

# Transforming Travel in Edmonton

**A Study of the Delivery Models Used in the Phased Delivery of the  
Edmonton Ring Road Program**

**The Canadian Council for Public-Private Partnerships**

PREPARED BY GAUER CONSULTING LTD. AND DELOITTE, NOVEMBER 2022

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# Executive Summary

## Content

Canada has more than 80 P3 projects in asset classes related to trade and transportation, including a number of road and highway projects, since the public-private partnership (P3) model was introduced in this country more than three decades ago.

The Edmonton Ring Road Program, known as Anthony Henday Drive (Highway 216), presents a unique opportunity to do a comparative analysis on highway delivery in Canada since the program's four stages used two different methods — three stages were procured using P3 models with one component procured using a traditional model.

Construction on the 80-kilometre transportation and utility corridor around the capital city started in 1990 and finished in 2016, completing a critical link in the north-south transportation corridor of Alberta.

In the spring of 2022, The Canadian Council for Public-Private Partnerships (CCPPP) collaborated with Gauer Consulting Inc., with support from Deloitte, on a comparative review of the various components of the Edmonton Ring Road Program, run by the Alberta government through Alberta Transportation.

This Ring Road is notable for several reasons, including the fact that it was the first time the Alberta government used the public-private partnership (P3) model for a highway project. This endeavor required the creation of a specialized P3 highway project agreement template, which remains in use by the province to this day. The template was based on best practices gleaned from other jurisdictions, as well as the unique provincial requirements and the Alberta highway design approach.

In addition, part of the uniqueness of the P3 approach in Canada, is a focus on evaluating Value-for-Money (VfM) to determine if the P3 approach provides the most cost-effective approach for

taxpayers compared with a traditional design-build procurement.

## Study Objective

This study reviewed the performance of the project procurement and delivery based on available project data, as well as through interviews conducted in spring-summer 2022 with relevant ministry transportation and major capital project leads, contractors, service providers, and industry stakeholders. The study focuses on the qualitative aspects (rather than a quantitative assessment) in the following key areas:

- Scope of Work
- Cost
- Schedule
- Risk
- Quality
- Innovation, and
- Delivery Model

## Findings

In general, the Edmonton Ring Road Program's P3 model was found to be successful, offering an approach that was viewed by both the public and private sector interview participants as the only way to deliver an ambitious program in such a short time. The three P3 sections took 11 years in total to complete compared to about two decades for the much smaller traditionally procured section.

In addition, the review found the whole life cycle approach used in the three P3 components produced additional value for the government and Edmonton residents.

Specifically, the P3 portions:

- Had a rigorous level of project definition, along with applying a higher design standard for the P3 components;

- Delivered the work at the fixed price bid for the work (except for one portion);
- Opened to the travelling public on schedule;
- Addressed and managed risk under the project risk transfer terms and conditions, primarily managed by the private sector delivery teams;
- Were the only way the projects could be completed within the specified time frames;
- Minimized impacts to live traffic and avoided the associated disruption to mobility, significantly reducing congestion, due to the design of the highway to a 30-year traffic forecast; and
- Eliminated the risk to the Alberta government in having to manage multiple work packages and having to take contract interface risk by contracting a private sector partner for the delivery of a larger scope of work within a reduced timeframe.

## Recommendations

### Need to Evolve Alberta P3 Delivery Model

The Alberta delivery model was constant over the P3 program in Edmonton and contributed to the program's success. However, since the Alberta P3 approach was set out in the early 2000s, the market's appetite for risk has markedly changed. In other jurisdictions, where work is more complex and constrained, such as in urban conditions, the model has also demonstrated a need to evolve. Modernization of the Alberta Highway P3 model would revitalize the approach, adapt to current realities and attract increased bidders' interest to continue to deliver a highly competitive, fair and transparent bid process for Albertans.

### Clear Project Limits

Alberta should align its functional plan design requirements with its Schedule 18 requirements, which would help set clear project limits and avoid uncertainty in the bid scope of work. In addition, construction bid essentials, location and the utility company responsibility in the utility relocation process, should be determined prior to RFP issuance for clarity of scope through proactive government

engagement with pipeline and utility companies. Enhanced utility definition and location is required on all projects, along with a defined process, such as a master utility agreement, to outline the conduct of utility companies engaging with P3 delivery teams.

### Indexing Critical Costs During Times of Uncertainty

Governments should index critical costs, given the current escalation in interest rates, widespread supply chain challenges, and volatile energy, material and labour costs. Also, mechanisms should be added to project agreements to share the risk of addressing unforeseen supply chain events and material unavailability.

### Completion Date Left to Private Sector Delivery Teams

Delivery teams should set project completion dates rather than the government, enabling the private sector to optimize the construction schedule based considering the project scope and complexity. The completion date is optimized considering the project financing approach. The delivery team setting the completion date means the consortiums bidding for the projects take a greater responsibility for schedule risk.

### Reconsideration of Project Risks

Unknowable unknowns cannot reasonably be transferred to the private sector. A review of the project agreement should reassess risk transfer of any such project elements where they may occur. Utility cost is already a shared risk. However, in difficult, complex and constrained areas, consideration should be given to sharing the risk of utility company performance. This is becoming a significant market concern across Canada and requires review of the Alberta project agreement template. Third-party risk transfer should likewise be reconsidered when neither party can best manage the risk.

### More Robust Quality Management System

A more robust Quality Management System (QMS) approach is recommended with an enhanced definition of quality requirements in the project agreement. On a P3 project, the best results occur

when the majority of the quality management responsibility resides at the private sector team level, with thorough and direct oversight by the Quality Management team, the engineer of record (EOR) and operator. The quality assurance process should be separate (in terms of management and reporting) from the quality control role by the design build team and their subcontractors. Severity of non-conformance records (NCRs) should be recognized in the QMS process considering differing consequences and the relative urgency of response from both government and the private sector team to disposition resolution. The NCR disposition process should be transparent with clear roles, responsibilities and accountabilities.

### **Prioritizing Innovation in Long-Term Agreements**

Alberta may be missing opportunities to innovate the bridge structure work on P3 projects, where there is a 30-year responsibility for maintenance and rehabilitation providing surety of performance over that time frame. With due consideration for durability and life cycle, the P3 process offers the opportunity to explore new, prudent and incremental innovations in bridge design and construction. To achieve this, a clear process is needed, particularly in the bid process and during construction, to address and evaluate innovation opportunities based on the project agreement in a clear and transparent fashion.

### **Rethinking Honorariums**

With more projects coming online with greater complexity and size, the government should re-examine and increase its honorarium levels and consider scored technical submissions. Both items contribute to innovation and competition in delivery of challenging, complex work. General market sentiment and experience on projects across Canada indicates market players will respond favorably to these types of improvements to the Alberta Highway P3 process. Healthy completion amongst bidders compensates for the higher stipends.

# Introduction

## Ring Road Program Development Context

The Edmonton Ring Road, known as Anthony Henday Drive or Highway 216, was procured and delivered in four phases, starting from 1990 in the southwest quadrant until the full completion of the Ring Road in October 2016.<sup>1</sup>

Construction started after almost 30 years of planning and land accumulation for a transportation and utility corridor by the Alberta government and City of Edmonton.<sup>2</sup> The now completed 80-kilometre Ring Road is a vital link in the north-south transportation corridor of the province, providing market access and quality of life for Albertans in the Edmonton metropolitan region.<sup>3</sup>

In the early 2000s, the province assessed the use of a public-private partnership (P3) model for the last three phases of the Ring Road after the province's capital plan required alternative financing options be investigated.<sup>4</sup>

The four segments of Edmonton's Ring Road project include:

### Traditional Procurement:

- **Southwest Anthony Henday (SW Henday):**  
In the 1990s, a segment of this four-lane highway was constructed in two stages by the City of Edmonton. From 2000 to 2011,

the remainder of the SW Henday was built by the province from Whitemud to Calgary Trail. In total, this section of the ring road is approximately 24 kilometres in length.

### P3 Procurement

- **Southeast Anthony Henday (SE Henday):**  
The Southeast quadrant from Calgary Trail to Highway 14 (10.5 kilometres) was built as a design-build-finance-maintain (DBFO) contract from 2005 to 2007. The private sector consortium selected for the \$493-million project<sup>5</sup> was Access Roads Edmonton Ltd. (AREL) comprising: ABN AMRO Bank N.V.; Macquarie Essential Assets Partnership (after December 2005); PCL Construction Management Inc.; PCL-Maxam (joint venture); Sureway Construction Management Ltd.; Lafarge Canada Inc.; Marshall Macklin Monaghan; Stantec Consulting; and Transportation Systems Management Inc.<sup>6</sup>
- **Northwest Anthony Henday (NW Henday):**  
The Northwest quadrant from Yellowhead to Highway 15 (21.4 kilometres) was built as a design-build-finance-maintain (DBFO) contract from 2008 to 2011. The consortium selected for the \$1.42-billion project<sup>7</sup> was NorthwestConnect General Partnership<sup>8</sup> comprising Bilfinger Berger;

<sup>1</sup> Edmonton Journal. "Paula Simons: After 26 years, Anthony Henday ring road finally comes full circle," September 30, 2016. (Accessed November 6, 2022).

<sup>2</sup> The Canadian Council for Public-Private Partnerships 2005 National Award Winners Case Studies. "Anthony Henday Drive Southeast Leg Ring Road, Alberta," pages 67-84, 2006.

<sup>3</sup> Government of Alberta. "Edmonton Ring Road," 2022. <https://www.alberta.ca/edmonton-ring-road.aspx> (Accessed October 3, 2022).

<sup>4</sup> The Canadian Council for Public-Private Partnerships 2005 National Award Winners Case Studies. "Anthony Henday Drive Southeast Leg Ring Road, Alberta," pages 67-84, 2006.

<sup>5</sup> Government of Alberta. "P3 enables Anthony Henday Drive S.E. to open in 2007," January 25, 2005.

<https://www.alberta.ca/release.cfm?xID=17518283FCDE1-8C4E-4EB3-A93F13E86CE3C94F> (Accessed October 31, 2022).

<sup>6</sup> The Canadian Council for Public-Private Partnerships 2005 National Award Winners Case Studies. "Anthony Henday Drive Southeast Leg Ring Road, Alberta," pages 67-84, 2006.

<sup>7</sup> Government of Alberta. "Construction set to begin on north Edmonton ring road," July 30, 2008.

<https://www.alberta.ca/release.cfm?xID=2409275398592-9B84-1488-511B291307B121FE> (Accessed October 31, 2022).

<sup>8</sup> Government of Alberta. "Agreement to design, build, finance and operate northwest Anthony Henday Drive, Edmonton," July 29, 2008.

Carmacks Enterprises Ltd.; CIT Group Securities (Canada) Inc.; Flatiron; Graham Construction and Engineering; and Parsons Overseas Co. of Canada;<sup>9</sup> and

- **Northeast Anthony Henday (NE Henday):** The Northeast quadrant from Highway 14 to Highway 15 (21.5 kilometres) was built as a Design-Build-Finance-Maintain (DBFO) contract from 2012 to 2016. The consortium selected for the \$1.81-billion project<sup>10</sup> was Capital City Link General Partnership, which included ACS NEAH Partner Inc.; HOCHTIEF NEAH Partner Inc., and Meridiam Infrastructure NEAH ULC.<sup>11</sup>

## Study Participation

Interviews were conducted with individuals from the following project stakeholders:

- Alberta Transportation leads
- Alberta Transportation Major Capital Projects leads/Edmonton Ring Road project leads, and
- Private partners and key contractors/service providers.

All interview participants were deeply involved in the Edmonton Ring Road Program and shared their experiences and successes in meeting the challenges of the delivery model, scope and complexity of the work. Input received through interviews were primarily from two different points of view: the owner's engineer and the Alberta Transportation senior management provided a similar perspective of the program from a government (owner's) point of view, while the engineers and contractors/developers shared their experience and feedback on the projects from a delivery team point of view.

Both perspectives were generally consistent and mostly complementary, while each had their own objectives, challenges and lessons learned. However, there were a few differences identified through the interviews. Those differences are important as they suggest possible improvements to the delivery approach and provide lessons learned.

## Study Methodology

The major components of the study included:

- **Project procurement and delivery** of the four segments of the Ring Road Program were assessed at a high-level in terms of **scope, cost and schedule**, including challenges and lessons learned.
- The **key project risks** were assessed in terms of risk transfer and mitigation. During the study, the team identified a few risks that were new or underestimated in the project planning stage, which are highlighted in the report.
- The **quality management** of the four segments of the Ring Road was assessed at a high level in terms of key challenges, issues and lessons learned.
- **Innovations** introduced by the private sector partners are described in the report.
- An assessment of the appropriateness of the **delivery model** with respect to the project scope was undertaken. This investigated how well the delivery model risks were addressed and how that contributed to overall project performance.

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<https://open.alberta.ca/dataset/a0b21d28-9a53-49d0-8023-a5a0a7a7432d/resource/6f865bc0-4b1a-4045-8c72-057f03233824/download/nwadbfo.pdf> (Accessed October 3, 2022).

<sup>9</sup> P3 Spectrum (Accessed October 31, 2022)

<sup>10</sup> Government of Alberta. "Construction digs-in on final leg of Edmonton ring road," July 16, 2012.

[https://www.strathcona.ca/files/files/at-edt-news-](https://www.strathcona.ca/files/files/at-edt-news-anthonyhenday-newsrelease.pdf)

[anthonyhenday-newsrelease.pdf](https://www.strathcona.ca/files/files/at-edt-news-anthonyhenday-newsrelease.pdf) (Accessed October 31, 2022).

<sup>11</sup> Government of Alberta. "Agreement to design, build, finance and operate Northeast Anthony Henday Drive, Edmonton," May 8, 2012.

<https://open.alberta.ca/dataset/c642634d-e6a7-468b-94cb-802a307ac54d/resource/da1f09ed-4efc-451e-aa77-ef54762c75ee/download/ahdnedbfoagreement.pdf> (Accessed October 3, 2022).

# Findings

## Performance of P3 Projects

In general, the interview subjects expressed satisfaction with the process and support for the Alberta P3 approach. The study findings on the performance of each of the three P3 projects are addressed in this study from the points of view of government (owner) and the private sector delivery team. The input received from the interview participants are summarized in the following sections and are grouped by topic, such as scope of work and delivery model, rather than on a project-by-project basis.

## Scope of Work

### Government (Owner) View:<sup>12</sup>

In advance of issuing the request for qualifications (RFQ) in 2003 for the southeast quadrant, the first Ring Road section to use the P3 model, the interviewees said Alberta Transportation put a great deal of effort in conducting site investigations and developing the project specifications. The intent was to do its “homework” to develop a strong project agreement and a complementary procurement process to enable projects to proceed smoothly.

From the discussions, it is clear Alberta Transportation was successful in their approach. The project agreement and processes set out at the outset were rigorous and thorough and the P3 methodology and project documents were said to have held up well over the delivery of the three P3 projects, with only a few tweaks.

Changes made to the initial process and project documents were largely bespoke based on the characteristics of subsequent work. Lessons learned led to minor changes to the specifications and

additional documentation of utility information for the NE Henday because of the greater scope and complexity of that work.

### Private Sector (Delivery Team)<sup>13</sup> View:

While the delivery teams felt the owner’s site due diligence was helpful, the government’s procurement “Data Room” did not provide all the required information. This meant private sector teams had to address project risks and unknowns either through in procurement site investigations, a contingency allowance and/or a scope management/risk mitigation approach.

For example, one team’s solution involved setting out a contingency sum to manage unknown project costs.

Another team’s approach involved identifying an estimate of work with the final fixed price set less than that amount. This approach required the P3 design-build teams to find savings as work progressed through less costly means and methods, improved processes, innovation or different solutions.

This demonstrates that often P3 bidders may use opposite approaches in cost and risk management. The latter scope/risk management approach clearly puts more pressure on the design-build teams, as they essentially worked with a negative contingency and needed to find substantial savings in design and construction.

A unique element of the Alberta P3 approach is the provision of a functional plan to the project proponents as the reference concept. The functional plan is developed based on the provincial standards and typical planning practice in Alberta. However, Project Agreement Schedule 18, which is the project performance specification, sets out an approximately 25 per cent higher standard for some geometric design elements compared to what was used in the

contracts to deliver the work with the Owner over the construction and operations term. The developer subcontracts the construction with a Design Build Contractor and the operations, maintenance and rehabilitation work with an Operator. The engineering firm responsible for design is a subconsultant to the Design Build Contractor.

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<sup>12</sup> In general, on a P3 project the government or owner’s team includes several internal department staff and external consultants including individuals with expertise in highway and structural design, illumination, water resources and drainage, environmental requirements, construction inspection and oversight and quality management systems.

<sup>13</sup> In general, the P3 delivery team generally includes a developer who responsible for the entire assignment and



functional planning. For example, the required profile for P3 delivery often requires flatter vertical curvature and grades. Proponents responding to the Ring Road Program RFPs needed to make extra effort to adapt the functional plan to the elevated P3 requirements. In some cases, property, spacing, layout and other constraints made that a difficult task.

Also, the in-market request for information (RFI) process was cumbersome and often frustrating for both parties to communicate, address and respond to design challenges and clarifications. The procurement and design-build process worked through the discrepancies and, in the end, the design of the new Ring Road P3 sections were delivered to a higher standard compared to a traditionally delivered highway.

One unclear scope issue involved the project limits at the Transportation Utility Corridor (TUC) boundary. The sideroad tapers often extended well beyond the TUC limit. It was not clear who was responsible for the work beyond the TUC and within the City of Edmonton right-of-way. On the SE Henday, this problem was only solved after the award of the project. The delivery team worked with the city and a separate agreement was negotiated by the proponent for the widening, pavement transitions and further work within city lands.

The pavement and foundation borehole data were sparse, and the contour information provided for the bid stage topography data required validation, as the earth mass haul is based on the ground surface. On the SE Henday all three proponents requested more geotechnical borehole information from Alberta Transportation. Alberta took in all requirements, coordinated the information and permitted the additional geotechnical work to occur, with the collected information shared and costs equally allocated among the proponents. As the topographic data needed verification, some teams purchased recently flown Lidar data for the corridor.

On the NW Henday there was limited information in a couple of areas regarding site conditions and project requirements. The Ring Road profile was controlled at St. Albert Trail, requiring a deep, depressed cut of the main highway under difficult hydrogeological and soil conditions, with added drainage conveyance challenges. Also, during the bid stage the adjacent Department of National Defence (DND) requirements were unclear where the Ring Road abutted the federal government's property.

On the NE Henday, some elements of the site conditions were also not well defined. Partway through the RFP process, coal mines were identified crossing below parts of the Ring Road corridor, but their location and elevations were poorly mapped. Furthermore, there were 500 utilities in the corridor. According to a design-build team, despite an attempted thorough and rigorous utility identification program undertaken by Alberta Transportation, some utilities were still missed. Also, protocols and processes for resources, timing and cooperation by the various pipeline companies and the review process by the National Energy Board were not fully addressed prior to the RFP issuance and the topic had limited coverage in the project documents. This created unknowns during the RFP stage.

In summary, the scope and site conditions were often not sufficient for the proponents and accordingly, each proponent augmented or addressed the data provided in their own way.

## Cost

### Government (Owner) View:

SE Henday was the first P3 highway project procured in Alberta. At that time, the province did not have a benchmark for P3 project costs. Therefore, there was a learning curve when developing the initial budget for the first project. As more projects were procured and delivered, the government was able to leverage historical data to refine cost estimates for projects going forward. All three P3 projects were awarded within the province's estimated budgets, but the budget for the initial project (SE Henday) was tight.

Two of the three P3 projects were delivered meeting the bid fixed price. The last project, the NE Henday, required a change order to address unknowns, such as pipeline companies moving their infrastructure and soil contamination.

For all three projects, the government's team of internal and external experts did a reasonable job in defining project risks, managing the challenges that arose, assessing the impact of identified issues and setting out appropriate contract terms. For NE Henday, there was a unique constraint, a lack of wiggle room to move the highway mainline alignment and ramps to avoid or minimize utility conflicts.

Utility relocation costs in the Alberta model were addressed via a threshold approach. Up to a certain

value, all utility related costs were the responsibility of the private sector team. Beyond that, and up to the second threshold value, the utility related costs were shared between the consortiums and the province. Beyond the second threshold, the remaining costs were the responsibility of the province. On SE Henday and on NW Henday, the first threshold was never reached. On the NE Henday, the utility related costs exceeded both thresholds.

Utility work on the NE Henday presented a major risk. When the cost threshold was breached and the utility company response to the private sector team affected construction, there were consequences to project delivery. Furthermore, the additional costs associated with major utilities can be more than just the relocation cost. For example, if a plant shutdown was required that adds to the utility cost. The province's approach was to pay for the actual utility relocation cost using the scaled cost sharing mechanism, but not to compensate for the private sector's mitigation efforts.

#### **Private Sector (Delivery Team) View:**

The views of the delivery teams were generally consistent with the government view.

The SE Henday was delivered to the fixed price without a change order. There were a few situations where claims could be considered for additional work. However, the province and Access Roads Edmonton Ltd. (AREL) worked out measures to mitigate and manage the costs, avoiding any need for change. The private sector team's contingency covered the balance of unexpected work.

On the NW Henday, work was delivered based on the fixed price and the NorthwestConnect General Partnership was able to manage work and implement mitigation strategies in delivery of the work.

On the NE Henday, utility work required a change order due to the high cost of utility relocation, as was outlined previously. Other project scope challenges, such as the existence of coal mines, were resolved by design and construction mitigation strategies. The subsurface extent of the coal shafts was identified, and shallow foundations were utilized when bridge foundations were located over mine locations. Railway approval, design and construction issues were largely addressed by revising the functional plan approach through changing the profile to construct the highway over the railways. This approach not only

eliminated the railway's involvement in the structure design and maintenance, but it also minimized the railway's involvement in track safety, approval and flagging. Both challenges were addressed within the project scope offering effective mitigation strategies.

## **Schedule**

#### **Government (Owner) View:**

All three P3 projects were delivered on time but were tight to the scheduled project completion date. In all situations, the construction schedule was seen as adequate but not generous.

On each project, the major requirement for opening the road to traffic and achieving substantial completion was a complete and safe roadway. On all three projects, there was some work, involving deficiencies, roadside grading or other minor works, carried over into the post-substantial completion period and finished prior to final completion.

The project schedules are shown in *Appendix A*. Of note is the duration of the various procurements. The first project, SE Henday, required 16 months from request for qualifications (RFQ) issuance to award. Following that, the NW Henday procurement duration was 12 months, and the NE Henday was 14.5 months. The procurement process for the SE Henday took longer than the second project because it was the first P3 highway project in Alberta. It was the prototype, and the initial go round took longer than expected, particularly the technical submission (SR2) phase. The second procurement took less time as it was the third highway P3 (NE Stony Trail having previously been procured in Calgary). The industry proponents and the province had by then tested the process on two precedent projects. The third Edmonton Ring Road segment was also the fifth highway P3 in the province. The procurement process took longer than the two earlier projects because it was larger in scope and had greater technical complexity in terms of railways, utilities and more work in an active highway corridor.

With respect to construction duration, the time from award to substantial completion was 33 months for the SE Henday, 39 months for the NW Henday and 57.5 months for the NE Henday. As would be expected, more time was required for design and construction as project size increased. It should be noted the SE Henday looks to have three full construction seasons, but as the work was awarded in

mid-January, full mobilization across the project at the start of the first construction season was limited due to a lack of advance design time. The NW Henday was awarded in August and the NE Henday in May. Both of those award dates permitted the design to get ahead of the main construction start the following year, which allowed for three full construction seasons for the NW Henday and four full construction seasons for the NE Henday, plus any work that could be fast tracked immediately after award in the fall of the year of award.

#### **Private Sector (Delivery Team) View:**

The delivery teams interviewed all agreed the work was delivered on time. However, the effort to achieve on schedule delivery was due to a number of special project efforts, initiatives, mitigation approaches and strategies. Significant effort was needed to move work along according to schedule and to address challenges as they occurred.

On the SE Henday, the schedule was met by fast tracking the design development process and the project moved into construction of the first two bridges in February 2005, just four weeks after the award. However, the shortage of equipment for pile driving reduced the capacity to place bridge piles in accordance with the project schedule. As mitigation, the foundation design was switched to augured caissons, as the equipment was more readily available and thus allowed the project schedule targets to be met. Some structure configurations were also altered to address productivity challenges in order to meet the project schedule. Bridge approach settlement was accelerated using wick drains to expedite the overall embankment construction.

On the NW Henday, similar measures were introduced, such as wick drains, to meet schedule. Compared to the SE Henday, the NW Henday had a significantly larger scope but only a slightly longer schedule. This introduced significant challenges to deliver the project on time. The 39-month construction schedule was considered aggressive. It was a significant achievement that NorthwestConnect General Partnership achieved substantial completion by the defined date.

On the NE Henday, the scope was almost four times larger than the SE Henday scope and approximately 30 per cent larger than the NW Henday project. The construction schedule was approximately 50 per cent

longer than the NW Henday and almost double the schedule duration of the SE Henday project. The longer construction duration was due to not only the increased scope but also the complexity in dealing with traffic on the existing highway, resolving design and construction issues with the railways and addressing the vast number of utilities within the constrained corridor. Therefore, although the construction schedule was more generous for the NE Henday, it was still tight given the larger scope and greater complexity of work.

## **Risk**

#### **Government (Owner) View:**

Interviewees from the owner's side indicated the risk transfer approach worked well from their point of view. The risk transfer was set at the outset of the program and was kept generally consistent among the three P3 projects, with certain adjustments for the bespoke aspects of the projects and minor tweaks, mostly in the threshold for utility cost sharing. In a few situations, unknown geotechnical and contamination were found during design and construction with the cost of remediation covered by the province. The unknown geotechnical and contamination situations were minor.

A major risk taken back by Alberta was the utility risk on the NE Henday, where the complexity, extent and constraints due to existing utilities on site caused the cost to exceed initial expectations. Under the cost sharing mechanism described earlier, Alberta was responsible to cover the utility costs above the second threshold.

Credit spread risk is always a concern. However, as the Alberta procurement approach minimized the time between the financial submission and project award, this risk was managed and minimal.

One provincial representative interviewed noted regarding the SEAHD: "it was evident that the quality of work was driven by the OMR (the operator's oversight and risk for operations, maintenance and rehabilitation) and it showed up in the work." This statement validated that the transfer of the life cycle risk contributed to the oversight of construction and the quality of work.

### **Private Sector (Delivery Team) View:**

From the private sector perspective, risk transfer included some difficult and often unmanageable risks that, under the Alberta delivery model, required them to identify and mitigate.

On the SE Henday, risk in terms of quality, vandalism, work constraints, stringent geometric requirements, environmental permits, wetland compensation, equipment supply, fuel and asphalt cement cost escalation and railway safety occurred during the construction. The risks were managed within the fixed price and mitigated through design and construction adaptations. The equipment availability challenge was managed by switching from pile driving to augured caissons for bridge foundations. Quality non-conformances were identified by Access Roads Edmonton Ltd. (AREL) and were the responsibility of the relevant suppliers to rectify. For example, faulty girders were replaced at one bridge when defects were assessed as beyond repair. Pavement crossfalls were rectified where surface asphalt was out of specification, with a minor tolerance adjustment by the province as the original requirements were deemed unreasonable and too difficult to achieve. Other risks were managed jointly by the designer, contractor and subcontractor working as a team. The utility cost risk was managed within the first cost threshold. The work flexibility across the large site provided opportunities for innovative solutions in addressing challenges identified and allowed for adaptation and mitigation of risks as they occurred.

On the NW Henday, risk considerations were similar. The utility risk was greater, as compared to the SE Henday, but was managed within the contract terms. Fitting the design within the right of way was a problem in a few locations but resolved by redesign and retaining systems. Risks associated with the DND adjacent site were addressed through discussion and design, with a lower illumination height addressing light intrusion and a stormwater approach minimizing bird attraction. Work performed at risk involved design starting prior to award in order to get a head start on construction. The design, drainage and soil risk at St. Albert Trail was mitigated by additional soil investigation and unique design solutions.

On the NE Henday, significant risks were encountered. These included working in traffic, physical constraints associated with existing infrastructure, railway approval, utility relocation, unknown subsoil conditions (mines), environmental requirements at the North Saskatchewan River and

wetland compensation. Many of these risks are discussed in other sections of this study, particularly the mines, utilities, river crossing approval, traffic management and railway risk. Like the SE Henday, the wetland compensation risk was addressed through working with Ducks Unlimited Canada for offsite compensation due to the constraints in compensating for lost wetlands on site.

## **Quality**

### **Government (Owner) View:**

The ISO 9000 Quality Management System (QMS) used for the projects was new to the Alberta government when the first Ring Road P3 was procured. As the approach was the first of its kind, the province continued oversight of the work by their own staff, augmenting efforts by the owner's engineer and looking in on the delivery team's management of the QMS. This involved site visits, following project issues and keeping track of non-conforming work.

Alberta Transportation focused the majority of their quality management effort on bridge work, both in design and construction, as they retained life cycle risk of these structures beyond year 30, for an added 45 years to the planned 75-year design life. Structural durability and quality were prioritized as key concerns. It was expected any issues with the roadwork would emerge within the 30-year P3 agreement, so such deficiencies or latent defects would be the responsibility of the private sector to repair during the operating period. Therefore, management of the overall quality process, inspecting structures, assessing durability of life cycle elements and ensuring safety were the province's primary oversight activities.

Given that approach, the interviewees' view was that most work was delivered to a high standard and the operator's involvement during construction gave comfort there were additional eyes on the construction activity. There was an observation across the projects that each project delivery team addressed quality differently. Because of this change, the level of involvement of the owner's engineer and their oversight in the QMS process increased as the Ring Road Program progressed. This was, in certain cases, to check in on the oversight of work by the engineer of record (EOR) and to address workmanship that required extra construction quality measures. A field review engineer requirement was

added for the NE Henday scope to ensure added field support for the EOR's oversight of work. On the SE Henday there were no owner defined non-conformance records (NCRs). On the NE Henday, there were situations where the province intervened in the NCR process to ensure deficiencies were recorded to address quality and durability concerns.

It was observed that quality processes were more sophisticated as the Ring Road Program matured, largely because the construction industry became more experienced in ISO type QMS approaches, processes and documentation over time. On the SE Henday, the quality culture was seen as a model with a high level of attention to quality, albeit with lesser formal process and documentation. Non-conforming work was identified by the delivery team, rectification measures were determined, and the owner's team was notified as deficiencies were corrected. With the progression to improved QMS processes on the latter projects, the province saw a need to increase their supervision effort. At times non-conforming work was identified and the province insisted on issuing the NCRs within the delivery team's QMS. For example, issues arose on steep slope stability, mechanically stabilized earth (MSE) wall construction, reinforcing bar cover, deck pour processes and similar matters, where the owner's field representatives interceded regarding NCRs and rectification measures.

#### **Private Sector (Delivery Team) View:**

The concept of a contractor QMS was new to civil construction in Alberta, introduced by the P3 delivery approach. Therefore, there was an evolution of process as the Ring Road Program proceeded. The SE Henday (the initial project) integrated the engineer of record team into their quality assurance oversight process as a last check on any construction witness or hold point. This served two functions:

- 1.) The EOR had an appropriate level of oversight in the field to observe construction, to provide input into field changes and to prepare the record drawings.
- 2.) The EOR team was embedded within the overall quality assurance team working under Design Builder's QMS process. This minimized duplication of work and clearly separated the quality control responsibility of the grading, roadway and bridge subcontractors from the quality assurance role at the Developer's level. The project

team management involved a design-build director supported directly by a consultant engineering manager and a construction manager. The EOR lead, the consultant engineering manager, reported directly to the design-build director.

From information provided by the owner's team, subsequent project QMS processes and systems were set up differently. From experience on other similar projects, this was likely due to the vertical integration of the Proponent teams. Quality assurance and quality control efforts were largely performed at similar levels within the organizations, the Design Build level for quality assurance and also at the Design Build team level for quality control. The EOR was a subconsultant, reporting to a contractor design manager, with their role primarily to address site changes, to resolve and signoff on NCRs and to prepare record drawings, with (possibly) a lesser level of involvement in the construction oversight quality assurance processes.

SE Henday had a few incidents in terms of quality. On one structure, concrete girders were found to have flaws and required replacement. This was identified upon erection and inspection by the quality assurance team that the girders were not fit for use. The owner's team was then advised of the issue and the girders were removed and replaced. Another quality issue involved the pavement crossfall tolerance. This was identified prior to handover in the quality assurance acceptance process. Corrections were subsequently made to true up the crossfalls as required to meet the province's requirements. Significant effort was needed to optimize the field-testing approach. In all cases, the quality assurance test or inspection results were used as the ultimate test for all material acceptance. This led to performing quality assurance checklists the day before any construction task, which avoided any last-minute work deferral. This proactive QMS approach contributed to a good quality culture on the project. Any EOR representative on the project could stop work and this led the quality control teams to be rigorous in their approach in order to avoid and minimize stoppages and material rejections. As a result, the SE Henday had no owner-imposed NCRs as the quality assurance process was appropriately self-managed and the quality process gained the trust of the owner.

On the NW Henday, the approach to quality was different. Discussions with interview participants indicated that there were a few challenges in the QMS

process to meet the expectations of the province. The engineering team was still involved in the quality assurance processes. When issues were identified, the EOR was involved in disposition and rectification. It was acknowledged that at time mistakes were made as work was not always completed in a perfect way. Lessons were learned from the experiences and carried forward. However, discussions indicated that although good quality systems and processes were in place, the delivery team and the owner's team did not always agree on the quality of some work. This is consistent with the owner's comments above, regarding their stepping in and imposing NCRs when there was concern with the quality of work.

Challenges and quality issues included work on MSE walls where, due to varying strap lengths, non-conforming reinforcing strap placement was identified, requiring wall replacement in certain locations.

It was noted during the interviews that there was an added responsibility for the quality approach, above that required on the NW Henday, introduced for the NE Henday. The province required a field review engineer (FRE) whose responsibility was to provide support to the EOR in field oversight. On this project, the FRE staff worked for the EOR lead engineering firm and certified the field work on behalf of the EOR consultant team.

## Innovation

### **Government (Owner) View:**

Alberta made a conscious decision to set up clear, defined specifications for the delivery teams to follow when building. Little latitude, particularly in regard to structures, was permitted. Innovative ideas were considered but they were required to demonstrate they were equal to or better than the defined Schedule 18 performance requirements. When innovative ideas were proposed that challenged the specifications, the province often pushed back and reinforced the specifications to clearly prohibit approaches that were not acceptable. The P3 requirements were deliberately set to a high standard to avoid minimums in design. This approach restricted changes in bridge design but allowed greater flexibility in roadway geometric design and construction means and methods.

A quote from one interviewee on the government's team was: "No, not open to innovation." The essence

of the Alberta approach was that while innovation was permitted within the project agreement, there were tight specifications governing the work limiting the opportunity to innovate. During procurement, there were two meetings where proponents could bring forward innovation opportunities in confidence with the government. Typically, only minor changes, such as interchange configurations, were considered at that time.

### **Private Sector (Delivery Team) View:**

The perspective from the delivery team confirmed the government's point of view. Innovation was often hard won whether it was in procurement, design or construction. Accepted innovations were generally limited to layout, geometry and construction means and methods.

The SE Henday, which won the Alberta Award for Innovation, introduced novel interchange configurations, utility protection approaches, revised bridge types and arrangements, environmental approaches on wetlands with Ducks Unlimited, illumination design and electrical wiring schemes.

In the procurement stage, the SE Henday design was challenged in satisfying the heightened project requirements. For example, the separation between Calgary Trail and 91 Street was insufficient to meet the minimum weave distance. However, this stimulated the proposal of a Parclo A-B interchange configuration to meet the weave distances. The change required significant effort in the bid stage request for information (RFI) process to obtain acceptance from the Alberta government. Ultimately, the discussion led to greater use of Parclo type interchanges on the Ring Road, as opposed to the planned functional plan diamond interchange configurations proposed in the corridor.

Further innovations were put forward in the design-build stage, but only where the time needed to implement an innovative solution did not affect the construction schedule. The SE Henday team innovated in a number of ways. For example, new crossing road locations were shifted from the functional design locations to maintain traffic on existing roads while constructing the new flyovers and interchanges. Kinked girders were used instead of curved girders on the Calgary Trail interchange third-level structure, which complicated design but reduced the quantity of steel significantly. A structure at the Bretona Interchange added a bridge span

instead of an earth fill to meet schedule constraints. As opposed to the trellis structures used in the design-bid-build delivery at Calgary Trail, a more compact, post tensioned bridge was designed to address the high skew ramp crossing geometry, saving in materials and construction effort. The electrical design introduced new concepts to the province in the design of the lighting system and wiring configuration, optimizing lighting circuits. Light weight fills were used over utilities and wick drains were used to accelerate long-term settlements. Bridges with closed abutments were introduced with two-stage MSE wall construction to allow for embankment settlement.

Environmental approvals were advanced by securing a letter of credit with Ducks Unlimited Canada to expedite approval and ensure wetland compensation expectations were guaranteed. The Bretona interchange involved a planned wetland, watercourse relocation and extensive earth borrow. The Bretona design change addressed project needs while improving the project quantity, design, environmental and geometric outcomes.

Pavement granular materials were stockpiled in winter, picked up by scrapers in the summer construction season and placed to accurate lift thicknesses. This approach reduced grader work and accelerated the granular placement activities. In the end, there were significant innovations introduced to the project, but all were within the tight specifications governing the work as was enforced by the owner's team.

The NW Henday also won the Alberta Award for Innovation based on the introduction of the rotary systems interchange configuration and innovation in the St. Albert Trail engineering solution. Again, it was noted by interviewees that the main challenge was the time required to prove the innovative concepts. Again, innovation was limited to actions that did not affect the project schedule. From the conversations, it was evident some of the innovative ideas pioneered on the SE Henday were adopted on the NW Henday, such as wick drains and shifting of crossing bridges to facilitate traffic staging.

The key innovation was the introduction of the rotary interchange concept, which was used at both the Yellowhead and Manning interchanges. The approach avoided the need for the stacked three-level interchange configuration and long ramp structures. It changed the interchange to two levels and reduced the overall bridge work. Although the change

required more ramp construction, the approach reduced the cost of work. Campbell Road and 97 Street were realigned to use the existing road as a detour, similar to the approach used on the SE Henday.

The NE Henday applied innovations to address the challenges in foundation design over coal mine shafts and wetland compensation. However, in the opinion of the delivery team, innovation on this project was often more difficult to achieve. The innovations that occurred were out of necessity. Innovations included the wetland compensation approach and shallow bridge foundations over the coal mine seams. A proposed change in geometry was suggested for the Yellowhead Highway, which the design team felt was viable and safe, but was not accepted by the Alberta government.

## Delivery Model

### Government (Owner) View:

The perspective of the owner's team was that the P3 approach to the Edmonton Ring Road Program was "the right thing to do." The project approach developed at the outset worked well for the Ring Road Programs in both Edmonton and Calgary, with the P3 risk transfer approach the same or similar across all the projects. The Alberta Transportation leadership was proud of their team, their P3 process and how the P3 projects were planned, procured and delivered.

As one interviewee noted, the initial planning and preparation work took longer than expected but it was "the only way" to build the remaining Ring Road sections." Another stated that any other approach would have taken much more time to deliver the overall program. By using the P3 delivery model, the government increased the certainty of project costs and locked in the delivery date.

The P3 Ring Road sections were built to meet the full 30-year requirements and that minimized the extent of future staging and improvements needed to provide for future growth. It was observed that the designers and builders worked together and achieved savings in time and cost. The increased scope of work and size of the project was best delivered by the P3 delivery approach. The private sector consortiums were required to work within the project agreement and deliver the projects in accordance with the pre-determined specifications, schedule and costs. The

projects achieved substantial Value-for-Money and the quality of construction was evident, in part due to the private sector's self interest in ensuring the long-term performance of the as built work. Potential use of a traditional DBB model for later Ring Road projects was considered but found unwarranted based on the evident performance of the P3 projects. The strong project agreement and the Alberta risk transfer approach contributed to project success, as was observed from the government's perspective. The efficiencies of the approach were evident. Competition for the work resulted in a good price and delivered the work in a shorter time frame than design bid build delivery.

#### **Delivery Team (Private Sector) View:**

The delivery teams all agreed the P3 delivery model was appropriate for the scope and magnitude of the three projects. However, they considered the risk transfer approach used to be favourable to the government, imposing increased risk to private sector teams. Their perspectives indicated:

- Procurement risk can be reduced by increasing the stipend, being more flexible regarding innovations and being more consistent in enforcement of the technical requirements across the projects;
- The team relationship was critical to project success. Delivery of a project of this scope and magnitude was a "once in a lifetime achievement"; and
- Early involvement by the private sector operator in the design and construction was key to addressing long-term risk and to improving the whole life cycle delivery of the

projects. Concern was voiced regarding how the government made calls in deciding its response to difficult and challenging situations in delivery of quality work.

The designers provided additional points of view, including:

- The Alberta process was successful. However, the market appetite for risk is changing and lessons learned from the Ring Road delivery should be considered for future work. Changes in terms of unknown geotechnical risk; consistent functional plan - P3 standards; sharing of third-party risk; and shared utility performance risk should be considered;
- The P3 delivery offers a significant benefit to governments. The approach is positive in terms of competition and in bringing the resources of a committed and motivated team to deliver the project. Further improvements to utility, permit and approval resolution and how to deal with site unknowns should be considered; and
- Under the deferred payment structure, the private sector delivery team is in an "all or nothing" situation to meet the project schedule. Transfer of unmanageable risks and dealing with difficult, constrained situations requires a more flexible approach be permitted by the government.



# Traditional Versus P3

The second comparison of work in this study is between the traditional delivery (DBB) approach (SW Henday) and the P3 delivery approaches (the remaining three Ring Road P3 segments). The performance of the P3 projects is discussed above. Below is an assessment of two of the SW Henday projects delivered using DBB or DB models.

## **Southwest Anthony Henday DBB**

The SW Henday was delivered using a traditional DBB delivery model. Prior to 2000, a segment of the four-lane highway between the Whitemud to Yellowhead was constructed in two stages by the City of Edmonton. From 2000 to 2011, the remainder of the SW Henday was built by the province from Whitemud to Calgary Trail. The 2000 to 2005 phase involved a series of contracts to construct the four-lane highway from the Whitemud Interchange across the North Saskatchewan River to Terwillegar. The remainder of work in the SW Henday, from Terwillegar to Calgary Trail, was completed in 2006, connecting west Edmonton from Highway 16 to Highway 2, including a concrete paving section from Lessard to Calgary Trail. Two follow-up contracts, both completed in 2011, eliminated the last traffic signals in the corridor. These contracts were the Stony Plain Road/100 Avenue design build (DB) and design bid build projects for the Callingwood/Lessard and Cameron Heights interchanges.

There were no detailed data or metrics available for the SW Henday, but the interviews identified the majority of the work between 2000 and 2006 was undertaken through contracts involving separate grading, paving and bridge works, estimated to be delivered using approximately 30 separate work packages.

Their perspective on this DBB delivery of the SW Henday included:

- No details were available regarding the City of Edmonton contracts prior to 2000. However, subsequent contracts encountered added cost in road widening and reconstruction due to the presence of topsoil/peat and fly ash affecting the

following reconstruction work. This required additional materials management, disposition and disposal.

- The work from 2000 to 2005 required Alberta Transportation to coordinate a large number of contracts designed by their engineering consultants who also coordinated the grading, paving and bridge work activity. Work pace and progress was based on budget allocations, which varied from year to year. This approach required overall management by the province to address schedule, contract interface, and interference and/or delays among the multiple contracts.
- The traditional delivery approach applied the standard Alberta Transportation contract and specifications based on design by the province's engineering consultants. The 2000 to 2005 phase was contracted by project component (for example grading, paving or structures). The following contracts delivered in 2011 were in complete packages, working in live traffic and performing grading, paving and bridge work in a single contract.
- Callingwood/Lessard was seen as a fairly routine and successful traditional project delivered on time and budget. There were minor unit cost overruns due to the unknown soil conditions mentioned above. From both the government and designer/contract administrator perspective, the traditional delivery model was appropriate to the scope and delivered good quality work. Some innovations were introduced, such as the use of precast concrete deck panels on the bridges, which were relatively new in Alberta. There were construction challenges in placement of the panels on the first bridge but the process was refined and kinks were worked out on the second bridge, where work went smoothly. This demonstrates the value of multiple similar operations improving

efficiency in subsequent iterations of the work.

- The 100 Avenue/Stony Plain Road work was the first time a design-build approach<sup>14</sup> was used on an Alberta highway project. The project scope, a systems interchange connecting to the SW Henday, was larger than the adjacent Callingwood/Lessard interchange project. Similar earthwork challenges were encountered due to peat and topsoil altering the soil mass balance, despite the design build team investigating the site conditions during the procurement phase. Weather was a major issue in project delivery and caused soil management challenges due to two wet construction seasons. There were a few unanticipated scope/cost issues where the project limits were not well defined. The City of Edmonton watermain relocation demanded unexpectedly high standards of construction. These issues contributed to the challenge in meeting the scheduled completion date. The unexpected circumstances also created financial pressures for the delivery team, as no change orders were accepted for the work.

During the preparation of this study, additional information was found regarding the long-term performance of the concrete pavement work on the Ring Road, from Terwillegar to Highway 2.<sup>15</sup> In 2017, a forensic evaluation was undertaken on this section. The report found poor performance of the pavement joint sealants used in the initial construction and a lack of longitudinal tie bars at merges and ramps. The pavement was identified as performing poorly, exhibiting inferior ride quality due to pavement warping, poor subsurface and surface drainage, missing tie bars and misplaced transverse dowels. The concrete pavement roadway segments had a far higher than expected traffic loading, but most of the performance problems were not caused by traffic volumes, but rather by design or construction issues. Extensive rehabilitation work was recommended by

the report. The poor pavement performance was evident from 2006 to 2017, particularly in terms of ride quality. Due to far greater traffic than forecast, the pavement was estimated to be close to its design life, with little remaining service life. Therefore, the pavement required diamond grinding to improve ride quality and skid resistance.

One interviewee, familiar with the current widening of the SW Henday to six lanes, noted that although the shoulders were built to a full lane width in the initial stage, to avoid pavement joints when widening, the widening effort was costly and inefficient due to the narrow shoulder widening and need for longitudinal connections between the existing pavement and the new shoulder in the concrete pavement sections. This widening work was noted to significantly affect traffic operating on the highway by constraining road capacity due to construction lane reductions. Traffic management and the restricted working area also added to the construction cost of work.

In summary, the SW Henday project has the following features of interest for this study:

**Scope of Work:** For the most part, the project scope of the various contracts was well defined except for the water main work and the poor definition of project limits at the 100 Avenue/Stony Plain Road interchange. Project due diligence investigations did not identify the poor soil conditions (peat and topsoil) left behind from the earlier city works, which complicated construction and added cost to the subsequent contracts.

**Cost:** Most components of the project were delivered on or close to the proposed costs. Some cost overruns occurred on Callingwood/Lessard due to earthworks overruns. On 100 Avenue/Stony Plain Road, the design build risk transfer approach required the design build contractor to absorb the weather, site condition and project definition risks.

**Schedule:** Most components of the project were delivered on schedule. However, it took about 20 years, from the initial city work starting in about 1991

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<sup>14</sup> Design Build (DB) involves the only two of the four components of a DBFO approach. The (DB) contractor works with a designer and the approach does not require a developer or an operator, as there is no 30-year concession.

<sup>15</sup> This was the first concrete roadway built by the Alberta government — a 14-kilometre stretch of Anthony Henday Drive between Lessard Road and Calgary Trail. Opened in 2006, it was expected to have a lifespan of up to 30 years. It is currently undergoing a second major rehabilitation as part of a \$125-million expansion project. See <https://www.cbc.ca/news/canada/edmonton/cracked-up-concrete-section-of-anthony-henday-ring-road-undergoing-2nd-major-rehab-1.5889766> (Accessed November 6, 2022).

to the 2011 completion of the SW section by the province, to build 24 kilometres of Ring Road.

**Risk:** Standard Alberta risk transfer applied to the DBB work, except for the design build assignment where the risk transfer is more consistent to a P3 approach. On the design build work, a number of risks were successfully transferred to the design build contractor.

On the Callingwood/Lessard project, the quantity overruns were the risk responsibility of the government. On the concrete paving contract, the DBB approach meant the province is responsible for the rehabilitation and cost of work to repair and widen the existing pavement. Part of that was by design, as the road construction was phased with an initial four-lane section, with widening happening as required by future traffic growth. The poor pavement performance was a latent defect in the initial construction and a risk retained by the Government of Alberta.

**Quality:** It appears the various contracts in most cases delivered good quality work. An exception is the early city work that disposed poor soil material adjacent to the roadways, affecting the future work. Another exception is the concrete pavement that exhibited material performance issues as identified in the above-mentioned forensic report.

**Innovation:** Some innovations occurred such as the concrete deck panels on the Callingwood/Lessard interchange project. However, in general the extent of innovation appears to be limited in DBB delivery. The concrete pavement experiment was an innovation that unfortunately did not yield positive results.

**Delivery Model:** The delivery approaches were seen by all interview participants to be commensurate with the size of the various projects. Most of the DBB work was well under \$100 million in value and was best delivered by a traditional contract.

**Other Factors:** Other considerations not addressed above were found to be inherent in the government's management of a highway program using smaller, traditionally delivered contracts. These factors include:

- **Traffic Management:** The DBB project did not build for a 30-year horizon. It involved initial construction with further work to be completed later. Therefore, the subsequent work occurred in live traffic, resulting in

additional cost and increased disruptions to mobility in the corridor.

- **Program Management:** Managing a large number of small contracts imposes a greater risk to the government to coordinate various work packages and avoid this interface risk between different contracts. The issue is usually solved by separating work by time and/or space. However, the consequence of that approach is that work takes longer to complete.
- **Traffic Congestion:** Staged DBB work involves construction and opening the work to traffic with subsequent follow-up work for future widenings and interchange construction. On the SW Henday, this approach contributed to congestion as the traffic forecasts underestimated growth and the roadway reached capacity sooner than anticipated. This leads to higher costs for the future work, as a greater proportion of work is in traffic requiring traffic staging, detours, lane management and lane closures. Looking back on the SW Henday, there were a number of news articles regarding complaints of delays due to the first-stage traffic signals. The congestion was partially relieved when the interchanges were built, and fully delivered when the highway was widened to six-lane lanes.
- **Project Certainty:** Work delivered through a traditional delivery model is often constrained by budget allocation limitations. Therefore, the work proceeded in stops and starts, creating greater uncertainty in the timing and completion of the overall program.

## P3 Ring Road Delivery Compared to Design Bid Build Delivery

The three P3 Ring Road projects were discussed in detail previously. A brief summary of the relevant findings is provided in the following sections to show a direct comparison of the P3 delivery approach to the DBB delivery approach.

**Scope of Work:** The P3 projects had a high level of project definition. Scope was well defined, except that the private sector teams bidding on the projects needed to take the functional plan provided by the province and update the design to meet the higher design standards specified in the P3 RFPs. This approach created a higher standard for the P3 projects but also complicated the delivery team's procurement task to refine the design during the procurement phase. On DBB projects, the design typically implements the functional plan.

Site due diligence is a key success factor for P3 highway projects. On a P3 project, the level of site investigation is less than that undertaken by a DBB design assignment because the design risk is transferred to the private sector partner, which is a large part of that due diligence. With design accounted for, pre-design due diligence is generally similar for DBB and P3 delivery. Design bid build work is focused on a single project with 100 per cent design, as opposed to a 30 per cent (or less) level of design at the start of the P3 procurement phase.

The three P3 Ring Road projects needed to adapt in a few situations to unknown or unanticipated site conditions:

- On the SE Henday, additional pavement and foundation work was performed during the procurement phase because the private sector teams required more information. The province facilitated a combined request where additional site investigations were performed at the cost of the consortiums bidding for the project. The additional investigations improved the proponents' understanding of subsurface conditions. Beyond that, there were no significant site condition issues on the SE Henday. However, the project limit at the Transportation Utility Corridor (TUC) was an unclear scope element only resolved working with the city to fund the design of road connections north and south of the TUC.
- On the NW Henday, the site conditions were considered well defined.
- On the NE Henday, there were a few situations where site conditions were not well defined in the opinion of the delivery team. One example was the unknown utilities encountered during the design and construction phase of the project. During the

procurement phase, the existence of coal mine shafts below the project were identified. However, the information did not provide solid and reliable data on location and elevation. This meant private sector consortiums bidding on the project were responsible for bearing the risk during project delivery, if selected.

**Cost:** Two of the three P3 projects, the SE Henday and NW Henday, were delivered at the fixed price agreed to for the work. The NE Henday had a change order due to the difficulty in organizing and scheduling major pipeline relocations and the additional cost of utility relocation.

**Schedule:** All three P3 projects were delivered on schedule. The NW Henday required management and mitigation of schedule to account for pipeline relocation impacts.

**Risk:** The standard Alberta P3 risk transfer was used on all three projects in a similar fashion. Risk did manifest on all projects and, in almost all cases, was addressed by the delivery teams under the project risk transfer terms and conditions. On all three projects, the design approval risk was a concern. Design review comments and observation responses did not match the pace of the design process. This affected delivery of the Issued for Construction (IFC) drawings. On the SE Henday, this was managed by going to construction with a due consideration of the outstanding input from the owner to manage risk considering the severity and impact of outstanding comments, adjusting design schedules and adapting work in the field accordingly.

- On the SE Henday, approval risk related to wetlands was addressed by securing a letter of credit with Ducks Unlimited Canada. This allowed the team to obtain early environmental approval to advance earthworks. Fuel cost risks were encountered, as diesel prices spiked during delivery. The additional cost was borne by the contractors involved. Equipment supply risk occurred because of a shortage of pile driving equipment, requiring a switch from piles to augured caissons for bridge foundations.
- On the NW Henday, the risks identified were addressed by the delivery team. Minor risks occurred including right-of-way constraints, coordination with National Defence on

lighting requirements and stormwater management pond bird nesting constraints. Another key risk was at St. Albert Trail. The controlled profile elevation caused challenges with uplift, soil pressures, frost susceptible soils and drainage. This was resolved using coordinated engineering and geotechnical designs.

- On the NE Henday, the major risks involved railways, utilities, major river crossing and coal mines below the corridor. As noted earlier in the study, the actual utility costs were higher than expected, which invoked the maximum sharing of utility costs in the project agreement. Also, due to undefined utilities and challenges in relocating pipelines, the delivery team had to mitigate the issues and work to meet the project schedule. The coal mine issue was resolved by the delivery team, undertaking additional investigations to locate mine shafts and design shallow foundation treatments where required. Management of traffic was another project challenge. The delivery and owner's teams worked out a practical solution when identified physical restrictions and constraints on in the highway corridor required greater flexibility in the design and construction approach. For railways, the functional plan showed the highway under the railway, which complicated both the construction of the rail structure (rail diversion) and the rail structure maintenance (by the railway company). The final design placed the highway over the tracks to minimize costs, reduce the railway approval timeline and simplify the track safety requirements. The North Saskatchewan River crossing bridge risk was managed by working closely with Fisheries and Oceans Canada and locating bridge piers to minimize watercourse impact.

**Quality:** It appears the P3 projects, in general, delivered good quality work. The owner's team indicated the P3 quality requirements were tightened up as work progressed. The owner's efforts on quality oversight increased from the first to the last P3 project under the Ring Road Program. This was in response to changes in quality system approaches on

the later projects. One owner's interviewee indicated "it was evident that the quality of work was driven by the OMR (operations, maintenance and rehabilitation) and it showed up in the work." This demonstrates how the whole life cycle approach incentivizes the private sector team's performance throughout the project, including both design and construction and operations. However, another owner's interviewee was not so sure the Alberta P3 lowest bid price approach delivered top quality.

**Innovation:** The Alberta approach allowed limited innovation in procurement, preferring to keep work within standards and specifications. However once awarded, there was more flexibility allowed in the roadway segments. Stricter requirements were applied to bridge design and construction, limiting innovation to changes in span and general arrangement. In general, all three P3 projects did manage to deliver innovation to a certain extent.

- The SE Henday won the Alberta Award for Innovation due to innovative interchange configurations, utility protection, bridge types, bridge arrangements, environmental approaches, illumination design and electrical wiring schemes.
- The NW Henday also won the Alberta Award for Innovation based on the introduction of the rotary systems interchange configuration and the innovative engineering solution for the St. Albert Trail.<sup>16</sup>
- The NE Henday delivered innovation to meet the project challenges in foundation design over coal mines and wetland compensation. However, innovation on this project was more difficult to achieve.

**Delivery Model:** The P3 delivery approach was seen by all interview participants to be commensurate with the size of the various projects. In almost all cases, the participants indicated using the P3 model was the only way the final three segments of the Ring Road could be completed within the government's ambitious time frame.

**Other Factors:** This section discusses the additional factors where P3 delivery was commensurate with a different, better outcome than a traditional design bid build approach. These additional factors include:

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<sup>16</sup> A major arterial road connecting the cities of Edmonton and St. Albert, AB.

- **Traffic Management:** P3 delivery involves a full build to a 30-year forecast traffic volume. This typically involves more greenfield work and completes all highway improvements upfront, with limited, deferred future work required. Therefore, the P3 approach minimizes impact to live traffic and avoids the associated costs and disruptions to mobility (traffic impact was generally limited to crossing roads and connections). This advantage was evident on the SE Henday and NW Henday segments. NE Henday was different, as it involved a greater extent of brownfield work along the existing east segment of the Ring Road. The initial staging approach for work in this corridor segment did not offer the opportunity for a complete greenfield construction scope.
- **Program Management:** The management of work under a single P3 project eliminates the risk to the government in having to manage multiple work packages and transfers the risk of coordinating various contracts by different contractors. The consequence is that P3 delivery allows for the delivery of a large scope of work within a reduced time frame.
- **Traffic Congestion:** As work is packaged and delivered as a single project, there is significantly reduced congestion. The development of the Ring Road P3 projects was based on a 30-year traffic forecast. Therefore, greater road capacity was built at the outset and any widening or expansion is pushed beyond 30 years into the future. This avoids future staged work within the next 30 years, including building the deferred interchanges and constructing the lane widenings, which occupied in the design bid build delivery of the first section of the Ring Road.
- **Project Certainty:** The P3 approach offers greater certainty of project delivery and there are financial consequences to the delivery team if the completion date is not met. All three P3 Ring Road projects were delivered in a short time frame, and all were on time.

# Summary

To conclude, the delivery of the Edmonton Ring Road Program was highly successful. The P3 approach offered what was considered the only way to deliver an ambitious program in such a short time.

## P3 Delivery Approach

The consensus was that the Alberta delivery approach was an excellent way to deliver a substantive, staged highway program. The scope of work was generally well defined, and the site investigation was appropriate for project delivery, but was considered a bit limited by some delivery teams. Work was delivered in accordance with the agreed fixed price, except for the NE Henday, which required a change

order to deal with the extent of the utility relocation effort.

Every P3 project was delivered meeting the planned project completion date. The risk transfer approach was seen as reasonable, benefiting the government because of risks transferred to the private sector delivery team. In most cases, the quality of the work was good, managed based on the ISO Quality Management Systems. At times, the owner's oversight process needed to intercede in the quality process to ensure its expectations were met. Innovation was not encouraged in the P3 process by the government. Notwithstanding that, the delivery teams did find opportunities to innovate to meet the project objectives, to solve project challenges and to minimize the cost of work. All parties interviewed supported the P3 delivery model. The owner's team

was satisfied with the approach. However, the delivery teams noted that market appetite for risk in the Alberta P3 model changed from 2004 to present. Modifications to the approach should be considered before future highway P3 projects are brought to market.

This study offers some lessons learned, gleaned from the various inputs and responses. Recommendations include:

#### **1.) Need to Evolve the Alberta P3 Delivery Model**

The Alberta delivery model was constant over the P3 program in Edmonton and contributed to the program's success. However, since the Alberta P3 approach was set out in the early 2000s, the market's appetite for risk has markedly changed. In other jurisdictions, where work is more complex and constrained, such as in urban conditions, the model has also demonstrated a need to evolve. Modernization of the Alberta Highway P3 model would revitalize the approach, adapt to current realities and attract increased bidders' interest to continue to deliver a highly competitive, fair and transparent bid process for Albertans.

#### **2.) Clear Project Limits**

Alberta should align its functional plan design requirements with its Schedule 18 requirements, which would help set clear project limits and avoid uncertainty in the bid scope of work. In addition, construction bid essentials, location and the utility company responsibility in the utility relocation process, should be determined prior to RFP issuance for clarity of scope through proactive government engagement with pipeline and utility companies. Enhanced utility definition and location is required on all projects, along with a defined process, such as a master utility agreement, to outline the conduct of utility companies engaging with P3 delivery teams.

#### **3.) Indexing Critical Costs During Times of Uncertainty**

Governments should index critical costs, given the current escalation in interest rates, widespread supply chain challenges, and volatile energy, material and labour costs. Also, mechanisms should be added to project agreements to share the risk of addressing

unforeseen supply chain events and material unavailability.

#### **4.) Completion Date Left to Private Sector Delivery Teams**

Delivery teams should set project completion dates rather than the government, enabling the private sector to optimize the construction schedule based considering the project scope and complexity. The completion date is optimized considering the project financing approach. The delivery team setting the completion date means the consortiums bidding for the projects take a greater responsibility for schedule risk.

#### **5.) Reconsideration of Project Risks**

Unknowable unknowns cannot reasonably be transferred to the private sector. A review of the project agreement should reassess risk transfer of any such project elements where they may occur. Utility cost is already a shared risk. However, in difficult, complex and constrained areas, consideration should be given to sharing the risk of utility company performance. This is becoming a significant market concern across Canada and requires review of the Alberta project agreement template. Third-party risk transfer should likewise be reconsidered when neither party can best manage the risk.

#### **6.) More Robust Quality Management System**

A more robust Quality Management System (QMS) approach is recommended with an enhanced definition of quality requirements in the project agreement. On a P3 project, the best results occur when the majority of the quality management responsibility resides at the private sector team level, with thorough and direct oversight by the Quality Management team, the engineer of record (EOR) and operator. The quality assurance process should be separate (in terms of management and reporting) from the quality control role by the design build team and their subcontractors. Severity of non-conformance records (NCRs) should be recognized in the QMS process considering differing consequences and the relative urgency of response from both government and the private sector team to disposition resolution. The NCR disposition process should be transparent with clear roles, responsibilities and accountabilities.

## 7.) Prioritizing Innovation in Long-Term Agreements

Alberta may be missing opportunities to innovate the bridge structure work on P3 projects, where there is a 30-year responsibility for maintenance and rehabilitation providing surety of performance over that time frame. With due consideration for durability and life cycle, the P3 process offers the opportunity to explore new, prudent and incremental innovations in bridge design and construction. To achieve this, a clear process is needed, particularly in the bid process and during construction, to address and evaluate innovation opportunities based on the project agreement in a clear and transparent fashion.

## 8.) Rethinking Honorariums

With more projects coming online with greater complexity and size, the government should re-examine and increase its honorarium levels and consider scored technical submissions. Both items contribute to innovation and competition in delivery of challenging, complex work. General market sentiment and experience on projects across Canada indicates market players will respond favorably to these types of improvements to the Alberta Highway P3 process. And a healthy completion amongst bidders compensates for the higher stipend.

# Design Bid Build Versus P3 Approaches

This study also compared a traditional design bid build approach to P3 delivery. The examination of the SW Henday using primarily traditionally procured DBB contracts is well contrasted by the performance of the three P3 assignments.

A number of the differences in the two approaches are as follows:

**Scope of Work:** The scope of work of the DBB assignment evolved from separate grading, paving and structure contracts, to complete assignments with all components in one contract. However, there were still many contracts required to deliver the SW Henday work, as compared to the P3 assignments.

An important difference between the two project delivery approaches is that work using the DBB on SW Henday was piecemeal with interchanges, flyovers and lanes added in stages over an almost two-decade period. This resulted in interim congestion in the corridor, as the work was not built to a 30-year design life, plus later expansion works had a significant, greater impact on mobility in the corridor due to lane closures, traffic staging and road widening work needed to upgrade the SW Ring Road to the 30-year design life configuration. Such impact is largely avoided by the P3 approach where the work is performed all at once meeting a longer design horizon. That approach has far less impact on the travelling public.

**Cost:** The cost of work between the two is difficult to assess, as work was contracted and carried out at different times and detailed cost information is not available for all the SW Henday work going back to the initial City of Edmonton works in the early 1990s. The DBB work does not include the 30 years of operations, maintenance and rehabilitation costs, which are included in the three P3 agreements.

Finally, the latent defect repair cost (concrete pavement repair) and the added cost for the current SW Henday mainline widening is estimated as \$125 million. There was consensus from those interviewed that Value-for-Money was delivered by the P3 projects. A direct cost comparison was not possible without more detailed information on the traditional procurements for SW Henday. **However, we can definitively state the P3 projects performed more work, meeting a higher design standard and achieving a longer design life, than the traditionally delivered work.**

Both the traditional approach and the P3 projects involved additional costs by change order. Neither approach is immune to claims and added cost. However, as the P3 work includes operations, maintenance and rehabilitation over the 30-year agreements, the risk of higher maintenance costs and latent defects affecting future cost for the Government of Alberta is reduced.

**Schedule:** The three P3 Ring Road projects delivered each project with construction schedule duration ranging from three to five years. The traditional



approach on the southwest Leg has taken two decades and work is still ongoing with the need to widen to six lanes. This clearly shows how the P3 approach delivers far a significantly larger scope of work in a much lesser time. This approach also lessened the impact on the travelling public.

**Risk:** The P3 approach transferred more risk to the private sector, including design, quantity, quality, constructor, traffic management, soils, permits, safety, contract interface, life cycle and schedule risk. That risk transfer offers improved value and significant savings to the government and Alberta taxpayers. The extent of risk transferred to and managed by the private sector is documented herein and is significant. Similar risk transfer does not occur on traditionally delivered projects.

A good example of the downside of traditional delivery is the latent defect in concrete pavement performance on a section of the SW Henday. Had this work been done under a P3 agreement, the cost of that deficiency would be borne by the private sector. In a traditional DBB, it is a government retained risk.

**Quality:** The traditional delivery and the P3 approach involve completely different approaches to quality. With traditional delivery, the government dictates the design and directs the work inspecting construction activity through their consultants. This gives the government more control in the performance of the work, but it is also responsible for the long-term performance after expiry of the warranty period. It is, therefore, a double-edged sword.

With P3 delivery, quality is managed by the private sector delivery team with government oversight. Government oversight ensures work is delivered as per the project agreement. However, the bulk of the quality effort falls to the private sector partner since it is responsible for design, construction and operation, as well as quality risk for 30 years post-substantial completion. That process creates accountability. As Alberta Transportation fully understands, the key to success is to focus on the safety and long-term durability of structures beyond the end of the P3 agreement period.

**Innovation:** Opportunity for innovation is limited in traditional delivery. It happens but ultimately the

**success or failure of any innovation is a savings or cost to the government, either in construction or operation.** As seen on the SW Henday, the concrete pavement experiment was not successful. It required additional costs and affected traffic during repair. Conversely, significant innovation was delivered by the P3 Ring Road Program projects with the risk of the innovations being the responsibility of the private sector delivery Teams.

**Based on the above considerations, the P3 approach can be seen as superior to the traditional DBB approach in scope of work, cost, schedule, risk transfer (particularly long-term performance risk) and innovation.**

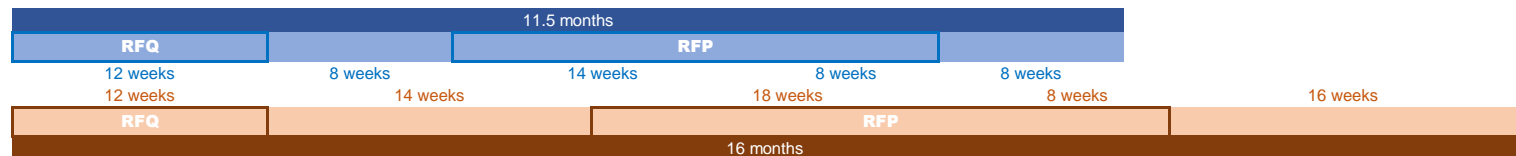
**For the Ring Road, both the P3 and DBB approach produced similar quality outcomes. By any reasonable measure, this study and the input from participants confirmed the benefits of the P3 process over traditional DBB delivery.**

# APPENDIX A

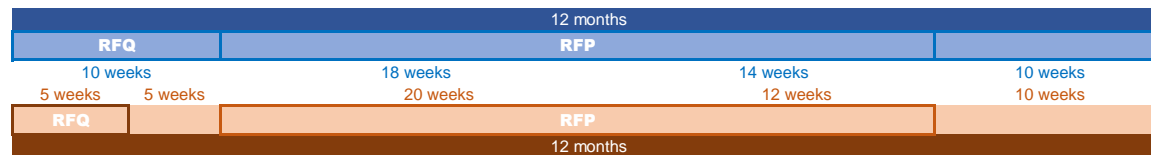
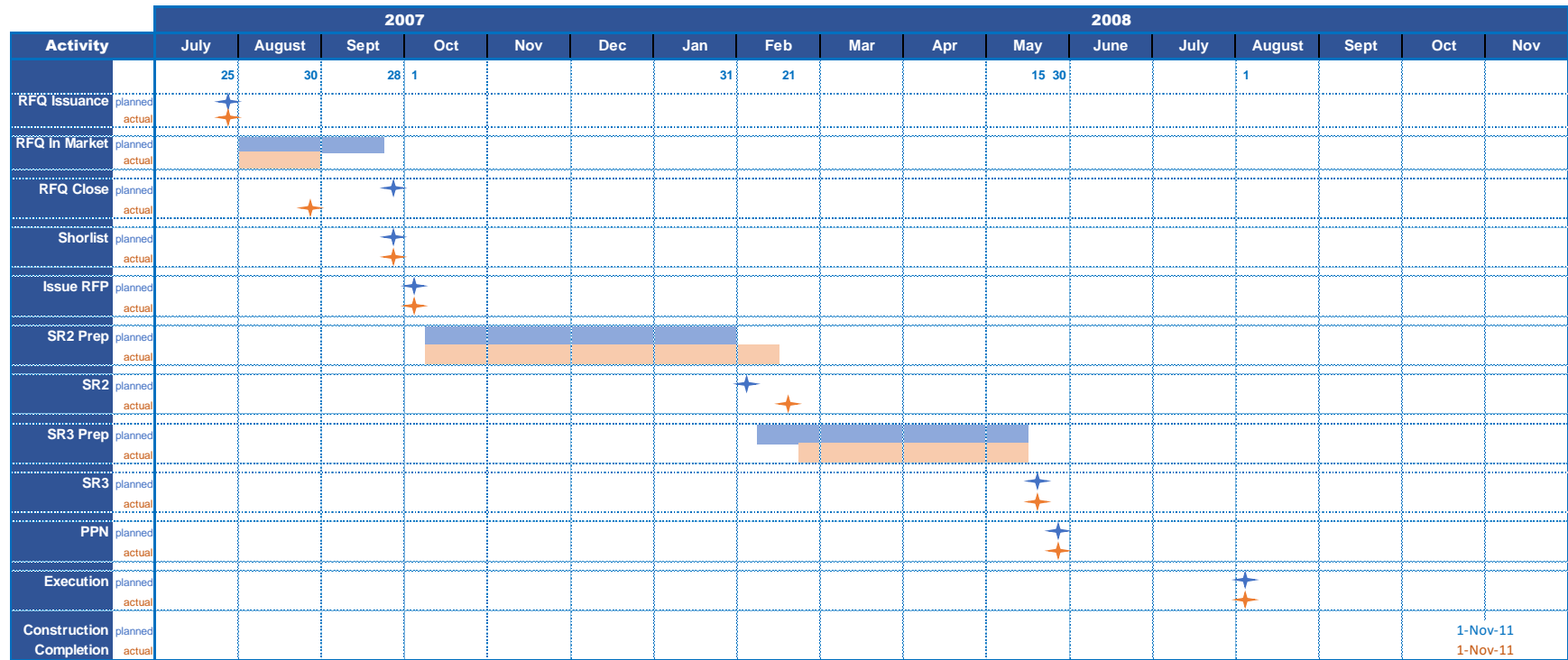
## P3 Project Schedules

Project SE Anthony Henday Drive

		2003				2004												2005
Activity		Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	August	Sept	Oct	Nov	Dec	Jan
RFQ Issuance	planned	22			16	15	15		5	15		15	3 15	15	1 29		15	25
	actual																	
RFQ In Market	planned																	
	actual																	
RFQ Close	planned																	
	actual																	
Shortlist	planned																	
	actual																	
Issue RFP	planned																	
	actual																	
SR2 Prep	planned																	
	actual																	
SR2	planned																	
	actual																	
SR3 Prep	planned																	
	actual																	
SR3	planned																	
	actual																	
PPN	planned																	
	actual																	
Execution	planned																	
	actual																	
Construction Completion	planned																	
	actual																	



Project NW Anthony Henday Drive



Project NE Anthony Henday Drive

