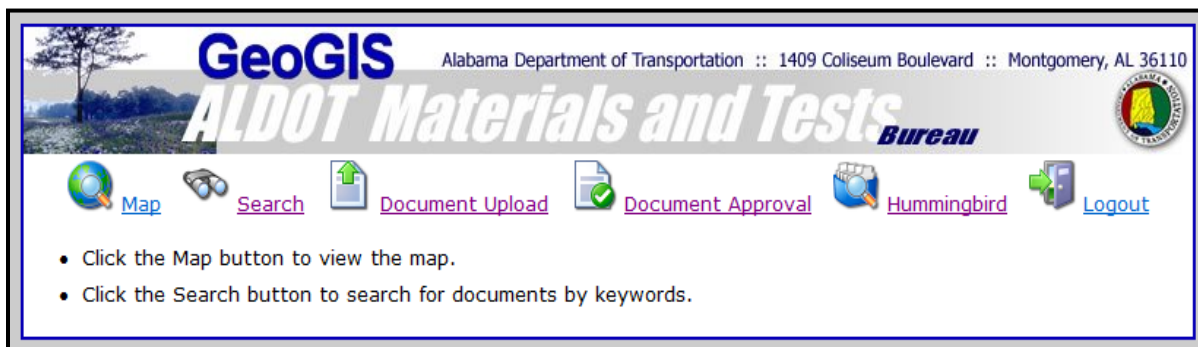


Figure A2 - GeoGIS Homepage

## 2.3 GeoGIS Map

Clicking the Map button will open a new window containing the GeoGIS map. The ALDOT projects that are in the GIS shapefile will appear on the map. Figure A3 shows the street map for Alabama; the red lines, green circles, and stars are the locations of projects currently in the GeoGIS.

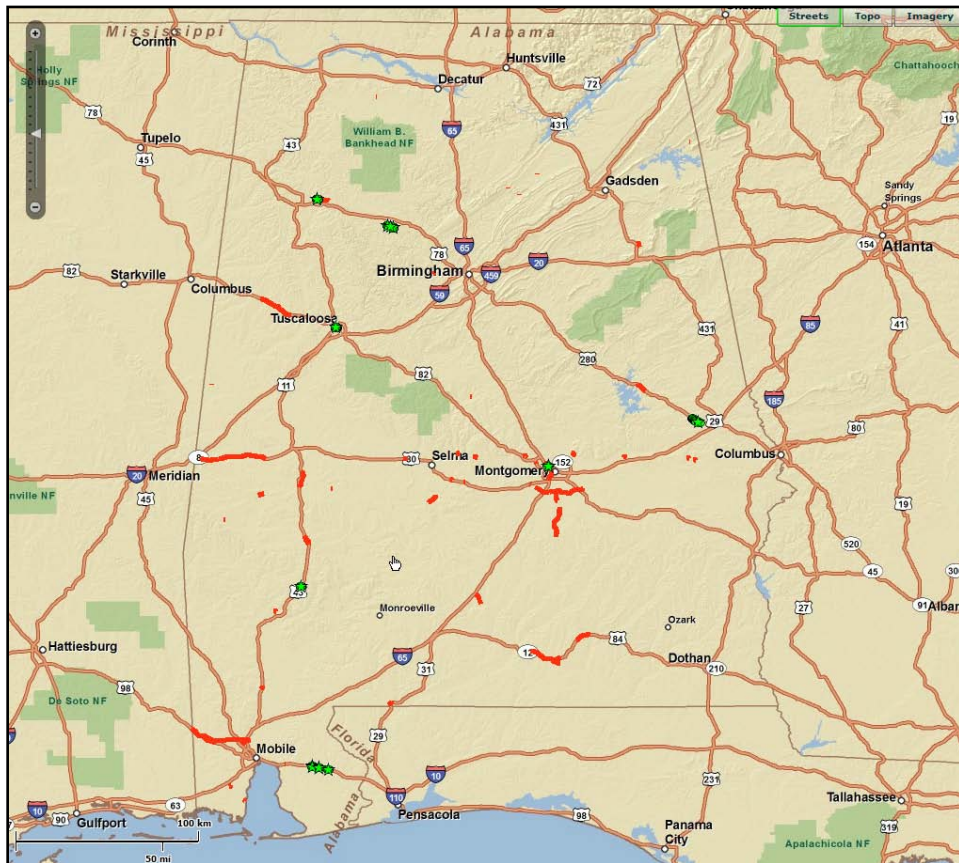


Figure A3– GeoGISWeb-Map Displaying Streets in Alabama

To move around the map, a user can simply click, hold, and move the map to pan. Clicking a point on the map will “grab” that point and move the map with the cursor. This will let a user easily locate an area of interest. To the upper left of the map is a grey vertical bar that looks like a ruler, this is the zoom feature. The small sliding arrow that points at the ruler



represents the scale of the map being displaying (i.e. when the arrow is low on the ruler, the scale is small and the map shows a larger area, when the arrow is high on the ruler, the scale is large and the map shows a smaller area). To zoom in incrementally, the user can click the plus button at the top of the ruler or slide the arrow upwards. To zoom out, the user can click the minus button at the bottom of the ruler or slide the arrow downwards.

The quickest way of zooming in and out of the map is by using the mouse wheel. Moving the mouse wheel forward will zoom to the cursor. Moving the mouse wheel back will zoom the map out. The mouse wheel allows quick and accurate zooming, and reduces the need to pan the map. Figure A4 below is a zoomed view of the street map.

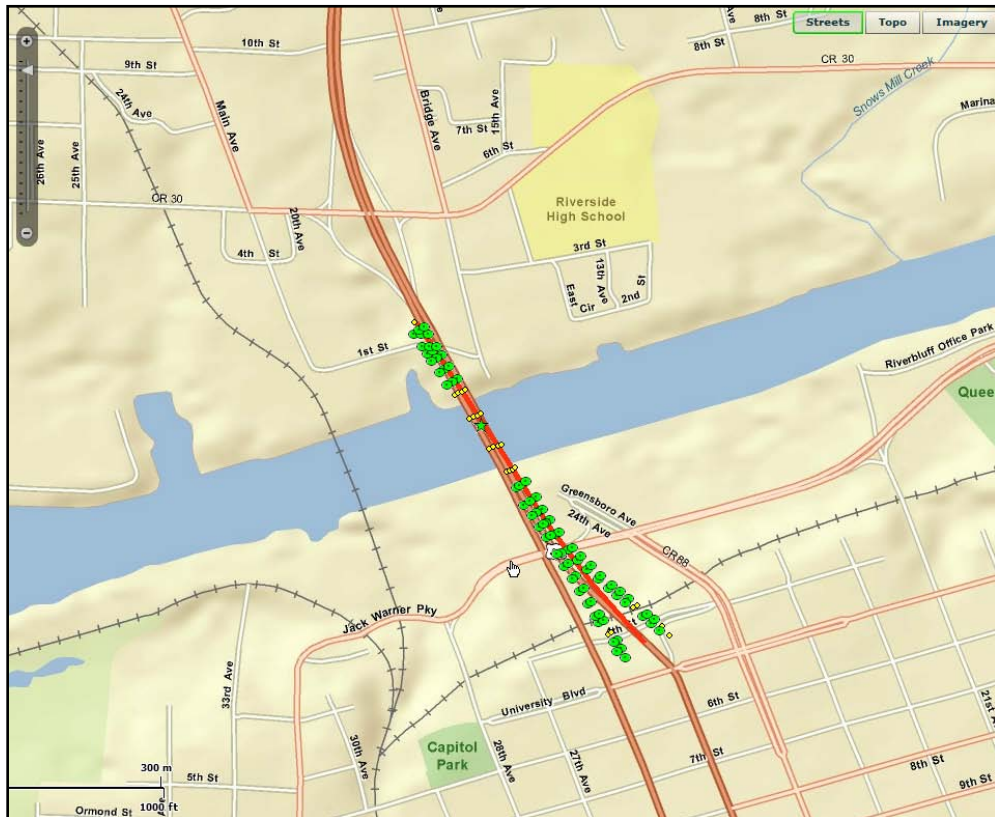


Figure A4 - Zoomed in View of the Street Map

There are three different basemap views available in the GeoGIS: Streets, Topo, and Imagery which are shown in Figure A5. Figure A5 (a) shows the street view map layer containing roads, road names, water bodies, and shaded relief. Figure A5 (b) shows the Topo option that is USGS topographic maps, which include roads, water bodies, elevation contours, townships, etc. The Imagery layer shown in Figure A5(c) shows a detailed aerial view. All map view options will display the GeoGIS project layers as seen in Figure A5.

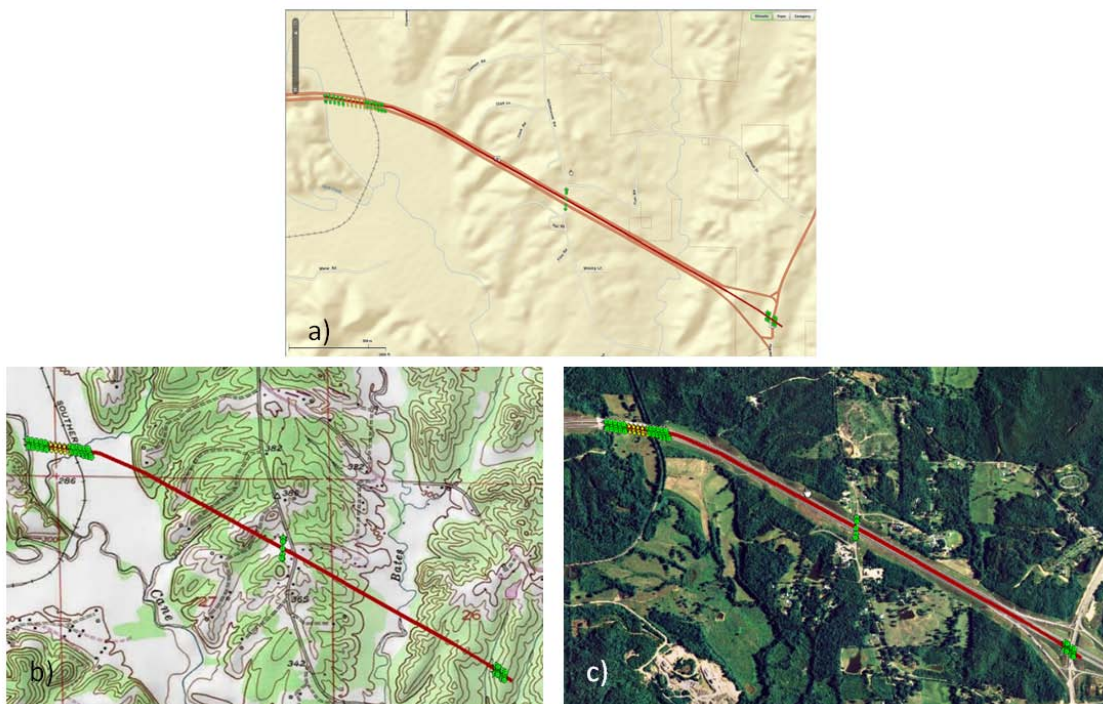


Figure A5 Streets, Topo, and Imagery Views in GeoGIS

Geotechnical projects that are included in the GeoGIS have four potential features: a project line, bridge points, foundation points, and soil boring points. A project line is represented as a thick red line showing the linear extent of a project as shown in Figure A5. This line represents the stretch of road that the project encompasses. A bridge location is represented as a green star. Each star represents a point on a bridge and is used to identify a

single bridge. There may be several bridges within one project. Green circles represent the location of foundations which can be driven or drilled and typically support a bridge. Smaller yellow dots are the soil boring locations. These dots represent the point where a soil boring was drilled. Figure A6 shows a zoomed in view of a pair of bridges associated with one project. Each set of features for a project represents the location of project data. However, the purpose of the GeoGIS is to provide a spatially explicit method for organizing geotechnical documents. To access documents, a user can simply click any of the GeoGIS features on the map for a particular project. The map will become the inactive window, and a window containing the Family Details page will appear.

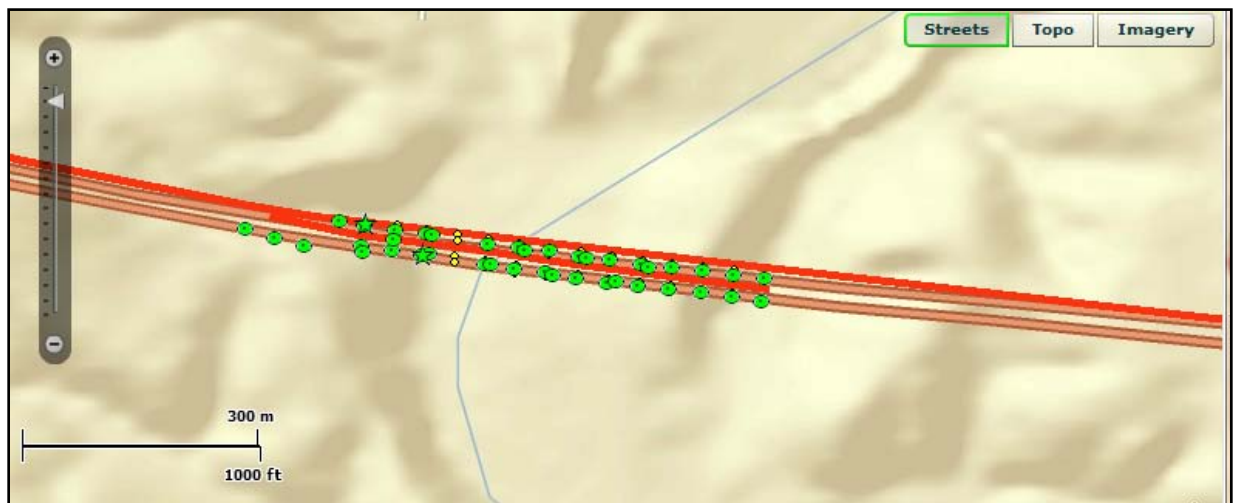


Figure A6 - Shapefiles for a Single ALDOT Project

## 2.4 Family Details Page

The Family Details page, shown in Figure A7, is the main page to access project information and related documents. The page consists of the project number, available Bridge Identification Numbers (BINs), a brief description of the project location from the CPMS database, and the list of documents. The Family Details page contains two general types of

documents: Pre-construction documents (left side) and Construction documents (right side). The documents in each document type are displayed in alphabetical order. Figure A7 displays the Family Details page for an example project. The project ID and a short description of the project location are listed underneath the “Family Details” title. To the right of the project number are BIN(s) for the project in red. The globe icon in front of the project number is a button to jump to the map and zoom to a project extents.

**GeoGIS** Alabama Department of Transportation :: 1409 Coliseum Boulevard :: Montgomery, AL 36110  
**ALDOT Materials and Tests Bureau**

Map Search Document Upload Document Approval Hummingbird Logout  
 Administration Project Initialization

**Family Details**

**CPMS# 9000000001 BIN 10773**  
 Project# STPAA -0003(521) HUGH THOMAS  
 Zoom to project on the map.

**Preconstruction Records**

- Soil Survey (4)
  - [soil\\_boring\\_100.jpg](#)
  - [soil\\_boring\\_102.jpg](#)
  - [soil\\_boring\\_98.jpg](#)
  - [soil\\_boring\\_99.jpg](#)
- Materials Report (0)
- Slope Study Report (0)
- Foundation Investigation Report (0)
- Retaining Wall Report (0)
- Coal Analysis Report (0)
- Culvert Report (0)
- Other Geotechnical Reports (0)
- Geohydrologic Report (0)
- Geotechnical Data (0)
- Soil Sample Test Request (0)
- Summary of Lab Tests (0)
- Foundation Recommendations (0)
- Foundation Analysis (0)
- Addenda (0)
- Correspondence (0)
- Photo (0)
- Other (0)
- Foundation Report (0)
- Landslide Report (0)
- Sinkhole Report (0)

**Construction Records**

- Bridge Card Image (0)
- Bridge Identification Information (0)
- Hammer Submittal (0)
- Bridge Foundation Report (0)
- Bearing Curves (PDA Results) (0)
- Test Pile Driving Record (1)
  - [test\\_pile\\_record.pdf](#)  
BIN 10773
- Pile Driving Record (4)
  - [pile\\_driving\\_record\\_1.pdf](#)  
BIN 10773
  - [pile\\_driving\\_record\\_2.pdf](#)  
BIN 10773
  - [pile\\_driving\\_record\\_3.pdf](#)  
BIN 10773
  - [pile\\_driving\\_record\\_4.pdf](#)  
BIN 10773
- Drilled Shaft Excavation Log (0)
- Drilled Shaft Pouring Record (0)
- Load Test (0)
- Plan (2)
  - [foundation.jpg](#)  
BIN 10773
  - [plan-elevation.jpg](#)  
BIN 10773
- Correspondence (0)
- Photo (0)
- Field Monitoring (0)
- Other (0)

Figure A7 - GeoGIS Family Details Page for a Project

There are eleven documents associated with the example project in Figure A7. The documents are shown in blue, underlined, and listed under specific document types. It can be seen in Figure A7 that some document types do not have any documents listed under the type. The Family Details page shows a user exactly which documents and documents types are

available. Many projects in the GeoGIS will contain a bridge and have a BIN. This number helps the user identify which bridges are associated with a project. If a document is specific to a certain BIN, that BIN is also placed in red underneath the document name as seen in Figure A7.

There are several options for a user to use to view a document. Hovering over a specific document on the Family Details page will bring up a thumbnail, as shown in Figure A8 below. The thumbnail view in the GeoGIS is a powerful tool to quickly scan through project documents. The ability to thumb through digital documents without opening each document is a common request from document management system users. The GeoGIS was specifically designed to contain this valuable functionality.

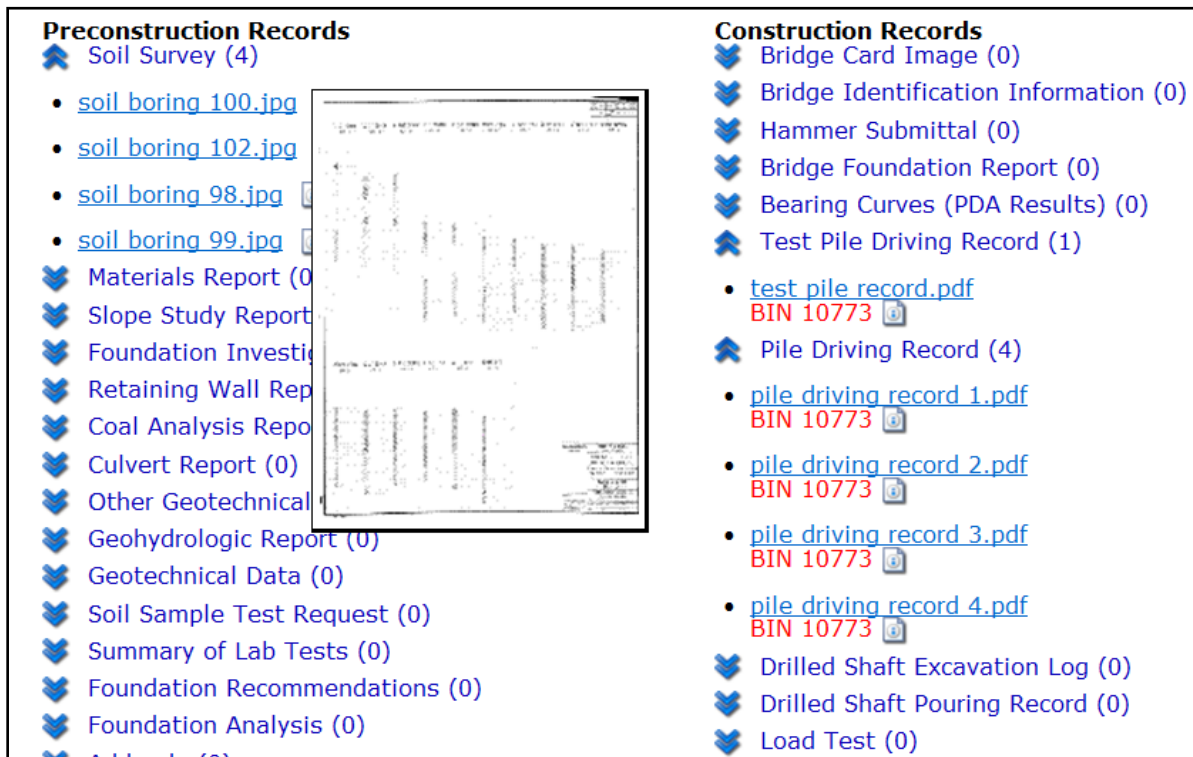


Figure A8 - Document Thumbnail View on Family Details Page



Clicking on a document name will open up a dialog box that allows the user to download or open a selected document. Figure A9 shows the dialog box that opens when document thumbnail or name is selected.

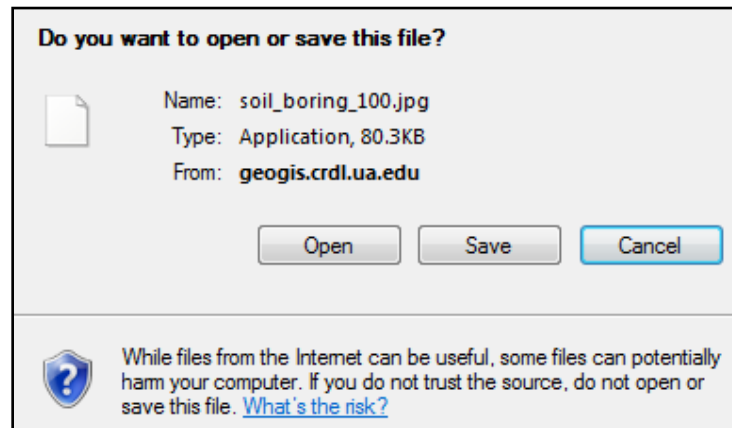


Figure A9 - File Download Dialog Box for a Soil Boring Document

The selected document in Figure A9 is a soil boring sheet, which is normally in a JPG file format. There are also PDF file formats, Microsoft Word Documents and many other file formats used in GeoGIS; to download and view PDF files, Adobe Acrobat is required (Acrobat is available for free from Adobe).

Another way to view a document from the Family Details page is by clicking the information symbol that is displayed below each document. This will direct the user to the Document Details page, which is discussed in the following section.

## 2.5 Document Details Page

The document details page lists database information about a document and displays a low resolution image of the document on the left side of the screen. If a document contains more than one page, only the first will appear in the thumbnail. Figure A10 shows the Document Details page for a soil boring sheet. A document can be downloaded by clicking the name of the document at the right of the Document Details page.

The screenshot shows the GeoGIS interface for the Alabama Department of Transportation. The header includes the logo and address: "Alabama Department of Transportation :: 1409 Coliseum Boulevard :: Montgomery, AL 36110". Below the header is a navigation menu with icons and links for Map, Search, Document Upload, Document Approval, Hummingbird, Logout, Administration, and Project Initialization. The main content area is titled "Document Details" and features a thumbnail of a soil boring sheet on the left. To the right of the thumbnail, the document name "soil boring 100.jpg" is displayed in purple. Below the name, the following information is listed: Upload Date: 10/27/2009 3:37:56 PM, Uploaded By: GeoGISUser, Approve Date: 1/26/2011 10:02:12 AM, Approved By: Blake\_Admin, Type: Soil Survey, File Size: 0.08MB, MD5 Hash: 027c6d93a46254589a4b1c8e1a51b8cc, Family: 900000001, Project: 900000001, HUGH THOMAS, and Applicable BINs.

Figure A10 - GeoGIS Document Details Page



The document details page allows a user to see information such as upload and approval dates, the users that uploaded and approved the document, the type and size of the document, the family and project details, and the applicable BIN.

## 2.6 Search Page

The search page is designed to allow a user to search the GeoGIS database based on a CPMS number, a BIN, a document name, or any keyword associated with a document or project.

Figure A11 shows the GeoGIS search page.



Figure A11 - GeoGIS Search Page

If a user wants to find all documents that are associated with I-65 North, for example, the user enters “I-65 North” into the text box on the Search page (shown in Figure A11), and clicks the “Search” button. The results of this search are displayed on the Document Search results page shown in Figure A12.


**GeoGIS** Alabama Department of Transportation :: 1409 Coliseum Boulevard :: Montgomery, AL 36110  
**ALDOT Materials and Tests Bureau**

Map Search Document Upload Document Approval Hummingbird Logout


### Document Search

Enter a project number or keyword to search for.


Search Query




[bridge identification information.pdf](#)  
 Search Matches: Description  
 Document Type: Bridge Identification Information  
 Project ID: 9000000003  
 Project Description: I-65 NORTH AND SOUTH BOUND LANES  
 Applicable BINs: 10696, 10697  
[Document Details](#) :: [Family Details](#)




[soil boring.JPG](#)  
 Search Matches: Description  
 Document Type: Soil Survey  
 Project ID: 9000000003  
 Project Description: I-65 NORTH AND SOUTH BOUND LANES  
 Applicable BINs: 10696, 10697  
[Document Details](#) :: [Family Details](#)



[bridge card.pdf](#)  
 Search Matches: Description  
 Document Type: Bridge Card Image  
 Project ID: 9000000003  
 Project Description: I-65 NORTH AND SOUTH BOUND LANES  
 Applicable BINs: 10696, 10697  
[Document Details](#) :: [Family Details](#)



[elevation.JPG](#)  
 Search Matches: Description  
 Document Type: Plan  
 Project ID: 9000000003  
 Project Description: I-65 NORTH AND SOUTH BOUND LANES  
 Applicable BINs: 10696, 10697  
[Document Details](#) :: [Family Details](#)



[test pile record.pdf](#)  
 Search Matches: Description  
 Document Type: Test Pile Driving Record  
 Project ID: 9000000003  
 Project Description: I-65 NORTH AND SOUTH BOUND LANES  
 Applicable BINs: 10696, 10697  
[Document Details](#) :: [Family Details](#)

Figure A12 - GeoGIS Search Results

The result of the search is a list of documents that met the search criteria. The list contains a thumbnail view of each document, a hyperlink to the document through the document

name (which can be used to download the document), the database field the search matched (in this example the search had a “Description” match for each document), the document type, the project ID, project description, applicable BIN(s), and links to the Document Details and the Family Details pages. Five documents appeared as a result of this example search, meaning there are five documents that contain the text “I-65 North” in the database. If a user had typed in a project ID or BIN, all documents associated with that number would have been displayed, and the match type would have read “PJ\_REF\_ID” (project ID number) or “BIN”, respectively.

## 2.6 Hummingbird

ALDOT maintains a document management system called Hummingbird that contains both current and historic documents. The Hummingbird document management system is for all types of transportation and project documents, while the GeoGIS is specifically designed for geotechnical documents for projects at specific locations. The GeoGIS uses a proprietary document database that is different than Hummingbird. To allow efficient movement between the two systems, a link to the Hummingbird system is in the GeoGIS. The link can be seen in Figure A13.

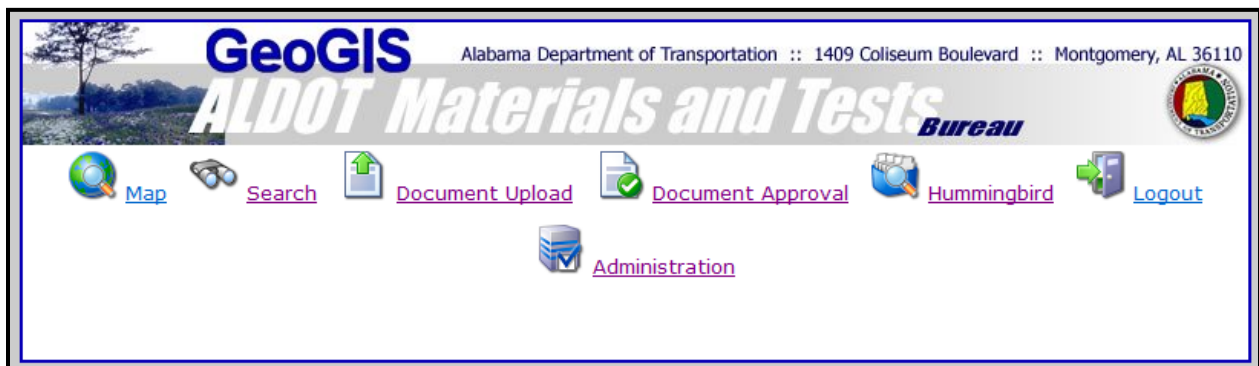


Figure A13 - GeoGIS Homepage Showing Hummingbird Link

In order to access the Hummingbird system, a user must obtain a separate username and password specifically for Hummingbird. Clicking the Hummingbird link will open an internet browser and connect to the website <http://www.aldotweb.dot.state.al.us>. A login box will appear requesting a valid username and password for Hummingbird. Once logged in, a user can browse through the documents that are in the Hummingbird system.

### 3.0 Consultant User Type

The consultant user type was created to allow a user to upload documents, but not approve documents. The consultant user type may include geotechnical firms, contractors, and other agencies that may own or create documents that are important to ALDOT. This user type can provide more efficient upload, since the consultant can upload the document as soon as the document is created, rather than sending the document to ALDOT for upload. The documents uploaded by this user type will still require approval from an ALDOT engineer user with higher GeoGIS privileges. It should be noted that in addition to document upload, a consultant has all the privileges of a general user.

#### 3.1 Document Upload Page

The Document Upload page is designed to facilitate quick and accurate uploads of geotechnical information by consultants. Figure A14 shows the Document Upload page before any information has been entered. To upload documents for a project, the project must exist in GeoGIS and be initiated by an ALDOT Engineer. In addition the user uploading the documents must be assigned to the project by an ALDOT Engineer. Once initiated, the project is available for document uploads. Creating a new project in the situation that a project does not exist in GeoGIS is explained in the Administrator User Type section of this Users Guide.

Alabama Department of Transportation :: 1409 Coliseum Boulevard :: Montgomery, AL 36110

[Map](#)
[Search](#)
[Document Upload](#)
[Document Approval](#)
[Hummingbird](#)
[Logout](#)

### Document Upload

**Upload Document to Existing Project**

Family ID: 
 Project #:

CPMS #: 
 BIN #: 
  
*Ex: "AA-BBB-I065(001)"*

Description  
 Keyword:

Figure A14 - GeoGIS Document Upload Page Prior to Selecting Project



In order to select a project the consultant enters the all known information into the fields provided in Figure A14. All projects that match the information entered are compiled in the Project Search Results Page shown in Figure A15.

The screenshot shows the 'Document Upload' section of the GeoGIS ALDOT Materials and Tests Bureau website. At the top, there is a navigation bar with links for Map, Search, Document Upload, Document Approval, Hummingbird, and Logout. Below the navigation bar is a 'Document Upload' heading and a 'Search Again' button. The main content is a table with 8 rows of search results. Each row includes a checkbox, a globe icon, a Family ID, Project #, CPMS #, Scope, BIN #, and a Description. The first row is selected, indicated by a checked checkbox. At the bottom of the table is a 'Begin Uploading' button.

Family ID	Project #	CPMS #	Scope	BIN #	Description
<input checked="" type="checkbox"/> <a href="#">23136</a>	BR-0009	100041415	PE	2627	SR-9 REPLACE BRG BIN 002627, OVER LITTLE HILLABEE CREEK, 1.0 MILE SOUTH OF MILLERVILLE. (SUFF=19.5, STAT=SD, 2001 HBRRP LIST)
<input type="checkbox"/> <a href="#">23136</a>	BR-0009	100041416	CN	2627	SR-9 REPLACE BRG BIN 002627, OVER LITTLE HILLABEE CREEK, 1.0 MILE SOUTH OF MILLERVILLE. (SUFF=19.5, STAT=SD, 2001 HBRRP LIST)
<input type="checkbox"/> <a href="#">23276</a>	BR-0009	100041616	CN	2666	REPLACE BRG SR-9 BIN 002666, OVER CAHULGA CREEK, SOUTH OF I-20 NEAR BELLTOWN
<input type="checkbox"/> <a href="#">1240</a>	BR-0009(508)	100003725	CN	3411 18631	BIN #003411 BR REPL & APP ON SR-9 OVER TERRAPIN CR #9-10-7.4
<input type="checkbox"/> <a href="#">1240</a>	BR-0009(508)	100043496	RW	3411 18631	BIN #003411 BR REPL & APP ON SR-9 OVER TERRAPIN CR #9-10-7.4
<input type="checkbox"/> <a href="#">1047</a>	BR-0009(515)	100003145	CN	2110 2111 18577 18578	BR REPL ON US-331 AT BRANCH S OF SNOWDOWN BIN 002111 (CULVERT)
<input type="checkbox"/> <a href="#">1047</a>	BR-0009(515)	100038165	UT	2110 2111 18577 18578	BR REPL ON SR-9 (US-331) @ 2 BR S OF SNOWDOWN #9-51-15.9 & 16.0
<input type="checkbox"/> <a href="#">23276</a>	BR-0009(516)	100041643	PE	2666	SR-9 REPLACE BRG BIN 002666, OVER CAHULGA CREEK, SOUTH OF I-20 NEAR BELLTOWN (SUFF=11.9, STAT=SD, 2001 HBRRP LIST)

Figure A15 Project Search Results

After a project is selected the Consultant then clicks the “Begin Uploading Button”. This takes the Consultant to a page where documents can be browsed and added in order to assign document types. When a the documents of interest have been added they appear in the Document Upload page as shown in Figure A16.

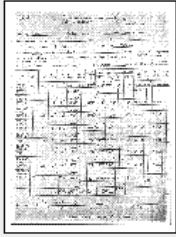

 Alabama Department of Transportation :: 1409 Coliseum Boulevard :: Montgomery, AL 36110  
**ALDOT Materials and Tests Bureau**


[Map](#)
[Search](#)
[Document Upload](#)
[Document Approval](#)
[Hummingbird](#)
[Logout](#)

### Document Upload

[Back to Project Selection](#)

Select file to upload:  [Browse...](#) [Add](#)

  
[BR-3419\(102\)bl.pdf](#)

Family ID: 23136  
 Project #: BR-0009

CPMS #:	BIN #:
<input type="checkbox"/> 100041415 (PE)	<input type="checkbox"/> 2627


Additional BINs:   
(seperate with commas, leave blank if none)

Preconstruction
  Construction

Soil Survey

[+ Add Document Type](#)

[Remove](#)

  
[BR-3419\(102\)pf.pdf](#)

Family ID: 23136  
 Project #: BR-0009

CPMS #:	BIN #:
<input type="checkbox"/> 100041415 (PE)	<input type="checkbox"/> 2627

Additional BINs:   
(seperate with commas, leave blank if none)

Preconstruction
  Construction

Soil Survey

[+ Add Document Type](#)

[Remove](#)

[Submit Documents](#)

Figure A16–Document Upload Page

From the Document Upload Page the Consultant then selects the CPMS number, applicable BINs, and the correct document type. Several document types can be entered into the GeoGIS. Table A1 shows the Preconstruction and Construction document types in the GeoGIS.



Table A1 Document Types in GeoGIS

<b>Preconstruction</b>	<b>Construction</b>
Soil Survey	Bridge Card Image
Materials Report	Bridge Identification
Coal Analysis Report	Hammer Submittal
Culvert Report	Bearing Curves (PDA Results)
Other Geotechnical Reports	Test Pile Driving Record
Geohydrologic Report	Pile Driving Record
Geotechnical Data	Drilled Shaft Excavation Log
Soil Sample Test Request	Drilled Shaft Pouring Record
Summary of Lab Tests	Correspondence
Foundation Recommendations	Photo
Foundation Analysis	Other
Addenda	
Correspondence	
Photo	
Other	
Foundation Report	
Landslide Report	
Sinkhole Report	

To specify which document type is being entered into the GeoGIS, select either the Preconstruction or Construction radio buttons, and then select an option from the drop down menu. In many cases documents may fit into multiple document type categories. Clicking add document type will allow the Consultant to tag additional document types to the same document. Many projects in the GeoGIS will contain a bridge and have a BIN. This helps user identify which bridges are associated with a project. After the document type is selected, the BIN should be selected. If the BIN is not known, or there is not a BIN associated with the project BIN check box should be left blank. Click the “Submit Documents” button at the bottom of the page to upload and submit the document for approval. As discussed previously, the uploaded documents can be viewed on the Family Details page; however, documents cannot be viewed until they have

been approved by an ALDOT engineer. The Document Approval page is only available to an ALDOT engineer user type or the site administrator.

#### 4.0 ALDOT Engineer User Type

The ALDOT engineer user type is designed for ALDOT personnel to approve documents if the documents are valid for specific projects within the GeoGIS. The ALDOT Engineer has all the privileges of a consultant and general GeoGIS user and can also approve documents. The next section describes the Document Approval page.

#### 4.1 Document Approval Page

An uploaded document cannot be used in the GeoGIS until the document has been approved. Figure A17 shows the Document Approval page with several documents awaiting approval.

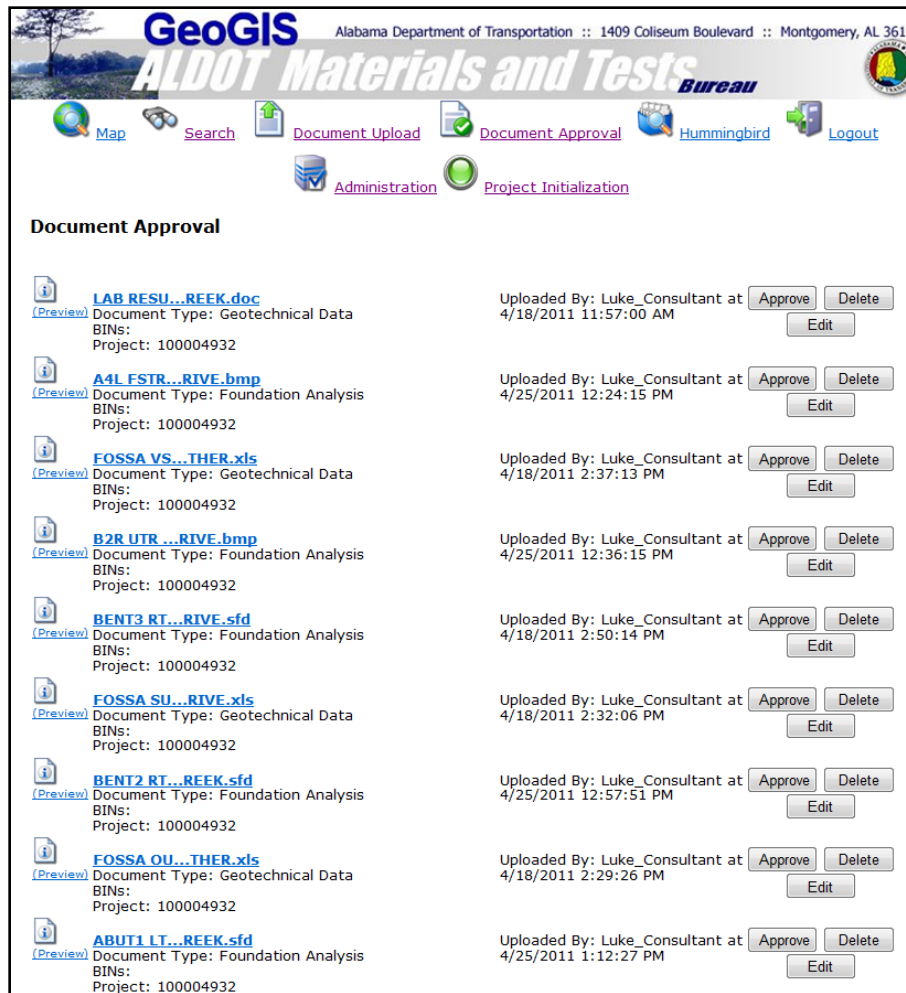


Figure A17 - Document Approval Page with Several Documents Pending

All pending documents are listed on the document approval page and show the document type, the associated project and description, the user that uploaded the document, the date/time the document was uploaded, and a link to preview the document. The ALDOT engineer or administrator can choose to approve or deny the document by either clicking the “Approve” button or the “Deny” button. In addition, an ALDOT engineer can use the “Edit” button to edit a document that has been uploaded. The edit page is shown in Figure A18. At the edit page an engineer can correct the document attributes and send it back to the Document Approval Page.

After a document is approved or denied and the page is refreshed, the document will no longer appear on the Document Approval page.

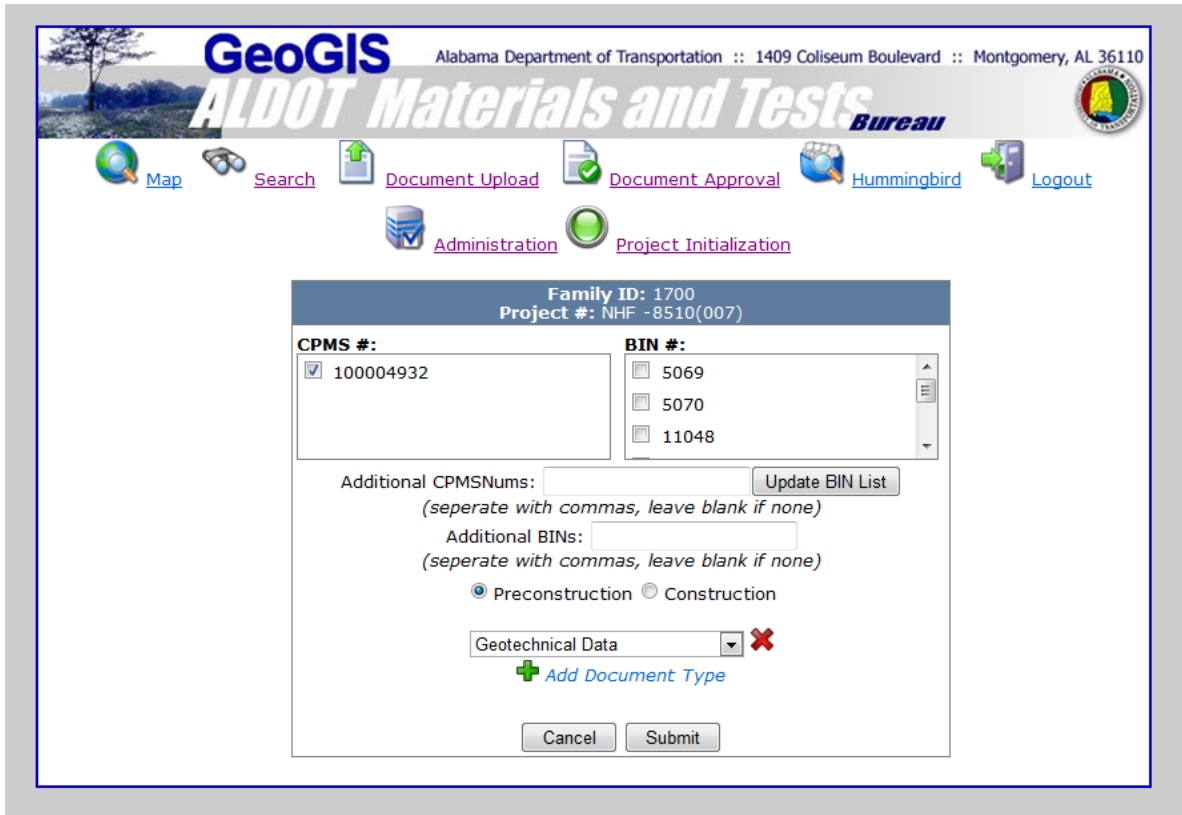


Figure A18 Document Edit Page

## 4.2 Project Initiation

The Project Initiation function is available to users with an ALDOT Engineer classification or higher. This page allows projects to be shown on the map, and enables documents to be uploaded to the project. When the engineer clicks the Project Initiation button the Project Search page shown in Figure A19 is displayed.

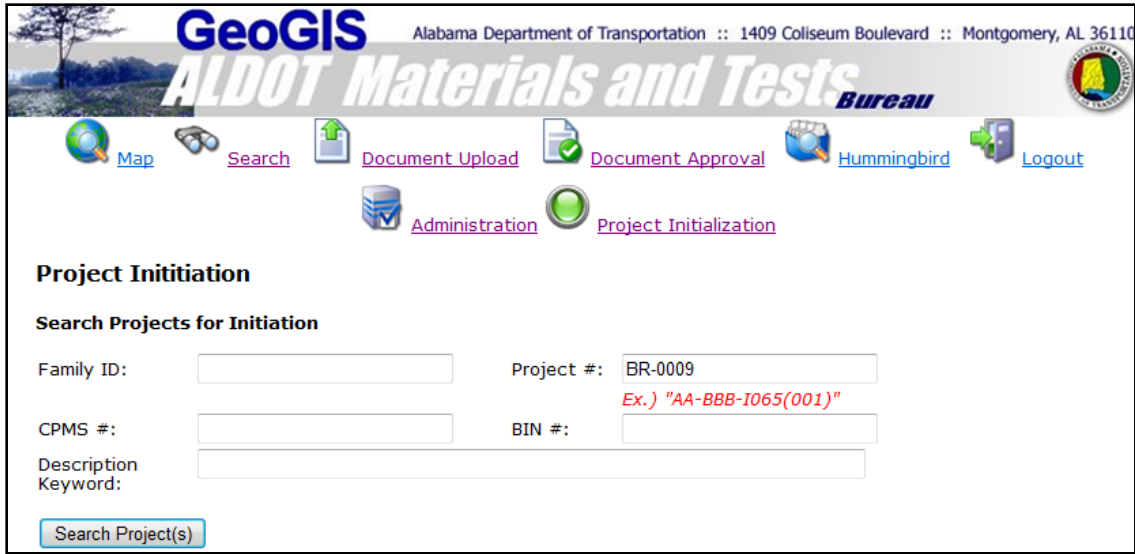


Figure A19 Project Search Page

The Engineer then enters all known information into the fields shown in Figure A19 and clicks the “Search Projects” button. All projects that match the information entered are compiled in the Project Search Results Page shown in Figure A20.

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**ALDOT Materials and Tests Bureau**

Map Search Document Upload Document Approval Hummingbird Logout

Administration Project Initialization

### Project Initiation

Family ID	Project #	CPMS #	Scope	BIN #	Description
<input checked="" type="radio"/> <a href="#">23136</a>	BR-0009	100041415	PE	2627	SR-9 REPLACE BRG BIN 002627, OVER LITTLE HILLABEE CREEK, 1.0 MILE SOUTH OF MILLERVILLE. (SUFF=19.5, STAT=SD, 2001 HBRRP LIST)
<input type="radio"/> <a href="#">23136</a>	BR-0009	100041416	CN	2627	SR-9 REPLACE BRG BIN 002627, OVER LITTLE HILLABEE CREEK, 1.0 MILE SOUTH OF MILLERVILLE. (SUFF=19.5, STAT=SD, 2001 HBRRP LIST)
<input type="radio"/> <a href="#">23276</a>	BR-0009	100041616	CN	2666	REPLACE BRG SR-9 BIN 002666, OVER CAHULGA CREEK, SOUTH OF I-20 NEAR BELLTOWN
<input type="radio"/> <a href="#">1240</a>	BR-0009(508)	100003725	CN	3411 18631	BIN #003411 BR REPL & APP ON SR-9 OVER TERRAPIN CR #9-10-7.4
<input type="radio"/> <a href="#">1240</a>	BR-0009(508)	100043496	RW	3411 18631	BIN #003411 BR REPL & APP ON SR-9 OVER TERRAPIN CR #9-10-7.4
<input type="radio"/> <a href="#">1047</a>	BR-0009(515)	100003145	CN	2110 2111 18577 18578	BR REPL ON US-331 AT BRANCH S OF SNOWDOWN BIN 002111 (CULVERT)
<input type="radio"/> <a href="#">1047</a>	BR-0009(515)	100038165	UT	2110 2111 18577 18578	BR REPL ON SR-9 (US-331) @ 2 BR S OF SNOWDOWN #9-51-15.9 & 16.0
<input type="radio"/> <a href="#">23276</a>	BR-0009(516)	100041643	PE	2666	SR-9 REPLACE BRG BIN 002666, OVER CAHULGA CREEK, SOUTH OF I-20 NEAR BELLTOWN (SUFF=11.9, STAT=SD, 2001 HBRRP LIST)

Figure A20 Project Search Results

After selecting the project to be initiated the Engineer then clicks the “Set Users” button. This takes the Engineer to the page shown in Figure A21 where users are assigned to the project. These users have the ability to upload documents to the project while others can only view the project. Once the engineer has assigned users to the project and clicks “Initiate” the project will appear on the map and be available for uploading documents. If users need to be added or edited the same process can be repeated and the engineer can then manage users for a project on the “Set Users” page.



Figure A21 Assigning Users to a Project

## 5.0 Administrator User Type

An administrator user has all the privileges available to an ALDOT Engineer, consultant, or a general GeoGIS user, plus many additional privileges. The main privilege of the administrator is the ability to create and modify user names, passwords, and user types. A GeoGIS user must contact the administrator to create a user name and password.

### 5.1 Administration Page

The Administration page allows an administrator a user friendly page to create and edit users. Figure A22 shows the Administration page.

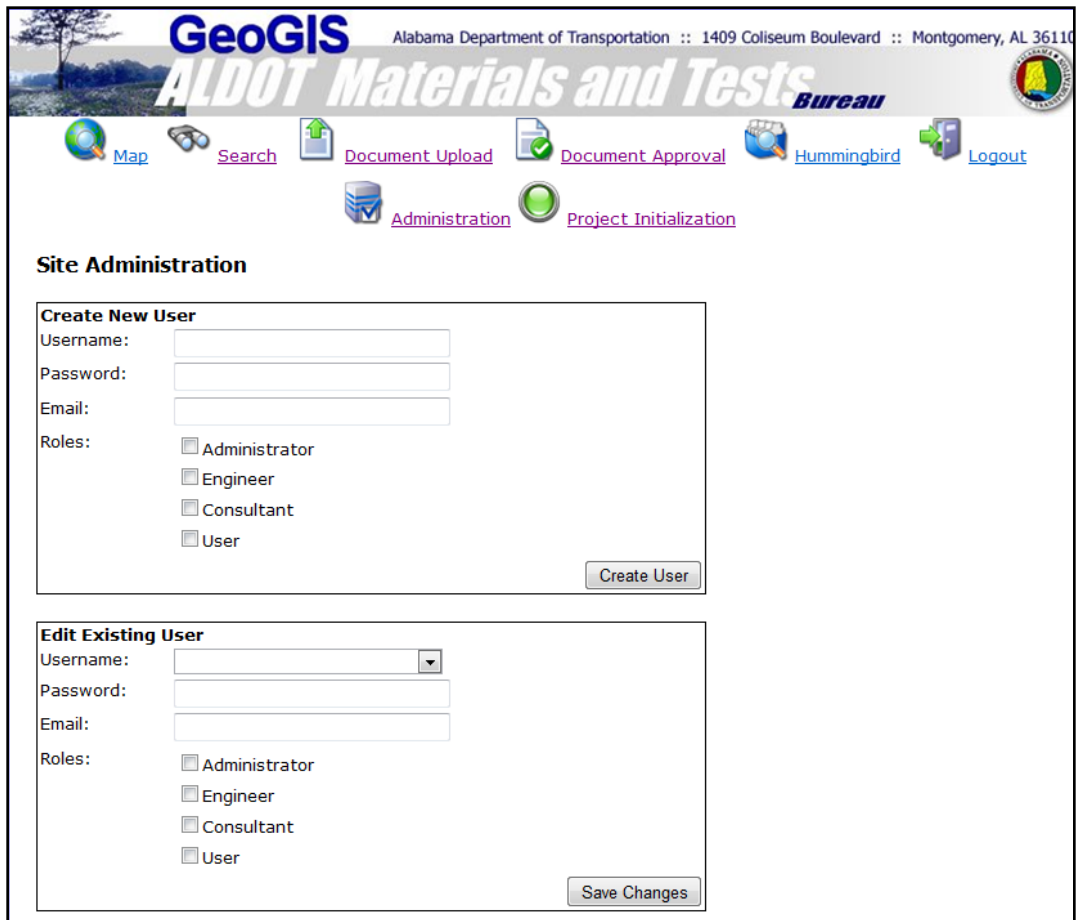


Figure A22 - Administration Page

The Administration page contains two sections that the Administrator can use to manage users. The first box, at the top of Figure A22, is used to create a new user. The Administrator will enter a user name, password, and user role; the new user must provide a valid email address. Once this information is entered, clicking the “Create User” button will add a new user to the GeoGIS system. The second box is for editing an existing user. The “Username” box is a drop-down box that lists the existing users in the system. The username cannot be edited, only the password, role, and email address of an existing user can be changed. To change a username, a new user must be created. Once changes to a user have been made, click the “Save Changes” button to save the changes.



## 5.2 Adding a Project to GeoGIS

This section describes the procedures to add a new project to the GeoGIS. Adding a project is sometimes necessary when the project in question does not exist in the CPMS table. The basic structure of the system and the programs that are needed for adding a new project are also described.

### 5.2.1 Structure of the GeoGIS

To add a new project to the GeoGIS both the database that stores the documents and attribute data, and the feature class in SDE that stores the project location, need to be updated. The database is an SQL database that is accessed through the Microsoft SQL Management Studio. Both the SQL Server and ArcGIS SDE need project records for a new project to be active. Once a project is active the project can be initiated at the project initiation page allowing the GeoGIS Map to display the project and documents to be uploaded to that project. Initiation is made possible through ArcGIS SDE. All shapefiles are stored in ArcGIS SDE and displayed on the GeoGIS Map through ArcGIS Server and Flex.

When a document is uploaded or a new user is created using the GeoGIS website, the website communicates with Microsoft SQL Server Management Studio. The SQL Server manages the tables that pertain to both GeoGIS users and the GeoGIS database. The SQL database stores GeoGIS tables including a copy of the CPMS projects table used by GeoGIS, the GeoGIS users and user types tables, and the uploaded and approved documents tables.

Although the SQL database is for attribute data management, the real power of the GeoGIS is the ability to display and search geotechnical data through a map interface. The GeoGIS map is managed, stored, and updated through a suite of GIS products produced by

ESRI. It was determined that desktop edits to features that exist in SDE, that in turn are automatically updated on the GeoGIS map interface was the most efficient way of managing GeoGIS. Both updating the SQL database and the GIS features are explained in the following sections.

### 5.2.2 Adding New GeoGIS Projects to the SQL Database

The SQL database contains a copy of the CPMS\_ProjectsLine table. This table currently contains approximately 10,000 records. The CPMS\_ProjectsLine table stores both recent and current ALDOT projects; therefore, most projects in the GeoGIS will be in the CPMS\_ProjectsLine table. Historic projects may not be in the CPMS\_ProjectsLine table and therefore may not be available to the GeoGIS. To check the CPMS\_ProjectsLine table for a project reference ID, open the SQL database with a database program and search the CPMS\_ProjectsLine table. This can be done with a standard SQL query:

```
SELECT * FROM [GeoGIS].[dbo].[CPMS_ProjectsLine]

WHERE pj_ref_id = "New GeoGIS Project ID";
```

This query tells SQL to “select *this* row and all columns from *this* table where *this* column is equal to *this* value.” Once the query is entered, simply click the execute button. If the project record exists in the database, then the project is available to accept GeoGIS documents.

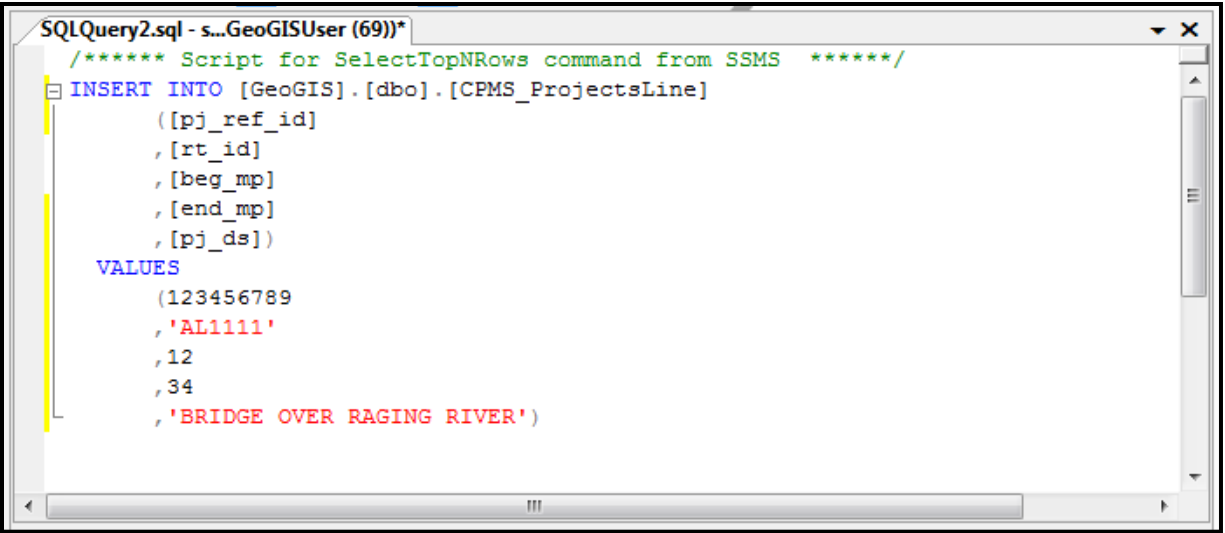
For projects that are not in the CPMS\_ProjectsLine table, a new record must be created. Most likely these are historic projects that do not have an official project reference ID or a new project that has not been assigned a CPMS number. At a minimum, five fields of data for a new project need to be inserted into the CPMS\_ProjectsLine table. These are shown in Table A2.

Table A2 - Required Fields for a New GeoGIS Project

Column Name	Column Description	Example
Pj_ref_id	Project Reference ID (a 10-digit number starting with 9000000...)	9000000009
Description	Description of project location	Bridge over Raging River
Rt_id	Route ID	AL1111
Beg_MP	Beginning mile post	111.1
End_MP	Ending mil post	112.0

By convention, new GeoGIS projects will be referenced with a pj\_ref\_id starting at 9000000000 and increasing in consecutive order. In this way, GeoGIS modifications to the CPMS data can be easily identified. The project description shown in Table A2 should be a written description of the project. The route ID and beginning and ending mile post data will be used to automatically create a line feature on the map at the correct location.

Once the attribute data for a GeoGIS project is determined, a record needs to be inserted into the CPMS\_ProjectsLine table. The “INSERT INTO” command will allow an administrator to insert a new record (i.e. project) into the database. Figure A23 shows the “INSERT INTO” command syntax.



```
SQLQuery2.sql - s...GeoGISUser (69))*
/***** Script for SelectTopNRows command from SSMS *****/
INSERT INTO [GeoGIS].[dbo].[CPMS_ProjectsLine]
    ([pj_ref_id]
    , [rt_id]
    , [beg_mp]
    , [end_mp]
    , [pj_ds])
VALUES
    (123456789
    , 'AL1111'
    , 12
    , 34
    , 'BRIDGE OVER RAGING RIVER')
```

Figure A23- Query Syntax for Inserting New Record in SQL

After the SQL command “INSERT INTO” shown in Figure A23, the user should specify the argument, which is “[GeoGIS].[dbo].[CPMS\_ProjectsLine]”, the database name and table name. The next several lines in Figure A23 are the column names, in parentheses and brackets and separated by commas. After the column names have been specified, the next line should read “VALUES,” followed by the data to be inserted into each column. Be careful to place each column value in proper order before executing the command. If any data is out of place, the location of the subsequent data will be incorrect. Character strings such as route ID and descriptions need to be in single quotes. Click the “Execute” button and the new record will be added to the CPMS\_ProjectsLine table. Simplification of this process will be performed during the transition phase.

### 5.2.3 Adding a New Line Feature to the CPMS\_ProjectsLine Shapefile

If a brand new project is being added, then the project line will not exist in the CPMS\_ProjectsLinefeature class in SDE. In this case, the project feature class can be edited to allow the feature to be drawn or created through a linear event. To draw on or edit a feature, the Editor

toolbar must be activated. Right-click in the tool space (the empty area next to the toolbars), and click the “Editor” label to activate the toolbar, a checkmark should appear next to the label. Once the Editor is activated, click the “Editor” button on the left side of the toolbar, and select the “Start Editing” command from the menu that appears. A dialog box appears that contains two boxes: the box on top contains all sources that are referenced by this map, and the box below shows a list of the features from each of the sources. Click on the source that contains the GeoGIS Project line feature, click OK, and then click “Start Editing”. The user is now in Editing mode. It is important that the Project line feature selected is the feature class that is located in SDE that is being used by GeoGIS.

On the ArcGIS map, locate the area where the project line will be drawn. Once the area is located and the project line is ready to be drawn, click the sketch tool button to begin drawing. Look at the Editor toolbar to be sure that the project shapefile name is in the “Target:” box. Since the shapefile being edited contains only lines, the drawing tool will automatically draw lines when editing this file. To draw a line, click the location where the line should begin. Then, digitize along the project path. Each click adds a point, and these points are connected by a line; therefore, the more points added, the more accurate the line will be, especially along curved sections. When the last point of the line has been placed, right-click on the map and then click “Finish Sketch” to end the drawing session. If a point is out of place, the point can be moved by double-clicking on the line, and simply dragging the point to a new location. When the edit is completed, click the “Editor” button and “Stop Editing.” A dialog will appear asking if the edits should be saved, click “Yes.” Figure A24 shows a line that has been drawn using the Editor toolbar.

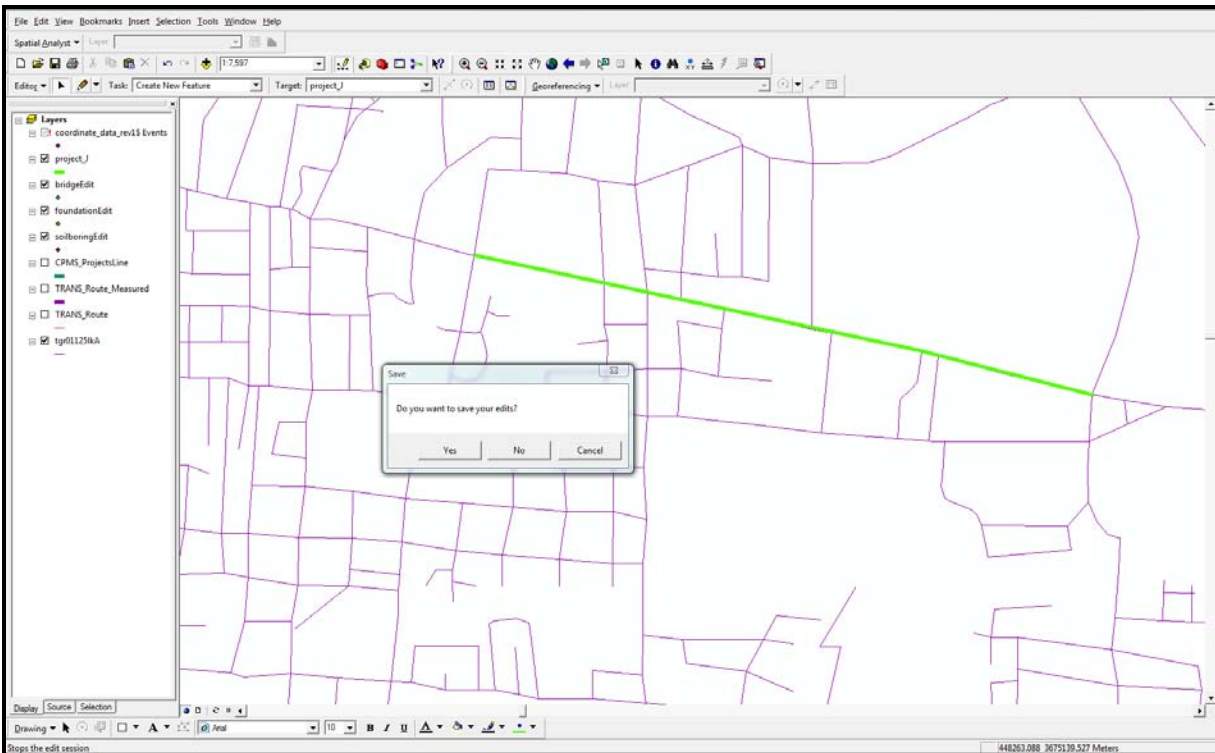


Figure A24 - New Line Drawn in the GeoGIS Project Shapefile Using Editing Session

If information for the route, beginning, and ending milepost is available for a new line feature, it may be more accurate to display linear events rather than drawing. To do this a database file will need to be created. One of the easiest options for creating this file is to use Microsoft Excel. Create an excel file with the column headings shown in Table A2. Enter the project information into the fields in the Excel table. This table can then be saved and added to ArcMap. Right click on the newly created database file and choose display route events. Specify the correct route shapefile, and the correct event table. Choose line events and use the beginning milepost as the from measure and the ending milepost as the to measure. Click OK to display the linear events. This new shapefile will then be appended to the CPMS\_Projectsline shapefile. To append the shapefile first launch the ArcToolbox application shown in Figure A25.

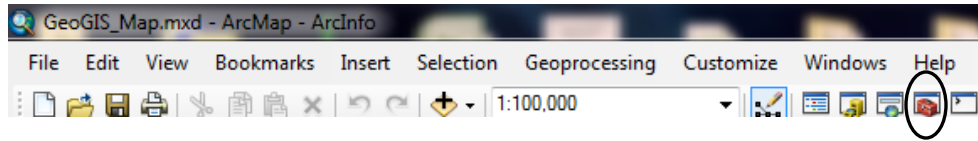


Figure A25 ArcToolbox Button

Click the plus sign beside “Data Management Tools” followed by the plus sign next to “General”. Double clicking on “Append” will launch the Append tool. Select the newly mapped linear event file for the “Input Dataset”, and the CPMS\_Projectsline file for the “Target Dataset”. Select “NO TEST” from the “Schema Type” dropdown menu and click the OK button. The new project is now included in the CPMS\_Projectsline shapefile. Since the shapefile has been altered it is necessary to republish the map to the web. Now that the new project exists it will need to be initiated at the Project Initiation page to be available on the map, and accessible to upload documents.

### 5.3 Appending Point Shapefiles

In addition to the project line shapefile, other relevant features may be added to the GeoGIS as well. These features include: bridge location points, foundation points, and soil boring points. It is important to note that when editing these features, the feature class being edited must be the feature class in SDE that is being used by GeoGIS.

Similar to the procedure to add a new project line discussed in the previous section, bridge points can be entered using the same procedure. A shapefile that locates every bridge in Alabama exists at ALDOT. Bridges from the ALDOT Bridge shapefile can be selected and appended to the GeoGIS Bridge shapefile following the same procedure used for appending the project lines. If the bridge cannot be located, then the user can edit the GeoGIS bridge shapefile, using the same edit procedure as discussed in the last section.

For foundation and soil boring points, the locations of these should be recorded in a file by the consulting firm that performed the work. These files should be in Excel format. Preferably, the coordinates for the individual points will be in the file in latitude-longitude format. If this is the case, the creation of the graphical points in ArcGIS is relatively simple.

The Excel file should have columns containing headings that specify which columns represent the latitude and longitude for the points. In ArcGIS, click “Tools” then “Add XY Data”. This will open a dialog as shown in Figure A26. At the top of the drop-down box, specify the location of the Excel file and which sheet in the file contains the coordinates. Specify the columns containing the X and Y coordinates of the points. If the columns are titled “Latitude” and “Longitude” or something similar, then those columns will be in the X and Y drop-down boxes. Be sure that the columns specified in these boxes are correct, X should be



longitude, and Y should be latitude. The coordinate system used by the map is GCS\_North\_American\_1983 and should appear in the coordinate description box. Finally, clicking OK will generate an event shapefile for the points.

The points will be added into ArcGIS as an “event” shapefile. This is a file that contains only the points that were just added. Since this is not the GeoGIS shapefile, these points need to be appended to the GeoGIS shapefile. Locate the “Append” command in the ArcToolbox under

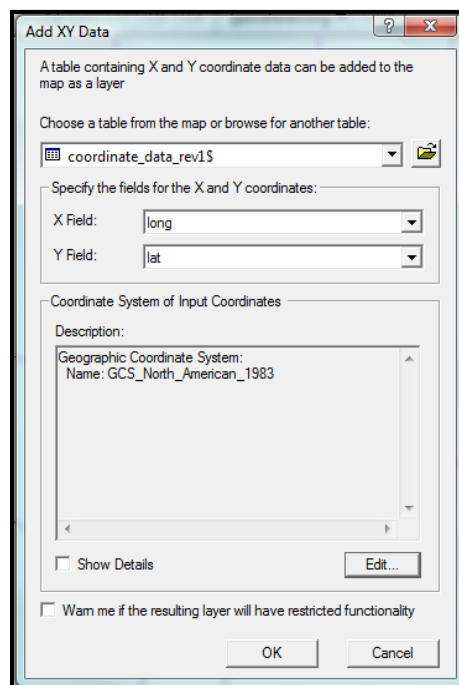


Figure A26 - Add XY Data Dialog Box

Data Management, then General, then “Append”, and enter the “event” shapefile as the input dataset. The target dataset will be the relevant GeoGIS feature class. Select “NO\_TEST” under “Schema Type” and click OK. Once the append command executes, the points will be a part of the GeoGIS feature class. If desired, the temporary “event” and export files can be deleted because the features are now located in the GeoGIS feature class.

Points can be added manually to the GeoGIS using the Editor toolbar if a file containing the coordinates does not exist. Be sure to select the correct GeoGIS shapefile when beginning an editing session and remember to save the edits. A frame of reference such as roads and rivers is not required when drawing new points, but existing spatial data will help improve accuracy.

Once the points are in the GeoGIS, depending on the way the points were added to the map, they may not contain the necessary attribute data to associate them with a specific project. To ensure points are associated with the necessary data, an Editing session should be started. In the edit session, the attribute table should be opened and the values of the records should be changed. Be sure to enter in all relevant data such as project reference IDs and BINs to match the information for that project. Once the new features have been added the map must be republished. It is important to note that new point shapefiles should not be added unless a project has previously been initiated.

### 5.3.1 Adjusting the Coordinate System

It is preferable to have a data file with coordinates in latitude-longitude format. However, some consultants may provide coordinates in northing-easting. If this is the case, the addition of points into the GeoGIS requires an additional step. The conversion from northing and easting to latitude and longitude is complex, so programs exist to automate the process. A program called Corpson6 created by the Army Corps of Engineers can be downloaded and used to convert coordinate data from one system to another. Corpson6 can be downloaded at:

<http://crunch.tec.army.mil/software/corpscon/corpscon.html>

The Corpscon file to be downloaded is called corpscon\_complete.exe. Install the application by following the on-screen instructions. After installing and starting Corpscon, the main Corpscon page will open as shown in Figure A27.

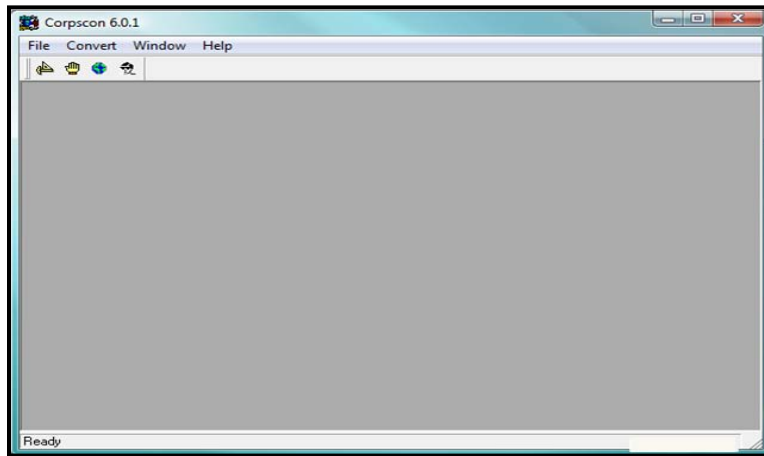


Figure A27 - Corpscon6 Program Opening Screen

From this screen, there are several options for converting points to a desired format. Northing and easting coordinates are in State Plane and need to be converted to Geographic format. To set up Corpscon for this conversion, click the “Setup” button in the top-left corner of the screen, beneath the “File” menu button.

Select the “Input/Output” tab, shown in Figure A27, on the Corpscon Setup page. The conversion is from State Plane to Geographic, so those should be selected for the input and output systems, respectively. The datum for each should be 1983 - NAD 83(86), unless there is a different datum specified. Other specifications for the input are: the zone, which in this example is Alabama West but may also be Alabama East depending on where the project is located; and the units, which should be US Survey Foot, unless otherwise known. Figure A28 shows how the Corpscon Setup page should look.

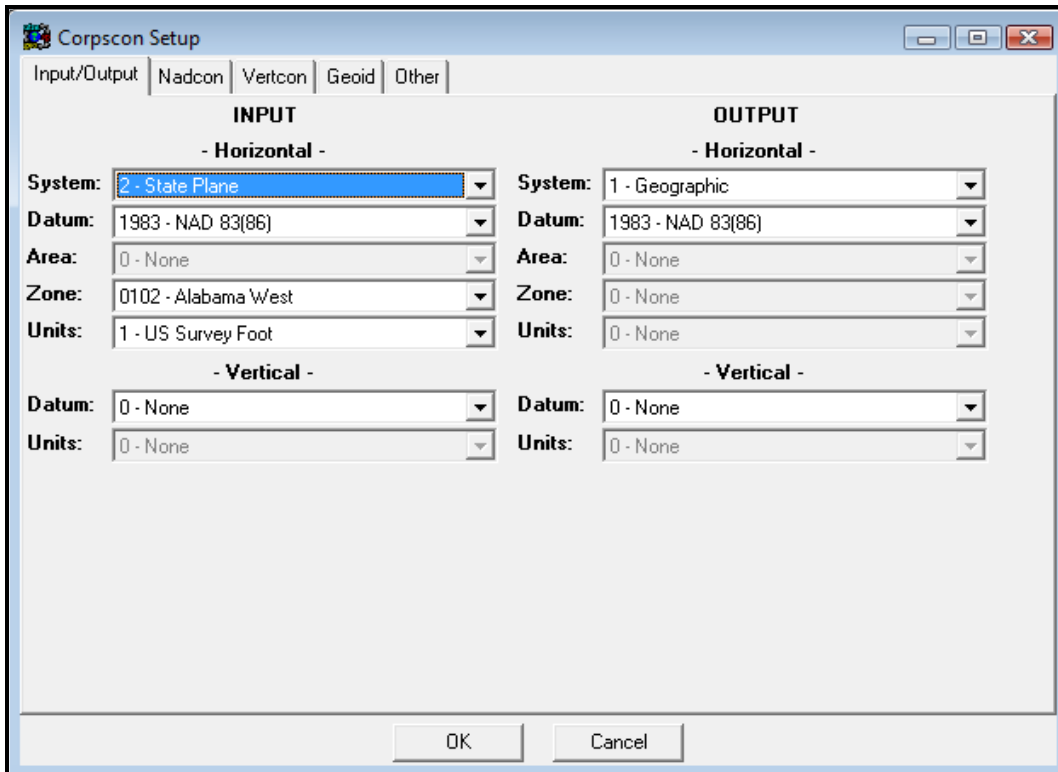



Figure A28 - Setup Page in Corpscon6

Once the setup has been completed, the Excel file containing the point coordinates must be converted into a text file because Corpscon cannot read an Excel file. To save an Excel file as text, open the Excel file, click “Save As”, and for the file type, select “Text” file, followed by “Save”. Close the file once it has been saved in text format. The coordinate file is now ready to be converted.

Click on the “Input File” button  in Corpscon to bring up the User Defined Input File page. This page requires an input text file and an output file. The output file can be the Excel file containing the Northing and Easting coordinates. The output will be in text format, but the output can be opened with Excel. Figure A29 shows how the User Defined Input File page should look when all input and output information is entered.

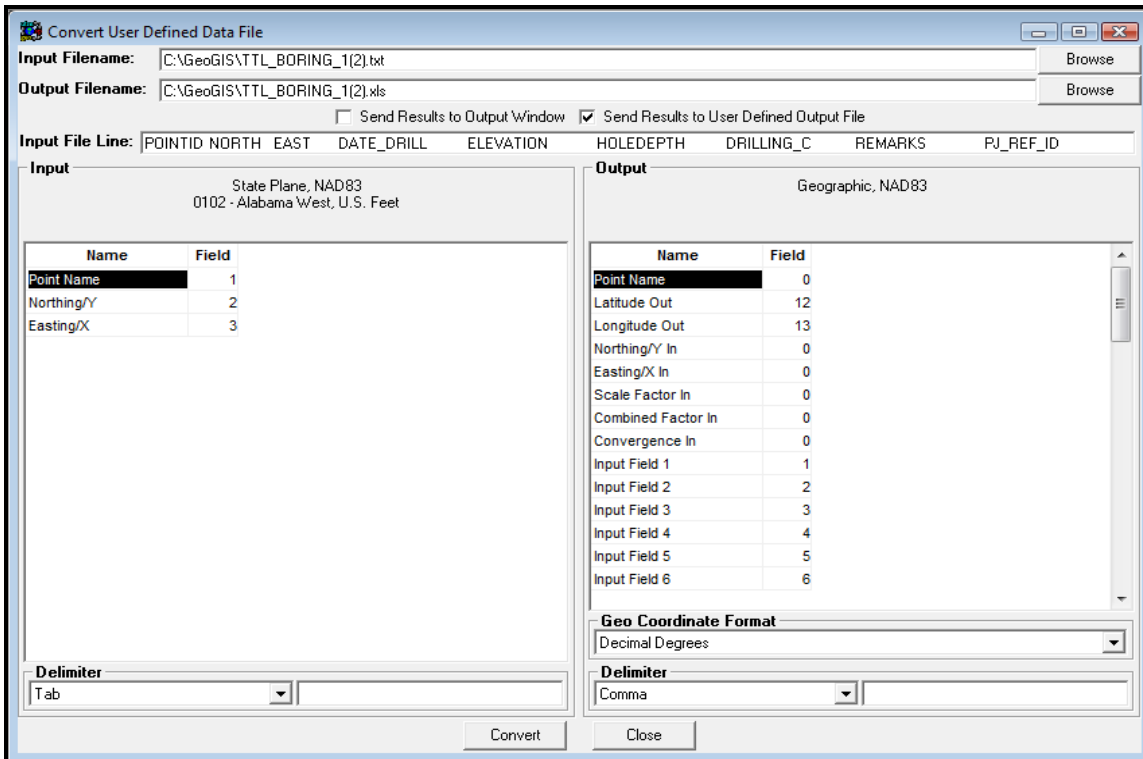


Figure A29 - User Defined Input File Page in Corpscon6

The top of the page contains an Input Filename text box and an Output Filename text box. For the Input text box, browse to the text file containing the coordinate information. For the Output text box, enter the Excel file as the output. Just beneath the Output text box, check the “Send Results to User Defined Output File” checkbox.

The Convert User Defined Data File dialog box has two main areas, the left is for the input fields and right is for the output fields. For both the input and output files there are two columns entitled “Name” and a second column entitled “Field.” For the input file side (left), the “Name” label represents the column name in the text file, and the “Field” is the numerical value for the column in the text file. The numbers assigned to these columns represent the order of the columns in the file. For example, in Figure A29, the “Point Name,” “Northing/Y,” and “Easting/X” columns are represented in the input file by the column names “POINTID,”

“NORTH,” and “EAST.” These are the first three columns in the file in that order, so the columns are given the values 1, 2, and 3, respectively. If the order or position of the columns is not known, the names are displayed just above the Input box in a textbox labeled Input File Line. In the example in Figure A28 the box contains the text “POINTID NORTH EAST DATE\_DRILL...” This is the order of the columns in the input file.

The right-hand box in Figure A29 is the Output file format with several rows in the box. The format is the same as the left-hand box, there are just more possibilities for the output file. Since the output file is the same Excel file that created the input text file, the output data will be appended to this file, and not replace the original data. The Corpscon6 program allows the user to “carry over” up to 50 user-defined fields. This is useful, because as long as the input file does not contain more than 50 columns, the new latitude-longitude coordinates can simply be added to the original table. In the example in Figure A29, the original Excel file had 11 columns, so the “Input Field 1” through “Input Field 11” will be the numerical values of these columns. The “Latitude Out” and “Longitude Out” columns will be given the subsequent values, in this case, 12 and 13. The rest of the columns should be left at zero unless other output information is desired.

Finally, the coordinate format and the delimiting criteria must be specified. The coordinate format should be Decimal Degrees, “Tab” should be selected as the input delimiter, and “Comma” should be selected as the output delimiter. The point coordinates data can now be converted.

Click the “Convert” button and a message box will appear stating that the output file already exists. It provides three courses of action: Append, Replace, and Cancel. Since all

columns were set up to “carry over” to the output file, click “Replace.” If everything was entered correctly, a screen will show up that says the conversion is complete.

Navigate to the Excel file, open the file, and click “Yes” when the dialog box appears. The text will be in a single column in the Excel file. To delineate the text, highlight only the first column, click the Data tab at the top of the page, and click the “Text to Columns” button. A window will appear asking how the data should be delineated; click “Next,” click the checkbox next to “Comma” and then “Finish.” The text will now be separated into columns. The column names for the latitude and longitude columns will be numbers, so change those names to “Latitude” and “Longitude.” Also, the longitude values should be negative so multiply the longitude values by negative one.

The coordinates are now converted from State Plane to Geographic format. This Excel file can now be used to input XY data into ArcGIS following the same procedure as described in the Appending Point Shapefiles section of this Users Guide.