Existing Right-of-way Plats Database

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Existing Right-of-way Plats Database

Final Report

Prepared for

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The Maryland State Highway Administration

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16. Abstract

The Maryland State Highway Administration's Office of Real Estate processes a high volume of plat information and research requests on a daily basis. This is a lengthy process which is completed manually. The Office of Real Estate intends to improve the plat retrieval process by incorporating an automated system. A team of University of Maryland researchers developed a prototype system in which graphical plat queries may be conducted. In order for the graphical search to work, the four corner coordinates of each plat must be included in a database that is tied to this system. Currently, this information is missing. A solution is to geo-reference plats to an ArcGIS map. There are approximately 60,000 plats in the plat inventory which are currently in use at the Office of Real Estate which need to be geo-referenced in order for this system to be effective. Two sample sets of plats were given to the University of Maryland research team to estimate the time needed to geo-reference the entire set of plats.

University of Maryland researchers participated in several training sessions at SHA to learn about plat reading and the geo-referencing of plats. This information coupled with ArcGIS skills allowed two researchers to geo-reference two sample sets of plats that included a total of 281 plats. The following issues were encountered during the process of geo-referencing the sample plats.

- Some plat files were too old and showed areas have been changed
- Some plats lacked information on very short segments of road
- In some cases, there were errors in plat drawing
- Scale of ArcGIS and plat files were inconsistent
- In some cases there were multiple road segments in a single plat drawing

If the location of a plat could not be determined, it could not be geo-referenced. Of the sample set, a total of 255 plats could be geo-referenced. 56 plats could not be geo-referenced due to one or more of the issues noted above. Our conclusion from geo-referencing the sample plats is that it takes an average of 13.77 minutes to geo-reference a plat. Based on this experiment, the research team estimates that geo-referencing all 60,000 plats will require approximately 13,800 person-hours. If we only consider the time that it took to geo-reference the plats in the second set that was provided by SHA, the average time to geo-reference a plat was 10.77 minutes. This reduction in average time is a result of the experience gained andthe lessons learned from geo-referencing the first set of plats. Considering this shorter average time per plat the total person-hours required to geo-reference all 60,000 plats is estimated to be 10,800.

The research team also investigated two systems that are currently in use in SHA in an effort to explore the possibility of integrating the Real Estate plat database in these systems. The Office of Real Estate Management System (OREMS) is a database

system which is used as an online organization tool for Maryland State Highway Administration's Office of Real Estate. The website includes a plat query database currently used to keep a record of plats, but not to locate plats. The database offers a text based query for a Plat Search, Project Search, and Property Search. The system does not currently have a graphical query capability. A number of suggestions are made in this report to enhance the current search engine. In an earlier effort, a team of researchers of University of Maryland developed an automated prototype system which has graphical query capability. So, a link between OREMS and this system must be established. With a few moderate changes, the system would be compatible with the SHA system.

The State Highway Administration Web Mapping Engine (SHAWME) is an application used to research geographical data in the state of Maryland. Current GIS data is available on this web-based application. The Office of Real Estate rarely uses SHAWME because plats are not included in the system. After exploring the SHAWME system in great depth, suggestions are made to integrate the prototype system that was developed in the University of Maryland earlier efforts with the GIS layers that are available in SHAWME and the plat database in OREMS. Completion of this integration along with completion of geo-referencing of the 60,000 plats will enable SHA Office of Real Estate personnel to access the full capabilities of the prototype system developed by the University of Maryland including the text based and graphical queries, plat search and plat retrieval and display.

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Table of Contents

List of Tables

List of Figures

Executive Summary

The Maryland State Highway Administration's Office of Real Estate processes a high volume of plat information and research requests on a daily basis. This is a lengthy process which is completed manually. The Office of Real Estate intends to improve the plat retrieval process by incorporating an automated system. A team of University of Maryland researchers developed a prototype system in which graphical plat queries may be conducted. In order for the graphical search to work, the four corner coordinates of each plat must be included in a database that is tied to this system. Currently, this information is missing. A solution is to geo-reference plats to an ArcGIS map. There are approximately 60,000 plats in the plat inventory which are currently in use at the Office of Real Estate which need to be geo-referenced in order for this system to be effective. Two sample sets of plats were given to the University of Maryland research team to estimate the time needed to geo-reference the entire set of plats.

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Project Description

Office of Real Estate (ORE) within Maryland State Highway Administration (SHA) processes a high volume of plat information and research requests on a daily basis. This is a lengthy process which is completed currently manually. The typical turnaround time for such a research request ranges from two to eight weeks. The ORE intends to establish a computerized system that can automate and hence speed up the plat retrieval process. In earlier phases of this project, a team of University of Maryland researchers developed a prototype system that allows a user to conduct plat queries graphically. The current phase of the project which is covered by this report focused on investigating the enhancements that need to be made to SHAWME and the OREMS database in order to integrate the prototype system developed by the University of Maryland with these systems to address the ORE needs. As part of this project the research team was also required to geo-reference 100 plats selected by the ORE personnel from different years and assess the time requirements for geo-referencing all existing plats.

An automated plat retrieval system requires each plat to include all four corner coordinates in the database. Plats issued after 2006 have coordinate information labeled on the plat image file, but these coordinates are not recorded in any database. Older plats do not have any coordinate information at all. Plats which are geo-referenced to an ArcGIS file can be located with the prototype system. Geo-referencing 60,000 plats is a large undertaking for which time and budget must be considered. The University of Maryland research team used a sample of 281 plats to estimate the time required to geo-reference the 60,000 plats and add them to the database. While originally the requirement was to geo-reference only 100 plats, through the process we concluded that it was best to geo-reference additional plats after gaining experience with the geo-referencing process to have a better estimate of the time required.

In order to implement the prototype system that was developed in earlier phases of the project, an in depth knowledge of the current State Highway Administration programs is necessary. The programs of interest are Office of Real Estate Management System (OREMS) and State Highway Administration Web Mapping Engine (SHAWME). To complete this project, University of Maryland researchers received training from SHA personnel. The researchers explored the OREMS and SHAWME test sites remotely, using a VPN client to gain access. Recommendations are made to facilitate the integration of the prototype plat retrieval system with OREMS and SHAWME effectively.

Plat Geo-referencing

1. Introduction

Maryland's Office of Real Estate database contains approximately 60,000 plats and this number is growing. Currently, any plat needed is found by hand, a time-consuming and error-prone process. A research team from the University of Maryland developed an automated computerized system that locates plats based on a graphical query input. This computerized system requires every plat to have coordinates on all four corners. Unfortunately, the vast majority of plats do not have these necessary coordinates.

Once a plat is geo-referenced to an ArcGIS file, it can be retrieved through the automated computerized system. In order to predict the time required to geo-reference all 60,000 plats in the database a set of sample plats was examined. Two persons worked with 281 sample plats within the state of Maryland. The first set included 104 plats from Baltimore County. The research team, SHA ORE personnel and the SHA project Manager concluded that a better time estimate could be obtained if additional plats were geo-referenced. Subsequently, a set of 177 additional plats were geo-referenced. The time spent processing each plat was recorded, whether or not the geo-referencing process was successful. If the research team was not able to geo-reference a plat, the reason was also noted. By analyzing the time required for geo-referencing each plat and the total time required for all 281 plats, we were able to estimate the total time required for geo-referencing all 60,000 plats relatively accurately.

2. Training Sessions

Two members of the University of Maryland research team participated in various training sessions that were conducted by the SHA personnel. The first one was conducted on Monday, March 9^{th,} 2009 was conducted at the SHA Headquarters by Mr. Carl Henderson, SHA GIS specialist who trained the University of Maryland personnel on geo-referencing. Mr. Henderson demonstrated the geo-referencing process step by step for plats with latitude and longitude coordinates. The trainees repeated the process, asking questions to clarify each step, while Mr. Henderson offered recommendations. Hadi Sadrsadat and Ms. Heather Smith attended this session.

The second training session was held on 20 March 2009 at the SHA Glen Bernie Shop. This training was focused on plat reading. The plat reading class was presented by the Maryland Office of Real Estate. This introductory class provided a general overview of basic plat reading skills. Topics included interpreting an engineering scale, identifying different types of land acquisition, understanding station numbers, centerlines, and offset terms, and reading symbols on plat drawings. Ms. Heather Smith attended this session.

Finally on 11 June 2009 at SHA Headquarters, SHA plat Real Property Specialist, Mr. Jim Engle, conducted a training session for Hadi Sadrsadat and Heather Smith. Mr. Engle defined key elements relevant to all plats. The most significant elements include the base line of right-of-way, reference block, match line, offset lines, equality stations, right-of-way line of through highway, acquisition data, and easements. He also showed the trainees the location of all plats on file and the master plat files.

3. Geo-referencing

The methodology of geo-referencing that was followed to geo-reference 281 sample plats is described as follows:

1. Open Arc Map.
2. Open geo-referencing tool bar.
3. Add plat file (in TIF format) to geo-reference and record start time.
4. Find the location of the plat file by county.
5. Add appropriate county ArcGIS file.
6. Find the location of the plat file on the ArcGIS file. This step is typically the most time consuming because older plats are hard to read.
7. Find common features between the plat file and the ArcGIS file. These common features include but are not limited to intersections, rivers, road shape, and road centerlines. Figure 1.1 shows this step.

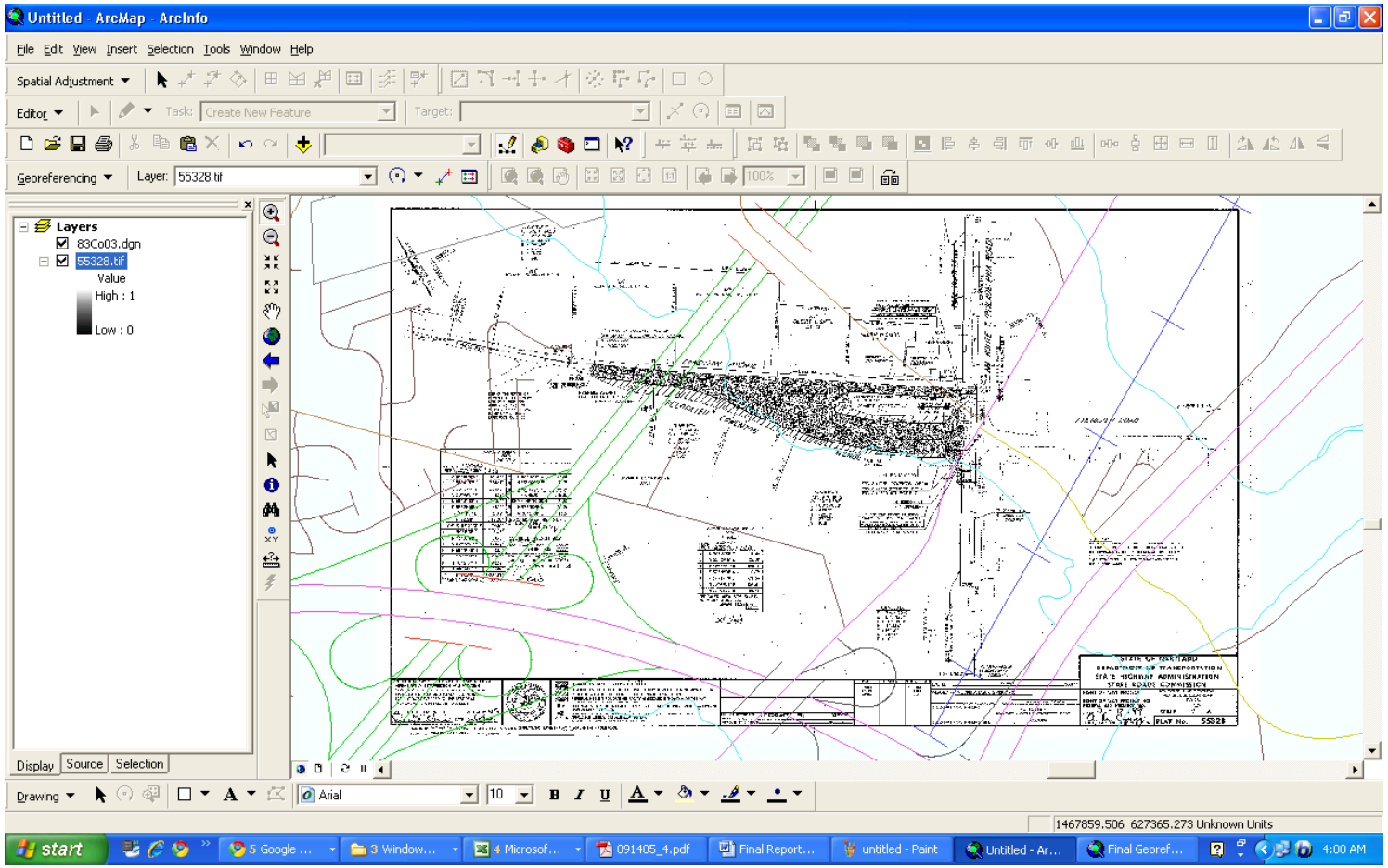


Figure 1.1

Step 7 in geo-referencing

8. Click on a feature of the plat using ‘add control point’. Then Click on the same feature/element on the ArcGIS file. This step is shown in Figure 1.2.
9. Repeat steps 7 and 8 for at least four common points. Figure 1.3 shows this step of the process.
10. Check if the residual value in the link table is less than 1 for all points. If it is greater than 1, delete the largest residual value point and geo-reference another point until all values are as close to 1 as possible. This step is shown in Figure 1.4.
11. Click ‘rectify’ and save it as a TIF file and record end time. Figure 1.5 shows this step. Figure 1.5 depicts this step.
12. Re peat steps 3 though 11 for each plat.

Two sample plat sets were used in the geo-referencing process to accurately estimate the time required for geo-referencing 60,000 plats. The first set of plats was composed of 104 plats all within Baltimore Country. They covered MD 7, MD 45, MD 128, MD 144, MD 147, MD 588, US 40 and US 1. Having a set of plats from the same county speeds up the geo-referencing process because in steps 4 and 5, finding the county to which the plat belongs and adding the appropriate ArcGIS file, does not need to be repeated for every plat. However, the time required for geo-referencing the first set of plats also accounts for the lack of experience of the researchers and the time required for learning and mastering the process.

The second set of 177 plats was from a range of Maryland counties. Many of the plats were sequential or from the same project. Since many of these plats were in different counties, finding the correct county in the ArcGIS file required additional time for geo-referencing, however further training, experience and logical plat order helped reduce the overall time required for geo-referencing these plats.

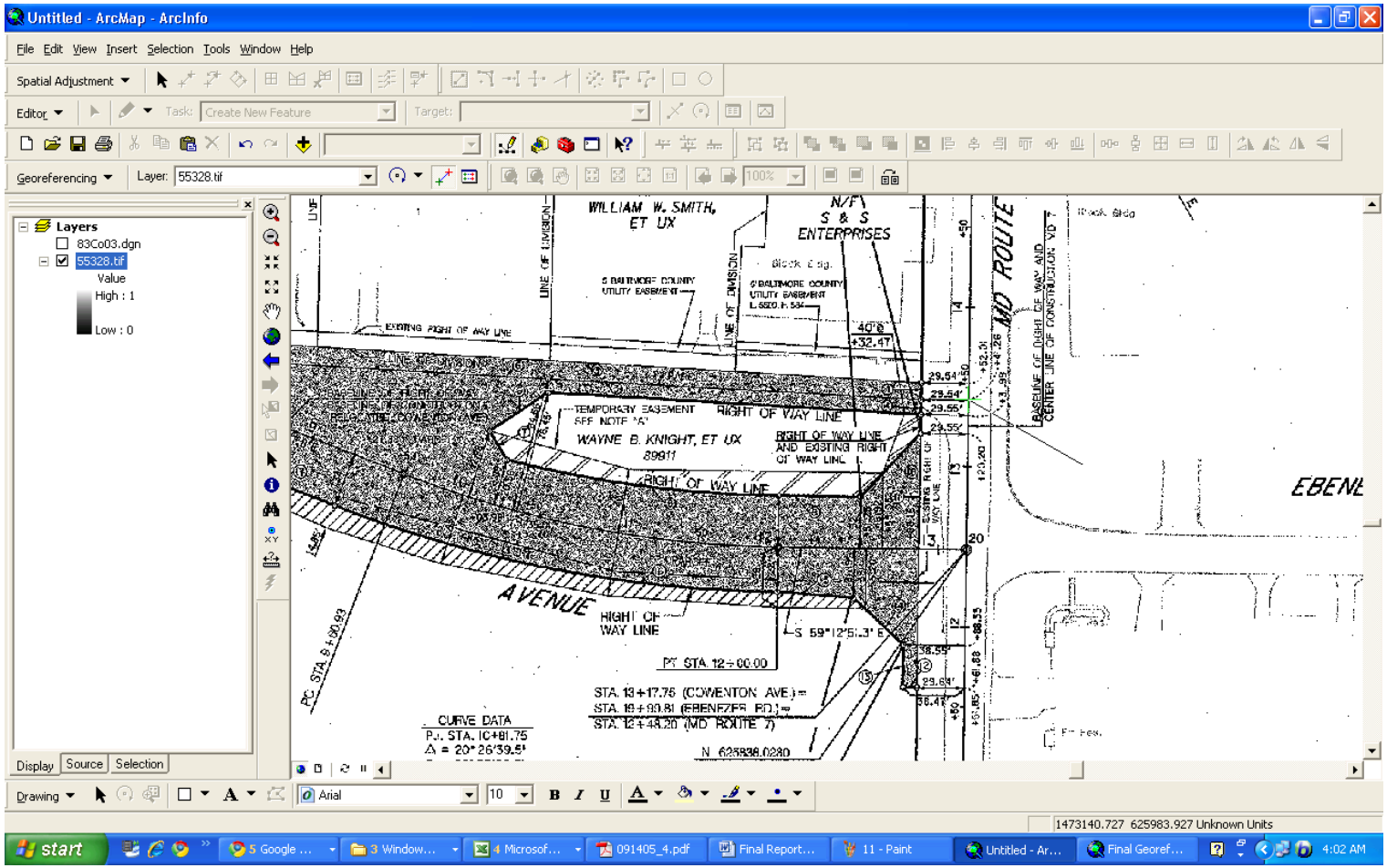


Figure 1.2

Step 8 in geo-referencing

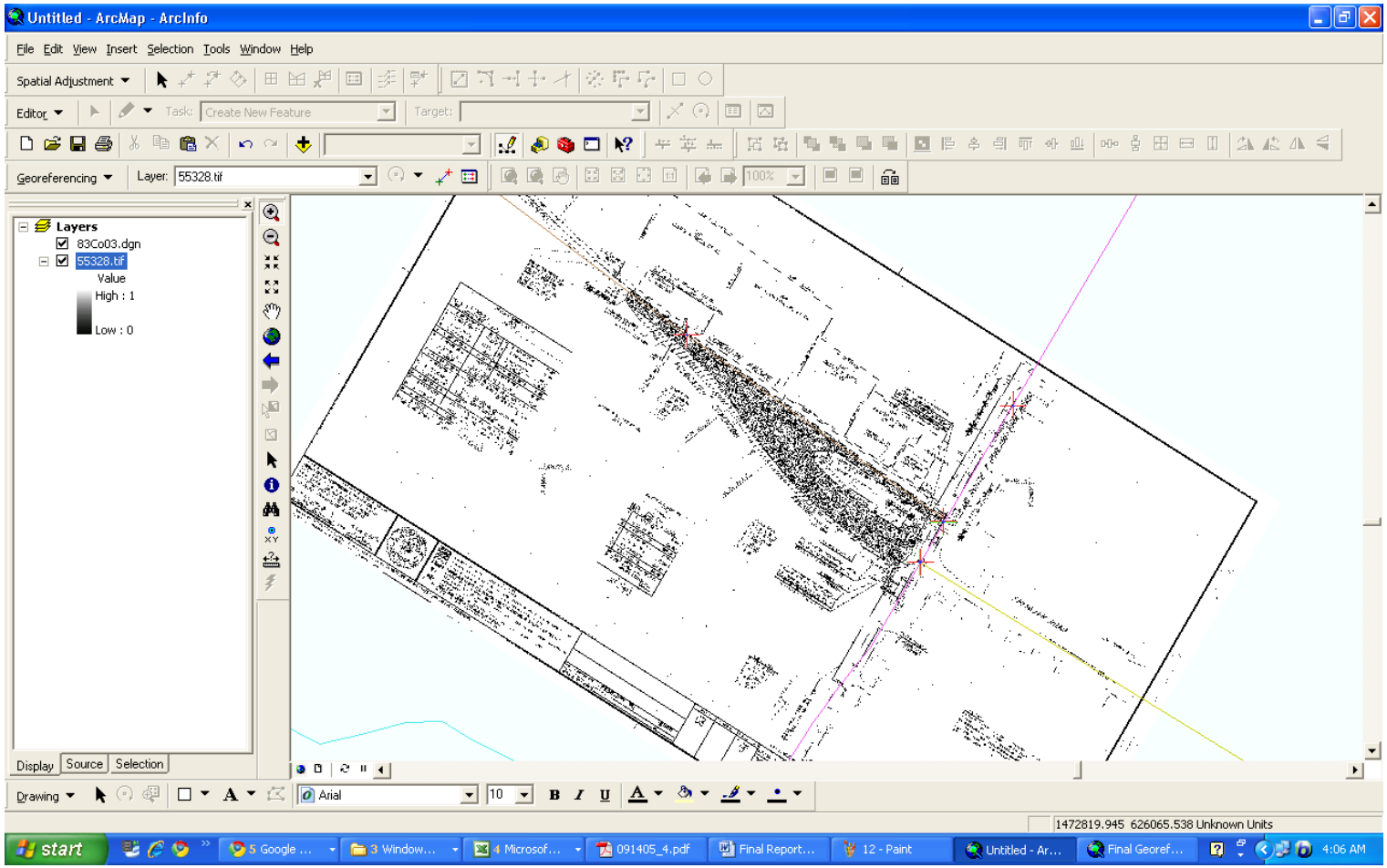


Figure 1.3

Step 9 in geo-referencing

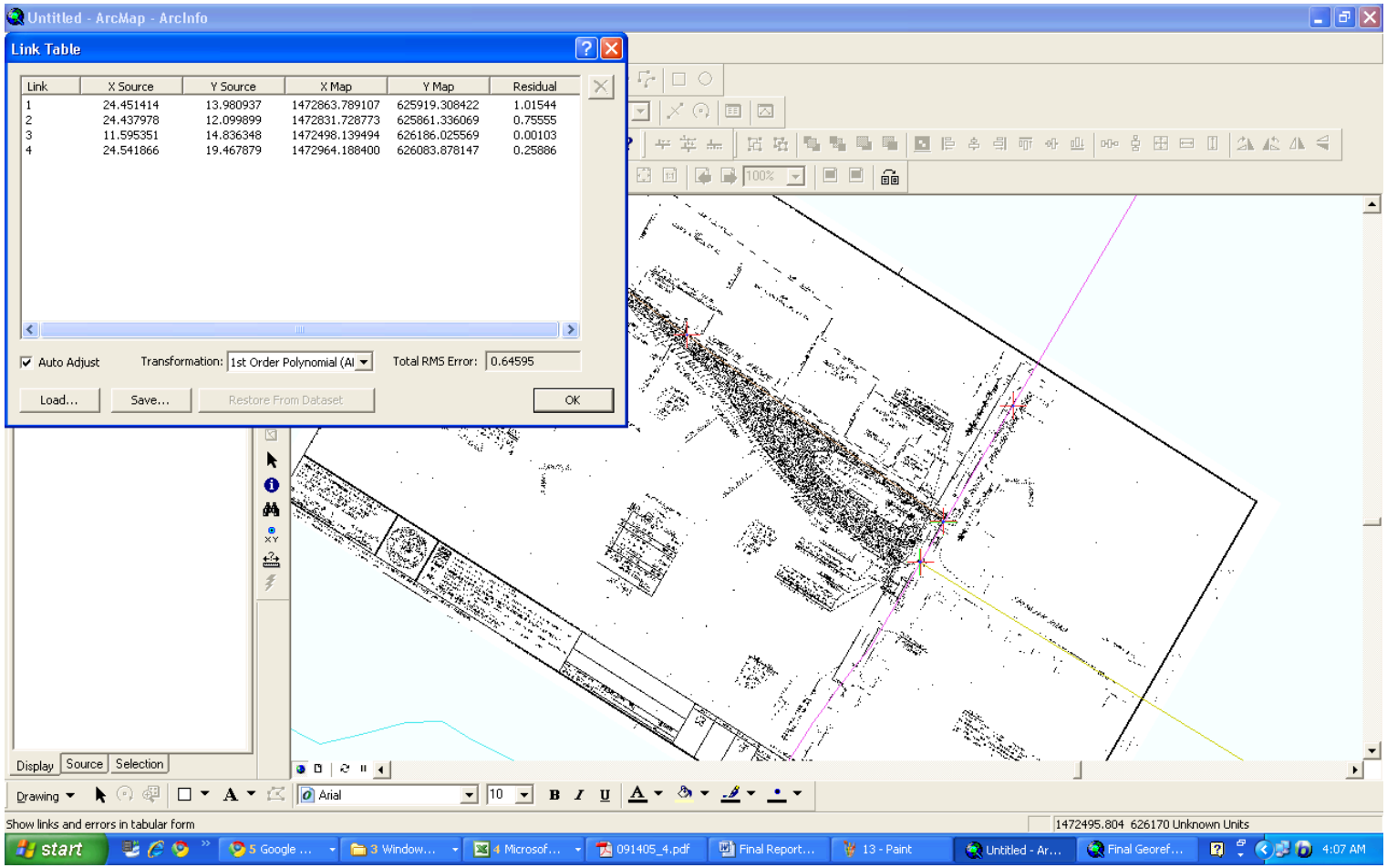


Figure 1.4

Step 10 in geo-referencing

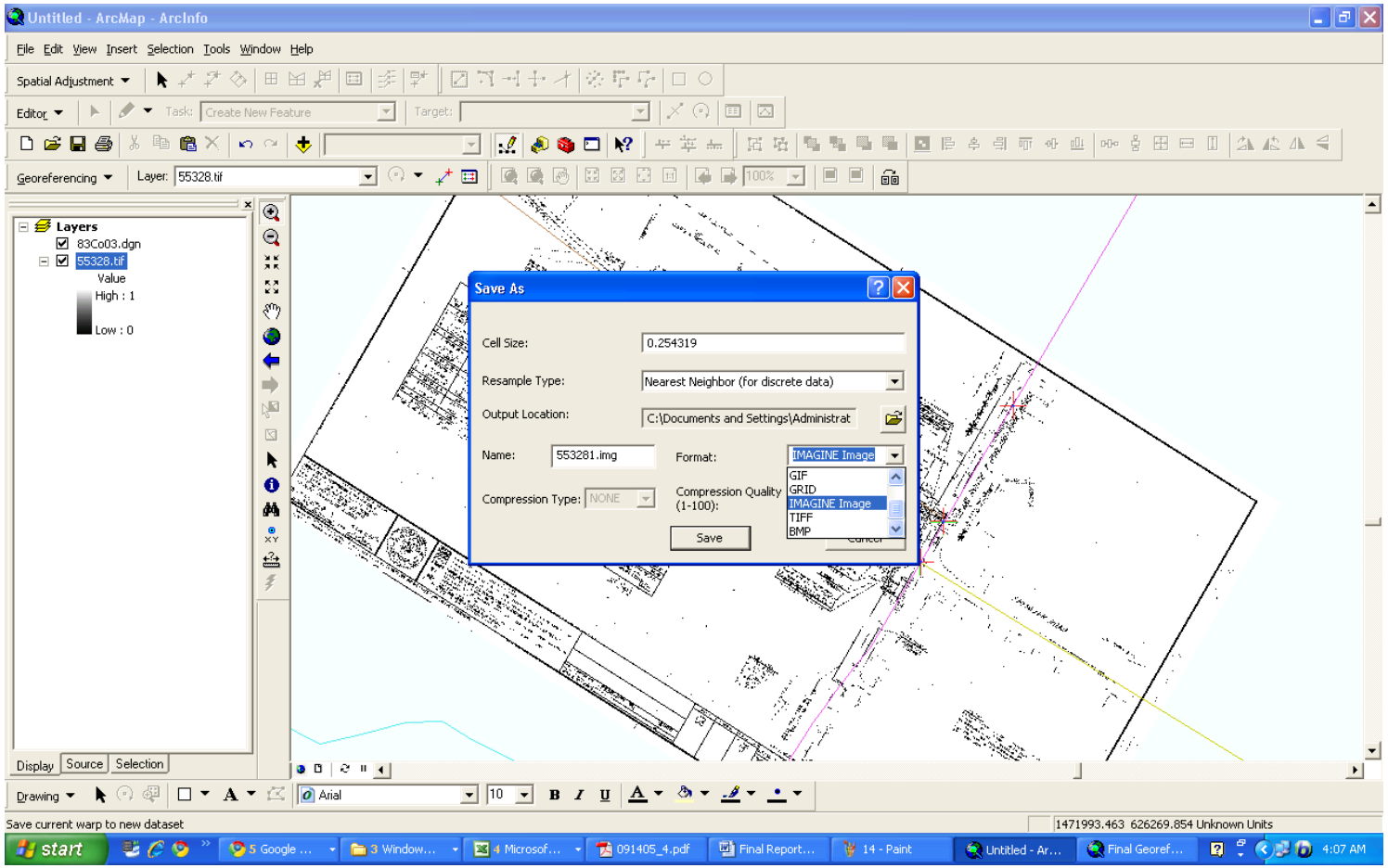


Figure 1.5

Step 11 in geo-referencing

4. Problems Encountered

Five types of problems were encountered during the geo-referencing process. These problems are summarized below.

4.1. Age of the plat file

Some plats were drawings of roads that no longer exist, or drawings of roads for which the road alignment has changed completely. When a few similarities were detected, the plat could be geo-referenced by making some assumptions. However, when everything is different it is impossible to determine the correct location of the plat. For instance, Figure 1.6 shows one plat file issued in 1947. Figure 1.7 shows the same area which exists in the current ArcGIS file. As the figures indicate, there is no loop on the plat file, whereas there are four loops in the ArcGIS file.

Information can be found on plat drawings titles. This gives information for earlier plats over the same area. If the research team had access to all plats in the database, rather than the limited sample, this information possibly could have been used to help located difficult plats.

4.2. Lack of information on a very short segment of road

Some plats did not have any intersecting roads or other distinguishable elements to determine a common feature between the plat and the ArcGIS file. If the plat was short and isolated, it was often impossible to accurately geo-reference. Most of these plats are single property plats. For instance, in Figure 1.8 the plat file only shows the property and does not have any other information that helps find its location. Also, in Figure 1.9 there are three streets to help finding the location, yet all of them are private roads and we cannot be found in the ArcGIS file.

In general, if a plat which is difficult to geo-reference has a neighboring plat with more information; it can be geo-referenced to the ArcGIS file based on the end station number location of the neighboring plat.

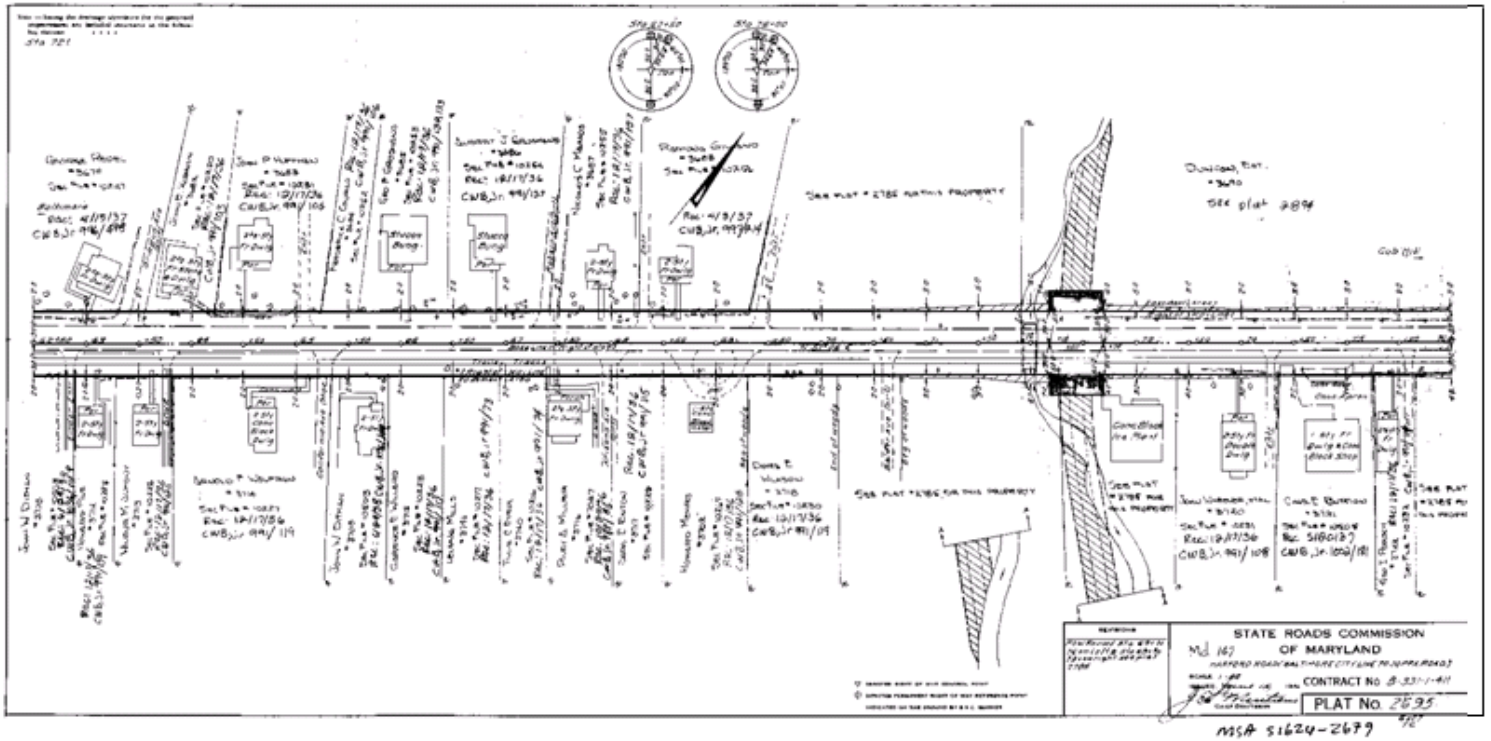


Figure 1.6

The original Plat file

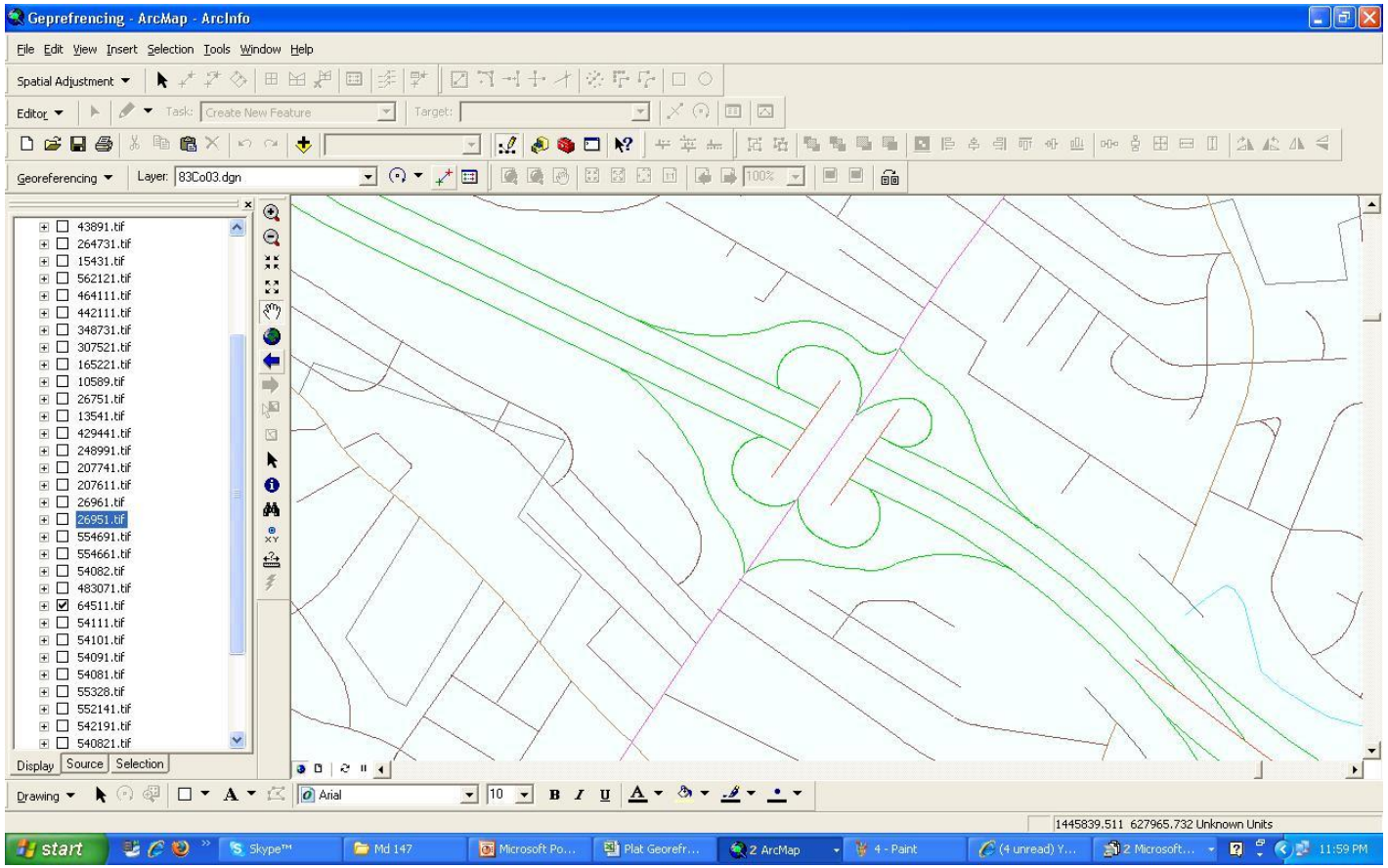


Figure 1.7

The current situation of Plat file

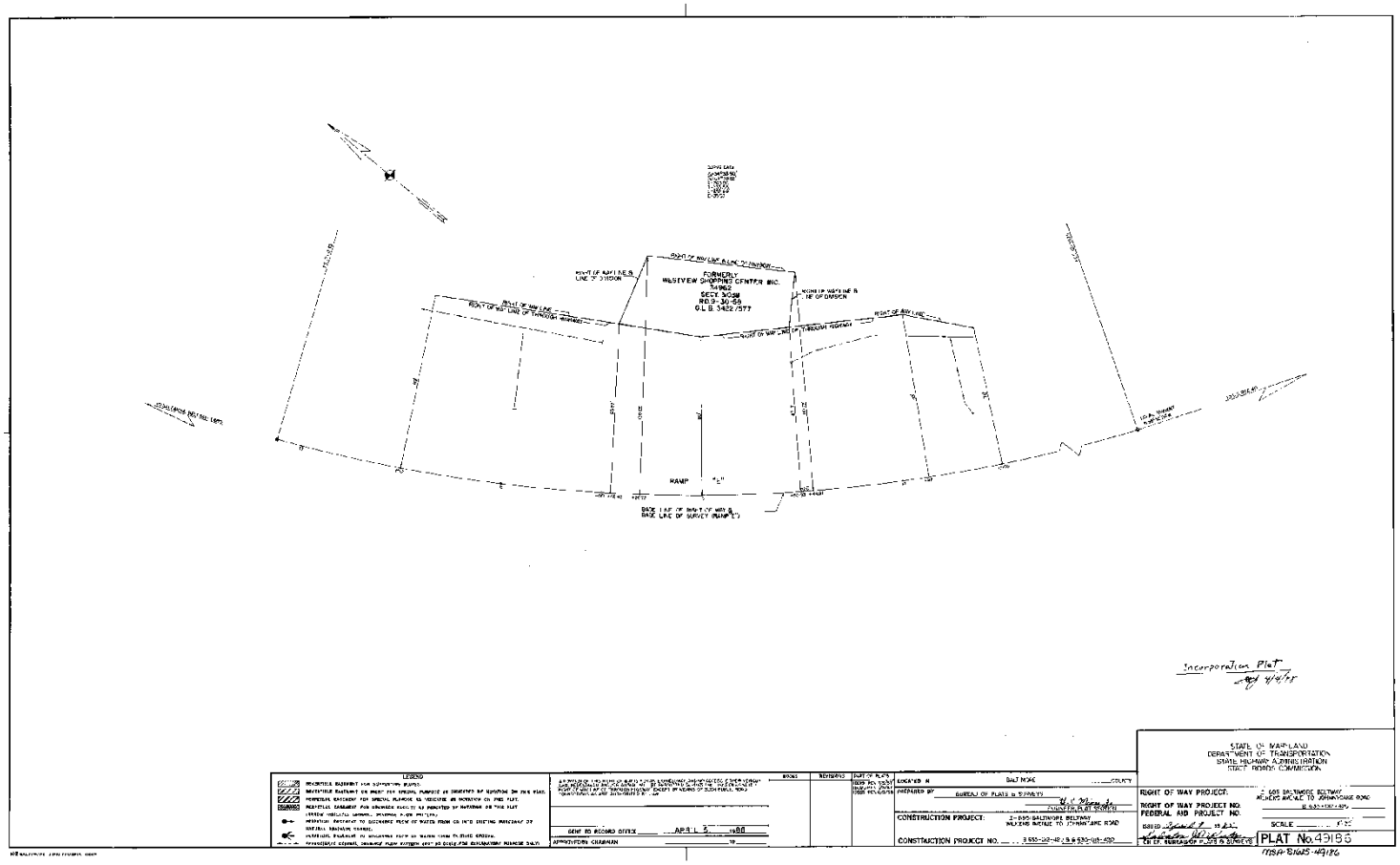


Figure 1.8

Sample of property plat file with no information

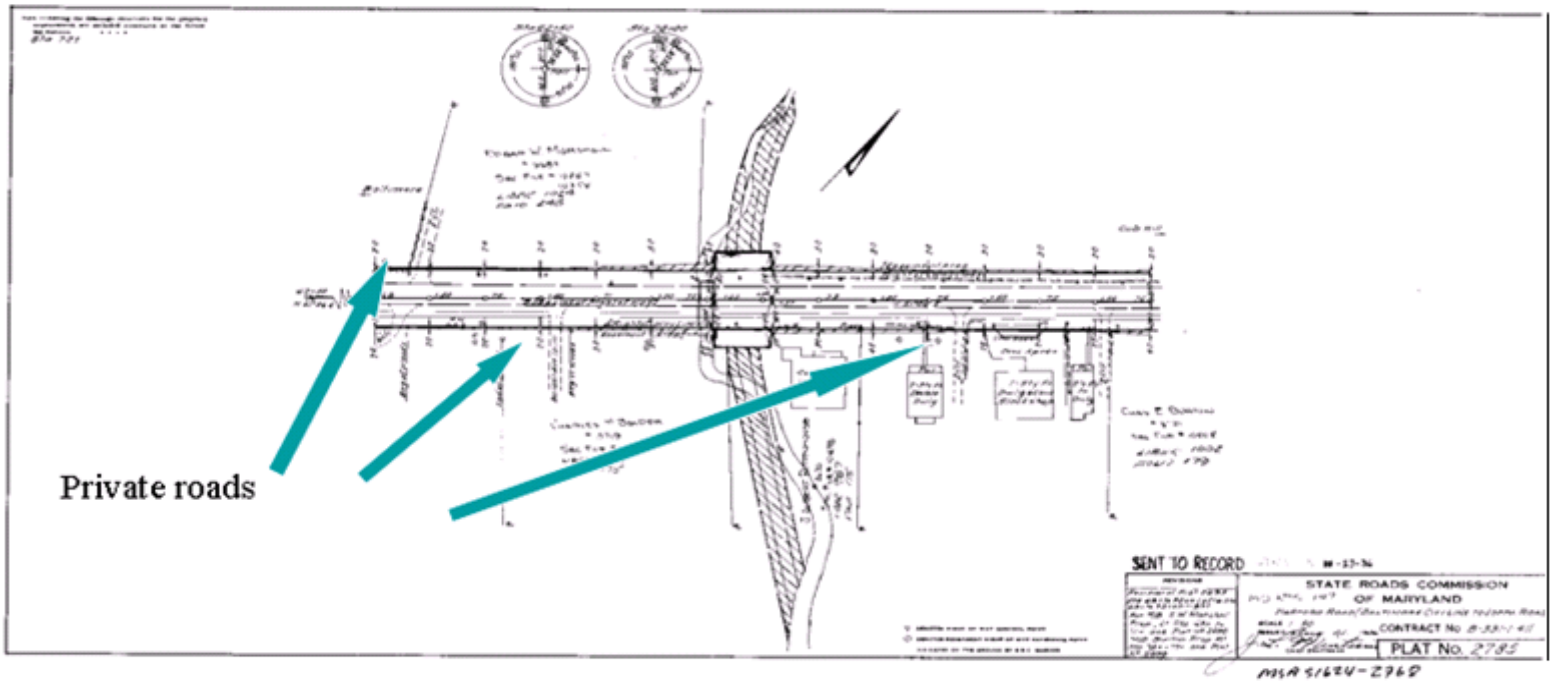


Figure 1.9

Sample of plat file with some information that does not help to find location

4.3. Error in plat drawing

In some cases, the plat file did not match with the ArcGIS file. When ArcGIS and Google Map matched and the plat drawing differed, it appeared that there were some errors in the plat file drawing. For instance, Figures 1.10 and 1.11 show the same area but the angle between two streets which is shown by red curve is completely different in the plat file and the ArcGIS file. This is most likely due to changes in topography as opposed to an error in any plat drawing. The plats were always drawn correctly for the road geometry at the time. After roads are changed and realigned, the original plat remains the same and on file and a new plat is drawn with the updated year recorded.

4.4. Scale of ArcGIS and plat files are inconsistent

In some instances, the ArcGIS file and plat file sometimes did not match in terms of scale. For example, three equally spaced intersections in the ArcGIS file showed up as two close intersections and one farther away. We used Google Maps to locate road names from the plat file in relation to the ArcGIS layout. In some cases when scales were inconsistent, Google Maps agreed with the ArcGIS, however in some other cases it matched the plat file. These plats were still geo-referenced according to the best fit based on the researchers' judgment. For instance, Figures 1.12, 1.13, and 1.14 show the same area on a plat, the ArcGIS file, and the Google Maps image. Comparing the size of the ramps shows that the ArcGIS file is inconsistent with Google Maps which seems to be more accurate. The plat file appears to be correct in this example.

4.5. Multiple road segments in one plat

A small number of the sample plats had two or three road segments in one plat drawing. Figure 1.15 shows an example of these plats. These road segments were sequential. If the beginning of 'road segment one' and the end of 'road segment three' were geo-referenced to their respective points on the ArcGIS, the plat became unreadable because it was significantly warped and stretched out. Instead, the top road segment was geo-referenced in the correct dimensions. Another approach for future work is to geo-reference the plat multiple times, so that each road segment is covered.

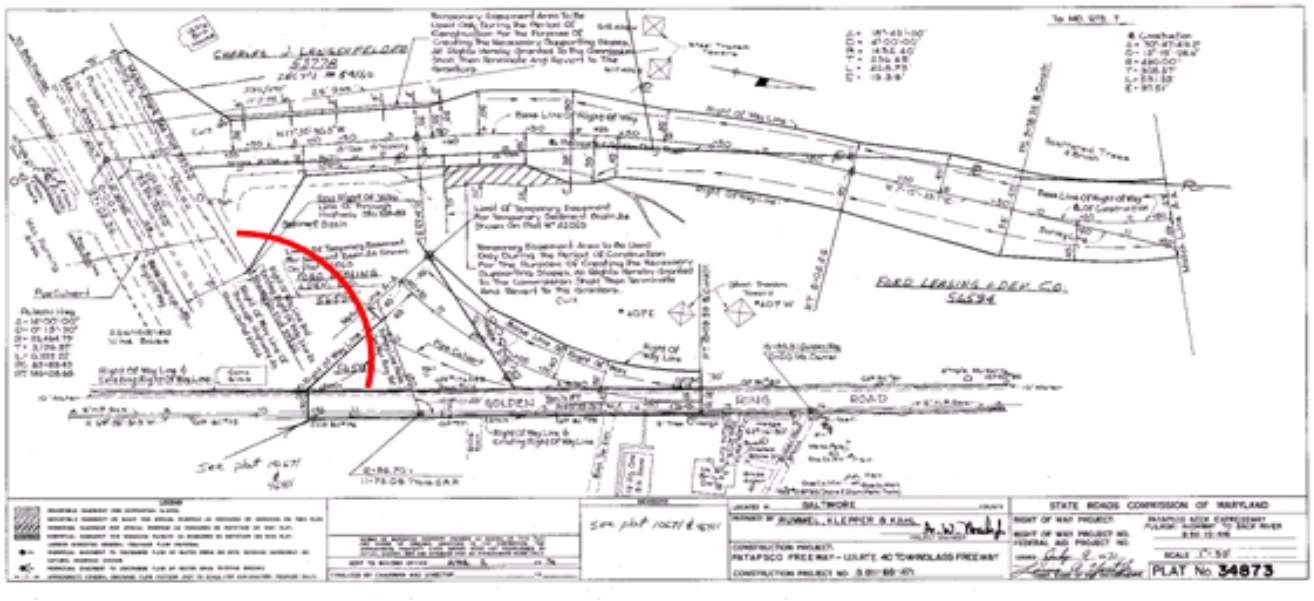


Figure 1.10

The angle between two streets is greater than 90 degrees in plat file

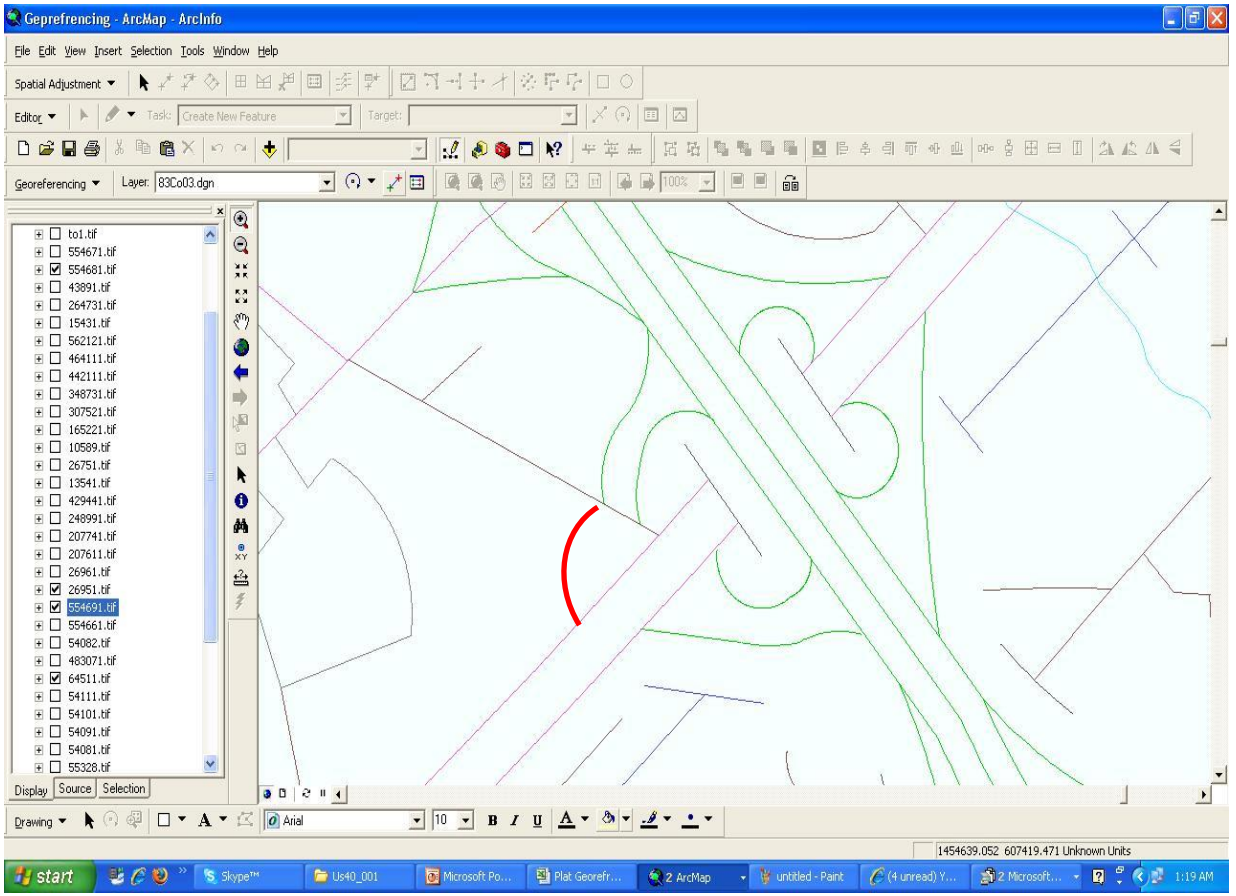


Figure 1.11

The angle between two streets is less than 90 degrees in ArcGIS file

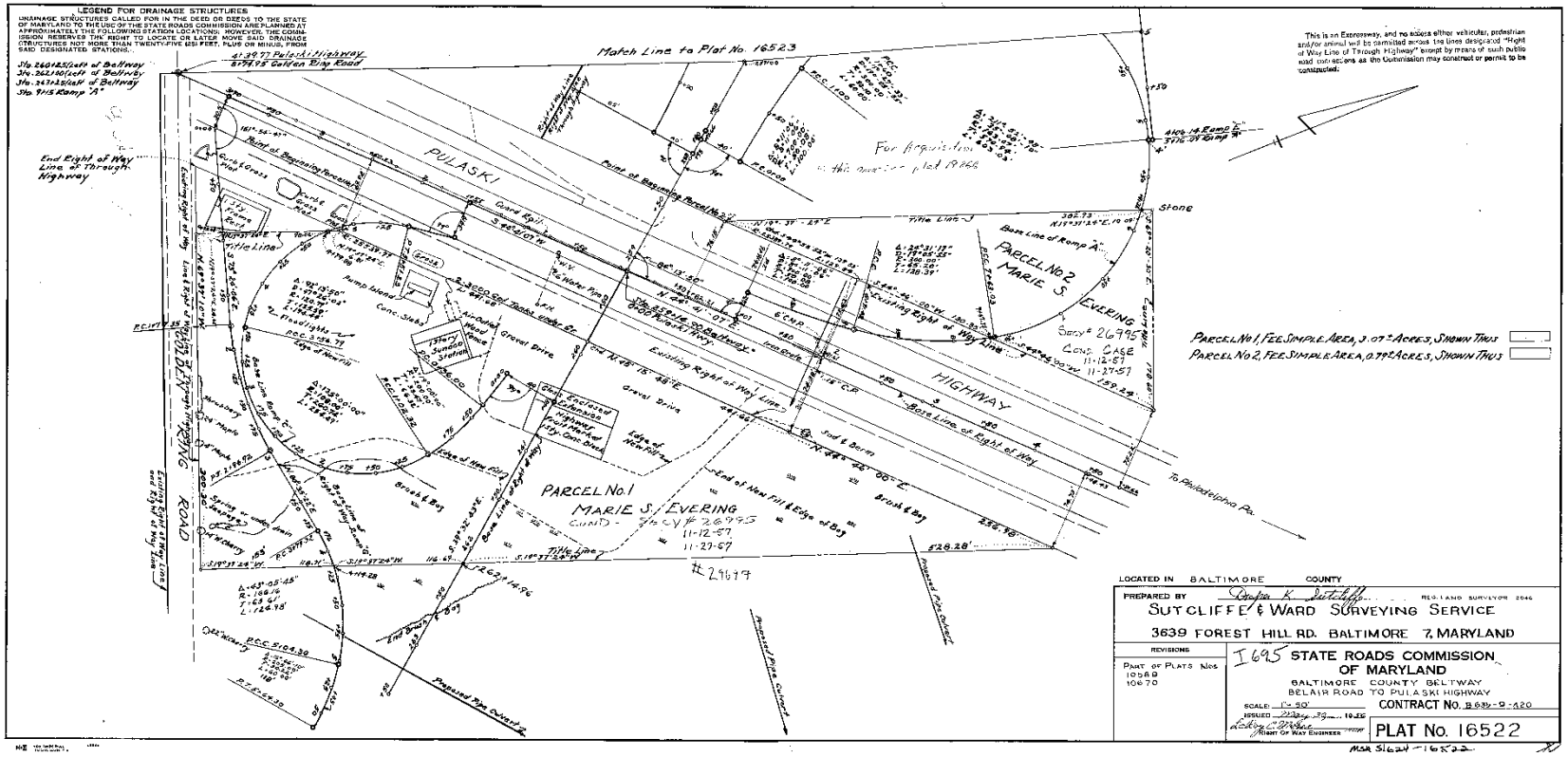


Figure 1.12

The plat file is consistent with the Google Maps file

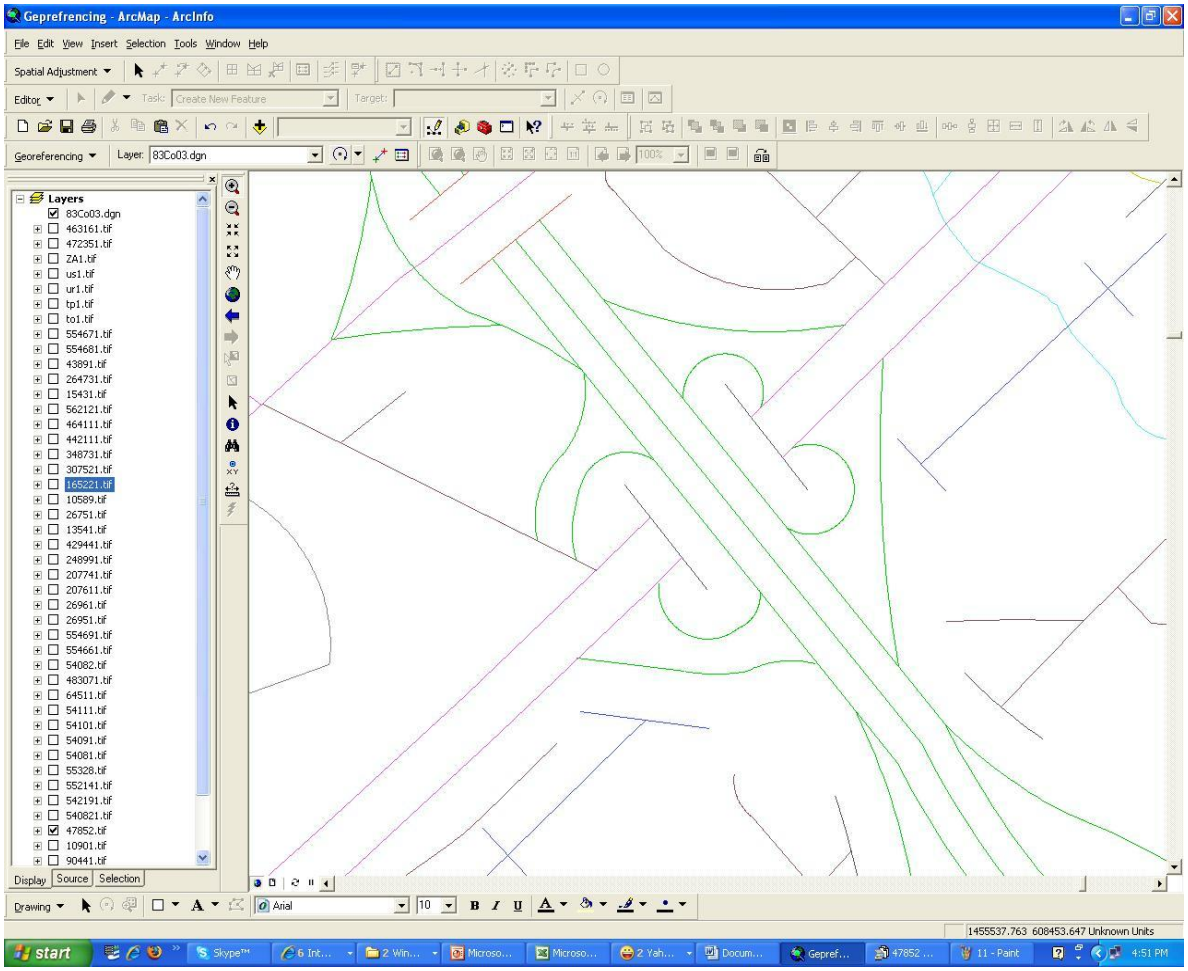


Figure 1.13

The ArcGIS file with some inconsistency with Google Maps file

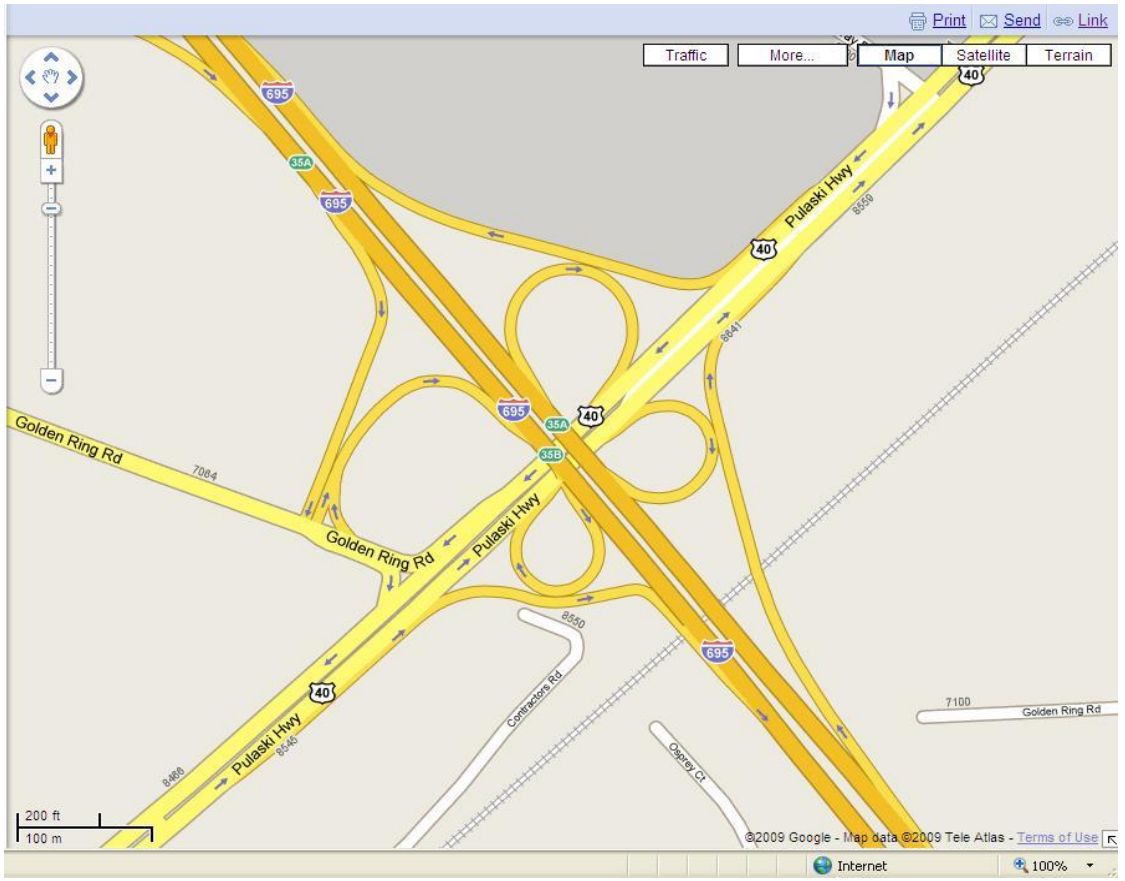


Figure 1.14

The Google Maps file of the study area

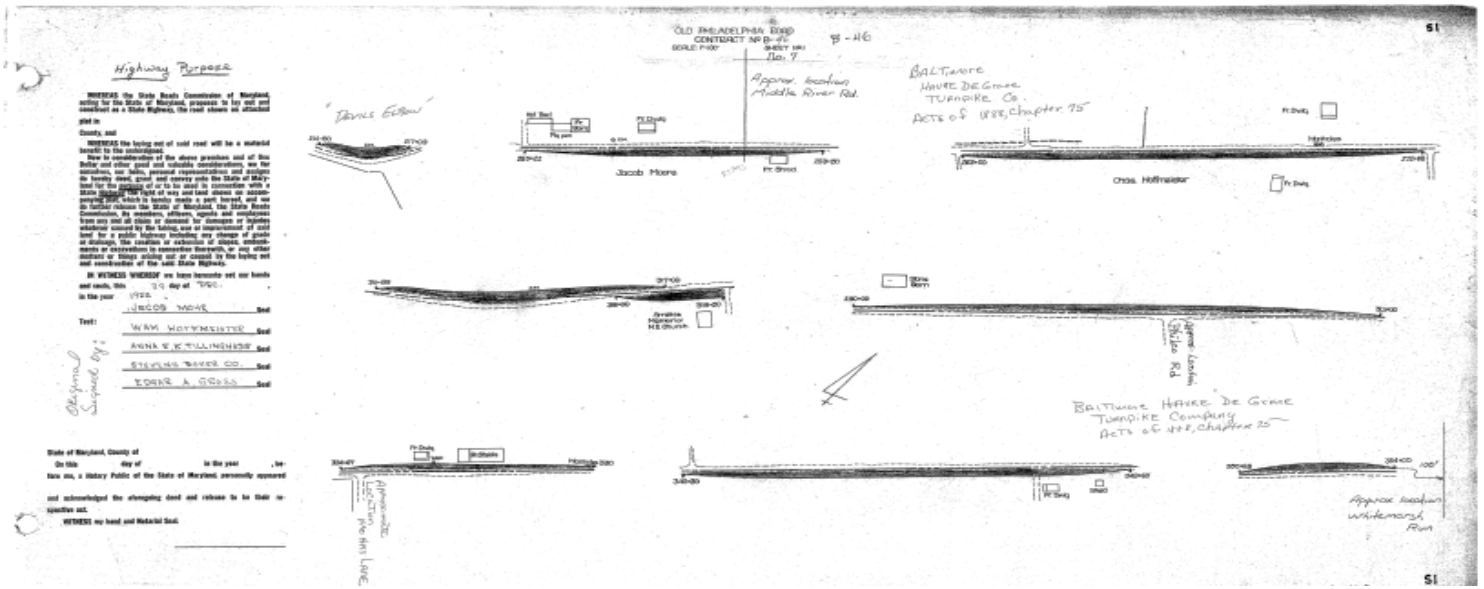


Figure 1.15

The plat file including more than one road segment

5. Results

Out of the first set of 104 sample plats, 86 were successfully geo-referenced by two persons. The maximum, minimum, and average time required for geo-referencing plats for the first person were 40, 4 and 15 minutes respectively. For the second person these numbers were 82, 9 and 24 minutes. Table 1.1 shows the summary statistics of the minimum, maximum, median, 25th percentile and 75th percentile of the time required for geo-referencing plats for individual researchers as well as both combined. Figure 1.16 shows the same statistics.

Table 1.1

Plat Geo-referencing Statistics: Person 1 and 2, Sample Set 1

Statistic	Person 1	Person 2	Overall
Minimum	3.75	9.00	3.75
25th percentile	8.35	15.00	10.30
Median	13.80	22.00	17.00
75th percentile	20.13	26.50	24.00
Maximum	40.00	82.00	82.00

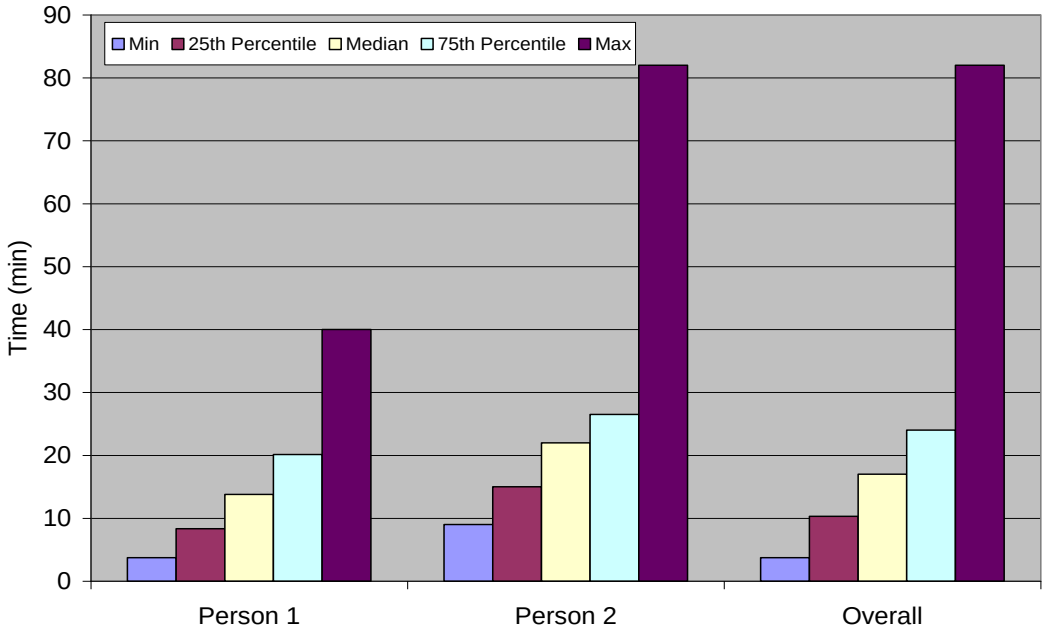
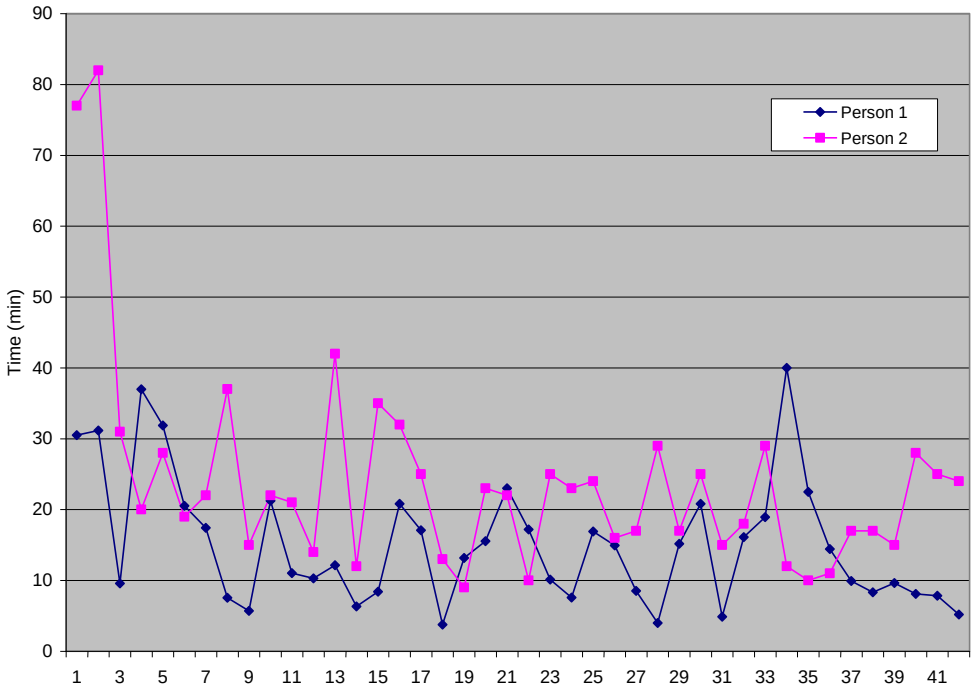


Figure 1.16

Plat Geo-referencing Statistics: Person 1 and 2, Sample Set 1

Figure 1.17 shows the learning curve for both persons for geo-referencing the first set of plats which is similar to normal learning curves. As the figure indicates, the time required for geo-referencing for the first five plats is much longer than that of the rest of the plats. In other words, it takes much time for both persons to learn how to geo-reference plats. For instance, the geo-referencing time for one of the persons was 82 minutes for the first plat. However as more plats are geo-referenced, the time required for the task is much shorter. It is also worth noting that the time required for geo-referencing some plats is longer than some others because of the problems mentioned in the previous section. Overall, the time required for geo-referencing plats decreases drastically at the beginning but then it levels off and remains relatively flat with a little variation.



Plat Number (Order of Geo-referencing)

Figure 1.17

Learning Curve: Time vs. Plat Number Sequentially, Sample Set 1

Out of the second set of 177 sample plats, 139 could be geo-referenced by two persons. The maximum, minimum, and average time required for geo-referencing plats for the first person were 32, 2, and 9 minutes respectively. The same numbers for the second person were 27, 5, and 12 minutes. Table A.1 In Appendix A shows the plats that were successfully geo-referenced along with their coordinates.

Table 1.2 summarizes the plats that could not be geo-referenced. This table also summarizes the problem associated with the plats that hindered the geo-referencing of the plat.

Table 1.2

Plats that could not be geo-referenced

Plat Number	Problem description
14786	Plat file is too old
25984	Plat file is too old
26180	Plat file is too old
27865	Lack of Information
2785	Lack of Information
2894	Lack of Information
2899	Lack of Information
10569	Lack of Information
10589	Lack of Information and error in plat drawing
34873	Lack of Information and error in plat drawing
45984	Lack of Information
49186	Lack of Information
51602	Lack of Information
21615	Lack of Information
23456	Lack of Information
44972	Lack of Information
10717	Plat file is too old
26170	Lack of Information
51354	Lack of Information
51653	Lack of Information
51654	Lack of Information
47858	Lack of Information
48206	Lack of Information
48409	Lack of Information
56544	Lack of Information
56545	Lack of Information
52259	Lack of Information
53147	Plat file is too old
52342	Lack of Information
52345	Lack of Information
32514	Lack of Information
32676	Lack of Information
33082	Plat file is too old
33239	Lack of Information
33413	Lack of Information
33414	Lack of Information
33415	Lack of Information
33416	Lack of Information

Table 1.2 (Cont'd)
Plats that could not be geo-referenced

Plat Number	Problem description
33417	Lack of Information
33419	Lack of Information
33420	Lack of Information
33509	Lack of Information
33510	Lack of Information
33699	Lack of Information
33700	Lack of Information
33701	Lack of Information
33702	Lack of Information
34494	Lack of Information
34668	Lack of Information
34834	Lack of Information
35011	Lack of Information
35013	Lack of Information
35500	Lack of Information
35501	Lack of Information
35698	Lack of Information
36546	Lack of Information

Table 1.3 shows the overall results combining the two sets of plats. As the table indicates the average geo-referencing time for all 281 plats was 11 min, 46 sec. The average processing time for 225 plats that could be geo-referenced was 13 min, 46 sec and the average processing time for 56 plats that could not be geo-referenced was 3 min, 59 sec.

Table 1.3

Average time required for geo-referencing per plat (minutes:seconds)

	Successfully Geo-referenced	Could not be Geo-referenced	All plats
Set 1	19:44	05:13	17:05
Set 2	10:46	03:29	08:46
Overall	13:46	03:59	11:46

The first set of plats included a number that required a significant amount of time for geo-referencing. This can be attributed to the learning process. The plats in the second set were geo-referenced quicker. Some plats were in groups, but many were isolated. Groups of sequential

plats are much faster to geo-reference because the approximate location is already known from previous plats.

Based on this experiment, the research team estimates that geo-referencing all 60,000 plats will require approximately 13,800 person-hours. If we only consider the time that it took to geo-reference the plats in the second set that was provided by SHA, the average time to geo-reference a plat was 10 minutes 46 seconds (10.77 minutes). This reduction in average time is a result of the experience gained and the lessons learned from geo-referencing the first set of plats. Considering this shorter average time per plat the total person-hours required to geo-reference all 60,000 plats is estimated to be 10,800.

6. Conclusions

Based on geo-referencing 281 plats, the research team estimates that the required effort to geo-reference all 60,000 plats will require somewhere between 10,800 and 13,800 person-hours assuming that the plats provided by ORE staff were reasonable samples of all plats and good representatives of the complexity of work involved. This time estimate is fairly conservative. It is expected that as the personnel who will undertake the geo-referencing task become more experienced, the process of geo-referencing becomes faster and the work of the research team on the second set of plats better represents the overall geo-referencing task particularly since the initial learning curve should not impact the overall time required for geo-referencing all 60,000 plats given that the number of plats is so large. Using the average time of 10.77 minutes per plat from the second set, the overall estimated effort should be much closer to 10,800 person-hours.

SHA Office of Real Estate Management System (OREMS)

1. Introduction

The Office of Real Estate Management System (OREMS) is an online database system used as an organizational tool for the Office of Real Estate (ORE) within the Maryland State Highway Administration (SHA). Current OREMS users include real estate staff and the Office of Council. Records and Research is one section within the Office of Real Estate. A major task undertaken by this section is to locate the newest plat in specific areas of the state and determine information about the degree of land ownership.

Consultants send requests for information about the specific area they need researched to plat researchers at the Records and Research Section. Such a request typically asks for the latest Right of Way information relative to the area in question. Past projects within the requested area are identified and all plats in this area are noted. When multiple plats from various points in time overlap the same location, the most recent plat is the one that is reported. The current process to locate plats is done by hand and takes several days.

The OREMS website includes a plat query database. It is currently used to keep a record of jobs; not for locating a series of plats. It can be used to find all of the plats within a project. The structure of the plat query database is described below.

2. Training Session

A training session was held on 22 July 2009 at the SHA Headquarters to provide an overview of OREMS and SHAWME systems. First, Mr. Shawn Cherry provided an introduction to the OREMS system, focusing on the relationship with plat information. Right-of-way agents associate a plat to the item number with which it corresponds. To associate a plat to an item number one clicks “District Offices”, selects “Project number” and then “Item number,” The “Plats link” is then clicked followed by “New Acquisition Plat Association”. The Plat number is entered and one determines whether the plat is Fee acquired, Perpetual easement, Temporary easement, or Revertible Easement. The Records and Research section is responsible for adding all new plats into OREMS. To add a new plat into OREMS one clicks on the “Records and Research” tab then the link named “Plats”. Next, one clicks on the “New Plat” button and enters

as much information as possible. The required field is "Plat Number". The system currently only has input boxes for one X and one Y coordinate. Six more input boxes are necessary to enter the complete plat information. Mr. Emmanuel Paderanga expressed confidence that an excel file with coordinates would easily transfer into the OREMS program once the additional input boxes have been added. Finally, Mr. Michel Sheffer presented an introduction to the SHAWME system. He gave a tutorial of each application and how it is currently used. Since the completion of this training session, the additional X and Y coordinate fields have been added into OREMS. An entry to these fields is required for plats with a plat number greater than 56789. It is important to note that parcels also haves X Y coordinate fields. However, these fields are for the coordinates of the parcel itself and not the plat.

3. Current Plat Retrieval Process

The Control Map is a large physical map that has the location of all projects labeled on it. When a request for information is received, the plat researcher finds the area of interest on the Control Map and determines the project numbers that fall within that area. There is a binder with all project numbers and its associated general file number. This list is updated constantly, as new projects are taken on. The general file number is necessary to find the appropriate master plat, which are organized in file cabinets in the office. A master plat is a folder that includes a map with the project area labeled and small copies of all the plats within (Barbara's note says "yjr"??) project. Once the master plat is located, all plat numbers in the project are recorded, searched for by plat number in the right-of-way plat search database, and finally printed. The plats are then assembled and checked for accuracy. This process takes an experienced plat researcher about three hours. The time required depends on the size and the complexity of the research area. Figure 2.1 displays the workflow involved during the plat retrieval process.

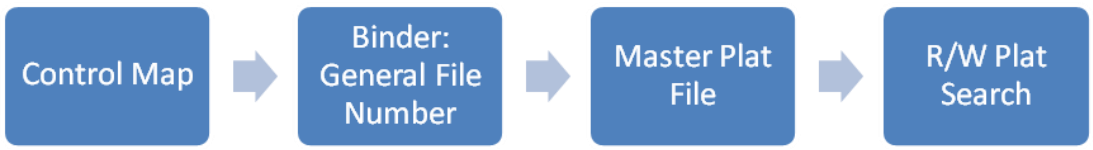


Figure 2.1

Workflow of plat retrieval process

Sometimes the OREMS database system is used to cross check the master plat file. There is a field to search plats by project number in OREMS. This is only utilized if it appears that the master plat is missing some information. The master plat file is considered more reliable than the OREMS database at this point in time because OREMS does not have complete data on all projects. It is less likely the very old plats are included in the database but they are often necessary for research requests.

4. OREMS

The ORE is the office within the SHA. One major responsibility of ORE is acquiring land SHA may need to execute projects. A plat is a drawing that shows the layout of a road construction project by SHA and the surrounding properties. Plat drawings include right-of-way lines, and types of easements along a road which describe land ownership status and area to be acquired.

When a new plat is created by a consultant and sent to SHA it begins in the Division of Plats and Surveys of the Office of Highway Development. In fact, the Division of Plats and Surveys prepares SHA right of way plats either in-house or by consultant. When that department is finished, the plat is delivered to the Records and Research Department. At this point the plat is entered into the OREMS database system. The standard way to enter the new plat into OREMS is to enter the plat number, project number, master plat suffix, description as newly issued, date issued, and date received. The plat is then scanned and saved as a TIF file on a server outside of the OREMS system.

Deed information for a plat comes from a number of sources such as the court, attorneys, property owners, and consultants. Plats are recorded at the time condemnation is filed or the first deed is executed. This means the plat is final and can be released to the public. Once the plat is recorded, the date recorded is added to the plat information in the OREMS database. If any changes are made to engineering plans affecting the acquisition, the plats must also be revised. The revised plats are scanned into the system and the revision date is entered into the OREMS database.

4.1. OREMS plat search

The plat search is conducted at the OREMS website. To search for a plat, one must click the ‘Records Research’ tab, then click ‘Plats’, and finally click the ‘Advanced Query’ plus sign. Figure 2.2 shows the advanced query of plats. This leads one to the Plat Query. The user then has the option between the following search criteria choice:

- Plat Search,
- Project Search, and
- Property Search.

The first item is a ‘Field List’ drop down menu. In this menu the following items can be chosen:

- Plat Number,
- Plat Description,
- Project Number,
- County,
- Road Name,
- Route Number,
- Termini,
- Plat Issued Date,
- Plat Received Date,
- Plat Recorded Date,
- Plat Revised Date,
- Issued Project Number,
- Construction Contract Number, and
- Item Number.

Figure 2.2

Plat Advanced Query

Figure 2.3 shows items in "Field List" menu. Once an item is selected from the Field List, a 'Match' drop down menu follows. If the 'Field List' involves a date in the description, the menu includes the following items:

- Is,
- Before,
- After,
- Between,

- Is Null, and
- Is Not Null.

Figure 2.3

Field List menu

On the other hand, if the 'Field List' does not involve a date in the description, the menu includes the following items:

- Whole Field,
- Any Part of Field,

- Start of Field,
- Not In,
- Is Null, and
- Is Not Null.

The final item is a ‘Criteria’ box that must be filled in. There is no drop down menu and no prompts for the correct format. Whatever is typed into this box is searched throughout the database. The ‘Field List’ tells the database what field to search, the ‘Match’ describes how it should be searched, and the ‘Criteria’ is the actual word or number searched.

Once the Field List, Match, and Criteria are determined, the user clicks the ‘Build’ button. At this point the user can run the query by clicking the ‘Apply’ button. If a more advanced query is necessary, the user can choose ‘AND’ or ‘OR’ and build upon the original search. When a new search is needed, the user clicks the ‘Clear’ button and starts from the beginning.

4.2. OREMS project search

The Project Search has the same structure as the Plat Search. The difference is the Field List is specific for projects. The drop down menu in the ‘Field List’ includes:

- Project Number,
- County,
- Road Name,
- Route Number,
- Termini,
- PDMS, and,
- Federal Project Number.

The Match drop down menu includes:

- Whole Field,
- Any Part of Field,
- Start of Field,

- Not In,
- Is Null, and,
- Is Not Null.

Just like in the Plat Search, the Criteria box must be filled in. In Figure 2.4 project search menu is shown.

4.3. OREMS property search

The Property Search also has the same structure as the Plat Search and Project Search. The drop down menu in 'Field List' is much longer than Plat or Project Search because there are more specific fields involved with individual properties. The 'Field List' drop down menu for Property Search includes the following:

- Item Number,
- Property Name,
- Project Number,
- County,
- Sex,
- Age,
- Race,
- Owner Name,
- Owner Address 1,
- Owner Address 2,
- Owner City,
- Owner State,
- Owner Zip,
- Owner Phone,
- Owner Interest,

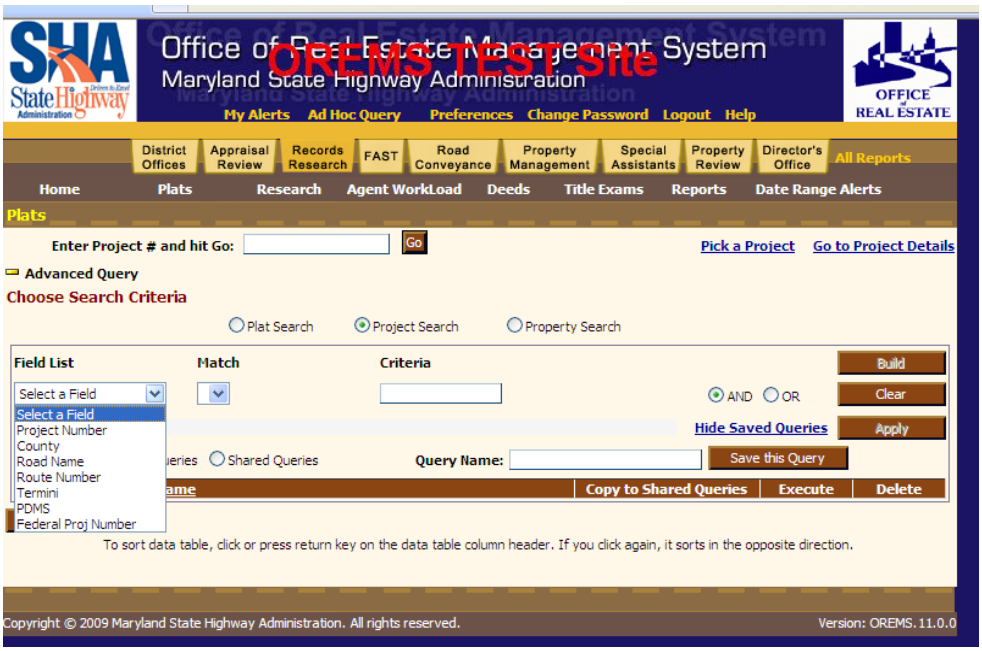


Figure 2.4

Project search menu in OREMS

- Owner SSN or Tax ID,
- Assessment Name,
- Tax Map,
- Grid,
- Parcel Number,
- Assess Land,
- Assess Building,
- Assessment Year,
- Sub Division Name,
- Block,
- Lot,
- Account Number,

- Property Location, and,
- Zoning.

The Match drop down menu includes:

- Whole Field,
- Any Part of Field,
- Start of Field,
- Not In,
- Is Null, and,
- Is Not Null.

Just like in the Plat Search, the Criteria box must be filled in. In Figure 2.5 property search menu is shown.

5. More Details about Database

There are over 60,000 plats in the database. More plats are added to the database as they are issued. Newer plats tend to have more complete fields in the database. However, in conducting searches, it is important to know what information is reliable within the database and what information is misleading. Using the 'Is Null' search, University of Maryland researchers investigated how many plats have specific information.

Every plat in database has a plat number, project number, and item number. These fields are extremely reliable to search because they are included on every plat. The Plat Number search is straight forward. The user can find a specific plat if the number is known or find a series of plats that begin with the same numbers. The Project Number query is also straight forward. It is a useful way to find a specific plat associated with a project. The only drawback with the project number search is the large number of plats associated with some projects.

The 'Issued Project Number' is the exact same number as the 'Project Number.' The 'Project Number' is organized with project information, while the 'Issued Project Number' is organized with plat information. In the database, 14 plats are missing the Issued Project Number. This was determined by searching for Issued Project Number using the Null search option.

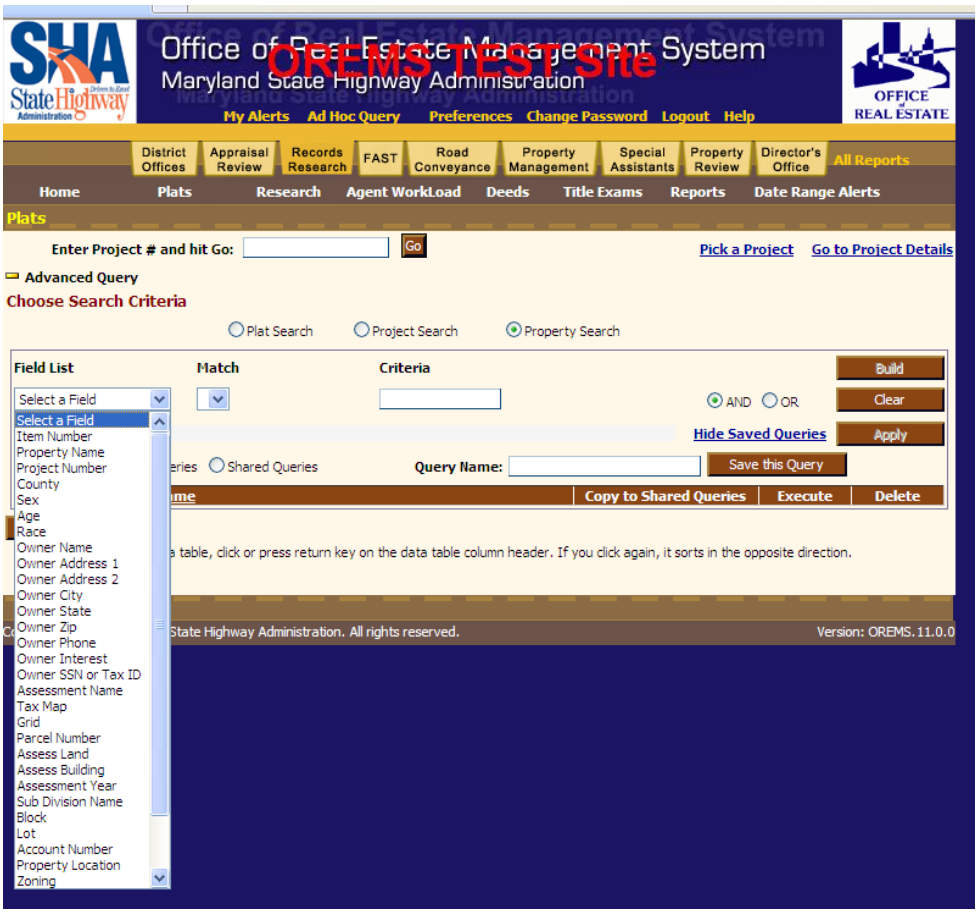


Figure 2.5

Property search menu in OREMS

The next most reliable search is by Route Number or County. 4,776 plats are missing the route number field, which are less than 10% of all plats. On the other hand, 6,000 plats (10% of all plats) are missing the county information. Route Number and County are two of the three searches that involve location. There is also a field to search for Road Name. Unfortunately, only 3,874 plats have Road Name information as part of the database. Newer plats are often the ones that include a road name, but the number is still very low of all 60,000 plats. The Road Name search is misleading as a location-based search because so few plats have that field completed.

Plat Issued Date, Plat Received Date, Plat Recorded Date, and Plat Revised Date are the four searches that involve a specific date. The best search involving a date is the date issued. 8,350 plats are missing this information. The date recorded is the next best date query with 21,616 plats missing the information. However, some plats are never used for acquisition and

therefore will never be assigned a recording date. Some plats are missing recording date information in the database. Only 18,768 plats include the date received, so this is not a reliable search option. Even fewer plats have revision dates; there are only 14,574 plats with this information in the database. This number may be a fair representation because not all plats are ever revised. It is difficult to judge the accuracy of this field because the database is missing so much other information.

The Plat Description search is not very useful. About 22,000 plats are missing the description field. Of the plats with description, over 5,000 plats in the database have 'New Plat' or 'Newly Issued' as the description. This is redundant information, since all plats are new when they are first issued. Other comments may be helpful for specific plat information, but very difficult to search for.

The two remaining query options are also limited. Only 8,165 have termini, which describes the end location of a project. This is a low percentage of the total plats in the database, as well as a difficult field to search without a dropdown menu. Finally only 1,805 have construction contract number, and these are almost all relatively new plats. Table 2.1 shows how many plats have information for each item seen in the field list and user can be able to run query over them.

6. Plat Types

There are 5 different types of plats:

1- Dedication plats: Plats used for donating land normally adjacent to a subdivision or commercial area so the land can be removed from the tax rolls. Donations can be made by Counties or private landowners.

2- Conveyance plats: Plats used for either disposal of excess land or the exchange of land at the time of acquisition.

3- Strip plats: Plats that show a strip taking of right of way, most often a survey plat.

4- Lettered plats: Plats that are labeled with letters instead of numbers (the first identification system). These are the oldest plats.

Table 2.1

The number and percentage of plats having information for each item

Item	Number of Plats	Percentage out of all plats
Plat Number	60000	100
Plat Description	38000	63
Project Number	60000	100
County	54000	90
Road Name	3874	6
Route Number	55224	92
Termini	8165	13
Plat Issued Date	51650	86
Plat Received Date	18768	31.28
Plat Recorded Date	38384	64
Plat Revised Date	14574	24
Issued Project Number	59986	99
Construction Contract Number	1805	3
Item Number	60000	100

5- Single property plats: Plat drawing for one property which their numbering system is often in series such as 1 of 3, 2 of 3, and 3 of 3.

The database does not differentiate between plat types. Currently, when a new plat is entered into the database, the plat type is not specified. Plat type is determined by human

judgment, and most types are displayed in a box on the plat image file. According to Real Property Specialists, plat researchers could benefit in the retrieval process if plat types were differentiated.

7. Suggestions for OREMS

The current OREMS includes a database of information on the SHA plats in Maryland. The query options for the database suffice as a means to find plat files by plat number, project number, or item number. A few additional features could improve this system to make it more powerful and user friendly. These are summarized below.

1. Criteria should have a drop down menu whenever possible. Route Number, County, and Road Name are good examples of fields in which a drop down menu makes sense. A date query should prompt the user to enter the date in the correct format. Any plat, project or item number would need to be typed just like in the current system. There is not much that can be done for Description or Termini, except possibly include key words in a drop down menu option.

2. The number of results should be displayed after a query. The current system displays information for ten plats at one time sorted by plat ID, and includes ten pages of results to browse through. There is no way to initially distinguish 110 results from 12,000 results.

3. Database details should be displayed, so the user knows the number of blank fields in each category. The percentage of plats in the database with certain information should be known in advance in order to evaluate the results properly.

4. The user may need to know what plats are around the specific plat. This capability does not exist in OREMS now. The system should be able to recognize the specific plat neighbors and make a list of them. To do this, it needs to categorize distance from origin plat and others. So, the user will be able to run query over plats and find what plats exist in a certain distance around the current plat.

5. Plats which have the same common border (match line) are likely important to the user to know. So, this capability should be added to the OREMS when the user clicks on plat file, s/he can find and see plat files having match line with the original plat file.

6. There are different plat types: conveyance plat, strip plat, lettered plat, single property plat, and dedocated plat. Now, when the plat information is inputted to the system, the type of plat is not inputted. So, type of plat does not exist in the system. Therefore, the field showing type of plat should be added to the database to give opportunity to the users to filter the plats by their type.

7. One kind of plat types is single property plat. Plat database of current OREMS does not contain any field related to name of property. If this field is added to database, it gives the ability to the user to search property plat file according to its property name.

8. Include a link to the stand alone map based query system. A query based on location is extremely limited because so few plats include road name information. The requests to SHA are described by location. It is important that a new system include a graphical query with a point and click retrieval system. There should be an option for all plats in the same project to appear at once, under a chosen graphical constraint. The prototype system developed by the University of Maryland in earlier phases of this project has this capability and can easily be integrated with the OREMS.

9. Plats should be seen after filtering. There is a link in the system to show the TIF file of plat, now but it is not working.

8. Conclusion

The OREMS database system is used to organize a wide range of information pertinent to the Office of Real Estate, including a plat database. Text based queries can be used to find plats. This application is useful if the database is accurate and complete. The database is only used to store plat information; not in the plat retrieval process. The process for finding plats manually involves a control map and master plat file. The OREMS database is sometimes used to check the accuracy of the master plat file. The OREMS plat search would be more practical if it had access to a map based search query. There are some suggestions in this report to enhance current OREMS system.

SHAWME System

1. Introduction

The State Highway Administration Web Mapping Engine (SHAWME) is an application used by SHA to explore a wide range of geographical data in the state of Maryland. It is a web-based application, with access to current geographic information systems (GIS) data. In the past, these data were scattered between many departments within SHA. When large spanning projects required geographic information, project leaders pieced DGN file maps and images together in order to cover the whole project. This took a great amount of effort, as the data came in a number of formats ranging from hard copy in file cabinets to digital files on different computers. Beginning in 2006, the SHAWME system offers access to all of this data in one location, allowing for quicker access to information.

The following data can be found in the SHAWME program:

- Aerial imagery
- Visidata (roadway video)
- Consolidated Transportation Plan (CTP) projects
- Highway Needs Inventory (HNI) locations
- Survey points
- Property data
- Numerous spatial layers (such as ZIP codes, legislative districts, scenic routes, nationally registered historic sites, etc.)

The layout of the SHAWME application page includes a Legend/Query tab on the left, a map window on the right, and a tab of results across the bottom which is shown in Figure 3.1.

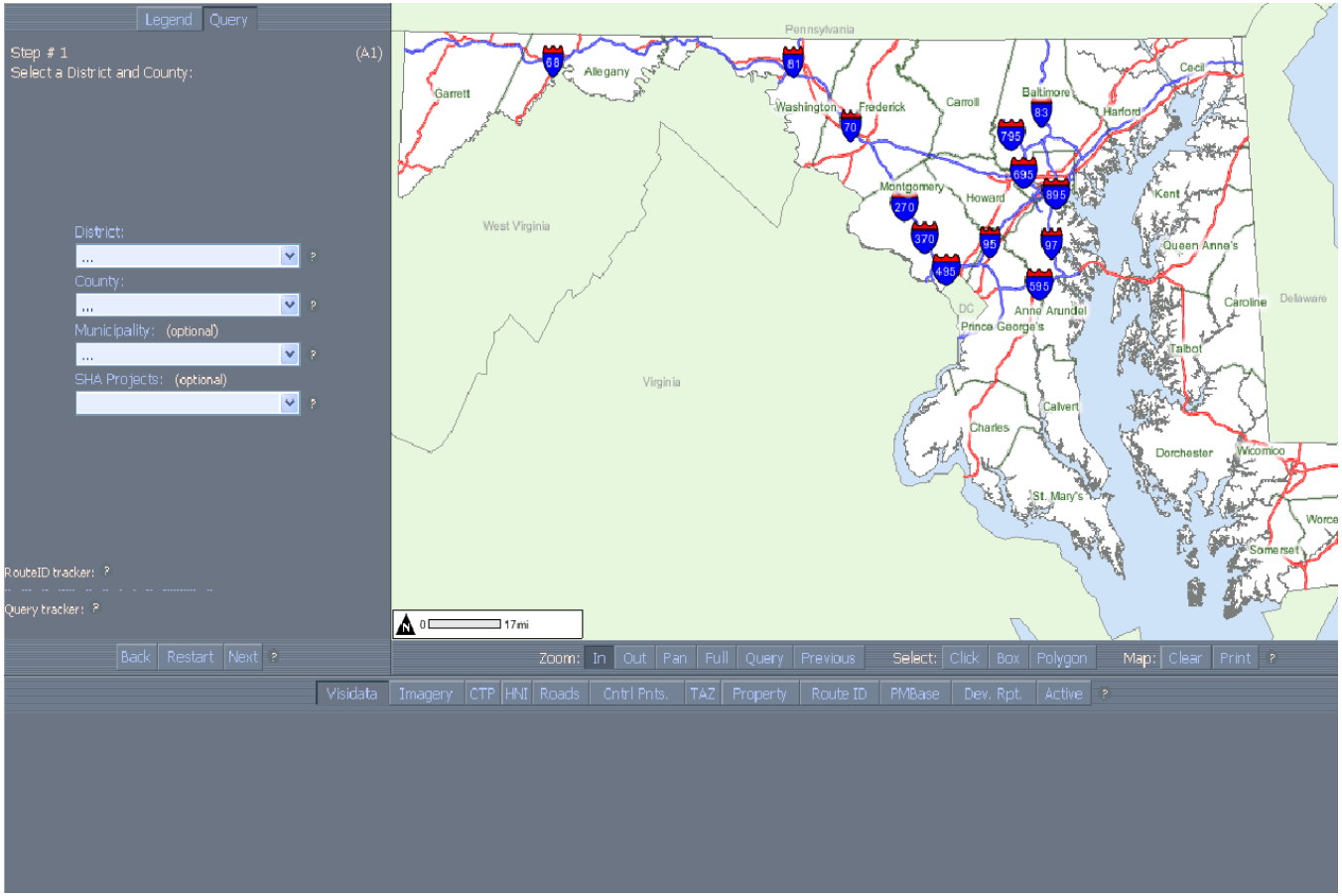


Figure 3.1

The layout of SHAWME application

2. Map Window

The map window is located in the upper right corner of the screen. Below the map there is a toolbar with the following sections:

- Zoom: In, Out, Pan, Full, Query, Previous
- Select: Click, Box, Polygon
- Map: Clear, Print

These tools allow the user to navigate the map and select an area of interest. Once the zoom and pan features are utilized to locate a region, the area of interest may be selected by clicking it, drawing a box, or drawing a polygon. There is a scale in the lower right hand corner of the map so the user always knows the relative area size.

3. Legend Tab

The upper left corner includes a Legend Query Tab. The Legend Tab has the following menu:

- Forecast
- Roadways
- Boundary
- Hydrology
- Historic
- Protected Environment
- Imagery
- District 7

Figure 3.2 shows the legend tab and its menu in SHAWME system.

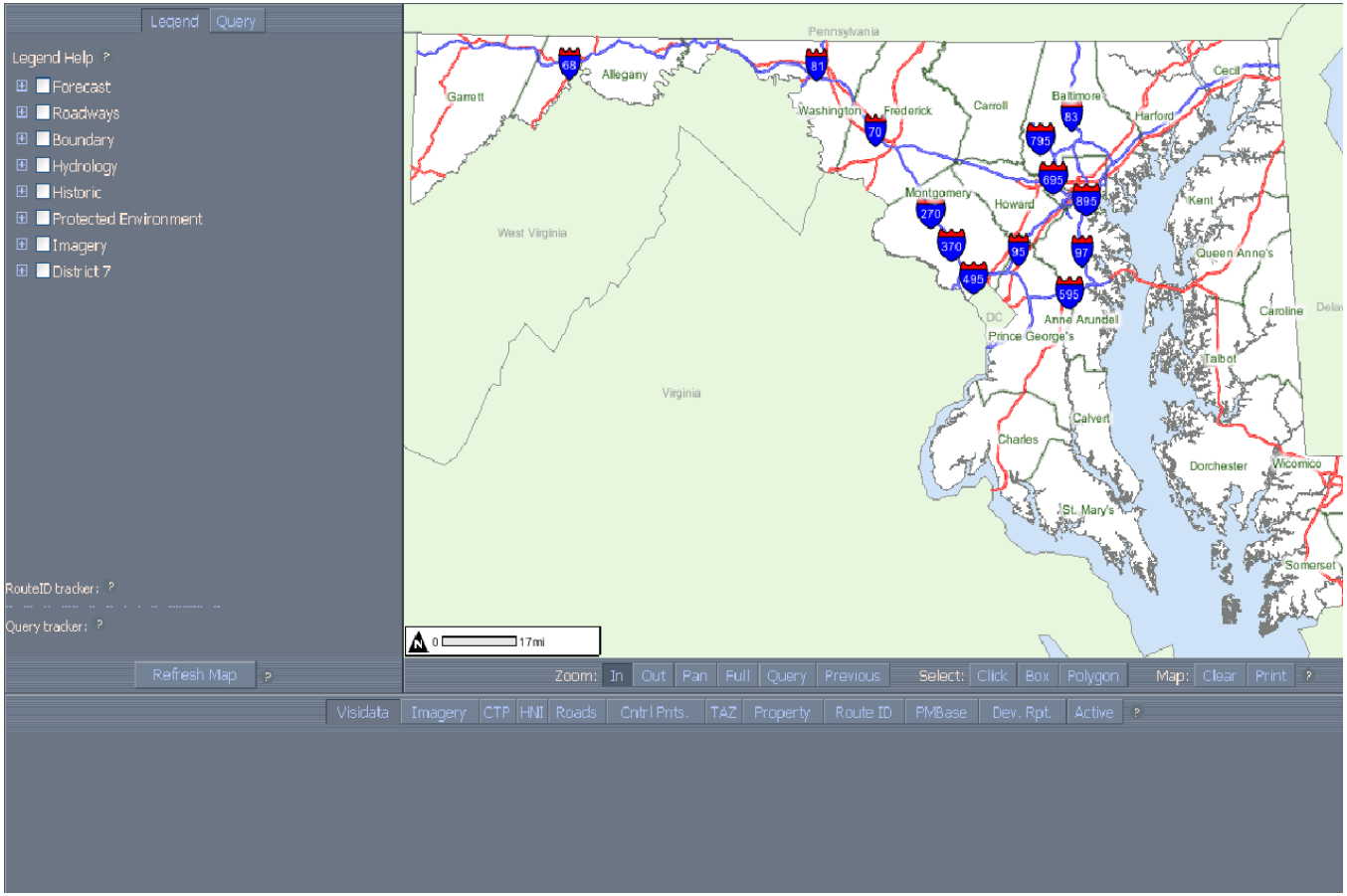


Figure 3.2

The legend tab and its menu in SHAWME system

Each of these options is a layer in the GIS map, and all include more detailed sub-layers. One can add or remove specific layers from the list above by selecting the box to the left of the layer. The 'Refresh Map' button below the layers is clicked in order to view the information on the map. Certain layers can only be viewed at specific scales, and this information is found by holding the mouse over the layer option. The names of layers are blue if the layer is visible at the current map scale and pink if it is not visible.

Imagery is a layer of interest for the potential plat layer. The sub-layers under imagery are currently SHA grids, SHA quarter grid index, property lines, property addresses, WDC imagery, and property (2007). This is an appropriate location for a layer of plat data because it is similar. Another option is to create a new layer specific for plats, below the District 7 layer.

4. Query Tab

The Query Tab is located in the upper left corner, adjacent to the Legend Tab. When selected, the message 'Step #1 Select a District and County' appears. Four drop down menus are displayed below the message. These are as follows:

- District
- County
- Municipality (optional)
- SHA Projects (optional)

When the user chooses a district, the county drop down menu only includes counties within that district. Municipality and SHA project should be selected if they are known. Three buttons below the drop down menus are 'Back,' 'Restart,' and 'Next.' The user should select 'Next' and move onto the next query. The message 'Step #2 Select the desired query type' is displayed. There are two options to choose from. These options are:

- Road Name
- Route Number

Once again, the user selects which type of query to run and clicks 'Next.' The message 'Step #3 Select the Route Prefix' is displayed. The 'Prefix' drop down menu includes CO, GV, MD, MU, OP, RP, SR, and US. The user selects one and clicks 'Next.' The message 'Step #4 Select a route number' is displayed. The 'Route' drop down menu includes all Route Numbers located in the selected District, County, and Route Prefix. The user selects the route number and

clicks ‘Next.’ The message ‘Step #5 Define the road section’ is displayed. The user decides how to sort intersections, by selecting MP (mile point) or Alpha (alphabetically). The starting and ending point of the road section must be defined. The road can be defined by mile point or intersecting road. The range of possible mile points is provided along with a drop down menu for intersecting roads. Finally, the message shown is ‘Step #6 You have queried for.’ Below this message is a summary of the query, including county, query by route number or road, route prefix and number or road name, and range of mile points. The map window also displays the location of your query and highlights the selected area. Figure C.1 in Appendix B shows one query in the SHAWME system.

5. Query Results

Results for queries are displayed at the bottom of the page. There are twelve categories of results, and each contains detailed information. Clicking on any result tab displays the information pertaining to the query area.

5.1. Visidata

In this tab the following data can be seen: county, direction (N, S, E, or W), route (prefix and number), BMP (beginning mile point), and EMP (ending mile point). Figure C.2 in Appendix B shows Visidata tab of one query.

5. 2. Imagery

Title, time period (year), IMG type (black and white or color), IMG format, server, and metadata are available in this tab. In Figure C.3 in Appendix B imagery tab is shown.

5. 3. CTP (Consolidated Transportation Program)

Some data such as county, item, CTP aggregate, and project information form are accessible in this tab.

5.4. HNI (Highway Needs Inventory)

In this tab the following data can be seen: district, county, route, improvement type, and length.

5.5. Roads

The following data are available in this tab: county, ML (mainline code), route, road name, MS (municipal area code), associated prefix, exit number, ramp, and HLR (highway location reference pop-up). Figure C.4 in Appendix B shows the road tab.

5.6. Cntrl Pnts. (Control Points)

The following data are available in this tab: designation, county, latitude, longitude, QUAD (USGS Quadrangle), and DS (NGS Datasheet Pop-up).

5.7. TAZ (Transportation Analysis Zones)

Some data such as TAZ zone (transportation analysis zone number), HHolds 2005 (households in 2005), HHolds 2030 (households in 2030), Pop 2005 (population in 2005- households and group quarter population), Pop 2030 (population 2030- households and group quarter population), Emp 2005 (employment in 2005- industrial, retail, office, and other employment), and Emp 2030 (employment in 2030- industrial, retail, office, and other employment) are accessible in this tab. In Figure C.5 in Appendix B TAZ tab is shown.

5.8. Property (Parcel Information)

The following data are available in this tab: ACCT # (account number), owner, address, city, zip code, and SDAT (Maryland Department of Assessments and Taxation). Figure C.6 in Appendix B shows property tab of one query.

5.9. Route ID (Route Identifier)

In this tab the following data can be seen: clip (copy the full route ID), route ID (full route ID), CN (county number), Mn (municipality code), Px (route prefix), route (route number), Sx (route suffix), ML (mainline code), MD (mile point direction), CD (calibration direction), AP

(associated ID prefix), exit number, and Rmp (ramp number). Figure C.7 in Appendix B shows the route ID tab.

5.10. PMBase (Pavement Management)

This tab contains the following items: route ID (SHA route ID), county, prefix (route prefix), Rte No (route number), suffix (route suffix), Cal Dir (calibration direction), BMP (beginning mile point), EMP (ending mile point), Con Hist (link to PMBase- Construction History), perform (link to PMBase- Performance), frict (link to PMBase- Friction), and cracking (link to PMBase- Cracking).

6. Suggestions

The following suggestions are made to enhance the SHAWME system and integrate the prototype ORE database system developed by the University of Maryland.

1- Plats are not included in the SHAWME system. Since SHAWME has the GIS layers for the whole state, there is a good opportunity to insert plat files in this system and run visual queries on it. There is no need to insert a plat database into SHAWME directly because it can be accessed from OREMS. If this were implemented, one would only need to connect these systems to each other. In this case, the plat database should have the four X and the four Y coordinates to be used in the SHAWME system.

To run query from plats in SHAWME, the prototype system developed by the University of Maryland for SHA can be used. This system was developed based on Geographic Information Systems (GIS) technology. Users can access it through a GIS interface. They may query for plats by providing some information to the system. This includes specific keywords (e.g., project number, plat number, county, route number), specified boundaries (e.g., within a drawn rectangular or circular area), and specified alignments in cases where users want to retrieve plats that cover planned alignments.

The system offers a user-friendly interactive map-based interface. The system is specially designed to minimize organizational impact and eliminate the time-consuming manual query to the extent possible. All requests to the ORE related to the

plat database can be processed quickly as long as the query area is covered by the plats that are in the database. The System consists of the following three components. These components are summarized below.

a) The Query component: This component provides the query capability. This capability is available based on either text-based or map-based query. Text-based query allows users to enter a known keyword or a combination of keywords, and then the system will find the matched plat records. Map-based query is more versatile. It allows users to do the query via GIS-interface. For example, users may simply point and click on the map to obtain plat(s) that cover that point. In addition, users can draw a rectangle or circle and let the system find the plat(s) that overlap the drawn shape. Also, users may draw a line or series of lines that represent a route; and then the system can find the plat(s) that intersect with the drawn route.

b) The Display component: This component provides the display of the query results obtained from the query component. It performs the basic functions that are available in GIS software such as zoom-in/zoom-out, zoom-to-full-extent, pan, etc.

c) The Output component: This component allows the users to send the query results to a standard output device. These include standard printers and plotters.

The query component of this prototype system can be inserted into the query part of current the SHAWME system. The current SHAWME system does not have a database of plats. Therefore, it should be connected to OREMS to gain access to the plat database. Making adjustments in the code produced by University of Maryland will allow it to access the plat database from OREMS and GIS layers from the SHAWME system. In this case, the SHAWME system will be able to run a query over plats and show results.

2- In the SHAWME interface, there are some tabs such as Visidata, Imagery, HNI, and Roads at the bottom of the page. Another tab named “Plat” can be added to this part. Then, the output component of the University of Maryland prototype system can be inserted behind it. Therefore by clicking on any point of a map, a list of plats that cover that point can be shown.

3- Now, in the “Select” we see “click”, “Box”, and “Polygon”. To get a complete graphical query over plats, another button named “Line” is needed to search with line.

In other words, we should be able to draw a line to find plats either having intersections with the line or lie in the specific distance around the line.

4- The SHAWME system should be able to show plats on GIS layers. Therefore, after filtering some plat files, it should be able to highlight plat files selected. In addition, it should be able to show all plat files that are located along the road. In fact, if one chooses a specific road, it should show all plats which are along that road and highlight them.

7. Conclusion

The State Highway Administration Web Mapping Engine (SHAWME) is a very powerful application. It merges a large variety of geographical data across the state of Maryland into one web-based source. Currently there is no data regarding plats in any GIS layer of SHAWME. The structure of SHAWME includes a map with graphical query capabilities. A practical addition to the current system is to include a map based search for plats. Connecting SHAWME to the OREMS database would allow the stand alone automated prototype system developed by the University of Maryland to function within the SHAWME system, while accessing plat data from OREMS.

Appendix A

Coordinates of the Geo-referenced Plats

Table A.1

Coordinates of the geo-referenced plats

Number	Plat Number	X1	Y1	X2	Y2	X3	Y3	X4	Y4
1	56	1372309.958	580632.2502	1372582.318	582009.1803	1374361.735	581924.4461	1374086.349	580526.3325
2	218	1372337.194	580813.8234	1372779.022	582075.7571	1374552.387	581987.9967	1374122.664	580735.1417
3	950	1455416.186	627254.642	1455580.215	627060.5787	1456377.261	628287.3363	1456542.602	628091.9158
4	951	1456942.443	629078.508	1458023.066	630260.3375	1457559.476	628582.2702	1458636.834	629777.1586
5	966	1478385.258	655837.5272	1478825.328	655799.149	1478541.33	657139.8271	1478980.611	657099.2012
6	993	1470451.662	623184.2711	1470714.427	622503.155	1471779.319	623651.0258	1471516.554	624304.4824
7	1043	1458052.938	630727.7749	1458561.268	630263.3459	1459014.144	631779.0944	1459541.146	631290.3501
8	1090	1470628.662	623497.5388	1471084.379	623066.3227	1472008.064	623936.1052	1471527.846	624382.0218
9	1354	1447541.691	601239.938	1447944.356	600173.4204	1449729.141	602092.4266	1450139.061	601029.5366
10	1539	1449434.369	615092.4526	1450015.144	615446.5838	1450111.96	613913.2703	1450691.372	614271.0489
11	1543	1453097.777	607990.9823	1453540.428	608845.9655	1454216.532	607157.2221	1454671.31	608042.5239
12	1673	1454066.401	607955.5041	1454386.039	608388.4308	1455318.652	607722.8566	1455001.037	607289.9299
13	2675	1382036.981	588767.7772	1383322.122	589208.7961	1381971.128	589426.3122	1383381.989	588548.2656
14	2695	1444743.223	625897.464	1443793.282	626442.7432	1446091.709	627733.5116	1445076.031	628312.5721
15	2696	1445586.516	628056.8461	1445518.735	628109.7487	1445770.804	628497.7406	1445842.671	628443.215
16	4389	1383176.958	588624.1038	1381877.314	588843.0119	1383107.933	589300.5496	1381806.317	589523.402
17	5408	1360559.231	658409.6754	1360625.088	659054.2731	1361952.201	658772.8852	1361888.34	658124.2963
18	5409	1361574.837	658676.3373	1361841.678	657821.3569	1363241.232	659286.2597	1363521.687	658434.0021
19	5410	1363291.749	659061.1997	1363442.867	658610.9628	1364402.541	658953.7037	1364251.424	659400.8248
20	5411	1364202.753	659588.3784	1364465.289	658802.9963	1365526.556	660048.9282	1365789.091	659265.771
21	6067	1446651.735	617501.3519	1447287.864	617092.1228	1446193.885	615803.6589	1445569.912	616225.0433
22	6076	1446646.377	617499.7236	1447295.267	617089.3964	1446207.422	615804.3405	1445564.894	616221.0294
23	6451	1363300.022	659055.7975	1363452.622	658610.4525	1364249.884	659393.6992	1364404.041	658949.9113
24	9044	1472573.302	625328.7206	1472803.325	625687.7804	1472670.281	625761.516	1472438.655	625400.0517
25	10672	1455667.595	609423.3763	1456169.314	609639.0687	1456406.107	608124.5332	1456907.826	608333.1921
26	10716	1403187.913	574924.7677	1403840.359	575210.529	1404556.027	573847.4729	1403908.639	573566.7693
27	13469	1410544.519	667292.6612	1411236.444	667318.9066	1411420.162	665882.5656	1410733.009	665849.1623
28	13470	1410779.007	667036.7647	1411341.412	667046.1381	1410746.2	668234.2169	1411306.261	668252.9637
29	13471	1410719.93	669249.8726	1411338.579	669141.2799	1411266.184	667558.4583	1410650.825	667667.051

Table A.1 (Cont'd)

Coordinates of the geo-referenced plats

Number	Plat Number	X1	Y1	X2	Y2	X3	Y3	X4	Y4
30	13472	1410432.306	668595.6664	1411108.985	668387.2251	1411791.706	669776.8337	1411118.047	669979.2332
31	16522	1456598.035	606447.2152	1457907.022	605578.048	1458284.01	607955.1678	1456964.551	608819.0991
32	20761	1444085.426	626747.0219	1444918.334	626157.521	1445321.476	628572.573	1446184.81	627979.2689
33	20774	1445536.258	628618.9631	1446548.016	627891.3422	1446215.883	627394.1025	1445209.885	628119.8036
34	21095	1456039.744	609705.0039	1455601.02	609344.6236	1457039.93	608511.5706	1456603.818	608153.8017
35	24139	1371966.141	581847.3391	1370930.717	582489.7175	1371309.911	582943.3648	1372338.409	582297.5234
36	24140	1371259.643	582321.7318	1371631.971	582545.5142	1370262.268	583313.3194	1370636.525	583537.1018
37	24899	1445609.212	628665.0394	1445236.762	628094.8457	1446244.681	627378.7438	1446617.13	627952.7772
38	25156	1370825.181	583420.3693	1370996.366	583637.0823	1371458.93	583271.9482	1371286.834	583057.0563
39	26473	1443666.084	628325.0795	1443009.712	627340.5204	1445977.658	627062.2755	1445324.852	626077.7164
40	26873	1370978.828	583003.9693	1370779.201	583184.5668	1370657.932	583150.2384	1370857.932	582969.2678
41	30752	1382493.588	589638.2608	1382761.875	588411.8069	1385285.048	588945.1866	1385016.761	590168.4465
42	32340	1174818.715	638833.1021	1175528.047	639259.9034	1173900.783	640351.1769	1174613.456	640780.0746
43	32341	1173609.29	641779.9612	1174296.362	641982.9598	1174730.987	640522.9311	1174043.915	640319.9324
44	32342	1173728.941	641771.0806	1174411.844	641752.8699	1173774.467	643223.3888	1174455.095	643200.6254
45	32343	1173775.273	644159.8402	1173846.106	642981.7841	1174399.718	643015.3364	1174330.749	644195.2565
46	32344	1173728.029	645234.6324	1174300.838	645265.595	1174362.763	644052.2464	1173795.76	644023.219
47	32345	1173127.658	645974.648	1173600.222	646300.8424	1174292.339	645292.9855	1173821.866	644968.8822
48	32346	1172221.411	646573.9843	1172616.787	647063.497	1173662.754	646222.5393	1173267.378	645730.9346
49	32347	1171129.086	647052.1483	1171454.201	647625.5329	1172685.697	646931.9542	1172360.582	646356.5992
50	32348	1170229.084	647881.0654	1170599.76	648327.936	1171617.06	647465.0844	1171244.325	647022.3323
51	32349	1169850.18	649210.8331	1170459.995	649473.8905	1171014.807	648184.9093	1170409.775	647924.2433
52	32350	1169529.288	650497.5193	1170195.082	650632.5737	1170486.515	649222.7958	1169825.46	649083.0027
53	32351	1169239.927	651614.6837	1169849.417	651798.2103	1170241.393	650502.1952	1169636.435	650318.6686
54	32352	1168657.366	652385.8874	1169122.937	652749.6151	1169896.118	651762.3541	1169432.625	651402.7832
55	32353	1168710.397	652182.7852	1169177.716	652606.0172	1168269.53	653604.5802	1167800.007	653179.1439
56	32369	1174002.112	641369.2785	1173312.614	641360.1158	1173395.079	642823.8677	1174089.158	642826.1584
57	32373	1170545.07	647709.1869	1170935.743	648294.1409	1172040.187	647550.8059	1171647.402	646965.852
58	32376	1170652.487	647878.6962	1171251.079	646562.5998	1170646.44	646602.909	1171255.11	647840.4024

Table A.1 (Cont'd)

Coordinates of the geo-referenced plats

Number	Plat Number	X1	Y1	X2	Y2	X3	Y3	X4	Y4
59	32377	1170787.623	648787.3775	1171254.596	648715.7977	1170739.903	647768.2178	1171209.346	647692.2374
60	32378	1174740.929	639620.0223	1176150.915	639357.3337	1176606.691	640351.9579	1175198.95	640623.6273
61	32379	1171478.554	647391.1599	1171803.381	647969.5101	1173035.346	647274.3015	1172710.519	646697.932
62	32381	1173580.845	643453.2641	1173525.757	642267.9156	1174082.338	642243.2209	1174139.326	643426.6697
63	32382	1172296.693	640958.9614	1174000.003	640454.6166	1173766.17	639656.8349	1172065.153	640165.7646
64	32383	1173369.227	639722.1331	1175114.881	639272.5674	1175447.273	640157.351	1173706.402	640606.9167
65	32385	1174320.485	640649.8196	1175028.132	641085.2948	1175962.589	639561.1315	1175251.918	639128.6804
66	32387	1173989.005	641896.5463	1174404.818	640450.023	1175082.718	640646.5889	1174666.906	642095.6323
67	32677	1178960.142	641086.1994	1178596.413	640535.5542	1179715.385	639833.3554	1180076.588	640389.0523
68	32678	1177738.231	641300.9157	1177663.934	640715.3835	1178916.371	640419.9639	1178990.669	641010.8031
69	32679	1177848.989	641255.9226	1176215.764	641477.2754	1176335.414	640211.9746	1177971.631	639984.6392
70	32680	1176455.43	640769.9433	1176391.742	641525.0957	1174842.011	641867.7954	1174905.699	641106.5775
71	32681	1176528.215	640421.1781	1176391.742	641273.3782	1174857.175	641458.3754	1174993.649	640603.1425
72	32682	1175390.938	641924.811	1174805.619	642134.0701	1174517.508	640829.9915	1175093.729	640614.6669
73	32683	1175111.735	642217.7821	1174685.38	642255.3227	1174309.974	640954.8071	1174728.284	640917.2664
74	32684	1174243.934	642795.732	1175013.632	642798.4712	1174934.197	641409.7278	1174164.499	641409.7278
75	32685	1174946.412	644377.7037	1174193.074	644310.5045	1174260.273	642616.3788	1175045.442	642641.1364
76	32686	1173755.044	644556.085	1173783.5	644025.9211	1175237.706	644043.8927	1175209.251	644578.5495
77	32687	1173962.542	644296.3581	1173910.614	644969.9405	1175351.661	644983.1743	1175406.407	644307.9746
78	32688	1174498.896	646000.9404	1173856.817	645900.6902	1174260.205	644786.0025	1174904.671	644886.2528
79	32689	1173302.836	647487.6343	1172745.339	646926.0977	1173985.567	645459.639	1174530.944	646021.1755
80	32690	1173236.965	648063.634	1172472.655	648045.8594	1172643.292	646218.6271	1173400.491	646232.8468
81	33100	1170435.878	648117.1728	1170842.951	648585.0966	1171845.944	647712.1984	1171436.773	647242.1763
82	33409	1170517.476	648917.1925	1169928.42	648005.2452	1171874.489	646770.4074	1172459.182	647677.9914
83	33418	1169014.78	653091.1761	1164985.925	650724.7126	1172456.909	643371.0738	1176740.013	645796.21
84	33479	1173971.824	648174.9937	1171753.104	647406.9752	1173939.823	642681.5279	1176137.21	643449.5464
85	33504	1173609.149	648238.9953	1171571.766	647182.9698	1173833.154	642852.1986	1175870.537	643908.2241
86	33505	1177914.193	638530.5913	1177227.633	637411.9708	1178358.09	635577.1964	1179050.57	636695.8169
87	33691	1170674.082	649222.5917	1169956.088	648504.5973	1171560.215	646977.7231	1172273.665	647695.7175

Table A.1 (Cont'd)

Coordinates of the geo-referenced plats

Number	Plat Number	X1	Y1	X2	Y2	X3	Y3	X4	Y4
88	34521	1170399.2	650795.7605	1168389.119	649436.5634	1170925.649	645933.2807	1172926.158	647282.906
89	34547	1170194.473	651571.0302	1168945	651304.3743	1169897.342	647510.2423	1171139.197	647784.5169
90	34548	1170857.303	651456.7491	1169028.806	651075.8121	1169615.449	647578.8109	1171428.709	647959.7479
91	34739	1168372.163	655431.5068	1167144.64	654990.1501	1168454.918	651907.5494	1169668.649	652335.1137
92	34807	1170571.111	648455.7945	1170154.755	647752.768	1171652.953	646728.943	1172069.308	647425.144
93	34829	1173504.239	640591.9532	1172993.947	639732.9006	1174763.448	638756.3708	1175277.411	639608.081
94	34997	1173817.234	640367.1476	1173493.948	639932.3052	1174427.379	639233.3701	1174746.112	639670.4891
95	35010	1170161.762	650600.6969	1168896.379	649719.4478	1170824.582	646819.6112	1172097.497	647708.3923
96	35012	1169960.072	650232.1239	1168447.784	648863.8634	1171364.339	645668.2551	1172858.624	647027.5138
97	37203	1171374.146	648646.4701	1170661.013	647526.5872	1173043.405	645999.9544	1173756.538	647119.8373
98	38598	1170818.271	648289.231	1170479.885	647871.5367	1171376.077	647036.1482	1171709.175	647453.8425
99	40943	1170171.954	649522.3406	1169646.321	649356.2078	1170008.545	648228.6839	1170534.178	648397.5401
100	40944	1170123.138	650468.9028	1169498.913	650334.2662	1169783.486	648990.9604	1170404.65	649131.7168
101	41928	1174391.793	644205.1334	1173737.949	644184.3293	1173785.501	642784.509	1174439.345	642805.3131
102	42944	1443799.681	626357.049	1444597.644	627581.8288	1445082.784	627136.4543	1444282.17	625909.0235
103	43356	1371617.479	582621.1636	1370544.624	583618.6903	1370320.922	583159.8737	1371396.06	582162.3469
104	43731	1424535.677	632548.968	1424985.39	632427.2569	1424801.792	631680.4866	1424333.513	631750.6252
105	44187	1424757.453	631546.9599	1424285.252	631646.1221	1424508.76	632590.5236	1424979.387	632488.2134
106	44211	1466222.018	614907.5235	1466663.944	614433.7924	1467226.395	615038.0926	1466787.817	615508.4758
107	44472	1424352.899	632479.8805	1425050.604	632524.3976	1425099.977	632213.5872	1424402.272	632177.1641
108	46260	1169343.387	653603.7133	1167576.51	652546.8895	1169335.131	649632.3677	1171102.008	650697.4479
109	46261	1170520.82	650959.1234	1168519.405	650119.8205	1169980.115	647028.926	1171997.67	647884.3694
110	46315	1174879.446	647210.0712	1172437.212	647240.2222	1172407.061	643629.6367	1174864.37	643591.9479
111	46316	1445788.689	628799.8082	1446092.689	628549.9292	1446215.901	629292.6572	1446524.508	629045.0812
112	46411	1455560.124	606302.1029	1456833.501	605721.879	1457678.526	607645.5745	1456409.042	608225.7984
113	47235	1445784.226	628868.4938	1446369.206	629374.2841	1446702.568	629054.972	1446115.033	628550.459
114	47557	1621545.953	340876.7981	1621668.496	340153.7932	1622930.691	341113.1315	1623056.735	340390.1266
115	47558	1622698.531	341023.8926	1624096.023	341192.2229	1624201.23	340338.2974	1622801.984	340169.9671
116	47559	1624118.306	340406.3154	1624010.188	341128.6045	1625185.973	341301.2932	1625297.094	340579.0041

Table A.1 (Cont'd)

Coordinates of the geo-referenced plats

Number	Plat Number	X1	Y1	X2	Y2	X3	Y3	X4	Y4
117	47560	1625198.813	341395.6551	1626707.53	341160.4559	1626567.94	340246.4297	1625053.487	340481.6289
118	47561	1626307.81	340351.6381	1626799.562	341118.7711	1628060.905	340319.6742	1627576.53	339550.0825
119	47562	1627526.783	339830.0979	1627814.523	340245.1083	1628493.757	339777.5299	1628210.166	339361.1362
120	47563	1628159.952	340128.3458	1627847.042	338922.2209	1630282.049	339530.9726	1629977.673	338327.6923
121	47564	1629912.326	339504.9245	1631009.433	339396.3	1630945.616	338728.2598	1629845.793	338836.8842
122	47565	1630946.847	339446.2526	1632076.305	339113.4946	1631874.73	338423.9818	1630743.673	338755.1399
123	47566	1631789.057	338449.4894	1631973.345	339171.4233	1633170.369	338823.1367	1632991.153	338101.2028
124	47567	1633105.017	338844.7942	1632793.906	338020.6581	1634503.988	338354.4332	1634199.058	337532.3575
125	47568	1634302.899	338511.4982	1635684.045	337974.2651	1635362.14	337128.1774	1633974.469	337665.4105
126	47849	1454755.514	607953.9813	1455498.694	607504.4481	1455243.112	607038.6012	1454498.12	607488.1344
127	47850	1455319.669	608099.3241	1454948.579	607769.7228	1455240.149	607357.145	1455611.239	607691.3561
128	47852	1457071.158	608786.9364	1456690.641	609188.891	1456056.446	608695.8266	1456440.536	608288.5126
129	47990	1633974.79	337666.3327	1634296.682	338502.829	1635681.666	337973.401	1635364.009	337139.0223
130	48204	1621536.585	340883.2124	1622872.926	341143.1535	1623063.084	340380.7761	1621724.998	340120.835
131	48307	1361878.762	658915.3582	1361657.806	657881.0971	1359847.849	658344.164	1360071.156	659380.7756
132	48516	1455279.333	608206.5021	1455570.903	607801.9915	1455194.051	607471.2378	1454904.786	607880.3582
133	49496	1411580.077	663908.4122	1411962.151	664047.0197	1411365.536	664543.596	1411748.816	664674.9718
134	49497	1411349.59	665091.6995	1411721.997	665221.6905	1411924.595	664592.8149	1411552.189	664461.6528
135	49498	1411104.7	665477.8375	1411486.119	665605.3672	1411697.888	664972.3989	1411317.639	664843.6992
136	49499	1410989.784	665861.522	1411370.49	665997.0673	1411583.826	665365.3084	1411206.657	665230.9417
137	49500	1410661.556	666431.179	1411071.388	666560.6659	1411341.676	665874.2594	1410931.844	665746.0296
138	50377	1456329.277	629120.0674	1457612.08	630502.0925	1458338.529	629587.8297	1457062.814	628205.8046
139	50510	1413813.007	656644.0958	1414692.43	657106.9502	1415315.504	655255.5324	1414443.201	654789.1176
140	50511	1413749.731	657764.5447	1414183.887	657924.1408	1414427.339	657207.3109	1413993.183	657043.6573
141	50512	1412891.782	659386.5058	1414042.423	659764.1702	1414695.395	657854.6708	1413537.694	657469.9473
142	50513	1412481.419	660726.6761	1413455.85	661085.1931	1413985.965	659442.7561	1413014.598	659090.3676
143	50514	1411893.113	662400.778	1413008.556	662561.8976	1413622.05	660699.7266	1412497.311	660544.8039
144	51265	1412432.717	661431.0897	1412930.819	661520.6363	1413216.249	660706.3224	1412715.348	660616.7759
145	51266	1412429.327	661797.41	1412719.381	661886.7922	1412866.598	661410.9635	1412579.173	661320.7051

Table A.1 (Cont'd)

Coordinates of the geo-referenced plats

Number	Plat Number	X1	Y1	X2	Y2	X3	Y3	X4	Y4
146	51267	1412192.67	662310.8666	1412580.179	662442.4283	1412802.638	661797.776	1412409.149	661665.0184
147	51268	1411919.13	662915.1389	1412368.087	663068.4747	1412623.647	662321.1351	1412171.927	662167.7992
148	51269	1411588.329	663679.1133	1412192.994	663788.0477	1412504.009	662872.3672	1411900.923	662763.4328
149	51528	1411907.412	662353.9447	1413007.074	662555.2912	1413611.114	660733.8793	1412502.159	660535.6304
150	51725	1411986.424	659375.4624	1414026.291	659316.1926	1413942.326	658051.7713	1411897.519	658113.5106
151	51840	1405755.189	579053.5913	1407286.915	578702.0476	1406395.501	576333.3122	1404855.404	576672.3008
152	51860	1189287.262	630437.6327	1189166.081	632154.3664	1191761.378	632541.473	1191875.827	630834.8377
153	51923	1467136.05	640713.4466	1468778.745	642149.8321	1469518.348	641067.6771	1467863.974	639623.5063
154	51929	1469543.995	642619.1779	1470901.615	643688.1935	1470188.938	641791.6479	1471555.393	642863.6084
155	51930	1470528.164	643574.4864	1471115.263	642645.6437	1472639.967	643612.4579	1472058.71	644538.3798
156	51931	1471793.542	644260.6867	1472003.844	643335.3558	1473349.78	644235.4504	1473139.477	645160.7812
157	52015	1412074.068	659255.7017	1413769.468	659156.6855	1413727.033	658134.1918	1412021.529	658229.1665
158	52016	1413087.751	659319.1269	1412965.752	658287.4906	1414827.834	659045.1654	1414712.257	658019.95
159	52017	1412657.218	659053.0712	1414180.425	659560.807	1415042.179	657045.4187	1413523.63	656523.7085
160	52028	1413263.07	658391.7047	1414111.756	658678.0395	1413639.69	660071.0198	1412788.424	659802.7421
161	52049	1412508.458	661331.7625	1412747.572	660651.2971	1413159.182	660739.3293	1412920.068	661419.7947
162	52050	1412508.25	661639.7636	1412746.379	661714.5837	1412868.681	661323.2167	1412631.271	661248.3965
163	52051	1412411.702	661473.3403	1412923.804	661644.0407	1412127.733	662317.2707	1412643.025	662489.5665
164	52052	1411907.755	662933.3181	1412366.257	663089.4338	1412623.637	662331.3587	1412162.322	662173.8366
165	52053	1411991.959	663174.2574	1412187.914	663206.5746	1412290.509	662908.025	1412093.015	662874.1688
166	52068	1410812.974	660207.6334	1413143.514	660043.2629	1413037.847	657284.1857	1410724.919	657460.297
167	52247	1468659.071	641836.8297	1469211.643	641182.4676	1470292.552	642098.5745	1469739.98	642752.9365
168	52325	1411726.54	663496.0431	1412199.205	663559.8383	1412435.537	662885.6387	1411958.523	662821.8435
169	52335	1409010.122	658819.6531	1410679.627	659756.1108	1411316.725	658739.0563	1409643.382	657806.4366
170	52336	1407955.002	657955.3009	1409490.721	658860.1491	1410035.072	657940.881	1408499.353	657028.8228
171	52337	1408303.37	658017.1549	1408852.555	657360.6578	1407728.935	656416.9434	1407182.906	657063.9717
172	52338	1407294.677	657165.0107	1408207.86	657170.8458	1408032.809	655685.8285	1407119.625	655679.9935
173	52339	1407100.47	655857.9377	1408001.21	656353.8507	1408834.479	654852.6175	1407923.618	654364.1264
174	52340	1407825.785	654734.543	1408632.065	655314.7949	1409374.248	654201.5209	1408561.22	653614.5219

Table A.1 (Cont'd)

Coordinates of the geo-referenced plats

Number	Plat Number	X1	Y1	X2	Y2	X3	Y3	X4	Y4
175	52341	1407704.057	658693.7159	1409306.709	659483.8817	1409788.845	658528.54	1408181.728	657720.5173
176	52343	1408690.648	658332.1146	1410070.09	659635.665	1410931.683	658666.9306	1409529.92	657358.916
177	52344	1361008.209	471934.7009	1360352.564	471163.1418	1361652.986	470087.3058	1362301.385	470866.1096
178	52346	1410623.942	660272.1152	1409653.253	659605.3338	1411794.211	658643.7172	1410828.059	657972.3999
179	52544	1411983.209	659336.4391	1413974.441	659294.3882	1413910.128	658097.1754	1411916.422	658139.2262
180	52633	1408979.593	658880.8536	1410646.225	659818.8373	1411338.642	658707.7493	1409672.01	657765.7399
181	52710	1480467.695	654852.0787	1481580.358	654521.6262	1481258.271	652718.7774	1480133.059	653053.4129
182	52839	1189471.537	632224.8132	1191588.884	632529.4674	1191887.445	630926.9864	1189767.052	630625.3787
183	52870	1410684.255	659751.8877	1411314.953	658741.8576	1409642.233	657804.9517	1409011.536	658819.5522
184	52932	1194403.109	631035.7826	1197535.478	630553.0421	1196936.59	631834.3008	1195001.998	629750.8942
185	52933	1193950.446	630995.2078	1194653.937	631916.6812	1195241.83	630711.1695	1194538.34	629786.3933
186	52934	1194034.441	631172.7621	1194860.772	630763.6873	1193360.831	629803.725	1194192.616	629397.3774
187	52935	1192508.583	631723.5832	1192128.176	630875.1753	1193917.591	630247.0032	1194292.992	631087.903
188	52936	1191426.503	631685.4405	1192023.662	632373.9004	1192862.645	631463.3566	1192260.551	630777.3643
189	52945	1194469.448	633586.1847	1195995.317	634074.4626	1195422.529	631050.8953	1196967.178	631553.2582
190	52947	1195906.248	633583.8474	1197466.83	634034.9889	1198364.509	631503.072	1196803.928	631051.9304
191	53051	1195269.142	630340.1806	1196395.826	631750.903	1199307.216	630217.0975	1198166.33	628815.843
192	53726	1411269.25	659710.7553	1411296.672	657398.1975	1407425.651	657393.6272	1407411.94	659706.185
193	53763	1412594.219	661273.9502	1412819.307	661429.2434	1412925.744	661147.4473	1412701.529	660992.1541
194	53775	1459284.442	631566.5699	1459590.614	631257.7236	1459095.925	630714.9029	1458792.427	631022.4122
195	54082	1457573.953	609927.4837	1457856.386	609566.9799	1458374.18	609980.2964	1458092.895	610338.504
196	54219	1470851.217	623781.3994	1471307.467	624559.8751	1471988.989	623536.1653	1471529.888	622751.9865
197	54366	1193942.756	630998.2857	1194538.656	629793.3168	1195246.493	630711.8587	1194653.885	631913.5354
198	54486	1193204.29	629876.7789	1194161.355	629483.752	1192481.24	628340.6739	1193438.306	627944.6468
199	55214	1472268.619	626605.5136	1471890.539	625936.292	1472949.971	625295.3757	1473326.029	625962.5756
200	55328	1472239.035	626660.0262	1473353.106	625958.8924	1472953.073	625262.06	1471836.851	625958.8924
201	55379	1194366.59	632091.6156	1194734.829	631061.7946	1197028.521	631710.8939	1196660.282	632737.5943
202	55395	1196096.412	632519.8475	1196952.649	632897.4805	1197556.458	631968.5437	1196704.259	631592.9301
203	55466	1467285.112	619822.9661	1468504.621	619004.0901	1469882.622	621020.4621	1468667.516	621843.7406

Table A.1 (Cont'd)

Coordinates of the geo-referenced plats

Number	Plat Number	X1	Y1	X2	Y2	X3	Y3	X4	Y4
204	55467	1469607.789	622267.4875	1470111.371	621825.1255	1468879.077	621432.1343	1469384.633	620987.7975
205	55468	1470121.005	622998.0553	1470712.857	622473.7772	1469240.218	622017.0727	1469834.4	621492.7946
206	55469	1470972.087	623702.2691	1471765.966	622999.6405	1469773.664	622443.0127	1470573.627	621740.3841
207	55473	1193159.011	629942.1349	1194220.213	629388.1743	1192451.544	628407.0634	1193506.071	627849.7656
208	55563	1523098.782	690546.6763	1523502.199	690550.9909	1523490.333	689860.6518	1523082.602	689855.2585
209	55564	1523308.303	690267.769	1523460.065	689819.3298	1524177.796	690104.5965	1524027.176	690554.1768
210	55565	1523809.941	690444.588	1523994.293	690007.3424	1524588.71	690325.2317	1524403.176	690761.2956
211	55983	1523787.763	690433.9629	1523998.265	690008.0345	1524480.82	690802.0339	1524691.322	690379.7986
212	55984	1523310.341	690270.4009	1523462.246	689819.3945	1524178.204	690126.7383	1524027.476	690573.0344
213	56212	1387666.16	591348.1263	1388907.257	591280.2538	1388913.721	590304.1829	1387674.24	590376.9034
214	56654	1412074.381	662859.5534	1412434.311	662988.6887	1412633.509	662410.3277	1412272.205	662279.8187
215	TO	1388571.664	679430.6104	1389664.653	679805.3496	1388514.412	682418.1142	1387390.195	682126.6504
216	TP	1386854.87	682534.5888	1388410.862	680390.6647	1389480.29	681074.8958	1387929.366	683208.6831
217	UF	1444660.652	615256.4249	1445159.333	614834.0726	1446067.644	615907.7634	1445568.963	616325.0271
218	UR	1371182.933	661353.603	1370334.69	662356.9018	1372177.111	663916.5755	1373002.552	662885.9139
219	US	1373723.931	667603.2612	1373237.129	668169.0736	1374246.416	669038.1817	1374730.669	668467.272
220	VN	1423095.139	624743.0099	1423701.876	624591.8812	1423957.461	625680.8965	1423355.169	625816.4678
221	VO	1423770.168	628042.0147	1424408.968	627897.2866	1424663.489	629055.1111	1424019.699	629219.8017
222	ZA	1388014.302	678886.9497	1386840.277	680438.5501	1388781.253	682249.7338	1389961.177	680662.7357
223	ZB	1388434.456	680091.9715	1388109.079	680550.1179	1389118.871	681150.3832	1389459.208	680692.2368
224	ZR	1406366.363	576726.6537	1405638.772	576583.1153	1405576.902	578117.4917	1406302.018	578256.0805
225	ZT	1405196.579	576657.3458	1405868.832	578304.7991	1405981.355	576386.1363	1406647.838	578016.2784

Appendix B

SHAWME Figures

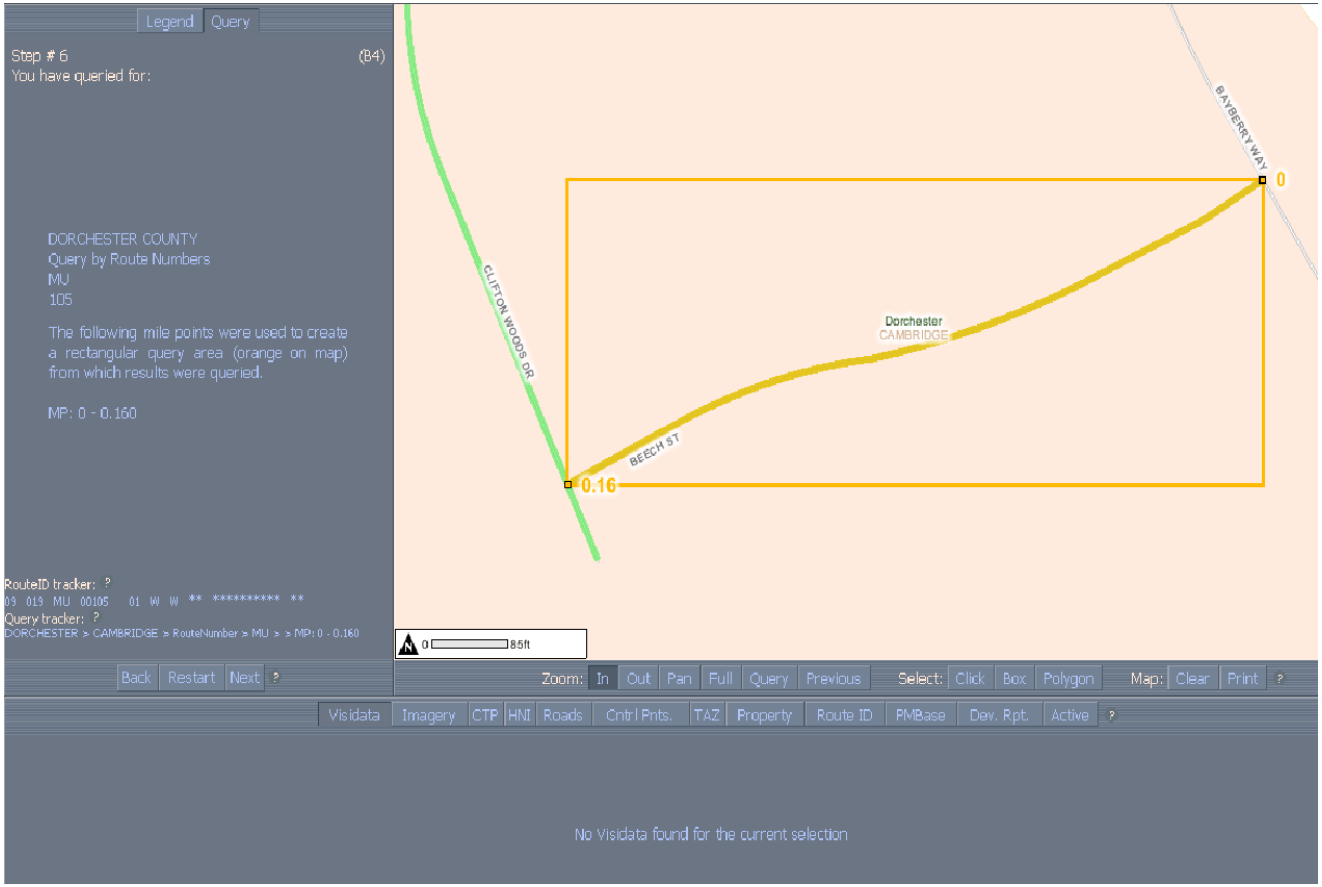


Figure C.1

One query in SHAWME system

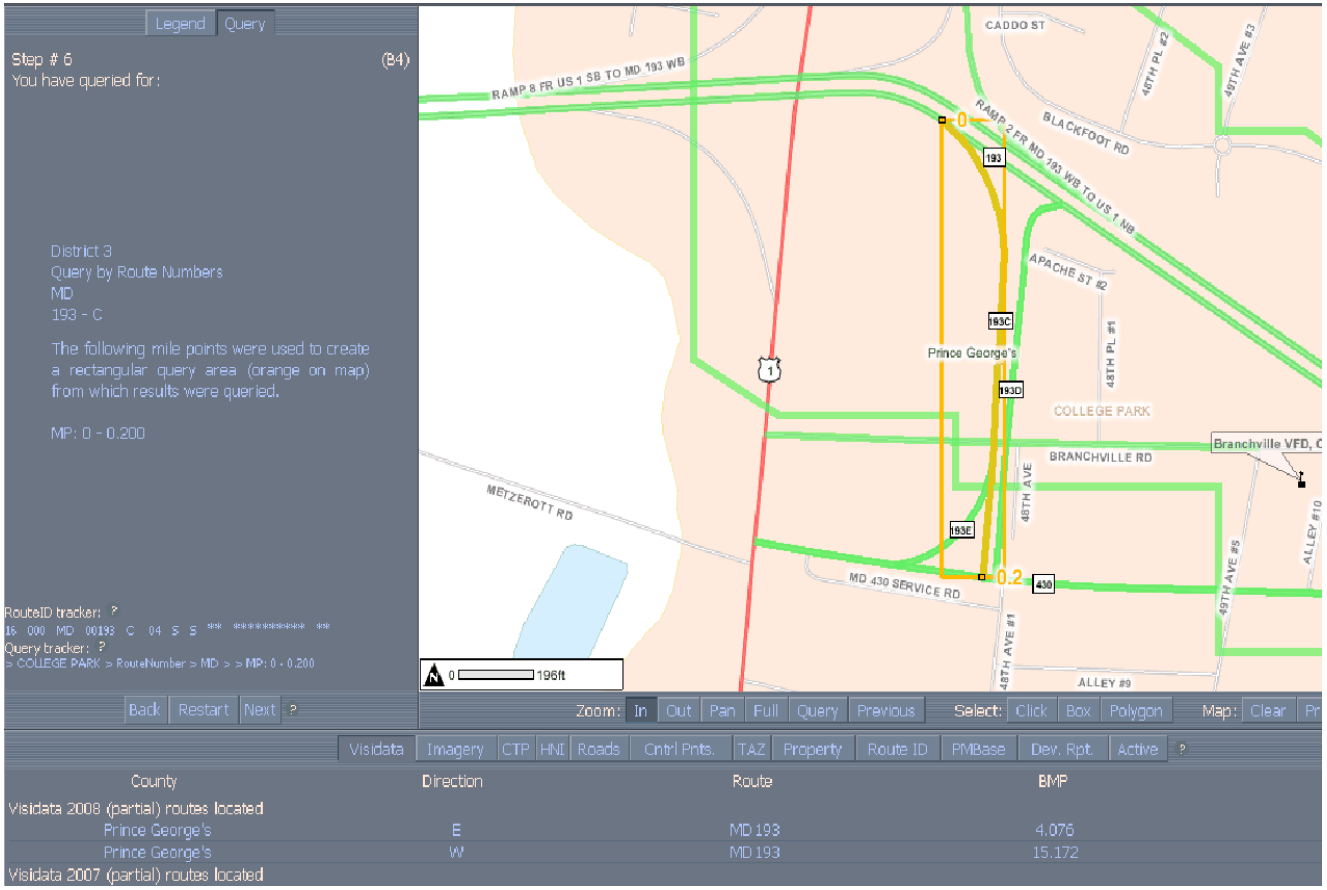


Figure C.2

Visidata tab query in SHAWME system

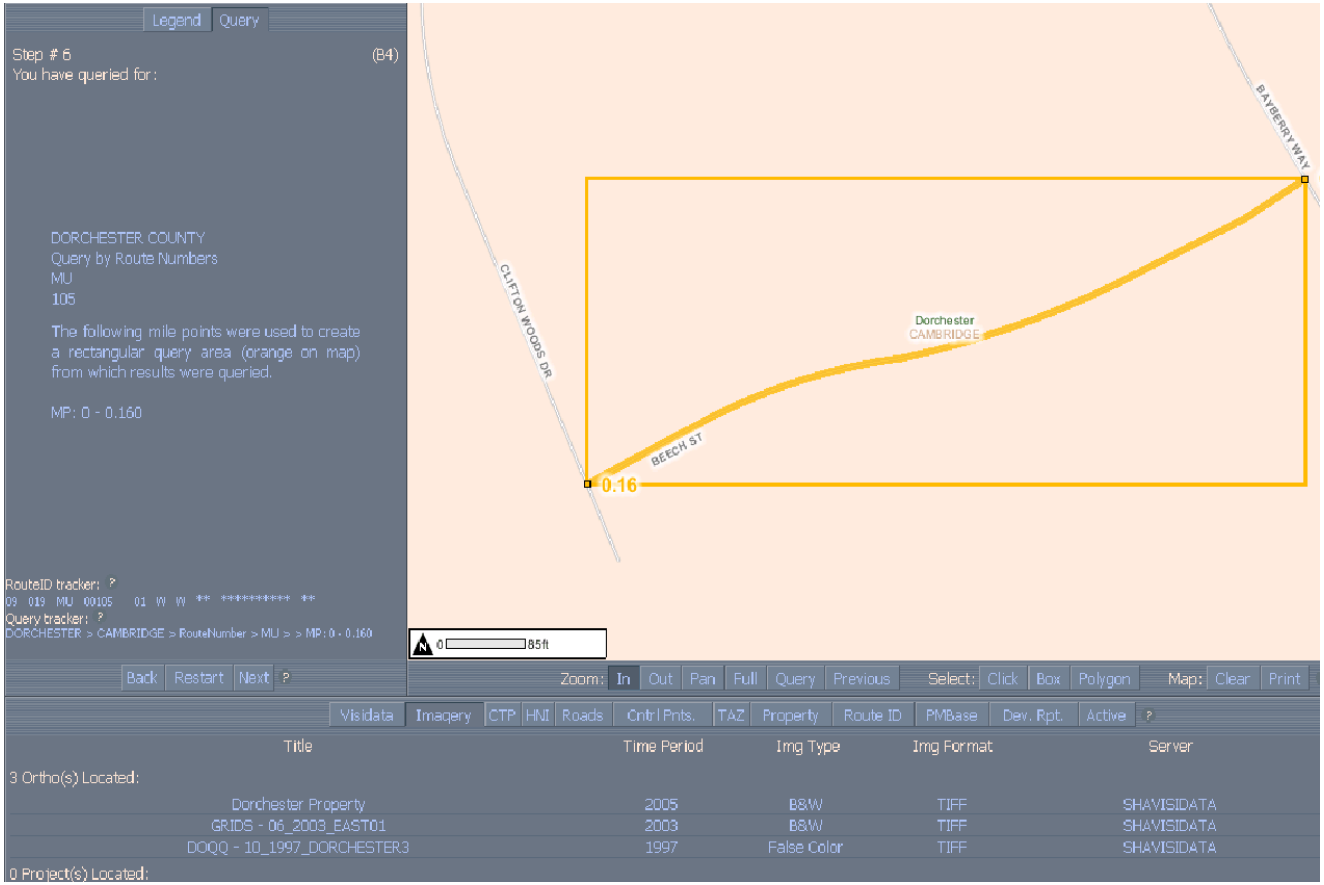


Figure C.3

Imagery tab query in SHAWME system

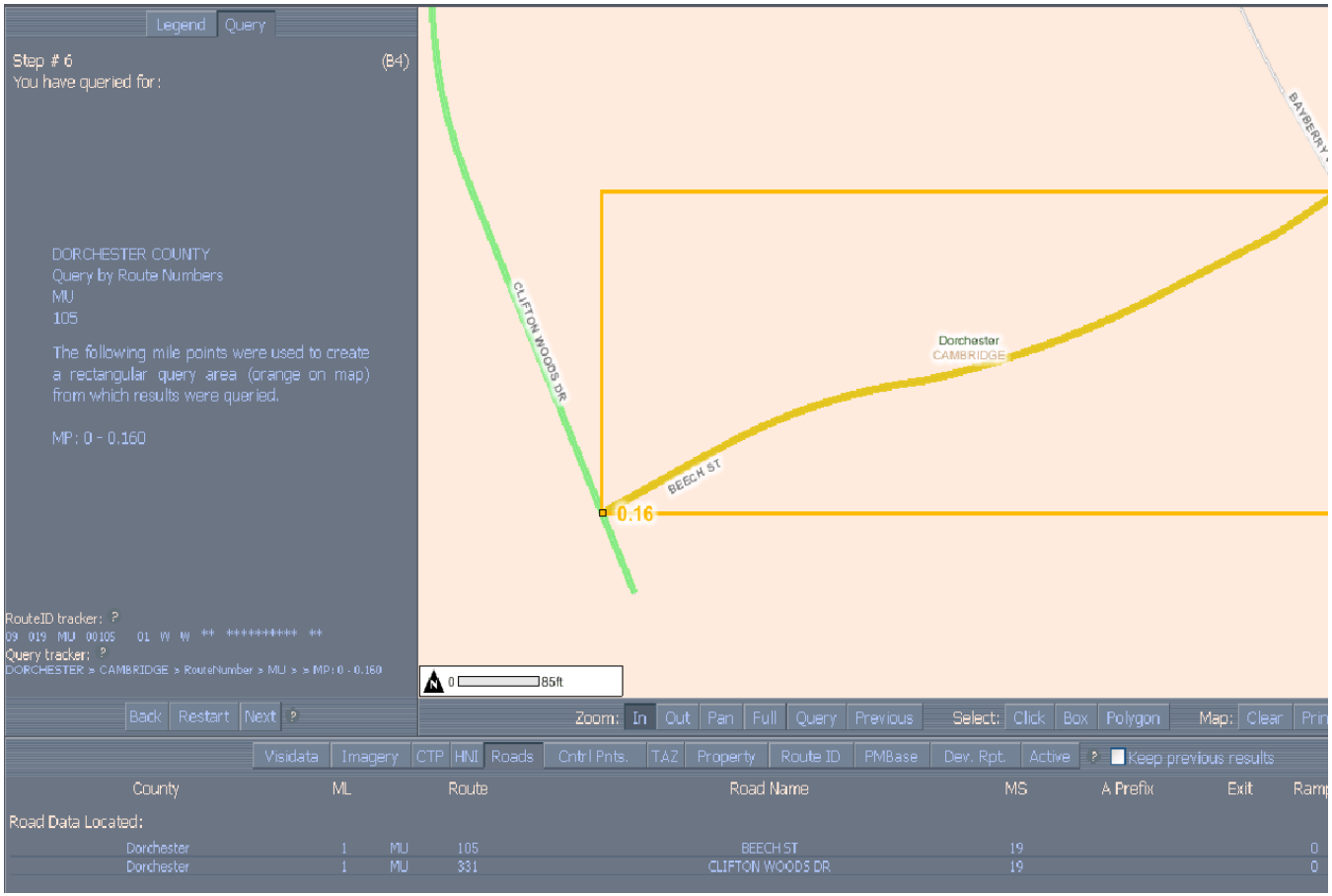


Figure C.4

Road tab query in SHAWME system

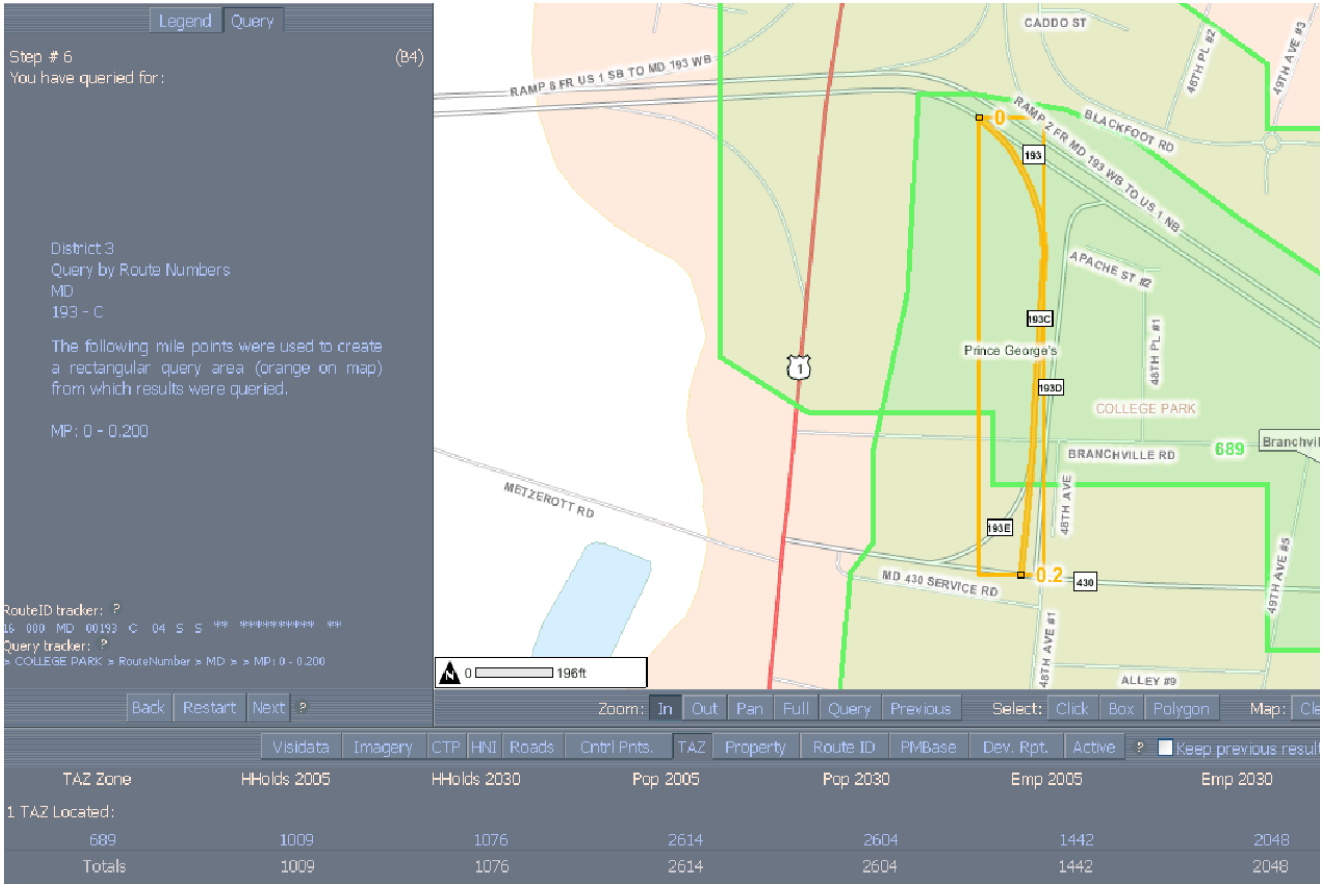


Figure C.5

TAZ tab query in SHAWME system

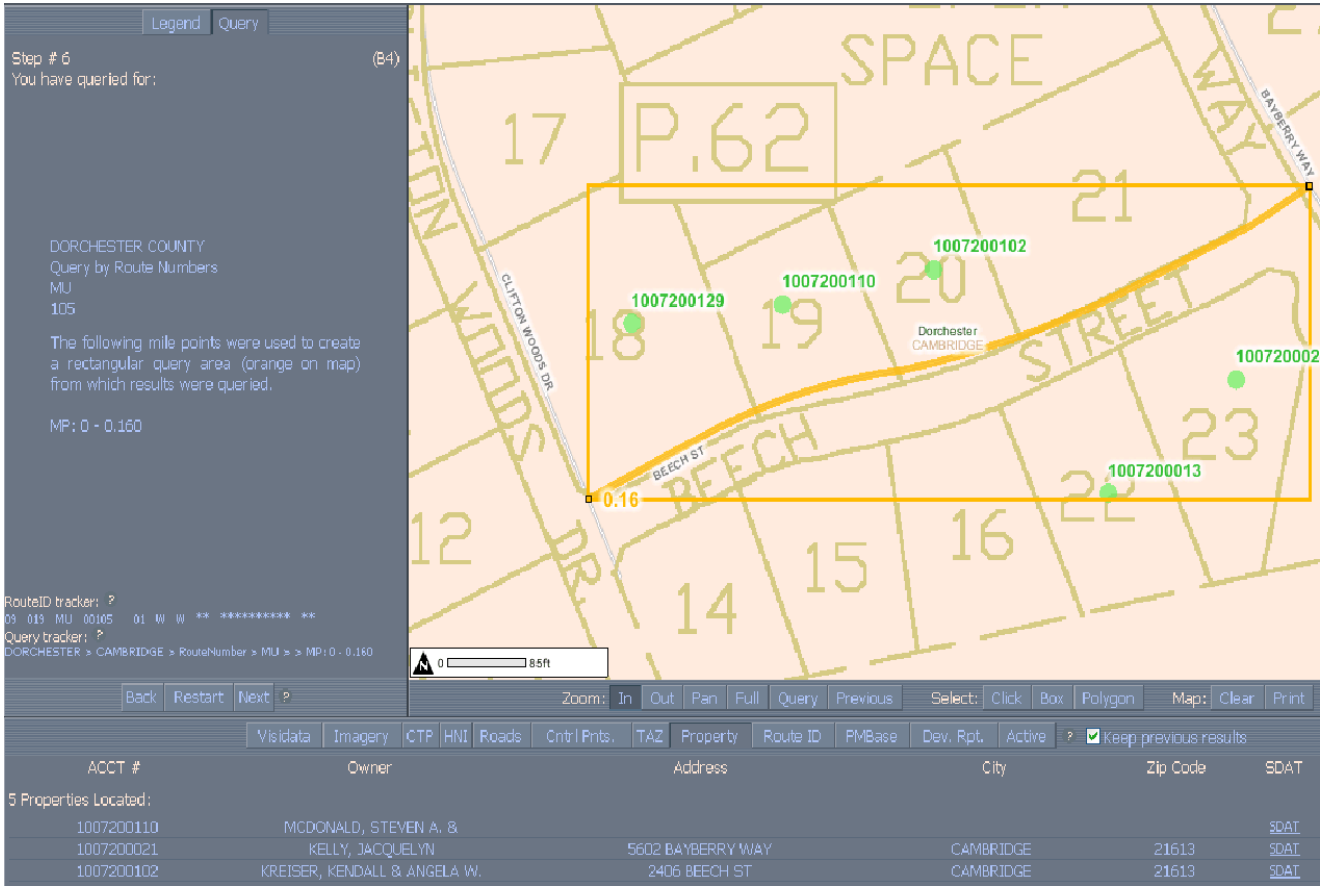


Figure C.6

Property tab query in SHAWME system

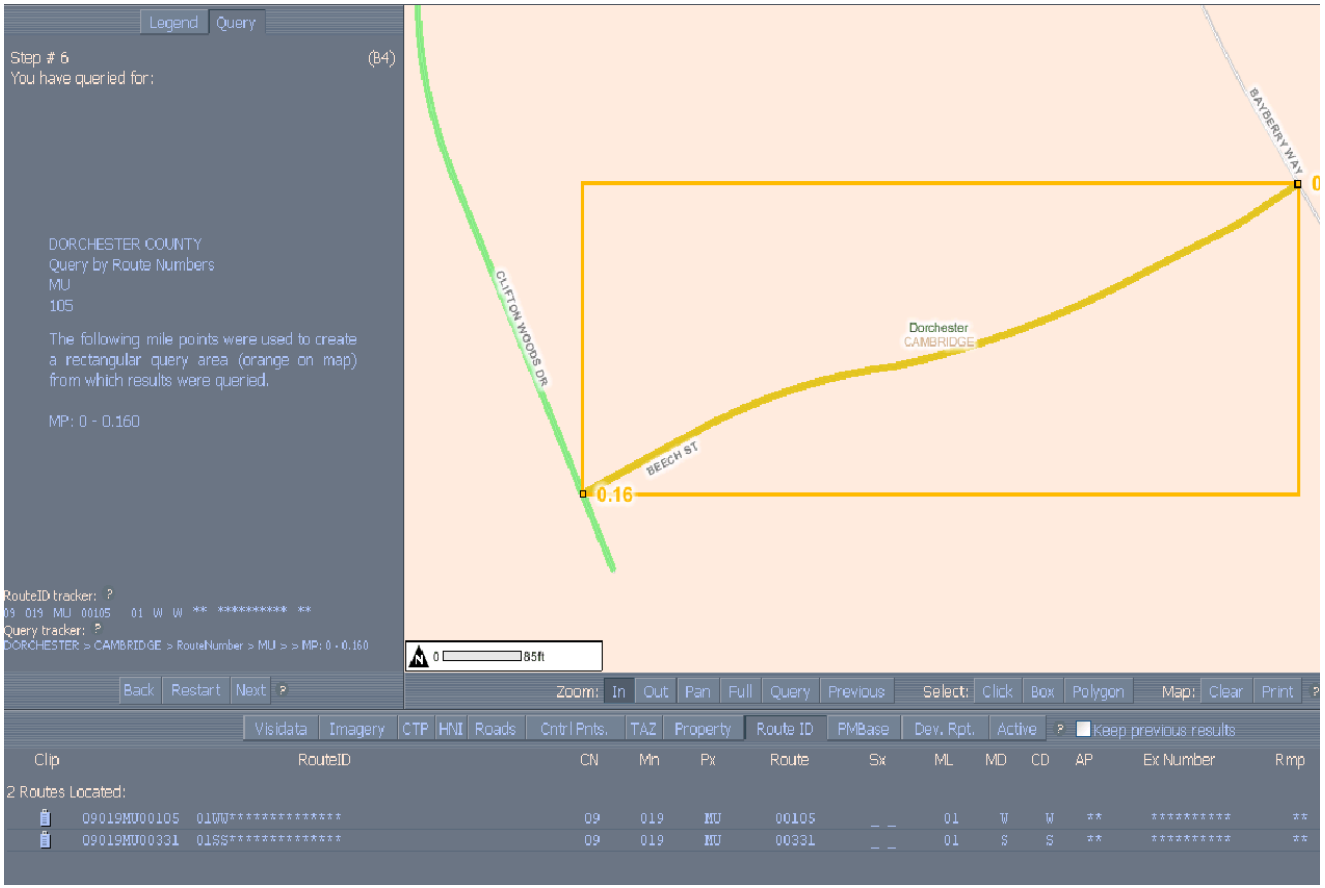


Figure C.7

Route ID query in SHAWME system