An Intelligent Transportation System Plan for Highway 2 Between Edmonton and Calgary

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ABSTRACT

In response to continuous demand for safe and efficient flow of goods and people, Alberta Transportation has developed a high level vision (ITS Strategic Plan) for implementing Intelligent Transportation Systems (ITS). Highway 2 between Edmonton and Calgary has been identified in the Strategic Plan as a priority corridor to serve as a testbed for ITS initiatives. As a result, Alberta Transportation has initiated a project to study the needs and develop plans for advanced transportation technologies along the Highway 2 corridor between Edmonton and Calgary. These technologies are potential tools to help monitor and manage traffic flow, detect and clear incidents and provide travellers with real-time information on traffic congestion and road conditions. The objectives of Alberta Transportation in conducting this project are to enhance safety and operations in the corridor, ensure opportunities exist to integrate identified solutions with adjacent municipal ITS plans and deploy ITS solutions in a cost-effective well-planned manner.

The project is based on a "needs driven" approach addressing specific safety and operational priorities, which in turn, will drive the recommendations of appropriate technologies for the corridor. To achieve this, a consultation process has been included to obtain input from “targeted” stakeholders representing a wide range of perspectives.

This paper summarizes the needs that have been identified within the Highway 2 corridor and how these are addressed in a comprehensive and coordinated plan for ITS deployment. It also includes highlights of the methodology used to establish the recommendations, the proposed staged implementation program and the anticipated benefits including details of the benefit/cost analysis

This project is unique due to the long linear nature of the study area (300 kilometres) and the variety of adjacent land uses and traffic conditions. Some of the challenges and more unique aspects of the project that will be described in the paper include:

- Dynamic message signs and how they can be best applied in a long linear corridor;
- Collecting and disseminating traveller information in a rural environment;
- Institutional issues and how they have been identified and addressed; and
- Deployment of ITS technologies to both rural and urban applications in an integrated fashion and in a manner that is both consistent and useful.

INTRODUCTION

In response to continuous demand for safe and efficient flow of goods and people, Alberta Transportation has developed a high level vision (ITS Strategic Plan) for implementing Intelligent Transportation Systems (ITS). Highway 2 between Edmonton and Calgary has been identified in the Strategic Plan as a priority corridor to serve as a testbed for ITS initiatives.

In response to the Strategic Plan, Alberta Transportation has initiated a project to study the needs and develop plans for advanced transportation technologies along the Highway 2 corridor between Edmonton and Calgary. The intent of this project is to translate the departmental ITS vision into a "blueprint" for ITS deployment in the Highway 2 corridor. These technologies are potential tools to help monitor and manage traffic flow, detect and clear incidents and provide travellers with real-time information on traffic congestion and road conditions. The blueprint is to include functional plans for the ITS components that identify equipment location, functional requirements and specifications and operations plans outlining the agencies involved and the role and responsibilities of each.

The objectives of Alberta Transportation in conducting this project are to enhance safety and operations in the corridor, ensure opportunities exist to integrate identified solutions with adjacent municipal ITS plans and deploy ITS solutions in a cost-effective well-planned manner.

The portion of Highway 2 that is included within this project includes:

- Highway 2 (rural divided freeway) between Edmonton and Calgary, approximately 260 km;
- Deerfoot Trail in the City of Calgary from the north city limits to the connection to Highway 2 (including the new section) in the south end, approximately 50 km; and
- Anthony Henday Drive in the City of Edmonton from Highway 16 interchange (north end) to Gateway Boulevard (south end), including short sections of Gateway Boulevard and Yellowhead Trail to the city limits, approximately 25 km.

For the road weather information system component, the study area includes Alberta's National Highway System which consists of Highways 1, 2, 3, 4, 9, 16, 35, 43 and 49 (excluding highways within the National Parks); approximately 3,400 km of roadway. It should be noted that the study area for this portion of the project includes Highway 2 only between Edmonton (junction with Highway 16) in the north and its junction with Highway 3 in the south.

Exhibits 1 and 2 illustrate the study area for this project.

NEEDS ASSESSMENT

Stakeholder Consultation

The stakeholder consultation program was the first major activity of the project and one of the most important since the information gathered formed a baseline reference for subsequent activities. Constructive involvement from all key stakeholders was considered to be vital to the development of an effective plan and implementation program for the project. Obtaining meaningful input from stakeholders does however have its challenges. Many stakeholders have divergent views and opinions on the needs and priorities of the study area. Others have little to no awareness of ITS and may not be well equipped to directly provide input. The consultation program provided an opportunity to educate those individuals and agencies with a low

awareness of ITS and help them understand what ITS can do for them. It also brings these people together and provides a forum for discussion where divergent views can be discussed and common interests identified with the intent of developing a blueprint for ITS that is coordinated and integrated across multiple jurisdictions.

The stakeholder consultation program developed for the project was based on a three-phase approach as follows:

- Identification of stakeholders agencies and initial contact;
- Two workshops as the study progresses to present study findings and recommendations and allow stakeholders to provide input; and
- Project website to provide broad access to information about the project and allow stakeholders to provide input.

The initial phase of the stakeholder consultation program was completed in the Needs Assessment phase of the project. Initial contact with stakeholders was through a series of one-to-one interviews with a designated contact person from each identified stakeholder agency. These one-to-one interviews provided a forum for the stakeholders to present the mandate and objectives of their respective agencies, discuss their current problems and needs as they may relate to ITS, and identify some of their aspirations with respect to future applications of ITS technologies onto their fields.

The two workshops were conducted in subsequent phases of the project; one near the completion of the ITS Blueprint to review the stakeholder needs and how they are addressed within the proposed ITS program for Highway 2 and one near the completion of the project to review the findings of the overall project and the details of the ITS Blueprint including functional plans for the ITS components and operations plans outlining the agencies involved and the role and responsibilities of each.

A project Internet web page was developed to provide broad access to information about the project and allow stakeholders to provide input. It is currently hosted by Alberta Transportation under the following address:
http://www.trans.gov.ab.ca/Content/doctype255/production/itsint01.htm

Data Analysis

Traffic and safety related data relative to Highway 2 between Edmonton and Calgary were reviewed at an overview level to provide background data into the types of problems and their extent and provide input into the types of ITS applications that would be most relevant for implementation in this section of the study area. From a review of these data and related analysis, the needs of the Highway 2 corridor between Edmonton and Calgary can be summarized as follows:

- High traffic volumes and related congestion (Level of Service C to D) are currently prevalent during peak periods in the Deerfoot Trail section of the corridor. Over the longer term, with continued growth forecast and no new alternate routes planned for implementation within this time frame, the level of service provided on this facility will continue to degrade.
- The suburban sections of the corridor (e.g. Airdrie to Calgary, Leduc to Edmonton, Anthony Henday Drive) currently experience limited congestion in peak hours. This congestion is likely to increase over the longer term as volumes continue to increase.

Incidents or any unplanned lane closure would have a significant impact on the level of service in these sections of the corridor, particularly during peak hours.

- The majority of the Highway 2 corridor is rural in nature and carries relatively light traffic volumes with AADT traffic volumes ranging from 15,000 to 30,000 vehicles per day. Congestion is not prevalent with levels of service of A to B provided during peak traffic flow.
- Commercial vehicles make up a significant portion of the vehicle stream and their needs should be taken into account in any initiative proposed for the corridor.
- Highway 2 cannot be considered as a safety deficient corridor due to its relatively low collision rate. The frequency of collisions in the corridor is however considered to be significant with over 800 collisions occurring in the rural section between Edmonton and Calgary in year 2000. Weather-related collisions and animal hits are two primary factors that contribute to over 50% of the collisions that occur within this rural section of the corridor. In the Deerfoot Trail, over 560 collisions occurred in year 2000 with approximately 70% of these collisions being rear-end and side-swipe collisions reflecting the congested conditions of this segment of the corridor.
- Agencies responsible for road maintenance and incident response identified bridge decks (especially over river courses) and grades (e.g. coulees, Antler Hill, etc.) as primary locations of collisions during the winter months. Collisions often result at these locations from degradation of driving conditions relative to adjacent sections of the network.
- Closures of Highway 2 are a frequent occurrence (4 to 6 times a year). This indicates a need for a mechanism that allows the highway to be closed safely, efficiently and in a location that provides travellers the option of turning around or seeking food and/or accommodation nearby.

Stakeholder Input

The decoding of stakeholders' interviews (a total of 50 interviews with over 45 agencies) revealed that there are some common themes in the various issues and needs, which can be used to identify relevant functional areas of ITS applications. These common themes have been used to cluster needs into the following general functional areas:

- Road Condition & Traffic Information
- Incident Management
- Road and Weather Information Systems
- Traffic Control and Management
- Work Zone Safety
- Commercial Vehicle Operations
- Inter-Agency Coordination
- Data Collection / Management

Most stakeholders identified both their needs from a user perspective as well as provided suggestions with respect to equipment or system related requirements that they perceive would help to satisfy their need. For each of the eight categories listed above, the stakeholder needs are presented in terms of users needs and system/equipment related requirements. ***Table 1*** summarizes the user needs and system requirements that were identified by the stakeholders related to each.

Table 1 – Summary of Stakeholders Needs

Functional Area	User Needs	System Requirements
Road Condition & Traffic Information	More accurate & real-time information on road conditions, weather & incidents	• Use existing DMS more regularly • Install more permanent DMS in the Highway 2 corridor • Use of Highway Advisory Radio (HAR), roadside kiosks, pagers, telephone service, Internet, etc.;
	Wider dissemination and easier access to traveller information	
	Improve sharing of traveller information data between agencies	• Use of Highway Advisory Radio (HAR), roadside kiosks, pagers, telephone service, Internet, etc.;
Incident Management	Timely detection & accurate information on incident location	• Dissemination of incident site video images to emergency services dispatch • Numbering of exit ramps • Use of mileage markers • Fog detection systems • Wildlife detection systems • Truck rollover monitoring systems on ramps
	Coordination, control & monitoring of lane closures	• Design of alternate routes and development of implementation procedures • Coordination with maintenance contractors to provide assistance • Use of permanent and portable DMS • Lane control and queue management during lane closures
	Ability to close the highway at a location that is safe and convenient	• Install more permanent DMS
	Protection of incident site & safety of personnel	• Training of emergency services staff • Coordination with maintenance contractors to provide assistance in lane closures • Use of permanent and portable DMS • Lane control and queue management during lane closures
	Knowledge of hazardous materials & atmospheric conditions at dangerous goods spill locations	• Real-time data on existing atmospheric conditions • Tracking of dangerous goods movements

Functional Area	User Needs	System Requirements
Road & Weather Information Systems	Knowledge of existing atmospheric & road conditions Ability to forecast atmospheric, visibility & pavement conditions	• Real-time data on existing conditions at strategic locations and the ability to access this data from a remote location; • Strategic locations for RWIS sites include both problem locations and trigger sites (i.e. sites that are representative of the surrounding road network
Traffic Control & Mgmt.	Improve safety Maximize capacity of existing infrastructure Minimize impacts of recurrent congestion Minimize number of stops & reduce travel time in major corridors	• Use of variable speed limits during congested periods in the Deerfoot Trail; • Use of ramp metering on the Deerfoot Trail to avoid congestion at high volume entrance ramps; • Use of traffic responsive control of traffic signals at ramp terminals to avoid queue back ups onto the Deerfoot Trail; • Coordination of traffic signals in the Anthony Henday corridor (Phase 1); • Integration of AT traffic signals into municipal signal systems (e.g. Calgary, Red Deer and Edmonton); • Central control and monitoring of AT traffic signals on potential alternate routes (e.g. Highway 2A); • Use of HOV and/or reversible lanes in the Deerfoot Trail
Work Zone Safety	Protection & safety of site personnel Improved traveller information	• Improved speed management and enforcement; • Use of portable DMS
Commercial Vehicle Operations	Minimize infrastructure damage due to over height and overweight loads	• Wider deployment of high load warning system and ability to identify offending vehicle; • More efficient method of monitoring and enforcing commercial vehicle weight, dimension and driver regulations (e.g. weigh in motion, electronic license plates, etc.);
	Minimize delays at commercial vehicle inspection stations	• More efficient method of monitoring and enforcing commercial vehicle weight, dimension and driver regulations (e.g. weigh in motion, electronic license plates, etc.);
	Compatibility & interoperability with other provinces and states	• Sharing of CVO safety and maintenance records with other provinces, states and agencies (e.g. Coordination and Information Centre);

Functional Area	User Needs	System Requirements
Inter-agency Coordination	Coordination, control & monitoring of lane closures	• Establish a protocol and warrant system for the use of the DMS and related messages and notify all agencies; • Use of common radio channels for emergency communications between agencies; • Coordination of response activities, route diversions, etc. in the event of incidents (e.g. incident control centre); • Improved sharing/exchange of information (e.g. lane closure, weather, incident, road condition, traffic data, CCTV images, etc.) between agencies (e.g. police, fire, ambulance, vehicle inspection stations, airports, municipalities, tourism, fleet managers, users, etc.);
	Improve sharing of traveller information data between agencies	• Improved sharing/exchange of information (e.g. lane closure, weather, incident, road condition, traffic data, CCTV images, etc.) between agencies (e.g. police, fire, ambulance, vehicle inspection stations, airports, municipalities, tourism, fleet managers, users, etc.);
Data Collection/Management	Improve sharing of traveller information data between agencies	• Utilize permanent count stations to collect real-time traffic data (e.g. volume, occupancy, etc.), monitor speeds and disseminate information through a web-based interface; • Improve incident reporting procedures with more accurate location data (using GPS receivers in emergency vehicles) and electronic transfer of MVA reports to a provincial incident database; • Link data to existing road asset database (TIMS) / GIS system; • Maintain a web-based provincial database for commercial vehicle monitoring and regulation enforcement (e.g. driver records, vehicle records, etc.); • Maintain a database of pavement conditions, atmospheric data, residual de-icing chemical, etc for management of maintenance contracts, liability/risk issues, correlation of collision data, etc.; • Automated process for monitoring maintenance contracts (e.g. use of GPS to track maintenance vehicles, maintain records of application of sand and salt, application rates, time of application, etc.);
	Maximize access to information and data	
	Minimize costs through development of partnerships	

In summary, a review of the ITS needs and the project stakeholders that identified them provides the following observations:

- The primary needs of the majority of ITS users for this project are focused in the areas of road conditions and traffic information, incident management and road weather information systems.
- Data collection / management and inter-agency coordination are key aspects that support the above primary needs. The sharing of information electronically and coordination between agencies is a particularly strong theme in the needs identified.
- Commercial vehicle operations, congestion management and work zone safety have special needs requirements, but appear to be less of a priority among the stakeholders.
- There is a clear need to provide timely and accurate information to the motorists about road and traffic conditions on Highway 2, including information about scheduled events (e.g., road closures due to maintenance) as well as about incidents and inclement weather. This need for information and the ability to have it easily accessible is a major focus of the majority of project stakeholders.
- There is a common opinion among the majority of stakeholders that the existing equipment and data can be better utilized to provide information to the traveller.
- Traffic management to address congestion and provide incident management is necessary in the urbanized sections of Highway 2 such as the Deerfoot Trail and to a lesser extent, Anthony Henday Drive. Coordination and/or integration with other local urban traffic signal control applications is also important.
- Road weather information systems and commercial vehicle operations applications should be seen from the broader perspective with a need for an inter-provincial and international network.
- There is an overall desire for integrated, efficient and effective ITS applications based on proven and compatible technologies.

ITS BLUEPRINT

In the development of the ITS Blueprint for Highway 2, the direction and pace of the plan and the framework for its development were established based on the following strategic considerations:

- Stakeholder needs identified through the consultation process and the related user services;
- ITS components that are associated with the relevant user services and in particular those components that overlap multiple applications or user services, thereby enabling a wide variety of ITS applications (i.e. enabling components); and
- Results of the data analyses and the relative priorities that can be determined from an analytical approach that demonstrate the size or extent of the problem and/or need.

These are considered to be the strategic considerations since they set the strategic direction of the ITS Blueprint for Highway 2.

Tactical considerations were also taken into account in the development of the details of the program, which directly impact the implementation and schedule of the ITS Blueprint. These include:

- Needs and Priorities: The needs and priorities of the various segments of the Highway 2 corridor are an important consideration in the development of the ITS Blueprint's implementation program. Addressing specific needs and priorities that are perceived to be a significant problem, the need to provide "early winner" projects that can be implemented with minimal effort and cost and the requirement to clearly demonstrate the benefits of ITS impose constraints on the selection of technologies, provision of facilities and preparation of the necessary institutional structures.
- Funding: Availability of capital is always an important consideration in the development of an implementation program. A careful balance is required between needs, priorities, technology elements and the related costs (both capital and operating) to find a realistic program that represents a worthwhile investment to the taxpayer of Alberta.
- Technology: Technology has a significant impact on both cost and technological risk. The implementation program must recognize the maturity of the available technologies as well as trends in technology development and allow a migration of technology over time using technologies that are mature without precluding the use of emerging technologies in the future as they mature.
- Legacy Systems: Compatibility with legacy systems and the need to be able to integrate these existing systems and field components. The legacy systems represent a significant investment and the implementation program must recognize this by maximizing the use of these systems as integral components of the ITS Blueprint.

The process used in the development of the ITS Blueprint for Highway 2 was to first use the strategic considerations to set the preferred strategic direction of the program. The tactical considerations were then used to set out the details of the plan and establish a realistic and achievable implementation plan that meets the needs and priorities in the Highway 2 corridor.

The development of the ITS Blueprint and the staging of the various projects was based on three time periods, namely immediate term (0 to 2 years), short term (3 to 5 years) and medium to long term (6 to 10 years). For the immediate term, many of the projects selected for implementation are those where the need is the greatest and the largest benefit can be attained.

Immediate Term (0 to 2 Years)

Within the immediate term the focus is on projects that can be implemented quickly, easily, at minimal cost and can address in an effective manner, the more urgent needs that have been identified. These are termed "early winners" and are a very important aspect of the ITS Blueprint as they demonstrate the benefits of ITS and will serve to gain future support and funding for the ongoing implementation of the plan. As a result the immediate term focuses on projects that maximize the use of existing infrastructure and utilize technologies that are mature, proven and available "off the shelf".

For the immediate term, the areas of focus are:

- Road Condition and Traffic Information;
- Road Weather Information; and
- Incident Management.

The needs analysis identified that more information with respect to road conditions, weather, incidents and congestion within the Highway 2 corridor should be available. The information should be timely, accurate and easily accessible to the traveller as well as a wide variety of interested parties. The approach for the immediate term is to focus on the collection and assembly of accurate and timely information through the development of a traveller information database. Then, the next immediate focus is to disseminate the information by making better use of existing infrastructure. Due to the long linear nature of the corridor, dissemination of the information focuses on the use of the Internet as the medium through which accurate and timely traveller information is provided to the media (e.g. commercial radio) media. Use of existing dynamic message signs (DMS) in the corridor is also enhanced through the traveller information database. Deployment of additional DMS is also recommended in the Red Deer area to improve dissemination of road and weather condition information, particularly in the event of a highway closure.

Road weather information (RWIS) is an area that was identified within the needs assessment by the various stakeholders and one that the Province of Alberta has been planning to implement for a number of years due to the increasing sensitivity to the use of de-icing chemicals and their impact on the roadside environment. The province currently has a plan to deploy approximately 70 RWIS sites throughout the province on a staged basis. In the immediate term the focus is on the installation of RWIS stations in high priority areas. RWIS deployment will also be an asset to the initiatives included within Road Condition and Traffic Information due to their ability to improve road maintenance staff's knowledge of existing atmospheric and surface conditions. Fixed Automated Spray Technology (FAST) is also included within the immediate timeframe of the RWIS program as a pilot test of the technology and to demonstrate its benefits. Recommended location is on the Calf Robe Bridge (Deerfoot Trail) to manage the frequent frost events that occur and reduce the frequency of weather-related collisions on this structure over the Bow River.

Incident management is an area of ITS where significant benefits can be realized, particularly in high volume corridors. Early detection and quick response to an incident is the key. In the immediate term the focus in incident management is to set the groundwork for a more ambitious program in the short term. This groundwork includes the set-up of a call-in centre for the Deerfoot Trail in Calgary providing motorists a free cellular number to call to report incidents, with the intent of being able to reduce detection and response time to minor incidents that do not normally get reported but can have a significant impact on carrying capacity of the facility, particularly during peak periods. Deployment of CCTV coverage at key locations in the corridor for verification purposes supplemented with vehicle detection stations to monitor traffic flow is also recommended. The vehicle detection station data will help operators identify problem areas and serve as a valuable source of information for the traveller information database. These initiatives in incident management will require close coordination and cooperation with the City of Calgary, particularly with respect to the operation of the call-in centre. In the rural section of the corridor, a pilot test of an animal detection and

motorist warning system is recommended in an effort to reduce the number of animal hits in the area.

The immediate term also includes minor initiatives in the areas of:

- Traffic Control and Management through improvements in traffic signal coordination and operation. Specific areas include City of Calgary streets adjacent to the Deerfoot Trail to reduce off-ramp queuing and proposed signalized intersections on Anthony Henday Drive;
- Work Zone Safety through the use of portable dynamic message signs in select construction zones to test their effectiveness and assess their impact on current operation; and
- Commercial Vehicle Operations in improvements in data collection on the number, frequency and time of occurrence of overheight loads.

Short Term (3 to 5 Years)

In this second stage of the ITS Blueprint, new initiatives in Incident Management and Road Condition and Traffic Information become the focus involving the deployment of new field equipment and systems to provide more automation and improve efficiency in the detection of incidents and collection and dissemination of traveller information. Expansion of initiatives in Road Weather Information, Traffic Control and Management and Work Zone Safety continues as well with a significant investment in the area of RWIS.

Incident Management is improved in the short term with several initiatives recommended throughout the Highway 2 corridor. In the Calgary area, the call-in centre initiative from the immediate term is expanded to include a more active role through the expansion of CCTV coverage and vehicle detection stations throughout the length of the Deerfoot Trail as well as implementation of automated incident detection algorithms to monitor traffic flow and provide alarms to operators in the event of unusual conditions. In the Edmonton and Red Deer areas the call-in centre concept is expanded to these areas of Highway 2 and Anthony Henday Drive. CCTV is recommended as part of the call-in centre concept at strategic locations where communications can be achieved cost-effectively. The experience gained in operating the call-in centre in the Calgary area in the immediate term will assist in locating the field equipment as well as in the set-up of operational policies and procedures for the Red Deer and Edmonton areas.

Road Condition and Traffic Information is a major focus of the short term with the provision of more automation in the entry and dissemination of traveller information. This includes:

- Expansion of the central database to allow direct input of traveller information by each of the agencies involved;
- Access to CCTV images and vehicle detection data from the Deerfoot Trail's Incident Management system;
- Automated recommendation of DMS message content;
- Implementation of a voice activated telephone call-in traveller information service; and
- Deployment of additional DMS in the Deerfoot Trail to complement existing signs and support the Incident Management system described above.

In the area of RWIS, the short term includes a continuation of the RWIS program across the province with additional stations, another FAST system in the Edmonton area and the use of GPS and other sensors on the snow plow fleet as a pilot test in automating surface condition detection and reporting. The short term also includes initiatives in Traffic Control and Management with implementation of a central control and monitoring systems for traffic signals on Highway 2A and in Work Zone Safety with the addition of portable DMS systems to detect traffic flow conditions and provide automated messages for motorist advisory.

Medium to Long Term (6 to 10 Years)

In the medium to long term the emphasis of the ITS Blueprint is the continued expansion of the program initiatives developed to date with emphasis in the testing and application of more advanced technologies and expansion of coverage in the areas of Incident Management, Traffic Control and Management and RWIS.

In Incident Management, additional research in automated incident detection in the Deerfoot Trail is recommended with the potential to test new technologies and incident detection algorithms to improve the detection rate and reduce false calls. Deployment of CCTV and automated incident detection is also recommended for Anthony Henday Drive in Edmonton as traffic volumes on this facility increase.

In the area of Traffic Control and Management, ramp metering in the Deerfoot Trail is recommended and potentially in the Anthony Henday Drive corridor, depending on traffic growth. Lane control and variable speed limits in the Deerfoot Trail are also identified as potential applications to improve the operational efficiency and safety of this high volume corridor, recognizing that they are technologies that will be expensive to implement and require legislative changes.

For Road Weather Information Systems, the emphasis is on the pilot test of software algorithms in maintenance decision support systems that help road maintenance staff to assess the impact of different de-icing chemicals and maintenance strategies. Additional FAST systems are also included in the long term for major river crossings in the rural portion of the Highway 2 corridor.

It is also recommended that the province investigate weigh-in-motion as the technology improves in performance and reliability and deploy this technology at a minimum of one location in the Highway 2 corridor. In the area of Road Condition and Traffic Information, the emphasis in the long term is in the area of public education and development of partnerships with value added resellers or information service providers to improve the dissemination of traveller information through a variety of personal and in-vehicle devices.

Inter-Agency Coordination

Inter-agency coordination is a common theme that was raised in the discussions with the majority of stakeholders. The stakeholders recognize the benefits of such a partnership approach and appear to be eager to put policies and procedures in place to bring a more coordinated approach to their daily operations. Inter-agency coordination is also a significant focus within many of the initiatives described above and is considered to be one of the founding principles of the ITS Blueprint.

The primary focus of inter-agency coordination is in the sharing of information and infrastructure in order to achieve each agency's goals as quickly and efficiently as possible. Examples of how this approach can benefit all agencies involved include:

- The sharing of road and traffic condition information not only to the road user and information service providers for dissemination, but also to such agencies as police, emergency services, municipalities, fleet managers/dispatchers, airports, etc. to help to improve the efficiency of their operations. Use of the Internet as a dissemination tool will be very valuable in getting this information to these various agencies in an effective manner.
- The sharing of information with other non-road transportation related government agencies (e.g. weather information, airline schedules, tourist related information, etc.). This can be accommodated through the use of the Internet traveller information site and the provision of "hot links" to other agencies' sites.
- The development of partnerships with other agencies for the sharing of data and joint use of infrastructure. Examples of this include the formation of a partnership between Alberta Transportation, Alberta Environment and Alberta Agriculture in the area of RWIS to share data, field equipment and communications infrastructure, use of RWIS station infrastructure to collect other data (e.g. volume, vehicle classification, speed, video images, etc.), location of DMS to provide motorist advisory of conditions on both provincial highways and municipal roads, etc.

The opportunities presented above present an overview of the importance of the data collected within the many systems that are contemplated within the Highway 2 corridor. Some will be directly under the control of Alberta Transportation while others will require close cooperation between agencies. The most important aspect of this data sharing is to recognize the potential, maintain close working relationships with the various agencies and to use open systems standards in the design of the various systems.

Traffic Management Centre

Typically, a traffic management centre (TMC) is considered to be one of the fundamental building blocks of an ITS strategic plan, serving as the focal point for regional traffic management initiatives and acting as the catalyst in developing strong inter-agency relationships. For the ITS Blueprint for Highway 2 there is a need for a TMC, however in this case the study area is a long linear corridor covering a length of 300 kilometres with a wide diversity of ITS applications and density of field equipment. The role of a TMC will therefore vary depending on the area of influence. From an overall perspective of the corridor, the role of a TMC would include:

- Control and monitoring of traffic control devices (e.g. traffic signals, ramp metering, lane control, speed advisory, etc.);
- Monitoring of traffic operations and identification of problem areas and incidents;
- Distribution of traffic and incident information for incident management (e.g. coordination of emergency response) and traveller information purposes;
- Implementation of traffic response plans to manage traffic in the event of an incident. Traffic response plans can vary widely depending on the needs and would include selection of DMS message sets, change of signal timing plans, etc.;

- Management of the systems and field equipment (administration, maintenance and operation); and
- Providing leadership in institutional aspects through such activities as system research and development, development of regional traffic management strategies and fostering inter-agency coordination and cooperation.

For the Highway 2 corridor, the recommendation is to implement a regional traffic management centre in each of Calgary, Edmonton and Red Deer. Staging of their implementation will be gradual with the City of Calgary's occurring in the short term, coincident with the implementation of incident management initiatives in the Deerfoot Trail. Regional centres in Edmonton and in Red Deer will follow with the implementation of incident management in each of these areas. The regional centres can be operated in partnership with each of the cities with the centre taking on the role of traffic management responsibilities on both provincial highways and the city road network. This provides the opportunity to maximize efficiency of staff and allows for better coordination of traffic management strategies on a regional basis. This approach is very similar to the way in which Alberta Transportation currently manages the implementation and operation of traffic signals on provincial highways, with the local municipality taking on these responsibilities for the province. In this case, the regional traffic management centre would act as the regional coordinator for traffic and incident management, monitoring and controlling field devices on both municipal and provincial facilities according to mutually agreed upon operating policies and procedures. This could include the placement of Alberta Transportation staff in the regional control centre or the ability for Alberta Transportation staff to monitor operation on provincial facilities, with the ability to override control, from a remote location.

COSTS

The costs associated with the ITS Blueprint are summarized in ***Tables 2 and 3***. They have been calculated on an order of magnitude basis using experience gained in other recent ITS related-projects implemented within Canada and the anticipated costs of several emerging technologies. It should be noted that costs for the medium to long term (6 to 10 years) of the ITS Blueprint have not been identified due to the uncertainty of the technology involved or the costs of the technology at that time.

The presentation of the costs utilizes an approach that groups the various ITS projects and components by time frame (immediate and short terms), geographic area (Deerfoot Trail rural section and Anthony Henday Drive) and by logical and clearly identifiable ITS "programs". The ITS programs and their primary elements selected for this analysis are as follows:

- Advanced Traffic Management and Traveller Information Systems (ATMS/ATIS)
  - Road Condition and Traffic Information;
  - Incident Management;
  - Traffic Control and Management; and
  - Work Zone Safety.
- Road Weather Information Systems (RWIS)
  - Road Weather Information.
- Fixed Automated Spray Technology (FAST)

- Road Weather Information.

- Commercial Vehicle Operations (CVO)
  - Commercial Vehicle Operations.

It should be noted that in some cases (e.g. traveller information and road weather information systems), certain ITS components could not be allocated to a particular geographic section. In these cases, the costs are provided under a "general" category.

Table 2 – Capital Cost Breakdown

Component	Capital Cost	
	Immediate Term (0 to 2 years)	Short Term (3 to 5 years)
ATMS/ATIS Initiatives	**$ 6,754,000**	**$ 6,886,000**
General	$ 580,000	$ 245,000
Deerfoot Trail	$ 4,215,000	$ 3,844,000
Rural Section	$ 1,574,000	$ 1,288,000
Anthony Henday Drive	$ 385,000	$ 1,509,000
Road Weather Information	**$ 2,310,000**	**$ 2,305,000**
General	$ 2,310,000	$ 2,305,000
Fixed Automated Spray	**$ 775,000**	**$ 485,000**
Deerfoot Trail	$ 660,000	
Anthony Henday Drive	$ 115,000	$ 485,000
Commercial Vehicle Operation	**$ 20,000**	
Rural Section	$ 20,000	
TOTAL CAPITAL COSTS	**$ 9,859,000**	**$ 9,676,000**

Table 3 – ITS Blueprint Annual Operating and Maintenance Costs

Year	Maintenance Costs	Operating Costs	Total
Immediate Term			
Year 1	-	-	-
Year 2	$ 340,300	$ 311,000	$ 651,300
Short Term			
Year 3	$ 680,600	$ 616,000	$ 1,296,600
Year 4	$ 909,800	$ 694,000	$ 1,603,800
Year 5	$ 1,135,000	$ 766,000	$ 1,901,000

Overall, the ITS Blueprint for the Highway 2 corridor represents a capital expenditure of approximately $ 20 million over 5 years. This expenditure is distributed as follows:

- 45% Deerfoot Trail;

- 15% Rural Section;
- 15% Anthony Henday Drive; and
- 25% Road Weather Information Systems.

With operating and maintenance costs included, the ITS program represents an annual expenditure of approximately $ 5 million annually. It should be noted that as the program builds, the recurring costs increase significantly as the capital expenditures and investment in ITS accumulate. This is a critical factor in the proposed program and one that must be recognized from the outset in order to ensure the necessary funds are allocated to properly operate and maintain the ITS program as proposed.

BENEFITS

The benefit / cost analysis was conducted to provide an indication of the potential value of the various ITS initiatives proposed in the ITS Blueprint for Highway 2. It is intended as a high level analysis and as such does not include a detailed analysis of each project considered but rather involves an analysis of the benefits and costs associated with various initiatives or groupings of projects by geographic section of the study area. It also includes only those projects that are recommended for the short and medium terms.

The quantifiable benefits used in the analysis include the following benefits that were quantified based on available data and experience in other jurisdictions. For purposes of this analysis, the benefits were assumed to remain constant over time, with no increase in traffic volume or number of collisions accounted for.

- Incident Management
  - Vehicle delays, fuel consumption and vehicle emissions
  - Collision reductions
- Road Weather Information Systems
  - Collision reductions
- Commercial Vehicle Operations
  - Savings in bridge repair costs

Translation of the benefits to a dollar figure requires assumptions that can sometimes be controversial and have a significant impact on the end result. The following lists the assumptions and rates used in the benefit/cost analysis.

- Time Period 15 years
- Discount Rate: 4 %
- Value of Time:
  - Passenger Vehicle: $ 13.25 / hour
  - Commercial: $ 24.25 / hour
- Average Vehicle Occupancy:
  - Passenger Vehicle: 1.8 persons / vehicle
  - Commercial: 1.0 persons / vehicle
- Value Assigned to Collisions:
  - PDO: $ 12,000 / PDO collision
  - Injury: $ 100,000 / Injury collision
  - Fatal: $ 1,340,000 / Fatal collision

- Fuel Consumption Rate: 2.1 litres / vehicle-hour of travel (based on congested traffic conditions)
- Fuel Cost: $ 0.70 / litre
- Pollution Emissions Rate: 0.5 kilograms / vehicle-hour of travel (Pollutants: Carbon Monoxide & Oxides of Nitrogen)

The benefit / cost ratios calculated for each of the ITS programs described above are summarized in ***Table 4*** for the immediate and short terms.

Table 4 – Benefit / Cost Ratios by ITS Program

Component	Benefit / Cost Ratio
ATMS/ATIS Initiatives (1)	
Deerfoot Trail	7:1
Rural Section	3:1
Anthony Henday Dr.	2:1
Road Weather Information	
Rural Section (2)	7:1
Fixed Automated Spray	
Deerfoot Trail	10:1
Anthony Henday Dr.	6:1

Notes:
1. General Costs identified in Table 2 have been allocated to the ATMS/ATIS initiatives in the Deerfoot Trail, Rural section and Anthony Henday Drive based on a 60%, 20% and 20% allocation respectively.
2. Benefit / Cost ratio is based on benefits and associated costs within the rural section of Highway 2 only.

A review of Table 4 indicates that the ITS projects proposed within the Deerfoot Trail portion of the study corridor have a very high benefit to cost ratio, largely due to the high traffic volumes using the corridor and the resultant vehicle delay benefits that result from any improvement in traffic operations. While this is a very strong indication of the benefits of ITS in high volume corridors, the reader is cautioned in the use of only benefit / cost ratios in the prioritization of projects and the need to consider other benefits of the related ITS projects in establishing the ITS priorities of the Highway 2 corridor.

CONCLUSIONS

The ITS Blueprint for the Highway 2 corridor between Edmonton and Calgary sets out the direction, pace and priorities of investments in the application of “smart” technology. It is a plan based on the transportation needs and priorities of the corridor, as identified

by the project stakeholders. It is also a plan that will significantly expand management capabilities both in terms of traffic management and road maintenance as well as provide methods of meaningfully communicating valuable traveller information to the road users.

The ITS Blueprint requires an estimated capital investment of $ 20 million dollars over the next 5 years. In return, it provides significant benefits in terms of a safer, more reliable and more efficient highway corridor. Given the significant role Highway 2 plays in the provincial highway network and as a key link in the CANAMEX North South Trade Corridor, the ITS Blueprint is considered to be a high priority and an essential ingredient in maintaining Alberta's long-term economic viability.

Exhibit 1 – Highway 2 Edmonton to Calgary Study Area

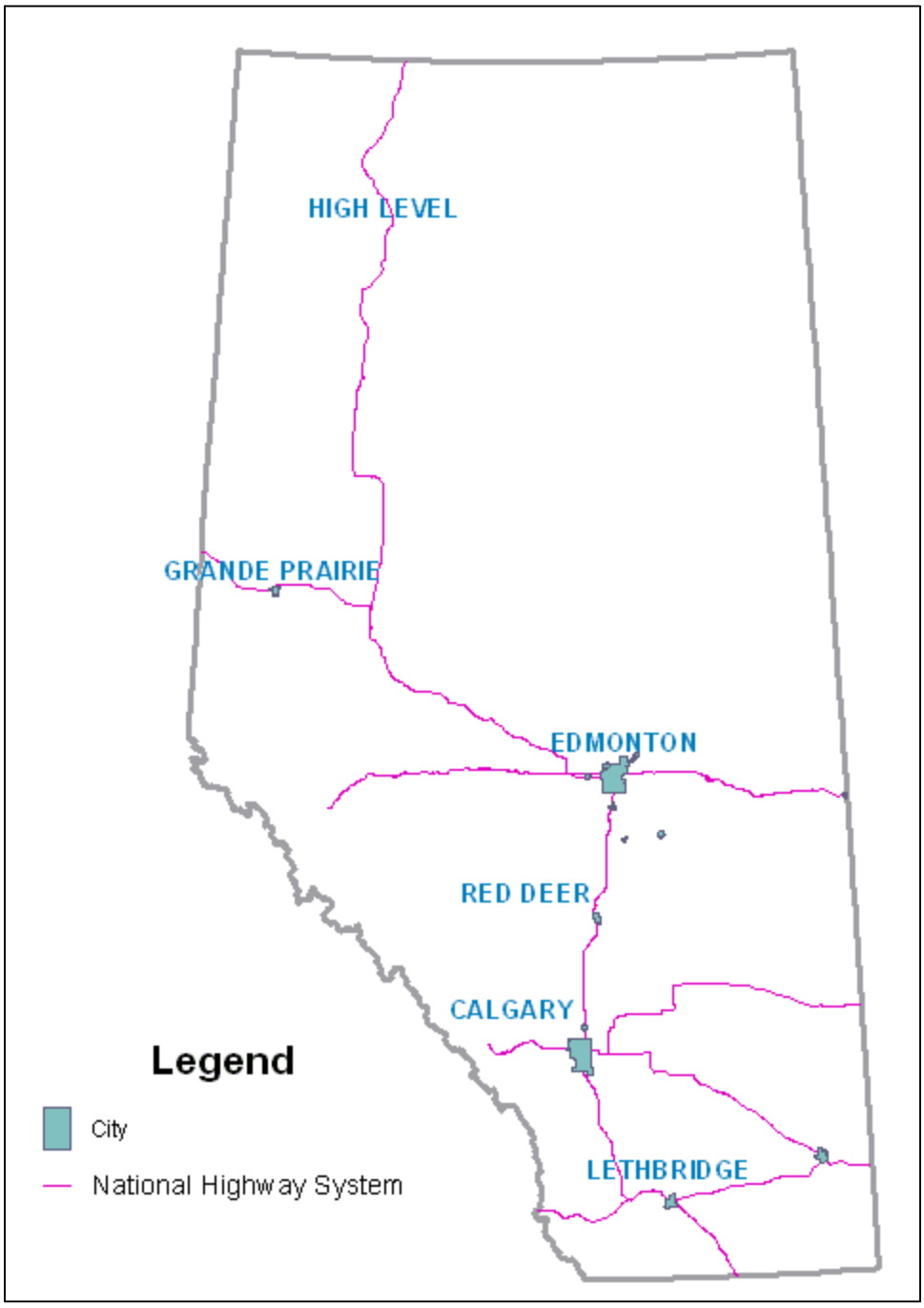

Exhibit 2 – Study Area for Road Weather Information System