

Date: March 30, 2011
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CC: Dr. Lu

TxDOT Culvert Inventory Geodatabase: Progress Report

Purpose Statement

The following report describes the progress of the Culvert Inventory Geodatabase by El Grupo de Alcantarilla (EGDA). Following the assignation of the project by Dr. Lu, the team began researching geodatabase design. In this report you will find information on the work that has been completed and the specific tasks that the group is currently working on. The report will describe the progress of the project and any issues or changes that have come up. Also, the report includes information on the final deliverables that will be submitted to the Texas Department of Transportation on the first week of May.

Background

The culvert inventory geodatabase is a project that involves designing a prototype geodatabase to catalogue small culverts that are excluded from the Bridge Inventory Inspection and Analysis Program (BRINSAP). The components of the project include a geodatabase, graphical user interface (GUI), and a user's manual for the geodatabase. The purpose of the project is to design a system where TxDOT maintenance workers can gather data on culverts and populate the geodatabase. Furthermore, the data inputted in the geodatabase will be able to be analyzed using ArcGIS or Microsoft Access. By developing a system of record keeping for small culverts, TxDOT will be able to improve road maintenance and the development of future projects.

Schedule

The project has three phases that will be completed by the project deadline

Data Collection and Interpretation (February 23-March 9): Collect data from TxDOT and other sources in order to start developing the conceptual design for the geodatabase.

The group will discuss the project with Dr. Kayser and the TxDOT maintenance office workers in order to determine any additional elements for the geodatabase.

Geodatabase Design (March 9-April 7): Develop the design for the culvert inventory geodatabase. Once the geodatabase design is complete, the group will develop the GUI. The functionality of the geodatabase and the GUI will be tested by populating the geodatabase with data from a road segment in Hays County, Texas.

Documentation and Final Deliverables (April 7-May 4): The group will complete the design of the geodatabase, GUI and the user's manual. The project materials will be turned in to TxDOT on May 6th after the final project presentation.

Data Collection and Interpretation

The following section is divided into two subparts:

- Needs assessment
- Create unique culvert ID

Needs Assessment

Work completed: Through a series of conference calls with you, we discussed the data definition and defined the attribute fields of the geodatabase. We discussed the TRM data and determined any additional sources of data that we needed from you to move forward in the project. On March 7th, the group met with Donald and Henry from the local Hays County TxDOT maintenance office. The group learned about the conventional methods of data collection used and we became familiarized with the forms the office uses to keep record of road features. The visit to the maintenance office was very helpful in getting an idea of what the GUI design should be like.

Work remaining: The group is completing the culvert inventory geodatabase and GUI; we plan on meeting with the maintenance office again to show them the work completed. Through this meeting the group will determine if needs of the maintenance workers have been met.

Create Unique Culvert ID

Work completed: It was determined that a unique identifier for each culvert feature (culvert ID) would need to be developed in order to allow for easier data management and functionality within a relational database model. The naming convention that we developed is based on the Texas Reference Marker System (TRM). Each unique ID is composed of the following elements:

Route prefix + Route number + Reference marker number + Distance of the feature downstream from the nearest upstream Reference Marker

An example would be: RM015004520.87

Work remaining: The IDs for each feature that will be used as an example will need to be entered into the geodatabase prior to the creation of the user's manual and the functionality testing.

Geodatabase Design

The following section contains three subparts:

- Development of conceptual/physical model
- Development of graphical user interface
- Functionality testing

Development of Conceptual/Physical Model

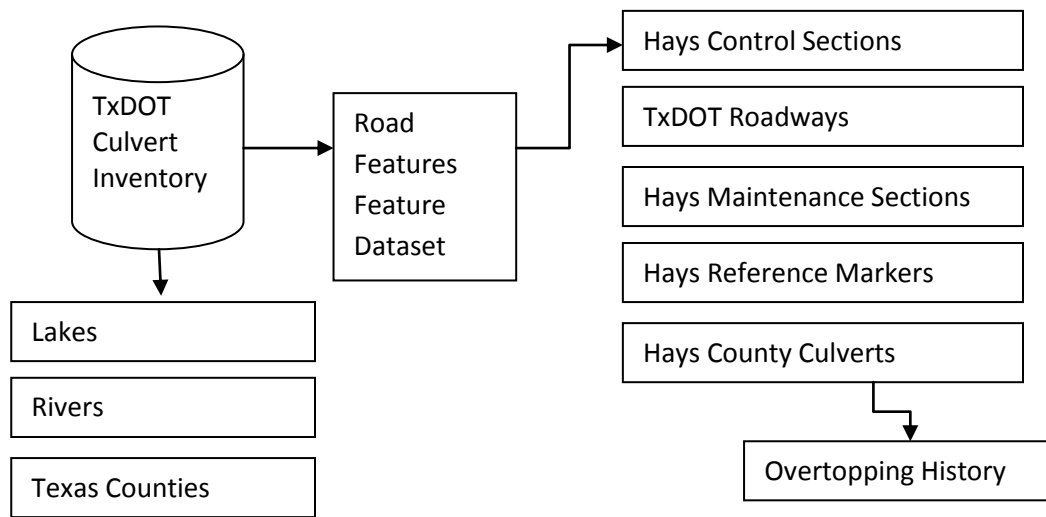
Work completed: The design of the geodatabase has been completed. The conceptual model was developed on paper and the structure of the necessary tables, data fields, and table relationships was determined at this time. A working prototype was then constructed in ArcGIS and the design has proven to be a success. The original data structure of the TRM data was maintained in the tables and new fields were created to reflect the attribute needs of TxDOT maintenance workers and hydrologists. Certain fields within the culvert features table were designed with coded domains to ensure data integrity and ease of use when data is being entered. As a user enters data into one of these fields, a dropdown menu will appear displaying only those values that may be entered for that particular attribute.

Work remaining: The handling of the photographs for each culvert feature is still in progress. We are in the process of researching best practices for image management within a geodatabase structure.

Below are screenshots showing the attribute table created for Hays County culverts:

OBJECTID	Shape	CNTY	HWY	REFNBR	REFDISP	RDBD	RWYCODE	RWYGRD	RWYSKEW	INTFTYPE	RWYNOTE	DFO	CSECT	MSCT	RTE_PFX_C	RTE_NBR	LATITUDE	LONGITUDE	CULVERT_ID	LENGTH	WIDTH	HEIGHT
17	Point M	106	RMO150	0452	0.67	KG	33	D	2100	73	3-30° P	4.57	119701	6	<Null>	<Null>	30.136831	-98.032505	<Null>	<Null>	<Null>	<Null>
18	Point M	106	RMO150	0470	1.28	KG	33	D	2100	73	3-42° P	23.19	80501	6	<Null>	<Null>	29.964831	-97.84998	<Null>	<Null>	<Null>	<Null>
49	Point M	106	RMO150	0460	0.46	KG	33	D	4100	73	24° P	12.65	80504	6	<Null>	<Null>	30.04635	-97.979948	<Null>	<Null>	<Null>	<Null>
50	Point M	106	RMO150	0464	1.98	KG	33	D	4100	75	18° P	17.68	80504	6	<Null>	<Null>	30.020311	-97.901174	<Null>	<Null>	<Null>	<Null>
53	Point M	106	RMO150	0462	0.86	KG	33	D	4100	73	24° P	14.75	80504	6	<Null>	<Null>	30.039901	-97.946181	<Null>	<Null>	<Null>	<Null>
55	Point M	106	RMO150	0450	1.98	KG	33	D	2100	73	24° P	3.98	119701	6	<Null>	<Null>	30.145591	-98.033362	<Null>	<Null>	<Null>	<Null>
72	Point M	106	RMO150	0458	0.21	KG	33	D	2100	74	24° P	10.2	119701	6	<Null>	<Null>	30.071387	-98.000829	<Null>	<Null>	<Null>	<Null>
83	Point M	106	RMO150	0472	0.5	KG	33	D	1115	73	2-30° P	24.33	80501	6	<Null>	<Null>	29.952446	-97.837404	<Null>	<Null>	<Null>	<Null>
87	Point M	106	RMO150	0472	0.39	KG	33	D	2100	73	2-24° P	24.23	80501	6	<Null>	<Null>	29.953625	-97.838387	<Null>	<Null>	<Null>	<Null>
94	Point M	106	RMO150	0466	0.76	KG	33	D	4100	74	24° P	18.66	80504	6	<Null>	<Null>	30.01241	-97.89182	<Null>	<Null>	<Null>	<Null>
95	Point M	106	RMO150	0462	1.64	KG	33	D	4100	73	24° P	15.53	80504	6	<Null>	<Null>	30.033421	-97.934839	<Null>	<Null>	<Null>	<Null>
96	Point M	106	RMO150	0456	1.86	KG	33	D	2100	74	24° P	9.65	119701	6	<Null>	<Null>	30.076296	-98.004078	<Null>	<Null>	<Null>	<Null>
129	Point M	106	RMO150	0454	0.49	KG	33	D	2100	73	24° P	8.48	119701	6	<Null>	<Null>	30.115593	-98.026118	<Null>	<Null>	<Null>	<Null>
133	Point M	106	RMO150	0452	0.67	KG	33	D	2100	73	48° P	4.66	119701	6	<Null>	<Null>	30.139639	-98.031922	<Null>	<Null>	<Null>	<Null>
134	Point M	106	RMO150	0456	0.58	KG	33	D	2100	73	24° P	8.57	119701	6	<Null>	<Null>	30.08763	-98.014665	<Null>	<Null>	<Null>	<Null>
162	Point M	106	RMO150	0458	1.87	KG	33	D	2100	73	24° P	11.87	119701	6	<Null>	<Null>	30.051062	-97.989022	<Null>	<Null>	<Null>	<Null>
163	Point M	106	RMO150	0464	1.69	KG	33	D	4100	73	24° P	17.6	80504	6	<Null>	<Null>	30.023096	-97.904594	<Null>	<Null>	<Null>	<Null>
166	Point M	106	RMO150	0450	1.72	KG	33	D	2100	73	3-30° P	3.72	119701	6	<Null>	<Null>	30.145556	-98.040189	<Null>	<Null>	<Null>	<Null>
168	Point M	106	RMO150	0450	1.33	KG	33	D	2100	73	24° P	3.33	119701	6	<Null>	<Null>	30.14366	-98.046347	<Null>	<Null>	<Null>	<Null>
174	Point M	106	RMO150	0470	0.45	KG	33	D	2100	73	42° P	22.37	80501	6	<Null>	<Null>	29.973191	-97.859776	<Null>	<Null>	<Null>	<Null>

LONGITUDE	CULVERT_ID	LENGTH	WIDTH	HEIGHT	DIAMETER	WATERBODY	DA	Tc	CN	RC	FLOW_DIR	MAT_TYPE	BARRELS	SFTY_RAIL	HEADWALL	WINGWALLS	SFTY_END_TRMT	CONDITION	MAINT_WKR	NOTES		
-98.032505	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	
-97.849956	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>
-97.979948	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>
-97.901174	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>
-97.946181	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>
-98.033362	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>
-98.000829	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>
-97.837404	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>
-97.838387	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>
-97.89182	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>
-97.934839	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>
-98.004078	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>
-98.026118	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>
-98.031922	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>
-98.014665	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>
-97.989022	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>
-97.904594	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>
-98.040189	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>
-98.046347	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>
-97.859776	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>

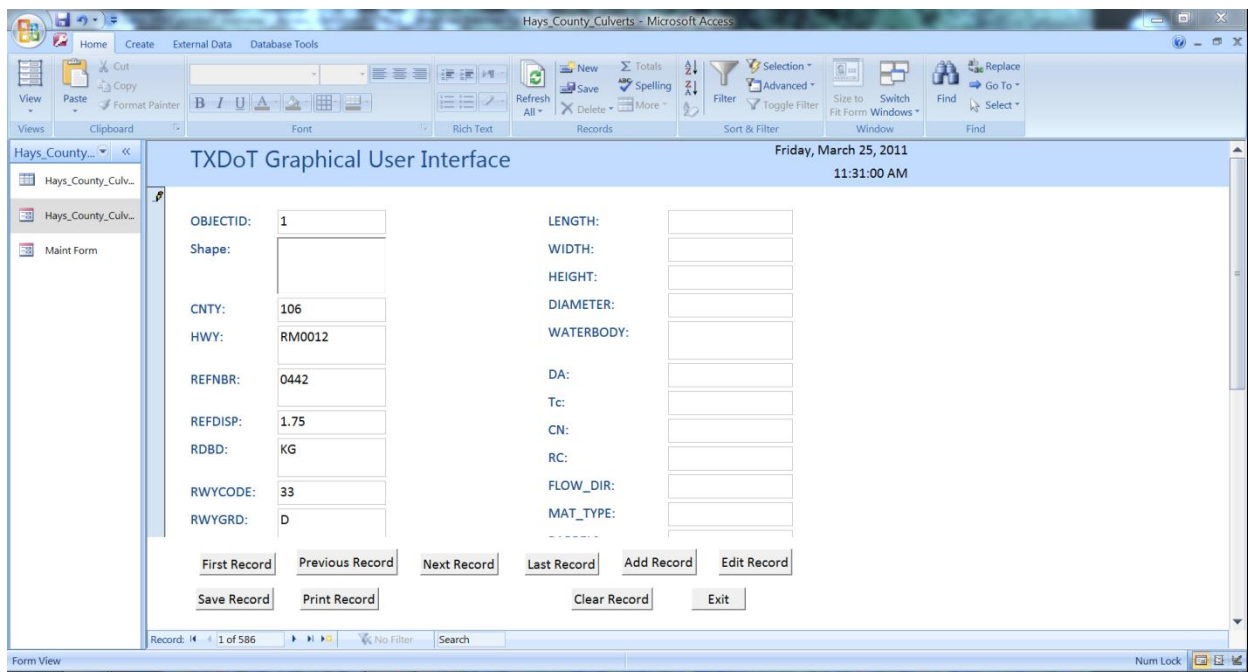


A figure showing the simplified geodatabase schema

Development of Graphical User Interface

Work completed: The design portion of the GUI is complete. We decided on creating two graphical user interfaces, one where the Hydrologist can add any data that they are interested in and another with data fields pertaining specifically to the maintenance department. Each Microsoft Access form will pull its own data from the same table. Figure 1 & 2 below shows a brief description of the respective GUI's.

Work remaining: The remaining work will consist of linking the Microsoft Access form to the geodatabase and finalizing the design.

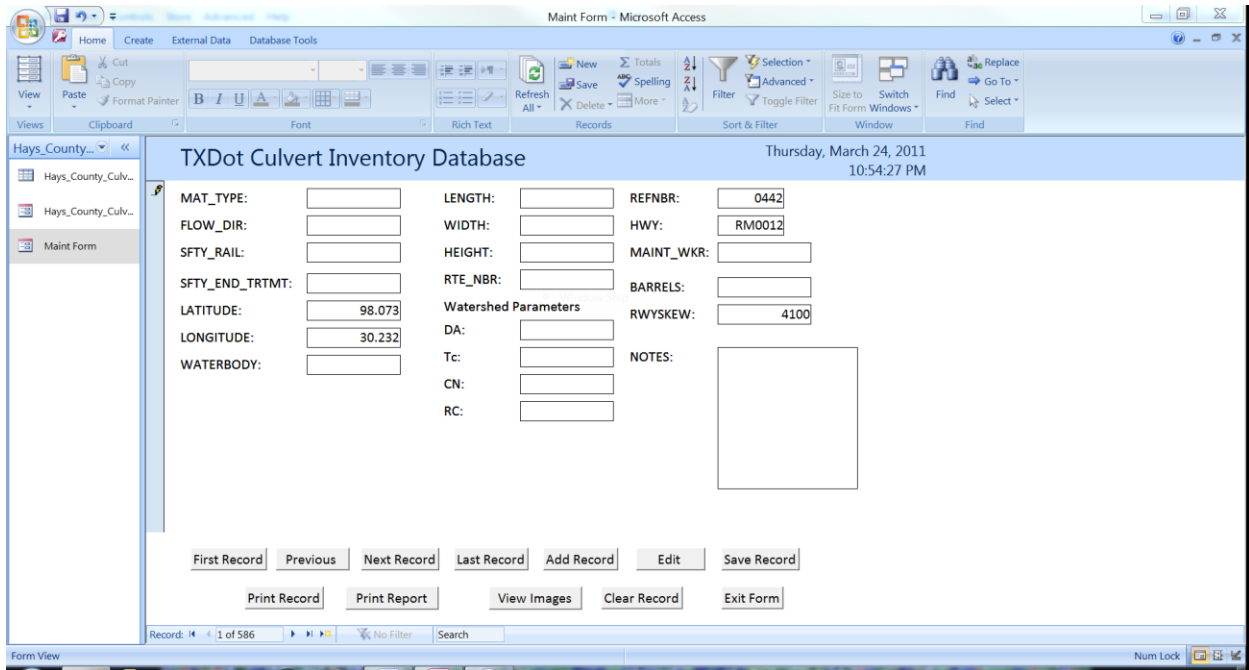


The screenshot shows a Microsoft Access form titled "TXDoT Graphical User Interface" in "Form View". The form is displayed within a window titled "Hays_County_Culverts - Microsoft Access". The interface includes a ribbon with tabs for "Home", "Create", "External Data", and "Database Tools". The main area contains a grid of data entry fields for various attributes. The current record is as follows:

Attribute	Value
OBJECTID:	1
Shape:	
CNTY:	106
HWY:	RM0012
REFNBR:	0442
REFDISP:	1.75
RDBD:	KG
RWYCODE:	33
RWYGRD:	D
LENGTH:	
WIDTH:	
HEIGHT:	
DIAMETER:	
WATERBODY:	
DA:	
Tc:	
CN:	
RC:	
FLOW_DIR:	
MAT_TYPE:	

At the bottom of the form, there are several navigation buttons: "First Record", "Previous Record", "Next Record", "Last Record", "Add Record", "Edit Record", "Save Record", "Print Record", "Clear Record", and "Exit". The status bar at the bottom indicates "Record: 1 of 586" and "No Filter".

Microsoft Access form showing the Hydrologist Interface



Microsoft Access form showing the Maintenance Interface

Functionality Testing

Work completed: At this time, the testing phase has not begun. It will begin as soon as we are able to obtain sample attribute data for our chosen route within Hays County. We have chosen to use RM 150 as the route on which to test the geodatabase.

Work remaining: The sample data for culverts located on RM 150 will need to be obtained and entered into the geodatabase through both ArcGIS and Microsoft Access. Next, we will test the functionality of the design to ensure that data entry and query functions operate properly and that data integrity is maintained throughout the model. It will also be necessary to confirm the positional accuracy of each culvert by analyzing orthoimagery and a further discussion with the local TxDOT maintenance office.

See figure on next page

The following map illustrates the positional correction process described in the *work remaining* paragraph of the functionality testing section.

Adjustment of Culvert Location on RM 150



Documentation and Final Deliverables

The following section contains three subparts:

- User's manual
- Final report
- Web design

User's Manual

Work completed: Work on this portion has not started.

Work remaining: We will create a manual that is a complete set of instructions on how to enter and edit data in the geodatabase; RM 150 will be used as an example. An attachment section will be added at the end of the user's manual on the description of each field in the database. The manual will be labeled with the description of each data field to avoid confusion by the user. It will explain how to use the GUI in Microsoft Access.

Final Report

Work completed: We have not started working on the final report at this stage of the project.

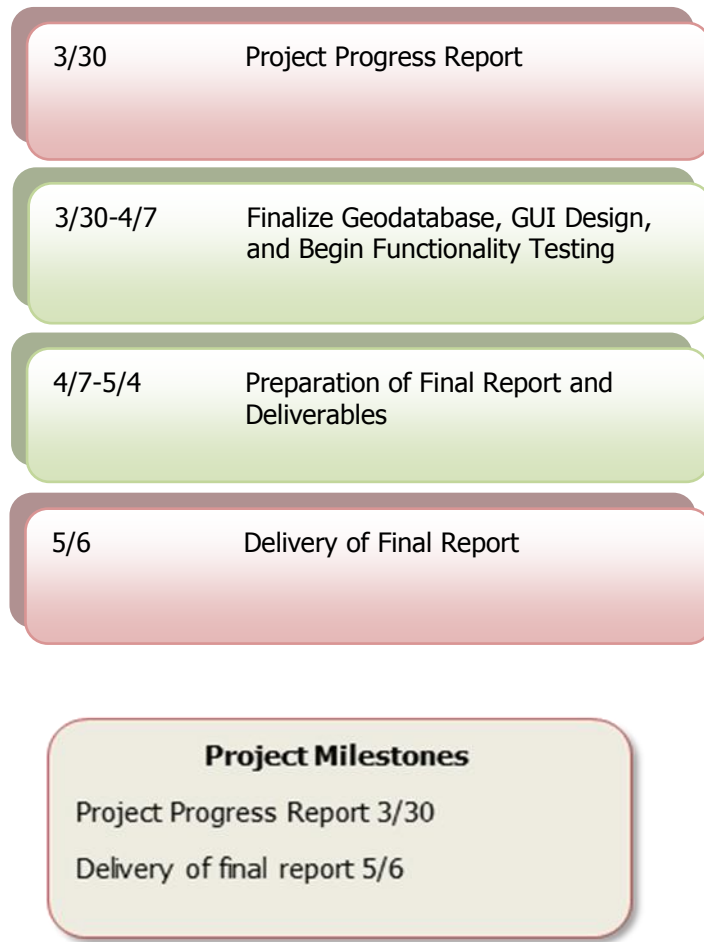
Work remaining: The team will generate a finalized report for TxDOT. The report will include a detailed methodology and future implications.

Web Design

Work completed: A template design has been selected for the web page.

Work remaining: Create a functional and user-friendly web page for all viewers. The group will determine the layout and necessary data to include for completion of the web page.

Project Timeline



Conclusion

The project is coming along quite well up to this point. We have not run into any unforeseen problems or issues and we have met all project milestones. Over the next several weeks we will complete all tasks pertaining to this project and will deliver the final product on the projected end date of May 6, 2011.