A GIS Prototype Application for Monitoring Washington State Transportation Planning Studies

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16. ABSTRACT

The Washington State Department of Transportation (WSDOT) assists regional and local jurisdictions with planning studies. A geographic information system (GIS) application has been developed to provide easy access to the location, type, and cost of regional transportation planning studies state-wide across all jurisdictions. The prototype application will provide information to regional transportation planners so that more effective intra- and inter-jurisdictional decisions can be made regarding new studies. A series of statements representative of the kinds of information that would benefit planners was developed as the basis for the database design. Multi-scales of representation were used. The existing WSDOT GIS environment was employed as the development environment.

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Final Report

Research Project T9233, Task 9
GIS for Transportation Planning

A GIS PROTOTYPE APPLICATION FOR MONITORING WASHINGTON STATE TRANSPORTATION PLANNING STUDIES

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SUMMARY

This report documents Task 3 of a three-part research project investigating the use of geographic information processing technology to support regional transportation planning. Geographic information systems (GIS) provide an effective means of capturing, storing, managing, analyzing, and displaying transportation planning studies information. A sample of 12 transportation planning studies sponsored by the Washington State Department of Transportation (WSDOT) was used to develop a prototype application.

Representative information needs of transportation planners were documented in the form of planning studies statements. From these statements, a prototype database was developed to characterize the planning studies in a GIS application.

The database design that was produced adheres to the current, advanced design concepts of the WSDOT. The design incorporates multi-scale representations of the data to show varying levels of detail. The database was implemented using WSDOT's Intergraph Microstation GIS Environment, but the database may also be implemented using a microcomputer version of the program.

This GIS application provides a new way to review the data. The GIS capabilities revealed that some data are not collected in the manual files that are being used to document the studies. Several design suggestions incorporating geographic information processing technology were formulated.

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

The GIS prototype application supported the concept of a meta-information application. Such applications are becoming more important as the amount of information concerning transportation issues grows. This prototype provided a reasonable understanding of how GIS can be beneficial in planning studies assessment, and how it might be useful in facilitating the sharing of study results.

The database design for the prototype application provided insight into what the database design for the production system should be. All data should be reloaded into the new database when it is established.

The application development also showed that manual files are inadequate for simply loading into a database. In trying to answer the queries developed from the applications design, the researchers found that data were often missing, inconsistent, or not collected in the manual files. As with other application development, the implementation of this GIS application was well worth the effort simply because it encourages better record keeping. More computer records can help improve the decisions that are based on them.

DESIGN RECOMMENDATIONS

The insights gained from this prototype implementation have led to a redesign of the application to more closely fit with the WSDOT GIS spatial database framework. That framework consists of three scales of spatial representation for all GIS work being performed. The scales are the 1:500,000 scale for state-wide presentation, the 1:24,000 scale for regional presentation, and scales below 1:1200 for site-specific presentation. WSDOT GIS staff are working on this redesign and it should be complete in the near future.

This GIS prototype application provides insight into how useful this overview information might be for route development plans, as well as regional transportation plans. In addition, there is some indication that this kind of application might be useful as a guide in developing an application for traffic engineering data and planning data. However, more detailed base maps would be required for the latter, e.g., for the 1:24,000 quads and urban insets.

The design issues that need clarification for production implementation include the following:

Standard Forms

A standard form for reporting portions of special studies results would be useful so that they could be compared in various ways. A standard form could also help make the information collection process easier. Too much standardization, however, could have a negative impact, making the information fit a limited range of pre-existing categories.

Global Search of the Data

To be able to access all studies, one or both of the following approaches could be used: (1) a global table, or (2) a join could be created to implement a view.

If a global table were created, it could be named "grant" or "study," since all special studies involve some kind of grant/study. This table would include the agreement_ID, as used in several of the tables in Appendix A. All of the common, basic "study" information would form part of the attribute name to be used; that is, all of the similar attribute fields among the large tables in the appendix would be condensed into a single table. This would allow each of the feature tables to address the feature categories in its own way. (The tables for Agency and Reports would remain the same.)

In the current design, a join must be performed to query more than one table at a time. To perform a join, common attribute values must exist in the respective attribute fields designated to define the join.

In either case, a join could be specified with one table as the primary table and all other tables as secondary tables. In the original design, the Reports table is a good candidate. In the new design, a table called "grant" could be specified.

Data Preparation: Scrubbing

The implementation of the prototype demonstrated that much database preparation, also called "scrubbing," must be performed before the data can be input. Several of the data fields are empty because data were not available or could not be discerned. A lack of data is often discovered during the implementation of GIS applications because it provides ways of examining information that were not previously possible.

Standard Naming Conventions

A standard naming convention is needed to code all names in the database, particularly for RTPOs, districts, other agencies of concern, counties, cities, and urbanized areas.

Scale Dependency

When features are coded using a particular spatial scale, hence, a digital file, that scale provides a specific geometry for graphic representation. One way to provide on-demand enhancement to spatial resolution is to develop a graphical retrieval based on route milepoints.

Methodology Coding

The files of studies in the prototype were reviewed for methodology specifications, and classification of methodologies was prepared. But the Planning Office must determine whether the classification is useful for its staff's purposes. This information was extracted on an *ad hoc* basis, and a taxonomy of methods was created. For example, in query 8, a specification for data collection was used. Several different kinds of data collection gleaned from the files might have been appropriate: O&D Survey, traffic count, field data collection, and traffic survey. Perhaps a general, hierarchical classification should be developed to make it easier to specify such information for retrieval.

INTRODUCTION

Tasks 1 and 2 of this project dealt with developing an understanding of transportation planners' needs within regional transportation planning organizations (RTPOs) and metropolitan planning organizations (MPOs) across the state of Washington. These information needs for information technology are documented in the report by Nyerges and Orrell titled "Using Geographic Information Systems for Regional Transportation Planning in a Growth Management Context."

Task 3 deals with transportation planners' needs for information concerning transportation planning studies. Knowing the location, types, and number of transportation planning studies that have been performed throughout the state provides pertinent background information for effective planning studies. This information is important to the Washington State Department of Transportation (WSDOT), RTPOs, MPOs, and local governments, and all other organizations and individuals involved with transportation planning.

The WSDOT Transportation Planning Office (TPO) maintains information on special studies, route development plans, and transportation improvement, and it evaluates the regional transportation plans forwarded by RTPOs and MPOs. The WSDOT TPO is investigating the use of a GIS for effective evaluation of these information sources, but it is focusing first on special studies.

PROCEDURES

GEOGRAPHIC INFORMATION NEEDS

Substantive statements were identified that exemplified the TPO's geographic information needs related to special studies. These statements were indicative of the requirements for database and analysis functions in an application. They, in fact, influenced the design of the application in a concrete way. The statements were as follows:

1. Display all of the transportation planning studies monitored by the Transportation Planning Office from 1980 to the present.

2. Display a summary, by WSDOT District, of the dollar amount spent on origin and destination (O & D) studies in past 10 years.

3. Display all of the studies that have been funded solely by RTPO discretionary funds.

4. Display all studies in the Intergovernmental Resource Center MPO/RTPO Region.

5. Show on a more detailed base map the geographic location of the corridor study xxx in Clark County.

6. Show those State Routes (and sections thereof) that have been the subject of transportation planning studies.

7. Shade the counties that have not had the opportunity to participate in a WSDOT-monitored transportation planning study in past 10 years.

8. Show those studies in Spokane County that have involved data collection techniques.

9. Display the boundaries of those studies on the map generated by statement 8 that focus on trip generation. Print a copy of the special study summary using GC#, cost, title, start and end date, lead agency, project manager, WSDOT account number, description of the technique, discussion of the process, where to acquire the report, summary of the findings of the report, and the WSDOT's position on the study results.

A set of design issues that would help guide prototype development were identified from the statements presented above.

PROTOTYPE DATABASE DESIGN

Twelve special studies were selected to be a part of the project. The 12 studies were selected for their representativeness and were not fully characterized. Two additional studies were added because of their selected tables, e.g., one dealing with study methodologies; however, these studies were not fully characterized in the database. The purpose of a prototype database is to explore design options, rather than to implement a data set for production proposes. Prototype databases are meant to be redesigned, if necessary, on the basis of what is learned in the study.

A database design was developed through a series of design meetings and testing meetings at the Geographic Services facility in Tumwater, Washington, from October 1991 to May 1992. These meetings determined the characteristics of the database design. Two iterations of the database design were performed: one to be used in the prototype phase and another as the recommended design for production implementation.

The major design consideration was how to construct meaningful study data categories using the feature table and attribute table constructs provided in the Modular Geographic Information System Environment (MGE). MGE Analyst is add-on software used to enhance the software functions of MGE. MGE is currently used by WSDOT Geographic Services, but it has just begun investigating MGE Analyst. So, MGE was the principal development environment for this prototype.

The data constructs for MGE consist of features. Feature data are composed of spatial data and attribute data. The spatial data are stored as predefined types of spatial elements. The attribute data are stored in attribute tables. The link between the two is a table called the feature table. A feature table lists the categories of features, the kinds of spatial, geometric elements that implement the features, and the attribute tables that contain information describing the features.

The prototype application consists of several kinds of features. A feature is a geo-locatable phenomenon. The feature names for special studies relate to the administrative kind and the geographic scope of each of the studies. They are as follows:

administrative-general	administrative-public
administrative-data	administrative-technical
administrative-other	intersection
linear-link	linear-corridor
area-sub	area-urban
area-region	state-wide

Each of the features is identified with a feature code (fcode). Feature codes are shortened notations for the feature names that are used for searching in the database.

The geometric feature type of each feature is designated in the field called **ftype**. The values indicate a general class of "point," "line," or "area-boundary" characterizing the feature.

The name of the data category is specified as "special study," since all of these data are for a special study. Later, these can also be specified as route development plan, transportation improvement program, and regional transportation plan.

The level is the numeric ID for data layer, which helps in organizing multitudes of data for display purposes.

The element type specifies the kind of geometric form to use for the data element. Essentially, this field designates how data will be stored for coordinate information.

The table name, which contains the attribute data, is given under the **table** field name. The naming convention used for the tables reflects the structural similarity in the kinds of data stored, rather than an individually descriptive name for each feature name. Four kinds of attribute data tables are used: administrative data table, point data table, line data table, and area data table.

Appendix A contains the attribute table layouts for the database design as implemented for the sample special studies. Each special study is described uniquely by an ID number. That number is a concatenation of the agreement number and the study type. The study type for administrative actually has several subtypes: general, public, data, technical, and other. Because these study types all have the same kind of attribute data, only a single administrative attribute table definition is needed.

The attribute data table for points (Appendix A) is similar in content to the administrative table, but has some differences. Spatial reference entries for the state-route milepoint (SR-MP) are necessary, as these elements are locations in the field. The same similarity exists for the line attribute table, but the spatial reference is different. It is essential to characterize the special study by beginning and ending state-route milepoint references. In addition, it is possible for each of the special studies to be associated with several geographic jurisdictions, including one or more counties, one or more cities, one or more RTPOs, and one or more urbanized areas. However, any given SR-MP reference can be associated with only one of each *kind* of geographic jurisdiction, i.e., one county, one city, one RTPO, and one urbanized area. Although, of course, the SR-MP may also have other SR-MPs at that location in geographic space.

The area table is similar to the line table, but several SR-MPs are used to depict the character of the study area, as these are the cordon points, the designated boundary points of the study area.

Once the database design was somewhat stable, the WSDOT Geographic Services implemented the design in MGE. The data were then entered for the special studies to populate the database. The implementation of the database required knowledge of MGE's setup processes, which are documented in the MGE/SX reference manual. WSDOT Geographic Services personnel accepted a major part of the responsibility for defining and building the features and schemas that were necessary to store the spatial and attribute data for this prototype.

QUERY RESULTS

Each of the statements listed previously was used as a basis for formulating a query. A query is a statement developed in the database retrieval language with the appropriate keywords, feature name, and attribute (column) names. MGE uses the structured query language (SQL) for composing queries. Some queries were more difficult to formulate in the MGE query environment than were others because of the language constraints dictated by the user interface.

The MGE software provides for a single table name in a query, as structured by the retrieval environment. This limits retrieval to that table name, hence the feature or attribute table associated with that feature. The form of the query is as follows:

```
SELECT * FROM table_name | view_name
WHERE
column_name expression [column name expression];
```

The asterisk indicates that all attribute fields in the selected table or view should be retrieved. Thus, all values for all attributes will be retrieved. A view is a selected set of attribute names from a table (or group of tables). The phrase **table_name or view_name** is replaced with an appropriate name from the database specification.

To query from multiple tables, a "relational join" must be performed. Thus, to answer global queries, i.e., queries that request data from all studies, a join must be performed in the prototype. A relational join is an operation that puts two tables together (joins them) using common data values, e.g., an ID or name, in the respective rows of the table. A join does not actually join tables permanently, but temporarily for ease in querying. Multiple tables are joined using "single joins," i.e., pair-wise joins, for all tables of interest.

Once a join has been defined in the Join Manager, a view can be defined in the View Manager. The View Manager is used to define "views" of tables and joins. The Design Recommendations section contains design considerations that make this type of query easier to perform.

The formulation of queries used to direct development of the prototype are described below. They are described in the same sequence as the statements listed previously. They are repeated here for clarity.

1. Display all of the transportation planning studies monitored by the Transportation Planning Office from 1980 to the present.

After entering the MGE software program, a user must first select a map. To perform a query, a user accesses the GeoDatabase Locate Form. A feature must be specified on this form. After a feature has been chosen, the tables or views associated with the feature can be accessed. A user then selects the Edit SQL query button. This will allow a user to compose a query in SQL. The statement is translated into the following SQL command:

```
SELECT * FROM studies
WHERE end_date > 1980 or end_date = 1980
```

Because this database focuses on special studies monitored by the Planning Office, the query is simplified somewhat. The "studies" table is a view created from joining point, line, and area feature tables to the table "reports," i.e., reports to **data_admin, data_pt, data_ln, data_area**. In this case, the table "reports" is considered the primary table for the join, and **data_pt, data_ln, data_area** are the secondary tables joined individually to reports. They are joined over the attribute name **ID_number** because this field appears in every feature table.

The result of the query is a display of the appropriate studies and a list of the values for the following attributes in the view:

ID_number
Title
Custodian_name

The resulting display is shown in Figure 1 (with studies loaded in the database).

2. Display a summary, by WSDOT District, of the dollar amount spent on origin and destination (O & D) studies in past 10 years.

Because WSDOT Districts are coded for each of the features, the column names for **district, district_1, district_2,** or **district_3** are used. The column names for

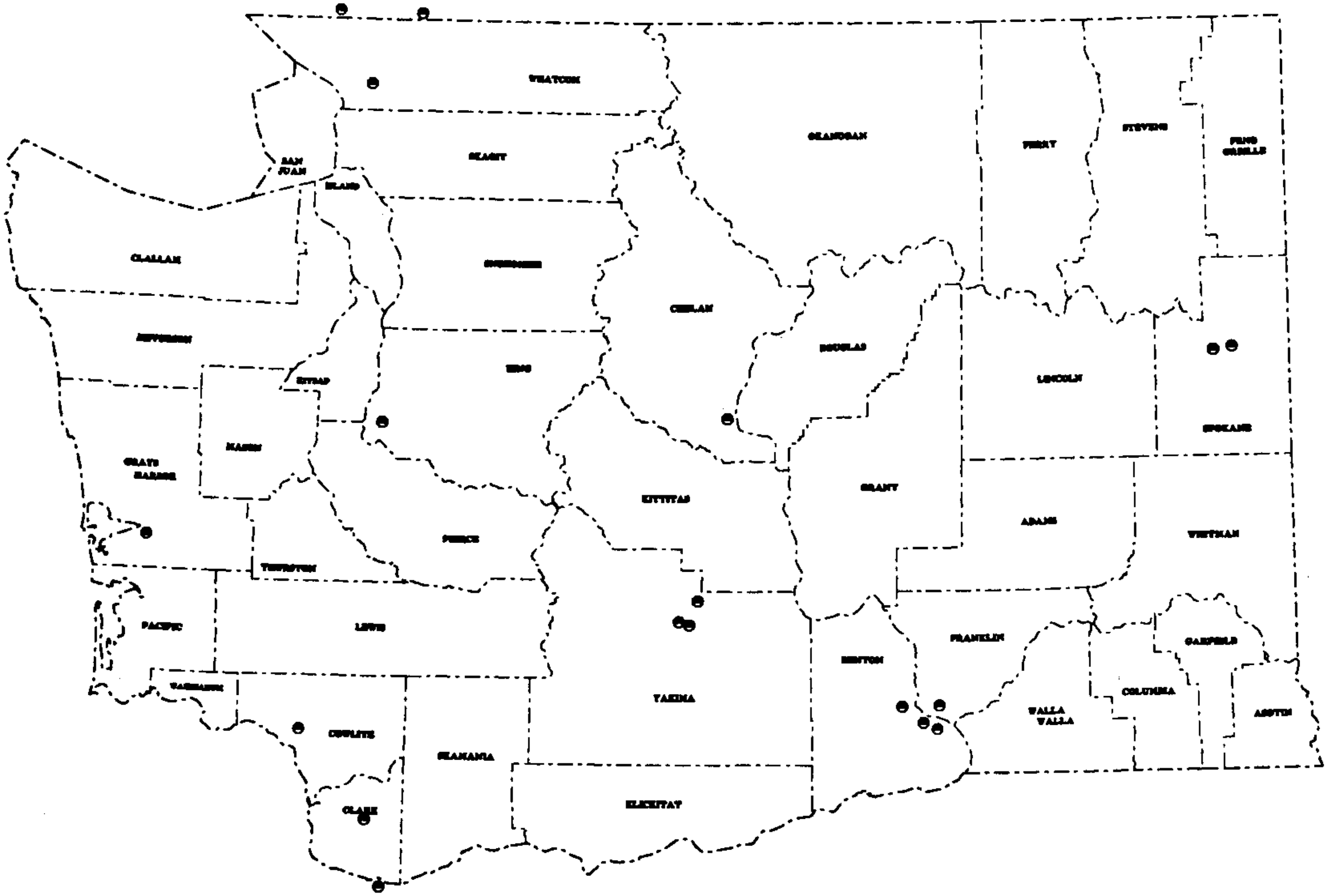

Figure 1. All studies in the sample database

methodology1A,
methodology1B,
methodology1C,
methodology2A, ... methodology4C

are also used. In addition, the column for **end_date** is used. Hence, the following query is formulated:

```
SELECT * FROM District_Methods
WHERE
method_1A = 'O&D Survey'
OR
method_1B = 'O&D Survey'
OR
method_1C = 'O&D Survey'
OR
method_2A

        .
        .
        .

method_4C = 'O&D Survey'
AND
end_date > 1981
AND
District = 1
OR
District_1 = 1
OR
District_2 = 1
OR
District_3 = 1
```

A view called District_Methods was created. This view simply adds more fields to the Studies view. The MGE SQL environment does not compute averages. The MGE Analyst supposedly can compute averages, but this was not investigated in this prototype.

The attribute fields of concern are as follows:

ID_number
Title
Custodian_name
Study cost
Method_1A

.
.
.

Method_4C

Only one of the studies was an O & D study, and it did not contain the total dollar amount spent on each project. Therefore, a display could not be generated to show the summary by district. Again, studies were selected for database loading on the basis of general representativeness rather than on a detailed review of the data available for loading. Despite the lack of data, the database design can support this query.

3. **Display all of the studies that have been funded solely by RTPO discretionary funds.**

```
SELECT * FROM Funds
WHERE
ST_RTPO > 0
AND
ST_NP = 0
Local = 0
other = 0
```

The Funds view is defined from the same join as in the Studies view. The view for Funds lists all the funding sources.

Again, the data were not available in the manual files and, hence, were not loaded into the database to answer this query. Once again, this situation points out that new forms of technology encourage new ways to look at, and hence require, certain kinds of data maintained in files.

4. **Display all studies in the Intergovernmental Resource Center MPO/RTPO Region.**

```
SELECT * FROM studies
WHERE
RTPO = 'IRC'
OR
RTPO1 = 'IRC'
OR
RTPO2 = 'IRC'
```

The Studies view is used, but is qualified in a locational manner rather than in a temporal manner, as in query 1. Because the Studies view is used, the attributes once again are

ID_number
Title
Custodian_name

Figure 2 shows the graphic results of this query. A color display shows the thematic information (study symbol) in red for easy recognition.

5. Show on a more detailed base map the geographic location of the corridor study xxx in Clark County.

SELECT * from Studies
WHERE
Title = 'SR 14 Columbia River Gorge%'

This query was addressed by retrieving the appropriate study and then attaching a large-scale map (reference file) for the Clark County area. However, in the current design a user has to know what reference map (quad) to attach. In the new design, the map (quad) name would be easier to identify if it were provided as a field in the retrieval. The % character is a wild card that allows a match against 0 or more characters in that position.

Two graphics were created to depict the response to this query. Figure 3a displays a small scale representation (more area shown) of the area. Figure 3b displays a larger scale representation (less area but more detail) of the geographic area.

6. Show those State Routes (and sections thereof) that have been the subject of transportation planning studies.

SELECT * State_routes
WHERE
Title = '%ransporation%lanning%tudy%'

The query is answered using a view called State_routes that qualifies the title of reports using a character string, **%ransporation%lanning%tudy%**. Again, the wild card is used to make the specification more generic.

The state routes resulting from this query are listed. The Modular GIS Analyst (MGA) must be used for the state routes to be displayed. This utilization was beyond the developers' expertise at the time the prototype was created, but implementation is currently being investigated by WSDOT Geographic Services.

Figure 4 depicts all state routes that have had a transportation planning study (from those studies located in the database that are associated with state routes). The

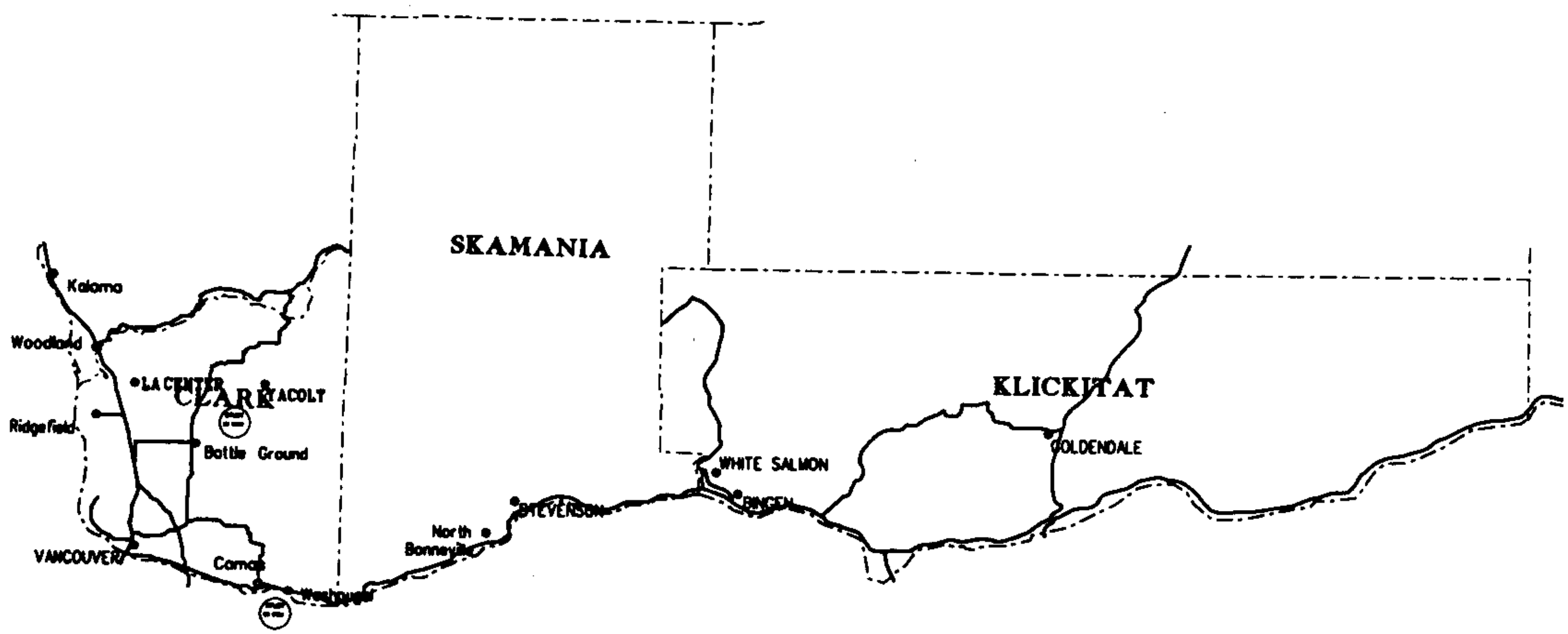

Figure 2. All studies in the Inter-regional Council jurisdiction

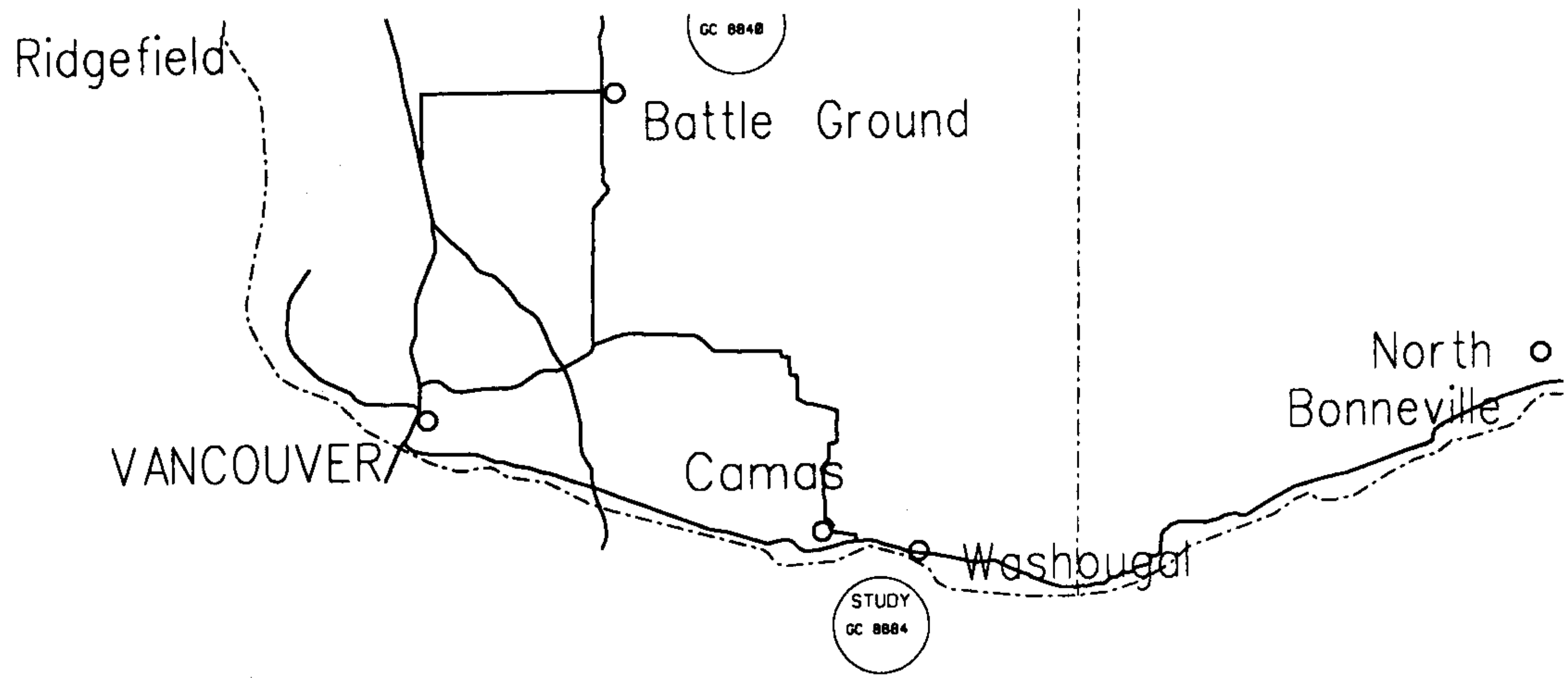

Figure 3a. Smaller-scale depiction of Inter-regional Council jurisdiction

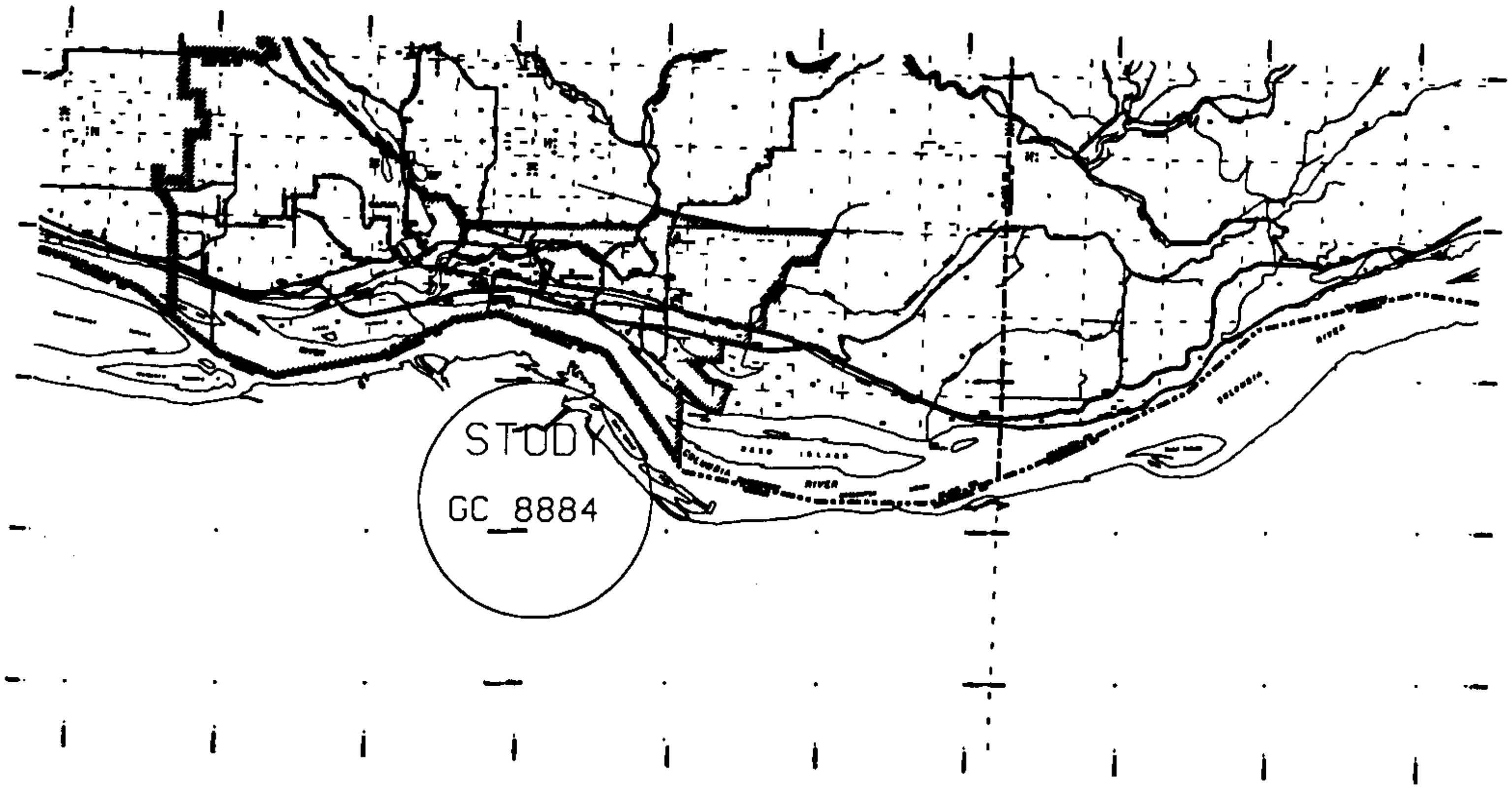

Figure 3b. Larger-scale depiction of Inter-regional Council jurisdiction

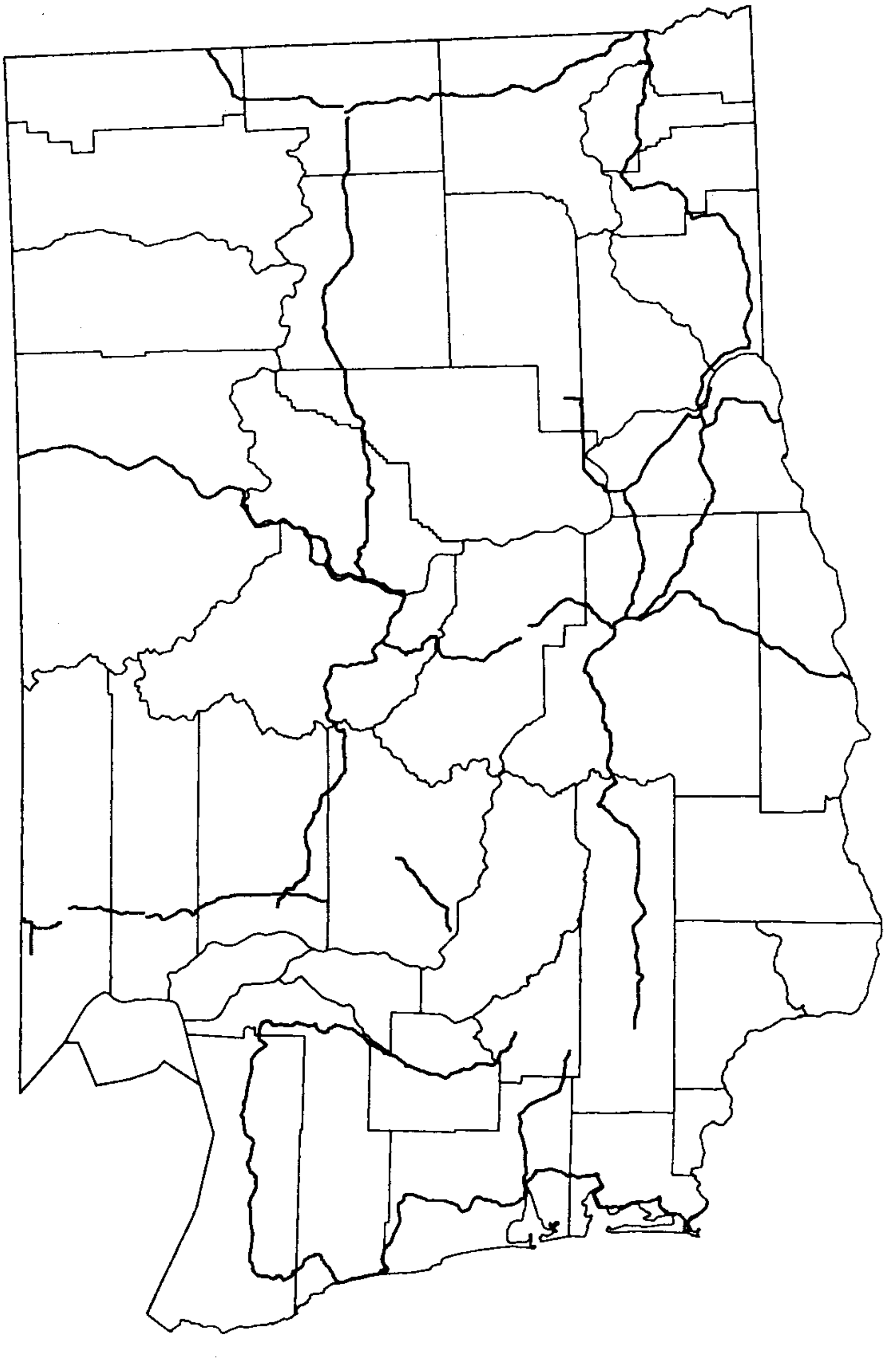

Figure 4. State routes with planning studies

limits in this display derive from the fact that the database has only ten studies. In addition, the entire state route is depicted in the display, rather than only the portion that is associated with the planning study. Depicting and/or highlighting only the portion associated with a study will be investigated after this project has been completed.

7. Shade the counties that have not had the opportunity to participate in a WSDOT-monitored transportation planning study in past 10 years.

The following query finds counties that have participated in a transportation planning study.

```
SELECT * FROM county_studies
WHERE
County > '%'
OR
County_1 > '%'
OR
County_2 > '%'
OR
County_3 > '%'
OR
County_4 > '%'
```

The query is formulated with the county_studies view. This view uses the same join as the studies, but the view expands the amount of information retrieved to include the county names and methodologies. The counties that do not appear in the list, but appear in a master list, are the ones to be shaded.

Figure 5 depicts those counties that did not have a planning study (from those studies in the database).

8. Show those studies in Spokane County that have involved data collection techniques.

This query is specified as follows:

```
SELECT * FROM county_studies
WHERE
County_1 = 'Spokane'
OR
County_2 = 'Spokane'
OR
County_3 = 'Spokane'
OR
County_4 = 'Spokane')
AND
```

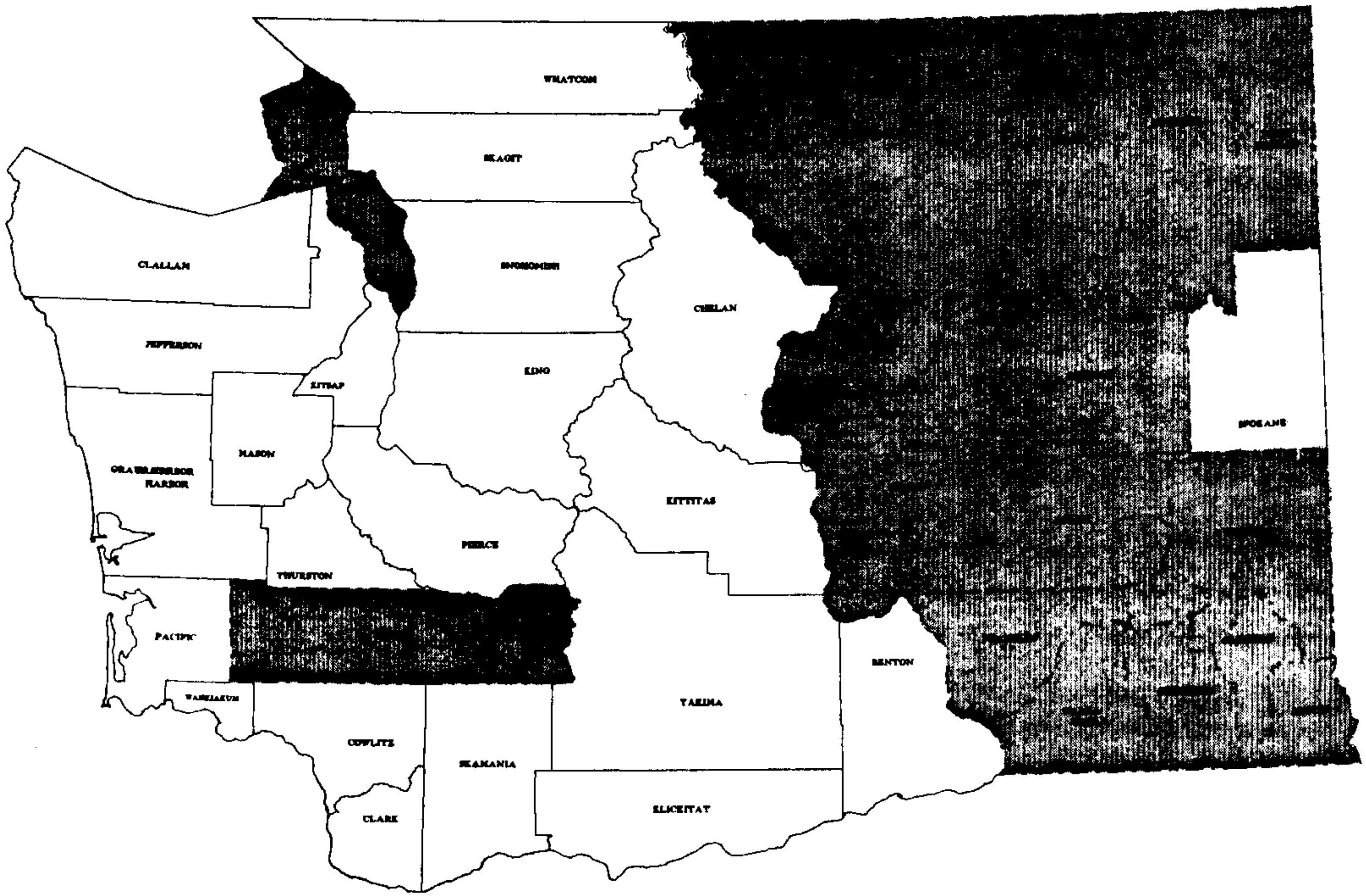

Figure 5. Counties without WSDOT monitored planning study are shaded

```
Method_1A = '%data collection%' or
Method_1B = '%data collection%' or
Method_1C = '%data collection%' or

        .
        .
        .

Method_6C = '%data collection%'
```

Again, the County_methods viewed is used, but with methodology as a qualifier. Unfortunately, no data were loaded for studies that had both data collection technique as a methodology and Spokane as a county.

We can change the query slightly to make it more representative of the intent as follows:

```
SELECT * FROM county_studies
WHERE
County = 'Whatcom'
OR
County_1 = 'Whatcom'
OR
County_2 = 'Whatcom'
OR
County_3 = 'Whatcom'
OR
County_4 = 'Whatcom'
AND
Method_1A = '%traffic model%' or
Method_1B = '%traffic model%' or
Method_1C = '%traffic model%' or

        .
        .
        .
```

No data were available to generate an answer to this query. Once again, the manual file did not contain sufficient information to load into the database.

9. **Display the boundaries of those studies on the map generated by statement 8 that focus on trip generation. Print a copy of the special study summary using GC#, cost, title, start and end date, lead agency, project manager, WSDOT account number, description of the technique, discussion of the process, where to acquire the report, summary of the findings of the report, and the WSDOT's position on the study results.**

Displaying the boundaries of a study would have required extensive work in MGA, which was beyond the development scope of the project. To locate a study involving trip generation, the activity would have had to be coded. No studies that included trip generation tables were identified in the report files. However, inferences regarding trip generation could be drawn from those studies involved with traffic models.

DISCUSSION

The insights gained from this prototype implementation have led to a redesign of the application to more closely fit with the WSDOT GIS spatial database framework. That framework consists of three scales of spatial representation for all GIS work being performed. The scales are the 1:500,000 scale for state-wide presentation, the 1:24,000 scale for regional presentation, and scales below 1:1200 for site-specific presentation. WSDOT GIS staff are working on this redesign and it should be complete in the near future.

This GIS prototype application provides insight into how useful this overview information might be for route development plans, as well as regional transportation plans plans. In addition, there is some indication that this kind of application might be useful as a guide in developing an application for traffic engineering data and planning data. However, more detailed base maps would be required for the latter, e.g., for the 1:24,000 quads and urban insets.

Implementing a database for route development plans and regional transportation plans in the intermediate term would require an additional database design effort because the information content is different than it is in the special studies. Similarly, long term implementation of the Regional Transportation Plans and Transportation Improvement Program data for this application would also require additional database designing because this information is different than in special studies and Route Development Plans.

APPLICATION AND IMPLEMENTATION

The issues for implementation of the production application can be divided into the following categories:

1. time horizons for application development,
2. levels of geographic detail, and
3. geographic domains for investigation.

The three categories can be further characterized in more detail using several basic categories for each, as indicated in the following discussion.

The four time horizons are as follows:

- Now — sample of special studies,
- Near future — remainder of special studies,
- Intermediate term — route development plans, and
- Long range — regional transportation plans and transportation improvement programs (local 6-year plan).

In the intermediate term, the WSDOT may want to consider remote access to district offices, with "read only" for base data (Geographic Services developed) at the district level, and a linkage to the TRIPS database that can support the detail needed for route development plans and transportation improvement programs.

The three levels of geographic detail are as follows:

- state route system — includes state routes, US routes and selected cities,
- all functional class routes (includes state system) and additional cities, and
- all streets/roads (includes all functional class) and all cities.

The three basic geographic domains are

- Washington state,
- WSDOT district, and
- RTPO/counties.

Table 1. Application Implementation Framework

	Geographic Domain		
Road Detail	Washington State	District	RTPO/Count
State Route System	1: Special Studies	2: Special Studies	2: Special Studies
All Functional Class Roads	(3:)*	(3:)*	3: RDP
All City/County Streets/Roads	(4:)*	(4:)*	4: RT Plans and TIPs

1 = now — ten (with a couple of extra) sample special studies

2 = near future — all special studies

3 = intermediate term — route development plans (RDP)

4 = long term — regional transportation (RT) plans and transportation improvement programs (TIP)

A 3 x 3 table of entries can be used to characterize the implementation framework using the above dimensions. Certain entries are practical options for implementation, as indicated in Table 1.

Entries in the table with an asterisk (*) indicate that the data are implemented at geographic scopes by default because of the more detailed consideration for district and/or RTPO/county.

The current application implementation framework includes a sample of ten special studies, each involving a Washington state route. This is characteristic of an entry marked with a **1**.

The near future application implementation framework includes the remainder of the special studies. More detailed maps are required for district, RTPO/County displays. These entries are marked with a **2**.

A full implementation of the special studies that the Planning Office is undertaking will require at least five person-months of effort to complete, assuming no new, major redesigning plans occur. This effort would include the data preparation and entering the data into the system.

The intermediate term application implementation framework includes the route development plans for each of the districts, the RTPOs and the counties. These entries are marked with a **3**.

The long term includes regional transportation plans and transportation improvement programs for the RTPOs and the respective districts. These entries are marked with a **4**.

Implementing a database for route development plans and regional transportation in the intermediate term would require an additional database design effort because the information content is different than it is in the special studies. Similarly, long term implementation of the RT Plans and TIP data for this application would also require an additional database design because this information is different than in special studies and RDPs.

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REFERENCES

1. Nyerges, T. and J. Orrell, 1992. "Using Geographic Information Systems for Regional Transportation Planning in a Growth Management Context," Washington State Department of Transportation, Technical Report, Research Project T9233.

APPENDIX A

Attribute Tables Included in the Database

Appendix: Attribute Tables included in the Database

Attribute Table

TABLE NAME:Agency

Column Name	data type	nulls allowed	data
mslink	Integer	N	
mppid	Integer	Y	
Agency_name	Char (34)	N	
Grant_name	Char (24)	N	
Address	Char (30)	N	
City	Char (15)	N	
State	Char (2)	Y	
Zip	Integer	N	
Phone	Char (12)	Y	
Fax	Char (12)	Y	
Scan	Char (12)	Y	
Grant_rec	Char(34)	N	

"Data Types are: real, short integer, long integer, character (length)"

Attribute Table

TABLE NAME:reports

Column Name	data type	nulls allowed	data
mslink	Integer	N	
mppid	Integer	Y	
ID_Number	Char (20)	N	
Title	Char (34)	N	
Custodian_name	Char (34)	N	
Format	Char (15)	N	
Method_1a	Char (24)	N	
Method_1b	Char (24)	N	
Method_1c	Char (24)	N	
Method_2a	Char (24)	N	
Method_2b	Char (24)	N	
Method_2c	Char (24)	N	
Method_3a	Char (24)	N	
Method_3b	Char (24)	N	
Method_3c	Char (24)	N	
Method_4a	Char (24)	N	
Method_4b	Char (24)	N	
Method_4c	Char (24)	N	
Method_5a	Char (24)	N	
Method_5b	Char (24)	N	
Method_5c	Char (24)	N	
Method_6a	Char (24)	N	
Method_6b	Char (24)	N	
Method_6c	Char (24)	N	
Summary	Char ( )	Y	

"Data Types are: real, short integer, long integer, character (length)"

Attribute Table

TABLE NAME:data_admin

Column Name	data type	nulls allowed	data
mslink	Integer	N	
mppid	Integer	Y	
Geo_descriptor	Char (20)	N	
ID_Number	Char (20)	N	
Agreement_Num	Char (12)	N	
Study_Name	Char (34)	N	
Study_Type	Char (2)	N	
Multi_Study	Char (1)	Y	
Activity_1	Char (2)	N	
Activity_2	Char (2)	Y	
Activity_3	Char (2)	Y	
Activity_4	Char (2)	Y	
Activity_5	Char (2)	Y	
Activity_6	Char (2)	Y	
Funding_Source	Integer	N	
PL	Integer	Y	
ST_NP	Integer	Y	
ST_RTPO	Integer	Y	
Local	Integer	Y	
Dist_Cont	Integer	Y	
other	Integer	Y	
Study_cost	Integer	N	
District	Integer	N	
Grant_Rec	Char (24)	N	
Start_Date	Integer	N	
Project_length	Integer	N	
End_Date	Integer	N	
FY_Start	Integer	N	
FY_End	Integer	N	

"Data Types are: real, short integer, long integer, character (length)"

Attribute Table

TABLE NAME:data_pt

Column Name	data type	nulls allowed	data
mslink	Integer	N	
mppid	Integer	Y	
ID_Number	Char (20)	N	
Agreement_Num	Char (12)	N	
Study_Name	Char (34)	N	
Study_Type	Char (2)	N	
Multi_Study	Char (1)	Y	
Activity_1	Char (2)	N	
Activity_2	Char (2)	Y	
Activity_3	Char (2)	Y	
Activity_4	Char (2)	Y	
Activity_5	Char (2)	Y	
Activity_6	Char (2)	Y	
Funding_Source	Integer	N	
PL	Integer	Y	
ST_NP	Integer	Y	
ST_RTPO	Integer	Y	
Local	Integer	Y	
Dist_Cont	Integer	Y	
Study_cost	Integer	N	
Grant_Rec	Char (24)	N	
Start_Date	Integer	N	
Project_length	Integer	N	
End_Date	Integer	N	
FY_Start	Integer	N	
FY_End	Integer	N	
District	Integer	N	
City	Char (15)	Y	
County	Char (15)	N	
RTPO	Char (24)	Y	
SR_1	Integer	N	
SR1_MP	Real	N	
SR_2	Integer	Y	
SR2_MP	Real	Y	
Urbanized	Char (10)	Y	

"Data Types are: real, short integer, long integer, character (length)"

Attribute Table

TABLE NAME:data_ln

Column Name	data type	nulls allowed	data
mslink	Integer	N	
mppid	Integer	Y	
ID_Number	Char (20)	N	
Agreement_Num	Char (12)	N	
Study_Name	Char (34)	N	
Study_Type	Char (2)	N	
Multi_Study	Char (1)	Y	
Activity_1	Char (2)	N	
Activity_2	Char (2)	Y	
Activity_3	Char (2)	Y	
Activity_4	Char (2)	Y	
Activity_5	Char (2)	Y	
Activity_6	Char (2)	Y	
Funding_Source	Integer	N	
PL	Integer	Y	
ST_NP	Integer	Y	
ST_RTPO	Integer	Y	
Local	Integer	Y	
Dist_Cont	Integer	Y	
Study_cost	Integer	N	
Grant_Rec	Char (24)	N	
Start_Date	Integer	N	
Project_length	Integer	N	
End_Date	Integer	N	
FY_Start	Integer	N	
FY_End	Integer	N	
District	Integer	N	
City	Char (15)	Y	
County	Char (15)	N	
RTPO	Char (24)	Y	
SR_1	Integer	N	
SR1_BegMP	Real	N	
SR1_EndMP	Real	N	
SR_2	Integer	Y	
SR2_BegMP	Real	Y	
SR2_EndMP	Real	Y	
Urbanized	Char (10)	Y	
Additional_City	Char (1)	N	
Additional_Cnty	Char (1)	N	
Additional_SR	Char (1)	N	

"Data Types are: real, short integer, long integer, character (length)"

Attribute Table

TABLE NAME:data_area

Column Name	data type	nulls data allowed
mslink	Integer	N
mppid	Integer	Y
ID_Number	Char (20)	N
Agreement_Num	Char (12)	N
Study_Name	Char (34)	N
Study_Type	Char (2)	N
Multi_Study	Char (1)	Y
Activity_1	Char (2)	N
Activity_2	Char (2)	Y
Activity_3	Char (2)	Y
Activity_4	Char (2)	Y
Activity_5	Char (2)	Y
Activity_6	Char (2)	Y
Funding_Source	Integer	N
PL	Integer	Y
ST_NP	Integer	Y
ST_RTPO	Integer	Y
Local	Integer	Y
Dist_Cont	Integer	Y
Study_cost	Integer	N
Grant_Rec	Char (24)	N
Start_Date	Integer	N
Project_length	Integer	N
End_Date	Integer	N
FY_Start	Integer	N
FY_End	Integer	N
District_1	Integer	N
District_2	Integer	Y
District_3	Integer	Y
City_1	Char (15)	Y
City_2	Char (15)	Y
City_3	Char (15)	Y
City_4	Char (15)	Y
County_1	Char (15)	N
County_2	Char (15)	Y
County_3	Char (15)	Y
County_4	Char (15)	Y
RTPO_1	Char (24)	N
RTPO_2	Char (24)	Y
Urbanized_1	Char (10)	Y
Urbanized_2	Char (10)	Y
SR_1	Char (5)	N
SR1_BegMP	Real	N
SR1_EndMP	Real	N
SR_2	Char (5)	Y
SR2_BegMP	Real	Y
SR2_EndMP	Real	Y

SR_3	Integer	Y
SR3_BegMP	Real	Y
SR3_EndMP	Real	Y
Additional_DIST	Char (1)	N
Additional_CO	Char (1)	N
Additional_City	Char (1)	N
Additional_RTPO	Char (1)	N

"Data Types are: real, short integer, long integer, character (length)"