



2019 CANADIAN CONSULTING ENGINEERING AWARDS

**OWNER'S ENGINEERING SERVICES FOR THE  
DESIGN BUILD OF INTERSECTION UPGRADES  
AT PTH 59/101 AND PTH 59/PR 202**

Submission Category: Project Management

# 1 PROJECT BACKGROUND

The role of Owner's Engineer was awarded to WSP Canada Group Limited (WSP) by Manitoba Infrastructure (MI) in May 2014. The project was divided into two phases; Phase 1 - Functional Design and Development of the Procurement Documents for a Design Build Contract, and Phase 2 - Engineering Construction Oversight. Phase 1 of the project allowed MI to select the appropriate contractor for this Design Build (DB) project. At the end of Phase 1, the Flatiron Constructors Canada Limited (FCCL) team was chosen as the preferred proponent. FCCL commenced construction in May of 2015.

# 2 TECHNOLOGY AND INNOVATION

The PTH 59/101 project utilized 15 different disciplines/departments within WSP and/or sub consultants:

- Alternative Delivery (Project Management Group);
- Transportation Planning;
- Bridge Design;
- Highway Design;
- Public Engagement;
- Document Management and Control;
- Geomatics;
- Utilities;
- Hydraulics/Drainage Design;
- Environmental Health and Safety;
- Environmental Management;
- Road Safety Audit;
- Geotechnical (Sub-consultant);
- Architecture (Sub-consultant); and
- Legal (Sub-consultant).

The team members involved during the course of the project numbered well over 80. Most disciplines were regularly represented by staff from WSP, MI, and FCCL.

The scope of application of the engineering disciplines was very broad. For instance, during the functional design, WSP was tasked with considering a total of five alternative designs for the interchange. WSP worked hand-in-hand with MI to distill the options down to one option which formed the basis for the functional design in the procurement documents put forward to the Design Build Contractors. Within the functional design, multiple alternatives were considered and discussed with MI prior to selecting the recommended plan.



*Aesthetic Treatment on Structural Barriers*

MI requested that an aesthetic theme be developed for the structures. Options were developed by the architectural team members and a prairie theme was selected. This required the design team and constructors to aesthetically treat the piers, barriers, and abutments of the bridges with scenes of prairie wheat fields formed into the face of the concrete to provide an interesting feature to the travelling public as they pass through the interchange.

The project provided several opportunities for **innovation** in the design and during the course of construction of the interchange. For example, the Contractor utilized wick drains to obtain the necessary settlements within the embankments prior to the construction of the roadway. This was critical in that the project schedule did not allow for the conventional technique of building and preloading embankments for at least a year. The extensive use of wick drains significantly reduced the construction schedule. Wick drains are not widely utilized within Manitoba, so MI needed to ensure that this innovation would meet the required schedule outcome. Other examples of



*Wick Drain Installation*

innovations are the creation of haul roads for embankment fill to alleviate congestion on PTH101 and PTH59 during construction, the use of specific machinery to expedite the construction schedule such as rock trucks and bobcat attachments for the installation of silt fencing, and the use of shear keys in sensitive geotechnical areas, to name a few.

This project **advanced the state of the engineer's art and skills**. It offered our staff the opportunity to work on not only the largest interchange that MI has ever undertaken, but also the first active transportation/emergency vehicle

“throughpass” built in Manitoba. Challenges in the project included not only geometric design, but also addressing current drainage areas in the study area and establishing a traffic plan which had to change on a regular basis to meet the needs of the contractor as well as the travelling public. The timelines were challenging but WSP, MI and FCCL staff worked together to bring the project in on time and on budget.

Another critical component included keeping the public informed and addressing concerns over the proposed closure of seven connections to the provincial highway system. This was identified as a critical element in the plan to improve operations and safety. WSP staff took the lead in identifying property needs for the project, and then WSP and provincial staff met with impacted property owners to discuss the process for obtaining the property required for the project.

### **3 SOCIAL/ ECONOMIC/ ENVIRONMENTAL IMPACT**

The PTH 59/101 project team took the social, economic, and environmental impacts very seriously. WSP/MI created the Functional Design which set the baseline for how the design would be developed. To mitigate social impacts, MI and WSP:

- Undertook two rounds of public and key stakeholder engagements on the study components and design elements/impacts. Public Open Houses were organized for interested residents to receive information on the

proposed project, which also gave them an opportunity to raise any concerns. This feedback allowed WSP to mitigate any potential social concerns;

- Held multiple municipal engagement sessions with elected officials and staff at the RM of East St. Paul to keep them apprised on the project design and schedule, as well as potential impacts that could result in queries to the RM;
- Held discussions with the City of Winnipeg elected official on the south side of the project area, as well as City staff, to coordinate design elements and reviews of work that was proposed at the south end of the project within the City of Winnipeg;
- Consulted with Brokenhead Ojibway Nation (BON) First Nation Council, band members, and staff;
- Developed a design that reduced the need to acquire a significant number of properties for an interchange of this size;
- Engineered the preliminary design to effectively accommodate the future traffic forecasts within the project limits;
- Created an Active Transportation connection to allow pedestrians and cyclists to safely cross PTH 101 at Raleigh Street. This link now helps to establish a regional trail extending from well within the City of Winnipeg, through the RM of East St. Paul and beyond to Birds Hill Park;
- Created an emergency service vehicular right-of-way adjacent to the AT path for quicker response times to a segregated section of the municipality; and
- Designed a new emergency crossing for the East St. Paul Emergency Responders near the former Wenzel crossing.



*Open House*



*Westbound-Northbound/Southbound Ramp from PTH101 to PTH59*

Historically, the PTH 59/101 intersection has been the most highly travelled intersection in the Province of Manitoba. Traffic lights on the Perimeter Highway exacerbated the high traffic volumes, particularly on summer weekends as cottagers made their way north to cottage country on Lake Winnipeg. Two traffic signal intersections were removed which improved the safety for the travelling public by allowing vehicles to travel the route without stopping. These signals had other safety concerns including tight turns for long haul vehicles. In addition, drainage for the low-lying land, which historically flooded every spring, has been alleviated.

A stipulation set out in the DB contract was to have all directions of traffic open to users at all times. The Contractor constructed numerous detours throughout the life of the project, thereby alleviating any negative economic or social impacts on the travelling public. In terms of economic impact, the removal of the signals at the PTH 59/101 intersections alleviated the need to stop at the intersection and allowed traffic to travel smoothly through, which results in savings of both time and fuel as well as a reduction in greenhouse gas emissions.

In terms of environmental impact, WSP completed an Environmental Site Assessment (ESA) during the functional design stages on properties that were to be acquired for the project foot print. One residential property had the yard raised using fill from an unknown source: a Phase II ESA drill program was implemented and determined that the soil on the property was contaminated with lead that exceeded the guidelines for a residential property. An additional investigation was conducted to further delineate lead impacts and a remediation plan was created. MI was able to remediate the site and return it to a safe parcel of property as a residential lot.

Historically, seed mix for highway rights-of-way used grass species that are now considered to be less desirable as they can become invasive (i.e., Smooth brome, *Bromus inermis*). For the revegetation of the project area, the use of native prairie plants to establish vegetation on slopes of embankments allows for a reduction in maintenance and increased biodiversity of the project area, and benefits native species that utilize the area.

The impacts on the surrounding areas and Manitoba's transportation infrastructure has been significant. This interchange construction has provided a notable benefit to society by improving traffic flow, alleviating traffic signals in high traffic areas, and removing potentially dangerous road conditions.

## 4 COMPLEXITY

This project was divided into two phases; Phase 1 - Functional Design and Development of the Procurement Documents for a Design Build Contract, and Phase 2 - Engineering Construction Oversight. Each phase came with a unique set of responsibilities and complexities.

### 4.1 PHASE 1 - FUNCTIONAL DESIGN

WSP provided engineering services for the functional design of a full interchange at the junction of PTH 59N and PTH 101 as well as other related works. This included the following engineering components:

- A “system” interchange at PTH 59N and PTH 101 (i.e., there will be no traffic signal controlled intersections);
- Realignment of PTH 101 near the interchange;
- An active transportation grade separation along the Raleigh/Gateway corridor across PTH 101;
- An upgraded intersection at PTH 59N and PR 202 with signalization and channelization;
- Preparation of conceptual plans for a future diamond interchange at PTH 59N and PR 202;

- Potential realignment of Wenzel Road with a new east-west component tying into PTH 59N at the intersection with PR 202;
- Provision for future six lanes on PTH 101 and for six lanes on PTH 59N;
- Paving of certain service roads leading to the PTH 59N and PR 202 intersection;
- Closure of seven service road connections to PTH 101 and PTH 59N; and
- Closure of Knowles Avenue at Lagimodiere Boulevard, with construction of an easterly extension of Headmaster Row connecting to a new north-south road providing access to Knowles Avenue.



*Sunset at the Start of a Deck Pour*

As Owner’s Engineer, WSP’s role at this stage was to develop a functional design report and assist with the development of specifications and tender documents to procure a Design Build Contractor (DB Contractor).

## **4.2 PHASE 2 - CONSTRUCTION OVERSIGHT**

Once the contract was awarded, WSP was engaged to provide construction oversight as follows:

- Provided resident services as a third level of quality oversight to ensure the DB Contractor conformed to project specifications; and
- Primary point of contact between the DB Contractor and MI.



*Bridge Demolition*

WSP managed the review of several thousand submittals from the DB Contractor.

Overseeing the design and construction of the largest interchange the Province has ever constructed without interrupting the highest volume of traffic on a seasonal basis is, by definition, a complex assignment. WSP, along with MI, created an 850-page specification document with the Technical Requirements for the project. The project specifications dealt only with the known conditions at the time of tendering of the work. Unknown conditions led to contract change orders which added complexity to the work both for the owner and the Contractor.

The number of project team members numbered well over 80 personnel in 15 different disciplines. With the 15 disciplines involved, management of changes was complex. The pros and cons were weighed in all situations, and after all parties were consulted the final decision was made by MI.

WSP had to address many challenges throughout the development of the Functional Design and Procurement Documents. Key challenges included:

- The milestone date for commencement of construction was set for summer 2015. This meant that the functional design had to be completed at the same time as the Request for Pre Qualifications and be accepted by the Owner in October 2014, with selection of a preferred proponent by May 2015. This required weekly collaboration between MI and WSP technical teams;
- The Functional Design Study included five alternative interchange configurations that met current and future traffic capacities going through the interchange. This included updating traffic forecasts and analysis that required several months to complete;
- The interchange location was determined to minimize the amount of land that needed to be acquired outside of the MI right-of-way;
- WSP supported MI by determining what properties needed to be expropriated. WSP assisted with all property visitations; however, MI had sole responsibility for dealing with land acquisition;
- Geotechnical investigation and soil testing, and environmental assessment of privately owned properties could not occur until after property acquisition was completed; and
- Development of a public engagement program, in concert with MI, to provide information to the public about the design as well as obtain public feedback, especially for components such as the AT crossing of PTH 101. This required an extensive stakeholder management plan.



*Night Pour at Structure 4 over Raleigh Street*

During Phase 2 – Construction Oversight of the Project, WSP faced additional challenges as follows:

- Ensuring that the proper lines of communication were followed. The nature of design build projects means that once the design is complete, there are limits set on the time for review by the engineering team. If the time limit is exceeded, the Contractor can proceed with construction (albeit at their own risk) without the benefit of the review comments from the Owner. It is critical to document all responses by both the Contractor's team and MI's team. WSP managed an electronic document control system that handled over 31,000 documents over the course of the project;
- The Contractor worked six days a week and at times, 24 hours a day. Staffing the site with WSP personnel to ensure that quality was not compromised during the off hours was a challenge. Additional staff were assigned to the site to ensure that all the Contractor shifts were covered; and



*Girder Erection*

- When contaminated material was discovered on one of the expropriated properties, WSP conducted an environmental assessment and notified MI of the actions that needed to be taken. This included notifying adjacent neighbors of the issue and arranging for the Contractor to have the contaminated material safely removed from the expropriated property. MI and WSP had an extensive discussion with the neighbor to consider testing his yard.

In summary, the technical complexity of this project was considered a challenge by all the project team members.

## **5 MANAGEMENT AND MEETING OWNER'S NEEDS**

The project involved a large number of consultants and Owner stakeholders, and as such, effective project management was critical. Weekly meetings were held with MI and the Contractor. Meetings were held on an as



required basis with residents, businesses, and utilities affected by the project such that they were kept informed regarding the project details and schedule.

During the Functional Design phase, WSP developed an aggressive schedule to meet the Owner's target of having "shovels in the ground" before August of 2015. The Functional Design and procurement of a DB Contractor was completed in 52 weeks and construction commenced in May of 2015. This phase of the project was completed on time and within budget.

WSP achieved many milestones during the Functional Design and Procurement Process. A few examples are as follows:

- Undertook a significant re-write of the project documents used for a previous Design Build project (CentrePort Canada Way) to incorporate lessons learned and updated project specifications;
- Collaborated with MI to ensure all required property was acquired prior to selection of a preferred proponent;
- Prepared a Design Build document, qualified three proponents, and worked with those proponents to ensure their bids were compliant; and
- Finished the Functional Design and assisted with the procurement of a DB Contractor in one year.



*Bridge Reinforcement Inspection on  
Structure 1 over PTH59*

All of this was done within the time frame set by MI.

During the Construction Oversight phase, WSP's role onsite was to document day-to-day activities, to ensure the DB Contractor was constructing the work in accordance with the Design Build Agreement and their submitted designs. Daily, weekly, and monthly reports were created to document and track all the work and issues. A Non-Conformance Report (NCR) program was set up to track non-conforming work. This enabled the Contractor to acknowledge a deficiency, document it, rectify the concern, and submit for WSP/MI reviews. WSP and MI worked closely with the Contractor to resolve unforeseen circumstances in the field.

Since the project was a Design Build, risk allocation was done on the following basis:

- 1 The Contractor had responsibility for risks which they had control over; and
- 2 MI managed risks which they had control over.

The DB Contractor was able to meet the Traffic Availability date of October 31, 2018, which was the primary target completion date. From the Owner's perspective, this project was an unqualified success.

## 5.1 COST MANAGEMENT

The Project Manager was charged with the cost management for all phases of the project – functional design, development and implementation of the procurement process, and monitoring of the construction oversight through to project completion. Discipline leads were responsible to ensure that those staff working on the project were doing so in a cost-effective manner. Individual team members were accountable for the level of effort for the scope of work assigned to them.

For the Functional Design and Procurement Project Scope of Work, the budget was developed through the proposal and sub-consultant agreement process. Fixed price contracts were established with each sub-consultant. All sub-consultants performed their assigned scope of work within the budgets that they had proposed.

For the Construction Oversight Scope of Work, the budget was developed on a time and material basis with an estimated budget to completion. Since this phase of the work was on a time and material basis, actual expenditures were reported to the Owner on a monthly basis.

In summary, MI considers the overall project to have been completed on time and under budget, and that this is one of the most significant positive outcomes for this project.

## 5.2 QUALITY MANAGEMENT

WSP developed the Functional Design Quality Management Plan (FDQMP) to document and ensure the quality requirements of the Owner's Engineering Services for the Design Build of Intersection Upgrades at PTH 59N/101 and PTH 59N/PR 202 were met in accordance with the contractual requirements of the Service Agreement with MI. This Quality Management Plan simply documented the quality processes that WSP already uses within the company and incorporated the client and outside reviewers within the process.

The FDQMP identified the processes and procedures that were used to control the project. This FDQMP applied to all WSP staff on this project and sub consultants during the entire Owner's Engineering Services for the Design Build of Intersection Upgrades at PTH 59N/101 and PTH 59N/PR 202.

During Functional Design, each deliverable had a preparer and a separate reviewer and approver. The reviewer and approver had the technical capability to review the preparer's design. These reviews were completed based on discipline specific checklists developed by the discipline. Deliverables had an internal discipline review prior to being submitted to the Owner.

Due to the collaboration between the Owner and the WSP team and strict adherence to the quality management plan, there was little to no rework and the Owner was satisfied with the project deliverable.

During Construction Oversight, the Contractor submitted their own quality plan to follow. WSP/MI reviewed the documents and ensured the Contractor abided by what they presented. The quality plan was based

on the testing requirements set forth in the DB contract and their own internal quality programs. WSP ensured that the Contractor abided by their quality plan by conducting qualitative testing of our own, site inspections and monitoring.



*PTH59/101 Interchange*

## 5.3 RISK MANAGEMENT

The challenge of managing risk is being able to identify and communicate the risk as soon as it arises, which minimizes the impact on the schedule and project cost.

The Risk Management Plan was created to identify, evaluate, and plan for the mitigation of identified risks that may affect delivery of the design product. A risk register was created and included in WSP's Project Management Plan. During the Functional Design, WSP developed the risk registry to further identify, analyze, prioritize, and monitor identified risk events. The Design Build Agreement (DBA) allocated risks between the Contractor and the Owner during the design and construction phases of the project.

*WSP's role in providing consultation for the functional design and procurement phase and their involvement during construction oversight was a critical success factor in achieving an end product that exceeded our expectations. The project is being completed under budget, on schedule and at a quality level that is considered exceptional.*

*- Don McRitchie, P. Eng., Team Leader, Capital Projects Branch, Manitoba Infrastructure*

In summary, MI has been receiving accolades on the design and performance of the PTH 59N/101 interchange from the public since it opened at the end of October 2018. This is a testament to the efforts of MI, WSP, and FCCL who are responsible for implementation of the project.