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Final

Phase II (Baseline) Report for the Greater Yellowstone Regional Traveler and Weather Information System (GYRTWIS)

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GLOSSARY OF ABBREVIATIONS

AASHTO	American Association of State Highway and Transportation Officials
APTA	American Public Transportation Association
ATIS	Advanced Traveler Information System
CCTV	Closed-Circuit Television
COTR	Contracting Officers technical Representative
DMS	Dynamic Message Sign
FCC	Federal Communications Commission
FHWA	Federal Highway Administration
GYRITS	Greater Yellowstone Rural Intelligent Transportation System
GYRTWIS	Greater Yellowstone Regional Traveler and Weather Information System
HAR	Highway Advisory Radio
HMVM	Hundred Million Vehicle Miles
ITS	Intelligent Transportation Systems
ITS America	Intelligent Transportation Systems of America
JPO	Joint Program Office
MOE	Measure of Effectiveness
MOU	Memorandum of Understanding
MSU	Montana State University
PAWG	Program Assessment Working Group
P-P	Public-Private
PTM	Pavement Thermal Model
RWIS	Road Weather Information System
SAIC	Science Applications International Corporation
U.S. DOT	United States Department of Transportation
VAMS	Value Added Meteorological Service
WTI	Western Transportation Institute

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Executive Summary

Montana is a large, rural state with a land mass of over 147,000 square miles and nearly 70,000 miles of public highways and roads. Although the State of Montana is larger than the combined areas of New York, Maryland, Delaware, Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, New Jersey, and Connecticut, it consists of only 2 percent of the combined population of those states.[1]

The mountainous corridors in Montana can be difficult to travel, especially during adverse weather conditions. Approximately 77.7 percent of Montana's vehicle miles traveled (VMT) take place outside of urban areas[2]. During the fall, winter, and early spring seasons, weather conditions can impact traveler safety and security and pose major challenges to road maintenance operations. In 1998, Montana averaged 2.5 fatal crashes per hundred-million vehicle miles (HMVM) vs. the national average of 1.6 fatal crashes per HMVM[3]. To improve road conditions in 1999, Montana DOT crews plowed 3,067,406 miles of highway, applied 1,856,376 gallons of liquid anti-icing/deicing materials, and deposited nearly 302,595 cubic yards of sand[4].

In an effort to make road and weather information more readily available to travelers and maintenance personnel, Montana is implementing the Greater Yellowstone Regional Traveler and Weather Information System (GYRTWIS). GYRTWIS replaces the existing *ROAD service (which is a non-interactive, recorded message system) with #SAFE, which will be interactive and which will use better weather models, including a new Pavement Thermal Model (PTM). The PTM is a computer model that receives regional weather and information and forecasted weather condition information and generates a location-specific prediction of pavement conditions. The PTM information will be integrated at the #SAFE Operations Center and be disseminated to travelers and maintenance personnel. The road condition and weather forecasts will be available through landline or cellular phones via a 511 telephone system and will ultimately be linked to neighboring states.

This evaluation builds upon and complements the ongoing Greater Yellowstone Regional Traveler and Weather Information System (GYRTWIS) evaluation being conducted by Western Transportation Institute/Montana State University (WTI/MSU). The WTI/MSU evaluation of GYRTWIS examines traveler perceptions of system accuracy, availability, usefulness, and understandability, the accuracy and usefulness of the information for maintenance operations, and perceptions of project success.

This evaluation complements WTI/MSU's GYRTWIS evaluation by investigating the following three areas:

- System impacts of 511 on usage and customer satisfaction
- Pavement Thermal Model accuracy

[1] Montana Fast Facts, http://www.mdt.state.mt.us/map/fastfact.htm
[2] ibid.
[3] 1998 USDOT
[4] Montana Fast Facts, http://www.mdt.state.mt.us/map/fastfact.htm

- Case study of the business model, institutional issues, and 511 implementation issues

The three study areas and objectives are shown in Table ES-1. The System Impacts Study will assess the impact of the deployment on both travelers and maintenance personnel. This study investigates impacts in terms of system usage and customer satisfaction. System usage will compare the baseline ("Before") usage of Montana's existing road and weather information phone service to the "After" 511 usage. In addition, Before and After perceptions of customer satisfaction will also be compared. The Before perceptions focus on satisfaction with currently available travel information and perceived needs. The After perceptions will investigate satisfaction with the 511 service and how well the pre-511 needs were satisfied.

The Pavement Thermal Model accuracy will be reported in the next phase of this evaluation. Predicted vs. actual pavement temperatures will be compared to determine the accuracy and reliability of the Pavement Thermal Model.

The Case Studies will investigate the GYRTWIS business model for Montana's 511 system, what the model is, how the service is being funded, how it is being marketed, and where the Montana DOT hopes to obtain funding for ongoing operations. A second objective is to identify the institutional benefits, challenges, and lessons learned of the effort to deploy 511 throughout the State of Montana. The third objective will be to investigate the challenges of integrating the technologies and the role of 511 guidelines and the use of the National ITS Architecture and standards in system design and implementation.

This document focuses on the methods, baseline results, and conclusions from Phase II of the evaluation. As such, the results and lessons learned reported here are based on the Before (or baseline) data collection effort.

Table ES-1. Evaluation Study Areas and Objectives

Study Areas	Objectives
System Impacts Study:	
System Usage Test	Compare traveler usage of Montana's new 511 service to existing road and weather information phone service.
	Compare maintenance personnel usage of the new pavement and weather forecasts to existing information.
Customer Satisfaction Test	Compare traveler satisfaction with Montana's new 511 service to the existing road and weather information phone service.
	Compare maintenance personnel satisfaction with the new pavement and weather forecasts to the existing information available.
Pavement Thermal Model Study:	
PTM Test for Accuracy	Examine the accuracy of the Pavement Thermal Model to be used for Montana's new 511service.
Case Studies:	
GYRTWIS Business Model	Examine the GYRTWIS business model, what it is, how MDOT is paying for the services, and where they hope to obtain funding for ongoing operations.
Institutional Lessons Learned	Identify the institutional benefits, challenges, and lessons learned from the GYRTWIS project.
511 Implementation Challenges, Guidelines, and Standards	Develop a case history of implementation challenges, the role of 511 guidelines/ITS Architecture standards, and the advantages, limitations, & suggested changes.

System Impacts

Montana DOT collected the baseline call volume data for the System Usage Test. The number of calls recorded by Montana DOT during the last two winter seasons (November 2000 to April 2001 and November 2001 to April 2002) were found to vary year-to-year and month-to-month. These data will provide a basis for comparison with the number of callers using the 511 telephone service being deployed for the 2002 – 2003 winter season. It is expected that the number of calls during the 2002 – 2003 winter season will also vary depending on weather conditions. Nevertheless, the volume of calls for the 2002 – 2003 winter seasons should provide a good indication of usage and provide evidence that complement the perceived customer satisfaction ratings.

WTI/MSU administered the *Montana Traveler Information Survey* during the summer of 2002. The purpose of the survey was to investigate user's perceptions of Montana DOT's legacy road and weather information phone service. Four survey items (perceived accuracy, availability, usefulness, and understandability) are reported here and will provide a basis for comparison after the GYRTWIS deployment.

In 1997, WTI/MSU also conducted the Rural Traveler Needs Survey to 411 travelers as part of the Greater Yellowstone Rural ITS Priority Corridor project[5]. The overall purpose of the survey was to determine the concerns and information needs of rural drivers/passengers when traveling in Montana, Wyoming and Idaho. The three objectives for the Rural Traveler Needs Survey were to determine:

1. *What* information the rural traveler needs and wants,
2. *Medium* through which information would be presented to the traveler, and
3. W*here* the traveler would want this information presented.

The *Montana Traveler Information Survey* found that Montana travelers perceived the existing Montana DOT road and weather information telephone service to be generally accurate, available, useful, and easy to understand. A majority (about two-thirds) of the survey respondents indicated that the phone service was Somewhat to Very Accurate (versus Neutral or Somewhat to Very Inaccurate). This same trend was also observed for the availability, usefulness, and understandability of the existing of the phone service. However, for usefulness and understandability most respondents chose Very Useful or Very Easy (to understand) over their respective Neutral or other not useful/not easy to understand choices.

The Rural Traveler Needs Survey found that travelers in rural Montana/Idaho/Wyoming often worried about safety concerns (such as road conditions like ice and snow, passing trucks and other heavy vehicles, and animals on the roadway) more than traffic delays and getting lost. They also considered information about the best route to a destination, road condition problems due to weather, adverse weather conditions, tourist attractions, and traveler service locations to be important information to know before leaving on a trip. However, a majority of travelers wanted access to this information both before starting a trip and while on the road.

To obtain the information, travelers thought dynamic message signs, a special radio channel, or a phone number would be used more readily than computerized information centers, cellular phones, or a small in-car TV screen. However, anecdotal evidence suggests that since July 1997, the number of cellular telephones users has grown, and therefore, cellular phone access may no longer be as large a deterrent for travelers obtaining information via the telephone.

Another source of baseline data, which captured the perceived usefulness of existing pavement and weather forecasting information, was the WTI/MSU Montana DOT Road Weather Information Survey of 87 Montana DOT maintenance personnel.

The Road Weather Information Survey indicated that a majority of maintenance personnel used Commercial Weather Forecasts and National Weather Service reports *very often* before making roadway maintenance decisions. Although about a quarter of the maintenance personnel reported using the Montana RWIS information, about one-half reported using the information

[5] Greater Yellowstone Rural Intelligent Transportation System Priority Corridor Project Rural Traveler Needs Survey Volume I. Prepared by Randy W. Carroll and John M. Mounce, October 1997.

only occasionally. Television, radio, and various Internet web sites were the commercial sources most often used to obtain the information.

When queried as to how they would like to receive weather information, maintenance personnel indicated their preferences of first using a dial-up RWIS voice recording of the current conditions, followed closely by using the Internet. Nearly three-fourths (70 percent) wanted RWIS data integrated with radar or satellite images; over one-third (36 percent) wanted RWIS data displayed directly on a map of RWIS sites; and 33 percent thought that providing estimated temperature readings for the length of road (thermal mapping) would be useful. Four types of information were highly desired: Road Surface Condition, Precipitation/Snowfall, Air Temperature, and Pavement Temperature.

Timeliness of information was reported to be problematic for some maintenance personnel. Nine percent reported encountering weather station site data that is not current more than once a day and 35 percent reported non-current information more than once a week. The importance of accurate forecasts was an important factor in improving anti-icing maintenance operations. Second only to more resources (people and equipment), nearly half of the maintenance personnel (48 percent) chose more reliable forecasts as a means to improving anti-icing operations.

Case Studies

The interviews for the Case Studies were conducted between February 28 and March 1, 2002 in Montana and between March 19 and 21, 2002 at the 2002 511 Deployment Conference in Scottsdale, Arizona.

The purpose of the GYRTWIS Business Model case study is to develop a qualitative assessment of the unique, state-wide rural model, examine how the services are being funded, where funding for ongoing operations will be obtained, and how the service is being marketed.

The GRYTWIS 511 telephone service emphasizes providing information to address traveler safety concerns. Consequently, the goal of the system is to provide accurate, timely weather and road condition information. This contrasts with urbanized areas that may emphasize congestion information over road condition. Since the GYRTWIS is, in a sense, an upgrade of existing services (i.e., *ROAD telephone service and maintenance information system), the public sector is more concerned about providing the service than generating revenue.

In comparison with the reported budgets in Kentucky and Boston, the GYRTWIS project has a small marketing and outreach budget. However, a low-cost "grassroots" approach is planned to educate resident travelers about the 511 service. Using approximately 240 Montana DOT employees in the Montana DOT Transportation Awareness Program (TAP), TAP participants will begin promoting the 511 service at informal settings such as county fairs, trade shows, and local festivals.

The project management has used several methods to minimize institutional challenges. To maintain open lines of communication, the team participates in scheduled telephone calls, reporting requirements, and project "team" meetings. Also, because a fairly small number of

people are involved in the GYRTWIS project, maintaining coordination, cooperation, and communication has not been a major challenge.

Two documents were mentioned as having a positive impact on overcoming obstacles. The Greater Yellowstone Regional Intelligent Transportation System (GYRITS) Regional Architecture was cited as a useful planning tool for guiding the GYRTWIS deployment. The Montana DOT Strategic Business Plan was also identified as being a useful tool to address job security issues and alleviate fear of job loss due to new technology.

During the development phase, the main challenge to project schedule was the procurement of telecommunications equipment. This was due to changes in Montana state laws. The new state law required all acquisitions of computer and telecom equipment to be handled by the Department of Administration.

The 511 Implementation Challenges, Guidelines and Standards study investigates the GYRTWIS implementation challenges and the role of 511 guidelines and ITS architecture standards in system design and implementation.

Two implementation challenges were mentioned. First, concern about the willingness of wireless companies to support the GYRTWIS 511 service was identified as a potential implementation stumbling block. Although not an isolated case, Montana DOT's concern is similar to 511 deployments in other parts of the country such as in Arizona and Northern Kentucky, where issues such as costs to operate and lost opportunities for value-added services have been raised. Montana DOT was arranging meetings with the wireless providers to try and coordinate efforts to resolve the issues.

Another challenge that was previously discussed in the Institutional Lessons Learned section is the recent legislative changes, whereby the Department of Administration is responsible for the purchase of computer and telephony equipment. This change has resulted in the procurement of the telephone equipment taking longer than anticipated.

The 511 Guidelines were perceived to be fairly general and not viewed as very helpful in terms of aiding development. However, the Guidelines were useful in providing a high level understanding of the 511 service.

The ITS Architecture Standards were viewed as useful for planning purposes and as noted in the Institutional Lessons Learned evaluation, provided a framework for the regional architecture as well as the development of GYRTWIS overall architecture.

The 511 Content and Consistency Guidelines was reviewed and a variety of suggestions and comments yielded the following key points.

- Allowing users to provide feedback can help planners/developers to identify problems, obtain input on suggested improvements to content, menu design, etc., and can be a valuable public relations tool.

- Flexibility in the selection of road segments, routes, or corridors is a desirable feature.
- Providing route-specific weather and highway information provides travelers a complete view of the route.
- Providing access to customer service center operators raises significant issues related to cost and service implications.
- The guidelines should include interregional information as part of the basic information required along highways.
- Implementing a system that allows callers to report incidents raises quality control issues.
- Some personalized services should be provided by the private sector.
- Accuracy, timeliness, and reliability are essential to maintaining users trust in the system.

Conclusions and Recommendation

The Phase II Evaluation of the GYRTWIS project has identified several interesting preliminary findings. Data collected by Montana DOT and WTI/MSU provide a good baseline snapshot of system usage and traveler and maintenance personnel perceptions of the existing road and weather information. Pre-deployment interviews with key GYRTWIS personnel has also provided good insights into the planned GYRTWIS Business Model, institutional challenges, 511 implementation challenges, and utility of the 511 Guidelines and ITS Architecture Standards.

The next phase of the evaluation will consist of the After data collection and allow comparison of Before and After system impacts, investigate any new institutional and implementation challenges or changes to the business model. Also, the Pavement Thermal Model accuracy data will be available for the evaluation.

Due to the cooperative efforts of the GYRTWIS team in support of the Evaluation Team, the Phase II evaluation has resulted in the collection of good baseline data and Case Study information. It is recommended that the evaluation continue into Phase III to allow the collection of After data and complete the assessment of system impacts, case study information, and Pavement Thermal Model accuracy.

1.0 Introduction

1.1 ITS Integration Program

The Intelligent Transportation System (ITS) Integration Program is being conducted to accelerate the integration and interoperability of intelligent transportation systems in metropolitan and rural areas. Projects approved for funding have been assessed as supporting the improvements of transportation efficiency, promoting safety, increasing traffic flow, reducing emissions, improving traveler information, enhancing alternative transportation modes, building on existing ITS projects, and promoting tourism. A small number of these projects have been selected for national evaluation. The Greater Yellowstone Regional Traveler and Weather Information System (GYRTWIS) is among the selected projects.

Montana is implementing the GYRTWIS to improve the road and weather information available to travelers and maintenance personnel. GYRTWIS replaces the existing *ROAD service (which is a non-interactive, recorded message system) with #SAFE, which will be interactive and which will use better weather models, including a new Pavement Thermal Model (PTM). The PTM is a computer model that receives road weather information and forecasted weather condition information and generates a location-specific prediction of pavement conditions. The PTM information will be integrated at the #SAFE Operations Center and be disseminated to travelers and maintenance personnel. The road condition and weather forecasts will be available through landline or cellular phones via a 511 telephone system, and will ultimately be linked to neighboring states.

A team led by SAIC, under direction from the USDOT ITS Joint Program Office (JPO), was selected to evaluate GYRTWIS. Three areas will be investigated for this evaluation:

- System impacts of 511 usage and customer satisfaction
- Pavement Thermal Model Accuracy
- Case study of the business model, institutional issues, and 511 implementation issues

The purpose of this evaluation is to determine whether the project goals are met, and to assist others who may be considering similar deployments. This document focuses on the methods, results, and lessons learned from Phase II of the evaluation. As such, the results and lessons learned reported below are based on the Before (or baseline) data collection effort.

1.2 Background

Montana is a large, rural state with a land mass of over 147,000 square miles and about 70,000 miles of public highways and roads. Although the state of Montana is larger than the combined areas of New York, Maryland, Delaware, Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, New Jersey, and Connecticut, it consists of only 2 percent of the combined population of those states.[6]

[6] Montana Fast Facts, http://www.mdt.state.mt.us/map/fastfact.htm

The mountainous corridors in Montana can be difficult to travel, especially during adverse weather conditions. Approximately 77.7 percent of Montana's vehicle miles traveled (VMT) takes place outside of urban areas[7]. It is during the fall, winter, and early spring seasons that weather conditions can adversely impact traveler safety and security and be challenging to road maintenance operations. In 1998, Montana averaged 2.5 fatal crashes per hundred-million vehicle miles (HMVM) vs. the national average of 1.6 fatal crashes per HMVM[8]. In 1999, Montana DOT crews plowed 3,067,406 miles of highway, applied 1,856,376 gallons of liquid anti-icing/deicing materials, and deposited nearly 302,595 cubic yards of sand.[9]

Annually, three million travelers visit Yellowstone National Park. Adjacent to the park are three states: Montana to the north and west; Idaho to the southwest; and Wyoming to the south and east. Yellowstone National Park and portions of the surrounding states and principal roadways are shown in Figure 1-1. The mountainous corridors in Montana can be difficult to travel, especially during adverse weather conditions. The Greater Yellowstone region receives an excess of snowfall with some areas averaging 200 – 300 inches of snow per year. Periods of high winds, fog, and heavy rain are also common to the region.

The Montana DOT has been proactive in deploying road weather information systems (RWIS) to capture/interpolate road condition information and predict travel conditions. Surface and atmospheric conditions are also measured at various sites (e.g., airports, cities, etc.) and by other agencies (e.g., National Weather Service, National Oceanographic and Atmospheric Administration, Agrimet, avalanche organizations, etc.). Despite these efforts, the information is often unavailable to travelers in a timely and consistent fashion. Furthermore, the information is difficult for road maintenance decision makers to use in an effective manner to maintain the roadways.

GYRTWIS is being deployed to assist Montana DOT maintenance operations and provide traveler information and weather conditions to travelers in Montana both in the areas near the Yellowstone Park and throughout the state. The system will also provide detailed weather forecasts to Montana DOT maintenance personnel that should benefit maintenance operations and improve the utilization of personnel, snow removal equipment, and anti-icing/de-icing activities. The system should result in fewer and less severe accidents related to poor road surface conditions and improved productivity and mobility.

The system will also provide Montana DOT the means to disseminate weather and road condition information to the traveling public. It is anticipated that travelers in Montana will find the 511 service a more useful and satisfying means to obtain weather and road condition information over the currently available *ROAD telephone service.

[7] ibid.
[8] 1998 USDOT
[9] Montana Fast Facts, http://www.mdt.state.mt.us/map/fastfact.htm

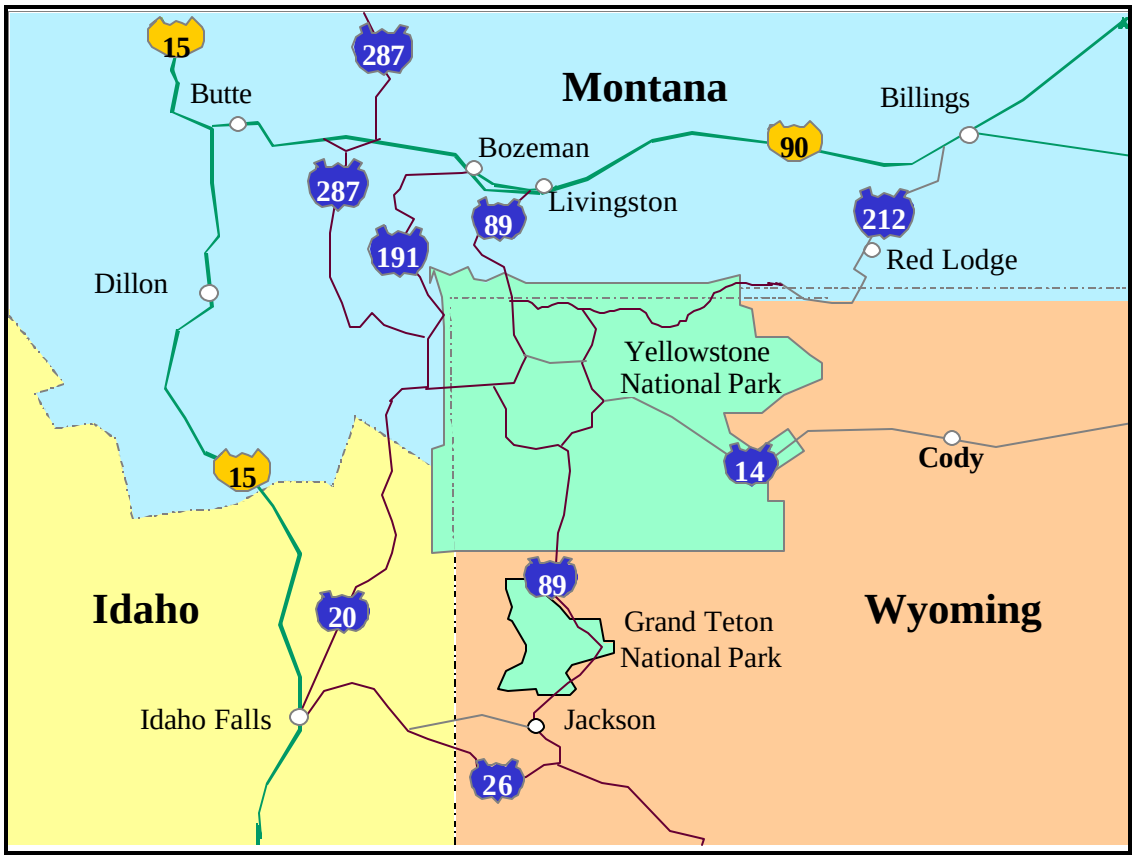

Figure 1-1. Greater Yellowstone Region

1.3 GYRTWIS Description

1.3.1 Project Goals and Objectives

The goals and objectives identified for the GYRTWIS project are shown in Table 1-1. The success of this project will be evaluated by determining how well each of these goals and objectives are met. Western Transportation Institute/Montana State University (WTI/MSU) has documented a procedure for evaluating the GYRTWIS project as described in "Greater Yellowstone Regional Traveler Weather Information System Evaluation Plan Version 1.0". Requests for additional information regarding this document should be forwarded to Mike Bousliman, Montana DOT (Mbousliman@state.mt.us).

Table 1-1. Project Goals and Objectives

Goals	Objectives
Inform the traveler of adverse weather conditions	Provide accurate and timely road weather conditions to the traveler. Provide road and weather information in a format that is useful to the traveler. Inform the public that the information is available.
Improve information available for maintenance and ice and snow removal activities.	Provide accurate and timely road weather conditions to maintenance personnel. Provide road and weather information in a format that is useful to the maintenance user.
Improve coordination of road information dissemination across jurisdictional boundaries and project boundaries	Provide easy access for the traveler to out-of-state information. Improve coordination between state information providers. Exchange data with other sources of road information.

The GYRTWIS project consists of three components:

- #SAFE, the Regional Multi-Modal Traveler Information Service
- Pavement Thermal Model
- 511 national traveler information telephone system

The output from both #SAFE and the Pavement Thermal Model will initially be disseminated through phone and Internet. In the future, the information will also be packaged for availability to kiosks, dynamic message signs (DMS), and other devices in Montana and adjoining states. The #SAFE, Pavement Thermal Model, and 511 system are described in more detail in the following sections.

1.3.2 #SAFE

Meridian Environmental Technologies of Grand Forks, North Dakota, developed #SAFE, the traveler information component of the GYRTWIS project in Montana. The #SAFE system will provide the traveler weather forecasts and road conditions from mesoscale meteorological data via cellular, PCS, and landline telephone. The weather and road information will also be available over the Internet.

The telephone service (shown graphically in Figure 1-2) works by interfacing coded weather information with a computer telephony system located in either Montana or North Dakota (depending on the caller's location). The system provides location-specific information through an interactive process with the traveler. Under GYRTWIS, #SAFE will be expanded into Montana and accessible to Montana travelers using the 511 system (in the future Wyoming and Idaho may also be added). Data from Montana DOT's 59 Remote Weather Information System (RWIS) stations will be integrated and used to provide the weather Nowcast/forecast and road condition information (see Pavement Thermal Model for additional detail on this subject).

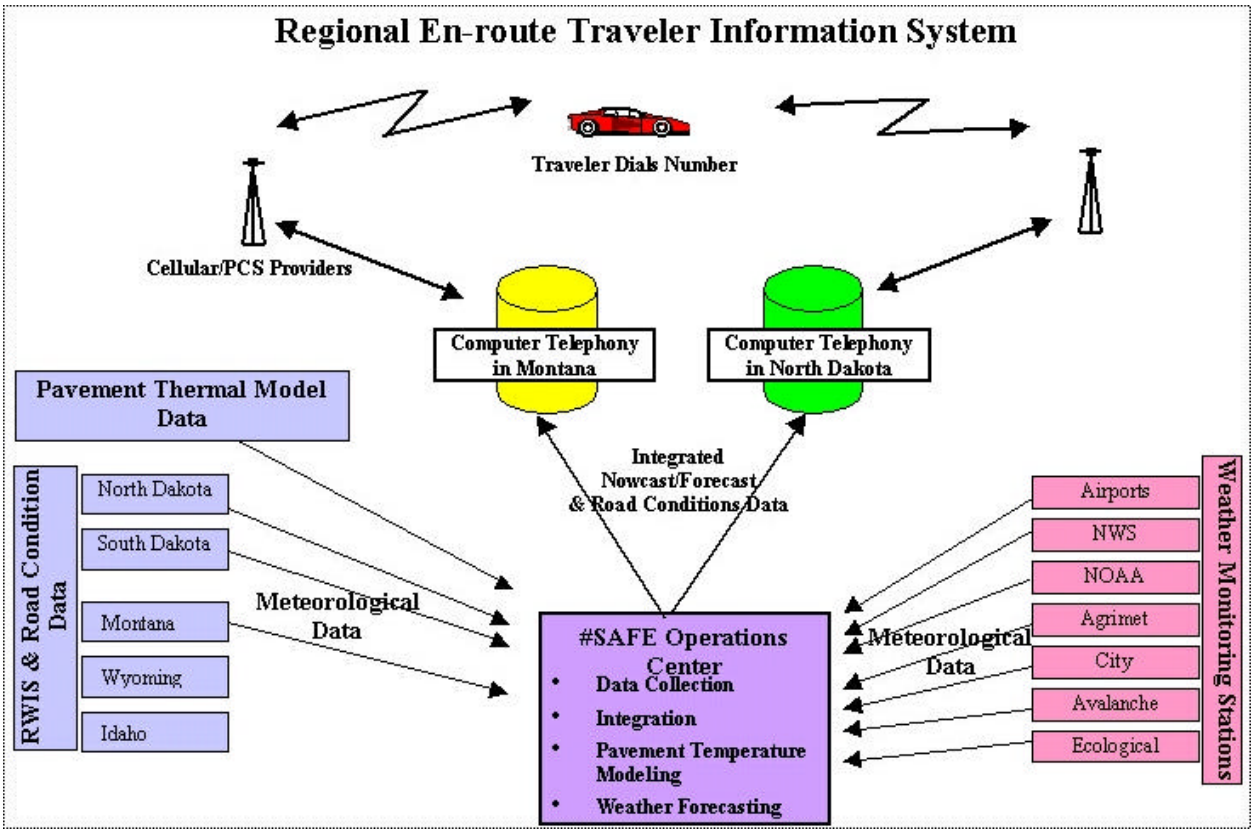

Figure 1-2. #SAFE System

After answering three to four questions about their location, Montana travelers calling the 511 number will hear a route-specific road conditions report and a 6-hour weather forecast. This forecast is not designed for the area the roadway is located within, but for a location 60 miles ahead of the traveler's reported location.

Both North and South Dakota have implemented the #SAFE system from which cellular and PCS telephone users can access the information. After the initial deployment of the system in those states, the Federal government designated 511 as the national traveler information number. Montana plans to use this new nationally designated phone number for dissemination of weather and road condition information under the GYRTWIS project.

1.3.3 Pavement Thermal Model

A second component of the GYRTWIS project is the Pavement Thermal Model that provides predictions of the current road surface conditions. The Pavement Thermal Model's pavement predictions will be integrated with the #SAFE Operations Center to provide forecasted road surface conditions to Montana travelers and state DOT maintenance personnel. The Pavement Thermal Model began in 1997 when WTI/MSU, in conjunction with Montana DOT and FHWA, began work on a proof of concept study under the Montana Partnership for the Advancement of Research in Transportation Small Project Program. This led to the Safe-Passage project, which employed a road and weather condition prediction model integrated with several traditional ITS technologies (RWIS, DMS, and HAR) to improve the safety of travel through Bozeman Pass (between Bozeman and Livingston, Montana).

As part of GYRTWIS, researchers at WTI/MSU are developing a Pavement Thermal Model that uses forecasted wind, air temperatures, humidity, and radiation, as well as the topography of the landscape, to predict pavement temperatures. This type of modeling has its greatest utility in areas with complex topography, such as mountain passes and coulees. The computer model has the potential of forecasting road surface conditions where no RWIS sites exist. In addition to Bozeman Pass, the GYRTWIS project plans to expand this thermal model to two new locations in Montana: the 19th Street Bridge in Bozeman; and to the Lookout Pass in northwest Montana.

1.3.4 511 Traveler Information System

In March 1999, the U.S. DOT petitioned the Federal Communications Commission (FCC) to adopt a new, national 3-digit telephone number to allow easy access to transportation and travel information. The nationally designated number provided travelers with a standard number to call in order to receive highway information (such as traffic conditions, construction, and road-weather); public transit information (like transit buses, ferries, light rail); and other optional content (such as services and attractions, tourist information, special events, etc.).

In July 2000, the FCC designated 511 as the United States' national traveler information telephone number. The FCC ruling left nearly all implementation issues and schedules to state and local agencies and telecommunications carriers. In an effort to assist state and local agencies with the development of 511 systems, the 511 Deployment Coalition was established. The Coalition consists of representatives from The American Association of State Highway and Transportation Officials (AASHTO), in conjunction with many other organizations including the American Public Transportation Association (APTA), and the Intelligent Transportation Society of America (ITS America), with support of the U.S. Department of Transportation.

In November 2001, the 511 Deployment Coalition released a set of guidelines to assist those implementers developing 511 systems. The purpose of the guidelines is to assist transportation agencies in establishing the service in the best possible manner by reducing the chances of service confusion and inconsistency. The Coalition recognizes that 511 services will be developed in a bottom-up fashion with state and local transportation agencies establishing services in areas and timeframes determined by them. The Coalition has developed the "Implementation Guidelines for Launching 511 Services" to assist implementers in their efforts

to develop quality systems and to lay the foundation for ultimately establishing a consistent nationwide 511 service.

The guidelines focus on two main areas: service content and service consistency. The service content describes basic and optional content. The basic content provides information that every 511 system should have, such as highway and public transportation information. The optional content provides information that is at the discretion of the system implementers and may be supported by public and/or private sector supported services. The service consistency guidance provides implementers a blueprint in the following areas:

1. User Interface
2. Initial Greeting
3. Commercial Advertising and Sponsorship
4. Fee Notification of Premium Services
5. Multi-lingual Capabilities
6. Time stamping of Information
7. System Access Quality
8. Hours of System Operation
9. Americans with Disabilities Act (ADA) Implementation
10. Environmental Justice
11. Use of Standards
12. Privacy
13. 511 Branding
14. Number Allocation and Service Coordination

2.0 Methodology

2.1 Evaluation Objectives

This evaluation builds upon and complements the ongoing GYRTWIS evaluation being conducted by WTI/MSU. The WTI/MSU evaluation of GYRTWIS examines traveler perceptions of accuracy, availability, usefulness, and understandability, the accuracy and usefulness of the information for maintenance operations, and perceptions of project success.

This evaluation complements WTI/MSU's GYRTWIS evaluation by investigating three areas:

- System impacts of 511 on usage and customer satisfaction
- Pavement Thermal Model accuracy
- Case study of the business model, institutional issues, and 511 implementation issues

The three study areas and respective objectives are shown in Table 2-1. The System Impacts Study compares the baseline ("Before") usage of Montana's existing road and weather information phone service to the "After" 511 usage. In addition, Before and After perceptions of customer satisfaction will also be compared. The Before perceptions focus on satisfaction with currently available travel information and perceived needs. The After perceptions will investigate satisfaction with the 511 service and how well the pre-511 needs were satisfied.

The Pavement Thermal Model accuracy will be reported in the next phase of this evaluation. Predicted vs. actual pavement temperatures will be compared to determine the accuracy and reliability of the Pavement Thermal Model.

The Case Studies investigate the GYRTWIS business model for Montana's 511 system, explore what the model is, how the services will be funded, how the services will be marketed, and where MDT hopes to obtain funding for ongoing operations. A second objective of the Case Studies is to identify the institutional benefits, challenges, and lessons learned from the effort to deploy 511 in Montana. The third objective is to investigate the challenges to integrating the technologies and the role of 511 guidelines and ITS Architecture standards in system design and implementation. Special consideration and emphasis on the advantages/limitations, and suggested changes will be noted. This document describes the methodology, baseline results, and conclusions for Phase II of the evaluation.

Table 2-1. Evaluation Study Areas and Objectives

Study Areas	Objectives
System Impacts Study:	
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511 Implementation Challenges, Guidelines, and Standards	Develop a case history of implementation challenges, the role of 511 guidelines/ITS Architecture standards, and the advantages, limitations, & suggested changes.

2.2 Evaluation Plan Status

A draft evaluation plan was presented to the Montana DOT project manager and key project personnel in February 2002 for review. A site visit to Montana was conducted during February 28 to March 1, 2002 to interview the key project personnel and learn about the Pavement Thermal Model and obtain qualitative information for the GYRTWIS Business Model, Institutional Lessons Learned, and 511 Implementation Challenges case studies "before" GYRTWIS deployment. An interim evaluation briefing was presented to the Performance Assessment Working Group (PAWG) in June 2002. The briefing included the evaluation status and preliminary findings based on the System Usage Test and Case Study interviews. A draft of this evaluation report was submitted to the stakeholders for review and comment in June 2002.

3.0 Results

3.1 System Impacts Study

The objective of evaluating the system impacts is to assess the impact of the GYRTWIS deployment on both travelers and maintenance personnel. This study investigates impacts in terms of system usage and customer satisfaction. To assess system usage and customer satisfaction by travelers and maintenance personnel, six hypotheses were derived as shown in Table 3-1, along with the measures of effectiveness (MOE) and Data Sources for the System Usage and Customer Satisfaction tests.

Table 3-1. System Impacts Evaluation

Hypotheses	MOE	Data Source
System Usage Test:		
Travelers will use the new GYRTWIS service more than the existing road and weather information phone service.	Number of Calls	WTI/MSU/Montana DOT call tracking
Maintenance personnel will use the road and weather information provided through GYRTWIS more than existing systems.	Number of Users	WTI/MSU/Montana DOT call tracking
Customer Satisfaction Test:		
Travelers will be more satisfied with the GYRTWIS service than the existing road and weather phone service.	Perceived accuracy, availability	WTI/MSU Traveler Surveys
Travelers will perceive the new GYRTWIS service provides useful weather, road condition, & safety information.	Perceived usefulness, understandability	WTI/MSU Traveler Surveys
Maintenance personnel will perceive the pavement and weather forecasts as useful.	Perceived usefulness	WTI/MSU Maintenance Interviews
Maintenance personnel will perceive the pavement and weather forecasts as accurate.	Perceived accuracy, timeliness	WTI/MSU Maintenance Interviews

3.1.1 System Usage Test

The following sections describe the methods, results, and conclusions for the System Usage Test.

3.1.1.1 Methods

Montana DOT collected the baseline call volume data for the System Usage Test. Montana DOT has archived call volume data for their existing *ROAD telephone service. The call volumes (number of calls per month) for the last two winter seasons (November 2000 to April 2001 and November 2001 to April 2002) will be used as a baseline for this evaluation. It is anticipated that the call volume data for the GYRTWIS 511 telephone service (the After condition) will also be collected and made available by Montana DOT.

3.1.1.2 Results

The number of calls to the *ROAD telephone service during the winter seasons of 2000 – 2001 and 2001 – 2002 are shown in Figure 3-1. The average number of calls was 27,235 per month for the 2000 – 2001 winter season vs. an average of 22,144 calls per month (or approximately 22 percent lower) for the 2001 – 2002 winter season. Archives obtained from the National Climatic Data Center suggest that this difference in call volumes is closely correlated to weather activity during the two periods. For example, during the winter of 2000 – 2001 there were 142 snow and ice events in Montana. During the winter of 2001 – 2002, there were 125 such events (or approximately 14 percent fewer)[10].

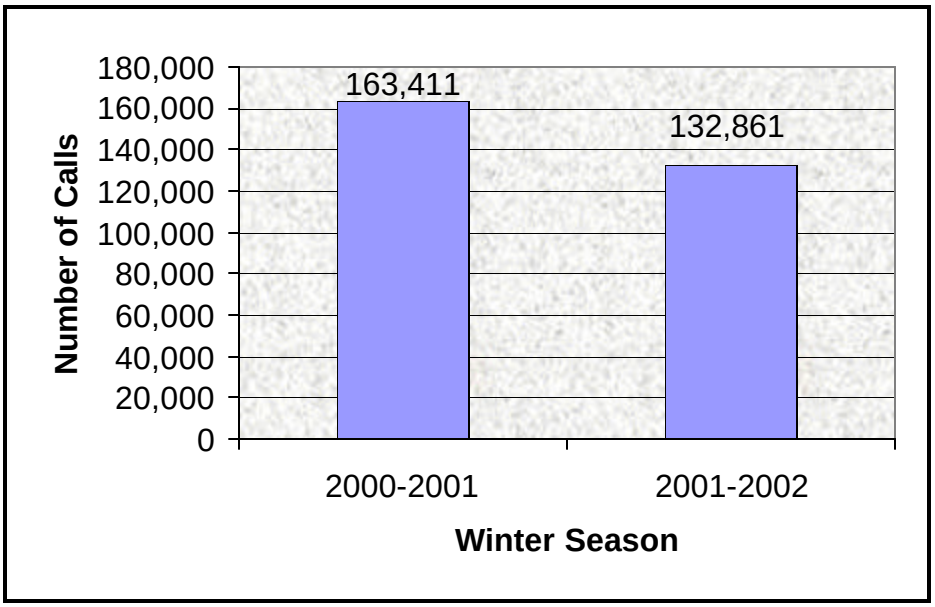

Figure 3-1. Total Number of Calls by Year per Winter Season

This trend is also evident when the call volumes are disaggregated by month. Figure 3-2 presents call volumes to *ROAD service by month and year, while Figure 3-3 illustrates the total number of snow and ice events across the state during the same time periods.

[10] Source: NOAA's National Climatic Data Center – Storm Events Web Site: http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~Storms

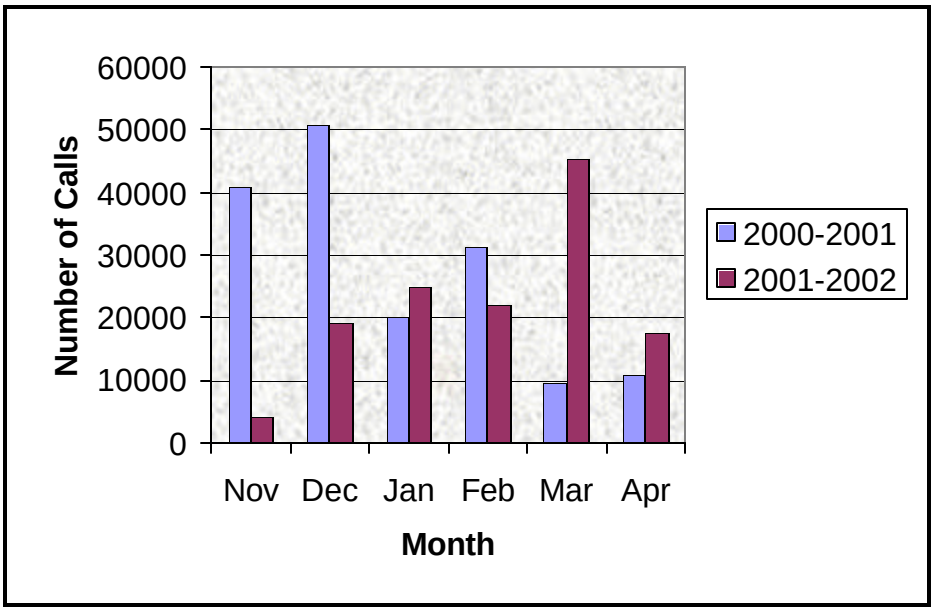

Figure 3-2. Number of Calls by Month and Year

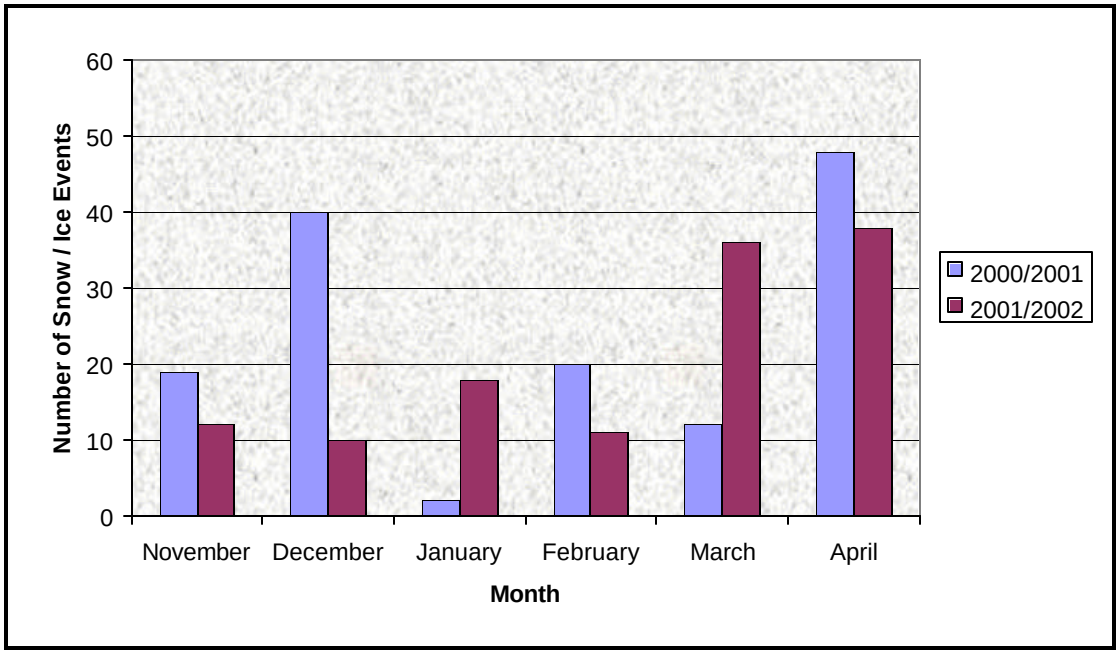

Figure 3-3. Number of Snow and Ice events in Montana by Month and Year

3.1.1.3 Summary

The number of calls recorded by Montana DOT were found to vary year-to-year and month-to-month for the 2000 – 2001 and 2001 – 2002 winter seasons, and appear consistent with climatic conditions. These data provide a basis for comparison with the number of callers using the 511

telephone service being deployed for the 2002 – 2003 winter season. It is expected that the number of calls during the 2002 – 2003 winter season will also vary depending on weather conditions. Nevertheless, the volume of calls for the 2002 – 2003 winter seasons should provide a good indication of usage and provide evidence which complements the perceived customer satisfaction ratings.

3.1.2 Customer Satisfaction Test

The following sections describe the baseline data for the Customer Satisfaction Test. Included are results from the 2002 WTI/MSU *Montana Traveler Information Survey*, 1997 WTI/MSU *Rural Traveler Needs Survey* and *Montana DOT Road Weather Information Survey*.

WTI/MSU administered the *Montana Traveler Information Survey* during the summer of 2002. The purpose of the survey was to investigate user's perceptions of Montana DOT's legacy road and weather information phone service. Four survey items (perceived accuracy, availability, usefulness, and understandability) are reported here and will provide a basis for comparison after the GYRTWIS deployment.

In 1997, WTI/MSU conducted the *Rural Traveler Needs Survey* as part of the Greater Yellowstone Rural ITS Priority Corridor project [11]. The overall purpose of the survey was to determine the concerns and information needs of rural drivers/passengers when traveling in Montana, Wyoming and Idaho. The three objectives for the Rural Traveler Needs Survey were to determine:

1. *What* information the rural traveler needs and wants,
2. *Medium* through which information would be presented to the traveler, and
3. W*here* the traveler would want this information presented.

The survey results were used to identify technologies that could disseminate information near the roadway or in surrounding areas to help travelers. Portions of the Rural Traveler Survey serve as the baseline data for the customer satisfaction test.

Another source of baseline data, which captured the perceived usefulness of existing pavement and weather forecasting information, was the WTI/MSU *Montana DOT Road Weather Information Survey* of Montana DOT maintenance personnel.

After GYRTWIS is deployed, WTI/MSU will collect traveler survey data and conduct maintenance personnel interviews as part of their self-evaluation effort, from which a portion of these data will be analyzed and reported for Phase III of this evaluation.

3.1.2.1 Methods

[11] Greater Yellowstone Rural Intelligent Transportation System Priority Corridor Project Rural Traveler Needs Survey Volume I. Prepared by Randy W. Carroll and John M. Mounce, October 1997.

Montana Traveler Information Survey. For the Montana Traveler Information Survey, 1500 surveys were evenly distributed to Montana residents based on zip codes within the 11 Montana DOT districts. The percentage of responses by DOT District was fairly uniform and ranged from 6.4 % to 15% of the total. Approximately 23 % or 348 surveys were returned.

The respondents consisted of 60 percent males and 40 percent females, the majority (51 percent) of whom was between the ages of 45 and 64 years old. Nearly all the respondents (96 percent) reported they primarily drive automobiles on Montana highways with 37 % traveling 100-300 miles per trip, 21% traveling less the 24 miles, 16% traveling 25-49 miles, and 14% traveling 50-99 miles per trip. The primary purpose for the majority of highway vehicle travel was for work (53%), visiting family or friends (14%), recreation (13%), or shopping (11%).

Rural Traveler Needs Survey. For the Rural Traveler Needs Survey, 481 responses were collected at 14 locations throughout Montana, Idaho, and Wyoming. Respondents consisted of Montana, Wyoming, and Idaho residents (30 percent), and tourists or individuals from other states (68 percent).

The respondents consisted of 55 percent males and 42 percent females, the majority of whom were between the ages of 45 and 64 (38 percent), with 56 percent reporting that they live in an urban area vs. 42 percent who reported living in a rural area. Additional demographic information reported that 56 percent were employed full-time, had a college degree (30 percent), had an income between $40,000 and $79,000 (34 percent), and 97 percent had a current driver's license. The majority of respondents (78 percent) reported their normal mode of travel as the driver of an automobile; 36 percent normally traveled zero to 49 miles per day; 27 percent normally traveled on two-lane highways; and their normal trip purpose is for recreation (47 percent).

Road Weather Information Survey. For the Road Weather Information Survey, 87 Montana DOT maintenance personnel from the 11 Montana DOT District offices were respondents. The respondents consisted of Field Supervisors (75 percent), Supervisors (15 percent), and Maintenance Chiefs (7 percent).

3.1.2.2 Results

Montana Traveler Information Survey. The survey participants were asked to answer questions about the accuracy, availability, usefulness, and understandability of Montana DOT's road and weather information phone service. The results are shown in Figures 3-4 through 3-7.

Accuracy. To investigate the perceived accuracy of the existing phone service, the survey participants were asked the question *"How accurate is this service's road condition reports and weather forecasts? (Check only one)*". On a five-point rating scale (ranging from Very Accurate to Very Inaccurate), nearly two-thirds of the respondents indicated the service was Somewhat Accurate (46%) to Very Accurate (16%). Leaving about one-third of the respondents who indicated Neutral or Somewhat Inaccurate. These results are shown in Figure 3-4.

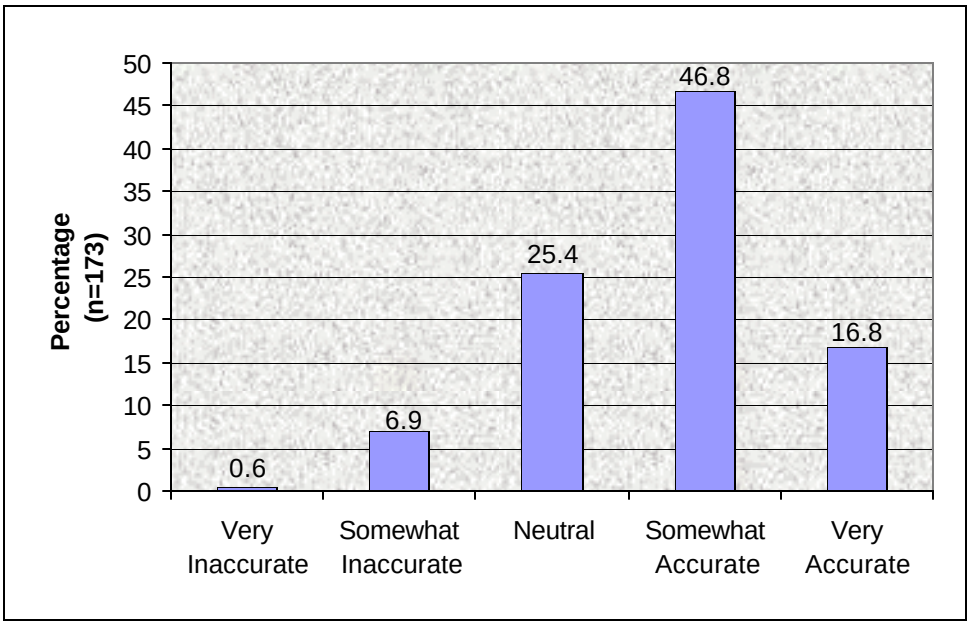

Figure 3-4. Accuracy Ratings for Road and Weather Information Phone Service

Availability. The survey participants were asked the question "*When trying to access this service, HOW AVAILABLE is it? (Check only one)*". On a five-point rating scale (ranging from Very Available to Very Unavailable), the majority of respondents indicated that the service was very to somewhat available. The most frequently selected choice was Somewhat Available with nearly 33% of the respondents choosing this option. Very Available with 29% was the second most common choice, followed closely by Neutral with 24%. The results are shown in Figure 3-5.

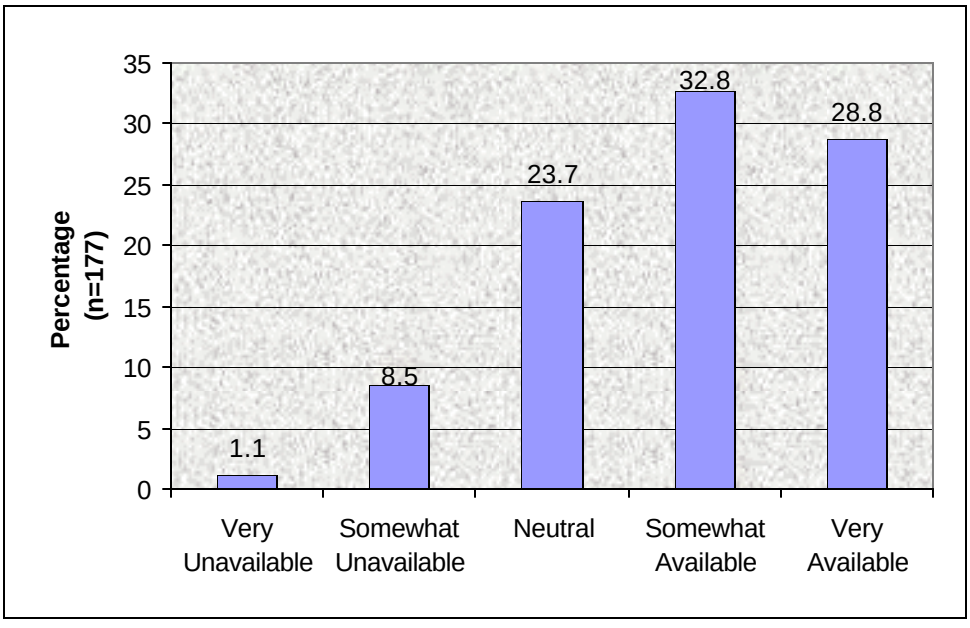

Figure 3-5. Availability Ratings for Road and Weather Information Phone Service

Usefulness. To investigate the overall perception of the usefulness of the phone service, participants were asked, *"Overall, HOW USEFUL is this service's road condition reports and weather forecasts? (Check only one)*". On a five-point rating scale (ranging from Very Useful to Very Useless), most respondents felt that the service was very to somewhat useful. Nearly 46% of the respondents indicated the phone service was Very Useful and 42% selected Somewhat Useful. These results are shown in Figure 3-6.

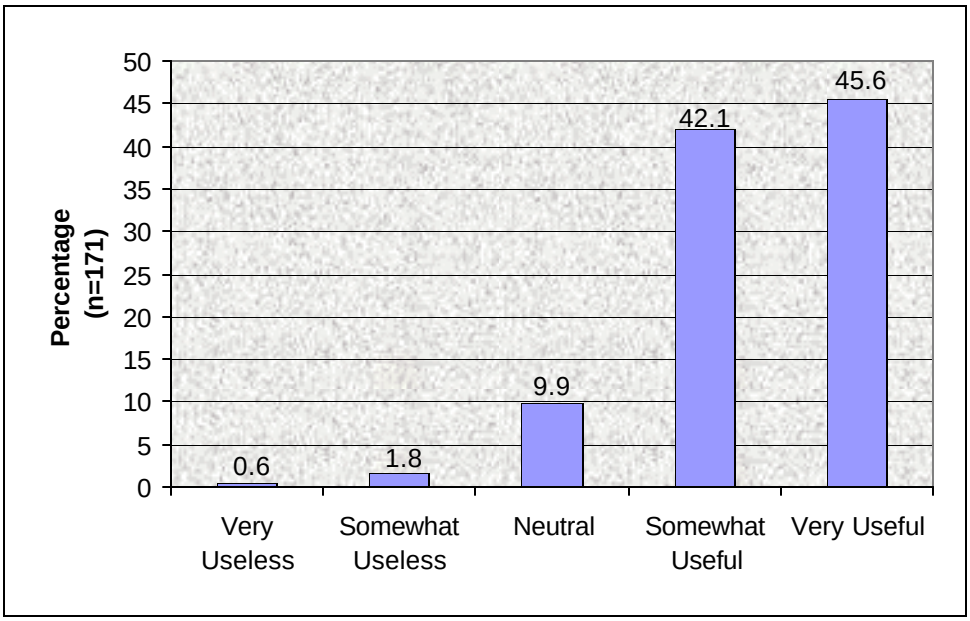

Figure 3-6. Usefulness Ratings for Road and Weather Information Phone Service

Easy to Understand. The survey participants were also asked the question "*HOW EASY to understand, are the road condition reports and weather forecasts provided by this service? (Check only one)*". On a five-point rating scale (ranging from Very Easy to Very Difficult), most of the respondents indicated the service was very to somewhat easy to understand. Approximately 44% indicated the phone service was Very Easy and 42% selected Somewhat Easy. Just over 8% of the respondents indicated the phone service was Somewhat Difficult (6.8%) or Very Difficult (1.7%). The results are shown in Figure 3-7.

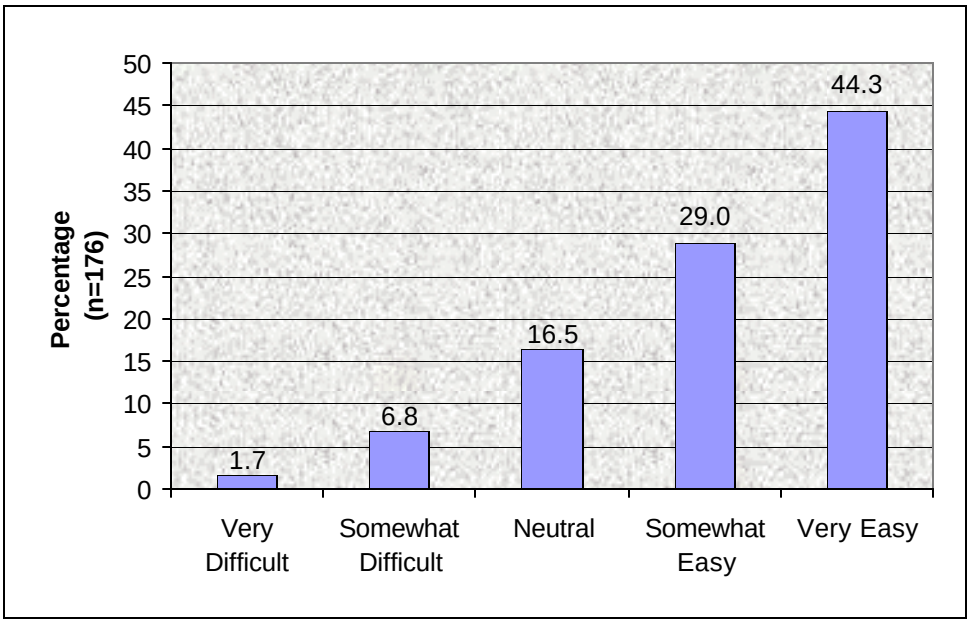

Figure 3-7. Easy to Understand Ratings for Road and Weather Information Phone Service

Rural Traveler Survey. Selected results from the Rural Traveler Survey are reported here to provide background information about traveler perceptions of types of useful information, when they would like to use the information, and how they would like to access the information.

The survey participants were asked the question: *"When traveling in rural Montana/Idaho/Wyoming, how frequently do you worry about the following safety concerns and other issues as a driver or passenger?"* On a five-point rating scale (where 1 means *Never Worry About It* and 5 means *Always Worry About It*), safety-related concerns were rated the highest. Worrying about road conditions such as ice and snow (mean = 3.18); passing trucks and other heavy vehicles (mean = 3.04); and animals, such as deer or farm animals on the roadway (mean = 3.01), rated higher than worries about getting lost (mean = 1.99) or traffic delays (mean = 2.71). Figure 3-8 presents the six categories of concerns and corresponding worry level frequencies.

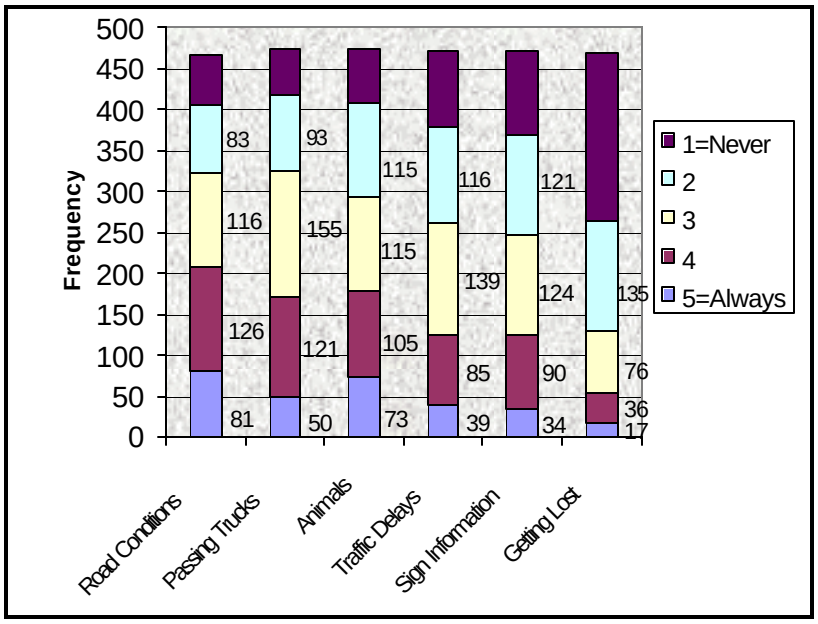

Figure 3-8. Concern Categories and Frequency of Worry

Ratings, however, were found to differ between Montana, Wyoming, and Idaho residents and tourists or residents from other states. According to the report by Carroll and Mounce[12]:

> *Tourists and residents of other states indicated they were more concerned with getting lost and not getting enough information from signs along the roadway. By comparison, residents of Montana, Idaho and Wyoming are generally familiar with the area they are traveling through and the direction in which they are going. Thus, their information needs tend to be oriented towards the road and weather conditions they will experience along their route.*

The survey participants were also asked to rate the importance of "*types of information…before you start your trip by motor vehicle on rural roads and highways*." The types of pre-trip information were each rated using a five-point scale, where 1 was *Not At All Important*, to 5, which was *Very Important*. Information about road condition problems due to weather (mean = 3.91) and adverse weather conditions (mean = 3.87) were rated nearly as important as having information about the best route to the destination (mean = 3.92). Other pre-trip information considered important was information about tourist attractions (mean = 3.85) and traveler service locations (mean = 3.73), particularly for tourists and residents of other states. Information about locations of traffic delays due to special events and locations of accidents/incidents were rated lower on the importance rating scale (mean = 3.15 and 3.14, respectively). Figure 3-9 shows the pre-trip information categories and importance ratings.

[12] Ibid.

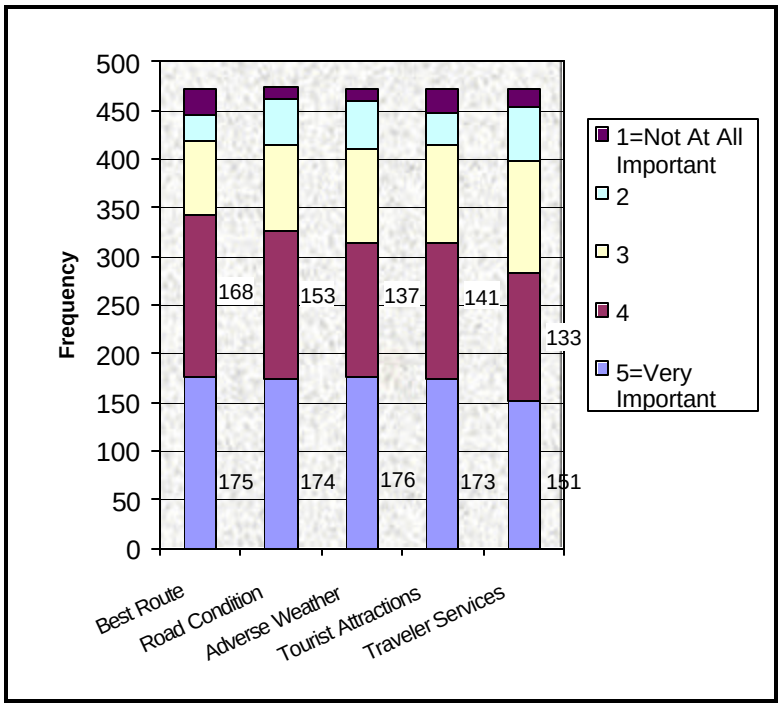

Figure 3-9. Pre-trip Information Categories and Frequency of Importance

Survey participants were also asked: *"Do you prefer to get information like road conditions, weather, and tourism accommodations, before you start a trip, while on the road, or both?"* More than two-thirds (69 percent) preferred getting information both before starting a trip and while on the road; 17 percent preferred getting the information before they started a trip; and just 9 percent preferred getting the information while on the road. No significant differences between any of the demographic groups were found ($p = 0.01$).

Using a five-point scale where 1 means *Not At All Likely* and 5 means *Very Likely*, the participants were asked: *"How likely would you use each of the following services to obtain current information about weather, construction zones, routes, and road conditions if you had it available to you?"* Dynamic message signs along the highway were rated as the source most likely to be used by the travelers (mean = 4.13). A special radio channel (mean = 3.66) or phone number (mean = 3.65) were next, rating higher than small computerized information centers at convenient locations, cellular phones, or a small TV screen with traveler information only for your car (mean = 3.32, 2.86, and 2.10 respectively). See Figure 3-10 for the information sources and likelihood of use ratings.

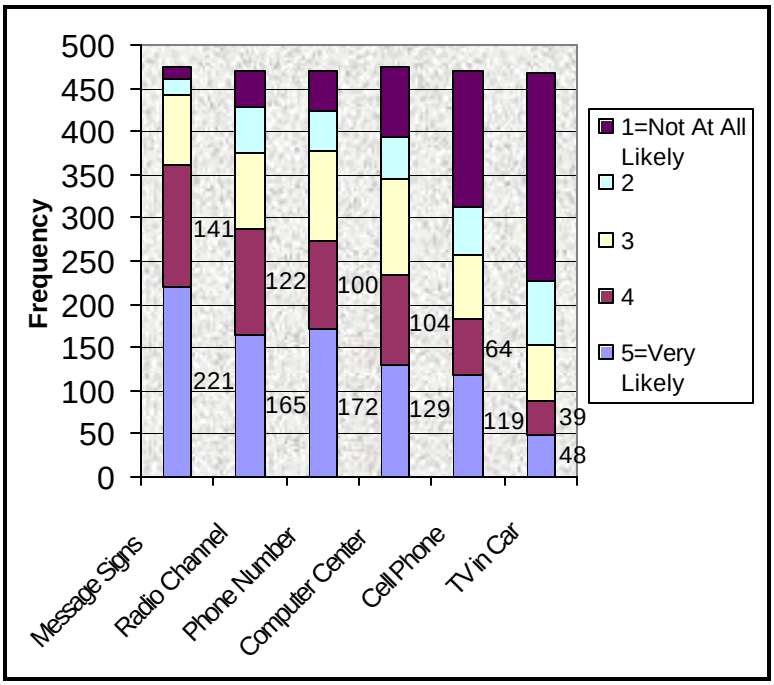

Figure 3-10. Information Source and Likelihood of Use

One explanation for these results is that a driver's convenience and familiarity with an item, such as viewing dynamic message signs and listening to a radio, may increase the likelihood of using such items. Conversely, lack of awareness of special information centers or the need to obtain new hardware (such as a cellular phone or small TV screen) are less convenient to a driver and therefore, less likely to be used.

Carroll and Mounce report differences between tourist and resident respondents. They found that Residents of Montana, Idaho, and Wyoming indicated they were more likely to use a phone number to obtain current information on weather, construction zones, routes and road conditions than were tourists or residents of other states[13]. Tourists were more likely to use small computerized information centers at convenient locations to obtain the same information because they indicated "*…it would be more convenient to use on-site information centers since their access to telephones could be limited while traveling*"[14]. Since the survey did not ask how many respondents had cellular phones at the time of the survey, it is unknown as to how many travelers had access to cellular telephones. However, anecdotal evidence suggests that since July 1997, the number of cellular telephones users has grown, and therefore, cellular phone access may no longer be as large a deterrent for travelers obtaining information via the telephone.

Road Weather Information Survey. Selected results from the Road Weather Information Survey are reported here. Only the results for questions related to usefulness, timeliness, and accuracy are included.

[13] Ibid.
[14] Ibid.

Usefulness. The maintenance personnel were asked: *"How often do you use the following types of weather information before making roadway maintenance decisions."* The respondents could select from five options: Not Available; 0 = Never – Not Needed; 1 = Rarely; 2 = Occasionally; and 3 = Very Often. Commercial Weather Forecasts (i.e., TV, Weather Channel, etc.) and National Weather Service reports were rated the highest (mean = 2.54 and 2.46, respectively) and as most often used. Of the 87 respondents, 60 percent (52 respondents) reported using commercial weather sources very often, whereas 52 percent (45 respondents) reported using the National Weather Service Weather reports very often. In contrast, the Montana RWIS information (mean = 2.00) was used very often by 25 percent (22 respondents) and occasionally by 48 percent (42 respondents). The Value Added Meteorological Service (VAMS) or contracted weather forecast service reports (mean = 1.34) were used very often by 8 of the respondents. The frequency of use is shown in Figure 3-11.

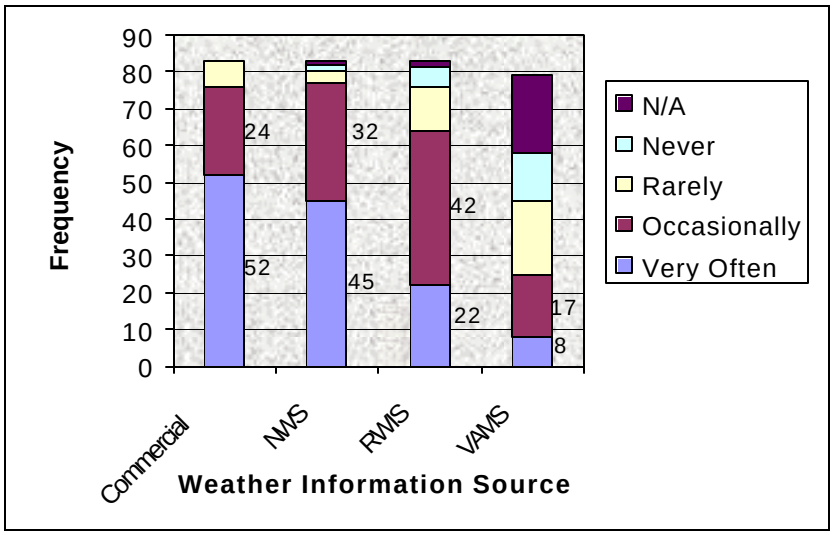

Figure 3-11. Information Used Before Making Maintenance Decisions

The maintenance personnel were asked *"How frequently do you use these methods to obtain weather information for making roadway maintenance decisions."* Televised weather reports were most commonly used (mean = 2.40), followed by weather radio broadcasts (mean = 2.23), commercial radio weather reports (mean = 2.11), and other (various) Internet web sites (mean = 2.06). These ratings are shown in Figure 3-12.

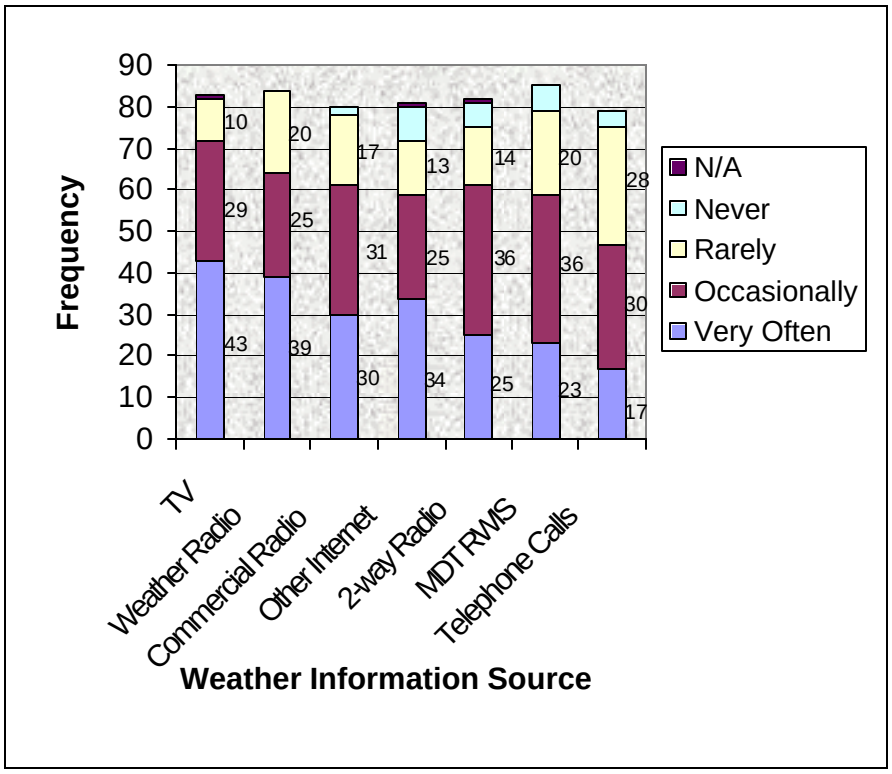

Figure 3-12. Methods Used to Obtain Weather Information

When the maintenance personnel were asked: *"If other methods for delivery of weather information were provided, which would be desirable?"* 46 percent of the respondents indicated that they desired a dial-up RWIS voice recording of the current conditions; 39 percent indicated the Internet as desirable; 30 percent indicated the radio was desirable; and 27 percent thought no other methods were needed.

In response to the question: *"How easy is it for you to obtain current RWIS information?"* 36 percent of the maintenance personnel reported *"It is Always Easy,"* whereas, 46 percent responded *"I sometimes encounter difficulties,"* and 14 percent reported *"I Often Encounter Difficulties"*. These results are shown in Figure 3-13.

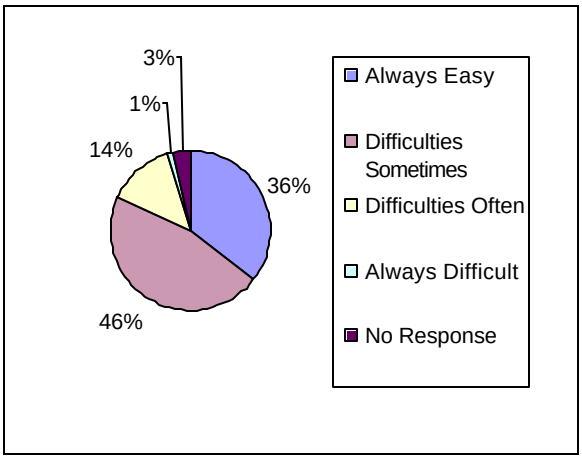

Figure 3-13. Ease of Obtaining Current RWIS Information

When asked "*Would any of the following changes make the display of RWIS data more useful?*" 70 percent of the maintenance personnel positively responded that integrating RWIS data with radar or satellite images would; 36 percent wanted to display RWIS data directly on a map of RWIS sites; and 33 percent thought providing estimated temperature readings for the length of road (thermal mapping) would be useful. Making the RWIS data easier to read and interpret was suggested by 26 percent of the respondents.

The maintenance personnel were also asked: *"How useful is the following site-specific information to you in doing your job?"* Using a four-point scale where 0 = Not at All Useful, 1 = Not Very Useful, 2 = Somewhat Useful, and 3 = Very Useful, the four highest ranking types of information were: Road Surface Condition (mean = 2.77); Precipitation/Snowfall (mean = 2.77); Air Temperature (mean = 2.74); and Pavement Temperature (mean = 2.72). The usefulness ratings for location-specific information are displayed in Figure 3-14.

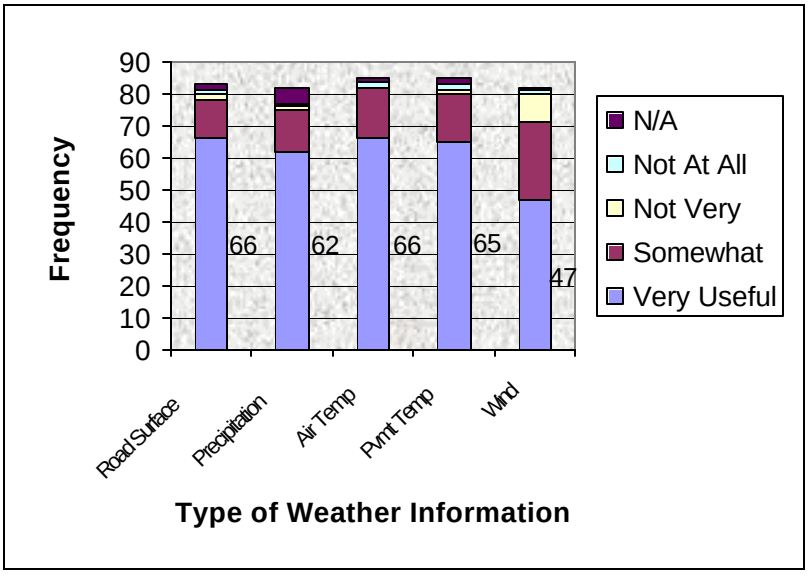

Figure 3-14. Usefulness of Location-Specific Information

Timeliness and Accuracy. The results for three questions were related to timeliness and accuracy. The timeliness question asked of Maintenance Personnel was: *"How often do you encounter weather station site data that is not current?"* 9 percent responded with more than once a day; 35 percent with more than once a week; 17 percent with more than once per month; and 15 percent responded with less than once a month.

The importance and impact reliable forecasts have on maintenance operations, such as anti-icing was found in the one question in particular. When asked: "*Which of the following would improve anti-icing in your region (select any that apply)*", besides more resources (people and equipment) as indicated by 51 percent, 48 percent chose more reliable forecasts as a means to improve anti-icing maintenance operations.

The survey participants were also asked: "*For what time period should forecasts be provided and updated?*" overall, the most frequently indicated time period was for a two-hour forecast with 48 percent of respondents choosing this response. The second most frequently chosen time period (40 percent) was a 24-hour forecast. The overall percentages by forecast category is shown in Figure 3-11. The heights of the bars indicate the overall percentage of the forecast periods. Within each bar, the colored sections show the recommended update period as a function of forecast time period. For each forecast time period, the choices for update periods were: hourly; 2 – 4 hours; 6 – 12 hours; 12 – 24 hours; or unspecified. Therefore, with two-hour forecasts, 28 respondents indicated that the update period should be every 2 – 4 hours and 12 respondents chose hourly updates. Figure 3-15 shows the preferred forecast time periods and update periods.

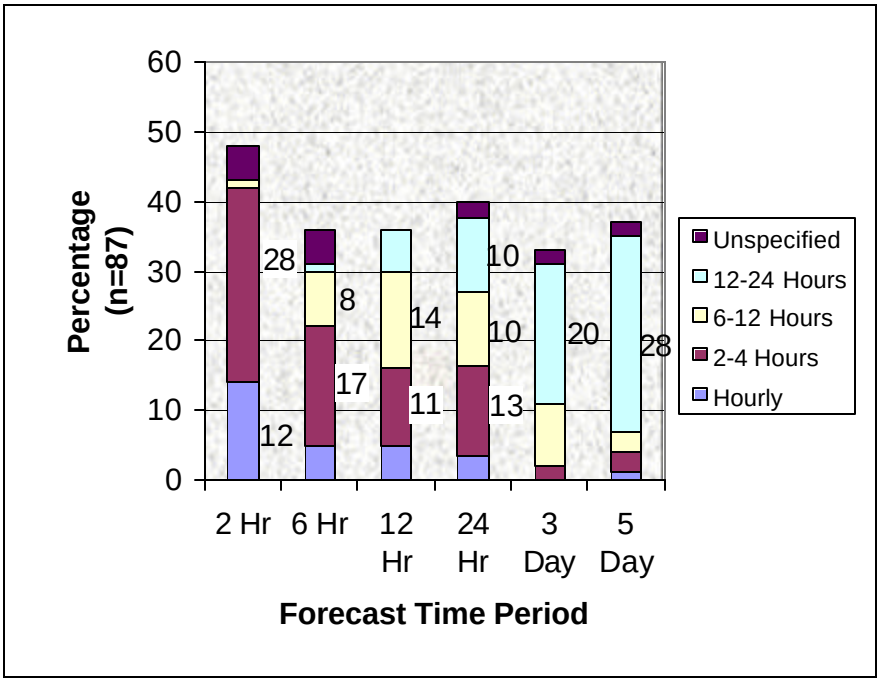

Figure 3-15. Preferred Forecast Time Periods and Update Periods

3.1.2.3 Summary

The *Montana Traveler Information Survey* found that Montana travelers perceived the existing Montana DOT road and weather information telephone service to be generally accurate, available, useful, and easy to understand. A majority (about two-thirds) of the survey respondents indicated that the phone service was Somewhat to Very Accurate (versus Neutral, Somewhat Inaccurate, or Very Inaccurate). This same trend was also observed for the availability, usefulness, and understandability of the existing of the phone service. However, for usefulness and understandability most respondents chose Very Useful or Very Easy (to understand) over their respective Neutral or other not useful/not easy to understand choices.

The Rural Traveler Survey found that travelers in rural Montana, Idaho, and Wyoming often worried about safety concerns (such as road conditions like ice and snow, passing trucks and other heavy vehicles, and animals on the roadway) more than traffic delays and getting lost. Travelers also considered information about the best route to a destination, road condition problems due to weather, adverse weather conditions, tourist attractions, and traveler service locations to be important information to know before leaving on a trip. A majority of travelers wanted access to this information both before starting a trip and while on the road. To obtain the information, travelers thought dynamic message signs, a special radio channel, or a phone number would be used more readily than computerized information centers, cellular phones, or a small in-car TV screen. However, anecdotal evidence suggests that since July 1997, the number of cellular telephones users has grown, and therefore, cellular phone access may no longer be as large a deterrent for travelers obtaining information via the telephone.

The Road Weather Information Survey indicated that a majority of maintenance personnel used Commercial Weather Forecasts (i.e., TV, Weather Channel, etc.) and National Weather Service reports *very often* before making roadway maintenance decisions. Although nearly a quarter of the maintenance personnel reported using the Montana RWIS information, about one-half reported using the information only occasionally. Television, radio, and various Internet web sites were the commercial sources most often used to obtain the information.

In terms of how they would like to receive weather information, maintenance personnel responded that a dial-up RWIS voice recording of the current conditions, followed by the Internet as the most popular choices. Unfortunately, 14 percent of the maintenance personnel *often* encountered difficulties obtaining the RWIS information and slightly less than one-half reported that they *sometimes* encountered difficulties.

The maintenance personnel indicated how they thought the RWIS information should be displayed and the type of information they wanted available. Nearly three-fourths (70 percent) wanted RWIS data integrated with radar or satellite images; over one-third (36 percent) wanted RWIS data displayed directly on a map of RWIS sites; and 33 percent thought providing estimated temperature readings for the length of road (thermal mapping) would be useful. Four types of information were highly desired: Road Surface Condition, Precipitation/Snowfall, Air Temperature, and Pavement Temperature.

Timeliness of information was reported to be problematic for some maintenance personnel. Nine percent reported encountering weather station site data that is not current more than once a day and 35 percent reported non-current information more than once a week. The importance of accurate forecasts was an important factor in improving anti-icing maintenance operations. Second only to more resources (people and equipment), nearly half of the maintenance personnel (48 percent) chose more reliable forecasts as a means to improving anti-icing operations.

Finally, for forecasts and updates, overall, the most frequently indicated time period preference was two-hour forecasts with nearly half (48 percent) of the respondents choosing this time period. The second most frequently chosen time period (40 percent) was a 24-hour forecast.

3.2 Case Studies

3.2.1 General Methodology

The general approach for the baseline Case Study interviews was to review relevant documents, such as the GYRTWIS meeting minutes and the Memorandum of Understanding, discuss current status of the project, prepare and distribute interview questions, and schedule and conduct interviews. The interviews were conducted between February 28 and March 1, 2002 in Montana and between March 19 and 21, 2002 at the 2002 511 Deployment Conference in Scottsdale, Arizona.

The following sections provide a detailed description of the methodology and baseline results for each of the Case Studies.

3.2.2 GYRTWIS Business Model

ATIS Business Models have been studied in many urban ITS deployment areas (e.g., San Francisco, Seattle, Phoenix, New York, Miami, and New England). However, little is known about rural ATIS Business Models and even less is known about rural Business Models for the 511 service.

This evaluation focused on developing a qualitative assessment of the GYRTWIS business model, how the services are being funded, and where funding for ongoing operations will be obtained. The goal is to present the findings and lessons learned to other regions considering similar systems. Table 3-2 presents the evaluation approach including the objective, measures of effectiveness (MOE), data sources, and proposed analysis.

Table 3-2. Rural 511 Business Model Evaluation

Objective	MOE	Data Source	Proposed Analysis
Examine the rural ATIS business model, how they are paying for the services, and the source of funding for ongoing operations.	For GYRTWIS what are the: - Revenue sources. - Level & type of financial support. - Marketing/outreach plans. - P-P partnership agreements. - Sharing infrastructure or services.	GYRTWIS documents: - MOU's - Contracts - Policy Statements Before/After interviews with key project personnel.	Case study analysis of interviews and documents

The data collection for the case study began with a review of relevant project documents (MOU's, policy statements, and meeting minutes) to understand the following elements:

1. The nature of the public-private partnership agreements.
2. Agency policies and procedures.
3. Business model topics/issues discussed during project meetings.

Next, a series of questions were developed for interviews with key project personnel. The key project personnel were comprised of project management personnel from both public agencies and private entities.

The interview results reported in this document provide an opportunity to capture pre-deployment concerns and provide guidance for the topics addressed in the After deployment interviews. Both Before and After interviews are expected to provide insight into the differences between the GYRTWIS 511 business model and that of urban 511 business models. Five topic areas were investigated:

- Revenue sources to implement the service.
- Level & type of financial support to sustain the service.
- Marketing/outreach plans.
- Nature of the public-private partnership agreements.
- Sharing of infrastructure or services exist.

3.2.2.1 Results

Revenue Sources to Implement and Sustain the Service

The GYRTWIS 511 system builds upon the existing RWIS information system originally developed for Montana DOT maintenance operations. The business model can be viewed as

both a public-private partnership and a traditional fixed-price contracting relationship. During the development phase, the funding sources were FY2000 ITS Congressional Earmark appropriations bill, Highway Trust funds, State of Montana funds, and either cash or in-kind partnership contributions. Montana DOT's agreement with Meridian and ThermoAnalytics can also be considered a fixed-price contracting relationship. As part of the financial arrangement, both companies are paid for their services. Meridian expanded the #SAFE weather model, provided mesoscale meteorological forecasts, and 511 telephony support. ThermoAnalytics improved the Pavement Thermal Model and provided a user interface for maintenance users.

Although a Regional Business Plan was under development during the time of the interviews, the current public sector view is that generating revenue to become self-sustaining is not a goal for the 511 service. Since the 511 system will replace the *ROAD telephone service and builds on existing Montana DOT maintenance processes and information, public opinion and support of the service is of higher priority than generating self-sustaining revenue.

In the future, however, advertising may be a potential revenue source. Currently, Montana state law prohibits advertising on state property. As a result, advertising revenues are not possible without changes to state regulations. Approval by the state legislature is required before the sale of advertising time on the 511 system would be permitted.

One other revenue source was mentioned, but requires the approval by Montana's state government. An increase or reallocation of hotel/motel/inn "bed tax" may be a means to collect revenue. Although this idea needs to be explored further, it seems to reason that since a good proportion of 511 users are travelers and that travelers frequently seek lodging, passing along a portion of the costs for 511 services through the collection of the lodging tax may be justified.

Marketing/Outreach Plans

The marketing and outreach plans are currently under development. The Montana DOT Public Information Office will be responsible for outreach activities. Marketing and outreach activities will begin in the summer of 2002, several months ahead of a ribbon-cutting event for the 511 service. An application for grant money from the FHWA has been submitted and the grant funding will be used to pay some of the marketing and outreach costs. The planned budget for marketing and outreach is approximately $20,000 to $30,000. The budget appears to be very small in comparison with many other 511 deployments. For example, at the 2002 511 Deployment Conference in Scottsdale, Arizona, it was reported that Kentucky had a "shoestring" budget-spending approximately $50 thousand dollars per year promoting their 511 service. Boston, on the other hand, reportedly spends approximately $1 million dollars per year on marketing and outreach.

In Montana, the plan is to use a low-cost "grassroots" approach to raise awareness of the 511 service to state residents. There are approximately 240 Montana DOT employees who participate in the Montana DOT Transportation Awareness Program (TAP). The TAP allows time-off (with pay) to Montana DOT employees who participate in approved public events to distribute information and educate the public about current Montana DOT programs and initiatives. These public events are often informal settings such as manning a booth at county fairs, trade shows, or local festivals. During the summer of 2002, TAP participants will begin educating the public and promoting the 511 service.

Other methods to promote 511 to both state residents and out-of-state travelers may include pamphlets, press releases, Internet web sites, bulletin boards at rest areas, and highway signs.

Public-Private Partnership Agreements

In June 2001, the Montana DOT entered into a Memorandum of Understanding (MOU) agreement with Western Transportation Institute/Montana State University, Meridian Environmental Technologies, and ThermoAnalytics, Incorporated. The purpose of the MOU was *"to identify the parties that are collectively interested in entering into an agreement for demonstration and evaluation of the Greater Yellowstone Regional Traveler and Weather Information System (GYRTWIS)"*[15].

Montana DOT agreed to:

1. Provide contract and grant administration.
2. Contribute matching resources in the form of cash and equipment.
3. Purchase equipment for implementation of the #SAFE system.
4. Provide support to Meridian for the development, deployment, and advertisement of the #SAFE system in the State of Montana.
5. Provide support to WTI in the development and deployment of the Pavement Thermal Model.
6. Participate in project meetings.
7. Participate in project evaluation exercises.

Western Transportation Institute, Montana State University agreed to:

1. Administer subcontracts with Meridian and ThermoAnalytics.
2. Contribute match in the form of in-kind contributions.
3. Develop project architecture.
4. Improve and implement the Pavement Thermal Model.
5. Work with project partners on integration issues.
6. Conduct a project evaluation.
7. Lead project meetings.

Meridian Environmental Technology agreed to:

1. Contribute matching resources in the form of in-kind contributions.
2. Expand the #SAFE weather model and telephony support to the State of Montana.
3. Provide mesoscale meteorological forecasts to WTI/MSU for input into the Pavement Thermal Model.

[15] Memorandum of Understanding for Greater Yellowstone Regional Traveler and Weather Information System, June 2001.

4. Work with project partners on integration issues.
5. Participate in project evaluation exercises, including #SAFE usage statistics.
6. Participate in project meetings.

ThermoAnalytics agreed to:

1. Contribute matching resources in the form of in-kind contributions.
2. Provide improvements to the software code for the Pavement Thermal Model.
3. Provide a user interface to the Pavement Thermal Model output for maintenance users.

In addition to the MOU, a Scope of Work document, *Greater Yellowstone Regional Traveler and Weather Information System Scope of Work*,[16] was developed to clearly define the scope of the project, schedule, and budget.

Shared Infrastructure or Services

In terms of sharing infrastructure or services, Montana DOT is making available the data collected at the RWIS sites. Although, originally, the RWIS information was primarily used to collect data to support winter maintenance operations, the data will now be integrated to also provide traveler information.

WTI/MSU is also sharing infrastructure and services. The development of the Pavement Thermal Model and processing system is being led by WTI/MSU. To support the computational-intensive Pavement Thermal Model, WTI/MSU will provide some of the needed computing resources.

3.2.2.2 Summary

The GRYTWIS 511 telephone service emphasizes providing readily available and accurate information to address traveler safety concerns. Therefore, the goal of the system is to provide accurate and timely weather and road condition information. This contrasts with urbanized areas where emphasis is most often placed on the need for congestion information over road condition. Since the GYRTWIS is, in a sense, an upgrade of existing services (i.e., *ROAD telephone service and maintenance information system), the public sector is more concerned about providing the service than generating revenue.

In comparison with the reported budgets in Kentucky and Boston, the GYRTWIS project has a small marketing and outreach budget. However, the low cost "grassroots" approach planned to educate resident travelers about the 511 service is intriguing. By using the approximately 240 Montana DOT employees who participate in the Montana DOT Transportation Awareness Program (TAP), TAP participants will begin educating the public and promoting the 511 service at informal settings such as county fairs, trade shows, and local festivals.

[16] Greater Yellowstone Regional Traveler and Weather Information System Scope of Work, June 2001.

A Memorandum of Understanding was used to define a general agreement between the different public and private organizations. The MOU described the roles, responsibilities, and contributions (cash or in-kind) for the GYRTWIS developers. A Scope of Work document was later developed to further define the scope of the project, schedule, and budget. As part of the agreement, Montana DOT agreed to make available the RWIS data and WTI/MSU agreed to provide computing resources to support the Pavement Thermal Model.

3.2.3 Institutional Lessons Learned

GYRTWIS is a rural project in Montana that will implement a 511 telephone service using the #SAFE system located in North Dakota and WTI/MSU's Pavement Thermal Model. Because GYRTWIS is a public-private partnership with operation centers in two states (Montana and North Dakota), it is important to document the institutional benefits and challenges that are encountered during GYRTWIS development and implementation. Problems arising during a deployment are not only technical, but also institutional, especially when the project involves participants from multiple states. The goal of this evaluation is to present findings and lessons learned to provide insight and guidance to others. Areas explored include:

- Project team coordination and cooperation.
- Information sharing and how gaps were accommodated.
- Management approach to overcoming obstacles.
- Benefits, advantages, challenges, and drawbacks.

Table 3-3 summarizes the evaluation approach including the objective, measures of effectiveness (MOE), data sources, and proposed analysis.

Table 3-3. Institutional Lessons Learned Evaluation

Objective	MOE	Data Source	Proposed Analysis
Identify the institutional benefits, challenges, and lessons learned of the 511 deployment.	Perceptions of: - Coordination issues. - Information sharing/gaps. - Approach to overcoming obstacles. - Benefits, advantages, challenges, and drawbacks.	Review GYRTWIS documents: - Meeting minutes - Other relevant docs Before/After interviews with key project personnel.	Case study analysis of interviews and documents

3.2.3.1 Results

Project Team Coordination and Cooperation

Since the project team developing GYRTWIS involves a fairly limited number of people, communication and coordination has not been a major challenge. In addition, partner consensus was reached early on with all project participants reviewing, commenting, and discussing the MOU and scope of work documents to ensure coordination and cooperation.

Project management has used several methods that have helped to maintain open lines of communication: scheduled telephone calls, reporting requirements, and project "team" meetings.

Schedule conflicts and the demands of working on multiple projects can result in missed communication opportunities. Scheduling weekly telephone calls has helped project personnel maintain contact and remain in touch with current developments. In addition, reporting requirements, such as Quarterly Reporting under GYRITS, has also encouraged communication and coordination of project activities. Lastly, project "team" meetings, where project personnel get together in-person to discuss issues have also improved coordination and cooperation among project personnel. The in-person meetings are preferred over telephone calls, but schedule conflicts and geographic separation inhibits frequent face-to-face meetings. However, the project team has taken advantage of opportunities to meet at conferences, such as ITS America and the 511 Deployment Conference.

Information Sharing and How Gaps were Accommodated

For GYRTWIS to succeed information needs to be shared between Montana DOT, WTI/MSU, and Meridian. RWIS information needs to flow from Montana DOT to both the Pavement Thermal Model at WTI/MSU and the meteorological models at Meridian. Pavement Thermal Model data flows to the #SAFE server at Meridian. The #SAFE server then sends information to the Montana DOT Headquarters and District Offices where it is sent out via the 511 telephone number, dynamic message signs, and highway advisory radio.

Items mentioned that facilitate the sharing of information and clarification of data requirements include: design documentation, detailed process flow diagrams; and clearly defined data needs, such as data dictionaries.

Management Approach to Overcoming Obstacles

Two items were mentioned that had a positive impact on overcoming obstacles: the Greater Yellowstone Regional Intelligent Transportation System (GYRITS) Regional Architecture and the Montana DOT Strategic Business Plan. Web site access to the GYRITS Regional Architecture (www.coe.montana.edu - /wti/wwwshare/GYRITS/) was cited as a useful planning tool for guiding ITS deployments in the region that are compatible with the National ITS Architecture and ITS Standards. The regional architecture assists agencies and stakeholders identify and plan the integration of ITS components and needed data exchanges. The GYRTWIS project architecture will be developed based on the GYRITS Regional Architecture and will identify the components being used and information sharing needed for project success.

The MDT Strategic Business Plan (www.mdt.state.mt.us/general/matrix/businessplan.html) was cited as being a useful tool to address job security issues and alleviate fear of job loss due to new technology. The plan is serves as the basis for business actions and performance measurement, both at the department and individual level. Employees have performance plans developed from twelve strategic initiatives and performance criteria that are tied to their division, district administrator, and overall departmental performance.

Benefits and Advantages

Working together has provided several benefits and advantages for Montana's travelers and maintenance personnel. Obviously, working together has resulted in the sharing of ideas and perspectives. This has allowed Montana DOT to work with others that have ITS experience and learn about ITS without having to hire additional personnel. This, in turn, has resulted in a greater knowledge and trust in ITS technologies at Montana DOT.

Challenges and Drawbacks

As with any development project there have been challenges both actual and anticipated. During the development phase, the main challenge to project schedule was the procurement of telecom equipment. This was due to changes in Montana State law. The new law required all acquisitions of computer and telecom equipment to be handled by the Department of Administration. Consequently, the telephony equipment will arrive later than was originally planned.

The lack of budget for meetings and workshops has also been a challenge. Although GYRTWIS involves a small close-knit group, they are geographically dispersed. Having budget for travel would allow the team to travel to meet and discuss issues in person. Whether for meetings in Montana at Montana DOT or WTI/MSU, in North Dakota at Meridian Technologies, or to attend workshops/conferences, traveling in-person to view progress and challenges can be productive and valuable for gaining knowledge and insight. Acquiring funding for user group meetings was also mentioned as a challenge.

An anticipated challenge that was mentioned was getting the participation of cellular phone providers. Montana DOT's concerns are related to experiences that have occurred with 511 deployments in other parts of the country such as in Arizona and Northern Kentucky. Some wireless carriers have raised objections to a national deployment of 511 services citing issues such as costs to operate and support the service and losing opportunities to provide the information as a value-added service. This challenge will need to be continually monitored in the coming months to determine the impact (if any).

3.2.3.2 Summary

There are a fairly small number of people involved in the GYRTWIS project, so maintaining coordination, cooperation, and communication has not been a major challenge. Nevertheless, the project management has used several methods that have helped to maintain open lines of communication via scheduled telephone calls, reporting requirements, and project "team" meetings.

Several items were mentioned that better facilitates the sharing of information and clarification of data requirements. These items include design documentation, detailed process flow diagrams, and clearly defined data needs, such as data dictionaries.

Two documents were mentioned as having a positive impact on overcoming obstacles. The Greater Yellowstone Regional Intelligent Transportation System (GYRITS) Regional Architecture was cited as a useful planning tool for guiding the GYRTWIS deployment. The Montana DOT Strategic Business Plan was cited as being a useful tool to address job security issues and alleviate fear of job loss due to new technology.

During the development phase, the main challenge to project schedule was the procurement of telecom equipment. This was due to changes in Montana state laws. The new state required all acquisitions of computer and telecom equipment to be handled by the Department of Administration.

3.2.4 511 Implementation Challenges, Guidelines and Standards

This study investigates the GYRTWIS implementation challenges and the role of 511 guidelines and ITS architecture standards in system design and implementation. The implementation challenges encountered during development of the system architecture are documented. Special attention to the role of 511 Content and Consistency guidelines and ITS architecture standards and the advantages, limitations, and suggested changes are also explored and reported. Table 3-4 summarizes the evaluation approach including the objective, measures of effectiveness (MOE), data sources, and proposed analysis.

Table 3-4. 511 Implementation Challenges, Guidelines, and Standards Evaluation

Objectives	MOE	Data Source	Proposed Analysis
Develop a case history of implementation challenges, the role of 511 guidelines/ITS architecture standards, and the advantages, limitations, and suggested changes.	Usefulness of 511 content/ consistency guidelines. Advantages/limitations. Suggested changes.	System engineering and architecture documents. Before/After interviews with key project personnel.	Case study analysis of: - Implementation challenges. - Role of guidelines and standards. - Guidelines / standards advantages, limitations, suggested changes.

Data Collection and Analysis

The data collection for the Implementation Challenges, Guidelines, and Standards case study involved reviewing system engineering documents and interviewing key personnel developing GYRTWIS. Pre-deployment interviews provided an opportunity to capture implementation challenges and perceptions of the 511 Guidelines and ITS Architecture Standards. The After interviews will capture additional challenges and focus on the system developers' perceptions of the role of guidelines and standards, advantages, limitations, and any suggested improvements.

A series of questions were developed for interviews with GYRTWIS key personnel. The Before interviews were conducted between February 28 and March 1, 2002 in Montana and between March 19 and 21, 2002 at the 2002 511 Deployment Conference in Scottsdale, Arizona.

3.2.4.1 Results

Implementation Challenges

Two implementation challenges were anticipated and encountered. First, as cited as an Institutional challenge, concern about the willingness of wireless companies to support the GYRTWIS 511 service was identified as a potential implementation stumbling block. At the time of these interviews, a great deal of uncertainty existed about how willing Montana's regional cellular providers would be to participate in the GYRTWIS 511 service. Although not an isolated case, Montana DOT's concern is similar to 511 deployments in other parts of the country such as in Arizona and Northern Kentucky where issues such as costs to operate and lost opportunities for value-added services have been raised. Montana DOT was arranging meetings with the wireless providers to try and work-through and resolve the issues.

Another challenge, previously discussed in the Institutional Lessons Learned section, is the recent legislative changes whereby the Montana Department of Administration is responsible for the purchase of computer and telephony equipment. This change has resulted in the procurement of the telephone equipment taking longer than anticipated.

Guidelines and Standards

The 511 Guidelines were perceived to be fairly general, yet useful in providing a high level understanding of the 511 service. However, since GYRTWIS is being deployed using Meridian's existing #SAFE system the Guidelines were not viewed as very helpful in terms of aiding development.

The ITS Architecture Standards were viewed as useful for planning purposes. As noted in the Institutional Lessons Learned evaluation, the ITS Architecture Standards provided a framework for the regional architecture as well as the development of GYRTWIS overall architecture. The GYRTWIS architecture, based on the GYRITS regional architecture, is based on the ITS Architecture Standards.

One limitation was noted regarding the ITS Architecture Standards. The ITS Architecture Standards for ATIS were not viewed as very helpful in providing guidance on message sets for signs.

Suggested Changes and Other Comments

In a review of the 511 Content and Consistency Guidelines a variety of suggestions and comments were provided to improve the 511 Guidelines. Below are some of the key points and comments.

- **Allowing users to provide feedback can help planners/developers to identify problems, obtain input on suggested improvements to content, menu design, etc., and can be a valuable public relations tool.** *"At a minimum, each 511 system should provide a comment, questions, or feedback line to record input from users and allow the state to respond to questions and comments in a timely manner."*

- **Flexibility in the selection of road segments, routes, or corridors is a desirable feature.** This was mentioned because, "*…while longer routes do need to be divided to facilitate detailed reporting of conditions along that segment of the route, Interstates should provide both an entire state route by interstate and a segment report across the interstate"*. Since commercial vehicles routinely travel the interstate through an entire state providing a "complete route" report option allows the commercial vehicle operator time to make route change decisions.

- **Providing route-specific weather and highway information provides travelers a complete view of the route.** Further, "*…the weather report should include current (Nowcast) and forecasted specific parameters of weather that are expected to affect the route requested. National Weather Service watches and warnings that cover the route must be included as well.*"

- **Providing access to customer service center operators raises significant issues related to cost and service implications.** While public transportation information should be part of the 511 system, easy access to customer service centers may need to be carefully considered. *"Duplication of telephone lines and their associated cost, consistent activity from the 511 system to these centers, and questions of a routine nature repeatedly being asked of operators that could easily be provided through the 511 automated system are just some of the issues a state or city would have to deal with."*

- **The guidelines should include interregional information as part of the basic information required along highways.** *"The importance of this multi-region integration goes to the heart of a Nationwide 511 Traveler Information System"*. Because of the importance of traveler access while traveling, integration of regional information can be determining factor as to whether or not a traveler receives the information requested.

  For example: "*Interstate 71 from Louisville KY to Cincinnati OH. This interstate segment runs along the Kentucky – Indiana border and Kentucky – Ohio border on the Kentucky side. Since radio waves don't recognize state lines, travelers between these two cities searching for route-specific information about Interstate 71 could easily find themselves connecting to a mobile tower in Indiana. Next they are told that no such Interstate number exists or they are connected to an Ohio mobile tower, only to discover the only information available along Interstate 71 is for Cincinnati to Columbus."*

- **Implementing a system that allows callers to report incidents raises quality control issues.** A system of quality control should be put in place to verify the accuracy yet ensure the timeliness of the information. *"It must be done very carefully to ensure a method is established to eliminate untrustworthy reports and expedite real reports.*"

- **Some personalized services should be provided by the private sector.** Providing travelers with information and allowing them to make decisions "*…relieves the state of the responsibility and possibly liability of providing driving directions, delays in itinerary or trip planning, hotel or restaurant reservations, or other items that when things go wrong.*"

- **Accuracy, timeliness, and reliability are essential to maintaining users trust in the system** because "*…once a system loses their trust, they no longer use the system*."

3.2.4.2 Summary

Two implementation challenges were cited. First, concern about the willingness of wireless companies to support the GYRTWIS 511 service was identified as a potential implementation stumbling block. Although not an isolated case, Montana DOT's concern is similar to 511 deployments in other parts of the country such as in Arizona, Northern Kentucky. Montana DOT was arranging meetings with the wireless providers to try and resolve the issue.

Another challenge, which was previously discussed in the Institutional Lessons Learned section, is the recent legislative changes whereby the Montana Department of Administration is responsible for the purchase of computer and telephony equipment. This change has resulted in the procurement of the telephone equipment taking longer than anticipated.

The 511 Guidelines were perceived to be fairly general and not viewed as very helpful in terms of aiding development. However, the Guidelines were useful in providing a high level understanding of the 511 service. The ITS Architecture Standards were viewed as useful for planning purposes, and as noted in the Institutional Lessons Learned evaluation, provided a framework for the regional architecture as well as the development of GYRTWIS overall architecture.

The 511 Content and Consistency Guidelines was reviewed and a variety of suggestions and comments yielded the following key points:

- Allowing users to provide feedback can help planners/developers to identify problems, obtain input on suggested improvements to content, menu design, etc., and can be a valuable public relations tool.
- Flexibility in the selection of road segments, routes, or corridors is a desirable feature.
- Providing route-specific weather and highway information provides travelers a complete view of the route.
- Providing access to customer service center operators raises significant issues related to cost and service implications.
- The guidelines should include interregional information as part of the basic information required along highways.
- Implementing a system that allows callers to report incidents raises quality control issues.
- Some personalized services should be provided by the private sector.
- Accuracy, timeliness, and reliability are essential to maintaining users trust in the system.

4.0 Summary

The Phase II Evaluation of the GYRTWIS project has identified several interesting preliminary findings. Survey data collected by Montana DOT and WTI/MSU provide a good baseline snapshot of traveler and maintenance personnel perceptions of the existing road and weather information and methods of dissemination. Call volumes for the *ROAD service is available for the past two winter seasons (2000 – 2001 and 2001 – 2002). Pre-deployment interviews with key GYRTWIS personnel has also provided valuable insight into the planned GYRTWIS Business Model, institutional challenges, 511 implementation challenges, and utility of the 511 Guidelines and ITS Architecture Standards.

The traveler surveys revealed the perceptions of accuracy, availability, usefulness, and understandability of Montana DOT's road and weather information phone service. Also identified were the traveler information needs and desires, preferences for information dissemination methods, and when the information is wanted. The maintenance personnel survey identified where they get their current weather conditions and forecasts, where they would like to get information, and what types of information is most useful.

The GYRTWIS Business Model case study investigated how the services are being funded and where funding for ongoing operations will be obtained. The next phase of the evaluation will investigate any changes to Montana DOT's focus on providing the service rather than generating revenue and the use of a low-cost "grassroots" approach to educate resident travelers about the 511 service.

Many of the (institutional and implementation) challenges identified were typical of other ITS deployments. Any new institutional and implementation challenges or changes to the business model will be captured in the next phase of the evaluation. Also, the data for the Pavement Thermal Model should also be available to examine the accuracy.

5.0 Recommendations

Due to the cooperative efforts of the GYRTWIS team in support of the Evaluation Team, the Phase II evaluation has resulted in the collection of good baseline data and Case Study information. It is recommended that the evaluation continue into Phase III to allow the collection of After data and complete the assessment of system impacts, case study information, and Pavement Thermal Model accuracy.