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# **PUBLICATIONS 2003**

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Upper Great Plains  
Transportation Institute  
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# Contents

2003 Staff Papers (SP) and Department Publications (DP) . . . . .	I
2003 Mountain-Plains Consortium (MPC) Publications . . . . .	5

Thank you for your interest in the Upper Great Plains Transportation Institute. This publication includes 2003 Staff Papers, Department Publications and Mountain-Plains Consortium (MPC) Publications with descriptions. Visit our web site at [www.ugpti.org](http://www.ugpti.org) for our complete list of publications.

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## 2003 STAFF PAPERS (SP) and DEPARTMENT PUBLICATIONS (DP)

### Advanced Traffic Management in 2nd Tier Cities

#### Agricultural Transportation

North Dakota's economic base is heavily concentrated in natural resources and processed natural resource commodities. The large basic sectors of the North Dakota economy include agricultural production, value-added processing of agricultural commodities, coal production, and petroleum refining. Of these sectors, agriculture is by far the dominant source of North Dakota income. Because of the long distances to major agricultural goods markets and the lack of transportation options for North Dakota shippers, efficient and effective transportation is critical to the state's agricultural shippers. The importance of efficient transportation to the state's agricultural sector is apparent in examining the portion of the selling price of wheat that the freight bill comprises. In 1995, the freight bill for North Dakota wheat traveling to its primary export point in the U.S. accounted for more than 20 percent of the selling price at that point. By comparison, the freight bill for Kansas wheat traveling to its primary export point in the U.S. accounted for 9 percent of the selling price at that point in the same year. The continued dominance of the agricultural sector in the state's economy, and the emergence of a strong value-added processing sector suggest an important role for research that examines issues affecting the efficiency and effectiveness of the state's agricultural transportation system. This program of research examines transportation pricing, transportation efficiency, transportation service performance, transportation infrastructure and facility investment, and other transportation issues as they relate to the agricultural sector.

**DP-155    Annual North Dakota Elevator Marketing Report, 2002-03** • Kimberly Vachal, Tamara VanWechel, 10/03

This report provides a benchmark for elevator managers in assessing performance, and supplies a source for recognizing trends in the characteristics of North Dakota elevators.

**DP-154    North Dakota Grain and Oilseed Transportation Statistics, 2002-03** • Kimberly Vachal, Tamara VanWechel, 10/03

This report represents a continuation of analysis concerned with the patterns and methods of distributing grains and oilseeds from North Dakota.

#### Intelligent Transportation Systems

Small- and medium-size cities are beginning to experience some of the mobility challenges of larger metropolitan areas, such as short-term congestion and delays. Further, traffic safety continues to be a high-priority issue in urban areas and the rural areas they serve. Many of these problems can be best addressed by taking advantage of Intelligent Transportation Systems applications, advanced modeling, and solid transportation engineering tools. This research program has a strong focus on providing technical assistance and training to cities, DOTs, private consultants, and other parties. Program activities are coordinated with the Advanced Traffic Analysis Center and the Rural Public Transit research program at the UGPTI.

**SP-157    Leveraging Technology Investments Integration of GPS, GIS and Maintenance Management**  
• Dennis Jacobson, Kellee Boulais Kruse, 9/03

This project attempts to ease the data collection burden of the ND DOT's maintenance manager, while increasing and improving pavement condition information.

## Logistics and Rural Economic Development

Rural areas face challenges in transporting products and receiving inputs. The geography, modal options and limited competition pose problems for producers, manufacturers and processors. For example the majority of the agricultural commodities produced in North Dakota leave the area to be processed elsewhere. If value can be added to the agriculture products prior to export it would improve the economic viability of the region. The goal of the logistics and rural economic development program is to provide education and research in the area of logistics and supply chain management to increase efficiencies in procurement, inventory management, production and marketing.

## Low Volume Roads

Trends in rural areas are creating challenges for local governments. Out-migration of residents is reducing the tax base needed to support necessary services. States and local governments are finding they have more roads than they can adequately maintain. For example, North Dakota has more roads per capita than any other state in the nation. Local governments need to focus on maintaining an adequate road system to support user needs that are safe and within available budgets. Local governments are addressing several issues including maintenance, funding, safety, economic viability and development, closing roads, and declaring minimum maintenance roads. The low volume road program is customer-oriented and aims at developing effective and practical tools for common problems as guided by users to meet the challenges of the 21<sup>st</sup> Century.

## Motor Carrier Safety, Economics, and Management

Motor carriers are a vital part of the nation's transportation network as they carry a significant portion of the goods delivered in the United States every day. In addition, in many rural areas, it may be the only mode available to transport goods. Since the passage of the Motor Carrier Act of 1980, competition in the motor carrier industry has increased substantially. In this competitive environment, it is important for motor carrier companies to run as effectively and efficiently as possible. This translates into attempting to keep driver turnover as low as possible, and managing safety systems to keep accidents to a minimum, among other things. Thus, the main focus areas of the motor carrier program are in the areas of driver turnover and management of highway safety systems.

## Railroad Economics and Management

Railroad transportation is critical to North Dakota's economy. In a typical year, 75-80 percent of the state's grain and oilseeds are transported to market by rail. Railroads annually transport about 95 percent of the grain and oilseeds destined to the Pacific Northwest and more than 75 percent of shipments to Minneapolis and Duluth. Railroads also transport most of the state's lignite coal and handle much of the chemicals and food products traffic. Some of the critical rail freight issues addressed by this research program include railroad organization and service, railroad pricing and cost analysis, impacts of 111-ton rail cars on light-density lines, adjustments to shuttle train rates, impacts of branch-line abandonment, rehabilitation and infrastructure needs of branch lines and short line railroads, and implications of rail system changes for highway infrastructure.

### **DP-153 Costing Individual Railroad Movements • Wesley W. Wilson, John Bitzan (9/03)**

Railroads operate under a network technology and are subject to a host of regulatory rules, which have evolved over time. For regulatory purposes, there is and has been a continuing need for accurate costing of individual railroad movements. This report reviews alternative costing methods and compares predictions across alternative methods to calculate the costs of specific movement.

**DP-152 The Importance of Short Line Railroads to Rural and Agricultural America** • Douglas Benson, John Bitzan, Kimberly Vachal, Tamara VanWechel, (8/03)

This report identifies several factors critical to the success of short line railroads. Success was measured and analyzed by looking at variables related to traffic volume, backhaul traffic, reliance on industries and/or commodities, number of shippers, flexibility of labor, track conditions, management, and transportation competition.

## Rural and Small Urban Transit

The need for transit services is crucial in rural areas. Elderly, disabled, and low income individuals are dependent on public transportation for their mobility needs such as doctor appointments and shopping. The vast land area and low population density of rural areas results in long rides for the transit-dependent. Main focus areas of the transit program of research include identifying methods to increase the efficiency and effectiveness of transit service, thereby managing costs and increasing services. Other issues addressed by the transit program of research include “access” issues such as welfare-to-work and assessing the use of Intelligent Transportation System (ITS) technologies to enhance transit services in both rural areas and small urban communities.

**SP-156 Carpooling to North Dakota State University, Survey Results** • Del Peterson, Jill Hough, 10/03

The Small Urban and Rural Transit Center (SURTC) of the Upper Great Plains Transportation Institute (UGPTI) developed a brief questionnaire to gain student and faculty perspectives on carpooling.

**SP-155 Taxi Survey Results for Concordia College - Moorhead, Minnesota** • Gary Hegland, Jill Hough, 10/03

The Small Urban and Rural Transit Center (SURTC) of the Upper Great Plains Transportation Institute (UGPTI) conducted a study to determine the potential acceptance and usage of a taxi service with a \$2 fare serving Concordia College.

**SP-154 Mobility of Concordia Students Transit Survey Results** • Del Peterson, Gary Hegland, Jill Hough, 10/03

The Small Urban and Rural Transit Center (SURTC) of the Upper Great Plains Transportation Institute (UGPTI) developed a survey to identify mobility of Concordia College students.

**SP-153 Mobility of MSUM Faculty and Staff Transit Survey Results** • Del Peterson, Gary Hegland, Jill Hough, 10/03

The Small Urban and Rural Transit Center (SURTC) of the Upper Great Plains Transportation Institute (UGPTI) developed a survey to determine faculty and staff transportation needs and to explore options and opportunities in meeting those needs.

**SP-152 Mobility of MSUM Students Transit Survey Results** • Del Peterson, Gary Hegland, Jill Hough, 10/03

The Small Urban and Rural Transit Center (SURTC) of the Upper Great Plains Transportation Institute (UGPTI) developed a survey to determine student transportation needs and to explore options and opportunities in meeting those needs.

**SP-151 Mobility of NDSU Faculty and Staff Transit Survey Results** • Gary Hegland, Jill Hough, 10/03

The Small Urban and Rural Transit Center (SURTC) of the Upper Great Plains Transportation Institute (UGPTI) developed a survey to determine faculty and staff transportation needs and to explore options and opportunities in meeting those needs.

**SP-150    Mobility of NDSU Students Transit Survey Results • Gary Hegland, Jill Hough, 10/03**

The Small Urban and Rural Transit Center (SURTC) of the Upper Great Plains Transportation Institute (UGPTI) developed a survey to determine student transportation needs and to explore options and opportunities in meeting those needs.

**DP-151    An Evaluation of Transportation Needs of the Disadvantaged in North Dakota • Gary Hegland, Jill Hough, 9/03**

The Upper Great Plains Transportation Institute (UGPTI) developed a survey to identify the transportation needs and measure how well the needs of the disadvantaged population are being met. The UGPTI worked with four Centers for Independent Living that serve the state of North Dakota. Each of the centers selected a random sample of their clients and mailed the survey to them. The results of the study are based on a 21 percent response rate. This study found that a higher percentage of North Dakota disadvantaged reported problems with transportation than the national average.

## **Statewide and Regional Transportation Planning**

The Intermodal Surface Transportation Efficiency Act of 1991 called for continuous multimodal statewide and metropolitan transportation planning and suggested comprehensive data management systems to support these efforts. Today, on-going highway and intermodal freight planning programs exist at both state and local levels of government and periodically produce documents such as intermodal, railroad, and metropolitan transportation plans. The statewide and regional transportation planning research area develops analytical techniques and data systems that aid state and local transportation planners and decision makers. Current and recently-completed research projects include profiles of major freight traffic generators and intermodal facilities, analysis of key rail freight planning issues, procedures for modeling the impacts of railroad traffic diversion on rural highways, and models that forecast truck traffic patterns and highway needs resulting from the location of new processing plants and related facilities.

## 2003 MOUNTAIN-PLAINS CONSORTIUM (MPC) PUBLICATIONS

### Environmental Impacts

Legislation in 1990 (Clean Air Act, Hazardous Waste Act) placed significant planning and management constraints on the transportation community. The 1991 Surface Transportation Act mandates that in four years, transportation agencies must have management systems for (a) pavements, (b) bridges, (c) safety, (d) congestion, (e) transit — rural and urban — and (f) intermodal linkages. These legislative elements include sharp limitations on transportation agencies related to the environmental impact of transportation and transportation infrastructure projects.

Region 8 has significant issues facing it relative to the above developments, including many that are specific to its rural mountain and plains setting. It is important to enhance and preserve its historic and scenic highways and byways. Significant amounts of agricultural fertilizers, chemicals, munitions, hazardous waste and other dangerous substances originate, terminate or move through the region. This movement of hazardous materials (HAZMAT) takes place on Region 8's vast road and bridge network — a network in need of extensive repair and replacement — and train systems. Safety risks are associated with placing heavy HAZMAT truckloads on bridges known to be structurally or functionally deficient. Seasonal traffic congestion in mountain recreation areas leads to air quality issues. A predominance of gravel roads creates dust control problems, as well as environmental concerns of treatments used to reduce dust. Poor pavement condition is a prevalent rural road issue that creates HAZMAT risks. Severe weather (storms, floods and tornadoes) can impact travel routing for HAZMAT. Safety during non-motorized vehicle travel to, and within, recreational areas is of particular concern and important to a health conscious Region 8 populace.

### Intermodal Freight and Logistics

The economic base of the Mountain-Plains region is dependent on movement of commodities into, out of, and within the region. A large portion of the agricultural commodities, coal, and other resources extracted or produced in the region, typically move to processing or consumption points outside the region. Because of the rural and agrarian nature of the region, many of the inputs, supplies, and manufactured goods needed are imported into the area or transported long distances within the region.

#### **MPC 03-152    Truck Costing Model for Transportation Managers • Mark Berwick, Mohammad Farooq (8/03)**

A software model was developed to estimate truck costs under different equipment configurations, input prices, and gross vehicle weights. The software was developed to obtain many different configurations and trip characteristics. Important conclusions can be drawn from running simulations including the sensitivity of costs and equipment use, wait time and trip distance, labor, and fuel price. Relationships of cost variables and the cost of operations are important for trucking companies and shippers.

#### **MPC 03-151    U.S. Containerized Grain & Oilseed Exporters - Industry Profile and Survey - Phase II • Heidi Reichert, Kimberly Vahcal, Tamara VanWechel (7/03)**

Containerization has evolved from an industry serving niche markets to an industry creating niche market opportunities. While the grain and oilseed industry is dominated by bulky, homogenized product marketing that is heavily reliant on economies of scale in delivering competitively priced commodities, technological advances, foreign market privatization, and declining global market transaction costs have supported diversification of this industry in niche markets such as small-volume containerized products. The findings of this research suggest an established and growing U.S. shipper population is active in marketing containerized grains and oilseed products.

#### **MPC 03-145    Industry Costs and Consolidation: Efficiency Gains and Mergers in the Railroad Industry • John Bitzan, Wesley Wilson (6/03)**

This study builds on the findings of an FRA study and others to provide a detailed analysis of previous rail mergers in terms of costs, pricing, and service, and discusses the implications of these findings for the future of regulatory oversight of mergers.

**MPC 03-144    The Differential Effects of Deregulation on Rail Rates • John Bitzan, Kimberly Vachal, Tamara VanWechel, Dan Vinje (6/03)**

This research focuses on the long-standing relationship between the rail industry and production agriculture. It will investigate the differential effects of policy change, considering factors that have influenced pricing service for corn, wheat and soybeans in a deregulated rail industry.

## International Cross-Border Traffic

The passage of the Canada-U.S. Trade Agreement (CUSTA) and the North American Free Trade Agreement (NAFTA) have broadened opportunities for commerce throughout the North American continent. Transportation infrastructure and operations play key roles in the growth of international commerce and future economic development in all three nations.

In order to fully realize the benefits of free North American commerce, the transportation systems of all three nations must be coordinated and partially integrated. Otherwise, transportation obstacles or bottlenecks will inhibit cross-border flows and slow the rate of commercial growth. For example, a recent U.S. DOT study concluded that the arterial highway network may be insufficient to handle future cross-border commercial traffic at some ports of entry on the U.S.-Canadian border.

Region 8 lies in the direct path of surface movements between Canada and Mexico. Two of the major trade routes in the Western U.S. originate (or terminate) at Winnipeg and Calgary, thus making I-29 and I-15 two potential international transportation corridors.

The goal of coordinating and partially integrating the transportation systems of North America poses many research questions and issues. First, should truck configurations, sizes and weights be standardized, and if so, which configurations and limits would be most cost-effective? Second, should pavement design practices and structural designs be standardized, and if so, what would be the most cost-effective standards and practices? Third, should trade corridors have different vehicle and structural designs than other types of highways, and if so, what would be the most cost-effective options? Fourth, how can IVHS/CVO technologies be applied to improve the efficiency of cross-border truck movements? Fifth, what role will railroads play in the cross-border movement of freight and what additional investments will be needed in rail infrastructure? Sixth, what is the long-run potential for tourism and recreational travel and what investments and technologies are needed to support it?

## Low Volume Roads and Bridges

The U.S. road network is predominantly composed of secondary and local roads. About 2.8 million miles of the nation's 3.7 million miles of roadway are rural in nature. Nearly two-thirds of rural mileage is under local control. Present annual investment in rural roads is about \$7 billion. Estimates for maintaining pavement, maintaining service, and improved service range from \$11.3 to \$17.3 billion annually. Major needs are resurfacing, pavement reconstruction, road widening, and road reconstruction. The National Bridge Inventory shows that about 82 percent of the 575,000 U.S. bridges are on secondary roads and half are local in function. Usage is low, representing about 20 percent of daily traffic. The majority have ADT's of less than 100 vehicles per day. However, over half of the nation's traffic fatalities are on rural roads and bridges.

About half of the bridges in the U.S. that are currently, or accruing to be, eligible for repair/replacement funds are at rural sites. Region 8 has more rural roads (94 percent of the total) than the national average. Indeed, all states in Region 8 have greater than the U.S. average roads per capita. In the farm sector, increased farm size, mechanization and productivity have been the trends. Heavier production inputs (feed, fertilizer, fuel) and larger trucks and farm equipment are also evident. Over 14 percent of Class I railroad tracks are in the region. However, in recent decades, significant abandonment of light density railroads has been occurring in some states. These factors contribute to an increased dependency on heavy trucks to move goods from, through, and to the region.

Critical characteristics of Region 8 are its extremely low population (about 3.06 percent of the national total), expansive area (about 19 percent of the national total) and consequent low tax base. Nearly 37 percent of the population is in rural locations. The economics of maintenance and improvement of roads and bridges are very unfavorable. The

challenge is evident in the state of the bridges. It is common that a county that has hundreds of bridges in disrepair is able to address only two to three annually. Low commodity prices, declines in tax base resources and reduction in the purchasing power of intergovernmental assistance limit the ability of local governments to maintain services such as bridge rehabilitation and replacement.

**MPC 03-148 Pier Moment-Rotation of Compact and Non-Compact HPS70W I-Girders • Bryan Hartnagel, An Vihn Tran (6/03)**

A project to study the pier moment-rotation behavior of compact and non-compact high performance steel HPS70W I-girders was conducted at Colorado State University in the context of examining two restrictions for inelastic design of steel bridge girders in the current edition of the AASHTO LRFD bridge code (AASHTO 1998, and interims through 2001). The first restriction is that inelastic design involving the moment-rotation relationship of steel girders with a yield strength exceeding 50 ksi is prohibited. The second restriction is that the AASHTO LRFD inelastic design methods cannot be used on girders that do not meet the compactness requirements stated in the provisions. To determine whether or not these restrictions should be modified, examination of the pier moment-rotation behavior of HPS70W I-shape girders was undertaken through large-scale laboratory testing and finite element simulation.

**MPC 03-147 Field Investigation of a Strengthened Timber Trestle Railroad Bridge • Richard Gutkowski, Abdalla Shigidi, An Vihn Tran (6/03)**

A three-span, open deck timber trestle railroad bridge had been previously field load tested. The prior testing program was done in cooperation with the Transportation Technology Center, Inc., a subsidiary of the Association of American Railroads. The bridge was subjected to static and moving train loads as well as controlled actuator ramp loading. The bridge was later strengthened by the addition of helper stringers. The bridge was load tested again by moving train loads. Comparisons of the stiffness of the bridge were made before and after the strengthening. The efficiency of the helper stringers was between 82 percent and 97 percent. Load sharing among stringers was determined empirically. No pattern of load sharing among them could be identified but individual stringers carried up to 9 percent more load share than in an equal load sharing distribution. The transient displacement responses showed predominantly no dynamic impact effect, but isolated increases of 6-10 percent were observed.

**MPC 03-146 Evaluating the Impact of DOT's QC/QA Programs on Pavement Performance • Nathan Butts, Khaled Ksaibati (6/03)**

In this study, the researchers evaluated the effectiveness of quality control/quality assurance (QC/QA) specifications in decreasing hot mix asphalt (HMA) variability. A questionnaire was written to gather general information about the QC/QA specification programs that are being used in the U.S., and an evaluation of the effectiveness of the QC/QA specification being used by the Wyoming DOT in decreasing HMA variability was conducted as a case study.

**MPC 03-143 Simplified Impact Testing of Traffic Barrier Systems, Phase I • Richard Gutkowski, Derek Winkler (6/03)**

A variety of portable safety and security barriers for directing traffic (public events, sports facilities, etc.), and securing private and public locations against access (courthouses, schools, etc.) have been developed. Some higher capacity systems have been developed for use on and around high speed automobile racing tracks. Generally, the barriers are hollow, plastic composite walls and use dead weight fill (sand, water) to resist impact without interconnection to the ground. Heavier solid systems, such as a concrete Jersey Wall type configuration, are used in highway construction as well. These are much more expensive and require heavy equipment to relocate them. Few of the filled, lightweight systems have been crash tested to meet federal standards, although some users have conducted their own impact tests. Typically, manufacturers are small businesses without the resources to conduct federal tests similar to crash tests of bridge guard rails. Thus, developing a comparable impact test method to conduct dependable preliminary tests has great merit.

**MPC 03-140    An Assessment of Regional Road User Needs in Three Rural States • Jill Hough, Gary Hegland, Crystal Bahe (6/03)**

This paper summarizes the results of a study on direct assessment of rural user needs in Montana, North Dakota, and South Dakota. The objective was to assess rural road users and providers' perceptions of rural road needs. Different rural road user groups were identified to obtain a representative sample of perceptions. User groups targeted in the study included commuters, delivery services, mail carriers, school bus drivers and farmers. An attitudinal survey was developed and administered to these groups. The survey yielded a good return rate in each of the states, suggesting that more road users are becoming aware of road management and finance issues.

## Rural Transit

The demographics and geography of the Mountain-Plains region creates a pressing need for rural transit services, and at the same time poses formidable challenges to service delivery. The Mountain-Plains region is sparsely populated with a large and growing elderly population. Some parts of the region are economically depressed, and many rural citizens are without access to private automobiles. This is particularly true on reservations and in adjacent areas. Low population densities, intercity distances, climate and topography all pose challenges for transit operations and planning. Unlike fixed route metropolitan transit systems, transit services in rural areas must be flexible and demand-responsive. All of these factors underscore the need for a strong MPC research focus in rural transit.

Rural transit is more than just a mode of transportation. Rural public transportation creates mobility and accessibility for citizens that might otherwise be deprived. Transit affords elderly, handicapped, and economically disadvantaged persons access to food and supplies, health care, and other essential services. In addition, transit empowers these people with mobility, allowing them to interact and lead a full social life. Both accessibility and mobility affect the quality of the lives of rural citizens. Without accessibility and mobility, many rural citizens might elect, or be forced, to migrate from the region. Out-migration will further erode the region's population and tax bases, increasing the cost of services per capita for the remaining population. Thus, the lack of effective transit services can be part of a chain of cause-and-effect that further depopulates and negatively impacts the Mountain-Plains region.

**MPC 03-150    University Transportation Survey: Transportation in University Communities • John Daggett, Richard Gutkowski (7/03)**

The premise of this study was to determine what types of relationships existed between transit performance and university policies or practices. The questionnaire was constructed to examine a number of substantive areas and to acquire foundation information such as demographics and transit performance information.

## Rural Transportation Safety

Safety is a top priority for the U.S. DOT and state transportation departments in the region. Much of MPC's previous research has focused on rural safety issues and potential solutions for state and local highways. Although several MPC focus areas encompass safety topics, an overarching focus area has been created to emphasize the importance of rural transportation safety. In the next five years, MPC research will highlight emerging technologies as rural road safety audits,

which have the potential to significantly improve safety on low-volume rural highways, and potential applications of GIS and ITS technologies to highway safety. As noted earlier, many safety-related issues will be addressed by projects in other focus areas, such as Low-Volume Roads and Bridges and Rural Transit.

#### **MPC 03-142 Real Time Measures of Effectiveness • Vikram Klyani, Peter Martin, Joseph Perrin Jr. (6/03)**

Sophisticated microsimulation models such as MITSIM, INTEGRATION and WATSIM are useful tools to test the potential impact of new ITS technologies, such as route diversion variable message signs, in-vehicle drive alarms, and weather sensitive speed advisory signs. Once implemented, the modeling should be tested with field observations. Rigorous experimental design demands that both pre- and post-data will be available. Frequently, the “pre-data” is overlooked. Subsequent evaluations are weakened. This research aims to identify and determine methods to automatically compute measures of effectiveness when supplied with real time traffic information.

## **Tourism and Recreational Travel**

The Mountain-Plains regional economy is heavily dependent on tourism and recreational activity. A better understanding of the characteristics of these travel activities and the impacts these travelers have upon the operation and safety of regional transportation systems is needed.

Recreational travel and tourism is a major generator of jobs in the MPC region. Service industry business receipts associated with the travel industry is the third largest nationwide. The Intermodal Surface Transportation Efficiency Act of 1991 created two separate programs: the “Scenic Byways” program and the “National Recreational Trails Funding” program. These programs were created in recognition of the importance of this industry to the national economy. Both programs have tremendous potential impact on the MPC regional transportation systems. The potential expansion of transit’s role in serving diverse point source recreational activities and tourist interests has not been fully explored or documented. Private operated transit in the MPC region exists for activities such as transport to ski areas or regional-based sight-seeing. Public transit developments to serve major regional generators such as Yellowstone National Park are being discussed as alternatives to enhance economic tourist-related development. Seasonal and daily traffic impacts caused by tourist and recreational travel exist and need to be fully understood and documented. Critical issues associated with travel demands include safety, congestion, environmental, and economic impacts.

## **Miscellaneous**

#### **MPC 03-155 Evaluate Effectiveness of Dilemma Zone Advanced Signal Warning • Peter T. Martin, Vikram C. Kalyani, Aleksander Stevanovic (11/03)**

UTL compared the intersections with an Advanced Warning System (AWS) to an intersection without AWS. They found that the AWS in St. George was not effective in reducing the number of drivers in DZs. Although 90% of drivers responded positively by reducing their speed when the signal was flashing, most of them reserved their decision to stop or proceed until they were close to the intersection. Speeds were reduced by an average of 5 to 10 mph. They were reduced less if drivers could see that the traffic light at the intersection was still green. St. George had 1.15% more vehicles in the DZ than the control intersection. The AWS setup at Brigham City was effective in reducing vehicles in the DZ. It had 1.4% fewer vehicles in the DZ than the Logan intersection. The effectiveness of AWS in Brigham City may be attributed to its combined AWS+AD setup. Because the research results did not yield conclusive results on the effectiveness of AWS systems, UTL recommends an intensive study at potential AWS locations before any future installations. UTL also recommends modifying the AWS system at St. George to improve its effectiveness.

#### **MPC 03-154 Detector Technology Evaluation • Peter T. Martin, Yuqi Feng, Xiaodong Wang (11/03)**

This paper evaluates detector technologies under a variety of criteria and provides user guidelines for detector technology selection. Information for the project came from applications of detector technologies, detector technology development, user manuals about specific detector devices, detector field-testing projects, and surveys of detector device vendors. Vendor surveys provided detailed information on devices, such as data type, device cost, system life, voltage supply, communication and data storage.