A feasibility case study of Automated Highway Systems in the Greater Yellowstone priority corridor
by Russell Scott Gomke

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in Civil Engineering
Montana State University

Abstract:
The use of Automated Highway Systems (AHS) technology has been proposed as a mitigating application to vehicle collisions in rural areas. The application of AHS in the urban environment is being tested and evaluated to reduce traffic congestion with secondary consideration to safety. Typically, recurring congestion is not a problem in the rural environment, while increasing traveler safety is a primary concern. Automated Highway Systems have the potential to address safety issues in the rural environment by providing the driver with critical collision warning and avoidance information.

The purpose of this study was to address the feasibility, applicability and institutional issues of deploying AHS components in the Greater Yellowstone Corridor. To accomplish the project objectives a systematic research approach was developed to assess the safety challenges and infrastructure deficiencies of the Greater Yellowstone Corridor. The primary tasks consisted of a transportation system inventory, an accident analysis, an AHS countermeasure assessment and a benefit-cost evaluation.

The research yielded several spot location applications with the potential to positively affect the safety challenges of the Greater Yellowstone Corridor. Potential technologies are friction/ice detection warning system, animal-vehicle collision warning, intersection collision warning and advanced horizontal curve warning. These are all near-term applications. Benefit-cost evaluations have indicated several multi-mile sections of highway in the Greater Yellowstone corridor where far-term countermeasures are applicable and feasible. Far-term applications include longitudinal and lateral warning and guidance. However, these applications require appropriate vehicle fleet penetration before any true benefits can be quantified. Market penetration may be facilitated by fleet vehicle deployment.

The work performed for this project is only the first phase. Funding will be pursued to develop some of the near-term applications into field operational tests. The sites identified in this thesis are estimated to have the greatest potential for improving safety in the Greater Yellowstone corridor.

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APPROVAL

of a thesis submitted by

Russell Scott Gomke

This thesis has been read by each member of the thesis committee and has been found to be satisfactory regarding content, English use, format citations, bibliographic style, and consistency, and is ready for submission to the College of Graduate Studies.

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Date 3/11/98

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- Jim Richard, District Engineer - Idaho Department of Transportation;
- Dennis Hult, ITS Program Coordinator - Montana Department of Transportation; and
- Bill Cottrill, Traffic Engineer - National Park Service, Denver Office.

These agencies provided the researcher with relevant information on the Greater Yellowstone Priority Corridor to allow an accurate evaluation.

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ABSTRACT

The use of Automated Highway Systems (AHS) technology has been proposed as a mitigating application to vehicle collisions in rural areas. The application of AHS in the urban environment is being tested and evaluated to reduce traffic congestion with secondary consideration to safety. Typically, recurring congestion is not a problem in the rural environment, while increasing traveler safety is a primary concern. Automated Highway Systems have the potential to address safety issues in the rural environment by providing the driver with critical collision warning and avoidance information.

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CHAPTER 1

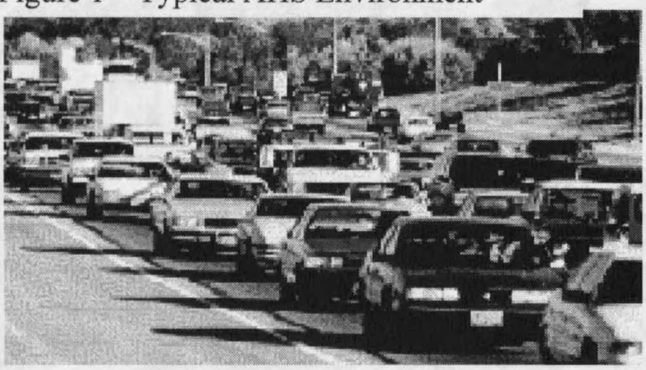
AUTOMATED HIGHWAY SYSTEMS

Introduction

The intent of this study was to recommend applications and consider implications of Automated Highway Systems (AHS) in a rural environment. This study focused on developing an applicable AHS for the Greater Yellowstone Rural Intelligent Transportation Systems (GYRITS) corridor (see Appendix A) that would ultimately increase safety and improve operation of the GYRITS corridor.

Initial activities by the National Automated Highway System Consortium (NAHSC) have focused on urbanized areas (see Figure 1). However, a need exists to

Figure 1 – Typical AHS Environment



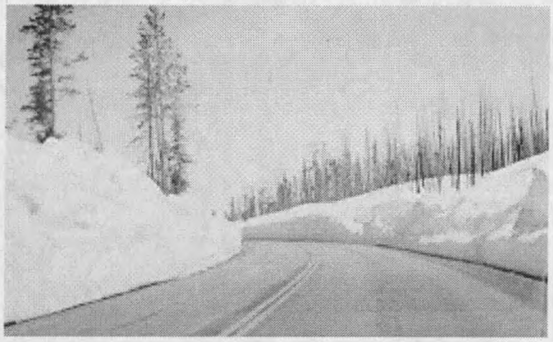
investigate the applicability of advanced transportation technology and AHS in rural settings. AHS applications have primarily focused on problems associated with urban traffic congestion; secondary considerations have related to safety, air quality and energy conservation. These areas are also of concern to the rural transportation provider; however, the primary focus of the rural transportation provider is improved safety.

There are many safety benefits potentially realized through the application of AHS technologies to the existing transportation infrastructure, particularly through advanced driver warnings. It is estimated that if a driver were warned of an impending collision one half second earlier, 50 percent of rear-end and cross-road crashes and 30 percent of head-on crashes could be avoided. If an additional second is provided to the driver, 90 percent of all crashes could be avoided. Experts estimate that advanced transportation technologies will potentially save 11,500 lives, 442,000 injuries, and $22 billion in property damage nationally by 2010. [2]

The selected corridor represents a vital transportation link for the trucking industry, connecting the Northwest and Canada with Intermountain and Southwest markets. Approximately 20 percent of the traffic traversing the GYRITS corridor is commercial. [3] Commercial vehicles use this route to transport goods between the aforementioned markets and markets within the corridor (e.g., mining, forestry, and agricultural industries). Because much of the corridor is two-lane highway, many dangerous passing situations result involving large trucks, recreational vehicles, tourists and slow-moving farm machinery. Poor sight distance, limited by the winding road and canyon walls, exacerbates the danger.

The corridor presents an environment filled with unique challenges that must be confronted when developing a viable transportation system. The corridor receives about 80 to 90 inches of snow in a typical winter (see Figure 2). Temperatures can reach 65 degrees below zero (Fahrenheit) and a 40 to 50 degree temperature shift from day to

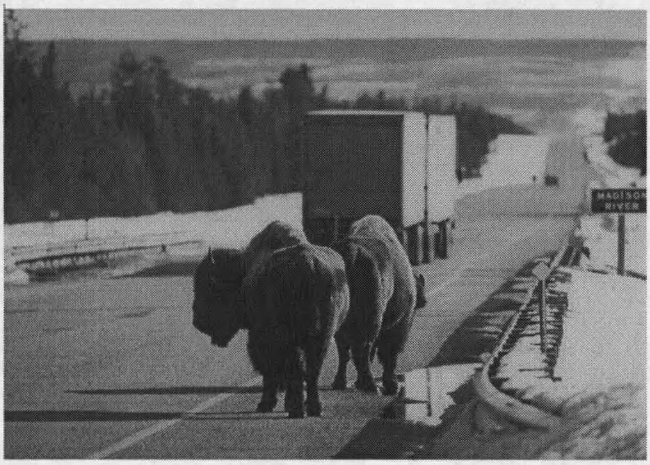
Figure 2 – Typical Corridor Snowfall



night is not unusual. Winter conditions typically last about eight months. However, it has been known to snow in the higher elevations in the summer months.

The corridor encompasses migration routes and habitat for deer, elk, bison and moose. Periodically, these animals can be found on the roadway, presenting a potential animal-vehicle conflict (see Figure 3). Over a recent three-year period, 367 animal-

Figure 3 – Potential Animal-vehicle Conflict



vehicle collisions were reported. Non-reported animal-vehicle collisions likely increase this number substantially.

Because much of the corridor abuts mountain ranges, many sections of the corridor are not covered by cellular phone service. The canyon walls also preclude the reception of AM or FM radio band signals throughout much of the corridor.

The combination of varied, often undesirable driving conditions with wildlife, unfamiliar drivers, a diverse traffic stream and a lack of communication infrastructure indicates an immediate and growing need for increased focus on safety. The problems experienced in the GYRITS corridor are common to many rural environments. Hence, it is an ideal location to showcase field operational demonstrations of advanced technologies.

Background

In the last couple of decades, the transportation community has seen the emergence of new transportation technologies. Many agencies across the country have implemented and demonstrated the use of advanced transportation technologies but with little or no national coordination, standards or strategic direction. The congressional enactment of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) restructured the United States Department of Transportation (USDOT) and made provisions for the development of an advanced technology program titled "Intelligent Vehicle-Highway Systems" (IVHS). The USDOT was required to develop a national strategic plan and a grant program for the research, development and deployment of advanced transportation technologies. Later IVHS evolved into Intelligent