AECOM

CANADIAN CONSULTING ENGINEERING AWARDS 2012

TRANSPORTATION

WEST REGINA BYPASS, REGINA, SASKATCHEWAN

SUBMITTED BY AECOM

CONTENTS

Project Highlights

West Regina Bypass
Regina, Saskatchewan

Category: Transportation

The Global Transportation Hub (GTH), funded by the Governments of Canada and Saskatchewan, is a major economic development initiative for the province. The developments around the GTH required a high speed, high capacity connection to the national highway system, which the Saskatchewan Ministry of Highways and Infrastructure (MHI), the City of Regina, and the RM of Sherwood commissioned AECOM to design. The new roadway connects Highway No. 1 and Highway No. 11 on the west side of Regina and became unofficially known as the West Regina Bypass (WRB).

The most important aspect of the project was the need to quickly establish a high quality connection to the national highway system from the GTH area. Staging of the work, both from a design and construction perspective was a key component. Critical decisions had to be made early in the planning process to allow work to proceed. The GTH development was the main generator of traffic, however not a lot of information was available on the expected speed that development would occur. Designs had to be flexible to allow future upgrading.

New application of existing techniques/ originality/ innovation

It was not possible to design and build the roadway, twin bridges over the CPR main line, an interchange and a bridge over Wascana Creek in the original time frame. Budget was also a concern. As a result, the project took a multi-stage approach with Stage 1 seeing the design and construction of an interim road to provide a high quality paved connection between the GTH and Highway No. 1. Stage 2 included design of the ultimate roadway between the GTH and Highway No. 1. Stage 3 is planned tentatively to happen in 5-10 years.

Traditional borrow pits were a concern because of the water attracting ducks and geese in close proximity to the airport runway. A solution was found in advancing the construction of the final section of the GTH drainage channel, which wasn't required for several years. The new channel allowed the design of two major dry bottom borrow pits on either side of the CPR main line to drain into the new drainage channel via culverts. Earth from the borrow pits and from the drainage channel were used to provide almost half of the 1.6 million cubic meters of earth fill required for the project. Contaminated soil from a former snow dump site was also used in the construction of embankments designed with drainage layers for quicker and more efficient pore water dissipation.

Design workshops were used to speed up the process to determine the best interchange layout to meet the present needs and flexible enough to accommodate those in the future. The first workshop identified five designs, with the advantages and disadvantages of each discussed in the second workshop. The final layout included a functional design for an interchange at Dewdney Avenue which is the primary arterial access from the GTH to the WRB.

West Regina Bypass
Regina, Saskatchewan

Category: Transportation

Complexity

Traffic volume forecasts and safety considerations were used to determine that the connection to Highway No. 1 should be designed as a 4-lane divided roadway, that the number of intersections should be limited, and an interchange was optimal to an intersection at Highway No. 1. Several alignments were considered, with existing conditions and constraints and environmental and heritage screening helping determine the final route.

Two separate, but related interchange designs were included in the project. A compact service interchange to meet the needs to complete the build out of the GTH and a second interchanges for when or if the South Bypass is constructed. The second interchange is unique in Saskatchewan and will allow for construction to occur with minimal impact on existing traffic.

Several major utility relocations were required including overhead transmission lines, underground petroleum pipelines, telephone lines, fibre optic cables, water mains and minor distribution lines servicing farmyards and local industry.

A significant public consultation program was implemented for the project, including the establishment of a Steering Committee and stakeholder group. The program included consultation with agencies and individuals directly impacted as well as public communications and engagement.

Environmental impact, social and economic benefits

A screening level environmental assessment was completed including an examination of the biophysical, cultural and socio-economic impacts of the new road on undisturbed agricultural land. The review identified potential problems and either devised mitigation measures or impacted the routing of the roadway. Wetlands that were directly impacted by the project required compensation, borrow pits were designed to minimize the potential for bird hazards for the airport, alignments were designed to avoid encroachments on First Nation lands, unmarked graves of children from a First Nations school impacted route selection, and a mass grave for hoof and mouth infected cattle also impacted alignments.

Meeting and exceeding client's needs

The WRB was an unplanned project with schedule and budget constraints. The phased approach allowed the project planning and design to be delivered on schedule. Public consultation resulted in public acceptance of the new roadway and environmental assessments helped ensure sensitivities were addressed and considered in the design. The project evolved during the project requiring a flexible and supportive approach. The project was recognized by the Consulting Engineers of Saskatchewan and was awarded the 2011 Brian Eckel Award of Excellence.

Project Description

Figure 1 : Air Photo

In December of 2007, the Government of Canada and the Province of Saskatchewan announced their intention to fund the Global Transportation Hub (GTH) as part of the Asia-Pacific Gateway and Corridor Initiative. The GTH has become one of Saskatchewan's most important economic development initiatives encompassing approximately 2,000 acres of serviced land to serve as a centre for transportation and logistics developments. Canadian Pacific Railway (CPR) is presently building a new state of the art intermodal facility capable of supporting 250,000 container lifts annually between trains and trucks. Canadian Logistics Services, servicing Loblaws stores, has a 1,000,000 square foot distribution centre. A second major development, the relocation of CPR yards from downtown Regina to the GTH to form a new intermodal facility, is also nearing completion.

These existing and future developments require a high speed, high capacity connection to the national highway system. The Saskatchewan Ministry of Highways and Infrastructure (MHI), in co-operation with the City of Regina and the Rural Municipality of Sherwood, initiated a plan to design and build a new roadway connection between Highway No. 1 and Highway No. 11 on the west side of Regina. The new roadway was to form a portion of the long term bypass around the City and provide access for future development, specifically the GTH.

MHI engaged AECOM to first provide a functional planning study to determine the best route for the new road and secondly to provide detailed design services. Planning for the new roadway started quickly after the initial project announcement with the new road informally called the West Regina Bypass (WRB).

The GTH was never envisioned prior to 2007, so there was little existing planning for the project. Work began with few preconceived ideas of the form and function of the WRB or the route the new road should take. The adjacent land was primarily agricultural with some localized pockets of industrial developments.

AECOM managed the project from inception. Starting with route planning in 2008, the detailed design is estimated for completion in October of 2011. Management of the project required the coordination of AECOM staff from several offices in western Canada, each providing their expert design skills. AECOM was assisted by several sub consultants. MDH Engineered Solutions provided all geotechnical services and Western Heritage Services provided support in the completion of the environmental review. Utility relocations were significant and involved private and public corporations with utility companies providing their own detailed designs based on AECOM's roadway plans.

The most important aspect of the project was the need to quickly establish a high quality connection to the national highway system from the GTH area. Staging of the work, both from a design and construction perspective was a key component. Critical decisions had to be made early in the planning process to allow work to proceed. The GTH development was the main generator of traffic, however not a lot of information was available on the expected speed that development would occur. Designs had to be flexible to allow future upgrading.

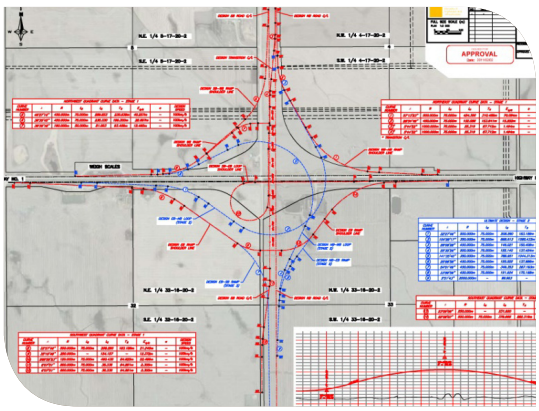
Important planning decisions included the choice of road to be built - freeway, free flow or industrial arterial. Decisions also had to be made on the options for construction as a 2-lane undivided initially and expanded later or to build divided from the beginning. Each major intersection was evaluated to determine if an interchange was warranted.

New application of existing techniques / originality / innovation

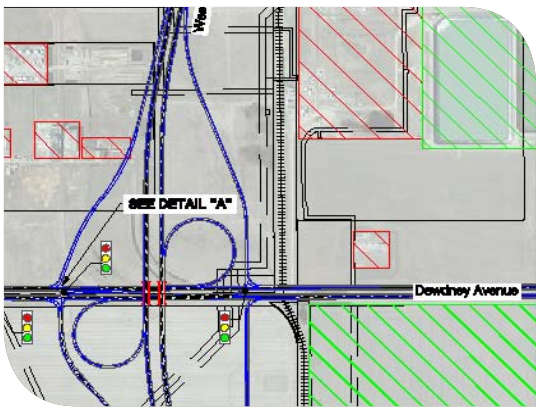
SOLUTIONS AND ACHIEVEMENTS

Construction staging was critical to meet the short time lines requirements for the project. It wasn't possible to design and build the ultimate roadway with twin bridges over the CPR main line, an interchange at Highway No. 1 and a bridge over Wascana Creek in the required time frame. Budget availability was also a concern. To account for the schedule and budget constraints, a multi-stage approach was taken. Stage 1 was the design and construction of an interim road in 2009-2010 to coincide with the opening of the Canadian Logistics Services warehouse, providing a high quality paved connection between the GTH with Highway No. 1 and included separate environmental review.

Stage 2 included the design of the ultimate roadway between the GTH and Highway No. 1. Work included moving 1.6 million cubic metres of earth, construction of about 8 kilometres of major and minor roadways, two 32 metre span overpasses at the CPR main line, a 45 and 50 metre span interchange bridge at Highway No. 1 and utility relocations costing $8MM. Total estimated cost of Stage 2 is $60MM. Stage 3 connects the GTH north to Highway No. 11 and includes an interchange at Highway No. 11. Design and construction of Stage 3 is tentatively planned in 5-10 years.



System Interchange



Dewdney Interchange

DETAILED DESIGN INNOVATIONS

BRIDGE DESIGN: Light weight fill material was used in the embankments approaching overpasses to limit settlement. This techninique allowed bridge construction to occur sooner than if traditional earth embankments where used.

EARTH BORROW SOURCES: The natural terrain is very flat and with the large amounts of earth fill required for the railway overpasses and the interchange, a balanced design between cuts and fills was not possible. The design called for approximately 1.6

million cubic metres of earth fill. Traditional deep type borrow pits were not possible due to the concern with water filling the borrow pits creating an attraction for ducks and geese. The proximity of the airport runway and the concern with bird/plane collisions precluded the use of traditional deep type borrow pits.

An agreement was reached with the City of Regina and the Global Transportation Hub Authority (GTHA) to advance the construction of the final section of GTH drainage channel. The drainage channel was not required for many years, but the agreement stated that the WRB project would fund the construction of the channel at no cost to the City or GTHA proving all the earth material could be utilized in the WRB embankments. This action also had another purpose. The presence of the new channel allowed the design of two major borrow pits on either side of the CPR main line. The borrow pits were very large and were designed to drain into the new drainage channel via culverts. The borrow pits are dry bottom pits with shallow side slopes that will allow local ranchers to utilize the borrow areas for cattle grazing. The drainage channel and the two borrow pits supplied almost half of the earth material required for the project.

The City was required to excavate approximately 100,000 cubic metres of contaminated soil from the site of a former snow dump site in the Harbour Landing subdivision . The contaminated soil had high salt content not suitable for residential zoning. The contaminated soil was used in the construction of large embankments at the CPR overpass. MDH Engineered Solutions prepared the containment plan to ensure the contaminated soil was encapsulated in a clay blanket.

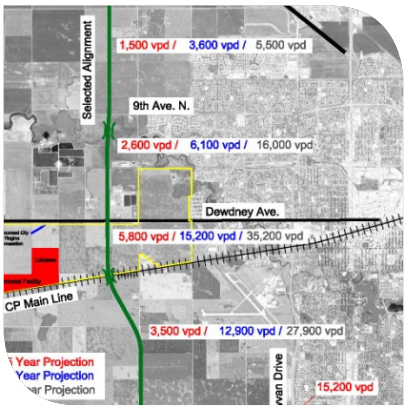
GRANULAR DRAINAGE LAYER: Rapid compaction of high embankments usually results in new pressures on the underlying soils and can bring about considerable delays as the contractor waits for pore water pressures to dissipate. Granular drainage layers were installed utilizing material that is common in granular sources in the Regina area. While drainage layers are not innovative, the simple layout of the drainage layer allows for quicker and more efficient pore water dissipation.

DESIGN WORKSHOPS: Several design workshops were conducted for the preliminary design of the interchange at Highway No.1. Representatives from Ministry departments and AECOM participated in two daylong sessions to determine the best interchange layout that meets the present needs and to determine how the interchange design can be flexible enough to accommodate future upgrading should the South Bypass be constructed. An AECOM design expert familiar with both system and service type interchanges facilitated the workshops. The first workshop resulted in five different designs that AECOM examined in more detail. The second workshop discussed advantages and disadvantages of the five options and lead to the selection of a preferred option. The preferred system interchange is illustrated in Figure 5. The workshops sped up the design process, reducing the Ministry's internal review time with the various design, construction and operation sections of the Ministry.

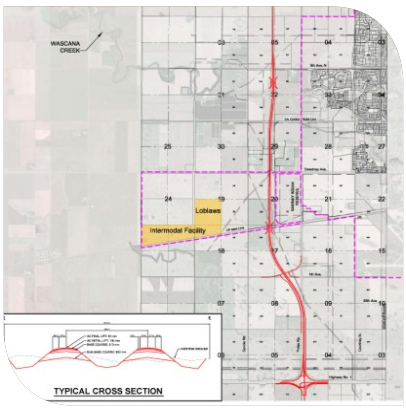
DEWDNEY AVENUE: Dewdney Avenue will be the primary arterial access to the GTH from the WRB. Traffic volumes on Dewdney Avenue will be very high and warrant immediate installation of traffic signals on the WRB and a 4-lane divided cross section in the future. It is critical that the WRB be a free flow facility so the long range plan must provide for an interchange at this location. The site has an adjacent railway line, First Nations property and numerous underground utilities. As well, the interchange layout should provide direct access for all trucks destined to or coming from the GTH.

A functional design was prepared to show how an interchange could be constructed at Dewdney Avenue impacting adjacent developments and meet the needs of the GTHA. Figure 6 illustrates the conceptual design for the Dewdney Avenue interchange.

Complexity



Forecast Traffic Volumes



Approved Alignment

PLANNING

The first step in designing the road was to determine the form and function of the road based on road user needs. Traffic volume forecasts were developed based on three factors.

1. The GTH will generate significant truck traffic destined to the national highway system and employ up to 14,000 people.
2. The new road will provide a connection between Highway No.1 and No. 11 for other non-GTH related interprovincial traffic.
3. Traffic from the City of Regina will use the new road for inter-city trips. Traffic volume would vary depending on how close the new road is to the city. A number of forecasting scenarios were considered based on the speed of GTH development.

Forecast traffic volumes determined the form of the road and when capacity increases would be necessary. The forecasts, in conjunction with safety considerations, determined that the new road connection to Highway No. 1 should immediately be constructed as a 4-lane divided roadway. Safety concerns with large trucks from the GTH turning on to Highway No. 1 reveal that an interchange should immediately be constructed at Highway No. 1.

Road user needs influenced the function of the WRB. Large trucks were a critical factor because of the economic impact of the GTH and the need to provide access to the national highway system. Large trucks need free flow at relatively high speeds, and the final design was for a free flow roadway that could be upgraded to a freeway if required in the future. The number of intersections was limited to reduce potential conflicts, oversized turning radii was provided for the potential use of turnpike triple trailers

and a 4-lane divided cross section was chosen to provide a safer method for vehicles to overtake and pass slower moving large trucks. An interchange was chosen over an intersection at Highway No. 1 for safety and capacity reasons.

Existing conditions were documented and a plan was prepared illustrating all constraints that could impact where the new road should be located. These constraints eventually became the deciding factor in the route selection. Environmental and heritage screening helped determine if the route should be adjusted to mitigate concerns.

A number of alignment options were considered as illustrated in Figure 2. Based on all the technical review and environmental, heritage and public input, a final alignment was selected and recommended to MHI. Figure 3 illustrates the approved alignment.

The route was approved in 2009 and detailed design started immediately on an interim road that would provide a temporary, high quality, paved connection between the GTH and Highway No. 1 until the ultimate roadway complete with grade separated structures at the CPR main line and at Highway No.1 were constructed.

The interim road was opened to traffic in 2010.

Access to adjacent parcels of land and to existing farmyards and businesses was an important consideration when setting the function of the road. Due to the importance of the road and maintaining free flow for the all vehicles, but particularly the large trucks, it was determined that private access not be permitted. Access to adjacent homes, businesses and to future developments will be via a system of services roads and a limited number of intersections that provides access to service roads. The location of all intersections were selected such that future interchanges can be constructed to upgrade the WRB into a freeway from a free flow type roadway.

TRAFFIC PROJECTIONS

The traffic operations analysis examined traffic impacts and determined infrastructure requirements for the WRB including cross section (i.e. 2-lane versus 4-lane roadway), intersection locations and configuration (i.e. auxiliary lane requirements), and level of control required at those intersections.

WRB traffic volume forecasts were composed of the following different types of traffic:

1. Background volumes (existing volumes on Pinkie Road that were projected to a 25-year forecast).
2. Trips transferred from other roads (i.e. Ring Road).
3. New trips generated by the GTH and adjacent industrial lands west of the City of Regina. This includes both truck trips destined to the highway network and internal trips by employees.

Figure 4 illustrates projected traffic volumes based on conservative growth of the GTH. Three scenarios were reviewed:

1. 5 year projection accounting for only known developments in the GTH (Canadian Logistic Services and CPR's intermodal facility),
2. The up to 25 year projection which assumes the GTH is half full,
3. The beyond 25 year scenario which assumes the GTH is full.

Truck traffic was estimated at 15 percent of all traffic, corresponding to 860 trucks per hour at full development. The trucks will be mostly B-Trains, but the design vehicle is the turnpike triple which is three full sized trailers. This type of tractor/trailer is not common nor is it permitted on most roads, but because of the possibility that this type may

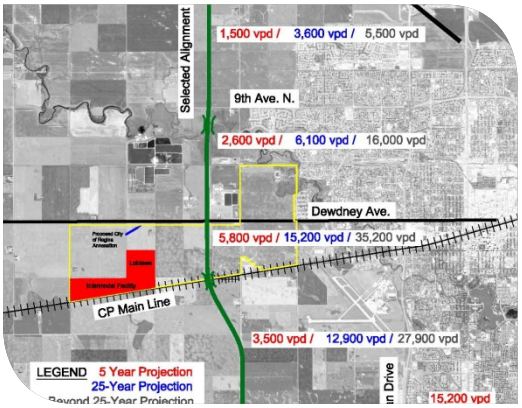


Figure 4 - Forecast Volumes

be used, it was used as the design vehicle. Traffic projections also took into account that a total of 13,695 employees are forecast for the total west side industrial area.

Level of Service calculations were used to help determine the need for interchanges at existing at-grade intersections. Traffic conditions considered were traffic volumes and speeds, motorist delay and potential of collision. A gap analysis at Highway No. 1 was required. Because of the very high cost to design and build an interchange, it usually is the last resort after all other measures have been taken to improve traffic conditions. In some cases when a new road is constructed to form a major intersection with an existing road, immediate construction of an interchange is considered when the Level of Service is predicted to be at Level of Service "D" within five years.

The need for an interchange at Highway No. 1 was not based on the overall operation of the intersection, but was based on one critical traffic movement. Based on projected volumes and the high percentage of large trucks making the southbound left turn onto Highway No. 1 it was determined that an interchange is required.

DETAILED DESIGN

Detailed design included two separate but inter-related interchange designs at the intersection of the WRB with Highway No. 1. A compact service type interchange was designed and tendered for construction in 2011. The service interchange will meet the Ministry's needs to complete build out of the GTH. The second interchange is presently being designed as a system to a functional level and would only be required when or if the South Bypass is constructed. The footprint of the system interchange will be much larger than the service interchange and can be constructed with little impact on existing traffic. The system interchange design is unique to Saskatchewan and involves two fully directional ramps with three levels of bridges. Directional ramps allows highway traffic to maintain relatively high speeds at all times.

UTILITY RELOCATION

There were a significant number of utilities that were impacted by the proposed Regina West Bypass including major power overhead transmission lines, underground petroleum pipelines, telephone lines, fibre optic cables, water mains and minor distribution lines servicing farmyards and local industry. Some of the major relocations are listed:

TRANSCANADA PIPELINES: Replacement and lowering of six large diameter pipelines (diameters vary between 864 mm to 1,219 mm). Estimated cost +$3MM.

TRANS GAS PIPELINES: Replacement and lowering of two large diameter pipelines (324 mm and 426 mm). Estimated cost $400,000. Also required the lowering of a decommissioned water main. Estimated cost $700,000

KINDER MORGAN + SPECTRA ENERGY PIPELINES: Three large diameter pipelines (two at 273 mm and 160 mm). Estimated cost $3.3MM.

SASKPOWER: Rerouting and burying overhead 72 kv and 25kv power lines. Estimated cost $2MM

The presence of deep underground caverns used to store gas was determined not to be a constraint. The above ground developments in the area were more of a constraint so the area was avoided.

PUBLIC CONSULTATION

A significant public consultation program was prepared and implemented. The program involved consultation with agencies and individuals directly impacted by the construction and as well as notifying the general public and requesting input.

A Steering Committee was established to guide the project. This Committee did not have any formal approval responsibilities; however they reviewed all deliverables before formal submission to MHI executive for approval. The Steering Committee was chaired by AECOM and included representatives from several departments of MHI, City of Regina and the Rural Municipality of Sherwood. The Committee meet at key milestones throughout the initial planning phases.

A stakeholder group was set up to participate in the initial planning process when the form and function of the road was determined and the various route options were considered. The stakeholder group was made up of different agencies, private business owners and larger property owners, each with their own perspective on what the road should look like and where it should be located. They were asked to discuss all major decision points and arrive at a consensus where they could recommend an approach that best represented a majority of the group.

During the initial planning process, open houses were held on June 25, 2008 and September 10, 2008. The public was first invited to review and comment on the study purpose, study schedule, various alternative alignment locations and provide comment. The public was later invited to review and comment on the preferred alignment including the proposed design, location, land requirements and access. On November 3, 2009 a third open house was held to solicit input and to present the 2009 environmental conditions field inventory results, the environmental assessment process potentially required for the project to proceed and detailed design.

A fourth open house was held on September 23, 2010 in order to present the public with a revised construction schedule and to provide a layout of the proposed interchange at Highway No. 1. Advertisements were placed in the Regina Leader Post inviting all residents to attend, with additional invites sent by mail to all property owners within 500 m of the new road. Copies of the display boards were made available on the MHI web page for those who could not attend the open house.

Numerous other meetings were held with property owners who would be directly impacted by the project.

OTHER CONCERNS

REGINA INTERNATIONAL AIRPORT: Meetings with the Airport Authority identified two primary concerns. The layout of the WRB should not in any manner impact the future expansion of airport runways and all water filled borrow pits must comply with Transport Canada's Airport Bird-hazard Risk Analysis Process and with a report prepared for the Regina Airport Authority by Gary Spearing entitled Airport Bird-hazard Risk Analysis Process for the Regina International Airport. These requirements eliminated several early route layouts.

FIRST NATIONS: Two First Nations own land in the area. Discussions were held with representatives of both groups. Sakimay had spent considerable effort on long range plans for their land. Due to the planning that had occurred and the delays associated with acquiring Crown land, Sakimay land was considered to be the highest level of constraint and was to be avoided. Cowessess land was located far enough away from all route options, so their land was not considered to be a constraint.

PUBLIC CONCERN: During public consultation, considerable objection was received from residents of the Westhill subdivision. Residents were concerned with noise and vibration generated by traffic on the WRB and the potential of hazardous material spills from a truck roll-over or collision. Unlike residential property owners, most existing business and property owners of potential commercial or industrial land wanted proximity and convenient access to the WRB. The function of the WRB eliminated any direct access from private land to the WRB, so an access system had to be designed. Access to businesses or to adjacent property was a key component of selecting the proposed route. The recommended route was chosen specifically to make it possible to provide the access requested by local property owners. Existing grid roads (Pinkie Road and Condie Road) were utilized as the main point of access to private property, with the WRB located between them and a limited number of stop controlled intersections providing access.

REGINA WASTE WATER TREATMENT PLANT: Regina's waste water treatment plant is located adjacent to the WRB corridor. After discussions with operators and a review of safety concerns, it was determined that the waste water treatment plant was not a constraint provided certain clearances were maintained between the WRB and the lagoons.

WASCANA CREEK: Located in a depressed flood plane, Wascana Creek is small and meandering, however flows are too high for culverts. A bridge was required. Technically, it was not considered to be a major constraint providing all the necessary environmental protection actions are undertaken.

CPR: CPR's main line presently intersects the WRB with a single line. CPR is actively involved in designing and building an intermodal facility with 3 additional tracks running parallel to the main line. The presence of the CPR line(s) had little impact on route selection as the crossing would be grade separated, however, there were numerous crossing agreements, design approvals and co-ordination meetings.

.

Environmental Impact

Transport Canada, as the federal environmental assessment coordinator, responsible authority and potential funding partner, under the Canadian Environmental Assessment Act (CEAA) requested that a screening level environmental assessment report be prepared for the WRB. AECOM prepared the document which examined the biophysical, cultural and socio-economic impacts of constructing a new road across disturbed agricultural land. Full public consultation occurred throughout the process. The environmental review was extensive and sought to identify potential problems and either devise mitigation measures or, in extreme cases, re-route the road.

BIOPHYSICAL CONCERNS: Species at risk (vegetation and wildlife), ground water and surface water, migratory birds and fish habitat, air quality and wetlands. It was determined that wetland compensation would be required for those wetlands that were directly impacted by the project.

Social and economic benefits

The environmental review included socio-economic and cultural reviews including:

SOCIO-ECONOMIC CONCERNS: land use, human health and safety, aboriginal concerns, noise, and the economics of the development on the community. A major issue to arise was the concerns with bird/plane collisions due to possible water filled borrow pits adjacent to the runway. To provide for the safety of airplanes, borrow sources were selected outside of the primary bird hazard zone and mitigation measures include draining borrow pits and designing them to preclude bird use. A second issue was the presence of First Nations land that may be impacted by the road corridor. This was resolved by designing the road alignment to avoid all encroachments on First Nation land.

Mitigation measures were listed and a monitoring program prepared to ensure that any necessary mitigation measures are properly implemented. They are included in the Environmental Assessment Screening Report for the West Regina Bypass. AECOM was responsible for making application to regulatory agencies to enter into negotiation for wetland compensation and applying for environmental permits such as the Aquatic Habitat Protection Permit. AECOM will be responsible for the environmental monitoring program during construction.

CULTURAL CONCERNS: Western Heritage Services prepared a Heritage Resources Impact Assessment (HRIA) for the entire WRB route. The findings of the HRIA did not list any constraints, however, there were concerns associated with future construction near Wascana Creek that may require further review when Stage 3 design starts.

Prior to selecting the present alignment, it was confirmed that several unmarked grave sites belonging to children of a headmaster at a First Nations school that operated many years ago were in close proximity to one of the considered routes. The exact location within Section NW-28-17-20-W2 is unknown, but that section of land was considered to be a significant constraint and was avoided. Another constraint was the report of a mass grave for cattle infected with hoof and mouth in the 1950s. An unspecified number of cattle were shot and buried in the area. Since the site was outside of the optional alignment routes no specific effort was made to avoid the general area.

Meeting and exceeding the client's needs

The project was delivered to the client on schedule and within budget. Obtaining public acceptance of an unplanned new road that severed properties, limited access and created environmental concerns was a significant challenge and a measure of the success of the design process. The project team was effective at anticipating client needs and receiving approvals to solve those needs, for a project that evolved over time and created changing needs for the new roadway system. AECOM's project team approach was flexible and supportive of change.

The Consulting Engineers of Saskatchewan awarded this project the **Brian Eckel Award of Excellence in 2011**.