

**STATE PLANNING AND RESEARCH
PART I PLANNING
PART II RESEARCH AND DEVELOPMENT**

**STATE OF MINNESOTA
DEPARTMENT OF TRANSPORTATION**

in cooperation with

**U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION**

This program is prepared and submitted in pursuant to provisions of Section 307 of Title 23, United States Code as amended.

The contents of this program describe the continuing efforts of the Minnesota Department of Transportation in highway planning and research activities. The task descriptions will serve from year to year. A new description will be written only when there is a major change to any of the basic components of a task or a new task is added.

The annual element of the State Planning and Research Work Program will contain the itemized cost estimates for the work program year, new tasks, revised tasks and a revision page delineating changes for that peculiar year. The annual elements are to replace similar sheets from the previous year program.

This program is organized by Office according to the Minnesota Department of Transportation organization structure. An index page is included showing the tasks by Volume according to the Federal Highway Administration's "Highway Planning and Programming Manual".

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**ITEMIZED COST ESTIMATE
FOR
PART ONE PLANNING**

**SPR PROJECT - 1(040)
(JANUARY 1, 2000 - DECEMBER 31, 2000)**

I. OFFICE OF INVESTMENT MANAGEMENT

101	Small Urbanized Area Planning	\$84,160
	Salaries	77,660/11 Person Months
	Travel	5,500
	Photo Lab.	1,000
102	Statewide Policy & Plan Development	\$346,325
	Salaries	226,325/41 Person Months
	Travel	10,500
	Print & Comm.	22,000
	Meeting Expense	38,000
	Consultant	50,000
103	Special Studies	\$139,717
	Salaries	135,217/25.5 Person Months
	Travel	1,500
	Consultant	3,000
106	Program Development	\$126,055
	Salaries	122,355/23 Person Months
	Travel	1,900
	Printing & Mailing	1,800
112	Project Authorization	\$199,240
	Salaries	199,240/32 Person Months
116	Program Management	\$82,240
	Salaries	82,040/21 Person Months
	Travel	200

218 Economic Analysis \$554,587

Salaries 535,087/84 Person Months
Travel 7,000
Consultant 12,500

201 SP&R Program Administration & Control \$25,490

Salaries 24,990/4 Person Months
Printing 500

Total Estimate Cost \$1,557,814

II. OFFICE OF MANAGEMENT DATA SERVICES

202	Transportation Information System (TIS) Management	\$907,090
	Salaries	905,890/178 Person months
	Photo Lab	1,200
213	Vehicle Classification and Truck Weight Studies	\$345,857
	Salaries	338,521/42 Person Months
	Travel	4,536
	Overtime	2,800
214	Traffic Counting	\$694,079
	Salaries	665,161/126 Person Months
	Travel	17,435
	Overtime	11,484
216	Traffic Forecasting for Highway Design	\$114,066
	Salaries	112,066/16 Person Months
	Travel	2,000
224	Transportation Information System Re-Engineering	\$161,303
	Salaries	161,303/21 Person Months
225	SP&R Technology Support	\$148,046
	Salaries	148,046/24 Person Months
Total Estimated Cost		\$2,370,441

III. OFFICE OF TRANSIT

301	Transit Program Planning	\$227,450
	Salaries	205,450/28 Person Months
	Travel	2,000
	Printing	20,000
302	Transit Research & Design Evaluation	\$141,612
	Salaries	139,612/23 Person Months
	Travel	2,000
Total Estimated Cost		\$369,062

IV. OFFICE OF FINANCIAL MANAGEMENT

401 Highway Statistics \$50,242

Salaries	27,516/5.25 Person Months
Consultant	22,726

Total Estimated Cost \$ 50,242

V. OFFICE OF TRAFFIC ENGINEERING

501	Speed Data Summaries	\$20,996
	Salaries	20,996/ 3 Person Months
502	Accident Surveillance	\$132,338
	Salaries	112,338/23 Person Months
	Consultant	20,000
Total Estimated Cost		\$153,334

VI. OFFICE OF LAND MANAGEMENT

601	Municipal Maps		\$361,285
	Salaries	360,185/63 Person Months	
	Travel	300	
	Photo Lab	800	
604	St. Paul - Minneapolis Area Maps		\$140,481
	Salaries	140,181/24.0 Person Months	
	Travel	100	
	Photo Lab	200	
606	County Maps		\$211,421
	Salaries	210,121/37.5 Person Months	
	Travel	300	
	Photo Lab	1,000	
608	State Maps		\$ 27,988
	Salaries	27,488/4.5 Person Months	
	Travel	200	
	Photo Lab	300	
609	GIS Base Map		\$213,573
	Salaries	211,673/39 Person Months	
	Travel	400	
	Photo Lab	1,500	
Total Estimated Cost			\$ 954,748

VII. OFFICE OF STATE AID

701 County State Aid Highway \$579,153

Salaries	343,753/58 Person Months
Travel	5,000
Photo Lab	3,600
Supplies	2,800
Computer	224,000

702 Municipal State Highway Need Study \$279,260

Salaries	214,760/45 Person Months
Travel	1,500
Computer	63,000

Total Estimated Cost \$858,413

VIII. OFFICE OF TECHNICAL SUPPORT

Trunk Highway Cultural Resource Investigation
Contracts \$1,175,000
Minnesota Historical Society and Cultural Resource Firms

County/Municipal Cultural Resource Investigation
Contracts \$74,663
Minnesota Historical Society and Cultural Resource Firms

Total Estimate Cost \$1,249,663

IX. OFFICE OF ADVANCED TRANSPORTATION

117 Bikeway Planning \$289,375

Salaries 289,375/52 Person Months

Total Estimated Cost \$289,375

X. OFFICE OF FREIGHT, RAILROADS & WATERWAYS

220 Freight Studies \$178,447

Salaries 178,447/24 Person Months

SUBTOTAL SP&R PART ONE PLANNING \$8,031,539

**ITEMIZED COST ESTIMATED FOR
PART TWO RESEARCH AND DEVELOPMENT
PROJECT SPR-1(040)
JANUARY 1, 2000 - DECEMBER 31, 2000**

State Study No.	Study Title	Commitment in Dollars (\$)
SPR-1(040)	ORS Administration Technology Transfer, Implementation and Special Projects.	\$ 1,111,820
TRB-1(000)	Transportation Research Board Membership Dues)	\$ 85,010
Total Part Two - Research & Development		\$ 1,196,830
Cooperative Research		
SPR-4(198)	National Cooperative Highway Research Program (NCHRP)	\$ 425,920
SPR-4(146)	Test of State Safety Systems	\$ 50,000
SPR-3(017)	Midwest States Crash Testing Program	\$ 48,750
SPR-3(020)	Enterprise	\$ 25,000
SPR-3(042)	Aurora	\$ 25,000
SPR-3(044)	North Central Superpave Center (NCSC)	\$ 20,000
SPR-3(049)	Urban Mobility Study-Texas DOT	\$ 15,000
SPR-3(062)	Deployment Research and Capacity Building	\$ 10,000
SPR-3(064)	National Strategic Plan for Advanced Construction and Maintenance Systems (ACMS)	\$ 20,000
SPR-3(068)	Field Evaluation of the CTCLS Load Switch	\$ 57,000
SPR-3(072)	Mechanically Stabilized Earth Walls (MSE)	\$ 10,000
SPR-3(074)	Pavement Research and Technology	\$ 15,000
SPR-3(083)	FIXS: Fabrication error Indexed eXamples and Solutions	\$ 17,500
Cooperative Research Total		\$ 739,170
Research Total		\$ 1,936,000

State Study No.	Study Title - Tentative Projects	Possible Commitment in Dollars (\$)
SPR-3(055)	Research and Development of the Third Phase of an Autonomous Shadow Vehicle Prototype	\$ 25,000
SPR-3(063)	IVI Specialty Vehicles Program	\$ 200,000
SPR-3(079)	Road Condition Acquisition and Reporting System (CARS)	\$ 30,000
Proposed Total		\$ 255,000

State Study No.	Study Title - Future Projects	Possible Commitment in Dollars (\$)
Proposed	Support for AASHTO Strategic Highway Safety Plan	\$ 240,000
Proposed	A Guide to Standardized Highway Lighting Pole Hardware	\$ 15,000
Proposed	Environmental Durability Evaluation of FRP Composite Strengthened Bridges	\$ 25,000
Proposed	CFRP Reinforcement in Pre-stress Concrete Bridges	\$ 25,000
Proposed Total		\$ 305,000

PL FUNDS

C.Y. 2000 METROPOLITAN PLANNING ORGANIZATION

Study No.	Location	CPG-UWP YEAR 2000	
		UWP Amounts- FHWA PL	ADJ Amounts- FHWA PL
PL-1013 (40)	Twin Cities Metro Council	\$ 1,783,893	\$ 1,876,055
PL-1113 (40)	Duluth-Superior MIC	\$ 323,884	\$ 286,388
PL-1244 (40)	Rochester ROCOG	\$ 216,043	\$ 198,886
PL-1268 (40)	St. Cloud APO	\$ 230,474	\$ 215,243
PL-1188 (40)	Fargo-Moorhead FMCOG	\$ 99,446	\$ 90,880
PL-1289 (40)	Grand Forks-E. Grand Forks	\$ 26,500	\$ 25,079
PL-1243 (40)	LaCrosse-LaCrescent	\$ 14,654	\$ 14,040
Total		\$ 2,694,894	\$ 2,706,571

Note: UWPs prepared prior to receipt of final appropriation amount of \$2,700,940

In the Year 2000 we will utilize the Consolidated Planning Grant (CPG) procedure for all of the MPOs

UWP PL amount adjusted to reflect increase in FTA 5303 appropriation

FINANCIAL SUMMARY
State Planning and Research Program
Calendar Year 2000

A. Federal Funds Research:

Study No. RD-TT	
ORS Administration	\$ 1,111,820
TRB dues	\$ 85,010
SPR-4(198)	\$ 425,920
SPR-4(146)	\$ 50,000
SPR-3(017)	\$ 48,750
SPR-3(020)	\$ 25,000
SPR-3(042)	\$ 25,000
SPR-3(044)	\$ 20,000
SPR-3(049)	\$ 15,000
SPR-3(062)	\$ 10,000
SPR-3(064)	\$ 20,000
SPR-3(068)	\$ 57,000
SPR-3(072)	\$ 10,000
SPR-3(074)	\$ 15,000
SPR-3(083)	\$ 17,500
TOTAL	\$ 1,936,000

* *Appropriation Code**Planning - Q55**Research, Development & Technology Transfer - Q56**MPO Planning - Q45***B. Total Estimated Participating**

<u>Project Number</u>	<u>Statewide Planning</u>	<u>Research</u>	<u>MPO Planning</u>
SPR-1(40)	\$ 5,807,998	\$1,936,000	\$2,700,940
Total Estimated Participating	\$10,444,938		

OFFICE OF

INVESTMENT

MANAGEMENT

TASK TITLE: Small Urbanized Area Planning

WORK AUTHORITY NO.: TH__101

WORK PERFORMED BY: Planning Program Development and Project Authorization Section

OBJECTIVE:

To assist the six small area Metropolitan Planning Organizations (MPO's) in developing and maintaining a transportation planning process which fulfills the requirements of the appropriate federal regulations.

METHODOLOGY:

- Manage the FHWA Title 23 U.S.C. Section 104(f) (planning-PL) pass-through funds to ensure effective expenditure by the MPO's.
- Coordinate with Mn/DOT District planning staff in the development, review and/or approval of MPO planning documents to ensure that MPO's maintain certifiable transportation planning processes.
- Coordinate with Mn/DOT District planning staff in the representation of Mn/DOT on MPO committees to ensure awareness and responsiveness to mutual transportation concerns.
- Provide technical assistance and training to MPO's and Mn/DOT District planning staff to ensure use of state-of-the-art planning procedures.
- Participate in Mn/DOT activities (ISTEA Implementation, district plans, related to planning to ensure consideration of MPOs perspective.)

PRODUCTS:

- Annual MPO Planning Work Programs and funding distribution agreements.
- Annual MPO Transportation Improvement Programs (TIP) and Certification.
- Current MPO Long Range Multimodal Transportation Plan reflecting short and long range goals of the urbanized area.

TASK TITLE: Statewide Planning and Policy Development

WORK AUTHORITY NO.: TH__102

WORK PERFORMED BY: Planning, Program Development and Project Authorization Section

OBJECTIVE:

To direct the preparation of statewide transportation planning and policy studies, such as the Statewide Transportation Planning; to serve as a consultant in developing frameworks for district/division and modal plans; to assist districts in developing district long-range transportation plans; and to coordinate, review and respond to national and state initiatives, policies, proposed regulations which impact on transportation. To administer and coordinate Mn/DOT's transportation planning activities with the Regional Development Commissions (RDC's), their committees and units of local government

METHODOLOGY:

- Coordinate research and analysis of transportation, demographic and economic trends.
- Develop and implement processes for ensuring stakeholder involvement in the identification of goals and objectives, issues, alternatives and recommended strategies and actions.
- Coordinate public involvement activities to enhance citizen understanding of and participation in statewide transportation planning studies, policy guidelines and performance measures.
- Work with district/division and modal offices to build frameworks for describing the results of effective planning processes.
- Participate on and provide staff support to various Department committees, councils and task forces related to statewide planning issue areas.
- Provide for the administration and coordination of the activities necessary to provide technical assistance for local planning activities to RDC's and to Mn/DOT Districts. Manage funding programs for planning to ensure funds are effectively expended by RDC's.

PRODUCTS:

- Development of the Statewide Transportation Plan Revisions and Updates.
- Development of guidelines and performance measures to support statewide transportation policies.
- Development of frameworks for district/division planning.

- Coordination of Mn/DOT responses and positions to national and state initiatives that impact on transportation.
- Preparation of reports on other statewide planning studies.
- A continuing and coordinated planning process for carrying out comprehensive transportation planning. Inclusion of projects in the Transportation Improvement Programs.

TASK TITLE: Special Studies

WORK AUTHORITY NO.: TH__103

WORK PERFORMED BY: Special Studies Section

OBJECTIVE:

To perform the necessary activities for evaluating the physical characteristics, performance, and programs on all road networks in Minnesota for use by department administrators, FHWA, State Legislature, and others.

METHODOLOGY:

This objective will be achieved by:

- Quantifying capital improvement cost alternatives for the trunk highway system for varying standards and levels of service and to provide the department with a system level policy analysis tool. (Highway Performance Monitoring System Investment Package).
- Operating and maintaining a computerized method of evaluating the adequacy of the Trunk Highway System (Highway Sufficiency and Condition Ratings). Annually collect and code data for updating the file.
- Maintaining the capability to periodically assess through annual reports, the condition of the highways, roads and streets in Minnesota to measure their performance and quality (Highway Performance Monitoring System). This is done in accordance with FHWA annual reporting requirements. Construction accomplishments and capital obligations are received from the local authorities as well as Mn/DOT.
- Providing review and coordination of the approval of local officials (RDC's & MPO's) approval of revisions to the Urban Area Boundaries, the Functional Classification Plans, and the eligibility of Federal-Aid Routes, in accordance with established procedures.
- Creating, maintaining, and providing maps and records for the Functional Classification system and the Federal-Aid system in a current status as necessitated by revisions or updates requested by local, state, or federal officials, in accordance with the provision under ISTEA and other established rules and procedures. (Includes coordination of requests for designation by the FHWA, of the National Highway System).
- General oversight of the Transportation Information Systems Files (TIS). Responsibility for the correctness of data entry related to Functional Classification, Federal-Aid, HPMS, Sufficiency, and Condition TIS coding. TIS is the reference file for most roadway information developed by and for in-house and outside users.

- Review of Federal-Aid considerations for recommendation of State Right of Way Reconveyance Orders. Part of the Mn/DOT responsibilities under the provisions of ISTEA.
- Coordination of review for truck route designations on Trunk Highways, recommendations forwarded to the Truck Center per Mn/DOT procedures conforming to Federal Register Vol. 55, No. 106, part 658.
- Provide guidance, authorship, and documentation of control section records and legislative control of routes as required by Mn/DOT and the Legislature.
- Solicit data and provide mapping and analysis of spring load restrictions as required by Minnesota law.
- Providing information from any of the above systems in the form of mapping, special reports, and data sets, on request from interested parties, while maintaining consistency and accuracy within the time limits of the client.

PRODUCTS:

- HPMS - Maintenance
- Sufficiency and Condition Ratings
- HPMS - Investment Package
- Functional Classification System (maps and records)
- Federal system documents (maps and records)
- National Highway System (maps and records)
- National Truck Network (Review) (maps)
- Provide reports and/or data for other highway studies as requested by FHWA, State, and Local Road Authorities, etc.

Note: (maps and records) referred to above are digital mapping and data records used to provide both "hard copy and electronic" information to users.

TASK TITLE: Program Development

WORK AUTHORITY NO: TH__106

WORK PERFORMED BY: Planning, Program Development and Project Authorization Section

OBJECTIVE:

To develop and manage a statewide transportation improvement program that promotes the safe and efficient movement of people and goods, and preserves and maintains the existing transportation system. Improvements to the system are made where cost effective and based on sound planning principles. Program Development is composed of several separate tasks.

STIP Guidance and Development: Develop and document the assumptions, procedures and processes to be used by the transportation partners when developing their respective Area Transportation Improvement Programs. To develop a Statewide Transportation Improvement Program that allows Minnesota to maintain and improve the safety of all components of the transportation system.

Special Federal Aid Programs: To develop, maintain, and program projects for special categories of funds, such as Forest Highways, Public Lands, and Emergency Relief.

METHODOLOGY

STIP Guidance and Development: Guidance for the development of the State Transportation Improvement Program (STIP) is provided through continuous communication with the District/ATP's and other partners through a Guidance document. The document provides transportation goals objectives and direction for use in making statewide transportation investments.

The Area Transportation Partnerships (ATPs) submit prioritized lists of candidate projects based upon the integration of transportation priorities from RDC's ,MPO's and Mn/DOT districts. The candidates are analyzed with respect to state goals, available funding, consistency and a draft STIP is developed. The draft STIP is reviewed by the ATP and with their comments considered, a final STIP is prepared.

Time frames:

April ATP submit candidate lists
May/June Draft Program reviewed by ATPs
July Final STIP developed and submitted to FHWA/FTA

PRODUCTS:

STIP Guidance and STIP: Guidance is sent to the Area Transportation Partners every year. A three year Statewide Transportation Improvement Program is then developed annually.

TASK TITLE: Special Federal Aid Programs and Project Authorization

WORK AUTHORITY NO: TH__112

WORK PERFORMED BY: Project Authorization Section

OBJECTIVE:

To provide administration of the Federal Aid Highway Program to maximize federal funds and utilize those funds effectively.

To provide budgetary control and fiscal management of the State Road Construction Programs in accordance with legislative constraints and Mn/DOT policy.

METHODOLOGY:

Conduct the Federal Aid programming process, the FHWA Project Status Record, and the submittal of project to the FHWA for authorization. Coordinate compliance with all Federal Aid requirements, engineering and fiscal, by other divisions and offices of Mn/DOT. Provide direction to the flow of federal funds between Mn/DOT and FHWA for their most efficient use. Ensure that program content is compatible with categorical distribution of program funding. Maintain the status of program budgets by listing expenditures, anticipated expenditures, and balances; and make the necessary adjustments that conform with legislated budget limits.

Special Federal Aid Programs: Program all viable projects in compliance with the published FHWA guidelines.

FAPG Sub-chapter G, Part 660 (Forest Highways)
FAPG Sub-chapter G, Part 667 (Public Lands Highways)
FAPG Sub-chapter G, Part 668 (Emergency Relief)

PRODUCTS:

A Federal Aid Program that effectively uses federal and other transportation funds.

An ongoing schedule of all special programs prepared for state, county, and municipal projects.

PROJECT TITLE: Program Management

WORK AUTHORITY NO.: TH__116

WORK PERFORMED BY: Planning, Program Development, and Project Authorization
Section

OBJECTIVE:

To maintain and develop computerized Mn/DOT program delivery schedules, and to further develop the financial tracking of projects in the Project Management and Scheduling System. This automated scheduling system contains all the information used in the distribution of State and Federal Funds, as well as manpower requirements for all pre-letting functions.

METHODOLOGY:

This task involves updating the most current program data into the computer system. It includes adding such data as letting dates, program funding estimates, amount of contract awards, type of funding, funding agreements, post-award changes, and program status.

PRODUCT:

A current on-line statewide program management and project scheduling system which is used as a tool in managing State Aid, Transit and Minnesota Department of Transportation construction program.

TASK TITLE: Administration and Control of State Planning & Research Program

WORK AUTHORITY NO.: TH__201

WORK PERFORMED BY: Project Authorization Section

OBJECTIVE:

To provide the direction, supervision and general office work necessary for the administration of the Planning and Research Work Program.

METHODOLOGY:

This work element provides for the administrative and coordination of the activities necessary to manage the State Planning and Research Work Program. The tasks in this program are reviewed and updated on an annual basis with funding obligation and program approval obtained from FHWA on or before the first of each year. An annual accomplishment report is prepared for monitoring the SP&R activities. This task provides for salaries and expenses of the SPR Coordinator to carry out the administrative responsibilities related to highway planning and research activities.

PRODUCT:

Annual Work Program, Annual Accomplishment and Financial Report. Internal quarterly financial report.

TASK TITLE: Economic Analysis

WORK AUTHORITY NO.: TH__218

WORK PERFORMED BY: Economic and Special Studies Section

OBJECTIVE:

To determine the most cost effective investments for transportation system improvements. Develop classic investment criteria to evaluate the economic feasibility and priority for proposed projects.

To investigate the relationship between transportation, including highways, and the economy and to investigate special issues.

This information is necessary to help guide Mn/DOT policy and decisions because transportation is not an end in itself, but rather exists to serve larger goals in society, including encouraging the growth of the economy.

METHODOLOGY:

1. Investigate the relationship between transportation, including highways, and the economies of the State and Nation including such topics as:
 - a. The effects of major demographic business and economic trends on transportation system demands and revenues.
 - b. The economic efficiency or financial returns of major transportation system segments and corridors.
 - c. Benefit incidence from transportation projects. To what extent do benefits accrue to local, regional, statewide, and/or national economies.
 - d. Economic impacts of alternative solutions to urban transportation problems.
 - e. Linkages between the Twin Cities and other regions of the state and other inter-regional relationships as well, with a focus on economic activities and transportation.
 - f. Distributional effects of transportation investments.
2. Develop criteria for evaluating the economic impact and feasibility of transportation projects through activities such as:
 - a. Conducting benefit/cost analysis of proposed transportation investment projects.
 - b. Calculating the economic rate of return to transportation investments.

- c. Evaluating the distribution of benefits and costs of transportation investments across identified groups in society.
 - d. Develop standards and practices for implementing investment analysis techniques.
 - e. Incorporating accepted investment analysis criteria into the project selection and prioritization process.
 - f. Providing technical training for implementing investment analysis to others involved in the transportation investment process.
3. Communicate the results of the investigations by means of reports, presentations, etc. appropriate to the stage of the projects and/or the audience involved.

PRODUCTS:

1. Components in Major Investment Studies for pending projects.
2. Workshops on use of investment analysis tools in transportation investment decisions.
3. Reports in various formats (memos, working papers, research reports) on the issues investigated and appropriate to the stages noted above and the intended audience.
4. Investment guidelines or criteria.
5. Economic analysis components of ATPs.

OFFICE OF

MANAGEMENT

DATA SERVICES

TASK TITLE: Transportation Information System (TIS) Management

WORK AUTHORITY NO.: TH__202

WORK PERFORMED BY: Transportation Information Systems & Development Section and the Transportation Data Section

OBJECTIVE:

- To manage the TIS by providing system, software, hardware and user support, data collection, file updating and maintenance, and by developing products such as visual and graphic reports.
- To act as liaisons between various Mn/DOT offices using the Transportation Data System (TIS) data and to maintain relationships with both internal and external users of TIS.
- To research, test and apply new products and technology in order that the various activities being conducted under this task are constantly improved and made more efficient.

METHODOLOGY:

The Office of Management Data Services is responsible for a major Information Resource System comprised of a number of databases and systems used for transportation planning and analysis. This system incorporates data about roads (trunk highways and all other roads), railways, bridges and bikeways. Attributes include physical characteristics, traffic volumes and classification, and truck weight data, accidents, etc.

This task consists of data collection, data maintenance, file maintenance, report generation, training, and providing technical support. Data is collected using various methods such as laptop computers for vehicle classification data, electronic systems imbedded in the highways for Weigh-in-Motion data and requests to various offices and governmental agencies for resolutions, construction plans etc. This information is used to update the information in TIS.

The information in TIS is used by Transportation decisions makers, planners and analysts. Programming and System analysis services, hardware installations, system enhancements and modifications, and overall system support are provided.

PRODUCT:

Prompt, efficient and accurate TIS file updates using up-to-date state of the art data maintenance and collection methods which meet the needs of the end users.

- TIS roadway data files able to be accessed by users with remote terminals.

- Current data on the physical characteristics of roads, vehicle classifications, truck weights is available for input into the T.I.S. to be used for various studies and submission to the Long Term Pavement Performance Study (LTPP) Traffic Database and for input into the Mn/DOT Traffic Database.
- Local road attributes maps for use by DPS and law enforcement agencies and Road Life records, Construction Project Logs, and Control Section Listings to be used as references by districts and other offices and agencies.

Hardware configuration, system data files, computer programs, and systems documentation to meet the needs of various internal and external users.

Maps, reports, user manuals, memos and articles detailing TIS capabilities, and in-house and on-site training in TIS and IBM software systems (JCL, TSO, ISPF, IOF).

TASK TITLE: Vehicle Classification Truck Weight Studies

WORK AUTHORITY NO.: TH__213

WORK PERFORMED BY: Traffic Forecasting and Analysis Section & Transportation Data Section

OBJECTIVE:

To determine the types and weights of vehicles using the state's roadways and continually improve our method of accomplishing this. Analyze and report on the data in the format needed by Mn/DOT traffic forecasters, FHWA, and various other public and private parties.

1. Collect weight data at 6 permanent Weigh In Motion Scales located throughout the state.
2. Perform routine maintenance annually at each WIM site.
3. Process vehicle classification data collected both manually and automatically throughout the state. About 100 locations are counted on a 2-year cycle and 900 on a 6-year cycle.
4. Process and store truck weight data.
5. Evaluate and update traffic data collection and analysis methods through the use of statistics, new technology and computer software while making available additional traffic data in the Transportation Information System.

METHODOLOGY:

Through the use of both PC based and mainframe programs, the raw data is processed to represent average day of the year values. Review of current methods and the use of innovative techniques will facilitate meeting users' needs.

PRODUCTS:

1. Annual Vehicle Classification and Truck Weight reports.
2. Truck volumes produced biennially on the state traffic flow map.
3. Biennial 5 axle semi maps.
4. Analysis of data and special studies.

TASK TITLE: Traffic Counting

WORK AUTHORITY NO.: TH__214

WORK PERFORMED BY: Traffic Forecast and Analysis Section & Transportation Data Section

OBJECTIVE:

To conduct and continually improve our traffic counting programs which provide data for determining annual average daily traffic, vehicle miles of travel and growth trends for Mn/DOT traffic forecasters, FHWA, and various other public and private agencies.

1. Collect traffic data, using portable counter-classifier and from Automatic Traffic Recorders (ATR's) located throughout the state, into TIS.
2. Test ATR's for accuracy by manually counting at each site and comparing results.
3. Process traffic data using acceptable statistical methods.
4. Prepare traffic maps for the state trunk highway system on a 2-year cycle. Enter the count data for items 1-3 in the Traffic Files of the Transportation Information System (TIS).
5. Improve our methods of handling and reporting on the data through the use of statistics, new technology, and computer software.
6. Prepare traffic maps for the 7 county metropolitan area on a 2-year cycle.
7. Prepare traffic maps for the 80 out-state counties on a 4-cycle.

METHODOLOGY:

A cooperative approach is used which has our personnel selecting the counting location, district personnel collecting the counts, and our personnel processing the data to produce the traffic volumes for the average day of the year. Use all resources at our disposal to improve the procedures.

PRODUCTS:

1. County work maps with traffic volumes on trunk highways plus a state traffic flow map derived from the county traffic maps.
2. An ATR summary report plus seasonal adjustment factors to apply to the counts taken in items 1-3 listed above.

3. Seven county metropolitan area maps on a 52-sheet street series with traffic volumes on the Municipal State Aid Street (MSAS) system.
4. 80 out-state county maps with traffic volumes on County State Aid Highways (CSAH's), County Roads (CR's) and MSAS.
5. Analysis of data and special studies.

TASK TITLE: Traffic Forecasting for Highway Design

WORK AUTHORITY NO.: TH__216

WORK PERFORMED BY: Traffic Forecast and Analysis Section

OBJECTIVE:

To provide traffic forecasts, data and reports for highway design for Mn/DOT district offices and highway planning and organization.

1. Prepare forecasts of traffic volumes, axle loading and truck traffic.
2. Provide rural districts with technical support in traffic forecasting.
3. Monitor short term traffic trends.
4. Assist Metropolitan Planning Organizations and communities with traffic forecasts and technical studies.
5. Assist the Metropolitan Council with transportation system analysis and planning.

METHODOLOGY:

Through the use of various computer traffic models, forecasting techniques and analysis of traffic data, projections of future truck and auto volumes will be calculated.

PRODUCTS:

1. Systems Planning and Analysis reports.
2. Individual highway traffic estimates.
3. Estimates of truck volumes and movements.
4. Traffic forecasting model maintenance updates.
5. Special studies and reports.

TASK TITLE: Transportation Information System (TIS) Migration and Conversion

WORK AUTHORITY NO.: TH__224

WORK PERFORMED BY: Transportation Information Management Section

OBJECTIVE:

To convert and migrate the Transportation Information System data from the mainframe to a relational database in the WINDOWS NT environment and to build applications that parallel the current TIS applications as needed.

METHODOLOGY:

Rationale: TIS, which is used to support reporting requirements for HSI, HPMS, WIMS, LTPP and other departmental needs and activities such as bridge management, pavement management, and bikeway management resides on an IBM mainframe computer. It suffers from a number of deficiencies that make it difficult to meet the transportation data management and analysis need of Mn/DOT. Examples of specific problems are listed below:

- Not user friendly.
- Information not easily accessible and quantified.
- Costly and cumbersome data maintenance procedures.
- Data outdated, incomplete and inaccurate.
- Cannot easily integrate with mapping software (GIS, CAD).
- System environment and architecture is very outdated (over 25 years old).
- Increasingly difficult to find information resource professionals who know IBM mainframe operating systems, procedures, and programs (TSO, JCL, PANVALET, PL/1, EASYTRIEVE) that are being used to maintain the system.

Plan: The plan is to design and build a relational database (Oracle) that will parallel the current structure of TIS and to build applications that correspond to TIS applications and create new applications as may be needed. The new system will be more user-friendly and will provide for easy integration of geographic applications (GIS and CAD).

The initial objective is to move the data for the trunk highway system (about 12,000 miles of roadway) from the mainframe to an Oracle database. It will be used primarily for displaying data on a map (GISmap). This will be phase one of the project.

The data will continue to be maintained using the mainframe TIS until all the data is migrated and the applications on the mainframe are duplicated on the relational database. A methodology for moving the data from the mainframe to the Oracle will be established to be able to refresh the data periodically.

Phase 2 of the project will be the development of the applications that will duplicate the mainframe applications, e.g., data entry and updating and report generation. Once this is developed, tested and working correctly, then phase 3, which is the migration and conversion of all of the transportation data will be done.

PRODUCT:

A relational database in Oracle with redesigned data files, data maintenance procedures, and analysis and reporting software, which will be integrated with GIS applications.

TASK TITLE: SP&R Technology Support

WORK AUTHORITY NO.: TH__225

WORK PERFORMED BY: Transportation Information Management Section

OBJECTIVE:

Provide for the acquisition, installation, operation, maintenance and training in the use of computer networks, hardware and software.

METHODOLOGY:

- Provide timely, access to information for clients as required.
- Lead in the innovative use of new technology and monitor implementation.
- Provide timely issue analysis, policy review and cooperatively participate in the development of IRM policies.
- Keep the in-place technology and network operational and up to date.
- Continuous efforts to secure IRM resources, enhance our products.

PRODUCT:

Enable Management and SP&R clients to make decisions that provide the citizens of Minnesota with a competitive, economical and efficient transportation system through the use of application and technology resources. Provide quality and timely technical data, information, knowledge and expertise as an integral link in the planning, research and decision-making process.

SP&R clients job numbers include:

TH__101, TH__102, TH__103, TH__105, TH__106, TH__112, TH__116, TH__118, TH__201,
TH__202, TH__206, TH__213, TH__214, TH__216, TH__224, TH__301, TH__302, TH__901,
TH__902, TH__903, TH__904, TH__905, TH__906

OFFICE OF

TRANSIT

TASK TITLE: Transit Program Planning

REFERENCE NO.: TH__301

WORK PERFORMED BY: Office of Transit

OBJECTIVE:

To prepare transit program plans and reports in cooperation with participating agencies and staff. To analyze, document and recommend transit program policies that encourage coordination and cost-effectiveness of transit services. To develop, evaluate and recommend alternative program strategies and performance criteria.

METHODOLOGY:

Produce an annual report which concisely summarizes public transit activities. Prepare specialized reports and present results to internal and external advisory groups. Legislative and regulatory developments will be monitored. Develop a transit information network which will maintain information on all transit services in the state in order to further coordination and cost effectiveness of transit services. Alternative strategies are developed and analyzed when issues arise. Establish performance measures that are applicable to the various transit services and providers. Policies and other considerations are combined and documented as part of overall program strategy implementation. Support office planning activities.

Results will be produced as needed and will be used as a focus for testing new approaches and implementing practical improvements in transit services.

PRODUCTS:

- Annual Report
- Policy Analysis Reports
- Transit issue Presentations
- Quarterly Progress Reports
- Five Year Transit Plan
- In-Transit News Letter
- Office of Transit Website

TASK TITLE: Transit Research and Program Evaluation

WORK AUTHORITY NO.: TH__302

WORK PERFORMED BY: Office of Transit

OBJECTIVE:

To research and prepare a variety of specialized reports, site studies, and surveys to ensure that adequate information is available to identify and evaluate alternative options involving numerous transit issues. To provide technical assistance to transit programs and project managers on specific transit planning and research projects. To develop research programs using a comprehensive computerized transit program data base and specialized software.

METHODOLOGY:

Prepare specialized reports on current transit topics. Analyze market characteristics for changing transit service areas. Conduct site studies for existing public transit systems. Develop, implement and analyze on-board transit surveys to continually update ridership profiles. Analyze trends (economic, social, demographic, etc.) that have current and/or potential impacts on public transit via utilization of specialized computer software. Support office research and program evaluation activities.

PRODUCTS:

- Program Performance Reports
- Demographic Trend Analysis Reports
- Site Studies for Transit Systems
- Transit Research Projects
- Transit Need Assessments
- Drug and Alcohol Program Technical Assistance

OFFICE OF

FINANCIAL

MANAGEMENT

TASK TITLE: Highway Statistics

WORK AUTHORITY NO.: TH__401

WORK PERFORMED BY: Financial and Management Analysis Section General Ledger Unit

OBJECTIVE:

To furnish information on motor vehicle registration, fees and taxes; driver license regulation and fees; and fuel consumption. This data is used to develop motor vehicle and motor fuel usage for forecasting future highway-user imposts and determining vehicle and fuel tax policies. Data is collected on state and local government highway finances and taxation for use in the formulation of highway policy, administration of highway matters, and informational use by legislators, public officials and the general public.

METHODOLOGY:

The procedures used to obtain statistical and financial data for reporting purposes are as follows:

- Motor vehicle registration and drivers' license data are received on an annual basis from the registrar of motor vehicles, Department of Public Safety. These data are researched, analyzed and compiled for use in the preparation of reports in accordance with instructions contained in Chapter 3, 4 and 5 of FHWA "A Guide To Reporting Highway Statistics."
- Motor fuel statistics are received monthly from the Petroleum Tax Division, Department of Revenue. Upon receipt of this information, monthly computations are made and placed on computerized spreadsheets for gasoline and special fuels gallonage. These statistics are used in the preparation of annual reports and in accordance with Chapter 2, FHWA "A Guide to Reporting Highway Statistics."
- Financial reports are prepared from information acquired from the Department's Financial Management Analysis Section records. These records are extensively examined and tabulations, etc. are prepared for use in the preparation of annual reports in accordance with the guidelines contained in Chapter 8 and Chapter 9 of FHWA "A Guide to Reporting Highway Statistics."
- Local government financial reporting is based on information furnished by all cities, towns and counties on an annual basis. This information is prepared by the Governmental Information Division of the State Auditor's Office. The Annual completed workup is submitted to the Department's Financial Management Analysis Section for review. It is then forwarded to the Federal Highway Administration. This is in accordance with instructions in Chapter 10, FHWA "A Guide to Reporting Highway Statistics."
- Travel takes place in connection with training workshops, seminars, etc. which are scheduled annually for increasing effectiveness and efficiency of financial and statistical reporting.

PRODUCTS:

FHWA-531	State Highway Income
FHWA-532	State Highway Expenditures
FHWA-534	Capital Outlay and Maintenance Expenditures
FHWA-536	Local Highway Finance Report - Cities, Counties, and Townships
FHWA-541	State Transportation Obligations Issued During Year and Allotment of Proceeds
FHWA-542	Status of State Transportation Debt
FHWA-543	State Transportation Sinking Fund and Debt Service transactions
FHWA-551M	Monthly Motor-Fuel Consumption
FHWA-556	State Motor-Fuel Tax Receipts and Initial Distribution by Collection Agencies
FHWA-561	State Motor Vehicle Registrations, Registration Fees and Other Receipts; Initial Distribution by Collecting Agencies
FHWA-562	State Drivers' Licenses and Fees
FHWA-566	State Motor Vehicle Registration Fees and Other Receipts; Initial Distribution by Collecting Agencies
FHWA-571	Receipts from State Taxation of Motor Vehicles Operated for Hire and Other Motor Carriers

These reports are used as a basis for the statistical data and the U.S. Department of Transportation's annual publication "Highway Statistics."

OFFICE OF

TRAFFIC

ENGINEERING

PROJECT TITLE: Speed Data Summaries

WORK AUTHORITY NO.: TH__501

WORK PERFORMED BY: Office of Traffic Engineering

OBJECTIVE:

To monitor highway speeds and develop speed characteristics at various sites located on five highway categories. Data summaries are reported quarterly and annually and are also available on the Internet.

METHODOLOGY:

Data collection procedures are developed by the Office of Traffic Engineering (OTE) and implemented through eight district traffic engineers. Monitoring 24 hour periods is desirable, therefore Mn/DOT uses a combination of automated traffic recorder stations and weigh-in-motion stations at sites with speed monitoring equipment accessible by telephone telemetry. Different software programs download the data, format it and finally analyze and print reports. Data is still visually screened to verify accuracy and potential hardware problems. The TRIM office maintains the hardware and OTE does the data analysis. This automated methodology has helped decrease the number of person hours required compared to previous years.

PRODUCTS:

A complete file of speed characteristics, on each category of highways. These files are used to develop quarterly and annual reports to evaluate motorists compliance with speed limits. Data may also be used to evaluate effectiveness of enforcement and public awareness programs. Speed trends also play a role in evaluating accident trends.

TASK TITLE: Crash Surveillance

WORK AUTHORITY NO.: TH__502

WORK PERFORMED BY: Office of Traffic Engineering

OBJECTIVE:

To provide crash data which can be used to reveal high crash locations and over represented crash characteristics on all roads and streets in the State. This information relates to the highway facility, vehicle, environment, and human factors and provides input for establishing highway safety needs and priorities for development of a long-range safety improvement program.

METHODOLOGY:

Traffic crashes, reported per state law by investigating officers or citizens, are processed by DPS and are on-line no later than 90 days afterward. A wide range of variables from the vehicle, injury, roadway, driver and environment support the federal emphasis of crash analysis and safety counter measure development. Various TIS software programs are executed by OTE And a report is developed for a requesting agency or internal application.

The software programs are over 15 years. A consultant was hired to modify and enhance this software. These changes will improve user friendliness of both maintaining the data files and producing customized reports.

PRODUCT:

Semi-annual crash reports will be prepared for road authorities. Comprehensive reports are prepared using district boundaries for comparative analysis of accidents within specified areas or highway categories. Customized reports can be developed for technical or non-engineering disciplines upon request. Crash rates can be calculated for isolated intersections, highway categories or statewide systems as designated by the scope of the requester.

This timely crash data and summarized reporting provides road authorities an objective basis for prioritizing and developing safety countermeasures, dedicated enforcement efforts and also minimizes tort liabilities.

OFFICE OF

LAND

MANAGEMENT

TASK TITLE: Municipal Maps

WORK AUTHORITY NO.: TH__601

WORK PERFORMED BY: Geographic Information and Mapping Unit

OBJECTIVE:

To prepare and maintain a complete set of planmetric street maps at suitable scales for all incorporated municipalities in Minnesota. Reproducible and prints of these maps are used by the department for general purpose planning and operation functions and for municipal corporate boundary reference. In addition, many federal, state and local agencies, and the general public, use these maps for business and recreational purposes.

METHODOLOGY:

The original base maps of all incorporated municipalities are prepared in accordance with standards outlined in the *FHWA Guide for a Highway Planning Map Manual (Volume 20, Appendix 25)*. Municipalities are categorized as being either over or under 5,000 population. The procedures followed in producing these maps are the same in both cases.

Municipalities having a population of 5,000 or greater are represented individually on one or more 24" x 36" map sheet. Municipalities with less than 5,000 population are grouped by county on one or more 24" x 36" sheets, with as many municipalities on a sheet as space will allow.

At the present time, there are 128 incorporated municipalities having a population of 5,000 or more on 142 map sheets, and 725 incorporated municipalities of less than 5,000 population on 229 sheets. This makes for a total of 853 municipalities represented on 371 24" x 36" map sheets.

In the development and maintenance of municipal maps, all possible current information is collected and compiled from the same various map information sources as listed under county maps. (See TASK TITLE on County Maps).

With the implementation of computer assisted design and drafting (CADD), we are in the process of converting our manually drafted maps (analog) to computer generated maps (digital). This process is called "digitizing" where the locations of geographic features (those elements to be mapped) are recorded as digital x, y, coordinates in a computer file.

These digital computer map files may be structured as either a vector format where linear features are represented as a list of ordered x, y coordinates, or as a raster format, where the data structure is composed of rows and columns forming a grid of cells which may be assigned various values. Computer plots of either file format can be made onto paper or film.

Update and revision are achieved by either manually drafting any changes to be on those municipal maps that have not be converted to a digital format or by entering any revisions to be made in the appropriate digital file and obtaining a new plot. At present, 218 municipal map sheets have been converted to a digital format.

Graphic records for all of Minnesota's municipal corporate boundaries are maintained by the Geographic Information and Mapping Unit. Due to age, many of these graphic files are in poor condition. We are in the process of converting those plats that are in the most serious condition and those that generate the most revision activity to a digital format.

For those deteriorating graphic records that only need preservation, a technique called "scanning" is used to generate a digital raster file. For those graphic records that have constant or extensive revisions to be mapped, digital vector CADD files are created from the existing analog map, and supplemented with additional information from appropriate Mn/DOT Right-of-Way maps, plat maps, legal land descriptions and city engineer maps.

The overlay method of mapping is used to produce Municipal State Aid Street (MSAS) maps for all municipalities having a population of 5,000 or more.

MSAS maps delineate state trunk highways, County State Aid Highways (CSAH), County Roads (CR) and MSAS routes on the appropriate municipal map. These various route systems are shown by overlaying approved patterns on the corresponding route. Additionally, MSAS streets are labeled with the number assigned in the Commissioner's Order that establishes the designation. For digital municipal maps, the corresponding MSAS overlay is also created in a digital format. A composite reproducible plot of the base map and the MSAS overlay (as a reference file) is then made for copying. For manually produced municipal maps, a drafting film overlay is manually prepared and combined with the respective municipal map to create a composite reproducible.

PRODUCTS:

A complete set of planmetric street maps of all incorporated municipalities in Minnesota.

Municipal State Aid Street (MSAS) maps for all incorporated Minnesota municipalities having a population of 5,000 or more.

TASK TITLE: St. Paul-Minneapolis Metropolitan Area Maps

WORK AUTHORITY NO.: TH__604

WORK PERFORMED BY: Geographic Information and Mapping Unit

OBJECTIVE:

To prepare and maintain maps of the St. Paul-Minneapolis Metropolitan Area showing existing streets and roads, route system designations, railroads, political boundaries and other miscellaneous features. These maps provide the department and various other governmental agencies with basic mapping for general purpose planning and operation functions.

METHODOLOGY:

The Geographic Information and Mapping Unit maintains a digital base map for the entire Seven County Metropolitan Area. This set of 50 map sheets is referred to as the Metro Area Street Series. While prepared, maintained and usually plotted as 50 individual digital map files, these sheets are structured for seamless mosaicking into desired metro area coverages.

These maps show all roads and streets in single line format. Route systems, such as state trunk highways or county roads, are portrayed by different line weights as well as their respective route designation symbol and number. These maps also show all political boundaries, hydrography and railroads as well as selected references to the Public Land Survey System (section, township, range) and geodetic location (lat/long and state plane coordinates).

The computer assisted design and drafting (CADD) method was used to produce the Metro Street Series. Using a high resolution computer graphic workstation and MicroStation® software, a mapping technician "digitizes" all the various graphic elements contained within the computer map file. (See Task Title on Municipal Maps for explanation of digitizing).

USGS 1:24000 scale 7½ minute quadrangle (quad) maps are used as the source for positional control and the initial line-work to be digitized. Using the same digitizing techniques, this "skeletal" line-work is then supplemented with other map information sources such as aerial photographs, road plans, road inventory notes and other maps.

Individual Metro Area Street Series map sheet coverage is formed by merging and "clipping" appropriate Mn/DOT "skeletal" quad files within the computer. The symbolical and text annotation needed to complete the map are also entered into the digital file. The finished map file is used to produce computer plots which are then used for copying.

From this same digitizing, The Geographic Information and Mapping Unit has formatted a single map sheet file titled the St. Paul-Minneapolis Metropolitan Area Map. Features depicted on this map include all state trunk highways and county state-aid highways, selected county roads and other local arterial roads, railroads, hydrography and political/civil boundaries. The graphic format and level assignment of this file resembles that of the county mapping activity. (See Task Title for County Maps).

A full-sized and a reduced scale computer plot are made for further paper map copies.

Additionally, this same Metro Area Street Series digitizing serves as the base for formatting individual municipal maps for those cities within the seven county metropolitan area.

PRODUCTS:

A 50 map sheet set (Metro Area Street Series) covering the entire Seven County St. Paul-Minneapolis Area at a scale of 1:24000 (one inch equals 2000 feet).

A single sheet St. Paul-Minneapolis Metropolitan Area Map.

TASK TITLE: County Maps

WORK AUTHORITY NO.: TH__606

WORK PERFORMED BY: Geographic Information and Mapping Unit

OBJECTIVE:

To maintain a complete set of current, accurate and uniform county maps at a scale of one inch equals one mile. Prints and/or duplicate reproducible of these maps are used in the planning, location, and design of projects by the Minnesota Department of Transportation. Additionally, these maps are used as base maps by most state agencies, local and county governmental units, many federal agencies, private sector business application, such as transit and transportation industry, utilities, manufacturing, etc., and by the general public for business or recreational purposes.

METHODOLOGY:

The original, full scale county maps are prepared and maintained in accordance with standards outlined in the FHWA Guide for a Highway Planning Map manual (Volume 20, Appendix 25).

Currently, 121 map sheets are required to map Minnesota's 87 counties. These are produced on a uniform sheet size of 36" x 56" requiring from one to seven sheets for a single county.

In the development of a new county map base all possible current information is obtained from the following reliable sources:

County Maps

1. U. S. Geological Survey 1:24000 quadrangle maps
2. Mn/DOT project construction plans
3. Aerial photography obtained from Mn/DOT Photogrammetric Unit, U.S. NAPP, Department of Natural Resources and Metropolitan Council
4. Road Status Reports from County and Municipal Engineers
5. Municipal and County project construction plans
6. Mn/DOT Intermodal Programs Division, Transportation Data Section road note data
7. Railroad and public utilities
8. Minnesota Department of Natural Resources
9. Various United States agencies such as Bureau of Land Management, Bureau of Indian Affairs, U. S. Forest Service, Federal Aviation Administration, and Federal Highway Administration
10. Decisions from the U. S. Board of Geographic Names
11. Others

After all data is collected the information is plotted using colors to denote various items. Colors are used to facilitate the later map preparation. Maps are prepared at a scale of one inch equals one mile using a polyconic projection. These are classified as full-scale county maps.

Originally, base maps were prepared by placing appropriate symbols and patterns on a mylar sheet. These were cut from pre-printed, adhesive-backed acetate sheets which we call "stipple". Since 1986, all new county map sheets have been prepared utilizing computer-assisted design and drafting (CADD). After completion and checking, copies are submitted to FHWA for approval.

With the implementation of CADD, a method called "digitizing" is being utilized to create new, updated and very accurate maps. The procedure for this process is described in the section on "Municipal Maps". This method is labor intensive in the initial stages but saves considerable time when making annual updates. The positional accuracy of the map product and the ability to seamlessly combine adjoining counties to create area maps are important benefits of this method.

At present, 110 county map sheets have been converted to a digital format. These digital county maps are being used in the development of a statewide Mn/DOT geographic information system (GIS) database.

The original base maps are filed in the Geographic Information and Mapping Unit and are used only to make full-size photographic mylar reproducibles. These full-size reproducibles are used to make copies on an "as ordered" basis and to make half-scale photographic reductions. Commercially printed lithographic prints of the half-scale maps are made and are available for sale or other distribution. Half-scale printing is done only every two years.

Minor revisions are received almost daily. These are filed for reference and every county map is updated at least once each year to reflect these changes.

PRODUCTS:

A complete set of county general highway maps covering the entire state at a scale of 1:63,360 (one inch equals one mile).

Half-scale reductions and lithographic prints of county maps.

TASK TITLE: State Maps

WORK AUTHORITY NO.: TH__608

WORK PERFORMED BY: Geographic Information and Mapping Unit

OBJECTIVE:

To prepare and maintain current, accurate and legible Minnesota maps depicting Minnesota's transportation systems statewide. These state maps are used by Mn/DOT for administrative and planning activities as well as by other federal, state and local governmental agencies in relating their concerns to Minnesota's transportation systems. Public utilities, private industry and business and the general public also make use of these maps for their individual needs.

METHODOLOGY:

State map originals are prepared and maintained in accordance with the standards outlined in the FHWA "Guide for a Highway Map Manual" (Volume 20, Appendix 25).

When Mn/DOT (formerly Minnesota Highway Department) began producing its own Official Highway Map in 1965, the base map showing state and county lines and the state trunk highway system was also to serve as a base for all other departmental statewide mapping concerns (See State Map Products). In 1992, work was completed on the digitizing of a new base map for the Official Minnesota Highway Map utilizing the capabilities of computer-assisted design and drafting (CADD).

The new Official Highway Map base was created, in much the same manner as is described in the section on "Municipal Maps". Digitizing was done using the U.S.G.S. 1:100000 quadrangle map series for Minnesota as the basis. Prior to digitizing, all pertinent map data was supplemented and updated with current information from all available sources. With the completion of this project, considerable flexibility is available in generating the necessary overlays for printing the current map.

Revision of the digitized base map and overlays to show current status is achieved by researching maps and data produced by reliable governmental mapping agencies and various other sources as listed under item number TH__606, County Maps. The Official Highway Map is updated every two years while the other map derivatives are updated as the need occurs, in accordance with current map production schedules.

The Geographic Information and Mapping Unit is also in the process of developing a statewide data base for transportation system mapping through the use of CADD. Because map features are being located in the field by state plane coordinates, a strict Lambert conformal conic projection is being plotted to preserve map accuracy. The CADD system allows many transportation related elements to be identified with the transportation networks of highways, rail, pipelines and waterways. It also allows for the use of "windowing in" on a statewide map down to regional,

district, county or even corridor specific maps. These additional capabilities and resulting flexibility will produce a better picture of transportation interrelationships within the State of Minnesota.

PRODUCTS:

The Official Highway Map is produced biennially under this project. All of the cartography, photography text and artwork for this publication are produced in-house. Offset four color printing is accomplished by low bid of local commercial printer. Mn/DOT funds are used for purchasing the number of maps needed by Mn/DOT distribution outlets at a unit price that covers the cost of printing. Other state agencies may also purchase quantities of maps, at the per unit printing cost, by coordinating their purchase request, with Mn/DOT's, through the Department of Administration.

The State Trunk Highway System Map and the state county outline map were prepared by digitizing U.S. Geological Survey 1:100000 scale maps. Appropriate map features from these 69 individual source maps were merged into one file of statewide coverage. Computer plots of these maps are made to various scales and copies are produced as the need arises.

Miscellaneous other state maps that portray transportation related data statewide are either derivatives of or overlays to the State Trunk Highway System Map. These types of maps are plotted and/or printed on an as needed basis.

A set of Mn/DOT district maps has also been digitized and annotated. District offices access, update and plot their respective areas through the network on an as needed basis.

TASK TITLE: GIS Base Map

WORK AUTHORITY NO.: TH__609

WORK PERFORMED BY: Geographic Information and Mapping Unit

OBJECTIVE:

To prepare and maintain a current and accurate statewide GIS BaseMap. The GIS BaseMap is used by Mn/DOT (C.O. and districts), federal, state, regional and local governments, universities (e.g. University of Minnesota, Mankato State, Ohio State, Michigan State) and is available to corporations (e.g. utilities, engineering businesses, consultants) and the general public.

METHODOLOGY:

BaseMap was developed to fill a need at Mn/DOT for a continuous, statewide GIS BaseMap. *BaseMap* is the product of a number of efforts including standards committees, user group meetings and pilot projects as well as the GIS Specialists who worked to digitize and build it.

The original linework was done by digitizing the USGS 1:24000 quadrangle map series. Then, using ESRI's Arc/Info to merge and separated into 23 coverages containing roadway, highway, csah, muni, etc. Attributes have been added to many of the coverages.

Revision of the GIS BaseMap to show current status is achieved by researching by researching maps and data produced by reliable governmental mapping agencies and various other sources as listed under item number TH__606, County Maps.

Revision allows users to display and analyze data from many sources and in any of several location-reference systems. It is under continuous development and it will be enhanced and maintained by Mn/DOT. A current version will be published yearly.

PRODUCTS

The State of Minnesota BaseMap is produced annually and is distributed via CD-ROM. All of the cartographic, graphics and artwork for this product are produced in-house. CD writing is accomplished by low bid of local commercial printer. Mn/DOT funds are used for production of 500 CDS annually. Distribution policies are that BaseMap is free to all government and education entities, and \$20 to private entities.

**OFFICE
OF
STATE AID**

TASK TITLE: County State Aid Highway Needs Study

WORK AUTHORITY NO.: TH__701

WORK PERFORMED BY: State Aid

OBJECTIVE:

To compile a computerized record of the entire County State Aid Highway System with specific attention given to mileage and money needs. Basically, money needs are defined as the construction cost required to improve the county state aid system to approved standards. Based on direction from the County Engineers Screening Board, each county's mileage and annual money needs are presented to the Commissioner of Transportation. Using this information and pursuant to Minnesota Statutes, Chapter 162; the Commissioner apportions the County State Aid portion of the road user fund to the various counties.

METHODOLOGY:

Each county engineer is annually required to update his needs study based on construction accomplished, system revision, traffic, needs reinstatement, and any other necessary changes. With these updates, the computer record is revised and a completely updated needs study is created.

Each year, in order to keep the needs study unit prices current, each year a five year average unit price study is produced. Using the results from this study, the County Engineers Screening Board develops new unit prices for inclusion into the needs study.

Each year approximately 25% of the counties have their traffic counted. This information is received from the Data Management Section and transferred onto the records in the needs study.

All the above data is presented to the County Engineers Screening Board for their use in making an annual recommendation of mileage, lane/miles, and money needs to the Commissioner of Transportation.

The entire needs study process (computer programs, etc.) is being reviewed and rewritten. This will take several years and will result in increased budget numbers.

PRODUCTS:

Two County Engineers Screening Board Reports.

One County State Aid Apportionment Booklet.

Misc. Legislative, Auditor, and client requests.

PROJECT TITLE: Municipal State Aid Street Needs Study

PROJECT AUTHORITY: TH__702

WORK PERFORMED BY: State Aid

OBJECTIVE:

To maintain the Municipal State Aid Needs Studies which result in the annual determination of State Aid Apportionment to municipalities over 5,000 population according to Minnesota Statutes, Rules and Screening Board Directives.

METHODOLOGY:

The City Engineers annually report the construction accomplishments, system revisions, certification of mileage and status corrections as outlined in the State Aid Manual. Any city may count traffic with their own forces every two years at their discretion and expense, unless the municipality has made arrangements with the Mn/DOT district to do the count. These items are processed through a computer program together with unit prices which are annually updated and approved by the Municipal Screening Board at their spring meeting.

The resulting needs and tentative apportionments are reported to the Municipal Screening Board at their fall meeting. Prior to November 1, of each year, the board recommends the money needs to be used by the Commissioner of Transportation for the following year's allotment to the municipalities over 5,000 population. The actual allotment is made by the Commissioner of Transportation in January of the following year when the funds available are known.

PRODUCTS:

Two reports to the Municipal Screening Board for use in making annual recommendations to the Commissioner of Transportation.

One annual "Municipal Apportionment" report to the municipalities over 5,000 population showing their annual allotment and the methods of determining the amounts.

**OFFICE OF
TECHNICAL
SUPPORT**

TASK TITLE: Cultural Resource Investigations

WORK AUTHORITY NO: TH__801 THROUGH TH __899

WORK PERFORMED BY: Office of Technical Support

OBJECTIVE:

To preserve and/or document cultural resources subject to disruption due to proposed highway improvements. This includes the archaeological survey of prehistoric and historic sites, historic research, geomorphological studies, and/or archaeological data recovery. The information from these investigations is included in the environmental impact study of highway corridors. Results are also forwarded to the State Archaeologist and the State Historic Preservation Office (SHPO).

Cultural resource investigations are done in conformance with:

Historic Preservation (36 CFR 800);
National Historic Preservation Act of 1966 (PL 89-665) as amended;
Department of Transportation Act of 1966 (PL 89-670);
Executive Order 11593;
Archaeological and Historic Preservation Act of 1974 (PL 93-291);
Title 36 of the Code of Federal Regulations (CFR) Parts 60-66 and 800;
Native American Graves Protection and Repatriation Act of 1990 (PL 101-601);
Secretary of the Interior's Standards and Guidelines for Archaeology and Historic Preservation Activities. As published in the Federal Register on September 29, 1983, Volume 2 48, No. 190, Part IV. (48 FR 44716 through 44740);
Association of Iowa Archaeologist's Guidelines for Geomorphological Investigation in Support of Archaeological Investigations (1992);
State Historic Preservation Office (SHPO) Guidelines for Archaeological Projects in Minnesota;
Manual for Standing Structures;
Minnesota State Comprehensive Plan;

Minnesota state historic preservation regulations and guidelines, and Secretary of the Interior and/or SHPO standards, guidelines, and directives in force during the period of work performance.

METHODOLOGY:

Projects which may be affected by proposed highway improvements are identified through the districts, counties, and municipalities. These projects are assigned to vendors in the T-contract program on a rotational basis based on the vendor's expertise, work load and availability. Projects are defined by type of investigation and phase as required by SHPO after review of the proposed project area. Types are Geomorphology, Historical, archaeological, and architectural phases are defined as:

Phase I - Initial Reconnaissance
Phase II - Intensive Survey (Determine Significance)

PRODUCTS:

Monthly progress reports, field notes are submitted. Pictures and documentation of historical sites, if historical research is cited. If archaeology is identified, artifacts are curated. Final reports and conclusion of research and findings.

See also enclosed Special Conditions of agreement.

**OFFICE OF
ADVANCED
TRANSPORTATION**

TASK TITLE: Bikeways Planning

WORK ACTIVITY NO.: TH__117

WORK PERFORMED BY: Sustainable Transportation Initiatives (STI)

OBJECTIVE:

To integrate safe, efficient, and accessible community mode facilities (i.e. bicycles, pedestrians, transit, telecommuting) into the state's roadway network through transportation planning and Mn/DOT policies.

METHODOLOGY:

This objective will be achieved by:

- Providing technical transportation planning assistance and training to the 8 Mn/DOT districts and Central Office to ensure proper consideration of appropriate bicycle and pedestrian enhancements on all trunk highway projects so that safety improvements for all travelers can be made in a cost effective manner.
- Providing technical assistance to local units of government in bikeway/pedestrian planning and development, and mapping.
- Working with and tracking funding of TEA-21 projects for the local units of government concerning bicycle/pedestrian improvements.
- Develop working partnerships with local, state, national and international organizations to investigate and plan for bicycle/pedestrian/transit friendly environments.
- Work with Minnesota State Bicycle Advisory Committee on issues concerning bicycles.
- Develop bicycle program and funding support policies for consideration and adoption by MN/DOT, various state agencies, the State Bicycle Advisory Committee, and the legislature.
- Educate Mn/DOT and general public on the benefits of telecommuting.
- Work with Metro Area and Greater Minnesota transit agencies on ways to help their operations be more accessible to bicyclists.

PRODUCTS:

- A continuing and coordinated bikeways planning process which assists Mn/DOT, other state agencies, and local units of government in the enhancement of bicycle travel in the state.

- Implement “Plan B: The Comprehensive State Bicycle Plan” program recommendations that call for a promotional campaign supporting the choice of bicycling. This project is under development as PR2000.
- A series of bikeways maps which provide accurate and up to date travel information, both on paper and eventually available via the Internet on Mn/DOT's home page.
- A program which assists communities in the establishment and development of efficient local bikeway systems using ISTEA and TEA-21 funding.
- Minnesota Bicycle Transportation Planning and Design Guidelines.
- Plan and hold a bicycle conference for advocates in Minnesota in cooperation with the State Bicycle Advisory Board.
- Development of Mn/DOT policy for effective accommodation of bicycles in both rural and urban settings.
- Work with communities in Minnesota on the Transportation Action Model (TAM). This citizen’s planning model has been recently used in St. Peter, Koochaching County and Little Falls and will be deployed in Detroit Lakes and Roseau this year.
- Develop and hold training classes for employees who are able to telecommute.
- Continue the research work developing an index for identifying sustainable transportation systems in communities with the Humphrey Institute at the University of Minnesota.
- Continue the research with the Humphrey Institute on defining more specifically the role and benefits of telecommuting as a transportation mode.
- Develop, in coordination with appropriate stakeholders, community centers that incorporate sustainable transportation. The Great Lake Commercial Center in Minneapolis, in conjunction with work already in progress on developing the Midtown Greenway, a pedestrian and bicycle trail.
- Conduct a minimum of two citizen based transportation planning exercises in Greater Minnesota.

OFFICE OF

FREIGHT, RAILROADS

& WATERWAYS

TASK TITLE: Freight Studies

WORK AUTHORITY NO.: TH__220

WORK PERFORMED BY: Freight Section

OBJECTIVE:

Improve Minnesota's transportation system by providing investment guidance and information to internal and external customers. To facilitate private/public partnerships that improve freight transportation generally and specifically intermodal freight transportation systems.

METHODOLOGY:

By increasing awareness and improving institutional knowledge about the importance of freight transportation to Minnesota's economic, social and environmental health. Promote strategies that result in better integration of freight issues into Mn/DOT's transportation planning and investment management. Conduct freight and commodity flow studies. Develop freight facility and freight movement databases. Staff and support Mn/DOT's internal Freight Investment Committee. Staff and support the Minnesota Freight Advisory Committee comprised primarily of private industry members that provide input to Mn/DOT's planning and investment process, and foster public/private cooperation.

PRODUCTS:

1. *Policy Development, Issue & Trend Analysis*
Analyze and articulate freight related issues and trends that reflect statewide or regional economic importance or require policy considerations. Provide information and analyses to Mn/DOT Districts and other planning agencies that result in improvements to state transportation facilities, the state's goods movement systems, and are consistent with state goals. Provide information and stimulate discussions that guide statewide policy in support of Minnesota's freight transportation systems and the needs of the shipping community. Provide information and support local and regional transportation investment decisions in freight facilities and infrastructures.
2. *Freight Expertise & Intermodal Freight Perspective*
Develop and maintain a high level of freight transportation expertise to support all levels of Mn/DOT. Provide advice and assistance on freight policy issues. Continue Freight Facilities and Freight Movement database development and related efforts to provide an intermodal perspective to transportation planning.
3. *Freight Information, Commodity Flows, & Database Development*
Provide for development and dissemination of freight transportation related information to improve Mn/DOT's understanding of goods movement to the state economy. Provide commodity flow data and information to improve Mn/DOT's understanding and knowledge of shipper needs, Minnesota markets, transportation demand and freight's relationship to

economic activities. Concentrate on statewide, multi-state, national/internal flows while working with MPOs, RDCs, Districts and Metro Division to develop regional and localized information.

4. *Research & Communication - Coordination*

Develop research proposals and stay current with freight related research efforts regionally and nationally. Coordinate within Mn/DOT and provide freight information to internal and external customers. Provide coordination of weight enforcement planning with the State Patrol.

DESCRIPTION OF RESEARCH STUDIES

DESCRIPTION OF RESEARCH STUDIES

I. State SPR Research

ORS Administration - SPR-1(040)

Provides for the preparation of proposals, detailed work outlines, and cost estimates for research studies to be submitted for the SPR Work Program. This includes incidental and miscellaneous expenses which occur during the course of the year and which are pertinent to the overall research, development and implementation efforts. Included will be the costs of support staff and researchers needed to administer and monitor the studies in the State's Research Program. These studies can be found in this section. Many of these studies are a part of the Mn/ROAD and the IVHS research effort. Also provides for attendance and participation in various meetings, workshops, including the annual FCP conference, which contribute to a better understanding of current problems, foster exchange of technical information and lead to improved research management practices.

Transportation Research Board Dues - TRB-1 (000)

The activities supported by this subscription include the collection of available information concerning past, current, and proposed research related to transportation from all sources including federal, state, and other governmental agencies, colleges and universities, research and planning organizations, transport operators and industry, as well as the TRB Annual Meeting and conference programs; the study and correlation of this information through the work of the committees of the Board and dissemination of the useful findings of research and other information by all feasible means including the several TRB publication series, the output of the Transportation Information Services, and through personal contacts during scheduled field visits by the TRB professional staff.

II. Cooperative Research

National Cooperative Highway Research Program (NCHRP) - SPR-4(198)

This is a joint program of the American Association of State Highway and Transportation Officials (AASHTO), the Federal Highway Administration (FHWA) and the Transportation Research Board (TRB).

The AASHTO acts as executive agent for State Highway Agencies (SHA) which contribute 5½ percent of their SP&R funds for the research. The AASHTO represents their interest in formulating the annual programs, approves the selection of contractors, and monitors the NCHRP and the individual studies in the program. The National Academy of Sciences (NAS), through TRB and NCHRP advisory groups, administers the annual programs and the Research and Development (R&D) studies in them. The FHWA advises and assists the other organizations.

Candidate studies for this program are submitted to AASHTO annually by SHA's. The Transportation Research Board selects the contractors, and reviews the research work through to its completion, and reviews and publishes the final reports. The majority of this research is conducted by independent contractors, universities, transportation departments of research foundations.

Testing of State Safety Systems - SPR-2(146)

States often require unique treatments for specific roadside safety problems. The development of these treatments involve the design and testing of safety hardware. This study will provide a means for interested states to get assistance in the design and testing of roadside hardware. Interested states would work with the research contractor and FHWA personnel to develop the required hardware. This would be funded by the State through a contribution to the pooled fund study equal to the cost of the effort. Only states requiring assistance would contribute. FHWA would provide staff assistance only; no FHWA contract funds would be included in the study. During the 2000 program year, a noise wall rub rail design will be submitted for crash testing.

Midwest States Pooled Fund Crash Testing Program - SPR-3(017)

This is a regional pooled fund study for full-scale crash testing of highway safety appurtenances and obstacles. The studies and full scale crash tests will be performed by the Midwest Roadside Safety Facility located at the University of Nebraska - Lincoln.

The objective of the regional pooled fund program is to share information concerning crash testing and to lower costs by coordinating crash testing of mutual interest among participating state highway agencies. The intent of the program is not to duplicate a national study, but to supplement it and to provide a quicker response to the more urgent regional safety problems. Participation in the pooled fund study is limited to no more than ten states to assure flexibility.

ENTERPRISE IVHS - SPR-3(020)

(Acronym for "Evaluating New Technologies for Road Program Initiatives in Safety and Efficiency - Intelligent Vehicle Highway System".)

The principal objective of the ENTERPRISE program will be to accelerate the systematic advancement of selected IVHS technologies. Within this overall theme, program members will support and execute IVHS projects and activities ranging from fundamental research efforts, through technology development, demonstration and standardization to fully operational system deployment. Technical goals of the ENTERPRISE program can be summarized as:

- to investigate and develop IVHS approaches and technologies that are compatible with and complementary to other national and international IVHS initiatives;
- to promote the development of marketable systems for in-vehicle use that are affordable and attractive to motorists;

- to implement early operational tests of technologies, wherever possible, to better illustrate the potential benefits and immediate feasibility of IVHS;
- to study and resolve human factors issues associated with the selected IVHS technologies;
- to help address any institutional and legal issues associated with the successful IVHS approaches; and
- to contribute to standardization activities for appropriate IVHS breakthroughs.

AURORA - SPR-3(042)

The AURORA Consortium is a proposed program of collaborative research, development and deployment ventures in the field of road and weather information systems that reflects the interests of governmental agencies and industrial groups.

AURORA is expected to provide the basis for productive public-private partnerships of mutual benefit to industry and government. The outcome of the research is improvement to and technological advancement of existing systems that will help improve operations, save lives, preserve property and significantly reduce the adverse impacts of winter driving conditions.

Vision and Mission

Vision - To deploy advanced road and weather information systems that fully integrate state-of-the-art roadway and weather forecasting technologies with coordinated, multi-agency weather monitoring infrastructures.

Mission - To create a joint program for cooperative research, evaluation and deployment of advanced technologies for detailed road weather monitoring/forecasting for efficient highway maintenance and effective real-time information outreach to travelers.

Proposed Project Areas

- Standardized Weather and Road Condition Presentation
- Expert System as a Decision Support Tool
- Adaptation of Local Climatological Model into New Areas/Geo Thermal Mapping Model
- Automated Low Visibility Detection
- R/WIS Communication Standards
- Institutional Issues Identification
- Standardized Testing
- Meso Scale Modeling

Goals and Objectives

The goals of AURORA members define areas of potential benefit which the group intends to pursue. AURORA's goals include the following:

- To provide and/or improve R/WIS information dissemination to both transportation providers and users;
- To improve the efficiency of maintenance operations, primarily costly winter maintenance activities;
- To reduce potential weather-related construction activity delays via improved R/WIS information;
- To support and enhance information dissemination activities in the rural environment.
- To reduce traffic congestion delays in urban areas due to adverse weather-related conditions; and
- To aid in the development of seamless maintenance operations and information dissemination R/WIS programs.

AURORA's objectives address activities or areas of work which will support realization of the above goals. General objectives for AURORA include:

- To enhance and support the individual road/weather system deployment plans of AURORA participants;
- To jointly pursue emerging road/weather project opportunities in areas of interest to the group's members;
- To identify common development and evaluation needs within the group and to coordinate resulting technical activities;
- To provide a mechanism to facilitate further regional and international project cooperation and technical information interchange;
- To support the development and deployment of promising advanced technologies for use in road weather monitoring, forecasting, information exchange and dissemination;
- To facilitate the formation of public-private partnerships addressing appropriate program activities; and
- To provide test beds in a variety of environments and locations for the evaluation of emerging road/weather system technologies and standards.

North Central Superpave Center (NCSC) SPR-3 (044)

This regional pooled fund study to provide base funding for the operation of the North Central Superpave Center which includes:

- communication of advancements, changes and experiences related to Superpave testing, specification, construction and performance through personal presentations, quarterly newsletter, news flashes via e-mail and/or fax, and electronic mail;
- training assistance including free tuition for up to four people in Superpave classes held at the North Central Superpave Center or a host state;
- consultations by phone, e-mail, fax or letter on Superpave related questions;
- cooperative research efforts with the states without the customary overhead charge; and

- Superpave binder or mixture testing in conjunction with pilot or experimental projects.

These activities are consistent with the Steering Committee's guidance that the North Central Superpave Center should work in the areas of communication, training and research. Industry in the state is also free to participate in these activities.

Urban Mobility Study Summary - Texas Transportation institute SPR-3(049)

The Texas Department of Transportation (TxDOT) provided funding for the Texas Transportation Institute (TTI) to develop a methodology to measure congestion levels in Texas in a way that was easy to convey to the public. This was accomplished with the development of the roadway congestion index (RCI) that is a macroscopic traffic density measure for an urban area. Eventually, 50 urban areas from across the United States were included in the congestion study and the duration of the project was extended to ten years.

Annually, the findings from the research report summarizing the study are released through an official media release. The results from this study generate a great deal of interest from the media, transportation professionals, and other public officials.

Transportation issues, including traffic congestion, have been among the top concerns of residents in urban areas for a long time. Examples of this concern include the development of tollways in many cities throughout the U.S. and the creation of transit authorities in many cities in the 1970s and 1980s. These actions indicate that urban residents are willing to support higher tax levels for important issues. Urban residents have shown that they perceive a relationship between ease of transportation and "quality of life".

If the public is asked to continue to support these programs and projects, quantitative measurement of traffic conditions seems appropriate to provide the public with an easily understood means of reviewing the effectiveness of these programs and projects. State Departments of Transportation staff need to be able to communicate the results of these types of congestion reduction methods with other transportation agencies and the public.

Deployment Research and Professional Capacity Building -SPR-3 (062)

The first objective of this project is to form a consortium, initially with four states - California, Minnesota, Texas and Washington - to pool their efforts and resources for ITS research and deployment. This pooling would allow each state to lever efforts from four areas into a focused approach. The model is a series of planning meetings and peer review sessions followed by research and evaluation. Benefits would be direct access to three other states' activities and the ability to share operational experience.

The second objective is to develop the concept of a national consortium for ITS Professional Capacity Building (PCB). The model of this concept would be regional centers devoted to established new and innovative partnerships to leverage existing

resources and maximize the dissemination of ITS knowledge both within educational institutions and among the general population.

National Strategic Plan for Advanced Construction and Maintenance Systems (ACMS) - SPR-3(064)

This proposed project's prime objective is to ensure that infrastructure caretakers have the tools necessary to seamlessly support ITS implementations. An investigation into the needs and unaddressed requirements of construction and maintenance in the future environment is needed. Coordinated research and effective technology transfer are key to enabling the nation for supporting the increasingly complex infrastructure. This project will conduct that investigation, research the possibilities for advancement, and produce a plan for coordinated research and implementation activities.

In May 1998, FHWA and ITS America advocated the coordination of Advanced Construction and Maintenance Systems (ACMS) research and sanctioned an ACMS Task Force. The Task Force mission is to recommend the means to enable infrastructure stakeholders to support the increasingly complex infrastructure. By bringing together key people and organizations, the Task Force will characterize the needs and requirements across the nation, catalyze partnerships among public and private associates, and ultimately raise the level of activity in this area.

A deliverable of this Task Force, which is of national importance, is a Strategic Plan for ACMS research and implementation. Included in the Plan will be Vision, Strategic Agenda (how to implement the plan), research priorities as seen by experts across the nation, and other consensus issues. The investigation and production of this Strategic Plan is the object of this proposed Federal Pooled-funded Study. The deliverable will be of use to all states across the nation and will be a product of multi-jurisdictional consultation and discussion.

Field Evaluation of the CTCLS Load Switch - SPR-3 (068)

Incandescent traffic signal lamp failure is a major cost factor in the operation of almost any highway agency.

CTC Series load switch that was developed as part of the NCHRP (National Cooperative highway Research Program) IDEA program project #8 and #26 is claimed to double (or even quadruple) traffic signal lamp life. The primary features of the CTC load switch are:

1. Soft-start: Gradual preheating of the filament over 45 msec prior to closing the circuit, in order to reduce the adverse effects of heat stress.
2. Micro processor based line voltage fluctuation regulation.
3. Fail safe feature that reverts the CTC load switch back into a normal load switch in the unlikely event of a micro processor failure.

Subjecting the CTC load switch to field conditions (4 major lamp manufacturers, various climatic regions) in an extended field study seems imperative in order to:

The field data that will be obtained in the proposed study will allow for an economic analysis of the CTC load switch application in combination with different lamp manufacturers for different climatic regions in the US. Load switch and lamp survival curves will be provided for a 2 year period for operation in the field. Recommendations regarding revamping schedules will be provided, in order to aid the highway agencies to optimize their traffic signal maintenance operations with regard to cost effectiveness.

The primary objectives of the proposed field study are:

1. Reject or confirm the hypothesis that use of the CTC load switches instead of conventional load switches does in fact double traffic signal bulb life under field conditions.
2. Establish early lamp failure rates after 720 hours (30 days)
3. Establish lamp failure rates after 8,640 hours (1 year)
4. Establish lamp failure rates after 17, 280 hours (2 years)
5. Establish survival curves for the conventional and the CTC load switches based on the 2 year field data.
6. Perform an economic analysis

Strength and Deformation Analysis of Mechanically Stabilized Earth (MSE) Walls at Working Loads and Failure - SPR-3 (072)

Abstract: The current methodology for internal design of steel and geosynthetic reinforced MSE walls was developed empirically using a mixture of limit equilibrium and working stress concepts. The current design procedures provided in the literature and design codes have been quite successful in terms of wall performance provided that good construction practice is used. However, based on available measurements of reinforcement strains and loads in full scale MSE structures, it appears that these design procedures are overly conservative in some cases, especially for geosynthetic reinforced structures.

Because of the potential that a more accurate design procedure for internal stability of MSE walls, especially geosynthetic walls, could result in significant cost savings, WSDOT has funded research for the last three bienniums on geosynthetic wall internal stability design. The research already funded by WSDOT and completed or at least underway is designed to produce a new, but approximate, design procedure for internal stability design of MSE walls. However, there are certain key variables which cannot be fully investigated in the funded research program which should be investigated to provide a complete and more accurate design procedure. These additional variables would be investigated in the

proposed study through a series of additional 3.6 m high full scale test walls combined with analytical modeling. As well as analytical modeling of other well instrumented full scale wall case histories not analyzed in the current study (in particular MSE walls with steel reinforcement).

The scope would remain limited to walls which utilize granular backfills, as is true of the current WSDOT study. A research report will then be produced which summarizes all of the results obtained and which provides recommendations for designing MSE walls for internal stability. Successful analytical modeling techniques developed as a result of this study will also be provided, in a step-by-step format.

The high cost of overly conservative designs can be avoided. It is anticipated that the amount of soil reinforcement needed for geosynthetic MSE walls can be reduced by a factor of two or more, and it may be possible to reduce reinforcement needs for steel MSE walls as well through better definition of the true factor of safety for internal stability. Furthermore, the data gathered through this study could be used to better define load and resistance factors for Load and Resistance Factor Design (LRFD) for walls. Finally, the results of this study could be used to settle a long standing debate regarding the level of safety required for both geosynthetic and steel reinforced MSE walls.

Pavement Research and Technology - SPR-3 (074)

California, Texas, Minnesota and Washington are among the leading states in the research, development and deployment of advanced pavement technology. Each State Department of Transportation (DOT) has a continuing research and development program designed to improve its pavement design, rehabilitation, construction and maintenance procedures. Each State DOT has long-standing research relationships with universities within that State, and substantial investments in research equipment and facilities which have produced significant improvements in pavement technology recently introduced into common practice within the state. Each State DOT has implemented advanced pavement technology and techniques which, if fully understood, could be of immediate and substantial benefit to other State DOT staff and university researchers and educators.

The sharing of information between researchers and practitioners in these States can be of substantial mutual benefit.

This pooled fund project establishes a working relationship among the four State DOT organizations. Under this agreement, each state will allocate funding to allow DOT personnel and university researchers to participate in a series of project meetings focused on (1) sharing information on current pavement technology recently developed and deployed in the respective states; (2) identifying critical issues requiring additional research and development; (3) developing plans for joint research to address and resolve critical issues, including the identification of additional public and/or private sector partners who can assist with the funding, conduct and evaluation of the research; and (4) educating transportation professionals on the latest development for design, construction, reconstruction and maintenance of highway pavements.

Project Description for Proposed Regional Pooled Fund Study - SPR-3 (083)

Research Project Title: FIXS - Fabrication error Indexed eXamples and Solutions.

During the fabrication of steel bridges errors occur. These errors need to be recognized and corrected properly and efficiently according to each individual situation. To arrive at the best possible solutions, engineers need not only knowledge of material and fabrication specifications but also experience and good understanding of the practical limitations faced by fabricators. This expertise is scattered and varies among both individuals and DOTs. A database of corrective actions can provide guidance to bridge engineers and improve engineers' confidence in non-textbook solutions to unusual but not unique problems. When a shareable and well reasoned repair database is used by several state DOTs within a geographical region, the database can lead to standardized solution procedures that would expedite bridge fabrication costs, which could result in a reduction of costs passed back to the DOTs.

A research project nearing completion at the University of Kansas has developed a fabrication repair database. The repair database software, fabrication error indexed examples and solutions (FIXS), examines fabrication errors of steel bridge members when detected in the plant and recommends corrective action. FIXS provides solutions and examples to steel bridge fabrication errors with graphical and instructive explanations based on both rule-based and case-based reasoning. Interim results of this project were very well received at the October 27, 1998 meeting of the AASHTO/NSBA Steel Bridge Collaboration. There remains a major opportunity to enhance the benefits of this successful project by initiating a pooled funds study to disseminate and expand FIXS.

Research Objectives

The purpose of this study is to make the results of the previous FIXS project widely available and to enhance the repair database.

TENTATIVE**Research and Development of an Autonomous Shadow Vehicle Prototype Phase III - SPR-3 (055)**

This project concerns the safety of drivers of Shadow Vehicles that follow, at some prescribed distance, Lead Maintenance Vehicles. A Shadow Vehicle is used as a means of providing some protection of roadway workers from other vehicles that are traveling on the adjacent roadway. Unfortunately, many shadow vehicle drivers have been critically injured or have lost their lives during freeway maintenance operations.

This is a project development of the third phase of a prototype non-driver Caltrans shadow Vehicle called one Autonomous Shadow Vehicle (ASV).

The intent of this research and development effort is to produce a prototype ASV to be employed operationally in freeway maintenance activities. Safe operation of the ASV is the major factor in determining the tracking technologies used. The main motivations for this research are:

- To remove the person standing and walking on the roadside controlling the Shadow Vehicle from harms way and to provide the opportunity to engage that person in other activities and
- To protect maintenance operations moving a speeds up to 64.37 km/h (40 mph) such as sweeping and paint stripe freeway maintenance operations.

IVI Specialty Vehicles Program - SPR -3(063)

This program, a Regional Pool and Federal IVI Funded program led by California Department of Transportation, is a collaborative effort between multiple state department of transportation and private industries with interest in advancement of specialty vehicles. Work facilitated under this program will support the goals and objectives of the Intelligent Vehicles Initiative Request for Information and the Specialty Vehicles Platform Steering Group. Studies will be supported to develop potential in technologies for operational testing and demonstration over the next six years. Initial activity will be to convene stakeholders and identify research areas with the most valuable possibilities. Participants will work together, referring to technical experts when appropriate, to steer the topics of study. On an ongoing basis, studies will be funded following review of a proposal and discussion of user needs, benefits, and technical merits thereof.

Studies facilitated by this program shall apply to Special Vehicle platforms defined to include vehicles used for:

Highway Maintenance and Construction
Law Enforcement
Emergency Medical Response
Emergency Fire Response

This work program will manage and fund various, as yet undefined efforts in specialty vehicle research and development. Collaborations between contributors will define, develop and select specific projects tailored to the needs of stakeholders and will be complementary to IVI efforts in other vehicle categories.

Road Condition Acquisition and Reporting System (CARS) Pooled Fund Project - SPR-3 (079)

Reliable, accurate and easily accessible road condition reporting systems are needed and much in demand by the motoring population of private, public and commercial drivers. To address this need Minnesota has joined in a partnership with the States of Iowa, Washington, Missouri and Michigan.

Scope of Work:

There are seven primary tasks to be completed for the study participants. Within the overall pooled fund project each participant may have specific outcomes to be addressed during the progress of this study. Those tasks are:

Task 1 - Identify system users and define reporting requirements

This task will define the information management roles for each of the relevant organizations likely to be entering condition descriptions, as well as primary users of the information. While the system will be developed in a manner that can accommodate changes in either agents or users at any time, the results of this task will be used in the design of graphical user interfaces and user interaction components. Completion of this task will also define the intended uses of the system within each state, in order to ensure that the end product meets the needs of the customer base.

Task 2 - Design CARS storyboard/demonstration

In this task, a series of storyboards will be created to describe in detail the process each agent will use to enter information into the system. Using both printouts and html mock-ups, the contractor will work with the participants review teams to gain consensus around these demonstration storyboards to ensure that the data entry process for each participant meets the needs and desires of each state to the extent possible.

Task 3 - Functional specification development

In order to implement a working system of supporting the agreed storyboards, the contractor and its sub-contractor(s) will develop functional specifications.

Task 4 - Database design and development

In this task, a Database Design Document will be developed. This will guide the later building of the software - within Task 6 - to support the database functionality using database specifications. The intent of the Database Design Document is to define all the entities and relationships in the database as well as column definitions.

Task 5 - User interface specification and development

This task will specify the functional-level software requirements for the web-based CARS user interface and radio logging functions/interface. This specification will provide a detailed guide of standards, links and functionality for the user interface. Additional functions will describe the user interface interaction with the database by defining stored procedures and queries.

Task 6 - Data input, exchange and display coding

This task will develop all necessary programs to link the user interface system and databases together into an operational system that meets the needs of CARS member states as defined in the functional requirements.

Task 7 - Demonstration and training

In this task the contractor will demonstrate the functional system to the core CARS states and perform training with selected representatives of each state. This training will include both operator and system administrator training. Training will be of the “train the trainer” format, leaving each state with a collection of training manuals and resources to conduct further internal training for additional agents.

FUTURE PROJECTS**Support for AASHTO Strategic Highway Safety Plan**

The Federal highway Administration (FHWA) proposes to initiate, if sufficient interest is indicated by the states, a new National Pooled-Fund (NPF) Safety-Related Program of Study supporting the AASHTO Strategic Highway Safety Plan. The goal of this study is to develop enhanced guidance and low-cost effective solutions for 16 major crash concerns (Part I) as well as conducting two related research studies to develop evaluation tools which would support wider implementation of those solutions (Parts II and III). The program of study was developed in coordination with the National Cooperative Highway research Program (NCHRP) Panel 17-18, “AASHTO Strategic Highway Safety Plan Implementation Support.”

Part I

This portion of the program of study will develop enhanced guidance and low-cost, effective solutions for major crash concerns identified in AASHTO’s Strategic highway Safety Plan which have the potential to reduce fatal crashes by at least 10 to 15 percent in three to five years.

Part II

This portion of the program of study will develop improved accident reduction factors for roadway improvements through well-designed before-after studies of solutions implemented in Part I. The resulting accident reduction factors may be used by State and local highway agencies in determining roadway improvement effectiveness and by FHWA in crash prediction algorithms used in the Interactive highway Safety Design Model (IHSDM).

Part III

A portion of the program of study for implementation will be a significant effort to identify, deploy, and evaluate safety improvements which have the potential to reduce fatal crashes by at least 10 to a5 percent in three to five years. The results of this effort will identify effective solutions that all states can deploy. The goal of this investment strategy should be to maximize accident reductions of all severities for a highway network in all project categories (ex, resurfacing, reconstruction, realignment, reconfiguration of an interchange, Intelligent Transportation System (ITS) projects, etc.). A new highway safety improvement model is needed to guide the investment strategy.

“A Guide to Standardized Highway Lighting Pole Hardware”

The existing Guide has been used by highway agencies to develop standard designs and standard plans, by local road agencies to specify components, by contracted engineering firms to detail plans, and by the manufacturing/supply arm of the industry as a forum for display of available products.

The Guide is outdated in several areas. It does not reflect the requirements of the 1994 AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaries, and Traffic Signals, nor is the rewrite of these specifications being considered by the AASHTO Subcommittee on Bridges and Structures. It does not reflect the successful results of the FHWA mandated crash testing of components. It does not include other materials currently being used, such as prestressed concrete, fiber reinforced plastic, and wood. Nor does it include a wide array of hardware associated with traffic signal poles, including span wire poles and hardware. An updated guide would incorporate metrication. Finally, the Guide would incorporate a process for compiling, incorporating, and disseminating pertinent new or updated standards and catalog information, thus, keeping the Guide up to date.

The objective of this project is to prepare, in printed and electronic formats, an update to the Guide, and to recommend an ongoing process for updating the publication.

SPR - Project Proposal Evaluation of FRP Composite Strengthened Bridges

With limited available funds and increasing number of deteriorated, underrated and overloaded bridges in the United States, an effective alternative to replacing concrete bridges is needed. Externally applied fiber reinforced polymer (FRP) sheets or plates offer a viable solution. The advantages of FRP are numerous, as exemplified in the following:

1. FRP has greater strength capabilities and is less susceptible to adverse environmental effects than either steel or concrete. FRP does not deteriorate in the presence of road salt. This claim will be confirmed from the outlined environment/durability tests.

2. FRP offers stiffness properties 3 times that of steel and 25 times that of concrete. FRP has strength to weight ratios of 50 times that of concrete and 18 times of steel. Therefore, application of FRP will enhance the load capacity of existing structures without a significant increase in the structures' weight.
3. FRP is light and can be applied with minimal tolls, and relatively fast. The resulting reduced construction time will save limited taxpayer funds.

In summary, fiber reinforced polymers will increase load-carrying capacity (strengthening) and will reduce deflections (stiffening) of inadequate bridges, and prolong their usable service life.

The objectives of this research project are outlined as follows:

- (i) To construct, instrument, test, and study the behavior of 81 simply supported beams strengthened with fiber reinforced polymer sheets. The test beams and FRP coupon specimens will be subjected to various environmental exposures. These environmental exposures are freeze/thaw cycles, repeating loading, UV lights, water immersion, salt-water, alkali, and dry heat. After the beams are subjected to these environmental conditions, four-point flexural loading tests will be conducted to determine the strength of each strengthened beam. Baseline beams will be tested without any exposure to any of the above listed environmental conditions.
- (ii) To establish design guidelines and reduction factors due to different environmental effects based on the experimental test results obtained from item (i).

CFRP Reinforcement in Prestressed Concrete Bridges

The lack of availability of (1) design guidelines for the use of carbon fiber reinforced polymer (CFRP) reinforcements, (2) CFRP - test standards, and (3) low cost CFRP prestressing strands, stirrups and reinforcing rods has contributed significantly to the delay in using composite materials in prestressed concrete construction in the United States.

Several states (DOT's Great Lakes Consortium) have realized the importance and the positive impact that this innovative/smart bridge system would have on developing new approaches for future construction of their highway bridges.

The proposed research program is tailored to: (1) develop design guidelines to aid the designers to safely design CFRP prestressed structural components, (2) establish appropriate test standards for CFRP prestressing strands, stirrups, and flexural reinforcing rods, and (3) construct a one-half scale bridge model and two prestressed concrete girders and test them under different loading conditions. The proposed investigation will result in design guidelines and technical data that are essential for the design and construction of future CFRP prestressed concrete bridges by the supporting state agencies.