FINAL REPORT

Queen Elizabeth II and 65th Avenue [Leduc] Interchange

Functional Planning Study

Presented to:

Government of Alberta
North Central Region
4513 - 62 Avenue
Barrhead, AB T7N 1A5

City of Leduc
#1 Alexandra Park
Leduc, AB T9E 4C4

Edmonton International Airport
1, 1000 Airport Road
Edmonton International Airport, AB T9E 0V3

Castleglenn Consultants
Engineers, Project Managers & Planners

R-1204

October, 2016

FUNCTIONAL PLANNING STUDY

Queen Elizabeth II and 65th Avenue [Leduc] Interchange

Mr. Arthur E. Gordon, B.A. P. Eng.
Transportation Planning
Castleglenn Consultants Ltd.
Consulting Engineers

Castleglenn Consultants
Engineers, Project Managers & Planners

Date: October 6th 2016

Accepted by:

Mr. Michael Botros, P. Eng.
Executive Director
North Central Region
Alberta Transportation

Date: DECEMBER 20, 2016

Mr. Des Williamson, P. Eng.
Acting Executive Director
Technical Standards Branch
Alberta Transportation

Date: December 22, 2016

Alberta Transportation

Mr. Mike Pieters, P. Eng.
General Manager
Infrastructure and Planning
City of Leduc

CITY OF Leduc

Date: November 1, 2016

Mr. Steve Rumley
Vice President
Infrastructure
Edmonton International Airport

EIA
we'll move you.

Date: December 15/16

Alberta Transportation

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File: 2600-19:10

December 22, 2016

Mr. Mike Pierters, P. Eng.
General Manager
Infrastructure and Planning
City of Leduc
1 Alexandra Park
Leduc, AB T9E 4C4

Mr. Steve Rumley
Vice President
Operations and Infrastructure
1, 1000 Airport Road
Edmonton International Airport, AB T9E 0V3

Dear Messrs. Pieters and Rumley:

RE: Queen Elizabeth II and 65th Avenue (Leduc) Interchange Functional Planning Study
Final Report (October, 2016: R-1204)

Thank you for your involvement in the above Functional Planning Study. Alberta Transportation is pleased to acknowledge acceptance of the recommendations, conclusions and supporting functional plans subject to the following concerns being addressed:

a) The supporting environmental evaluation is to be expanded to remain in compliance with the most current Alberta Transportation requirements with particular emphasis on areas which may be contaminated. This is to take place prior to undertaking the detailed design of the infrastructure indicated within the document.

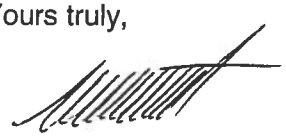
b) The existing 50th Street bridge will be required to be removed at the time of the QE II having to be realigned which is expected to coincide with the timing of the 65th Avenue interchange. It is Alberta Transportation's position that with the advent of a new six-lane 65th Avenue interchange, improvements to the Airport Road interchange, and the two lanes afforded on the new twinned 50th Street bridge, that sufficient access will be provided for the study area. A replacement 50th Street bridge, if desired would primarily serve local requirements and is to be funded by others.

c) The detailed design is to consider options to improve the weaving distance along Highway 2 between the 50th Avenue NB-On-Ramp and the 50th Street/64th Avenue NB-Off-Ramp which potentially should include ramp modifications to either or both ramps.

.../2

Alberta Transportation wishes to convey our thanks to the participating agencies that have made this functional planning study possible. The document is sure to provide a useful guide in the development of transportation infrastructure in the years to come.

Yours truly,



Michael Botros, P.Eng.
Regional Director

MB/jm

CITY OF Leduc

January 13, 2017

To: Michael Botros, P. Eng	Mr. Steve Rumley
Regional Director	Vice President
Alberta Transportation	Operations and Infrastructure
Delivery Services, North Central Region	Edmonton International Airport
Box, 4596, 4513 - 62 Avenue	1, 1000 Airport Road
Barhead, Alberta	Edmonton International Airport, Alberta
T7N 1A5	T9E 0V3

SENT BY EMAIL

Michael.Botros@gov.ab.ca; SRumley@flyeia.com

Dear Messrs. Botros and Rumley

RE: Queen Elizabeth II and 65th Avenue (Leduc) Interchange Functional Planning Study Final Report (October, 2016: R-1204) - Your File 2600-19:10

Thank you for your letter dated December 22nd, 2016. The City of Leduc would like to acknowledge and to reply to each of the three concerns being addressed. The City of Leduc:

a) acknowledges Alberta Transportation's (AT) desire to expand the environmental evaluation to remain in compliance with AT requirements with emphasis on identifying contaminated sites and their required mitigation that could affect the detailed design.

b) would support a more cautious approach be taken prior to concluding that "sufficient" access be provided once the 65th Ave interchange is in place without the ultimate replacement of the exiting 50th Street bridge structure. This conclusion is based on what is today; a "best-guess" of traffic forecasts within the next two decades. The City would support on-going monitoring of traffic levels and land use forecasts within both the EIA and the City of Leduc lands, prior to concluding sufficiency in the absence of bridge replacement during detailed design of the ultimate interchange.

c) We acknowledge and concur with Alberta Transportation's (AT) desire to explore additional ramp modification options to further improve the weaving distance between 50th Avenue and the 50th Street/64h Avenue NB Off-Ramp at the time of detailed design.

Thank you for your participation within this functional planning document. The City looks forward to confirmation that AT will contribute towards the detailed design where we will analyze and resolve the issues identified above.

Sincerely,

Mike Pieters, P.Eng.
General Manager, Infrastructure and Planning

Phone: (780) 980-7151
mpieters@leduc.ca

CASTLEGLENN CONSULTANTS LTD.
THIRD PARTY DISCLAIMER

This study has been prepared by CastleGlenn Consultants Inc. ("CGC") for the benefit of the Client to whom it is addressed. The information and data contained herein represents CGC's best professional judgment in light of the knowledge and information available to CGC at the time of preparation. Except as required by law, this study and the information and data contained herein are to be treated as confidential and may be used and relied upon only by the Client, its officers and employees. CGC denies any liability whatsoever to other parties who may obtain access to this study for any injury, loss or damage suffered by such parties arising from their use of, or reliance upon, this study or any of its contents without the express written consent of CGC and the Client.

ACKNOWLEDGMENTS

The Consulting Team of Castleglenn Consultants Inc., The Archaeology Group, Vertex Environmental, Golder Associates, Thurber Engineering Ltd., BT Engineering and AECOM wish to extend their sincere appreciation to those individuals and groups from Alberta Transportation, City of Leduc, Leduc County, Edmonton International Airport and the residents, employers and organizations without whose cooperation and input this study could not have been accomplished.

In particular, we wish to express our sincere appreciation to those who have served as members of the Technical Review Committee, which include:

- Mr. Shawn Olson, Director, Engineering, City of Leduc
- Mr. Ryan Graham, Manager, Infrastructure, City of Leduc
- Mr. Kevin Cole, Former Director Engineering, City of Leduc
- Mr. Michael Pieters, General Manager, Infrastructure and Planning, City of Leduc
- Mr. Konrad Dunbar, Manager, Engineering, Public Works & Engineering, Leduc County
- Mr. Steve Rumley, Vice President, Operations and Infrastructure, EIA
- Mr. Rob Hough, Manager, Engineering, Planning & Compliance, EIA
- Mr. Blair Knott, Highway Planner, Alberta Transportation
- Mr. David McKay, Director Highway and Roadside Planning, Alberta Transportation
- Mr. Shoaib Kiani, Planning Engineer, Alberta Transportation
- Mr. Aaron Manuel, Infrastructure Engineer Intern, Barrhead, Alberta Transportation
- Ms. Caroline Watt, Bridge Planning Engineer, Alberta Transportation
- Mr. Julian Macdonald, Planning Engineering, Major Capital Planning, Alberta Transportation
- Mr. David McKay, Director, Highway & Roadside Planning, Alberta Transportation
- Mr. Dean Litke, Infrastructure Manager, Barrhead, Alberta Transportation
- Mr. Ernie Waschuk, Bridge Planning Specialist, Alberta Transportation

The contents of this document must be credited to numerous other individuals within the above agencies who have inadvertently been excluded from the above list, but which have contributed to the study process through their comments and guidance.

EXECUTIVE SUMMARY

The QE II Corridor

Alberta Transportation (AT) in partnership with the City of Leduc and the Edmonton International Airport (EIA) initiated the *"Queen Elizabeth II and 65th Avenue (Leduc) Functional Planning Study"* in September 2014 to address the long-term roadway and freeway requirements in the vicinity of 65th Avenue and the 50th Street Fly-over bridge. The study was intended to provide both functional plans to address an "*interim"* and "*ultimate"* strategy that would provide for enhanced accessibility across the QE II (Hwy 2) corridor and suggest a preferred configuration for a new QE II/65th Avenue Interchange. As well, the study was intended to outline the property requirements necessary to ensure the ultimate development of the corridor and the associated interchange improvements.

The QE II functions as a primary north-south freeway corridor and is part of the National Highway System, connecting the City of Calgary to the City of Edmonton. The 65thAvenue corridor was seen also as an opportunity to address congestion issues on Highway 39/50th Avenue. Highway 39 (50th Avenue) in the vicinity of the QE II is currently characterized by congestion during the peak periods and was at the time of the study initiation forecast to continue to deteriorate as development intensifies. There is limited opportunity for property acquisition along the Hwy 39 within the urbanized area of Leduc.

Study Area

- The study includes 8km of the QE II corridor centering on 65th Avenue.
- The majority of the study area is located within the City of Leduc's municipal boundary with the outer limits of the study area within Leduc County's jurisdiction.

Municipal Jurisdiction

- The land uses on the east side of the QE II are commercial, retail and light industrial. The lands on the west side of the QE II are currently largely un-developed.

Land Uses

Existing Conditions and Envisioned Growth

- *65th Avenue* falls within the City of Leduc's jurisdiction. A WB-23 truck was selected as the design vehicle for the roadway, with a 60 km/h as posted speed limit.

65th Avenue Classification

- The QE II is classified as a *"Long Combination Vehicle"* (LCV) route[1] accommodating *"Turnpike Double"* (Modified WB-36) heavy vehicles up to 41m in length. Furthermore QE II is not designed as a High Load Corridor[2]. A WB-36 was selected as the design vehicle for the QE II.

Heavy Vehicles

- The existing single-lane 50th Street Fly-over bridge was recently rehabilitated and has an estimate structural life of 25-to-30 years (2040-to-2045).
- The QE II[3] is classified as a "Level 1" highway that accommodates the movement

[1] Alberta Transportation Highway Geometric Design Guide (ATHGDG): Figure D-5c, Section D.5: Design Vehicle, Chapter D: At-Grade Intersections
[2] ATHGDG: Figure A-11, Section A.11: High Load Corridor, Chapter A: Basic Design Principals
[3] "*Alberta Transportation Design Bulletin #27/2005"* (Revised December 2008)

of people, goods and services inter-provincially and internationally and is defined as a core route in the National Highway System (NHS). The 8km section of the QE II addressed within this functional planning study represents a small (1.7%) portion of the total QE II (Hwy 2) corridor length between Hwy 3 in the vicinity of Fort McLeod to Edmonton which is roughly 450km in length. Access to the NHS corridor is generally restricted to major arterial roadways only[4].

- Current daily (2014) traffic on the existing QE II corridor:
  - 60,300-to-65,500 vehicles per day between north of 50th Street and south of the Airport Road Interchange with 11% heavy vehicles; and
  - 48,400-to-52,500 vehicles per day between north of 50th Avenue to south of the 50th Street Fly-over with 12% heavy vehicles.

Traffic Growth

- The average annual traffic growth rate along the QE II corridor north of 50th Ave is in the range of 4-to-5%. South of 50th Ave the average annual growth is in the range of 3-to-4%.
- During the peak hours of travel demand the QE II corridor experiences congestion at many of the QE II Interchange ramp intersections within the study area. As freeway traffic continues to grow and without the advent of infrastructure improvements, motorists making use of the QE II corridor are anticipated to experience increased merging and weaving constraints.

Collision History

- A review of 5-year historical collision information along the 8km length of the QE II corridor within the study area indicated a total of 620 collisions.

Planning with the Public

Public Involvement

- Two public open houses and three focus group meetings were held in January, June and September of 2015 with attendance at the public venues ranging between 10 and 30 individuals. Comments and concerns were recorded and responses documented.

The Edmonton International Airport (EIA) and NAV Canada

The EIA

- The EIA accommodates over 8M passengers per year and represented an active stakeholder throughout the entire planning process in relation to the development of land use forecasts, interpretation of the EIA Master Plan, and the applicability of runway clearance envelopes and obstacle surfaces. The study plans have been reviewed by senior staff and presented as an information item to the Board of Directors.
- EIA's current development plans include a large commercial/retail development inclusive of offices, hotel and commercial uses south of Airport Road and west of the QE II. In addition growth in the areas of passengers travel, cargo demands and airport support related services were accounted for throughout the EIA lands.

NAV Canada

- *NAV Canada* responding to a "Land Use Program" submission regarding the functional plans indicated no objection to the proposed new 65th Avenue interchange design.

[4] "*Provincial Highway Service Classification*" Stantec Consulting Ltd., 2007

The Municipalities

Local Municipalities

- *Leduc City Council* was informed by way of a Council brief and a presentation provided at the December 8th, 2015 Council Meeting where Council unanimously endorsed the results and conclusions of the study.
- Staff of the Leduc County were informed of the findings of this study as the study progressed

Municipal Growth

Planned Development Initiatives

- *the South Development Area* includes lands south of 65th Avenue and west of the QE II corridor inclusive of the planned Aerotropolis development. The entire developable area when built-out accounts for approximately in 2,600 gross acres of potential residential, commercial, business and public institutional development;
- *the North Development Area* is located north of the EIA lands and west of the QE II corridor and includes the proposed Crossroads development. The entire developable area when built-out accounts for approximately 3,600 acres of potential industrial, office and commercial development;
- an average annual growth rate of 2% was applied to the QE II highway thru-traffic component attributable to the QE II corridor;
- Future developments on the east side of the QE II corridor were accounted for by applying a separate growth factor of 2.5% over the next decade followed by 1% growth thereafter to all movements generated from/to east of the QE II corridor.

Analysis, Assessments and Evaluations

Alternatives

- The study assessed explicit considerations (such as existing conditions, constraints, traffic; the historical, present and forecast growth; existing and proposed land uses; public input, safety and opportunity to maximize the economic benefit in accordance to the community forecasts) and implicit considerations (such as the transportation network vision, the anticipated traffic volumes along it, staging; existing and proposed land uses outside the study area and conformance to Alberta Transportation standards).
- The analysis included an examination of traffic forecasts which were developed to represent a 2-year, 10-year, 20-year, 30-year, 60-year and 100 year+ time horizons. This approach permitted an examination of incremental infrastructure requirements.
- *alternative network scenarios* were evaluated assuming development of a Twinned 50th Street Bridge solution and/or a future 65th Avenue Interchange inclusive of the impacts upon the QE II corridor, adjacent interchanges and surrounding intersections and arterials.
- *alternative configurations* were evaluated and assessed with infrastructure assumptions detailing the 65th Avenue interchange over the current QE II alignment and a future realigned QE II corridor, in addition to roundabout vs. standard intersection ramp terminal evaluations;
- *staging* alternatives were analyzed which included the various timing of infrastructure options, (e.g. This included an evaluation of developing a 50th Street Twinned Bridge solution versus initially developing a 65th Avenue Interchange solution) as well as the potential staging of infrastructure elements (ramps, loops weaving lanes etc.)

- *timing* requirements associated with the development of the QE II core and collector lanes, interchange improvements and new north-south transportation corridors (e.g. Terwillegar Drive South Extension, Nisku Spine Road, and Rapid Transit) were analysed and assessed.

The Proposed Plans

a) The Interim Configuration

A New Bridge

- *A Twinned 50th Street Bridge*: The consultant's preferred solution envisions the twinning of the existing 50th Street Fly-over bridge with a new 2-lane southbound bridge located to the south of the existing fly-over bridge. The existing fly-over bridge would convert to northbound operation. The advent of this improvement would provide an additional east-west corridor over the QE II (connecting 65th Avenue East and the future 65th Avenue West) and assure local access for Leduc residents to access the EIA lands.
- At the time of detailed design, the advantages of developing a wider twinned bridge cross-section that would support an eventual conversion to a 3-lane cross-section are to be assessed. This offers the potential of not having to replace the existing 50th Street Fly-Over bridge at a later time, however, the conclusion assumes the traffic forecast results indicated in this study, that two NB lanes will never be required.
- *Approach Improvements*: The new twinned 50th Street bridge improvements would also include improvements to the bridge approaches:
  - *50th Street* (between the existing fly-over and 65th Avenue) would be widened to accommodate a proposed roundabout on the east side of the QE II; two lanes SB connecting the bridge to 65th Avenue East and two continuous NB lanes north of 65th Avenue connecting to the QE II NB lanes; and
  - *65th Avenue/50th Street Intersection* improvements would include new auxiliary turning lanes and tapers.
- *A New 65th Avenue West Arterial* is proposed that would be initially envisioned as a 4-lane arterial cross-section located west of the QE II corridor and extending westward to the Discovery Way intersection and potentially beyond.
- *New QE II / 65th Avenue West SB On & Off Ramps*: The interim improvements include direct access to/from the new 65th Ave West arterial which would be intended to form the gateway access into the planned Aerotropolis lands and development initiatives further west. These ramps would be developed when warranted.

Why the 50th Street Twinning is Considered a First Stage

- The advent of the twinned 50th Street Bridge Solution 50th Street Twinned Bridge Solution ...
  - avoids accelerating significant improvements to the QE II Airport Road and the QE II 50th Avenue Interchanges and the QE II realignment;
  - is significantly less expensive in terms of up-front costs and maintenance costs than other options considered;

- is beneficial to all development initiatives as it provides access to EIA lands and the planned developments along the 65th Avenue East-West corridor;
- provides less overall risk and flexibility to respond to the pace and location of imminent development initiatives;
- provides QE II SB access directly onto the 65th Avenue West corridor;
- creates a new continuous north-south corridor incorporating the EIA's Perimeter Road corridor and the City of Leduc's 50th Street corridor; and
- maintains compatibility and integrates with both the existing and ultimate realigned QE II corridors.

b) The Ultimate Stage

A New 65th Avenue Interchange & QE II Realignment

- *A New 65th Avenue Interchange*, in concert with the *Realignment of the QE II Corridor* further west, was developed as a later stage within the functional planning study. Travel demand forecasts indicate the 65th Avenue interchange was found to be warranted within a decade after the 50th Street Bridge solution is implemented, assuming significant development of the lands along the 65th Avenue W corridor.
- Development of the new interchange:
  - would require the adjustment of the 65th Avenue West SB On and Off-Ramps;
  - was envisioned as a 6-lane arterial bridge with auxiliary turning lanes;
  - would require the relocation of EIA's Perimeter Road / 65th Avenue intersection to a new more westerly location;
  - would provide, if warranted, a double EB-NB On-Loop to access the QE II NB lanes; and
  - is anticipated to integrate with a 6-lane arterial standard for 65th Avenue West corridor.

  The new interchange would provide east-west connectivity, providing additional access to the 65th Avenue West lands. Access to the QE II NB corridor would be improved and traffic diverted from the QE II/Airport Road and QE II 50th Avenue interchanges.

50th Street Fly-Over Replacement

- *A New 50th Street Replacement Bridge*: The plan provides for the existing 50th Street Bridge to be replaced with either a single-lane or two-lane cross-section. This study found that the "ultimate" 65th Avenue Interchange to be warranted within the 20-year (2035) time horizon and the development of QE II core lanes warranted soon after, or in concert with the 65th Avenue interchange. The development of the "ultimate" core lane arrangment to the 65th Avenue interchange would in turn trigger the need to replace the existing 50th Street Fly-Over Bridge as it is incompatible with the core lane arrangement. The 20-year time horizon is dependent upon the pace of development. The existing 50th Street Fly-over bridge has a remaining structural life of 25-to-30 years (2040-to-2045).

- At the time of the 65th Avenue interchange construction, the function of the existing NB 50th Street fly-over bridge will become independent of the QE II corridor and would serve only a local function connecting Leduc's urban area to the

EIA. Therefore the potential cost impacts associated with continued maintenance (as well as the timing and cost of the fly-over bridge replacement) of the existing 50th Street bridge versus the capital outlay required to accommodate the additional local traffic traveling along the QE II destined to the EIA lands remains to be determined.

Construction Costs

Costs

- The conceptual cost of the entire project was determined to be in the range of $160M including replacement of the existing 50th Avenue Fly-Over bridge.
- Replacement of the existing 50th Avenue Fly-Over bridge with a single-lane structure including ancillary roadwork was estimated at an additional $12.4M and a double-lane structure was estimated at an additional $16.5M. Bridge costs alone were estimated at $9.1M for a single lane bridge and $12.3M for a 2-lane replacement bridge.
- Excluding the 50th Avenue Fly-Over bridge replacement, the project would be staged with $53.7M representing the "interim" stage and $91.2M representing the "ultimate" stage.
- The above costs are presented independent of allocation among Alberta Transportation, the EIA and the City of Leduc. Financial responsibilities for of each organization remain to be determined. All affected property (excluding the 65th Avenue corridor and 50th Street) falls within the jurisdictions of either Alberta Transportation or the EIA. Land transfer and conveyances will be required.

Other Study Findings

Other Related Findings

The evaluation of traffic demands over several time horizons permitted an evaluation of alternative infrastructure staging considerations. Other relevant study findings from this analysis included:

- the QE II core lanes will be required within the short term from a point north of the study area and must be in place in their entirety extending from/to the 65th Avenue interchange within the next two decades;
- improvements to the adjacent QE II / Airport Road Interchange must be coordinated with the improvements noted within this study.
- the Hwy 2/ 50th Avenue Interchange modification was found to be required shortly after the development of the 65th Avenue Interchange.

Conclusions

The proposed functional planning solution:

- was found to be significantly less expensive in terms of up-front capital costs;
- is characterized by the least amount of "throw away" costs as compared to other options considered;
- maximizes the economic benefit to the community;
- provide less overall risk;
- offer flexibility in being able to best respond to the pace of development;
- is staged so as to satisfy imminent development and longer term initiatives;

- develops improved access for Leduc residents, businesses and industries;
- improves the 50th Street Bridge crossing;
- would see the extension of Perimeter Road from Hwy 19 through to 65th Ave W;
- provides an alternative access to the Edmonton International Airport (EIA);
- provides alternative "emergency access routes" (Alberta Health Services, STARS, Medivac Base);
- remains consistent with the City of Leduc development planning efforts;
- provides for the future development of the land west of the city and south o the EIA;
- provides for QE II access to/from 65th Avenue West;
- accommodates the expansion of the ultimate QE II core-collector freeway facility;
- provides for shared use of Perimeter Road within the Airport lands; and
- provides for a future connection of Discovery Way to 65th Ave. W.

Recommendations

It is recommended that…

1. The infrastructure improvements outlined in the *Queen Elizabeth II and 65th Avenue (Leduc) Functional Planning Study* be received and approved by Alberta Transportation, the City of Leduc and the Edmonton International Airport.
2. All parties be informed that this *Functional Planning Study* represents a planning document and QE II improvements are not currently scheduled nor funded at this time.
3. All parties incorporate the *Functional Planning Study* infrastructure assumptions and conclusions within their respective planning documents (Municipal Development Plans, Transportation Master Plans and Area Structure Plans).
4. Alberta Transportation, the City of Leduc and the Edmonton International Airport pursue those initiatives necessary to confirm the detailed engineering feasibility of the proposed improvements. These activities would likely include, but not be limited to:
   a. Assuring that additional environmental review be undertaken in accordance with AT's new "Terms of Reference for Environmental Evaluation of Highway Infrastructure Projects" (September 2014)
   b. Seeking commitments and endorsement for those components of the functional plan that would proceed to detailed design;
   c. Responding to development driven initiatives to assure that access provisions are in accordance with the 65th Avenue W and QE II access management strategy presented within the Functional Plans; and
   d. Developing individual detailed construction staging plans that offer the flexibility to advance the proposed improvements when warranted.

EXHIBIT ES–1

PROJECT NO.	01055

FUNCTIONAL PLAN
SUBJECT TO REVISION
DATE: OCT 04, 2016

Castleglenn Consultants
Engineers, Project Managers & Planners

QUEEN ELIZABETH II AND 65TH AVENUE (LEDUC)
FUNCTIONAL PLANNING STUDY
CS. HWY 2:30 TO 2:32

65TH AVENUE INTERCHANGE
INTERIM STAGE

PLAN VIEW

REGION	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL		HWY 2:30 TO 2:32		1 OF 01

40m 0 80m HORIZONTAL

City of Leduc
EIA
Alberta Transportation

65th Ave. West

65th Ave / Perimeter Road Intersection

INTERSECTION 4

STUDY LIMIT

50th Street New 2-Lane Bridge

Existing 50th Street Bridge

Proposed 50th Street East Side Roundabout

Perimeter Road connects 4-lane 65th Avenue W with a T intersection

4-lane Perimeter Road connection

TO CALGARY

QE II Coridor

New SB On-Ramp

EDMONTON INTERNATIONAL AIRPORT

PERIMETER RD.

2 new intersections

New SB Off-Ramp to 65th Avenue

New 2-Lane Off-ramp to EIA / Leduc

QE II Corridor

TO EDMONTON

50TH STREET

50th Street

5parrow Drive

Widened NB Off-Ramp

Ramp Widening

Ramp Widening

Existing 50th Street Bridge provides a single lane NB access and new parallel 2 lane structure provides SB access

Right-In / Right Out Sparrow Drive Intersection

65th Ave

65th Ave / 50th Street Intersection

New Roundabout

65th Ave/50th Street Intersection

CP RAILWAY

Exhibit ES-1: Interim Configuration

EXHIBIT ES–2

PROJECT NO.	01055

FUNCTIONAL PLAN
SUBJECT TO REVISION
DATE: OCT 04, 2016

Castleglenn Consultants
Engineers, Project Managers & Planners

QUEEN ELIZABETH II AND 65TH AVENUE (LEDUC)
FUNCTIONAL PLANNING STUDY
CS. HWY 2:30 TO 2:32
65TH AVENUE INTERCHANGE
ULTIMATE STAGE
PLAN VIEW

REGION	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL		HWY 2:30 TO 2:32		1 OF 01

40m 0 80m HORIZONTAL

City of Leduc
EIA
Alberta Transportation

FUNCTIONAL PLAN ONLY

65th Ave. West

Discovery Way

65th Ave / Discovery Way Intersection

Realignment of the QE II Corridor

New 65th Avenue Bridge

Perimeter Road Realignment

50th Street Existing Bridge Replacement

Proposed 50th Street East Side Roundabout

QE II – Core-Collector Lane Arrangement from north of 65th Avenue

QE II Corridor

50th Street

Closure of the Sparrow Drive Intersection

65th Ave / 50th Street Intersection

Direct access onto QE II from 65th Ave W via loop ramp

Replacement of existing 50th Street Bridge

TO CALGARY

TO EDMONTON

EDMONTON INTERNATIONAL AIRPORT

Exhibit ES-2: Ultimate Configuration

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1.0 INTRODUCTION

CastleGlenn Consultants Inc. was retained in September, 2014 to undertake a functional planning study that would determine the "interim" and "ultimate" requirements for the Queen Elizabeth II (QE II) corridor and a future 65th Avenue interchange within the City of Leduc. The *"Queen Elizabeth II and 65th Avenue (Leduc) Interchange Functional Planning Study"* was intended to identify:

- the preferred configuration of a new "*interim*" connection of 65th Avenue in Leduc and the QE II corridor;
- the preferred configuration of a new "*ultimate*" interchange connecting 65th Avenue in Leduc to the QE II corridor; and
- the "*ultimate*" requirements of the QE II core-collector freeway corridor in the vicinity of the interchange.

This study also outlines the property requirements necessary to ensure the ultimate development of the corridor and the associated interchange improvements. As well, the interchange improvements associated with this functional planning study include the proposed twinning of the existing 50th Street SB Fly-over as an interim initiative.

1.1 Study Area

The greater study area (See Exhibit 1-1) encompasses the area of influence along the QE II corridor that is contained within Leduc County and is approximately 4 km on either side of the future 65th Avenue corridor interchange. The greater study area is bounded by Rge Rd 255 (184th Street) on the west; Rge Rd 245 on the east; the intersection of 50th Street/Hwy 2A on the south and a point 800m north of Airport Road. Exhibit 1-1 also illustrates the current boundaries of the Edmonton International Airport (EIA) and the City of Leduc.

The QE II functions as a primary north-south freeway corridor and is part of the National Highway System, connecting the City of Calgary to the City of Edmonton.

The current land uses within the study area are for the most part urbanized within the City of Leduc's boundary and are characterized by residential, commercial, commercial retail, institutional and light industrial land uses on the east side of the QE II. The City's developments on the west side of the QE II are for the most part, residential, retail and institutional. Significant un-developed lands within the City boundaries are located to the west of the QE II, and include the Aerotropolis lands (adjacent to 65th Avenue West for which urbanization and development plans are in the process of being formulated), and lands on either side of Rge Rd 254 (74th Street) where area structure plans (ASP's) have been developed and approved by the municipality.

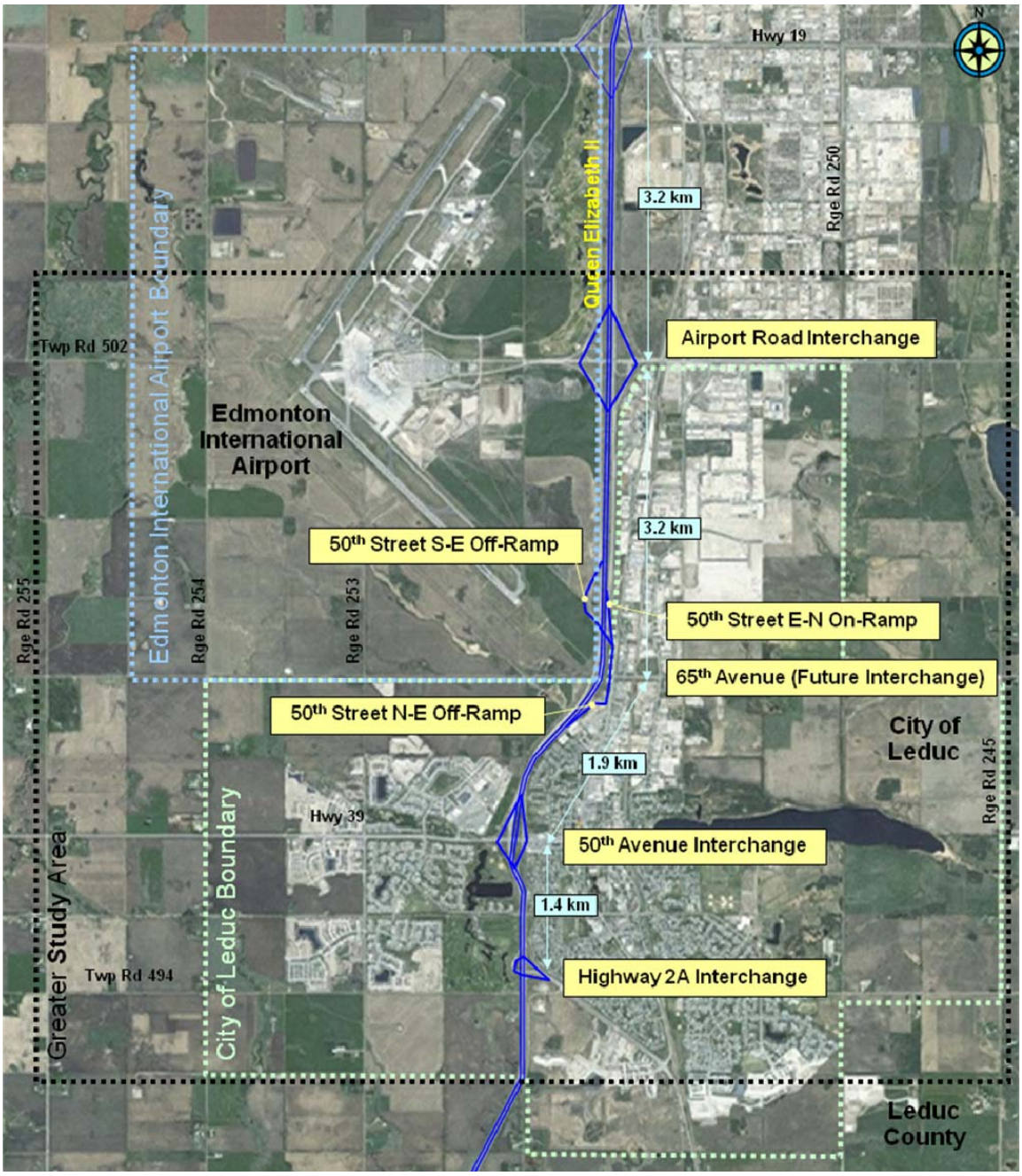


Exhibit 1-1: Study Area

Within Leduc County the land uses are predominantly rural and agricultural in character, however, Leduc County also contains a significant industrial park development in Nisku to the east of the QE II corridor and has plans which involve expanded employment on the west side of the QE II corridor north of Hwy 19 which include the proposed Crossroads development and a North development area as far west as Rge Rd. 254, and as far north as Twp Rd 510.

The study area also includes the Edmonton International Airport which:

- accommodated over 8M passengers in 2015, [This is only slightly down by 2.5% from the 2014 high of 8.2M passengers. The effect of the downturn in the energy sector has not resulted in a similar decline in passenger travel.];
- is the fastest growing airport in Canada over the last decade;
- is a major regional economic driver, creating 12,600 direct and indirect jobs and generating nearly $1.2 billion in GDP with total economic output of over $2.2 billion;
- boasts of 6 consecutive years of volume growth in cargo services with transatlantic and transpacific routes;
- has been designated as a Foreign Trade Zone, allowing companies to reduce or eliminate normal trade barriers such as tariffs, quotas and compliance costs and build a collaborative network that supports industry growth, expanded trade and investment; and
- has planned for a major commercial development on its lands adjacent to the QE II corridor.

1.2 Past Planning Initiatives

Numerous functional planning studies have taken place along the QE II corridor in recognition of the extensive growth experienced within the Province. Development pressures on adjacent lands on the west side of the QE II in the City of Leduc and on the Edmonton International Airport (EIA) lands have been identified as having the potential of resulting in significant pressures for transportation facility upgrades. In addition, the completion of Anthony Henday Drive (southeast and southwest) and the proposed City of Edmonton annexation (urbanization) to the south will continue to result in increased use of the QE II corridor.

Alberta Transportation[1], the City of Leduc/Leduc County[2,3] and the Edmonton International Airport[4] have undertaken a significant amount of planning to identify the infrastructure requirements along the QE II corridor, the adjacent future communities and the related airport requirements; however, much of the highway planning initiative has concentrated on the long-term or "ultimate" time frame.

Past planning initiatives undertaken by various agencies have produced alternative visions for a future QE II corridor and interchanges, between 50th Avenue and Airport Road in Leduc. Such initiatives included:

[1] "*Highway 2 Upgrades S of Leduc to N of Ellerslie Road 2010 Functional Planning Study*", Focus Group (May, 2010)
[2] "*City of Leduc Aerotropolis Integrated Land Use Compatibility Plan*", InterVISTAS Consulting 28 June, 2011. "*City of Leduc Transportation Study Update 2006-to-2016*" (June 2009)
[3] "2010 Leduc County Draft Transportation Master Plan Update"
[4] *"Draft Edmonton International Airport 2010-2035 Master Plan Update (2010)"*

- "*Highway 2 Upgrades S of Leduc to N of Ellerslie Road 2010 Functional Planning Study*" (Focus Group, May 2010). This study outlined future upgrades to Highway 2 (QEII) from south of the City of Leduc to north of Ellerslie Road in the City of Edmonton. The plans were prepared to accommodate a future Edmonton Census Metropolitan Area (CMA) population of 3.2 million. The identified improvements include:
  - constructing a dual freeway (core-collector) system which separates shorter distance trips from longer distance trips;
  - upgrades to the existing interchanges at Highway 19, Airport Road, Highway 39, and Highway 2A;
  - a new interchange at 41st Avenue in Edmonton (which has since been developed);
  - a new diamond interchange at 65th Avenue in Leduc to increase connectivity with surrounding lands. The interchange would be located 1.9 km north of the existing 50th Ave. Interchange and 3.2km south of the existing Airport Road Interchange;
  - a new systems (freeway-to-freeway) interchange with a potential future east-west freeway located south of the City of Edmonton; and
  - the reconstruction/realignment of the section of the QE II through Leduc to improve safety. The functional plans for the QE II corridor depicted a realignment of both the NB and SB QE II lanes in the vicinity of the 65th Avenue corridor.

- "*City of Leduc Aerotropolis Integrated Land Use Compatibility Plan*" (InterVISTAS Consulting, June 2011). The stakeholders associated with this study included the City of Leduc, Edmonton International Airport, Melcor, Oxford Homes and Alberta Transportation. The plan identified the lands on the south of the EIA as future premier North American warehousing, distribution and multi-modal distribution centre. The purpose of the study was to ensure planning over a 50 year time frame would be compatible with current and future activities and able to support longer-term regional development objectives. The study recognized the impacts related to noise associated with the EIA, the QE II corridor and the proposed 65th Avenue arterial. The study findings served to prescribe compatible land uses which were suggested for incorporation within the Municipal Development Plan. As part of this study, the City of Leduc engaged (Delcan, Sept. 2010) to produce a VISUM™ travel demand model estimating impacts associated with a 2060 horizon year (50+ years that assumed a 107,605 population / 80.800 employee land use and 3% QE II annual growth rate) for the Leduc area.

- "*City of Leduc Transportation Study Update 2006-to-2016*" (ISL Engineering and Land Services, June 2009). The purpose of this study was to highlight *"the effects of ongoing population and employment growth in Leduc over time and the transportation infrastructure requirements needed to respond to this growth"*. One of the major recommendations was related to the construction and upgrading of the QE II/65th Avenue interchange. Subsequent to the completion of this study, it was recognized that implementing a combined QE II realignment and a new 65th Avenue interchange would represent a significant commitment to all parties concerned. Subsequent to the study an alternative interchange solution was proposed by ISL that envisioned a lower cost "hybrid" partial interchange solution at 65th Avenue.

- "*City of Leduc Leduc Transportation Master Plan (2013)*" (ISL Engineering) The objectives of the TMP were to define the City's transportation needs in terms of roadway and transit improvement for 30.5K, 35K and 44K population horizons, estimate the costs of the required improvements, recommend short and medium term capital plans and develop key policy statements consistent with a number of policy documents. The themes of the TMP included public transit, traffic congestion, vehicle speed, walking and sidewalks, cycling and trails, traffic signals and signage and merge lanes. A key conclusion included that the "*65th Avenue interchange should be implemented in the short-term time frame*." Other findings have resulted in transit improvements, enhancements to the multiways pathway system, and a supportive TMP policy framework.
- *"Draft Edmonton International Airport 2010-2035 Master Plan Update (2010)"*. The EIA Master Plan represented a significant initiative that envisioned a long-term (60-year) planning horizon taking into account the prevailing economic, social, environmental and regulatory conditions at the time. The plan envisioned the development of significant infrastructure upgrades inclusive of future grade separated interchanges at the QE II /Airport Road interchange, at the 65th Avenue West Access to the EIA lands and along the Highway 19 corridor. The document highlights the role of Perimeter Road forming an alternative NS corridor to the QE II linking Hwy 19 thru to 65th Avenue West. The plan also provides for significant transit upgrades inclusive of provisions for BRT, LRT and High Speed Rail opportunities.

1.3 Future Development Initiatives

The following information was collected, reviewed and referenced as part of the study area familiarization process:

- Historical Traffic Count Information (Referenced from AT's website);
- *"Airport Integrated Land Use Compatibility Plan: Traffic Forecasting Review"*, Delcan (September 2010);
- *"City of Leduc/Leduc County Inter-municipal Development Plan 2010-2044"* , City of Leduc and Leduc County (Received, August 19, 2014);
- *"QE II Reports completed in 1992, 2000 and 2010"*Alberta Transportations (Received, August 19, 2014);
- *"City of Leduc – Transportation Master Plan"* City of Leduc (June 2013*);*
- *"Alberta Aerotropolis – Aerotropolis Viability Study"* Leduc Partnership (MXD Development Strategists/Stantec, May 2015);
- *"EIA Highway Commercial Parcel Development Strategy"* Edmonton International Airport (MXD Development Strategists/Stantec, July 2011);
- *"Highway Commercial Development, Edmonton International Airport"* Edmonton International Airport (MMM Group, August 2013);
- *"West Area Structure Plan"* City of Leduc (IBI Group, June 2014);

- *"West Area Leduc Lands: Traffic Impact Assessment"* Hollands, Molsberry, Moussa, City of Leduc and Melcor (IBI Group, October 2013);
- *"Discovery Park – Local Area Structure Plan – Leduc County"* Remington Development Corp. (Focus Corporation, February 2011);
- *"Discovery Park – Traffic Impact Assessment Report"* Remington Development Corp. (Focus Corporation, October 2010);
- *"Discovery Park – Highway 19 Upgrades – QE II Interchange to 42nd Street, Leduc County – Project Design Standards"* Alberta Transportation (Focus Corporation, October 2010);
- *"Crossroads – Area Structure Plan"* Remington Development Corp. (Focus Corporation, January 2012); and
- *"Crossroads Traffic Impact Assessment Report"* Leduc County (Focus Corporation, January 2012).

The above documents were used to determine future land use assumptions and travel demand forecasts related to this functional planning study.

1.4 Goals and Objectives

The Terms of Reference for this functional planning study defined the following objectives:

1.1 A high-level network evaluation of all connecting corridors and surrounding (existing and planned) intersections/interchanges was to be undertaken;

1.2 The justification of access to the QE II from the east and west side of 65th Avenue from a network and strategic investment perspective was to be determined;

1.3 All feasible options were to be explored and functional plans developed along with a staging strategy that would depict each of the critical stages of development leading to an ultimate stage (3.6 million population threshold) that would recommend a connection to the QE II from the east and west sides of 65th Avenue. Configurations were to be identified and double line plans, profiles, and footprints developed that would meet current standards. Supporting rationale and justification, along with sufficient information and guidance were to be provided to advance to detailed design;

1.4 The right-of-way requirements were to be determined and protection plans produced that illustrate all right-of-way dimensions and areas needed to accommodate the proposed facility. Right of way requirements were to be rationalized and clearly support the study recommendations;

1.5 Itemized cost estimates for different stages of recommended improvement were to be developed.

In addition to the above objectives, the functional planning process itself catalyzed several related issues that required resolution as part of the study mandate. The issues are stated below in the form of questions, which are addressed within this study document:

- Is there an *interim strategy for realigning the QE II corridor* in the absence of collector-distributor lanes?
- What is the "ultimate" 65th Avenue *interchange configuration* that would provide AT with design and staging flexibility, supported by a justification that would adhere to AT policies and standards?
- Is there the possibility of using any of the existing QE II infrastructures as part of an interim *staging strategy*?
- What is the optimal *municipal roadway* network required to accommodate and integrate with the proposed ultimate 65th Avenue interchange?
- How much *property* is required to ensure the "ultimate" development of the 65th Avenue corridor, service roads and the associated interchange?
- Would a strategic investment strategy involving *developing a "throw-away" interchange* over the existing QE II alignment make sense and what would the implications be to future constructability of the ultimate interchange configuration?

1.5 Functional Planning Methodology

The methodology used to undertake this functional planning study incorporated the following six phases:

- *Phase I – Identify Existing Conditions, Alternatives and Constraints*

  This initial phase determined the existing conditions within the study area and obtain an understanding of all potential constraints related to the corridor and interchange when designing to a multi-lane freeway standard (130 km/hr design speed) for the QE II corridor.

- *Phase II – Confirm the "Ultimate" QE II Realignment*

  This phase was used to confirm or refine the conclusions reached in the 2010 QE II functional planning study[5] that addressed the QE II corridor requirements from south of Leduc to Ellerslie Road which recommended a core-collector concept

- *Phase III – Identify QE II Corridor Alternatives*

  This phase included an evaluation and feasibility assessment of the QE II corridor interchange location and configuration alternatives.

- *Phase IV – Evaluate, Analyze and Recommend Preferred "Ultimate" Interchange*

  The fourth phase of the project involved the identification and evaluation of various interchange concepts which were produced and reviewed as to their flexibility to respond to future travel demand forecasts and their suitability to assure economic development opportunities and compliance with Transport Canada requirements (TP312/OLS Restrictions). This lead to a recommended interchange configuration.

- *Phase V – Develop and Refine a "Staged" Solution*

[5] "*Highway 2 Upgrades S of Leduc to N of Ellerslie Road 2010 Functional Planning Study*", Focus Group (May, 2010).

The recommended "ultimate" QE II/65th Avenue interchange was examined for staging opportunities and a simplified "staged solution" was identified. Staging opportunities took into account the initial development opportunities of the Aerotropolis and Port Alberta lands while integrating with the ultimate interchange and QE II core-collector configuration. The staging was assessed in terms of minimizing throw-away costs with emphasis placed on constructability and achieving a realistic costing. The staging included an assessment of the infrastructure requirements associated with multiple population horizons.

- *Phase VI – Develop Functional Plans, ROW Mosaic and Report*

  The final phase of the project was achieved once a consensus existed regarding the scope of the proposed improvements. At this stage the "ultimate" design was prepared, which incorporated refinements to the recommended solution.

The study methodology included:

- A *Value Planning Exercise* that was undertaken in a workshop format (February 2015) at the problem definition stage to provide for a visioning and creative brainstorming session. The Value Planning event included team members, independent experts who are only involved in the project for the workshop, and external stakeholders. The exercise was intended to accelerate the project schedule by early involvement of all study participants and create a team building environment. The need and justification for the project were reviewed from first principles and the objectives (safety, level of service, access management, capturing economic development opportunities and coordination of projects (Provincial and municipal) etc.) confirmed. Innovative creative ideas, convergent and divergent thinking (non-conventional problem solving approach) took place early in the study prior to decisions being made;
- A *Land use Assessment* exercise that assessed various area structure plans, traffic impact studies and planning documents detailing the plans of development envisioned within the study area.
- A *Federal Regulations Review* of Transport Canada's TP 1247E & TP 312 guidelines needed to assure compliance with regarding permitted land uses in the vicinity of airports and the permitted vertical clearance envelopes in relation to the proposed infrastructure. NAV Canada was contacted and indicated that they "*have no objection to the project as submitted*".
- A *Public Involvement* exercise was undertaken that provided for 2 public open houses (Jan. and Sept. 2015) and 3 focus groups (Jan., June and Sept. 2015).
- A *traffic simulation & modelling* exercise which evaluated traffic forecasts depicting six time horizons to provide insight into what infrastructure requirements would likely be necessary and potential capacity triggers of such infrastructure.

2.0 EXISTING CONDITIONS

An existing conditions overview and assessment was conducted to provide documentation concerning the existing state of the QE II and 65th Avenue corridors. This effort served to identify and outline issues and constraints that could potentially arise with the implementation of the proposed future QE II/65th Avenue interchange.

Appendix "A" contains independent sub-consultant studies dealing with the existing conditions within the study area within several areas, which include:

- *Environmental Evaluation* (See Section 2.9 & Appendix "A-1"): This was undertaken to identify the study area existing conditions and areas of potential environmental concern, including: wildlife, fisheries, vegetation, soils/landforms, and wetlands, surface and groundwater;
- *Historical Statement of Justification* (See Section 2.10 & Appendix "A-2"): This was aimed at evaluating the historical resource potential inclusive of archaeological sites, historic sites and registered historic structures within the study area and their historical significance. The SOJ also makes recommendations regarding the need for further work within the study area;
- *Preliminary Geotechnical Assessment* (See Section 2.11 & Appendix "A-3"): This assessment provided a general overview of the site geology and geotechnical conditions within the study area;
- *Hydro-technical and Storm-water Assessment* (See Section 2.12 & Appendix "A-4"): This assessment provided a general overview of the existing hydrological and drainage characteristics; and
- *Bridge Investigation* (See Section 2.13 & Appendix "A-5"): This assessment provided a review of the existing structures within the study area. The review verified information documented within Bridge Inspection and Maintenance (BIM) Inspection Reports and existing drawings.
- *Geometric Overview* (See Section 2.14 & Appendix "A-6"): Vertical profile drawings (EBA Engineering) made available by AT depicted the existing QE II alignment (CS 2:30 and 2:32) from a point south of Leduc (Hwy 2A) to the City of Edmonton municipal boundary.
- *Utility Review* (See Section 8): A review of all existing utilities was undertaken within the proximity of QE II corridor by contacting utility providers.

The following sections serve to describe the existing characteristics of the QE II and 65th Avenue study corridors and provide a brief summary of the key findings.

2.1 The Existing QE II Corridor

The QE II corridor within the study area represents an 8km long (from 800 m north of Airport Road to 800 m south of the Hwy 2A interchange) corridor that can be characterised as follows:

- *Classification:* The QE II[1] is classified as a "Level 1" highway that accommodates the movement of people, goods and services inter-provincially and internationally and is defined as a core route in the National Highway System (NHS). The 8km section of the QE II addressed within this functional planning study represents a small (1.7%) portion of the total QE II (Hwy 2) corridor length between Hwy 3 in the vicinity of Fort McLeod to Edmonton which is roughly 450km in length. Access to the NHS corridor is generally restricted to major arterial roadways only[2].
- *Vehicle Designation:* The QE II is a Long Combination Vehicle (LCV) route[3] accommodating Turnpike Double (Modified WB-36) heavy vehicles up to 41m in length.
- *Over-Dimension Vehicles:* The QE II was not designated as a High Load Corridor[4].
- *Posted Speed:* The posted speed limit along the QE II is 110km/hr.
- *Design Speed*: The design speed for the QE II is 130km/hr. The future core lanes will also have a design speed of 130km/hr, while the future collector lanes will have a design speed of 110km/hr.
- *Access Management:* The QE II corridor is designated as a freeway, and therefore access should be restricted to grade-separated interchanges only in locations as per the *Freeways and Access Locations Designation Order* (Order in Council 587/2009). Table 2-1 indicates, and Exhibit 2-1 illustrates, the location of each existing access along the corridor over the 8 km length of the study area.

Table 2-1: Location of Existing Accesses and Interchanges

	Roadway / Access	*Description*	*Station[5]*	*Municipality*
1	Highway 2A - Interchange	Four-lane, divided, overpass.	33+850	City of Leduc
2	50th Avenue - Interchange	Four-lane, divided, underpass.	35+217/0+000	City of Leduc
3	50th Street, NB-EB Off-Ramp	Single-lane, slip-ramp.	1+225	City of Leduc
4	64th Street, WB-NB On-Ramp	Single-lane, slip-ramp.	2+125	City of Leduc
5	50th Street, NB On-Ramp	Single-lane, slip-ramp.	3+000	City of Leduc
6	50th Street, SB Fly-Over-Off Ramp	Single-lane, ramp-to-overpass structure.	3+145	City of Leduc
7	Sparrow Crescent, NB-EB Off-Ramp	Single-lane, slip-ramp.	4+110	City of Leduc
8	Median Crossing / Break	Emergency/maintenance turnaround	4+465	City of Leduc
9	Airport Road - Interchange	Four-lane, undivided, overpass.	5+170	Leduc County

- Non Interchange Junctions - Interchange Junctions

- *Cross-Section:* The existing 4-to-6-lane divided cross-section consists of:
  - highway grades that vary from approximately 0-to-3% (which meet the desirable maximum of 3% for a 130 km/hr design speed corridors);
  - a horizontal alignment with numerous curves, between Highway 2A and the Airport Road interchange. The minimum curve radius was identified as 660 m at CS:2N KM 1+000 (the recommended minimum for new facilities is 950 m);

[1] "*Alberta Transportation Design Bulletin #27/2005"* (Revised December 2008)
[2] "*Provincial Highway Service Classification*" Stantec Consulting Ltd., 2007
[3] Alberta Transportation Highway Geometric Design Guide (ATHGDG): Figure D-5c, Section D.5: Design Vehicle, Chapter D: At-Grade Intersections
[4] ATHGDG: Figure A-11, Section A.11: High Load Corridor, Chapter A: Basic Design Principals
[5] Stationing is referenced from Functional Plans (See Annex "A").

- pavement widths of:
  - Hwy 2:30:Northbound: [KM 33+000 to KM 35+217]: 10m (two 3.7 m lanes);
  - Hwy 2:32:Northbound: [KM 0+000 to KM 0+579]: 11.2 m (two 3.8 m lanes);
  - Hwy 2:32:Northbound: [KM 0+579 to KM 2+530]: 16.7m (three 3.7 m lanes);
  - Hwy 2:32:Northbound: [KM 2+530 to KM 11+989]: 16.6 m (three 3.7 m lanes);
  - Hwy 2:30:Southbound: [KM 33+000 to KM 35+217]: 11 m (two 3.8 m lanes);
  - Hwy 2:32:Southbound: [KM 0+000 to KM 0+113]:10.8 m (two 3.8 m lanes);
  - Hwy 2:32:Southbound: [KM 0+113 to KM 0+579]: 15.8 m (two 3.8 m lanes); and
  - Hwy 2:32:Southbound: [KM 0+579 to KM 9+318]: 16.6 m (three 3.7 m lanes).

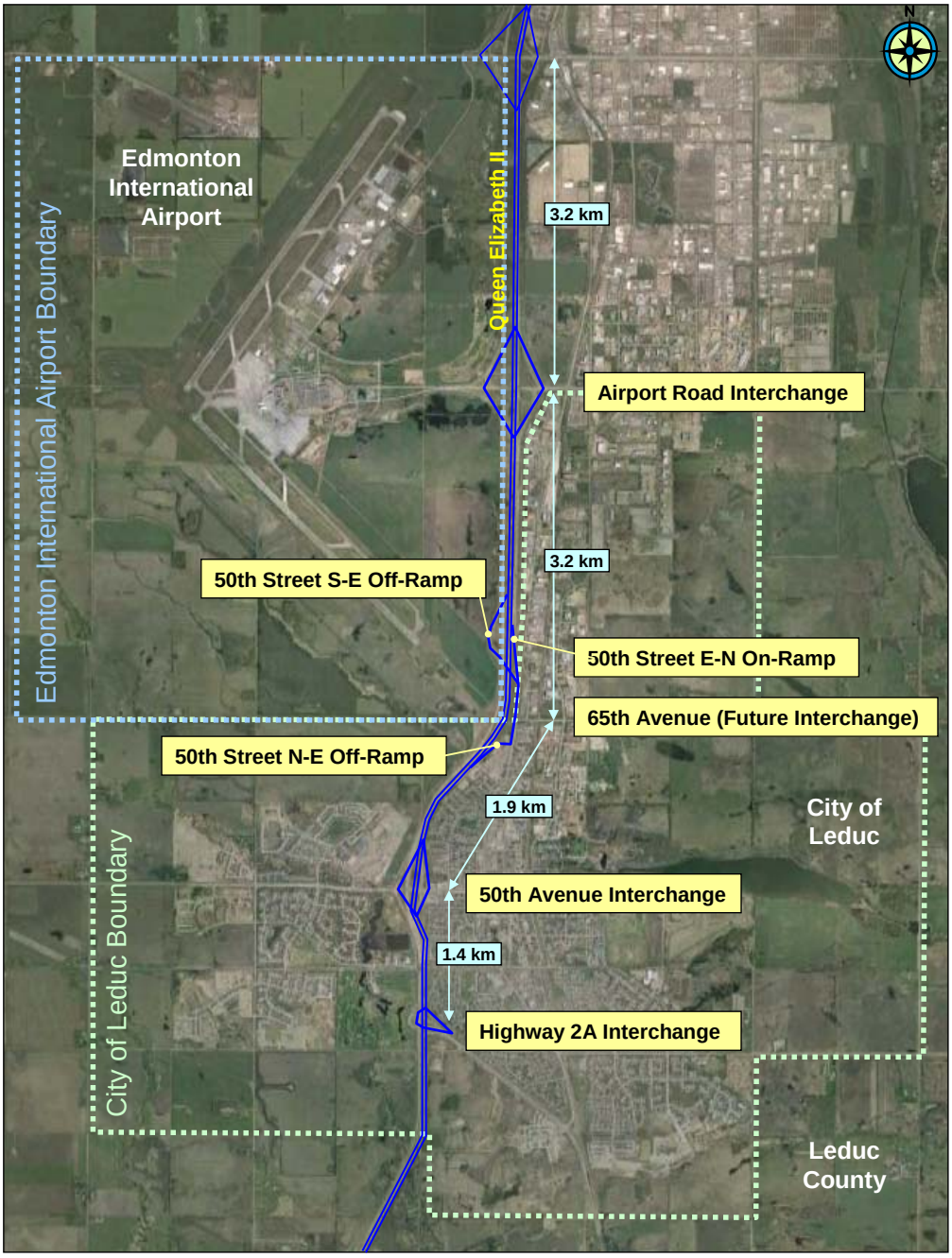


Exhibit 2-1: Highway II Corridor Existing (2015) Access Locations

2.2 The Existing 65th Avenue Corridor

The existing 65th Avenue corridor is an east-west arterial, approximately 2.4km in length, is posted at 50 km/hr through the City's urban area and extends from 50th Street eastward to the City of Leduc municipal boundary. The roadway continues eastward and transition onto Twp Rd 500 within Leduc County and is posted at 70 km/hr. The corridor serves to connect to the QE II by way of the 50th Street SB Fly-over Off-Ramp and the 50th Street NB On-Ramp.

The City of Leduc envisions that the 65th Avenue corridor is to be extended westward by an additional 4.2 km across the QE II to its west municipal boundary located at Rge Rd 254 (74th Street). The 65th Avenue W corridor is intended to provide access to the future Port Alberta lands (within the EIA) and Aerotropolis lands (within the City) as well as the proposed developments abutting Rge Rd 254 (West Area Structure Plan and lands W of Twp Rd 254). A future full-movement grade separated interchange is planned at the junction of QE II/65th Avenue.

2.3 Land Uses within the Study Area

The land uses within the vicinity of the future QE II/65th Avenue interchange are best described as a mixture of commercial and industrial development. Immediately to the east of the QE II, lands are described as "General Commercial" and transition to "Light Industrial" and "Medium Industrial" further eastward to the municipal boundary. To the northwest of the future interchange site is the Edmonton International Airport (EIA) lands and to the southwest the lands are described as "Urban Reserve". The future transportation system must integrate to the greatest extent possible with the envisioned land use plans within the study area.

In general, the area of influence within this functional planning study includes the:

- *City of Leduc:* The future interchange is located within the north central area of the City of Leduc. The population of the City of Leduc according to its 2015 municipal census was 29,304 persons, representing 73% growth over the last decade when compared to the 2006 census[6]. Clearly, the City has undergone significant growth over the last decade and is anticipating continued, albeit slower growth. The City of Leduc's municipal boundaries provide for several significant land parcels around its western, southern and eastern boundaries defined as "Urban Reserve" to accommodate future municipal growth.
- *Edmonton International Airport:* The EIA is in the process of developing Phase 1 of a 6-phase commercial development along the property's eastern boundary (adjacent to the QE II). [The first phase includes development of a 150 room hotel, 50,000 SF of office, a 588,381 SF GFA Outlet Mall, a 160,000 SF big box retail facility and a small 5,000 SF restaurant pad.] The commercial development is ancitipated to support airport business and amenities and generate non-aeronautical revenues for EIA[7].

[6] Statistics Canada. In 2006, Leduc had a population of 16,967 living in 6,718 dwellings.
[7] EIA *"Edmonton International Airport Master Plan 2010-2035"*, 2011.

- *Aerotropolis Lands:* The Aerotropolis study area is approximately 530 acres[8] and is located immediately to the south of the EIA and west of the QE II corridor within the City of Leduc. Due to its proximity to the airport, the future land uses and building heights for the development lands must meet numerous Federal requirements. The proposed developments would mainly consist of industiral, commercial and public/semi public uses (including a logistics park, distribution centres, exhibition/convention centres, research and technology park, medical offices, community centres/recreation facilities)[9].
- *Port Alberta:* The Port Alberta study area is approximately 700 acres and is located within the EIA property boundary. The lands are intended to be developed as a multi-modal transportation hub, as it is within the immediate proximity to the QE II corridor, railway facilities and the airport[10]. The proposed developments would mainly consist of commercial and industrial developments (including manufacturing, production, supply, distribution and storage activities).

Section 3.3 and Appendix "B-1" of this report provide additional information concerning existing and forecast land use assumptions adopted as part of this functional planning study.

2.4 Historical Traffic Growth and the Impact of the Energy Sector

Historical traffic count information along the QE II corridor within the study area was referenced from Alberta Transportation sources[11].

Exhibit 2-2 illustrates the ten-year historical traffic count information that was reviewed as part of this functional planning study. The review indicated that:

- the average annual traffic growth rate along the QE II corridor:
  - north of 50th Avenue is in the range of 4-to-5%.
  - south of 50th Avenue the average annual growth is in the range of 3-to-4%.
- the 2010 Provincial 10-year Average Growth for Level 1 Highways was 1.83% in 2014.
- as one gets closer to Edmonton's urban area, the growth rate increases.

All this being said, the downturn in the energy sector experienced throughout the Province in late 2014 continues. A review of 2015 traffic volume information indicated that the Nisku industrial development was particularly effected by the downturn. As well, a review of City of Leduc building permit information indicated a 60% decrease in residential units permits from 2014 to 2015 and a further 66% decline over the first quarter of 2016. EIA Passenger travel activity from 2014-to-2015 resulted in a 2.5% decline from 8.2M-to-8.0M passengers-per-year.

[8] City of Leduc "*Aerotropolis Integrated Land Use Compatibility Plan*", June 2011
[9] City of Leduc "*Aerotropolis Integrated Land Use Compatibility Plan*", June 2011
[10] City of Leduc "*Aerotropolis Integrated Land Use Compatibility Plan*", June 2011
[11] Alberta Transportation "*Alberta Highways 1 TO 986, Traffic Volume History 2004 – 2013*" Investment Strategies Branch, Transportation Modeling and Analysis

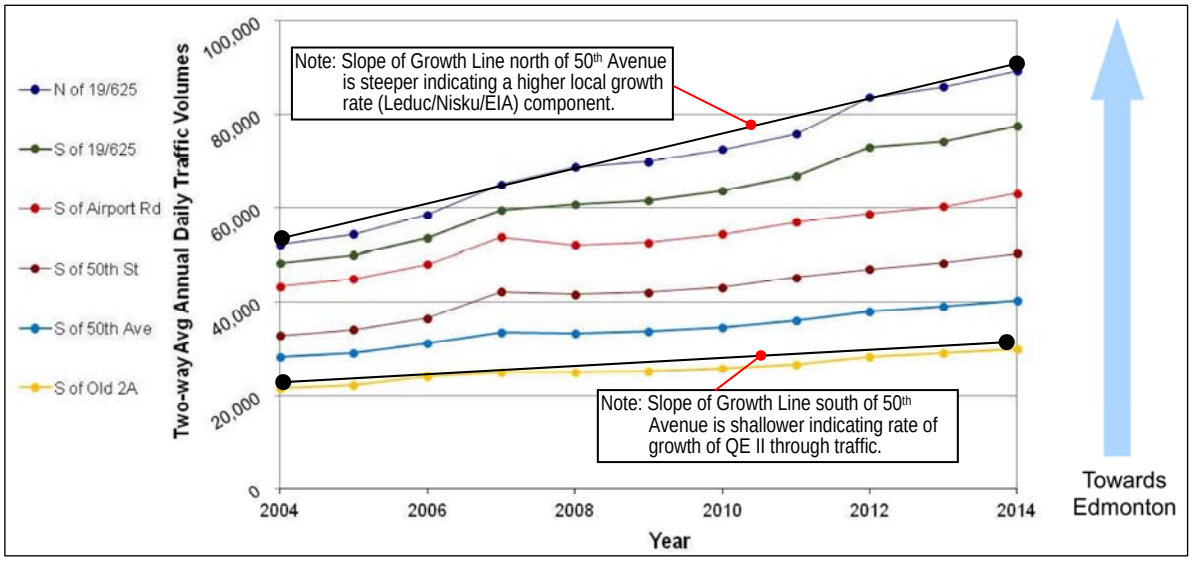


Exhibit 2-2: Historical Annual QE II Traffic

The overall effect of the energy sector downturn will effect the pace of development; growth will continue to occur, but at a slower rate. This provides a valued opportunity that will better permit all agencies to develop, refine and ultimately proactively manage its transportation planning initiatives and accommodate sustainable, affordable, robust and flexible planning strategies that can withstand public scrutiny and serve to guide the infrastructure objectives well into the next decade. The timelines noted within this functional planning study remain valid as milestones and whether or not the growth occurs in 2025 or 2035 or even 2045 is somewhat irrelevant, as growth will continue to occur and protection of the required lands to provide for such future infrastructure remains prudent.

For the purpose of this FP Study, the 2014 higher traffic volume base information was used reflecting a more conservative base line of heavier traffic volumes.

2.5 Existing Traffic Volumes

Exhibit 2-3 presents the current (2014) average morning and afternoon peak hour traffic volumes along the QE II corridor. Daily traffic volumes on the QE II:

- *South of Airport Road and north of 50th Street:* are in the range of 60,300 vehicles-per-day (vpd). Summer AADTs reach 65,440 vpd. Approximately 9.5% of the QE II vehicle traffic is considered heavy vehicle traffic (single unit trucks and tractor trailer units); and

- *South of 50th Street and north of 50th Avenue:* are currently in the range of 50,390 vpd. Summer AADTs reach 54,220 vpd. Approximately 11.6% of the QE II vehicle traffic is considered heavy vehicle traffic.

Appendix "B-2" illustrates the base year peak hour traffic volumes.

2.6 Existing Traffic Operations

Intersection capacity analysis was conducted assuming the balanced peak hour traffic volumes along the QE II corridor and at the ramp terminal and critical intersections in-between Highway 19 and 50th Avenue.

Table 2-2 identifies the traffic operational characteristics at each location along the QE II corridor. The table presents for the directional approach/turning movement that was determined to be critical: the peak hour traffic volume, the LOS, delay and volume-to-capacity (v/c ratio) for the morning and afternoon peak hour of travel demand.

Exhibit 2-3: QE II Corridor: Existing (2014) Traffic Daily Volumes

Table 2-2: Existing (2014) Traffic Operational Analysis (Assuming Existing Configuration and Intersection Improvements)

Intersections		Control Type	Overall LOS	AM Peak Hour				Overall LOS	PM Peak Hour			
				Approach	LOS	Delay (sec.)	V/C		Approach	LOS	Delay (sec.)	V/C
Hwy 19 & QE II	Airport Rd & RR 251 /Airport Service Road	STOP-Controlled	D	NB SB	F	Err 1212	Err 2.08	F	NB SB	F	404 844	1.81 0.83
	QEII & Hwy 19: West Ramp Terminal EB-SB On-Ramp / SB-EB/WB Off-Ramp	Signalized	F	SB-LT (1,840 veh/h) EB-T/RT (1,441 veh/h)	F	124 170	1.22 1.31	B	WB-TH (1,153 veh/h)	B	14	0.68
	QEII & Hwy 19: East Ramp Terminal NB-EB/WB Off-Ramp & WB-NB On-Ramp	Signalized	F	EB-TH (2,809 veh/h)	F	248	1.51	B	WB-TH (1,491 veh/h)	B	17	0.86
	Hwy 19 & Sparrow Drive	Signalized	F	EB-TH (2,582 veh/h)	F	427	1.89	F	WB-T/RT (2,252 veh/h)	F	163	1.28
Airport Rd and QE-II	Airport Rd Westbound & 31 St E	Signalized	B	WB-TH	B	11	0.70	B	WB-TH	B	13	0.65
	Airport Rd Eastbound & 31 St E	Signalized	B	EB-TH	B	16	0.62	B	EB-TH	B	14	0.70
	QEII & Airport Road: West Ramp Terminal SB-EB/WB Off-Ramp	STOP-Controlled	E	SB-LT (920 veh/h)	F	900	2.99	A	SB-LT (400 veh/h)	F	192	1.31
		If Signalized[1]	C	SB-LT	C	26	0.90	B	SB-LT	B	13	0.63
		If Signalized[2]	D		D	39	1.01					
	QEII & Airport Road: East Ramp Terminal NB-EB/WB Off-Ramp and WB-NB On-Ramp	STOP-Controlled	D	NB-LT (200 veh/h)	F	562	2.74	D	NB-LT	C	19	0.37
		If Signalized	A	NB-LT	B	15	0.35	A	NB-LT	A	9	0.31
	Airport Rd and Sparrow Dr	Signalized	E	EB Shared (2,201 veh/h)	F	109	1.20	F	WB Shared (1,992veh/h) NB-T/LT (LT = 300 veh/h)	F	182 146	1.35 1.18
65th Ave	65th Avenue / 64th Avenue	Signalized	A	SB-T/LT	B	19	0.52	B	WB Shared	A	7	0.37
	65th Avenue & 50th Street	Signalized	B	SB-LT	D	40	0.98	B	WB-LT	C	22	0.71
50th Ave and QE-II	QEII & 50th Ave: West Ramp Terminal EB/WB-SB On-Ramp & SB-EB/WB Off-Ramp	Signalized	F	EB-T/RT (2,205 veh/h) WB-TH (1,670 veh/h)	F	291 327	1.59 1.67	F	EB-T/RT (1,701 veh/h) WB-LT (168 veh/h) WB-TH (1,631 veh/h)	F	232 492 477	1.44 1.95 1.98
	QEII & 50th Avenue: East Ramp Terminal NB-EB/WB Off-Ramp and EB/WB-NB On-Ramp	Signalized	F	EB-LT (780 veh/h) WB-T/RT (1,790 veh/h)	F	217 96	1.39 1.15	E	EB-LT (666 veh/h) WB-T/RT (1,735 veh/h)	F	119 82	1.15 1.12
50thSt	QEII & 50th Street NB-EB Off-Ramp	Signalized	A	EB-LT	B	17	0.56	A	SB-TH	A	4	0.60

Indicates Constrained level of Service and unsatisfactory traffic operations

1. This analysis assumes the current 900 veh/h making the SB-LT remains constant.
2. This analysis assumes the current 900 veh/h increases to 1,200 veh/h accounting for the additional 300 veh/h traffic which appear to be making the SB-RT at the West ramp terminal (to avoid the SB-LT queue in the morning peak hour heading to the Leduc Industrial Area) and making a U turn at the 31st Street / Airport Road traffic signal lights. See Section 5.5 Current Traffic Trends Airport Road Corridor

The existing peak hour traffic operational characteristics indicated that nine (9) out of the fourteen (14) intersections analyzed currently either operate at congested or failure level of service during the peak hours of travel demand. Particularly, failure levels of service were exhibited at:

- *The QE II & Hwy 19 West Ramp Terminal* during the morning peak hour exhibits a failure level-of-service (LOS "F") in the SB-LT (which is currently afforded a double SB LT lane) maneovre and the shared EB Th/RT movement due to dominant attraction of the Leduc & Nisku Industrial/Business areas;
- *The QE II & Hwy 19 East Ramp Terminal* during the morning peak hour exhibits a failure level-of-service (LOS "F") in the EB-Th movement;
- The *Hwy 19/Sparrow Drive Intersection*;
- *The QE II & Airport Road West and East Ramp Terminals* are currently STOP controlled and the left turn movements are experiencing a failure level-of-service, predominantly in the AM due to the heavy EB demand into the Leduc & Nisku Industrial/Business area, which must accommodate a heavy SB-LT at the West Ramp Terminal resulting in a heavy EB-Th movement at the West Ramp Terminal.
- The *Airport Road / Sparrow Drive Intersection*; and
- The *65th Avenue / 50th Street Intersection* (which exhibited a 0-.98 v/c ratio).
- The *QE II & 50th Avenue West and East Ramp Terminals*: are currently traffic signal controlled and both intersections exhibit unsatisfactory levels of service and congested conditions during both peak hours of travel demand. The cause of the east-west congestion is current demand out-stripped the supply offered by the existing 4-lane urban cross-section of the 50th Avenue corridor.

Table 2-2 highlights the effect of intersection modifications that are proposed to be implemented by the EIA prior to 2017. These modifications/upgrades include establishment of a new Perimeter Road/Airport Road intersection that would provide access into the newly proposed commercial development on EIA lands. As well modifications are proposed to both QE II / Airport Road ramp terminals on either side of the Airport Road bridge. The analysis below indicates the extent of improvements required, independent of the EIA's commercial development and suggests that traffic signals on either side of the Airport Road bridge are warranted to meet current demands.

- *Airport Road SB-Off Ramp - West Ramp Terminal*: The intersection operates at satisfactory level of service with the advent of traffic control signals. The intersection would also require a double southbound left-turn (SB-LT) [AM = 920 veh/h].
- *Airport Road NB-Off Ramp - East Ramp Terminal*: This intersection also operates at satisfactory level of service once signalized providing more gaps to the minor northbound left-turn (NB-LT) movement.

Table 2-2 also highlights the intersection modifications identified to meet "current" demand requirements at the Sparrow Drive/Airport Road intersection. These improvements are to be addressed separately within a joint project sponsored by the City of Leduc and Leduc County which address the entire Airport Road corridor which includes:

- *Airport Road / Sparrow Drive Intersection:* This intersection would operate at an overall satisfactory level of service assuming an additional lane in the westbound (WB) and eastbound (EB) direction. The WB shared movement operates at unsatisfactory volume-to-capacity (v/c) ratio of 1.35. Other congested movements include the EB shared movement during the morning peak hour of travel demand.; and
- *6 laning of the Airport Road Corridor:* This project includes widening of Airport Road from Sparrow Road through to just east of the 5th Street / 42nd Street intersection.

Intersection capacity analysis was performed using Synchro 8™ traffic analysis software assuming the existing Base Year (2014) balanced traffic volumes for the intersections along the QE II corridor. Appendix "B-2" illustrates the base year traffic volumes used in the analysis, the existing intersection configurations, and the detailed intersection capacity analysis of existing (2014) baseline conditions. Appendix "B-2" details:

- the "overall" level of service for each intersection;
- specific LOS for the "worst case" critical movement(s) at each intersection;
- the number of vehicles making the movement;
- the theoretical delay in seconds-per-vehicle for the movement; and
- the volume-to-capacity (v/c) ratio for the critical movement.

Table 2-3 provides a summary of the intersection on either side of the existing QE II interchange bridge structures along the corridor for ease of reference.

2.7 Merge/Diverge Analysis

Merge / Diverge Analysis was undertaken to assess the ability of the various ramps along the QE II corridor between the Hwy 19 and Hwy 2A interchanges to accommodate entry and exit manoeuvres into and out of the freeway traffic stream. Appendix "B-2" presents the HCM[12] merge and diverge analyses results that assume the existing QE II freeway ramp and loop configurations and existing (2014) base-year traffic volumes.

Exhibit 2-4 illustrates the results of the merge/diverge analyses at each of the QE II interchange ramps and loops. The results are indicated for the "worst-case" peak hour conditions (whether it be AM or PM).

In general, the results indicated that the merge and diverge operations at ramps and loops were found to operate at satisfactory level-of-service (LOS) “D”-or-better.

[12] Highway Capacity Manual (HCM) Software Version - 2010

Table 2-3: Intersection Capacity Analysis Results – Existing (2014) Traffic Volumes

Interchange Ramp Terminal	Analysis Characteristics for Worst-Case Approach							
	AM Peak Hour				PM Peak Hour			
	Approach Movement (veh/h)	LOS	Delay (sec.)	V/C Ratio	Approach Movement (veh/h)	LOS	Delay (sec.)	V/C Ratio
QEII & Hwy 19: West Ramp Terminal - Signalized	Overall "F"				Overall "B"			
	SB-LT (1,840 veh/h) EB-T/RT (1,441 veh/h)	F	124 170	1.22 1.31	WB-TH	B	14	0.68
QEII & Hwy 19: East Ramp Terminal - Signalized	Overall "F"				Overall "D"			
	EB-TH (2,809 veh/h)	F	248	1.51	WB-TH (1,491 veh/h)	B	17	0.86
QEII & Airport Road: West Ramp Terminal - STOP Controlled	Overall "E"				Overall "A"			
	SB-LT (920 veh/h)	F	900 (15 min)	2.99	SB-LT (400 veh/h)	F	192	1.31
- With Traffic Signals	SB-LT (920 veh/h) (1,220 veh/h)	C D	26 39	0.90 1.01[1]	SB-LT (400 veh/h)	B	13	0.63
QEII & Airport Road: East Ramp Terminal - STOP Controlled	Overall "D"				Overall "D"			
	NB-LT (200 veh/h)	F	562 (9 min.)	2.74	NB-LT	F	88	0.86
- With Traffic Signals	NB-LT	B	15	0.48	NB-LT	A	9	0.31
QEII & 50th Ave: West Ramp Terminal - Signalized	Overall "F"				Overall "F"			
	EB-T/RT (2,205 veh/h) WB-TH (1,670 veh/h)	F	291 (5 min) 327 (5 min)	1.59 1.67	EB-T/RT (1,701 veh/h) WB-LT (168 veh/h) WB-TH (1,631 veh/h)	F	232 492 477	1.44 1.95 1.98
QEII & 50th Avenue: East Ramp Terminal - Signalized	Overall "F"				Overall "E"			
	EB-LT (780 veh/h) WB-T/RT (1,790 veh/h)	F	217 96	1.39 1.15	EB-LT (666 veh/h) WB-T/RT (1,735 veh/h)	F	119 82	1.15 1.12

1- Assumes additional vehicles would use the SB-LT (1,220 veh/h instead of 920 veh/h) given that it will be signalized. Motorists will less likely double back and use 31st Street if the intersection becomes signalized.

Bold Values represent congested conditions and poor levels-of-service

Yellow highlighted rows indicate theoretical levels of service assuming traffic signal controlled intersections at the QE II/Airport Rd Ramp Terminals

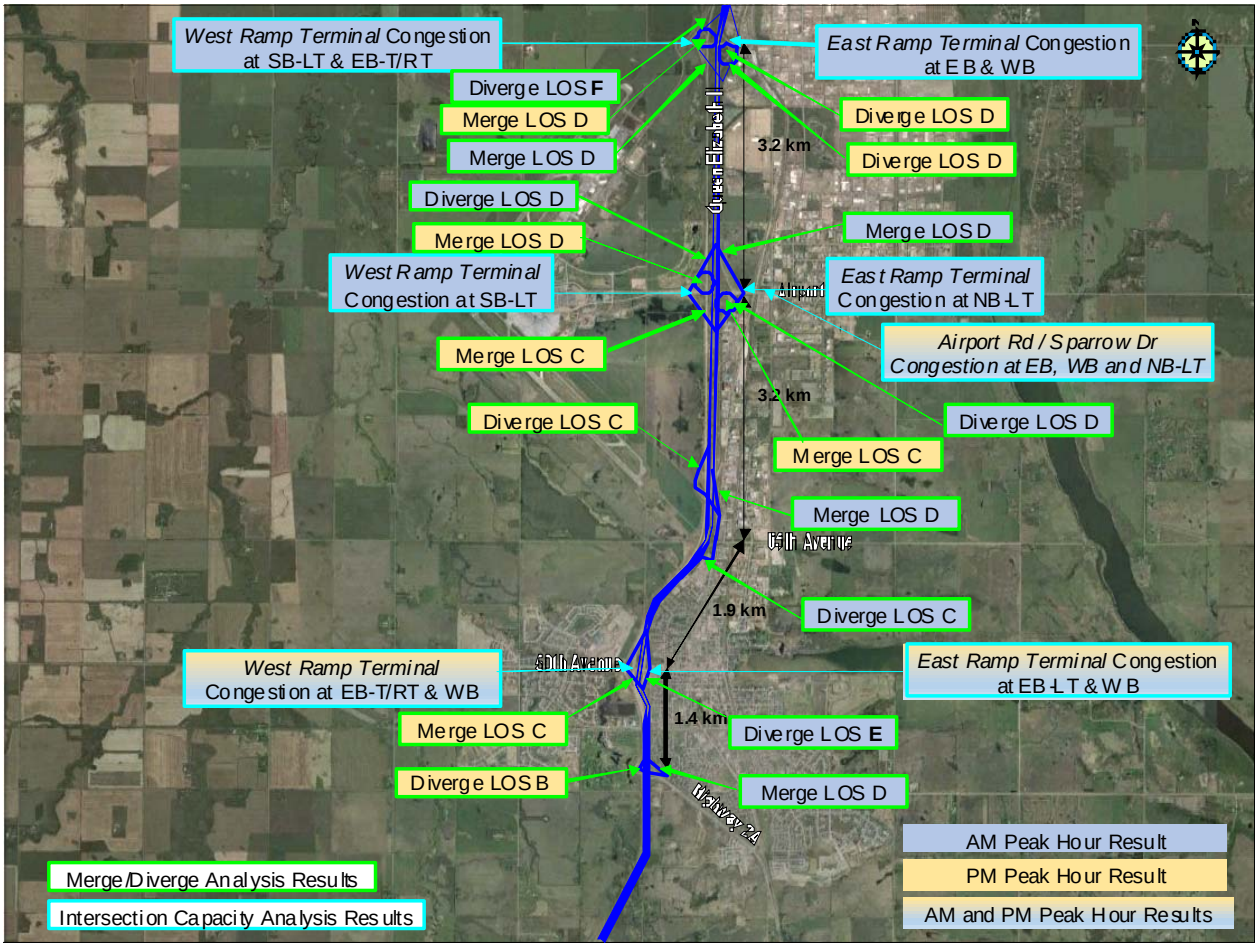


Exhibit 2-4: QE II Corridor - Existing Operational Constraints

However, two existing merge-diverge constraints were identified:

- *Highway 19 SB-EB/WB Off-Ramp Diverge*: was found to operate at an unsatisfactory LOS "F" during the morning peak hour of travel demand. This is due to heavy traffic volumes (approx. 2,150 veh/h) attempting to diverge away from the heavy southbound through traffic (approx 6,830 veh/h).

  Currently the QE II SB approach to this off-ramp is afforded a single-lane exit. A two-lane exit to the Hwy 19 SB-EB/WB Off-Ramp and an additional lane on the QE II SB north of Hwy 19 would address this constraint **These improvements are scheduled to be undertaken by Alberta Transportation as part of their QE II improvement plans and are currently on the Province's 2016-2019 Three-Year Construction Program**.

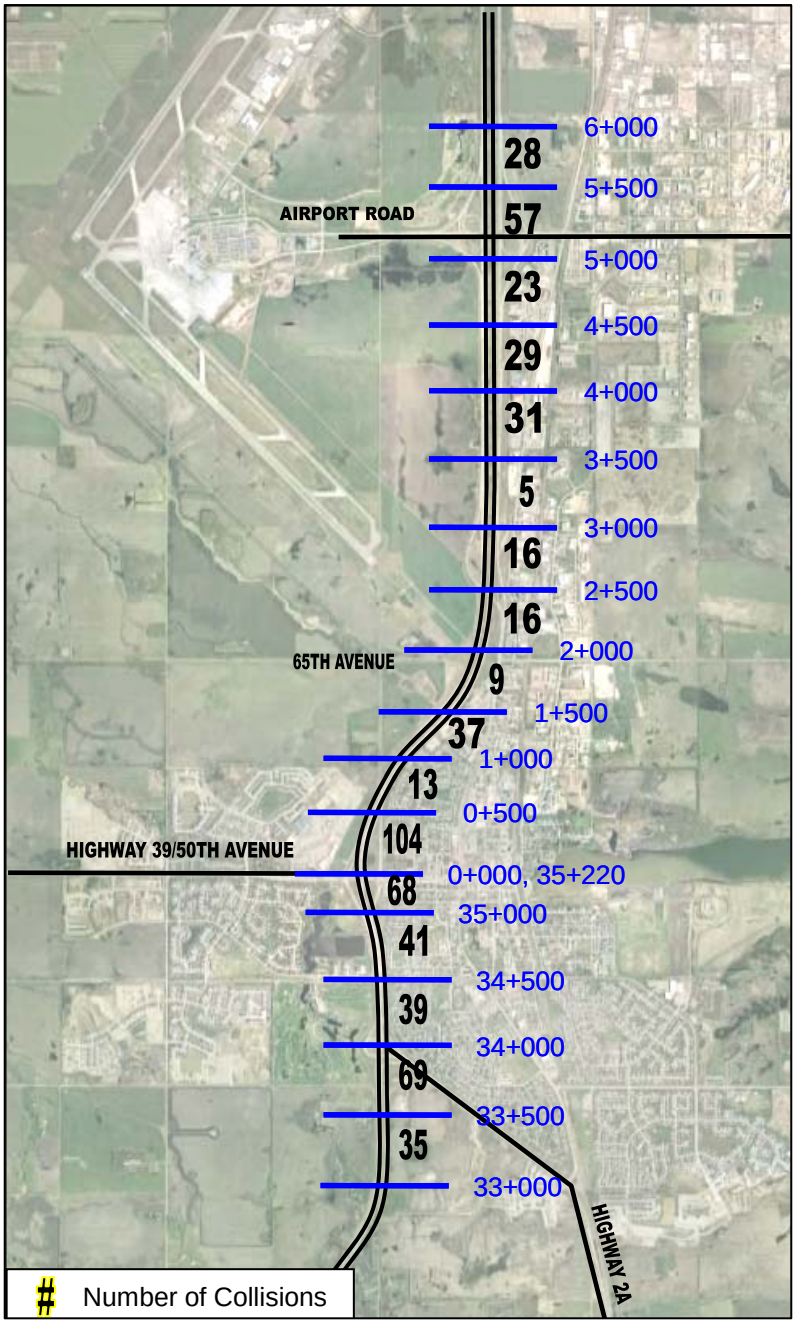
- *50th Avenue NB-EB/WB Off-Ramp Diverge*: was found to operate at an unsatisfactory LOS "E" during the morning peak hour of travel demand. There are approximately 350 veh/h exiting the northbound traffic (approx. 3,450 veh/h) stream onto the ramp. Despite the low number of vehicles exiting the QE II, the unsatisfactory diverge analysis was found to be due to the 2 NB QE II lanes operating at capacity.

  Widening of the NB QE II corridor south of the interchange to afford an additional NB through lane would resolve this issue however this **would also require the widening of the east bridge over Black Gold Drive and the CP Rail corridor located 350m south of the ramp gore**.

2.8 Collision History

Exhibit 2-5: Collisions along QE II Corridor[13]

The results of a collision[14] analysis of current (2008-to-2012) reported information provided by Alberta Transportation indicated that a total of 620 collisions were reported along the 8.0 km segment of QE II corridor. The study area was defined as being a distance of 4km on either side of the 65th Avenue corridor.



Location

Exhibit 2-5 illustrates the approximate location within 0.5 km intervals of the reported collisions[15]. QE II's Control Section CS 2:30 extends from Station 33+000 to 35+220 (50th Avenue/Hwy 39). QE II's CS 2:33 extends from Station 0+000 (50th Avenue/Hwy 39) to 6+000 (N of Airport Road).

- Only 4% (25 [16+9]) of the total collisions were reported to have occurred within a 1km influence area (500m on either side of the 65th Avenue corridor, between Station 1+500 and 2+500). This segment of highway currently has no exit or entry ramps.

[13] The stationing referenced in the collision analysis refers to AT's standard stationing where Km 0.0 relates to the intersection with Highway 39/ 50th Avenue.
[14] See Appendix "B-3".
[15] Collisions that occurred at intersecting highways (e.g. Hwy 39, Hwy 2A) are recorded as occurring on the lower-numbered highway, in this case, the collisions would be recorded on the QE II.

- 13% (80 [23+57] collisions) of the total 620 collisions were found to occur within 1 km of the Airport Road interchange [between Station 4+500 and 5+500];
- 28% (172 [104+68] collisions) of the total 620 collisions were found to occur within 0.72 km of the 50th Avenue (Highway 39) interchange [between Station 35+000 and 0+500]; and
- 17% (108 [69+39] collisions) of the total 620 collisions were found to occur within 1 km of the Highway 2A interchange [between Station 33+500 and 34+500].

Type of Collision

- 46% (286) of the total collisions involved a single vehicle:
  - 31% (196) accounted for vehicles that either struck an object (26%) or an animal (5%);
  - 15% (90) accounted for vehicles that simply ran off the road.
- 47% (292) collisions involved two-or-more vehicles and consisted of:
  - 22% (136) rear-end collisions;
  - <1% (2) head-on collisions;
  - 20% (122) sideswipe collisions; and
  - 5% (32) angle collisions.
- 7% (42) additional collisions were classified as "miscellaneous".

Collision Severity

Approximately 81% (504) of the total 620 collisions resulted in property damage, 18% (112) in personal injuries and less than 1% (4) in fatalities.

- A total of 113 collisions resulted in 149 persons injured over the 5-year period analyzed.
- There were four fatalities reported along the QE-II corridor over the 5 year period.
  - In 2012, a fatality at the Sparrow Crescent NB-EB Off-Ramp just south of the Airport Road Off-Ramp. High rates of speed and alcohol were noted as contributing factor;
  - In 2012, a fatality resulted north of the Hwy 2A SB-EB Off-Ramp in the median area;
  - In 2012, a fatality resulted north of the Hwy 2A Interchange where a NB vehicle reported as operating in excess of 150 km/h lost control and hit a guard rail; and
  - In 2009, a fatality occurred at the Black Gold Drive Overpass where a SB vehicle in the inner SB lane hit the shoulder and swerved back into the SB traffic stream.

Collision Rates

Table 2-4 presents the average Provincial 2012 collision rates for various facility types.

Table 2-4: Provincial Average Collision Rates (2012)
[Number of collisions per-100-million-vehicle-km]

Facility Type	*Collision Rate*
4 Lane Divided Expressway - At Grade	55.0
4 Lane Divided Freeway - Not At Grade	52.8
6 or more lanes	47.5

Source: Alberta Transportation: Alberta Collision Information System - Provincial Highway Report Analysis. - Run Date May 15, 2014

The average annual collision rate (based on 2008-2012 information) along the QE-II corridor for the 8 km section (between Station 33+000 and Station 6+000) was determined to be 76 collisions per-100-million-vehicle-km. . It was confirmed with AT's Office of Traffic Safety that this 8 km section of the QE II corridor exhibits an overall collision frequency that is higher than the Provincial "rural" average for similar facilities.

2.9 Environmental Evaluation

An initial *Environmental Evaluation* was undertaken to identify areas of potential environmental concern in the vicinity of the future QE II / 65th Avenue interchange. The evaluation consisted of an overview of existing conditions and potential environmental impacts (inclusive of: landforms/soils, vegetation, wildlife, wetlands, fisheries and water quality). The evaluation[16] included a desktop/literature review, a field investigation (undertaken in October 2014), a determination of potential impacts and the identification of preliminary mitigation measures and areas requiring that may require further assessment.

The evaluation noted that the study area in the vicinity of the QE II is located within close proximity to the urban area of the City of Leduc and the EIA. The natural environment of the surrounding area can best be characterized by the significant disruption caused by past human activities.

The following points are intended to provide a brief synopsis of the environmental findings:

- *Study Area*: The study area is located in the *Central Parkland Natural Subregion* of Alberta.
- *Landforms/Soils*: A desktop review indicated that soils within this area are generally Orthic Black Chernozems with some Solonetzic, Dark Gray Luvisols and Gleysolic soils. The region is generally characterized by undulating glacial till plains. The site visit identified that the majority of the soils in the vicinity of the future 65th Avenue interchange are Eluviated Black Chernozem soils, with some Orthic Gray Chernozems, which are well drained. Bedrock within the study area is part of the Horseshoe Canyon Formation, which is a non-marine formation. Surficial geology within the immediate vicinity of the interchange is moraine, with glaciolacustrine deposits further to the west of the QE II corridor.
- *Vegetation:* A field assessment identified that the dominant vegetation is characterized by common agricultural species, such as canola and wheat. Other species obseved included: poplar, foxtail barley, tickle grass, junegrass, mint, tufted white priarie aster and other grasses. Various weeds, such as scentless chamomile, perennial sow thistle, tansy and Canada thistle were also observed. Within wet areas, aquatic vegetation was identified, including common cattails, sedges, willows, marsh reed grass, dock, slough grass, tall mannagrass and water parsnip. The Alberta Conservation Information Management

[16] See Appendix "A-1": Environmental Evaluation

System (ACIMS) database indicated two occurrences of "non-sensitive element occurrences" vegetation species within the general study area along Deer Creek (green-cushioned weissia moss and aloe-like rigid screw moss); both signtings occurred in the early 70's and the species were not identified during the site assessment. Deer Creek is not located within the immediate vicinity of proposed future freeway infrastructure.

- *Wildlife*: Wildlife observations during the field assessment included gyrfalcon, muskrat, Canada geese and an unknown duck species. Referenced[17] sources of information identified the Short-Eared Owl listed as "May be at risk" according to *Alberta Species at Risk* (2010) and seven other species (Lesser scaup, Swainson's hawk, Least flycatcher, Common yellowthroat, Northern pygmy-owl, Sora and Eastern phoebe) as "sensitive" that could potentially be found within the study area.
- *Wetlands*: A total of seven wetlands were identified on the west side of the QE II within the EIA's lands and along the future 65th Avenue West corridor. Six of which would be directly impacted by the proposed infrastructure associated with this study. (See Appendix "A-1", Figure 7 - Wetland Area 7 is in the vicinity of the EIA Commercial lands and is not impacted by the roadway infrastructure associated with this functional planning study.) A series of 9 mitigation measures have been proposed for implementation associated with proposed QE II modifications. (See Section 5.6.2, 5.6.4 and Section 7.)
- *Fisheries*: Telford Lake and Deer Creek were identified as fish bearing water bodies, however these are not located within the immediate vicinity of proposed future infrastructure. References[18] have identified five fish species within these water bodies. According to *Alberta Species at Risk* (2010), all species were listed as "Secure" within the study area. (White Sucker, Lake Chub, Brook Stickleback, Rainbow Trout and Fathead Minnow).
- *Surface Water and Groundwater*: Numerous lakes, creeks and tributaries are located within the study area; however none were identified within the immediate vicinity of the future interchange location.

2.10 Historical Resources Overview

A *Historical Resources Overview*[19] (more recently referred to as a "Statement of Justification") was undertaken to identify areas of potential historical concern within the study limits and to determine if a *Historical Resources Impact Assessment* (HRIA) would be required as part of this initiative.

The majority of the study area has been previously developed and pas disturbances are present (including residential, commercial, industrial, airport, roadwork, agriculture, etc.). A search of previously recorded archaeological sites identified eleven (11) sites within the vicinity of the study area, but none of these sites are located within the project study area. All

[17] The *Committee on the Status of Endangered Wildlife in Canada* (COSEWIC) website and the *Alberta Fish and Wildlife Management Information System* (FWMIS)

[18] "*The Committee on the Status of Endangered Wildlife in Canada*" COSEWIC and the "*Alberta Fish and Wildlife Management Information System*" (FWMIS)

[19] See Appendix "A-2": Statement of Justification for Historical Resources Act, July 2015

archaeological sites were found in cultivated fields or in areas of surface disturbance. In the case of ten (10) sites no significant historical remains were found, as the sites were not considered significant (all HRV=0); site FhPi-1 was the only exception (HRV= 4-5[20]), but located more than 3 kilometers away from the study area; hence no further work was recommended for any of these sites.

The closest sites to the study area were sites located within areas already destroyed by agricultural use, commercial, residential and highway development (See Appendix "A-2").

A single palaeo site (Leduc Palaeo) was recorded, however this is located more than two kilometres away from the study area.

The previously disturbed nature of the study area lands suggested that there remains little potential for finding undisturbed historical resource sites.

In conclusion additional Historical Resource investigation was determined to be unnecessary for the QE II / 65th Avenue Interchange study area.

2.11 Preliminary Geotechnical Assessment

A *Preliminary Geotechnical Assessment*[21] inclusive of a desktop study was undertaken to determine the general geotechnical conditions, identify any geotechnical constraints and provide preliminary geotechnical input to assist in developing design options.

The surficial geology desktop analysis outlined in the study area the following major geological units exposed on the ground surface. (According to recent maps[22] the total thickness of the surficial deposits in the study area varies between 10-to-50 m):

- *Glacial deposits:* ground moraine till, composed of clay, silt and sand with pebbles and boulders. This till overlies the bedrock and underlies the other surficial geology units.
- *Lacustrine deposits:* formed by Glacial Lake Edmonton and composed of stratified clay, silt and sand. Due to a partial erosion the thickness is uneven and probably less than 1m.
- *Alluvial deposits:* present in a number of tributaries to Whitemud Creek, and composed of clay, sand and silt.
- *Colluvial Deposits:* consist of weathered surficial and bedrock material, which are present along the side slopes of the Gwynne Outlet channel.
- *Organic Deposits:* developed in shallow ponds and poorly drained areas (some areas become temporally filled by water during rainy periods, while others remain dry enough to be cultivated).

[20] "HRV 4" indicates a historic resource that may require avoidance and "HRV 5" is believed to contain a historic resource
[21] See Appendix "A-3": Preliminary Geotechnical Assessment Report, November 2014
[22] Published by Alberta Geological Survey (Slattery 2011)

The preliminary geotechnical assessment...:

- indicated that the construction of an interchange and associated highway/roadway alignment modifications within the study area were feasible, from a geotechnical point of view;
- suggested to perform a geotechnical investigation in order to accurately assess the depth to solid bedrock at the proposed interchange foundation locations, because surficial deposits are expected to vary from about 6 m to 7 m in thickness in the study area;
- found no signs of visible instability or distress to the existing 50th Street flyover subsequent to an inspection of the approach fills (November 2014) and a review of the bridge file BF77994;
- indicated that, for functional planning purposes, it could be assumed that the 50th Street Bridge embankments could likely be constructed with 2H:1V head slopes and 3H:1V side slopes if suitable fill materials were to be used;
- indicated that the most feasible foundation types for a future 65th Avenue interchange bridge would likely be steel piles driven to practical refusal in the bedrock. For functional planning purposes, the bedrock depth could be assumed to be in the order of 10 m-or-less below the existing ground surface;
- indicated that at any location embankment fill design and construction must take into account the presence of glaciolacustrine clay and silt with low to medium strength and medium to high compressibility, hence wick drains or staged construction may be required;
- suggested that the approached fills to the bridge should be constructed in advance or construction to allow for settling;
- indicated that the natural drainage condition was found to be poor, hence suitable drainage structures or facilities would be required at the interchange and approach road sub-grades;
- indicated that to reduce potential slope instability the permanent cut and fill slopes should be top-soiled and re-vegetated as soon as possible; and
- indicated that some area with organic materials and water bodies were identified and suggested that where possible these areas should be avoided.

2.12 Existing Hydrology

A preliminary hydrological assessment[23] of the existing drainage of the area was conduced. The study focused on: regional drainage, local drainage, existing meteorology and existing surface runoff conditions. Numerous drainage ditches and approximately 26 culverts were identified within the study area.

[23] See Appendix "A-4": Hydrological Assessment of Existing Drainage: QE II / 65th Avenue Interchange, November 2014.

- *Regional Drainage.* Four drainage areas were identified (North Region, Central region, South-East Region and South-West Region). On a large scale the runoff drains into two creeks: an unnamed first order tributary of Whitemud Creek (west side of QE II) and an unnamed first order tributary of Blackmud Creek (east side of QE II).
- *Local Drainage.* The drainage region within the study area was identified and culverts, drainage paths, general drainage condition for each region were analyzed. It was determined that a future realignment of the QE II to the west and the future 65th Avenue W corridor would impact the drainage to the Whitemud tributary and remains to be addressed. The drainage pattern to the Blackmud Creek (east side of QE II and north of the 50th Street fly-over) would likely be unaffected by the future QE II realignment or the QE II / 65th Avenue interchange.
- *Existing Meteorology.* Meteorological information was available at a station located less than 5 km away from the future interchange site (i.e. EIA). Climate normals for the 30 year period from 1981-to-2010 were analyzed as representative of the expected mean climate. The peak precipitation applicable to the study area occurs in July with a mean precipitation of just under 100mm. Peak accumulation of snow means remain under 20 cm during the month of February, with the mean monthly snow fall peaking in January at 22 cm. Warm temperatures occur in July-August, with a daily average temperature around +16^{o}C, whereas winter temperatures decline to an average of -12^{o}C in December-January.
- *Existing Surface Runoff Condition.* Four land types (each with a corresponding runoff coefficient RC) were identified in the study area: urban (RC 0.70), cultivate lands/grass (RC 0.35), QE II corridor (RC 0.75), and land under development (RC 0.80). Existing compositions of drainage regions and corresponding runoff coefficients for urban (Leduc), the QE II corridor, the "cultivated lands/grasses" and "under development" areas were calculated and existing surface runoff conditions (RC values) were estimated. The QE II corridor was calculated to have a RC value of 0.75 based on a general composition of 2/3$^{rd'}$s roadway and 1/3rd grass.

2.13 Bridge Investigation of Existing Structures

A preliminary assessment[24] of the existing bridge structures within the study area was conducted which included a review of Alberta Transportation (AT) Structure Reports and AT BIM Inspection Reports. Table 2-5 provides a brief synopsis of the existing bridge characteristics and the estimated applicable remaining lifespan.

[24] See Appendix "A-5": Conceptual Bridge Planning Assessment

Table 2-5: Existing QE II Bridge Characteristics

Existing QE II Bridges	*Highway 2A Interchange Bridge*	*CPR and Black Gold Drive Underpass (Twin Bridges)*	*Hwy 39/50th Avenue Interchange Underpass (Twin Bridges)*	*Southbound 50th Street Bridge (Fly-Over)*	*Airport Road Interchange Bridge*
Bridge File No.	[BF 75522]	[BF 75058]	[BF 75055]	[BF 77994]	[BF 75066]
No. of Existing Lanes on Bridge	2	2 lanes on each bridge	2 lanes on each bridge	1 Lane SB	4 lanes (2 lanes in each direction)
No. of Lanes Bridge traverses Over	4 divided rural expressway QE II lanes	2 lane arterial Black Gold Drive & CP Rail Corridor	5 lane arterial 50th Avenue (3 EB and 2 WB lanes)	6 lane median divided rural expressway QE II lanes	6 lane median divided rural expressway QE II lanes
Crossing Angle	Near 90°	Near 90°	Near 90°	40°	Near 90°
Construction Year	1963 (53 Years Old)	1961 (55 Years Old)	1960 (56 Years Old)	1977 (39 Years Old)	1980 (36 Years Old)
No of Spans and Span Length (m)	[4Spans] 1 - 12.5m 2 - 21.3m 3 - 21.3m 4 - 12.5m	[4Spans] 1 - 14.6m 2 - 20.1m 3 - 20.1m 4 - 14.6m	[3 Spans] 1 - 13.7m 2 - 15.8m 3 - 13.7m	[3 Spans] 1 - 57.9m 2 - 64.0m 3 - 42.7m	[4Spans] 1 - 45.1m 2 - 45.1m 3 - 45.1m 4 - 45.1m
Total Bridge Length (m)	67.6m	69.4m	43.2m	164.6m	180.4m
Vertical Clearance	5.2 - to - 5.3 m	7.4 m	4.85 m	5.3 - to - 5.57 m	5.3 - to - 5.57 m
Clear Roadway Width on Bridge	14.6 m	11.6 m	11.6 m	7.6 m	19.9 m
Estimated Remaining Lifespan	10-15 years (2013 BIM Report)	30-35 years (2013 BIM Report)	10-15 years (2013 BIM Report)	25-30 years (Rehabilitated in 2014/2015)*	30-35 years (2013 BIM Report)

* Communications with Mr. Jeff Zhang (Bridge Manager, AT Barrhead) indicated that rehabilitation of 50th Street Flyover was underway during the 2014 / 2015 during the summer construction seasons. The rehabilitation is anticipated to extend the life of the structure by approximately 25 to 30 years; therefore a revised replacement year of 2045 is anticipated rather than the 2030 value listed in the BIM Report.

2.14 Geometric Overview of Existing QE II Corridor

The design review of the existing QE II corridor involved a desktop assessment and an evaluation of the corridor based on a site overview. The review of existing conditions served to identify the following geometric and access management issues:

- *Horizontal Alignment:* There are four horizontal curves along the QE II corridor in the southbound direction and five in the northbound direction within the study area. The minimum desirable radius for new highway construction, with a design speed of 130 km/hr, is 950 m for emax=6%. Three of the curves in each direction were less than 950 m (southbound: R690, R890 and R930; northbound: R730, R 870 and R660).
- *Vertical Alignment:* The QE II corridor consists of numerous sag and crest vertical curves and highway grades that vary from 0.0% to 3.0% (where a 3% grade is the desirable maximum for a freeway facility[25]). Generally the existing geometry of the QE II vertical alignment can be characterised as follows:
  - *Northbound QE II*: There are seven sag curves and four crest curves along the 8km QE II alignment. A single crest curve (K36 located at approximately Station 0+050) does not meet the 3R/4R desirable (K50) minimum; and
  - *Southbound QE II*: There are seven sag curves and six crest curves, all of which met the 3R/4R desirable minimums (k= 50 for crest curves and k=35 for sag curves).
- *Pavement Width*: The current standard for a new rural twinned highway surface (inclusive of travel lanes and shoulders) requires a 12.4m pavement width per direction for a 4-lane cross-section and 16.6m width per direction for a 6-lane cross-section[26]. For 3R/4R projects, the existing pavement widths along the QE II corridor (described in Section 2.1 above) are acceptable and meet AT's 3R/4R standards.
- *Access Management*: The interchange spacing along the QE II corridor within the study area, with a few exceptions, is consistent with AT's access management guidelines for freeway facilities (1.6 km separation between interchange) there are however two exceptions:
  - the separation between the Hwy 2A and 50th Avenue interchanges is only 1.3 km; and
  - the separation between the 50th Avenue interchange and the 50th Street NB-EB slip Off-Ramp is only approximately 1.2 km.

2.15 Existing Utilities

Eleven utility providers were found to be listed along the QE II corridor[27]. Each of the following utility providers was contacted as part of this functional planning study to confirm the presence and location of their services within the study area. (See Section 8):

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[25] ATHGDG: Table A-7, Section A.7: General Design Contronls and Standards for Rural Highways, Chapter A: Basic Design Principles

[26] ibid

[27] *Alberta One Call*

- Alberta Capital Region Wastewater Commission
- Alberta Products Pipeline
- Altagas (Gas)
- Atco Gas (Gas)
- Atco Pipelines
- Bell
- Edmonton Regional Airport Authority
- Fortis Alberta
- MTS Allstream Inc.
- Pembina Pipeline Corporation
- Telus Communications

The existing utilities within the study area were identified and analyzed in terms of possible interferences/influences associated with a future QE II/ 65th Avenue interchange and further improvements to the 50th Street fly-over configuration.

3.0 TRAFFIC FORECASTING AND ANALYSIS

3.1 Initial Traffic Forecast Evaluation Based on Edmonton Regional Travel Model

The early stages of this study reviewed traffic forecasts efforts undertaken by the Transportation Modelling and Analysis section of Alberta Transportation[1] prepared on behalf of the greater Edmonton Capital Regional Board (CRB). These travel demand forecasts are representative of 1.8M and 3.6M population planning thresholds. For the purposes of this study, these population thresholds were estimated to coincide approximately with the 2044 (30-year) and 2146 (130-year) horizon years.

A technical summary detailing a traffic forecast evaluation that would impact the study area was prepared during the early stages of the study, and is included within Appendix "B-4". The evaluation included:

- An overview of population and employment RTM forecasts for 2016, 2044 and "Ultimate" (2146) time horizons for the Greater Edmonton Area;
- An aggregation of traffic zones to regional areas, intended to simplify the forecast model output; and
- Several Edmonton Regional Travel Model (RTM) runs were produced (which excluded the EIA lands from the travel demand forecasts). The RTM demographic input variables are largely employment and population based. This FP study produced a more accurate estimate of traffic generated by the EIA in terms of passenger travel, cargo operations, support service improvements and executive flight centre activity. This information was used to provide more detailed estimates of activities related to the Airport lands that was then superimposed on the RTM network.

For the purposes of this study, an approach was undertaken that extrapolated a 2044 (30-year) forecast by building upon the 2025 (10-year) and 2035 (20-year) forecasts developed as part of the EIA TIA[2] and the Airport Road Interchange Functional Planning studies. The resulting 2044 (30-year) forecast travel demand associated with this study were determined to be significantly higher than the 2044 RTM results which may potentially be attributed significant higher transit-use assumptions within the RTM.

3.2 The Horizon Years

A combined modeling exercise was completed to assure uniformity in the traffic forecasts presented within this functional planning study with the following two planning initiatives:

1. The EIA TIA[2] concentrated on a short-term 2017 (2-year); 2025 (10-year); and 2035 (20-year) horizon years. This was intended to address the requirements along the Airport Road

[1] Mr. Ali Farhan and Ms. Sabrina Chan - Travel Demand Forecasting Engineers

[2] "*Edmonton International Airport (EIA) Highway Commercial Development Transportation Impact Assessment*" (Castleglenn Consultants Inc., January 2016)

corridor necessary to obtain a Roadside Development Permit for the proposed EIA commercial development initiatives; Phase 1 of which was considered imminent.

2. The Airport Road Interchange Functional Planning Study examined the horizon years beyond 2035 and included a forecasts for 2044 (~30 years), and 2075 (+60-years) which corresponds with the horizon year of the EIA's Master Plan.

Beyond the 2075 horizon, the 2146 (130-year) horizon year model results representing the 3.6M population planning thresholds obtained from the RTM that were examined only from a link volume perspective since 130-year travel forecasts are at best speculative and perhaps inappropriate for detailed analyses such as intersection capacity analysis or merge-weave operational analysis.

In summary, the following horizon years are addressed within this functional planning study:

1. 2025 Forecast (+10 years);
2. 2035 Forecast (+20 years);
3. 2044 Forecast (+30 years), equivalent to a 1.7M population defined by the CRB;
4. 2075 Forecast (+60 years); and
5. 2146 Forecast (+130 years), equivalent to a 3.6M population defined by the CRB.

3.3 Land Use and Traffic Forecasting

Appendix "B-1" highlights the adopted land use assumptions, and applied traffic generation rates used to prepare the traffic forecasts for each horizon year, inclusive of infrastructure assumptions. Appendix "B-2" documents the historical traffic volume information and calculations used to determine annual growth rates (See Section 2.4).

3.3.1 Traffic Forecast Methodology

A superposition methodology was used to provide traffic forecasts for the 2025, 2035, 2044 and 2075 horizon years for this study. The methodology involved aggregating various layers of traffic to produce travel demand forecasts. The traffic layers included:

- *Base traffic volumes* which included a review of existing (2013), and subsequently updated to 2014) traffic volumes.
- *A balancing approach* was then applied to assure that traffic leaving one intersection would balance with traffic arriving at an adjacent intersection (while accounting for any possible mid-block gains/losses[3].)
- *Five separate development areas*, representing some 6,200 gross acres of potential development (excluding the EIA lands) were identified, reviewed and evaluated to determine site generated peak hour traffic for each of the horizon years. Traffic was distributed to area roadways and the QE II corridor based on an appreciation of existing and forecast population and employment trends obtained from the RTM as well as local traffic trends

[3] These mid-block gains/losses do not occur along the QE II corridor as all ramps are well defined, but they do occur along the urban arterial corridors where driveway accesses/egress can occur .

obtained from the City of Leduc\Leduc County. (See Section 3.3.2 and Appendix "B-1");

- *Edmonton International Airport (EIA)* was examined in terms of forecast growth trends associated with passenger travel, cargo flights and business aviation and airport support services. In addition, the EIA's significant commercial development initiatives located immediately adjacent to the QE II were determined. Traffic generation rates were applied and the total traffic forecast generated by the EIA was determined for each horizon year. EIA Traffic was distributed to the adjacent roadway network based on an appreciation of existing and forecast population and employment trends obtained from the RTM.
- *background highway thru-traffic growth.* Traffic along the QE II and Highway 19 corridors are comprised of two components. QE II Highway thru-traffic represents the component of vehicle traffic which neither originates from, nor is destined to, the City of Leduc, EIA, Nisku Industrial lands nor any access/interchange in-between. Highway thru traffic simply represents the motorist that simply want to use the QE II corridor to travel between the City of Edmonton (or more northern areas) and areas south of the City of Leduc. A detailed assessment of existing traffic volume information was used to disaggregate the highway thru traffic component of traffic from the total traffic using both the QE II and Highway 19 corridors. (See Section 3.3.3).
- *"orphan movements"* were defined as those turning movements along the QE II corridor for which growth can be anticipated, but remain unaffected by either the known adjacent development initiatives or highway thru-traffic volumes. Growth at these turning movements are attributed to further development intensification within existing developed areas or growth in areas not accounted for within this study. Over 38 individual orphan turning movements were identified, an annual growth rate was applied based on a historical review of traffic volumes and then distributed along the roadway network accounting for forecast population and employment trends. (See Section 3.3.3).
- *Infrastructure Improvements.* Several future roadway initiatives have been contemplated in past planning efforts that would have a significant impact upon travel demands along the QE II corridor. These include:
  - The *Terwillegar South Extension* (from its current location in Edmonton through to the future QE II interchange south of the City of Leduc). Depending on the configuration of this future corridor (expressway, arterial, etc.) the development of a NS corridor to the west of the QE II would serve to divert a component of Edmonton West-to/from-QE II S away from the QE II corridor.
  - The *Nisku Spine Road corridor* (extending southward from 9th Street in Edmonton, looping to the east of Telford Lake and extending to the southwest to the future QE II interchange south of the City of Leduc). This corridor is being designed as an arterial roadway and will also serve to reduce QE II NS traffic volumes.

    The extent of the likely traffic diversion to both the above corridors was assessed by making use of the RTM. Scenarios were run that assumed the new infrastructure to be in place and the resulting NS traffic volumes along the QE II corridor and the future Terwillegar and Spine road corridors were evaluated to determine the extent of the traffic diversion.
- *Transit Improvements:* A rapid transit corridor is being protected on the west side of the QE II corridor, which would serve planned developments, to the north of Hwy 19, the Edmonton International Airport, and potentially planned developments further south.

The extension of transit services along this corridor parallel to, and west of the QE II at this time remains conceptual[4]. The corridor is not planned to occur before the 30-year time horizon[5] and its configuration (BRT, LRT, supporting Park-n-Ride facilities) and station locations are conceptual. The ultimate transit configuration will have an effect on the mode share of potential transit patronage that could be relied upon to divert traffic from the QE II.

Recognizing the potential of the proposed transit corridor along the west side of the QE II, an approach was used that identified a transit share target to be achieved within each of the adjacent development areas correlated to enhanced transit service (i.e. regular transit, BRT, LRT, stations etc.) to reflect increased ridership. Sensitivity analysis was undertaken to determine the effects of enhanced transit services upon roadway infrastructure requirements by reducing the traffic generation rates by an assumed transit share. For example:

- within each of the new five separate development areas, sensitivity analysis was applied to reflect increased transit activity by reducing the vehicle traffic generates by the mode share attracted to transit;
- Within the EIA lands, the effect of transit activity was determined (using sensitivity analysis) by correlating higher frequency and quality of transit services provided to:
  - *EIA employees* commuting to and from work were felt to be more likely to utilize transit services than Airport passengers which may be loaded down with luggage etc.
  - *Employees within Supporting EIA Developments* (e.g. Aerotropolis and Highway Commercial Development) were felt to make greater use of transit than hotel/tourism and shopping patronage.
- within the "existing" developments such as the City of Leduc's Bridgeport. / Deer Valley communities and "existing" traffic along the west side of the QE II an enhanced transit share was applied. (Although outlying communities located farther away from the transit line, such as Devon, may be accessed through transit Park-n-Ride facilities along the corridor, existing Leduc communities on the west side of the City would benefit directly from an enhanced west transit corridor).

In general, a central finding was that increased transit share served to delay necessary roadway infrastructure improvements but not avoid them.

For the ultimate time (2146) horizon, traffic forecasts associated with the EIA Master Plan were superimposed over a CRB's 3.6M population forecasts. For the purpose of this study, the EIA's land use zones within the RTM were set to zero values and replaced with values based on EIA forecast passenger volumes, cargo forecasts, and forecast development impacts to ensure the EIA zone forecasts would be provided with greater accuracy than just population and employment. This permitted an assessment of the CRB's 3.6M population forecast assuming more accurate land use information related to the EIA lands.

[4] Capital Region Board, Integrated Regional Transportation Master Plan (2011).
[5] Email from Julian Macdonald, Highway Planning Engineer, dated May 29th, 2015

3.3.2 Land Use Assumptions and Site Generated Traffic in Vicinity of Leduc

A comprehensive list of past planning initiatives and impact studies undertaken within the study area was assembled, gathered, and reviewed. Estimates of the number of dwellings, acreage, gross-floor-area (SF GFA) or employee estimates for each individual development was prepared by referencing both the available land use information for individual sites and reviewing assumptions that had been documented within previous studies.

This study identified three major growth areas on the west side of the QE II corridor which remain largely undeveloped but which have been addressed within various Master Plans and Area Structure documents[6] initiated by the City/County. Appendix "B-1" serves to provide further detail for each of the development areas. Exhibit 3-1 illustrates these land use areas.

1. *South Development Area: (SDA)*

   This area (located south of the proposed 65th Avenue West corridor and west of the Rge. Rd 254 corridor) represents approximately 2,600 gross acres of potential development to be comprised of a mix of residential, commercial, business and public institutional uses.

   a. The western part of the SDA is to be characterized by approx. 840 net acres of business industrial land uses, 135 net acres associated with a proposed Town-Centre development, 108 net acres of retail space, and 27 net acres of office developments.

   b. The central part of the SDA would see approx. 213 net acres of involving a mix of business employment, residential, commercial and public institutional land uses.

   c. The eastern part of the SDA which includes the proposed Aerotropolis initiative is forecast to accommodate approx. 208 net acres of industrial land uses, 80 net acres of office, 42 net acres of retail space, and 16 net acres of public institutional land uses.

2. *Edmonton International Airport:*

   The Edmonton International Airport (EIA) continues to experience significant growth. Over the last two years the EIA has seen passenger levels exceed 8M passengers despite the downturn in the energy sector. For the purposes of this functional planning study the EIA lands were segmented into 5 sectors. The lands closest to the QE II corridor and south of Airport Road (Phase 1-thru-5) will see a large commercial/retail/hotel development inclusive of office space (that would provides almost 1M SF of retail space, approximately 630 hotel rooms and just over 400,000 SF of office space). In addition, the EIA is anticipated to experience growth related to increased passenger travel, cargo demands and support services.

3. *North Development Area (NDA) and Crossroads Development:*

   This area is located west of the QE II and north of Highway 19 corridors. The area represents approximately 3,600 acres of potential development and includes the proposed *Crossroads* Development closest to the QE II as well as additional development to the west (referred to as the North Development Area within this FP study). Both sites are proposed to be comprised of industrial, office, and commercial land uses.

[6] See Sections 1.2 and 1.3 for a description of referenced planning documents.

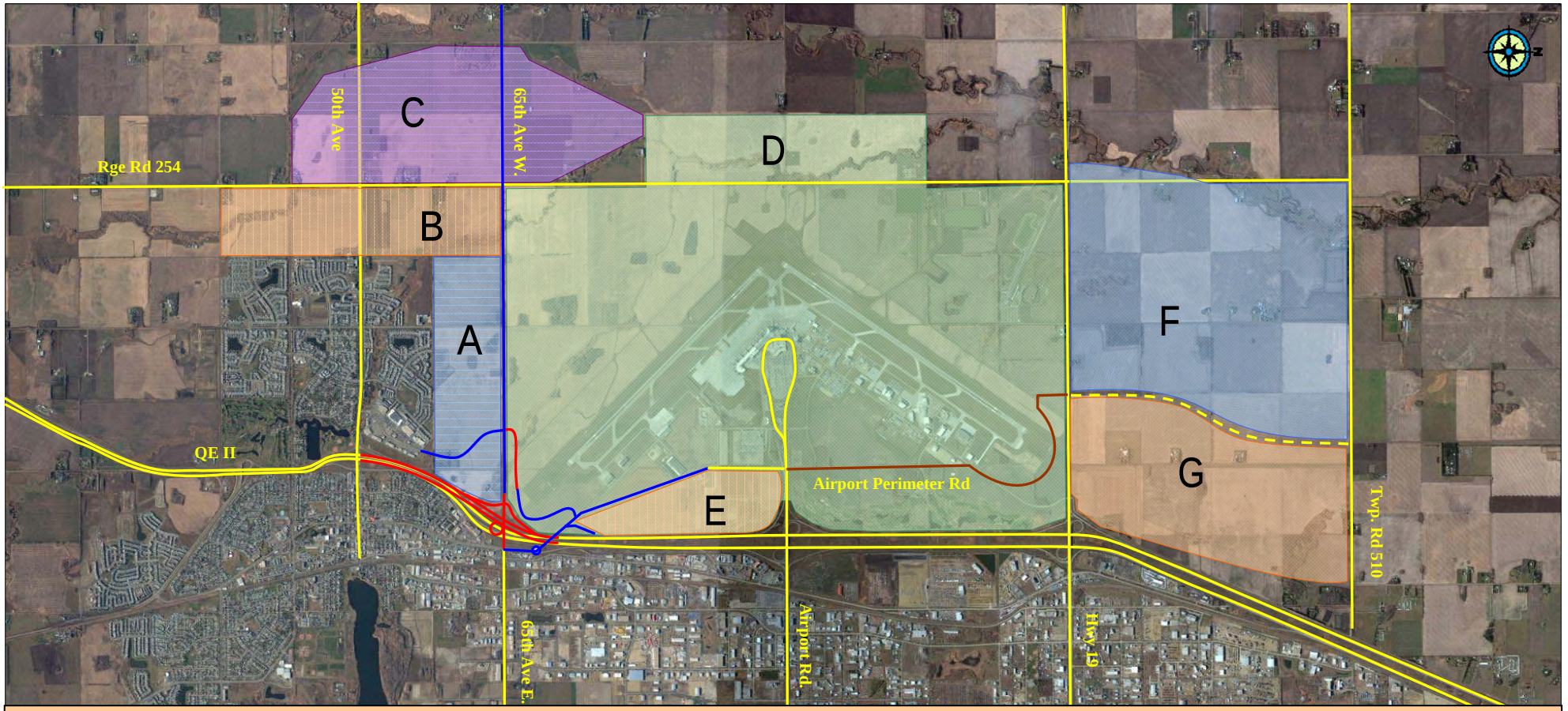

Exhibit 3-1: Maior Land Use Area

Table 3-1: Two-Way Peak Hour Cumulative Site Generated Traffic Applied to Study Area Roads (Vehicles per hour)

Development Name	South Development Area				Edmonton International Airport			North of Hwy 19			Total
	Sub Area 1	Sub Area 2	Sub Area 3	Total South Growth	EIA Highway Commercial Development	Other EIA Growth	Total EIA Growth	North Development Area	Crossroads Development	Total North Growth	
Location on Map	*A*	*B*	*C*	*A, B and C*	*E*	*D, exclusive of E*	*D*	*F*	*G*	*F and G*	*A, B, C, D, F, G*
2017 Horizon Year	0 (0)	155 (304)	0 (0)	155 (304)	701 (2,479)	252 (310)	953 (2,789)	0 (0)	1,126 (2,267)	1,126 (2,267)	2,234 (5,360)
2025 Horizon Year	398 (621)	776 (1,519)	0 (0)	1,174 (2,140)	850 (2,684)	999 (995)	1,849 (3,679)	157 (151)	1,625 (2,801)	1,782 (2,952)	4,805 (8,771)
2035 Horizon Year	1,204 (1,807)	1,552 (3,037)	1,583 (2,844)	4,339 (7,688)	1,155 (3,382)	1,893 (1,839)	3,048 (5,221)	522 (502)	2,033 (3,237)	2,555 (3,739)	9,942 (16,648)
2044 Horizon Year	1,879 (2,516)	2,251 (4,404)	4,022 (6,564)	8,152 (13,484)	1,321 (3,639)	2,727 (2,730)	4,048 (6,369)	2,114 (2,298)	2,033 (3,237)	4,147 (5,535)	16,347 (25,388)
2075 Horizon Year	1,879 (2,516)	2,251 (4,404)	5,690 (8,392)	9,820 (15,312)	1,892 (4,522)	5,318 (5,608)	7,210 (10,130)	3,627 (3,870)	2,033 (3,237)	5,660 (7,107)	22,690 (32,549)

1 Format: Morning Peak Hour (Afternoon Peak Hour)

Traffic forecasts for some of these areas (i.e. the Crossroads Development, and the central part of the SDA) were derived from previous transportation impact assessments (TIA's). The assessment of other areas involved developing assumptions from first principles involving land use estimates, developing traffic generation rates and traffic forecast to determine the likely build-out potential and staging of initiatives. (See Appendix "B-1")

3.3.3 Background Traffic Growth (Thru-Traffic and Orphan Movements)

Background traffic growth was simulated by addressing the following two traffic components individually:

- *Orphan Movements:* Future developments on the east side of the QE II corridor were accounted for with the use of "orphan movements" which represents a growth of traffic along certain paths unaffected by the above described developments. These orphan movements were assigned an average annual growth rate of 2.5% over the next decade followed by 1% growth thereafter.
- *Highway Thru Traffic:*, It was necessary to determine an annual growth rate to simulate the effect of the growth in QE II Highway thru-traffic (traffic traveling along the QE II corridor from/to south of Hwy 2A to/from the City of Edmonton) volumes. The historical growth rate at a point near Kavanaugh/Glen Park Road, south of to Hwy 2A was reviewed, where QE II highway thru-traffic volumes were felt to best represent the highest proportion of the overall traffic counts. The QE II corridor was found to exhibit a year-over-year growth rate of approximately 3.5%.

  Nonetheless, this growth rate:
  - included components of traffic attributed to the Nisku, Beaumont and Leduc communities which have all experienced significant growth in the last decade;
  - was heavily influenced by the jump in traffic volumes that occurred in 2012 and that was in the order of 6%; and
  - would be influenced by the growth in related orphan movements that was already accounted for, and ignoring this would result in double counting.

  It was considered reasonable to assume that an average annual growth rate of 2% would be indicative of the highway thru-traffic component attributable to the QE II corridor.

3.3.4 Traffic Forecasts

Table 3-1 summarizes the forecast traffic volumes generated from each development area considered on the west side of the QE II corridor. The forecast traffic growth of the proposed developments are approximately (excluding thru-traffic and "orphan movements"):

- By 2025: 4,810 AM peak hour and 8,770 PM peak hour two-way trips;
- By 2035: 9,940 AM peak hour and 16,650 PM peak hour two-way trips;
- By 2044: 16,350 AM peak hour and 25,390 PM peak hour two-way trips; and
- By 2075: 22,690 AM peak hour and 32,550 PM peak hour two-way trips.

Exhibits 3-2 and 3-3 illustrate the forecast traffic demand for the 2025 (10-year) and 2035 (20-year) time Horizon Years. Appendices "B-5" present the traffic forecasts associated with these horizon years with enlargements of the QE II / 65th Avenue Interchange.

3.4 Traffic Operational Analyses Results

Appendix "B-6" presents the traffic operational analyses that were carried out to identify the requirements for the planned QE II / 65th Avenue Interchange and the QE II corridor in the vicinity of this planned improvement.

Sections 3.41-thru-3.4.3 summarize the impacts associated with recommended improvements identified as necessary to satisfy travel demand estimates:

i) the "Interim Stage": Where the 50th Street Twinned Bridge Solution is implemented;
ii) the "Ultimate Stage": Where the 65th Avenue Interchange is implemented; and
iii) the advent of "Core Lanes" within the QE II corridor.

A large portion of the traffic operational results presented in this section (and the related Appendix documentation) are based on the capacity of various types of roadways. For the purposes of this functional planning study, the following capacities were adopted:

- *Arterial Roadways* (including bridges[7]): A travel volume demand capacity of 1,200 vehicles-per-hour-per-lane (veh/h/ln) was adopted to correspond to an acceptable level-of-service (LOS) "C" standard. A 1,600 veh/h/ln capacity was adopted to represent congested conditions with a LOS "E".
- *Freeway Lanes*: A capacity of 1,900 veh/h/ln was adopted to correspond to an acceptable level-of-service (LOS) "C" standard. A 2,300 veh/h/ln capacity was adopted to represent congested conditions with a LOS "E".
- *Directional Ramps* and *Loop Ramps*: The capacity of ramps differs from their connecting points at the freeway corridor from the capacity afforded nearest the ramp terminal which often connects to an arterial roadway.
    - Nearest the arterial roadway, ramp capacities of 1,400 veh/h/ln and 800 veh/h/ln were adopted to represent acceptable level-of-service (LOS) "C" conditions for directional and loop ramps, respectively[8] given the proximity to traffic signals and urban conditions.
    - Nearest the access point ramp would be characterized by a capacity similar to that of the connecting freeway segments. At these points, a capacity of 1,900 veh/h/ln representing acceptable LOS "C" condition was assumed.

[7] As bridge structures are a significant expense, they are often found to operate at a higher congestion level. For example, the Hwy 19 bridge presently has 2 EB lanes carrying almost 3,200 vehicles per hour during the morning peak hour, but at congested capabilities. This is equivalent to 1,600 vehicles per hour per lane, and a LOS "E".

[8] Institute of Transportation Engineers. *Freeway and Interchange Geometric Design Handbook*. Page 259.

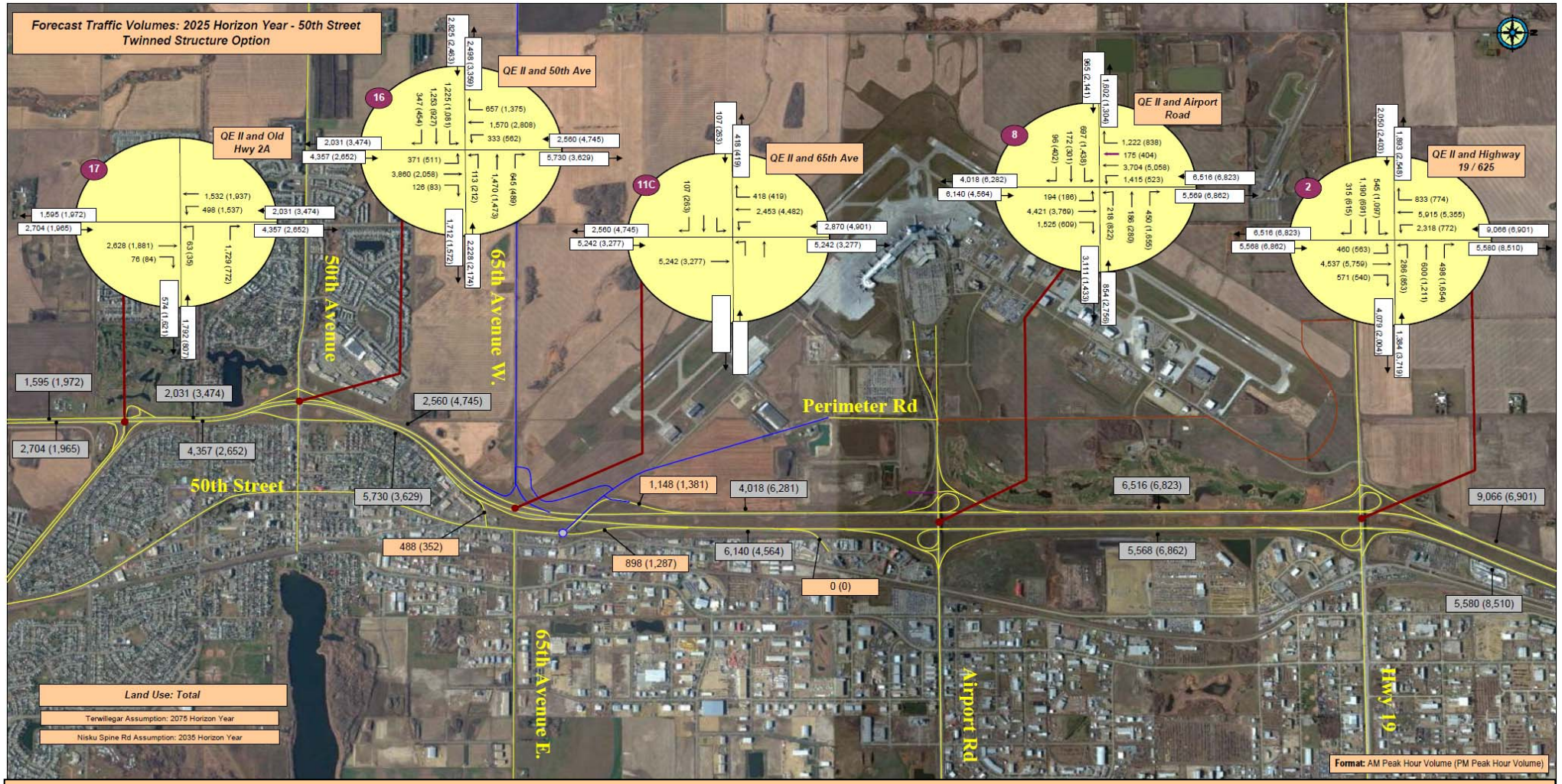

Exhibit 3-2: 2025 (10-year) Traffic Forecasts

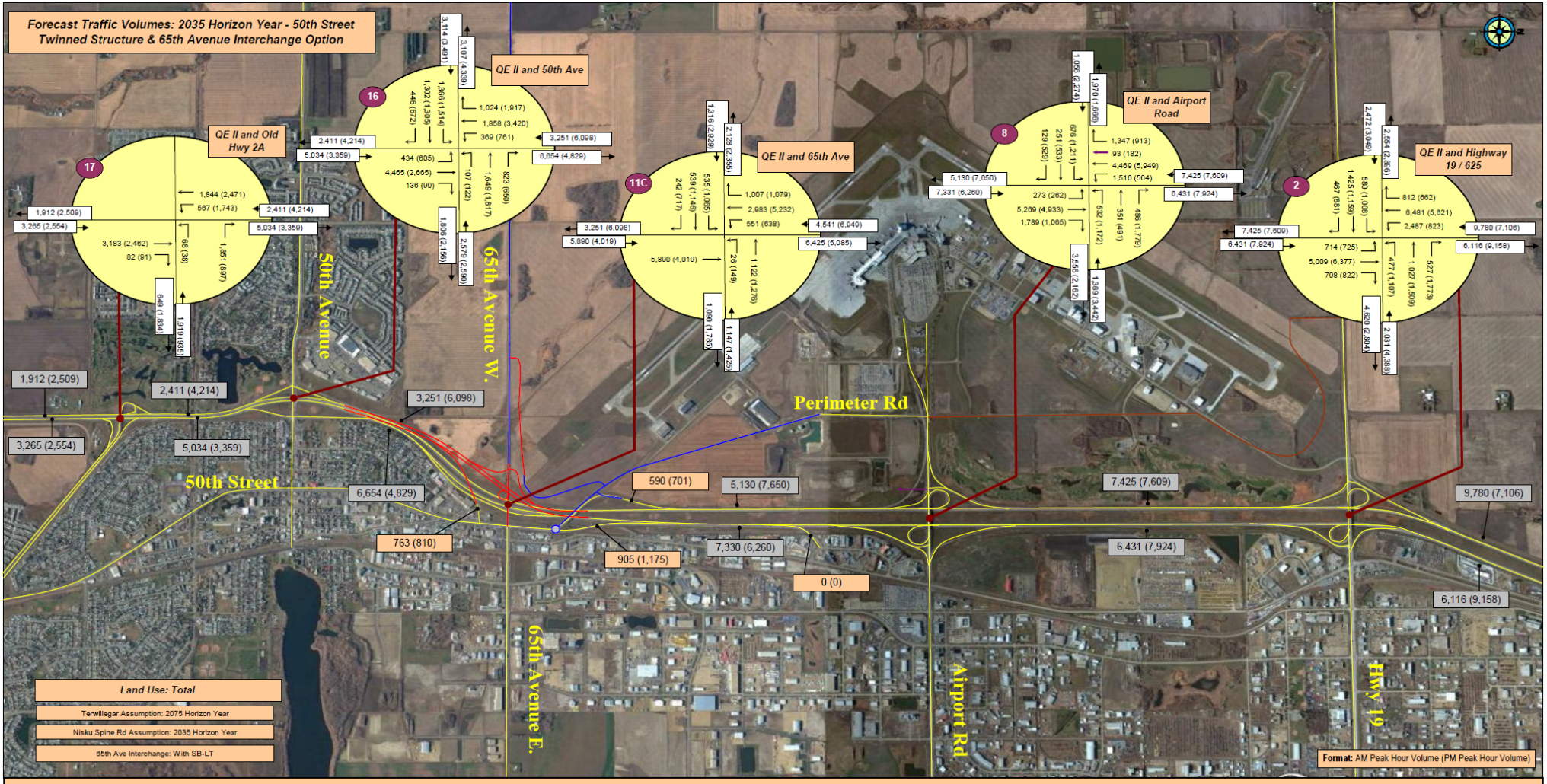

Exhibit 3-3: 2035 (20-year) Traffic Forecasts

3.4.1 Interim Stage: The 50th Street Twinned Bridge Solution

Table 3-1 indicated that within the next decade (by 2025), the lands within the Edmonton International Airport (EIA) are forecast to generate an additional 3,600 two-way vehicle trips during the afternoon peak hour of travel demand. Similarly, the lands to the south of the EIA are forecast to generate an additional 2,140 two-way vehicles during the afternoon peak hour.

Conclusion: Without the advent of an additional east-west crossing of the QE II corridor, the Airport Road and 50th Avenue interchanges would be under significant additional pressure.

- *Airport Road Bridge:* During the 2025 afternoon peak hour almost 3,000 veh/h are forecast to head EB over the Airport Road bridge (effectively exceeding the two-lane capacity of 2,400 veh/h). This triggers the need to widen the Airport Road bridge beyond its 4-lane cross-section.
- *50th Avenue Underpass:* During the 2025 afternoon peak hour nearly 2,700 veh/h would be forecast to head WB on 50th Ave under the QE II (effectively exceeding the two-lane capacity of 2,400 veh/h). This triggers the need to provide additional WB capacity under the QE II bridge.

A new crossing of the QE II was found to be warranted to provide additional east-west capacity by 2025. Appendix "B-6.4" (Tech Mem. No. 2) outlines a technical memorandum addressing the 50th Street twinned bridge concept at its original inception during a value engineering exercise that was conducted on Tues/Wed Feb 3rd/4th, 2015. Appendix "B-6.3" (Tech Mem. No. 3) was used to further refine the functional design concept of the 50th Street Twin Bridge solution.

Exhibit 3-4 illustrates the refined and preferred solution to provide additional short-term east-west capacity by way of an Interim Stage that would see a *50th Street Twinned Bridge Solution*.

The twinned 50th Street bridge solution would provide for the construction of a new 2-lane bridge located directly south of the existing 50th Street bridge structure. This new bridge would accommodate two new lanes of SB traffic; and the existing SB fly-over would be converted to accommodate a single NB lane.

- On the west side of the QE II corridor the existing 50th Street single lane bridge would flare out to 2 NB lanes until such time as additional capacity is required or the existing fly-over structure requires replacement;
- The proposed new 2-lane SB structure would be designed to accommodate both the existing QE II lane configuration and the future QE II realignment inclusive of the core- collector lane arrangement.

Exhibit 3-4: Twinned 50th Street Bridge Crossing

Junctions would be developed on either side of the 50th Street Twinned bridges:

- The *West Junction* would be developed as two offset "T" three-leg signalized intersections.
  - the south-eastern intersection would connect 50th Street with the QE II / 50th Street SB-EB/WB Off-Ramp; and
  - the north-western intersection would connect 50th Street with the northern and southern portions of the planned EIA's Airport Perimeter Road. (The northern leg would lead to Airport Road and the EIA Commercial Development; and southern leg would connect to 65th Avenue West and permit access to the development lands south of 65th Ave W.)
- The *East Junction* could be developed as either a three-leg single-lane roundabout (as illustrated in Exhibit 3-4) or a three-leg traffic signal controlled intersection.

Intersection capacity analysis indicated that assuming 2025 forecast traffic volumes and worst-case afternoon peak hour conditions:

- The *West Junction* includes the two intersections on the west side of the QE II which would be traffic signal controlled. Operational analysis indicates that by 2025 these would exhibit an acceptable level-of-service (LOS) of "B"-or-above.
- The *East Junction* was found to:
  - operate at acceptable LOS "A" assuming a traffic signal controlled intersection configuration; and
  - operate at critical conditions assuming a single-lane roundabout and **a very conservative capacity model.** (See Appendix "B-6" for a detailed discussion.).

Nonetheless, the roundabout remains the preferred option for functional planning purposes and the decision of roundabout versus traffic signal control is to be re-evaluated closer to the time of detailed design when land uses gains increasing certainty.

The 50th Street Twinned Bridge Solution was found to result in a 25%(pm)-to-35%(am) reduction in peak hour traffic WB volumes across the Airport Road Interchange bridge. Similarly the WB peak hour volumes under the QE II at 50th Avenue were forecast to decrease by 15%(am)-to-20%(pm) [See Appendix B-8].

3.4.2 The Ultimate Stage: The 65th Avenue Interchange

By the 2035 Horizon Year, development to the south of the EIA (including the Aerotropolis lands) along the 65th Avenue West corridor was found to trigger the need for additional east-west capacity beyond that afforded by the twinned 50th Street bridge solution. Exhibit 3-5 illustrates the planned ultimate 65th Avenue Interchange that was found to meet the ultimate time-frame travel demand requirements.

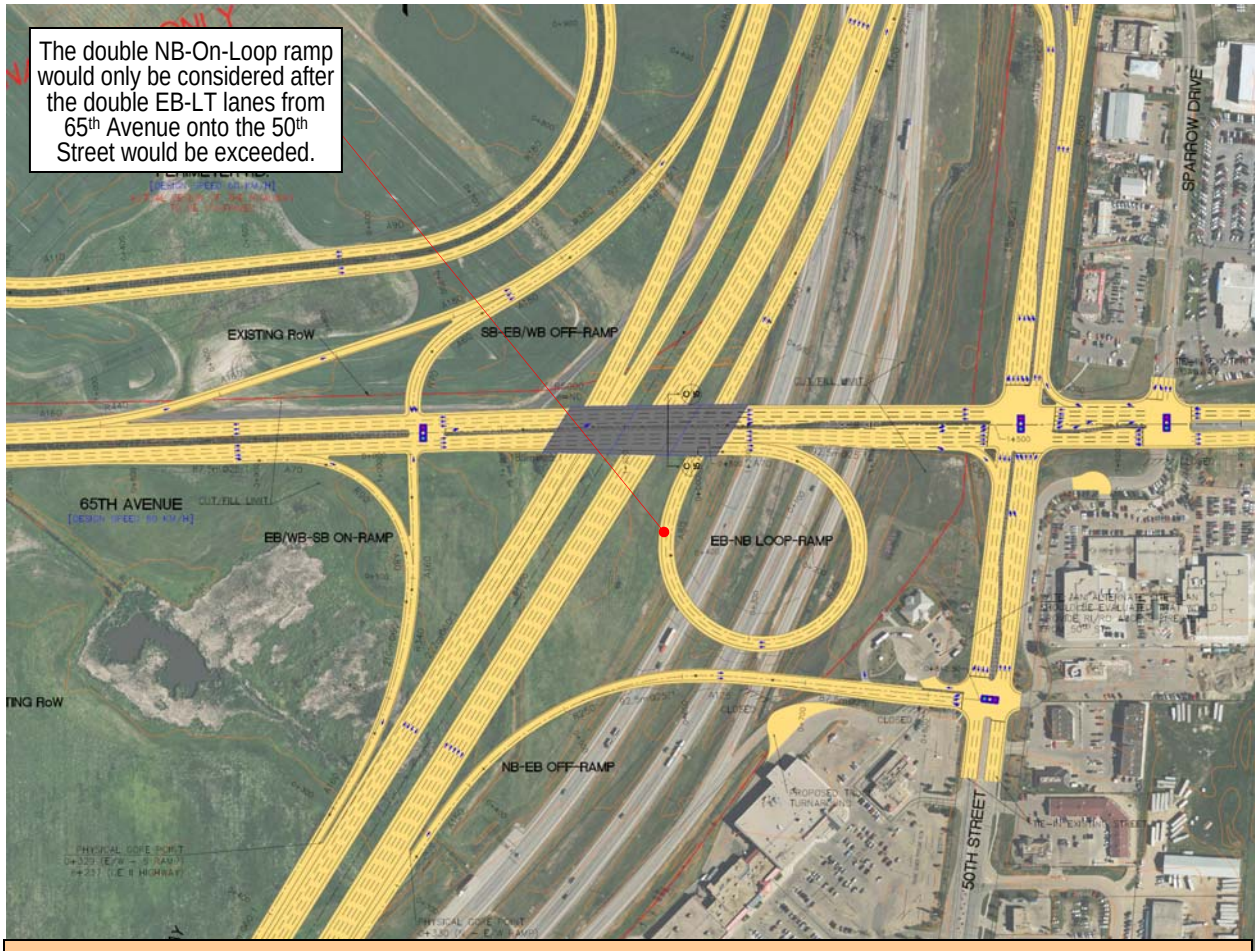

Exhibit 3-5: Ultimate QE II / 65th Avenue Interchange Configuration

Without the advent of the 65th Avenue Interchange by the 2035 Horizon Year:

- The southeast-bound 50th Street Twinned Bridge is forecast to carry approx. 2,900 veh/h during the afternoon peak hour, effectively exceeding the two-lane capacity of 2,400 veh/h.
- The northwest-bound 50th Street Twinned Bridge is forecast to carry approx. 1,500 veh/h during the afternoon peak hour, effectively exceeding the single-lane capacity of 1,200 veh/h.
- The 50th Street ***East Junction*** would exhibit failure operation conditions as a single-lane roundabout or as a signalized intersection (with a single NB-LT lane onto the existing 50th Street fly-over bridge).
- The 50th Avenue Interchange would be surcharged with over 4,000 EB vehicles during the afternoon peak hour exceeding the three-lane capacity of 3,600 veh/h/ln.

The 65th Avenue interchange would ultimately accommodate:

- a 6-lane 65th EW corridor (plus auxiliary lanes);
- a realignment of the QE II lanes;
- a realignment of the SB and NB ramps (associated with the change from the Interim stage); and
- the development of a EB-NB On-Loop. (Without the advent of the QE II / 65th Avenue EB-NB On-Loop, the EB-LT movement at the four-leg 65th Avenue / 50th Street intersection was found to exhibit failure conditions during the afternoon peak hour (LOS "F", volume-to-capacity ratio (v/c) of 1.16).

The justification of the EB-NB On-Loop Ramp has been based on a forecast (30-year, 2044) traffic volume of over 1,500 veh/h. A traffic volume of this magnitude would easily exceed the capacity of a conventional diamond interchange offering double EB-LT lanes onto a QE II EB-NB On-Ramp and result in an EB queue that would extend well past the west ramp terminal resulting in congestion on the entire length of the bridge. Accommodating the EB-NB On-Loop ramp would require additional bridge length, however. the loop ramp was viewed as a sequential stage to be confirmed at the time of detailed design of the 65th Avenue interchange and would only be justified based on confirmed land uses forecast for the 65th Avenue West corridor. The double EB-NB On-Loop ramp would only be considered after the double EB-LT lanes from 65th Avenue onto the 50th Street would be exceeded. A further advantage of the preferred interchange configuration, (as opposed to a conventional tight diamond configuration), is that the need for an east ramp terminal has effectively been eliminated.

As well, in the ultimate time frame the southern limit of the Airport Perimeter Road South corridor adjacent to 65th Avenue West would be extended further west. In the 2025 interim time frame Perimeter Road and the Perimeter Road/65th Avenue West intersection functioned as a public roadway. With the advent of the ultimate 65th Avenue interchange, the new QE II /65th Avenue SB-EB/WB Off-Ramp, the new EB/WB-SB On-Ramp, the new Perimeter Road/65th Avenue West intersection would be relocated further to the west but within the Airside

Southwest portion of the EIA property. A new intersection would be developed to connect to 65th Avenue West and the Aerotropolis developments to the south.

With the development of the 65th Avenue Interchange in 2035, the 2025 configuration for the 50th Street Twinned bridge junctions was found to continue to provide satisfactory levels-of-service:

- The two intersections that comprise the ***West Junction*** was found to exhibit a satisfactory level-of-service (LOS) of "B"-or-above.
- The ***East Junction*** was found to operate at a satisfactory:
  - LOS "A" assuming a traffic signal controlled intersection configuration, and
  - LOS "C" assuming a single-lane roundabout configuration.

3.4.3 Implementation of QE II Core Lanes

A previous study[9] identified a core-collector lane arrangement extending from Anthony Henday Drive, up to the future 65th Avenue interchange. A transfer lane arrangement to provide a connection between the QE II core lanes and the collector lanes (i.e. egress from core lanes in the SB direction, and access onto the core lanes in the NB direction) was illustrated to be located between the Hwy 19 and Airport Road interchanges.

The study indicated:

- transfer lanes ... "*were strategically located to provide a balance of traffic along the freeway that maximizes the available freeway capacity.*" [10]
- "*The location of transfer lanes should be confirmed during subsequent stages of design when traffic volumes for the 3.2M population horizon are confirmed and when accurate dynamic modelling is completed for the QE II corridor as well as the regional network.*"[11]

Exhibit 3-6: QE II Ultimate Core-Collector Configuration Transition Point in Vicinity of 50th Street

[9] "*Queen Elizabeth II Highway: Ellerslie Road to South Leduc Functional Planning Study*" (Focus Group)
[10] ibid, Page 5-1
[11] ibid, Page 5-2

From a "*lane capacity perspective*", this study adopted a "trigger" to identify the requirement for the QE II core-lanes was the need for additional collector capacity beyond a 4-lane cross-section in a single direction along the QE II corridor. The 1,900 veh/h/ln over 4-lanes resulted in a rule-of-thumb 7,600 veh/h LOS "C" capacity threshold being adopted for the ultimate QE II collector lanes. Using this criteria, in concert with the travel demand forecasts, resulted in the following needs for the development of the NB and SB QE II core lanes being identified:

- Development of the SB and NB core lanes to a point south of the Hwy 19 Interchange; (estimated as the first segment to be required)
- Development of the SB core lanes to a point south of the 50th Street SB-EB/WB Off-Ramp; and development of the NB core lanes to a point south of the Airport Road Interchange (i.e. EB-NB On-Loop-Ramp). (estimated to be required by 2035);
- Development of the SB and NB core lanes to their ultimate end location within the vicinity of the QE II / 65th Avenue Interchange. (estimated to be required by 2044);

Appendix "B-6.3" summarises the QE II merge-diverge weave analysis inclusive of the core-collector lane interaction.

A review of traffic forecasts associated with this study indicated that:

- Significant local traffic use the Highway 19 and Airport Road interchanges:
  - The Airport and Leduc/Nisku employment centres can be considered significant local traffic generators and as such experience high SB traffic volumes in the morning peak hour; and high NB volumes during the afternoon peak hour.
- The effect of combining this local demand onto the core lanes was found to result in:
  - significant SB ramp-to-ramp transfers from the core lanes onto the collector lanes and then onto the Airport Road Interchange SB-EB/WB Off-Ramp to access both the EIA and the Leduc/Nisku developments.
  - significant NB ramp-to-ramp transfers from the Airport Road Interchange EB-NB On-Loop and the WB-NB On-Ramp across the collector lanes to access the core lanes.

The advent of the new enhanced 50th Street Twin Bridge access on its own, albeit from a traffic volume perspective offers satisfactory levels of service, however, it does not address the above weaving constraint affecting the transfer lanes. As such, this study would recommend that consideration be given to the following phasing and location of transfer lanes.

The transfer lanes from/to the core lanes is proposed as a two-phase process (within this study area, i.e. the QE II corridor from 800m south of Hwy 2A to 800m north of Airport Road):

- *Phase I* would see the core-lanes developed to the vicinity of the QE II / Airport Road Interchange:
  - is estimated as the 2025 Horizon Year;
  - the SB lanes would be developed to a point south of the Airport Road SB-EB/WB Off-Ramp; but north of the Airport Road bridge where transfer lanes would channel the core-lane traffic onto the SB collector lanes; and
  - the NB lanes would be developed starting at a point south of Airport Road in the vicinity of the existing Sparrow Crescent Off-Ramp (which is to be closed) where transfer lanes would channel traffic from the collector lanes onto the core lanes.

  In this way, SB traffic destined to the EIA can choose to use either the collector lanes to access the EIA by way of the Airport Road interchange, or the core lanes to access the EIA by way of the new 50th Street access. As well, Leduc / Nisku employment destined traffic would use the collector lanes to access the areas by way of the Airport Road interchange, while Leduc downtown and residential traffic would maintain access to the core lanes by way of the 50th Street access.

  The exact location of the NB transfer lane is to be confirmed at the time of detailed design of the core lanes when such facilities may become warranted.

- *Phase II* would see the core lanes extended to their ultimate south transition point (in the vicinity of the new 65th Avenue interchange). Phase II:
  - is estimated to be necessary by the 2035 Horizon Year;
  - would indicate the need to demolish or replace the existing 50th Street fly-over structure; and
  - would minimise the throw-away associated with an temporary realignment of the QE II prior to the advent of the "ultimate" QE II alignment through the 65th Avenue interchange. (See Section 11.1)

Appendix "B-6.6" includes Technical Memorandum No. 4 and Technical Memorandum No. 4, Addendum No. 1, which further discusses the core-collector transfer lane locations.

3.4.4 Intersection Capacity Analysis (ICA)

Table 3-2 provides a summary of (and Appendix "B-6" details) the intersection capacity analysis (ICA) results assuming the 2025 and 2035 forecast AM and PM peak hour traffic volumes and Annex "A" intersection configurations. ICA results are not presented for horizon years beyond these time frames as the accuracy of intersection turning movements beyond a 20-year time frame is highly suspect. Nonetheless, very long-term (2044 and 2075) ICA was completed for the junctions on either side of the 50th Street Twinned Bridge and the 65th Avenue Interchange to determine the forecast operational performance characteristics at the 30-year time frame and beyond. (See Appendix "B-6.1").

Table 3-2 indicates the following constraints:

- *50th Street East Junction:* This intersection would connect 50th Street with the QE II EB/NB-NB On-Ramp and the twinned 50th Street bridges. For functional planning purposes and provide the maximum right-of-way protection, this intersection was envisioned to be a three-leg roundabout connecting to a single lane (existing 50th Street bridge). The LOS "F" indicated for the roundabout is attributed to a single NB-LT lane leading to a single NWB lane on the 50th Street Bridge. Assuming a double NB-LT lane and a 2-lane NWB replacement bridge was found to result in satisfactory traffic operations. As well, a three-leg traffic signal controlled intersection was also considered (See Exhibit 3-7) and determined to offer satisfactory traffic operations. The decision of roundabout versus traffic signal controlled intersection is to be made at the time of detailed design.
- *Perimeter Rd South - 65th Ave W. / QE II SB Ramps:* This "grey" shaded area in Table 3-2 indicates that the interim intersection that connects Perimeter Rd South (within the EIA lands), to 65th Avenue West and the QE II SB Off/On-Ramps would be required to be relocated further west at the time when the "ultimate" 65th Avenue Interchange is developed.
- *65th Ave / 50th Street:* This existing three-leg intersection would see the addition of a 2nd SB-LT lane in 2025 and the consideration of converting the outer NB lane to shared NB-Th/RT operations. With the implementation of the "ultimate"65th Avenue Interchange in 2035, this intersection would accommodate four legs and a 6-lane east-west corridor.
- *65th Ave / Sparrow Dr.:* This existing intersection would be upgraded in 2025 with a dedicated EB-LT lane and conversion of the south leg to RI-RO. With the implementation of the "ultimate" 65th Avenue Interchange in 2035, this intersection would accommodate a 6-lane east-west cross-section and the closure of its south leg.

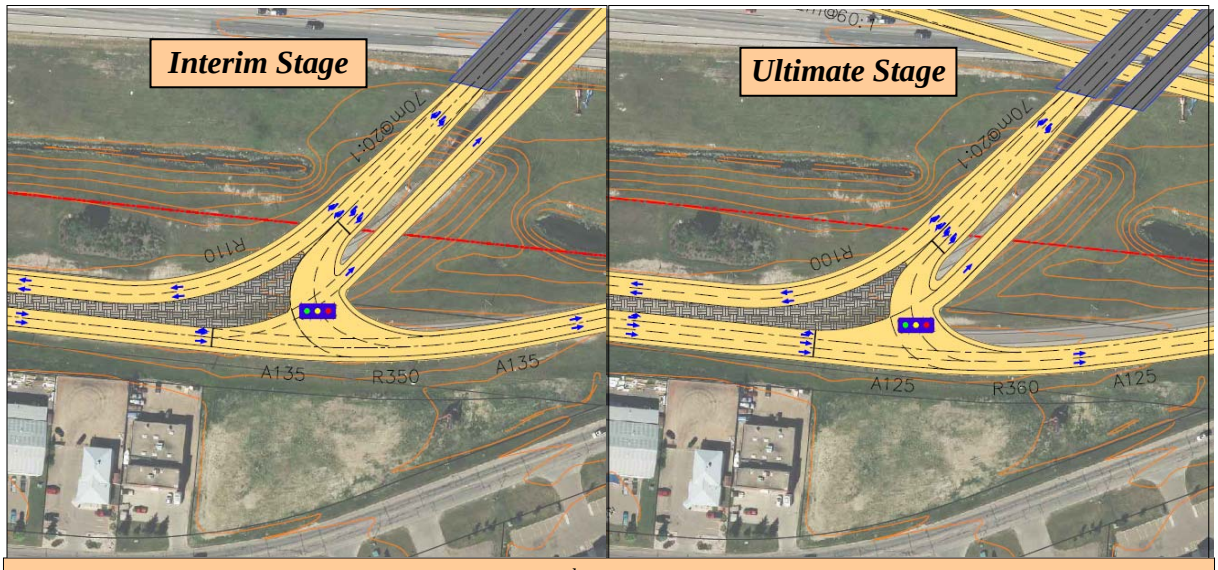

Exhibit 3-7: 50th Street East Junction
Traffic Signal Controlled Intersection Options

Table 3-2: Intersection Capacity Analysis Summary (10 & 20 Year Forecast)

Intersection and Proposed Configuration	2025 Horizon Year										2035 Horizon Year									
	Morning Peak Hour					Afternoon Peak Hour					Morning Peak Hour					Afternoon Peak Hour				
	Overall LOS	Critical Movement				Overall LOS	Critical Movement				Overall LOS	Critical Movement				Overall LOS	Critical Movement			
		Movement & Volume (veh/h)	LOS	Delay (s.)	v/c		Movement & Volume (veh/h)	LOS	Delay (s.)	v/c		Movement & Volume (veh/h)	LOS	Delay (s.)	v/c		Movement & Volume (veh/h)	LOS	Delay (s.)	v/c
1) 50th Street NW Perimeter Rd Intersection Three Leg Signalized Intersection	A	EB-LT (114)	B	12.8	0.24	A	EB-LT (184)	C	21.7	0.48	A	EB-LT (328)	B	14.6	0.30	A	EB-LT (377)	B	11.3	0.48
2) 50th Street West Junction Three Leg Signalized Intersection	A	SB-LT (1,020)	B	11.9	0.72	B	SB-LT (1,106)	B	18.8	0.83	B	SB-LT (528)	C	27.8	0.68	A	SB-LT (522)	B	16.0	0.60
3) 50th Street East Junction – Single Lane Roundabout	B	NB-LT (493)	B	11.9	0.58	F*	NB-LT (585)	F*	57.1	0.99	A	NB-LT (534)	A	9.8	0.54	C	NB-LT (655)	C	17.8	0.75
3) 50th Street East Junction – 3-Leg Signalized Intersection	B	NB-LT/Th (1,234)	A	5.8	0.68	A	NB-LT/Th (1,389)	A	4.8	0.71	A	NB-LT (534)	A	4.9	0.61	A	NB-LT (655)	A	7.4	0.66
5) Perimeter Road South - 65th Ave / QE II SB Ramps (West 2025) Three Leg Signalized Intersection (Intersection removed by 2035)	A	EB-LT (244)	A	5.5	0.43	A	EB-LT (468)	B	11.6	0.73										
6) 65th Avenue / QE II SB Ramps (West 2035 + Four Leg Signalized Intersection (Implemented in 2035)											A	SB-LT (551)	A	2.4	0.39	B	SB-LT (638)	D	47.7	0.88
7) 65th Avenue / 50th Street (East) Three Leg (2025) and Four Leg (2035) Signalized Intersection	B	NB-Th (766)	B	14.6	0.89	B	NB-Th (588)	B	16.4	0.87	B	SB-LT (490)	C	24.8	0.87	C	NB-LT (528)	E	75.0	1.06
8) 65th Avenue / Sparrow Drive Four Leg RI-RO (2025) and Three Leg (2035) Signalized Intersection	A	EB-LT (577)	B	10.9	0.81	B	EB-LT (217)	B	10.3	0.59	B	EB-LT (683)	C	32.4	0.93	C	EB-LT (306)	D	35.6	0.92
9) QE II NB-EB 50th Street Off-Ramp / 50th Street Four Leg Signalized Intersection	A	EB-LT (325)	B	19.5	0.62	A	EB-LT (214)	D	38.7	0.74	B	EB-LT (643)	C	27.8	0.74	A	EB-LT (702)	E	67.7	1.00

* The LOS "F" indicated for the roundabout is attributed to a single NB-LT lane leading to a single NWB Lane on the 50th Street Bridge. Assuming a double NB-LT lane and a 2-lane NWB bridge results in satisfactory traffic operations. Ten-Year traffic forecasts should be confirmed. Traffic signals at this location represent an alternative option which also provides satisfactory operations. (See Appendix "B-6.01")

3.4.5 QE II Merge-Diverge-Weave Analyses

Table 3-3 provides a summary (and Appendix "B-6.2" details), an evaluation using 2025 and 2035 horizon year traffic volumes and the proposed infrastructure along the QE II corridor as depicted in the functional plans. (The analysis did not consider the segments south of 50th Avenue, as the 50th Avenue interchange will require complete re-construction[12].) The table indicates the results of the merge-diverge-weave analysis indicating forecast traffic volumes, level of service in both the AM and PM peak periods, and the estimated acceleration-deceleration weave distance for each of the various QE II segments considered.

The Interim QE II Corridor (2025)

The "existing" QE II corridor is characterized by two lanes in each direction (four north/south freeway lanes total) south of the 50th Avenue interchange. North of the 50th Avenue interchange, the QE II corridor is characterized by three lanes in each direction (six lanes total). The 50th Avenue EB/WB-NB On-Ramp introduces a 3rd continuous lane, while the 3rd Southbound lane exits at the 50th Avenue SB-EB/WB Off-Ramp.

a) Analysis Segments (2025)

The HCM 2010 merge/diverge analysis in both the northbound and southbound directions between the 50th Avenue interchange and the Airport Road interchange analyzed the following QE II freeway segments for the 2025 Horizon Year:

- 50th Avenue SB-EB/WB Off-Ramp and EB/WB-NB On-Ramp;
- 50th Street NB-EB Off-Ramp;
- 65th Avenue EB-SB On-Ramp and SB-WB Off-Ramp;
- 50th Street EB/NB-NB On-Ramp[13] (Weaving Segment Length: 1,150m);
- 50th Street SB-EB/WB Off-Ramp (Weaving Segment Length: 1,585m);
- Airport Road NB-EB/WB Off-Ramp
- Airport Road EB-SB On-Ramp;
- Assumes SB Core Transfer lane merge and 50th Street SB-EB/WB Off-Ramp Diverge (2,750m distance separation).
- Two-Sided Weave from the EB/NB-NB 50th Street On-Ramp to the NB Core Junction (1,400m)

Table 3-3 indicates that the majority of segments were found to operate under satisfactory traffic operations of LOS "E" or better.

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12 ibid: Plan P3376-044 illustrates a new 50th Avenue interchange as traversing over the QE II Lanes.

13 Page 12-15 of the HCM 2010 states that any weaving length greater than 850m is "improbable" and should be treated as merge/diverge segments. Any One-Way weaving segments greater than 850m were considered as a separate merge/diverge analysis

Table 3-3: Merge-Diverge-Weave Analysis Summary (10 & 20 Year Forecast)

	Segment	Class	2025 (Ten-Year Horizon)				2035 (Twenty-Year Horizon)				
			Ramp Volume AM(PM)	Level of Service		Acc. / Dec. Weave Length (m)	Modified Segment*	Ramp Volume AM(PM)	Level of Service		Acc. / Dec. Weave Length (m)
				AM	PM				AM	PM	
Airport Road Interchange	SB-EB/WB Off Ramp* (2-Lane Off Ramp)	Diverge	2,812 (1,764)	"A"	"A"	460	No Change	2,956 (1,660)	"A"	"A"	460
	WB-SB On-Loop*	Merge	218 (822)	B"	"C"	460	No Change	532 (1,172)	"B"	"C"	460
	EB-SB On-Ramp	Merge	96 (402)	"B"	"C"	140	No Change	129 (529)	"B"	"C"	140
	WB-NB On-Ramp	Merge	450 (1,655)	"B"	"C"	125	No Change	486 (1,779)	"B"	"D"	125
	EB-NB On-Loop*	Merge	697 (1,438)	"A"	"B"	460	No Change	676 (1,211)	"B"	"C"	460
	NB-EB/WB Off-Ramp*	Diverge	1,719 (795)	"D"	"B"	275	(2-Lane Off Ramp)	2,062 (1,327)	"A"	"A"	275
50th Street	SB-EB/WB Off-Ramp*	Diverge	1,148 (1,381)	"B"	"C"	460	No Change	590 (701)	"A"	"A"	460
	EB/NB-NB On-Ramp To NB Core Lanes	Two-Sided Weave	--	"D"	"D"	1,400	No Change	905 (1,175)	"A"	"A"	130
65th Ave Ramps	EB-SB On-Ramp	Merge	107 (263)	"B"	"C"	150	EB/WB-SB On-Ramp	268 (867)	"B"	"C"	150
	50th Street NB-EB Off-Ramp	Diverge	488 (352)	"E"	"D"	185	No Change	763 (810)	"C"	"D"	185
	SB-WB Off-Ramp	Diverge	418 (419)	"B"	"C"	200	SB-EB/WB Off-Ramp	1,558 (1,717)	"B"	"C"	200
							EB-NB On-Loop Merge	535 (1,065)	"C"	"B"	460
50th Ave Interchange	SB-EB/WB Off-Ramp*	Diverge	990 (1,937)	"A"	"C"	460	No Change	1,392 (2,678)	"A"	"A"	460
							SB-EB/WB Off Ramp 65th Ave to 50th Ave Weave	--	"B"	"F"	520
	EB/WB-NB On-Ramp*	Merge	1,870 (1,571)	"D"	"C"	460	No Change	2,189 (2,165)	"D"	"C"	460
Core Junctions	SB Core Lane	Merge	1,905 (2,816)	"C"	"C"	460	SB Core Lane (Airport Rd) - Merge	647 (807)	"A"	"B"	460
							SB Core Lane To 65th Ave Two-Sided Weave	--	"B"	"D"	1,100
	NB Core Lane	Two-Sided Weave	--	"D"	"D"	1,400	NB Core Lane 50th Street Bridge - Diverge	2,696 (1,787)	"A"	"A"	1,400

* A maximum length of 460m was provided as the segment either commences or terminates a continuous lane. An On-Ramp would therefore have the entire continuous lane to merge onto the main flow of the highway. Likewise, an Off-Ramp would have a continuous lane terminating, providing the majority of the continuous lane as a deceleration lane.

1. " No Change" - Indicative of there being no change in merge-weave configuration from 2025 to 2035 Horizon Year.

NOTE: The 2035 time horizon envisions the complete core lane arrangement. LOS improvements are evidenced since the remaining traffic on the collector lanes impacts diverge/merge analysis.

The following QE II improvements were identified as being necessary by the 2025 Horizon Year and assumed to be in place (See Appendix B-6.6, Annex D for exhibit depicting plan):

b) Phase I Core Lanes

- The phasing strategy assumes that within the next decade traffic volumes on the QE II will exceed the LOS "C" capacity threshold. Should AT wish to initiate the QE II core lanes extending from the north southward this first phase assumed development of:
  - The SB Core transfer lanes located at a point south of the Airport Road SB-EB/WB Off-Ramp but north of the Airport Road bridge; and
  - The NB Core transfer lanes located at a point south of the Airport Road Interchange in the vicinity of the existing Sparrow Crescent Off-Ramp (which is to be closed).

c) Identified Required Ramp Improvements

- The Airport Rd NB-EB/WB Off-Ramp requires a 2-lane exit configuration in order to accommodate traffic (2025 - 1,719 veh/h / 2035 - 2,062 veh/h) in the AM peak period. The resulting diverge LOS was found to be "A" assuming a 2-lane Off-Ramp configuration that was considered to be implemented in 2025 along with the closure of the Sparrow Cres. NB-EB Off-Ramp; (See Section 11 - Ancillary Issues.)
- 50th Street - Development of 2-Lane SB-EB/WB Off-Ramp;
- Development of a single lane 65th Avenue West SB-EB Off-Ramp and WB-SB On-Ramp; and
- Closure of the 60th Avenue and 50th Street NB-EB Off-Ramp STOP controlled RI-RO intersection.

d) Identified Weave Segment Improvements

- As development proceeds in Leduc South, the QE II within the vicinity of the existing 50th Street Fly-Over was found to require weave lane improvements, which include:
  - a fourth NB 'Weave' lane from the 50th Street EB/NB-NB On-Ramp to the Airport Road NB-EB/WB Off-Ramp; and
  - a fourth SB 'Weave' lane from the Airport Road WB-SB On-Loop to the 50th Street SB-EB/WB Off-Ramp.

e) Findings

The sole exception to 2025 merge-diverge-weave satisfactory results is the northbound 50th Street NB-EB Off-Ramp (488 veh/h) diverge movement.

The LOS "E" 2025 result is attributed to the high QE II volume from 50th Avenue EB/WB-NB On-Ramp (1,870 veh/h) which create a lack of sufficient gaps for the diverging motorists to exit at the 50th Street NB-EB Off-Ramp. Motorists attempting to diverge at the 50th Street NB-EB Off-Ramp are required to lane change into the same lane that is being used for the 50th Avenue northbound EB/WB-NB On-Ramp vehicles.

When developing a solution, the following must be considered:

- The NB volumes on the 50th Avenue EB/WB-NB On-Ramp remain to be confirmed and are subject to the development forecasts for Leduc South. In short, the 50th Street NB-EB Off-Ramp constraint in 2025 is a forecast and remains to be confirmed;
- The 50th Avenue Interchange requires re-engineering, any modifications to the QE II and 50th Ave ramps in the vicinity of the interchange would be throw-away;
- The close proximity of the 50th Avenue interchange to the 50th Street NB-EB Off-Ramp creates congestion as the movements are in conflict at peak periods.

The "Ultimate" QE II Corridor

Table 3-3 also provides a summary of the results of the merge-diverge-weave analysis for the various QE II segments assuming 2035 horizon year traffic volumes and the ultimate configuration of the 65th Avenue interchange.

a) Analysis Segments

The following QE II freeway segments were analyzed:

- Airport Road SB-EB/WB Off-Ramp, WB-SB On-Loop and EB-SB On-Ramp;
- Airport Road NB-EB/WB Off-Ramp, EB-NB On-Loop and WB-NB On-Ramp;
- 50th Street EB/NB-NB On-Ramp and SB-EB/WB Off-Ramp;
- 65th Avenue EB/WB-SB On-Ramp, SB-EB/WB Off-Ramp and EB-NB On-Loop;
- 50th Street NB-EB Off-Ramp;
- 50th Avenue SB-EB/WB Off-Ramp Diverge and EB/WB-NB On-Ramp;
- 65th Avenue EB/WB-SB On-Ramp Weave to 50th Avenue SB-WB/EB Off-Ramp;
- SB Core Weave to 50th Ave SB-EB/WB Off-Ramp;
- SB Core Merge at the SB Core Junction north of Airport Road;
- NB Core Junction Diverge at the 50th Street Bridge structure

The following QE II additional improvements were envisioned for the "Ultimate" QE II analysis and are illustrated in Annex "A".

b) Phase II Core Lanes

- From a "*merge-diverge-weave analysis*" perspective, Phase II of the core lanes being extended further south would be required by the twenty-year (2035) time horizon.
- The SB Core lanes would be extended to the south to transition onto the new SB collector lanes at a point south of the 65th Avenue SB-EB/WB Off-Ramp but north of the 65th Avenue Interchange bridge;

- The SB Core transfer lanes from the core lanes onto the collector lanes located north of the Airport Road Bridge but south of the Airport Road SB-EB/WB Off-Ramp would be maintained;
- The NB Core transfer lanes would commence just south of the 50th Street bridge and the NB Core Junction developed in Phase I of the core lane development to the south of Airport Road would be closed;

c) Assumed Interchange and QE II Improvements

- The 50th Avenue interchange would be reconfigured to provide for 4 north-south lanes in each direction along the QE II corridor aligned to travel under a new 50th Ave interchange bridge;
- The ultimate 65th Avenue Interchange would be in place; and
- A fifth NB continuous lane commencing at the 50th Ave EB/WB-NB On-Ramp.

d) Assumed Required Weave Lane Ramp Improvements

- The 65th Avenue Double EB-NB On-Loop would be implemented;
- 50th Avenue Two-Lane SB-EB/WB Off-Ramp.

e) Identified Weave Segment Improvements

- A SB Weaving lane (5 lanes in total) would extend from the 65th Avenue EB/WB-SB On-Ramp to the 50th Avenue SB-EB/WB Off-Ramp;

f) Findings

- The 50th Street NB-EB Off-Ramp was found to exhibit improved operations and provide an acceptable LOS "D". The "Ultimate" QE II alignment provides for a total of five NB lanes where the NB-On-Ramp (1-lane) joins with the 4 NB QE II lanes. This is anticipated to increase the number and length of gaps provided for the 50th Street NB-EB Off-Ramp diverging traffic;
- The weave manoeuvre from the 65th Avenue EB/WB-SB On-Ramp to the 50th Avenue SB-EB/WB Off-ramp is expected to operate at a LOS "F" assuming the Focus Group configuration for the 50th Avenue interchange. The weaving length from the "Ultimate" 65th Avenue EB/WB-SB On-Ramp to the 50th Avenue interchange (FOCUS group design) 2-lane off-ramp is approximately 520m. The 50th Avenue "Ultimate" interchange design remains to be confirmed. Improvements to the weaving concern can be addressed by providing an additional 300m of weaving length by shifting the 50th Avenue SB-EB/WB Off-Ramp further south. An 850m separation between on-and-off ramps would result in this section of QE II no longer being considered a weaving section and would see the segment operate as separate merge-diverge movements. Analysis indicated that satisfactory operations (Merge-LOS "C" and Diverge-LOS "A") are anticipated assuming an 850m separation.

4.0 QE II CORRIDOR AND 65TH AVENUE INTERCHANGE PLANNING

This functional planning study addressed the "*interim*" and "*ultimate*" requirements of a future 65th Avenue interchange in Leduc. This included a determination of the preferred configuration of a new interchange that would address constraints at the QE II / 50th Avenue Interchange within the City of Leduc and accommodate new forecast developments west of the QE II corridor and south of the EIA.

The following sections provide a summary of the functional planning that was undertaken to reach the preferred "interim" and "ultimate" interchange configuration and design attributes.

4.1 Identified Issues and Constraints

Numerous constraints and issues were identified within the study area, which were determined to have a direct impact on the proposed location and design of the 65th Avenue Interchange and the twinned 50th Street Bridge concept. These included:

- meeting NAV Canada restrictions regarding obstacle, take off and landing surfaces;
- achieving horizontal alignment, vertical alignment and topography; and
- accommodating Heavy vehicle (WB 36 truck – 38 m long truck tractor and 2 trailers) requirements.

The following sections elaborate on each of these constraints and issues, which were used to consider and determine the preferred location and design constraints associated with the future 65th Avenue interchange site.

4.1.1 NAV Canada Restrictions

It was recognized early in the study that the close proximity of the Edmonton International Airport (EIA)'s Runway 12-30 could pose a constraint on the vertical profile of the future infrastructure proposed for the 65th Avenue interchange effecting both interim and ultimate stages.

Relevant documents[1] were reviewed and provided two conflicting obstacle-limitation-surface (OLS) requirements:

- Chapter 2, Section 2.3.4.7, indicated that for obstacle mapping a 1.2% slope is to be assumed (This represents an ICAO[2] requirement.); and
- Chapter 4, Section 4.2.4.3, indicated that a 2.0% slope must be protected as a take-off/landing surface.

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1 "*Aerodrome Standards and Recommended Practices – TP 312E"* - 5th Edition - Draft

2 ICAO - International Civil Aviation Organization

During the early stages of the study, concerns were raised in that both an interim (a new 65th Avenue interchange located over the existing QE II corridor) and an ultimate (a new 65th Avenue interchange located in the vicinity of the Focus Group location approx. 310m west of the 65th Avenue E/50th Street intersection) location for the new interchange were found to protrude beyond the 1.2% obstacle envelope by about 2-3m; however sufficient clearance was provided within the 2.0% slope take-off/landing surface.

Communication with EIA staff[3] indicated that all regulatory requirements (including compliance with the new and DRAFT versions of TP 312) fall under Transport Canada's purview, however NAV Canada, despite not being the regulator, would be the decision making body as concerns the implementation of the regulations. The EIA indicated that the particular obstacle-limitation-surface (OLS) that must be respected is the plane formed by the take-off/approach surface, a 2% slope from the start of the runway strip. The functional plans as presented depict all elements below the 2% OLS. It was emphasized that the ICAO Type A charts illustrating the 1.2% OLS were used to indicate graphical elements and identify the elements of existing objects such as signs, towers, etc., that may effect airport operations. The 1.2% OLS is not a protected surface under the regulations.

The TP 312 document at the time of this study was under review.[4] EIA staff indicated that a revised edition would clarify how the take-off/approach surface is to be protected.

NAV CANADA must assess and approve all proposals for land use near airports and air navigation infrastructure before construction begins to ensure that air navigation system safety and efficiency are not compromised by proposed land development. NAV Canada was formally approached on September 18th, 2015 through their "Land Use Program" submission process. The application concentrated on the preferred "ultimate" configuration of the proposed 65th Avenue interchange as illustrated in Annex "A".

Appendix "E-5" provides exhibits which illustrate the proposed interchange and vertical profiles illustrating the OLS boundaries which were forwarded to NAV Canada for review. (See Section 10.5 for a summary of NAV Canada's Response).

4.1.2 QE II Horizontal and Vertical Alignments

4.1.2.1 Horizontal Alignment

As identified within Section 2.14 of this report, there are three horizontal curves (in each direction (southbound: R690, R890 and R930; northbound: R730, R 870 and R660) within the study area

[3] Mr. Robert Hough, Manager, Engineering, Planning & Operational Compliance, EIA, - December 2014

[4] The 5th edition of TP 312 was anticipated for release before the end of 2015.

between the 50th Avenue and Airport Road interchanges that do not meet the minimum desirable radius (950m) for "NEW" highway construction with a design speed of 130 km/hr. The R690 SB and R730 NB horizontal curves are located south of the QE II / 50th Avenue interchange and outside of the design study limits.

It was confirmed as part of the planning process that the horizontal curvature deficiencies must be addressed as part of this FPS. [One option was presented as part of the Value Planning session that would maintain the horizontal curvature deficiency, however this was considered unacceptable by AT. It was also estimated that an improved alignment would avoid 40-to-100 collisions ($20-$55M societal costs) over a 30 year period. If the improved curves can be accomplished within the range of $10-25M cost, then the curve improvements should be considered.]

Annex "A" indicates that the existing (R890-SB-&-R930-SB and R870-NB-&-R660-NB) horizontal curves have been addressed and replaced with a single R-2000 curve. This is consistent with the previous FP initiative and alignment through the 50th Avenue interchange.[5]

4.1.2.2 Vertical Alignment

Previous planning[6] for the 65th Avenue interchange provided for a lower QE II vertical profile by approximately 2.5m in the vicinity of the 65th Avenue interchange site. It is thought that the reason for the lower vertical profile was to accommodate a new 65th Avenue bridge structure over the realigned QE II lanes, while still meeting the O.L.S. requirements as well as the 65th Avenue corridor vertical profile. One of the main concerns with the lowered profile was the issues of the stormwater management and the potential need for pumping stations along the QE II corridor.

Following the review of the NAV Canada requirements, it was determined that a lowering of the QE II profile was not desired. The design for the QE II realignment was refined to accommodate the two vertical “pinch points” along the QE II corridor being:

- the QE II elevation under the Twinned 50th Street bridges; and
- the QE II elevation under the proposed 65th Avenue Bridge.

It remained possible to have the realigned QE II corridor follow a vertical profile that was either the same elevation, or higher, than the existing QE II corridor within the vicinity of 65th Avenue, while achieving the “desirable maximum gradient” of three percent (based on

[5] "*Queen Elizabeth II Highway: Ellerslie Road to South Leduc Functional Planning Study*" (Focus Group) Plan P-3376-045

[6] ibid, Plan P=3376-044

AT's design standards[7]). In this way positive drainage can be achieved and the need for pumping stations eliminated. The new vertical profile would transition:

- on the south side of 65th Avenue approximately 0.5 km north of the new QE II / 50th Avenue interchange; and
- on the north side of 65th Avenue approximately1.5 km south of the Airport Road interchange.

4.1.3 Heavy vehicle requirements

The QE II is classified as a "Long Combination Vehicle" (LCV) route[8] accommodating *"Turnpike Double"* (Modified WB-36) heavy vehicles up to 41m in length. Furthermore the QE II corridor is NOT designed as a High Load Corridor[9].

The proposed 65th interchange was designed to fit the turning movements of a long double-trailer truck (WB-36 truck - 38m in length) in accordance with to AT's design vehicle standards. All turning movements and design radii were tested to remain in conformance with this design vehicle.

4.2 Value Planning - The Study Approach

A Value Planning (VP) session was arranged and held on February 2015 with the intention to provide guidance regarding various planning issues related to this study and options to be explored in greater depth. The purpose of the workshop was to provide an independent review of the project to date, the needs, issues and feasible alternatives as an initial step in this planning study and develop a list of viable ideas.

Appendix "C-2" contains the entire VP session report which identified a total of 115 ideas that had the opportunity to improve value. A total of 29 ideas were short-listed, 22 were carried forward for further development, analysis and conceptual level costing.

The concept of the Twinned 50th Street bridges was generated within the VP session.

4.3 Preliminary Concepts Developed

Appendix "C-1" illustrates the preliminary options that were developed as part of the planning process. A total of three options were developed, each of which were intended to accommodate the short-term requirements associated with the 65th Avenue corridor.

[7] ATHGDG: Table A-7, Section A.7: General Design Contronls and Standards for Rural Highways, Chapter A: Basic Design Principles

[8] Alberta Transportation Highway Geometric Design Guide (ATHGDG): Figure D-5c, Section D.5: Design Vehicle, Chapter D: At-Grade Intersections

[9] ATHGDG: Figure A-11, Section A.11: High Load Corridor, Chapter A: Basic Design Principals

4.3.1 Concept 1 - A New 65th Avenue Bridge over the Existing QE II Corridor

Exhibit 4-1 illustrates a concept which depicts a new 65th Avenue bridge (approximately 97 m long and 34 m wide) across the "existing" QE II lanes that would be initially developed to meet existing requirements. This would later have to be removed to provide for the ultimate realignment of the QE II corridor. In short, this option involves building the 65th Avenue interchange twice in two different locations.

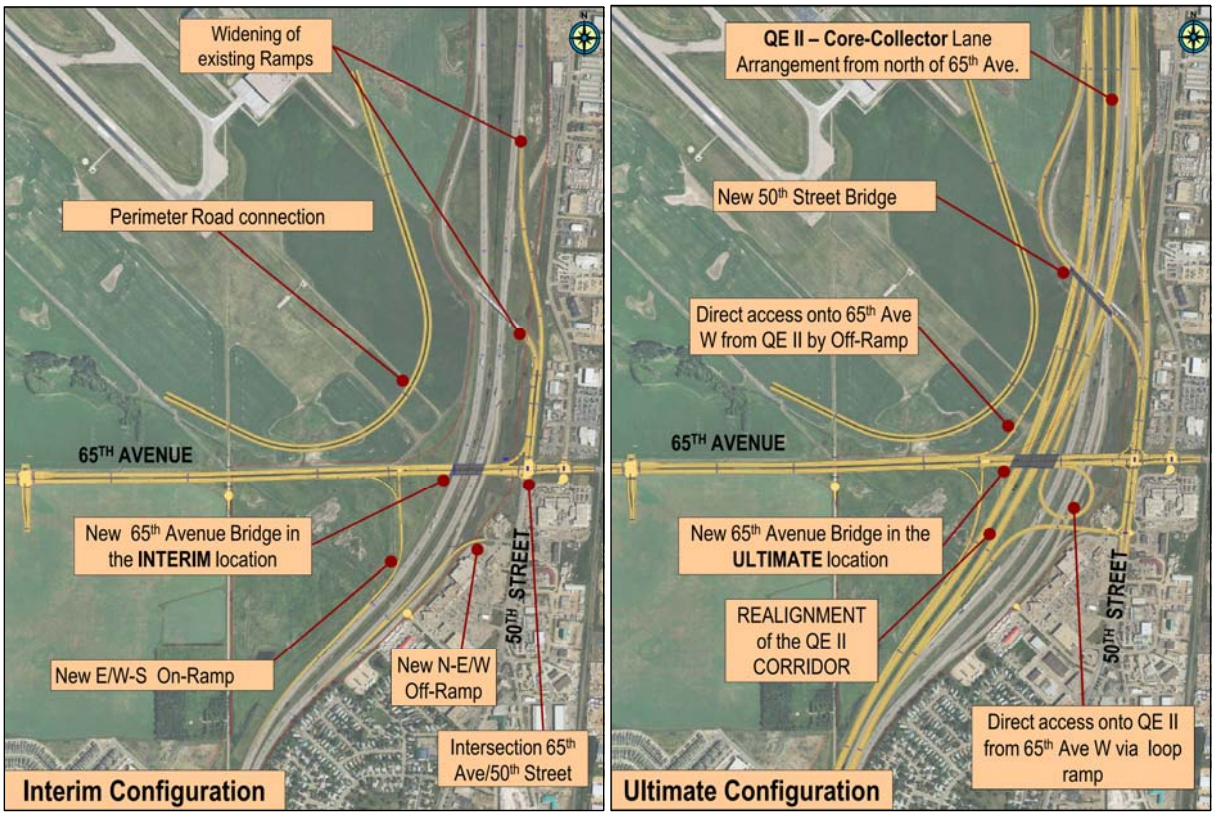

Exhibit 4-1: Proposed Configurations for Concept 1

4.3.1.1 Interim Stage: Concept 1

This concept would involve the construction of a new 6-lane 65th Avenue bridge across the "existing" QE II lanes. The concept was intended to be cost-sensitive and provided for only a single new EB/WB-SB QE II on-ramp. All the other movements would be provided by existing QE II on-off ramps.

50th Street Flyover Options Considered

At the onset of this study, the 50th Street Flyover was seen as a major constraint[10] to the construction of the new 65th Avenue interchange and the QE II core-collector freeway realignment. The 50th Street Flyover underwent significant rehabilitation (during the 2014 and 2015 construction seasons), and is expected to extend the life of the bridge by 25-30 years[11].

Section 11.1 details each of the 3 options considered which were described in a previous functional planning initiative that was to address the constraint of the 50th Street fly-over.

Of the three options, Concept 1 assumes the 50th Street Flyover would remain in its current location and configuration and would later be re-constructed as part of the ultimate configuration. This option provided the greatest use of existing infrastructure up until the advent of the 65th Avenue interchange.

The initial conceptual cost for this option as depicted in the inset picture on the left side of Exhibit 4-1 was determined to be approximately $50.8M.

4.3.1.2 Ultimate Stage: Concept 1

At the ultimate stage, the QE II corridor would be required to be realigned to accommodate the planned core-collector freeway network assuming a R2580 horizontal curvature. The interim 65th Avenue bridge would be required to be removed. A new 65th Avenue bridge and a new 50th Street bridge would be required to accommodate the realigned QE II corridor and the planned core-collector freeway network.

The interim 65th Avenue bridge over the existing QE II lanes could not be re-used:

- as moveable bridge structure; [This option was evaluated and determined to be unfeasible (due to the required differences in span lengths, bridge skews, staging issues, etc.).]
- by simply extending the interim bridge to accommodate a longer span over the realigned QE II lanes. This could not be achieved due to differences in the vertical profile of the new and existing QE II corridors and the two bridges that would result along the 65th Avenue corridor, the long-term maintenance requirements, and the visual impact of having a bridge existing over green space (where the existing QE II lanes would have been removed).

The ultimate life-cycle costs associated with Concept 1 of having to remove the interim 65th Avenue bridge structure to make way for the ultimate QE II realigned planned core-collector

[10] One of the "pinch" points with the Focus Group plan is the existing 50th Street Flyover structure. The bridge spans the existing QE II corridor, however at the time when a future realignment and construction of the QE II core-collector freeway underway, the structure will need to be replaced in its ultimate location (at an estimated capital cost of $13.8M assuming a double lane bridge and the Focus Group R2580 alignment.)

[11] Communication with Mr. Jeff Zhang, P.Eng., Bridge Manager, AT (December 16th, 2014).

freeway network was approximately $163.5M (including the Discovery way / 65th Avenue intersection and a 6-lane 65th Avenue corridor.)

The conceptual costing estimate also focused on the costs associated with infrastructures built at the interim stage that would need to be removed and disposed of at the ultimate stage. For Concept 1 this cost was estimated at $29.6M (approximately 63% of the original interim construction costs could be considered throw-away.)

4.3.2 Concept 2 - A New 65th Avenue Bridge in its Ultimate Location

Exhibit 4-2 illustrates a concept that would involve the construction of a new 65th Avenue bridge (approximately 189 m long, 37.5-to-43.1m wide tapered) in its ultimate location.

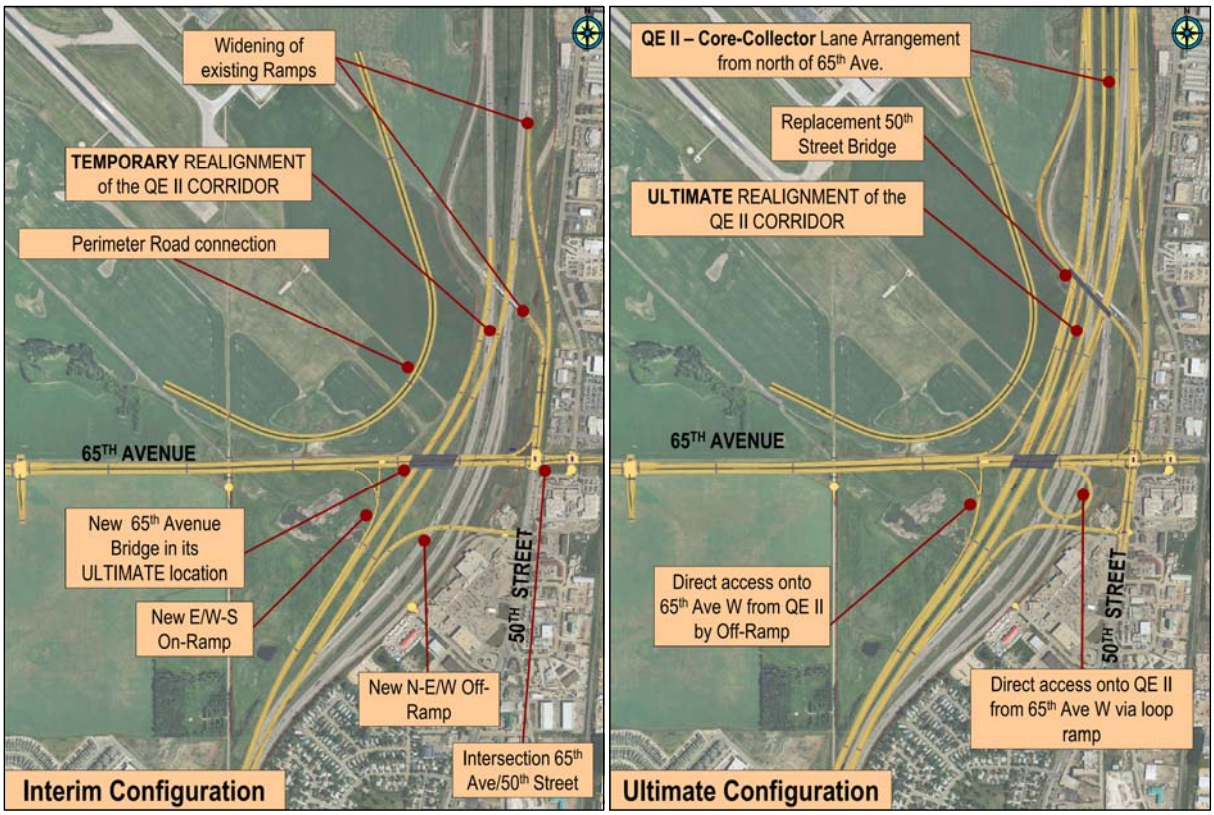

Exhibit 4-2: Proposed Configurations for Concept 2

4.3.2.1 Interim Stage

The left inset of Exhibit 4-2 indicates that a temporary realignment (collector-only arrangement) (R1100 south of 65th Avenue and R950 north of 65th Avenue) of the QE II corridor (approximately 3.2 km in length) that would tie into the existing QE II corridor in the vicinity of the existing 50th Street Flyover to the north and in the vicinity of 59th Avenue to the south is required.

This option would serve to delay the need to replace the existing single lane 50th Street Bridge. The concept includes provision for a EB/WB-SB QE II On-Ramp and a NB-EB/WB QE II Off-ramp. The existing 50th Street QE II Off-Ramp would provide access from the N to 65th Avenue East and West.

The interim stage cost estimated for budgetary purposes was found to be in the order of $77.1M. This conceptual costing assumes the ultimate bridge being developed at the outset. Opportunities exist to potentially stage the bridge structure to reduce the short-term costs further.

4.3.2.2 Ultimate Stage

In the ultimate stage, the concept would see the ultimate realignment of the QE II corridor (R2580) to accommodate the planned core-collector freeway network. This would require the existing 50th Street Bridge to be replaced. The concept also provides for the advent of a double EB-NB QE II Loop-Ramp that would serve to provide direct access onto the QE II NB from 65th Avenue West as well, the concept would see the SB-WB QE II off ramp providing direct access to 65th Avenue W.

The long-term life-cycle costs associated with having to realign the QE II corridor a second time (needed to accommodate the core-collector freeway network) would also require replacement of the 50th Street Flyover with a new 2-lane bridge. In total, the ultimate stage cost was determined in the order of $142.2M (including the Discovery way/ 65th Avenue intersection). The conceptual "throw away costs" identified with infrastructure built at the interim stage and later removed /disposed of at the ultimate stage, was estimated at $17.5M (approximately 24% of the original interim construction costs can be considered throw-away.)

A request was made to provide an estimate of the conceptual construction cost associated with building the ultimate stage as depicted on the right side of Exhibit 4-2 (without any interim stage). This cost was determined to be approximately $119M.

4.3.3 Concept 3 - A New Twinned 50th Street Bridge

Exhibit 4-3 illustrates a concept that was developed as part of the Value Planning exercise. The concept that would make use of the existing 50th Street Flyover Bridge (which would convert to NB traffic operation) and includes a new 2-lane twinned 50th Street structure (that would provide for SB traffic). This arrangement would provide local Leduc / EIA connectivity across the QE II corridor and also connect the 50th Street/65th Avenue intersection (east of the QE II corridor) to Perimeter Road (west of the QE II corridor) within the EIA lands.

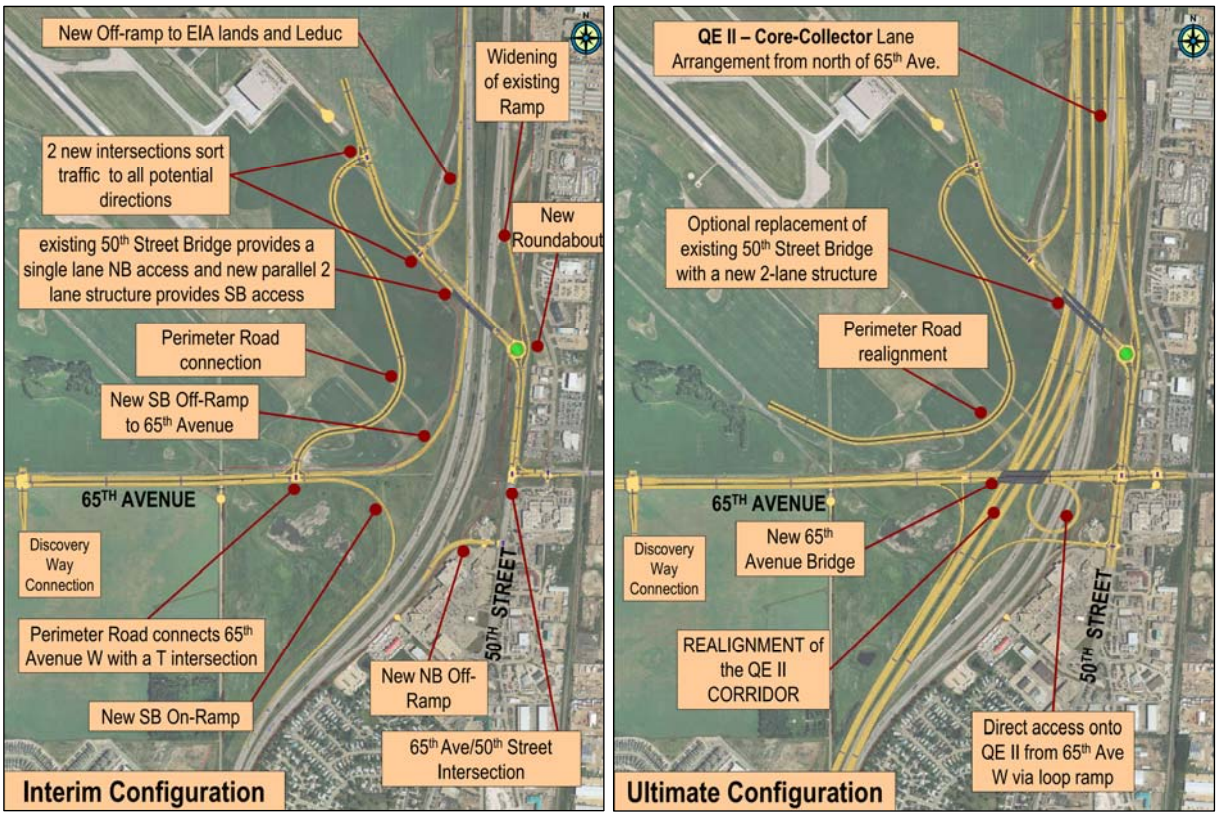

Exhibit 4-3: Preferred Configurations for Concept 3

4.3.3.1 Interim Stage

The concept would see a new twinned structure (approximately 175m long, 14.4m wide) constructed to meet both the requirements of the existing QE II lanes as well as the ultimate realignment of the QE II (i.e. in terms of pier locations). Hence, the concept:

- can be developed using the existing QE II corridor prior to the QE II having to be realigned;
- can transition onto a later stage that envisions a QE II realignment (R950 & R1100) as part of a new 65th Avenue interchange while maintaining the existing 50th Street Flyover bridge; and
- can transition as a subsequent stage that envisions a QE II ultimate realignment (R1500) that provides for a replacement 50th Avenue bridge; and.
- provides for a direct access for Leduc residents into the EIA's planned commercial lands and also serves to link the future 65th Avenue West corridor in advance of the need for a 65th Avenue interchange.

The initial conceptual cost estimated for budgetary purposes was determined to be approximately $55.5M.

4.3.3.2 Ultimate Stage

At the ultimate stage, when the core-collector freeway network is required, the existing 50th Street QE II Flyover bridge would be removed or replaced. This concept would integrate with the ultimate 65th Avenue interchange structure that would be constructed over a new QE II realigned corridor (R1500).

The concept is advantageous in that the 65th Avenue interchange would serve to accommodate interchange traffic while the twinned 50th Street bridges would accommodate local Leduc/EIA traffic. The two crossings would work in conjunction with one another and present significant cost deferral opportunities, while still meeting shorter-term travel demands. As well, Section 3.4.1 highlights the resulting traffic volumes associated with the Airport Road Interchange and the 50th Avenue Interchange bridges in the absence of the new Twinned 50th Street and/or the 65th Avenue interchange recognizing the diversion of local traffic to a third crossing point.

The conceptual construction cost of the entire project was determined to be approximately $159.4M, excluding property acquisition costs. The total is anticipated to be shared between Alberta Transportation, the EIA and the City of Leduc. Discussions regarding cost sharing remain to be initiated. All affected properties (excluding the 65th Avenue corridor and the 50th Street) falls within the jurisdictions of either Alberta Transportation or the EIA/Transport Canada.

The conceptual "throw away costs" associated with infrastructure required during the interim stage and later removed / disposed during the ultimate stage, was estimated at $9.8M (approximately 19% of the original interim construction costs could be considered throwaway).

4.4 Concept Comparison

The three interchange concepts considered were compared to one another accounting for:

- the interchange costs, including structure and roadwork costs, earthworks and drainage requirements;
- connecting roadways costs, including roadwork, earthworks and drainage requirements;
- the amount of interim conceptual construction cost that would be considered "throw away";
- area impacts, including geotechnical, environmental and historical conditions;
- temporary traffic accommodations (detours, etc.) from the interim to ultimate stage;
- traffic operational characteristics of each option and envisioned configuration; and

- comments and concerns raised during the public involvement[12] sessions.

The results of the interchange comparison (See Table 4.1) are summarized as follows:

- *Conceptual Cost Estimates:* Table 4.1 indicates that Concept 3 (a new Twinned 50th Street Bridge) is the preferred solution and results in significant cost savings. From a cost perspective, Concept 3 was found to be more favourable as it permitted the deferral of about $20M. In addition, although the overall total cost of Concept 3 was determined to be higher than Concept 2 the opportunity for cost and benefit sharing with the EIA was perceived as a method by which the total cost of Option 2 and 3 would be almost identical to public agencies. As well, the percentage of throw away costs associated with Concept 2 was almost $8M higher if compared to the percentage of throw away costs associated with Concept 3. Concept 2 has a $22M extra up-front interim cost and a restriction on limiting access to the (2017) EIA commercial development to only the Airport Road interchange.
- *Area Impacts:* No major geotechnical, environmental nor historical issues were foreseen at the interchange sites considered in all 3 concepts that would prohibit the construction of an interchange.
- *Traffic Operations Comparison:* Without the advent of the Twinned 50th Street solution Appendix "B-6.3"[13] indicates that an 8-lane cross-section excluding auxiliary lanes would be required for both the 65th Avenue and Airport Road interchanges. The above conceptual cost estimates exclude this impact. Concept 3 was found to offer the maximum flexibility to AT to accommodate forecast demands.
- *Public Involvement Comments/Concerns:* In general, the public open houses and focus groups indicated a desire to advance the 65th Avenue interchange Concept 2 over Concept 3 as it would result in an immediate benefit to City residents not wanting to divert through EIA lands as an interim inconvenience.

4.5 Conclusion

The comparative analysis of the three concepts considered indicates that Concept 3 (a new Twinned 50th Street Bridge) was found to provide significant advantages in terms of cost savings, traffic operations, as well as providing the greatest flexibility for AT to respond to changing development patterns, intensity and travel demand configurations.

[12] See "*Public Consultation Report*".
[13] Appendix "B-6.3", Page 39.

Table 4-1: Concept Comparison

Concept	*Concept 1*		*Concept 2*		*Concept 3*	
Stage	*Interim*	*Ultimate*	*Interim*	*Ultimate*	*Interim*	*Ultimate*
Description	Partial Diamond Interchange over Existing QE II Corridor	65th Avenue Full Interchange over Realigned QE II	Partial Interchange over Realigned QE II	65th Avenue Full Interchange over Realigned QE II	Twinned 50th Street Bridge Solution	65th Avenue Full Interchange over Realigned QE II
Partial Cost	$50.8M	$112.7M	$77.1M	$65.0M	$55.5M	$103.9M
Total Option Cost	$163.5M		$142.1M		$159.4M	
% of Interim Costs Considered to be "Throw away"	59% ($29.6M)		23% ($17.5M)		18% ($9.8M)	
	Cost of first stage would be "throw away" as entire initial bridge could not be salvaged or would be considered redundant with realignment of QE II.		Throwaway costs were $7.7M higher than Option 3.		EIA cost participation in 50th Street Solution was viewed as a benefit.	
Area Impact	Specialist concluded that there are no major geotechnical, environmental nor historical issues were foreseen at the interchange sites considered in all 3 concepts that would prohibit the construction of an interchange.					
Environmental	In all cases, the subject lands have experienced significant disruption along both sides of the QE II corridor. Regional impacts are not expected as the area surrounding the project provides similar habitat features. All options were found not to impact sensitive vegetation species nor fish bearing water bodies.					
Historical Resource	All archaeological and paleo sites identified were in the general project vicinity but outside of the project study area.					
Geotechnical	The construction of each of the options are feasible from a geotechnical point of view. Specific testing will be required for the proposed bridge structures.					
Drainage / Hydrology	All 3 concepts indicate impacts to the wetland area on the west side of the QE II corridor. Each of the options will require additional storage areas due to the proposed increased impervious area.					
Property Requirements	Ultimate property requirements are the same for all interchange considered.					
Development Impacts	Concept would serve EIA lands only indirectly via 65th Avenue. There is little if any diversion of traffic away from the Airport Road Interchange.				Initial concept would serve both EIA lands and 65th Avenue Lands Accommodates known and imminent development.	
Traffic Operations	The first stage offers accessibility to the Leduc 65th Avenue West lands but would be designed to provide minimal capacity recognizing the infrastructure is throwaway.		Requires a more robust 65th Avenue interchange when compared to Concept 3 which uses 50th Street local bridges to divert traffic NB traffic destined to the EIA lands.		Provides immediate benefits in that extensive improvements to the Airport Road interchange are delayed. Provides separate 50th Street access for local traffic which would no longer use the QE II.	
Staging Integration	There is little benefit to staging offered by this option as the initial investment is throwaway.		Requires QE II realignment up front prior to 65th Ave interchange being developed.		Delays QE II realignment and provides flexible staging of realignment & 65th interchange.	
Public Involvement	Of all comments received no one expressed a preference for Option 1		Public indicated a preference for this option as it would benefit Leduc residence and not require any "back tracking" to reach 65th Ave West.		Perceived as the best use of public tax dollars with minimal throwaway costs despite not providing direct access along 65th Avenue. -	

5.0 FUNCTIONAL DESIGN OF CORRIDORS AND INTERCHANGE

Annex "A" presents the functional plans illustrating the technical characteristics of the proposed QE II / 65th Avenue interchange and the QE II corridor within the immediate study area. The plans address:

- a potential staging strategy;
- plan and profile views of the QE II corridor realignment;
- plan and profile views of the QE II/65th Avenue interchange ramps;
- QE II/65th Avenue interchange ramp cross-sections;
- plan and profile views of the 65th Avenue corridor;
- plan and profile views of the Airport Perimeter Road corridor;
- the QE II corridor cross-sections;
- the 65th Avenue corridor cross-sections; and
- adjacent arterial/local roads and intersections improvements and modifications.

Annex "B" provides the property requirements associated with the “ultimate” improvements in the form of Right-of-Way request plans. (See Section 5.7)

Annex "C" illustrates an alternate "ultimate" functional plan for the 65th Avenue East corridor that would provide for a grade-separated crossing over the CP Railway corridor. The CP Rail corridor runs parallel to the QE II, and is located approximately 450m east of the 50th Street corridor and 200m east of Sparrow Drive. Annex "C" also provides Right-of-Way request plans should the municipality wish to implement this solution at a future time.

5.1 Design Criteria

Table 5-1 provides a comprehensive summary of the adopted design criteria parameters used to develop the QE II corridor, 65th Avenue corridor, and the proposed Twinned 50th Street bridges.

Intersection Design

The approach taken in determining the applicable intersection design at traffic signal controlled intersections was based on AT's urban supplement design guide which specifically indicates that "*the traffic analysis will determine the need for right or left turn lanes beyond the general criteria outlined in the following sections.*"[1] To this end traffic intersection capacity analysis was undertaken at each intersection and the required right turn lane

[1] "*Highway Geometric Design Guide, Urban Supplement*" (Draft Nov. 2003), U.D.6.1 Guidelines for Right and Left Turn Bays, Page U.D-11

Table 5 - 1: Design Criteria as Referenced from Alberta Transportation's Highway Geometric Design Guide

CRITERIA		QE II Highway		65th Avenue	QE II Ramps	
		Core	Collector		Loops	Ramps
	Design Speed	130km/h[1]	110km/h[1]	80km/h	40km/hr	70km/hr
	Design Vehicle	WB-36		WB-23	WB-36	
HORIZONTAL ALIGNMENT	Min. Horizontal Curve Radius	R 950m		R 250m	R 55m	R 190m
	Max. Super elevation	6.0%		6.0%	6.0%	
VERTICAL ALIGNMENT	Min. "K" Value (Crest Curves)	140		35	5	25
	Min. "K" Value (Sag Curves)	70		35	7	25
	Min. S.S.D.	275m		140m	45	110
	Min. D.S.D	500m		230m	110	200
	Max. Gradient	3.0%		6.0%	3.5%[4]	
CROSS - SECTION	No. of Basic Lanes	2-3 per direction	3-4 per direction	6	1	
	Basic Lane Width	3.7m		3.7m	4.8m	
	Shoulder Width (Outside)	3.0m		2.0m	2.5m	
	Shoulder Width (Inside)	2.0m (2 lanes) 2.5m (3 lanes)	2.5m (3 lanes) 3.0m (4 lanes)	---	1.0m	
	Median Width[3]	26.6m	31.0m	6m (semi-rural)	-	
	Side Slope	6:1 normal / 4:1 max[2]		4:1 max[2]	4:1 max[2]	
	Basic R/W Width	100m (typ.) 90m (min.)		45m (min.)	30m (min)	

1 Despite the different Design Speed, the functional plan assumes the most restrictive design criteria for both the core and the collector lanes.

2. The functional plans accommodate a barrier free design with 4:1 maximum side slopes.

3. Median width is measured from pavement edge.

4. Maximum gradient is AT common practice. TAC indicates a maximum gradient of 5% on uphill slopes and 6% for downhill slopes (Table 2.4.6.3).

configuration (STOP, YIELD, MERGE and ADDED LANE)[2], was determined taking into account the following factors:

- forecast traffic volumes making the right turn;
- forecast traffic volumes to which the right turn must merge with;

[2] ibid, Exhibit U.D.6.1b, Page U.D-17

- up-stream intersection spacing and lane configuration;
- intersection performance;
- the impact of other movements which compete for traffic signal phase time;
- overall traffic trends;
- approach and egress speeds of adjoining roadways;
- lane balancing;
- integration with future additional upstream infrastructure requirements;
- investments being "throw-away" when not accounting for future changes;
- right-of-way / property limitations;
- flexibility in assuring that sufficient right-of-way / property has been protected;

A similar process was used for traffic signal controlled left turn auxiliary lane configurations.

5.2 Design Vehicle

The design vehicles selected for the QE II corridor and the QE II Hwy/65th Avenue interchange account for Long Combination Vehicles (LCVs).

- The QE II is designated as a "*Long Combination Vehicle Route*". As such, Exhibit 5-1 illustrates the WB-36 (Turnpike Double) design vehicle, which is characterized by a maximum length of 38 m.
- The QE II is not a designated "*High Load Corridor*". As such, above standard vertical clearance under the proposed interchange bridges and/or modified interchange ramp configurations are not required.
- *65th Avenue* does not fall under the Provincial Highway System as it currently represents a local connection, under municipal jurisdiction. A standard WB-23 truck was selected as the design vehicle for the roadway.

5.3 The QE II Re-alignment

A previous functional planning study[3], developed ultimate functional-level roadway plans for the QE II corridor between Ellerslie Road and the lands south of Leduc based on "freeway" design criteria and proposed interchange configurations intended to accommodate long-range traffic demands. This previous initiative depicted the QE II corridor in an ultimate "core-collector" arrangement that began south of Anthony Henday and extended southward to the 65th Avenue Interchange, within the City of Leduc.

[3] "*Queen Elizabeth II Highway - Ellerslie Road to South of Leduc"* Functional Planning Study, (2010 - TransTech and Focus Group) -

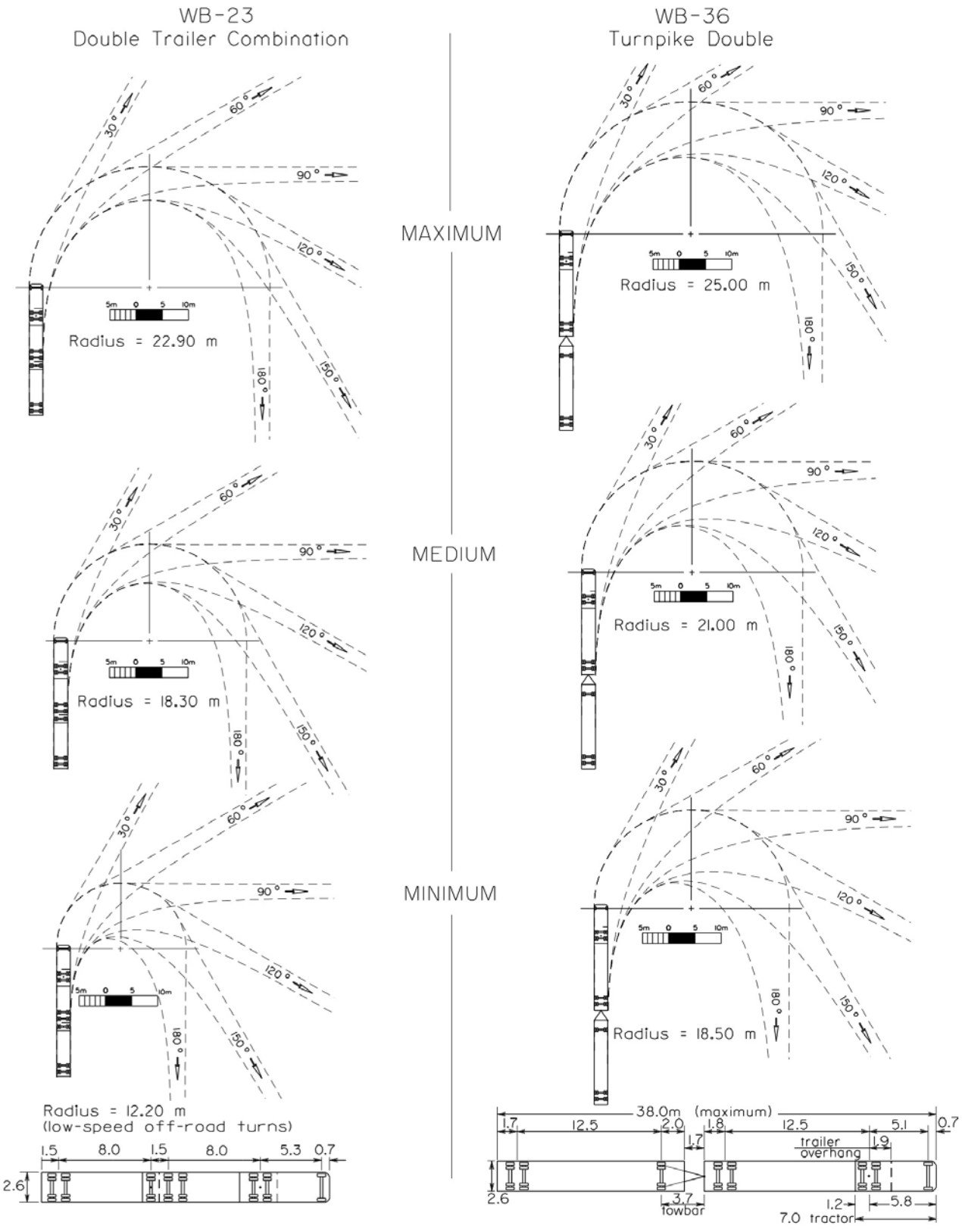

Exhibit 5 - 1: Turning Templates

- The core lanes system consisted of two (2) basic lanes in each direction with a rural cross-section. The 65th Avenue corridor represented the point at which the core lanes were introduced along the QE II corridor;
- The collector lanes system in both directions consisted of a basic four (4) lane rural cross section located on the outside of the core lanes. A centre-line spacing of 43.0 m was proposed between the core and collector lanes to accommodate high-speed transfer lanes.

The recommended QE II Highway alignment proposed in the previous initiative included use of the existing segments of the QE II corridor (where feasible) and improvements to the horizontal curves along the freeway corridor. These improvements were intended to address the existing R1100m curve in the vicinity of 65th Avenue and the R650m curve to the south in the vicinity of 50th Avenue.

The ultimate functional plans illustrated in Annex "A" of this study tie-in to the ultimate plans presented within this previous initiative1 at a point south of the QE II / Airport Road interchange and north of the 50th Avenue interchange.

5.4 Interim Stage Improvements

5.4.1 The Interim Stage Concept

The interim stage involves twinning of the existing 50th Sreet Fly-over bridge with a new 2-lane SB bridge located immediatly to the south of the existing fly-over. The existing fly-over bridge would convert to NB operation. On the west side, the two bridges would connect to Perimeter Road located within the EIA lands. A roadway would be extended south from the EIA lands to provide access to the new 65th Avenue West corridor.

This concept:

- provides an additional east-west corridor over the QE II (connecting 65th Avenue east and the future 65th Avenue west);
- assures alternate local access for Leduc residents to the EIA lands and EIA patrons to Leduc's downtown area;
- diverts traffic away from the QE II/Airport Road and the QE II/50th Avenue interchanges; and
- provides the opportunity to provide a SB-WB Off-Ramp and a EB-SB On-Ramp connecting the 65th Avenue corridor, when warranted.
- is intended to make the maximum use of existing infrastructure while providing enhanced connectivity supporting further supporting economic development;

The concept of the Twinned 50th Street Bridge solution was found to:

- delay the need for the 65th Avenue interchange;
- delay the need to undertake QE II freeway realignment modifications prior to developing the QE II / 65th Avenue interchange.

- delay the need for widening the Airport Road Interchange;
- delay the need for an improved QE II/50th Avenue Interchange; and
- avoid the need to develop an ultimate 8-lane 65th Avenue Interchange.

The elements of the Interim Stage are described in greater detail within the following sections:

5.4.2 The QE II - 50th Street NB On-Off Ramps

- The existing 50th Street NB on-off-ramp would be modified to provide only NB Off-Ramp access. The NB On-Ramp segment of the ramps would be closed off.
- The 50th Street NB-EB Off-Ramp would be re-configured to provide a 2-lane exit directly onto 50th Street while maintaining access to the Leduc Chamber of Commerce Building. The proposed interim 2025 50th Street NB-EB Off-Ramp widening design would be characterized by a 87.5m long 25:1 taper using the existing R130 horizontal curve. The purpose of the widening would be to provide additional storage length to accommodate double EB-LT lanes and enhance the operations of the 50th Street ramp terminal. The weave distance between the 50th Avenue interchange and 50th Street NB-EB Off-Ramp were not intended to be addressed at this (interim 2025) stage as the entire QE II corridor is to be relocated in the future and any weave concern is not anticipated until after the interim stage. The weave concern, should it materialize, would be addressed in the following (ultimate 2035) stage. The design reflects the minimum work required to improve operation at the 50th Street intersection. Modifying the 50th Street NB-EB Off-Ramp could potentially be achieved that would provide for an additional 150m of weaving distance, recognizing the proposed cul-de-sac at the 60th Avenue intersection with the ramp, should weave distance become a documented concern. However, any additional monies spent in reconfiguring the ramp during the interim stage would be considered throw-away given the desire to ultimately realign the QE II corridor.
- The intersection formed by 60th Avenue and the NB-EB Off-Ramp would be reconfigured as a cul-de-sac to eliminate the potential for mid-ramp conflicts.

5.4.3 The New QE II - 50th Street Twinned Bridge and Ramp Terminals

- *The New Bridge*: The interim plan calls for the introduction of a new 2-lane SB twinned 50th Street Bridge (total pavement width 12.9m - 178m length - 3 span) located immediatly to the south of the existing single lane 50th Street flyover bridge. The existing bridge would convert to NB operation. (See Chapter 6 - Bridge Planning; See Appendix "C-5" which discusses pier location and integration with the future QE II alignment.)
- *The East Ramp Terminal:* A 3-leg roundabout is to be located on the east side of the QE II corridor linking 50th Street to the new Bridge arrangement and the QE II NB corridor. The roundabout would have an inner radius (radius of the central island) of 23.00 m and an outer radius of 29.5 m (outer diameter of 59.00 m). The width of the roundabout circle is 6.50 m (single lane) and the width of the outer shoulder is 1.00 m. The roundabout is

characterized by a 2.50 m wide truck apron. Turning templates were produced to assure[4] that this apron configuration can accommodate the movements of a WB-36 design vehicle; The south and the north-west legs of the roundabout provide for a radius of the entering approaching lane curve of 30m. The exiting lanes are characterized by the following radii: [South leg: 50 m; North leg: 100 m; North-West leg: 40 m]

- The 40 m radius proposed for the North-West leg is constrained by the proximity of the abutment of the existing 50th Street Flyover bridge.
- A 100 m radius was adopted for the North leg, to facilitate the acceleration of the exiting vehicles, especially trucks, leaving the roundabout and merging onto the NB QE II on-ramp.
- A slip lane past the roundabout was provided for vehicle access to the QE II EB/NB-NB On-ramp from the 65th Avenue / 50th Street intersection. A horizontal radii of 100 m was used assuming a slip ramp design speed of 50 km/h.

Consideration was given to removing the NW segment of the Roundabout as U-turns originating from 50th Street were thought unnecessary. As well, this would have the added benefit of eliminating traffic control (yield entry) for southbound traffic originating from the bridge. However:

- for emergency purposes (should a segment of the loop be blocked);
- for getting vehicles to slow down from travelling across the long continuous bridge when entering the roundabout; and
- for providing redundancy for those motorists unfamiliar with the area,

It was thought prudent to continue to assure the NW segment would be provided for. The segment could always be painted out with pavement markings. Despite the above, the functional plans have been modified to depict the roundabout being "hatched" [See Annex "A", Plans R1204-PL003, PL004, PL010, PL018, and PL022]

- *The West Ramp Terminal:* A signalized "T" intersection is to be located on the west side of the QE II corridor linking the QE II SB corridor via a realigned 2-lane SB-EB/WB Off-ramp to Perimeter Road to the new bridge arrangement. The proposed intersection provides for:
  - double SB left turn lanes onto the new 2-lane Twinned 50th Street SB bridge;
  - a single channelized right turn lane that directs traffic onto Perimeter Road NB. [Turning templates[2] were produced to assure that the intersection configurations would accommodate the movements of a WB-36 design vehicle by way of a R50 turning radii. The design assumes the presence of the 65th Avenue West SB-WB Off-Ramp (as described in the Section 5.4.5.); hence WB-LT's onto Perimeter Road South from the QE II SB would be minimal. In the absence of a 65th Avenue West SB-WB Off-Ramp, the design at this ramp terminal merits review as merging from the QE II onto Perimeter Road South will become constrained given the 300m separation between the gore of the ramp and the Perimeter Road South intersection.]

[4] All the turning movements have been checked using the AutoTurn™ swept path analysis software.

5.4.4 The Interim QE II - 50th Street On-Off Ramps

The interim concept provides for QE II Ramps connecting from/to the new Twin 50th Street bridges. The QE II SB free-flow off-ramp to the existing 50th Street Flyover would be reconfigured as 2-lane ramp leading to a "T" traffic signal controlled intersection. The QE NB On-Ramp would be modified to accommodate a free-flow roundabout on the east side of the Twinned 50th Street bridges.

- *SB Off-Ramp to 50th Street:* The existing SB Off-ramp leading to the 50th Street Flyover would be removed and replaced by a new double lane off-ramp. The proposed off-ramp is characterized by two 3.7m wide lanes, a 3.0m right shoulder and a 2.5m left shoulder. A 4th QE II SB lane (weave) lane is envisioned between the Airport Road Interchange EB-SB On-Ramp and the new 2-lane 50th Street SB-EB/WB Off-ramp to the south.
- *NB On-Ramp from 50th Street:* Annex "A" depicts the connection between the proposed roundabout located at the 50th Street east ramp terminal and the existing QE II NB on-ramp. The interim configuration assumes the QE II corridor would be widened to provide a 4 NB (weave) lane from the 50th Street EB/NB-NB On-ramp entrance to the Airport Road NB-EB/WB Off-ramp to the north.

5.4.5 The Interim QE II - 65th Avenue West On-Off Ramps

The interim concept provides for direct QE II SB On/Off Ramps connecting to the new 65th Avenue West corridor. The need and justification for these new ramps is predicated on the need to relieve the growing 50th Avenue Interchange SB constraints as well as the future development potential of the Aerotropolis / 65th Avenue W developments. As such, the warrants for these ramps is to be monitored and can be considered a seperate stage to the Twinned 50th Street Bridge concept.

- *SB-WB Off-Ramp to 65th Avenue West*: Annex "A" depicts a single lane SB-WB off-ramp connecting the QE II SB lanes to the new 65th Avenue West corridor. The ramp, which has been designed assuming a 70 km/h design speed, is characterized by a 4.8m wide lane, a 2.5m right shoulder and a 1.0m left shoulder. The maximum grade along the proposed ramp is 1.5%. The ramp design assummed a QE II mainline speed of 130 km/h which would require a 30:1 taper. The "minimum" radius noted in AT's Design Guide is 190m and the "desirable" radius is 340m. Annex "A" illurates a radius of 200m which is the largest radius that can be used while still assuring that the ramp and taper can commence immediatly south of the existing 50th Street flyover. The design of the off-ramp uses a 330m taper followed by a 130m spiral leading to the off-ramp. It is agreed that this is not optimal but it does comply with existing design standards. This design can be improved by cutting the toe-wall of the existing 50th Street Fly-over back by way of a retaining wall to create room for a longer exit lane and a larger radius ramp. Our assessment is that the cost of achieving the extra ramp length must be weighed against the throwaway nature of this improvement given that the work on the 50th Street Fly-over could be considered throw-away. This option merits further examination at the time of detailed design.
- *EB-SB On-Ramp from 65th Avenue West*: This ramp will provide SB access to the QE II SB lanes from 65th Avenue West. The design for this ramp assumes a 70 km/h design

speed and a typical single lane cross section (4.8m lane, 2.5m right shoulder, 1.0m left shoulder). The QE II entrance lane will be characterized by a 500m@50:1 taper, assuming the existing QE II mainline design speed of 120 km/h. The radius of the horizontal controlling curve is 205m and the spiral parameter is 135m; the spiral ends approximately at the physical gore.

5.4.6 The 65th Avenue West Corridor

- The 65th Avenue West corridor would be developed initially as a 4-lane arterial roadway that:
  - is linked to the QE II highway by way of a SB-WB Off-Ramp and EB-SB On-Ramp;
  - provides for an intersection to the EIA's southern extension of Perimeter Road;
  - provides for an future intersection with the norterly extension of Discover Way / Bridgeport Blvd.
  - depicts 54ath Street as a cul-de-sac. In the ultimate time frame an intersection at this location would be located too close to the interchange free-flow SB ramps.

5.4.7 The 65th Avenue East Corridor

- The 65th Avenue East corridor would be upgraded:
  - the south leg of the 65th Avenue / Sparrow Drive intersection would be converted to right-in-right-out access to reduce the number of conflicting turning movements approaching the 65th Avenue/50th Street intersection which is located only 75m to the west;
  - the west leg of the 65th Avenue / Sparrow Drive intersection would be re-configured to provide a dedicated EB left turn lane onto Sparrow Drive North;
  - the east leg of the 65th Avenue / 50th Street "T" intersection would be re-configured to provide a dedicated WB right turn lane onto 50th Street North;
  - the north leg of the 65th Avenue / 50th Street "T" intersection would be re-configured to provide dedicated double SB left turn lanes onto 65th Avenue East. As well, a 2nd NB thru lane has been added.

5.4.8 The EIA's Perimeter Road South Extension

- The interim plans call for the southerly extension of Perimeter Road and details connections to the new 50th Street bridge arrangement and 65th Avenue West corridor. Both corridors are depicted as being 4-lane aterial roadways with a 6m raised median.
- The Perimeter Road south extension to 65th Avenue west is 1.3km in length and characterized by a design speed of 60 km/h. This roadway would be used in the interim by the public to connect 65th Avenue West to the 50th Street bridges. As such an agreement would have to be in place assurring the City of Leduc of continued access, (at least until such time as the 65th Avenue Interchange is developed), and assurring the EIA of security related provisions have been satisfied. (Median breaks are not illustrated but may be required to assure security where appropriate.)

- Appendix "E-5" provides insight into the design characteritics associated with such elements as frangable bases for lighting and the designed vertical profile of the Perimeter Road South corridor necessary to meet Transport Canada requirements.
- The design provides for two off-set intersections formed the of the Perimeter Road South intersection with Perimeter Road.

5.5 Ultimate Stage Improvements

5.5.1 The Concept

The ultimate stage involves the construction of the new 65th Avenue interchange over a re-aligned QE II corridor. The new 65th Avenue interchange:

- was found to be required within a decade (2035) after the Twin 50th Street bridge solution is implemented, assuming significant development of the lands along the 65th Avenue west corridor is achieved;
- would provide east-west connectivity, providing additional access to the 65th Avenue west lands. Access to the QE II NB corridor would be improved and traffic diverted from the QE II/Airport Road and QE II 50th Avenue interchanges.
- was envisioned as a 6-lane arterial bridge with auxiliary turning lanes; and
- was envisioned as a double EB-NB On-loop Ramp to access the QE II NB lanes. As traffic forecasts are highly dependent on development, it was thought prudent to plan for double EB-LT lanes and if found to be inadequate, have the flexibility to convert to a double loop ramp if proven necessary.

The ultimate stage also provides flexibility in that the core lane arrrangement/configuration can be implemented as a separate stage if, and when, warranted.

Transitioning from the interim stage to the ultimate stage would require modifications to the 65th Avenue West corridor which include:

- the relocation of EIA's Perimeter Road / 65th Avenue intersection to a new more westerly location to make way for the required new QE II / 65th Avenue interchange SB On/Off Ramps; and
- the removal/adjustment of the interim stage 65th Avenue West On/Off-Ramps, should they be implemented in advance of the interchange.

The elements of the ultimate stage are described in greater detail within the following sections:

5.5.2 The QE II Corridor Re-Alignment

Annex "A" depicts the proposed realignment of the QE II corridor at the ultimate stage and provides for the ultimate core-collector network configuration north of a new QE II / 65th Avenue interchange. The realigned QE II corridor is characterized by a basic 8-lane (4 lanes in

each direction) configuration with a 38.0m centreline spacing at a point south of the QE II / 65th Avenue interchange and north of the 50th Avenue interchange.

The ultimate corridor alignment would see:

- a horizontal back-to-back curve configuration where a R2000m curve (in the vicinity of the 50th Avenue interchange) is followed by a 750m long tangent and a R1500m curve (in the vicinity of the Twin 50th Street bridges).
- a 38m CL spacing between the collector lanes south of 65th Avenue is illustrated in Annex "A". This was done to tie into the previous functional design plans which indicate a 38m CL spacing in the vicinity of the redesigned 50th Avenue interchange. However, CL spacing should be 40m accorrding to current design standards. A note to this effect has been placed on the drawings.
- a new 65th Avenue interchange located in the vicinity of the transition between the tangent and the R1500m curve.
- an R1500 realignment in the vicinity of the 50th Street Twinned bridge solution. This represents the maximum curvature possible assuming the Twinned Bridge Interim solution where a new SB bridge pier span must meet, not only the pier location requirements associated with the existing QE II corridor, but also the new realigned QE II corridor requirements. This R1500 horizontal alignment was determined subsequent to significant iteration testing to determine the maximum possible curvature given the bridge constraints. This differs significantly from the R2580 alignment proposed within the previous FP initiative, but provides for an interim stage where two 50th Street bridges can operate side-by-side for at least two-decades and avoid the necessity of a 8-lane 65th Avenue bridge with additional auxiliary lanes and delays the need for an expanded QE II / Airport Road bridge;
- The realigned QE II corridor requires modifications to the existing QE II NB-EB 50th Street Off-Ramp. As the QE II alignment shifts westward the NB-EB Off-Ramp would be redesigned to provide a 30:1 taper followed by an R250 horizontal control curve leading to the 50th Street/Off-Ramp traffic signal controlled intersection. It was recognized that the "desirable" curve radius would be R440 and the "minimum" permitted would be R190. A R250 curve was selected to assure that the weaving length between the 50th Avenue WB/EB-NB On-Ramp and the 50th Street NB-EB Off-Ramp would be maximized. Weaving length was felt to be a more valuable variable in terms of safety and operations as opposed to the gentle curvature offered by a R440 versus an R250 radius which was provided.
- The realigned QE II corridor provides for a vertical profile that is either the same elevation, or higher, than the existing QE II corridor within the vicinity of 65th Avenue, with gradients ranging from 0.25%-to-0.80% along the corridor.
- The potential for accommodating up to 5 SB collector lanes between the Airport Road interchange and the Twinned 50th Street Bridges. Annex "A" illustrates 4 SB collector lanes which traffic forecast results indicated as being sufficient to a point beyond the thirty-year (2044) time horizon. The later expansion to five (5) SB lanes would only be

required upon the ultimate development of the Airport Road interchange which is forecast at the sixty year (2075) time horizon.[5]

5.5.3 The QE II Core Lanes

- Annex "A" illustrates 2 core lanes in each direction situated between the QE II collector lanes.
- The core lanes are introduced immediately to the north of the 65th Avenue corridor and are intended to extend northward as far as Anthony Henday;
- The core lanes system consists of two (2) basic lanes in each direction with a rural cross-section (based on a 38.0 m centre-line spacing).
- Future flexibility is provided to accommodate additional expansion, if and when necessary, to a four (4) lane cross-section in each direction.
- The SB transfer lane from the QE II core lane onto the QE II collector lane was envisioned to occur south of the QE II / Airport Road SB-EB/WB Off-Ramp and north of the Airport Road Bridge.
- The NB transfer lane from the QE II collector lane onto the QE II core lane was envisioned to occur in the vicinity of the existing Sparrow Crescent Off-Ramp (which is to be closed).

5.5.4 The 65th Avenue Corridor Improvements

- The new 65th Avenue interchange bridge (37.5-to-43.5m wide tapered, 144m long, 3 spans) would connect 65th Avenue West to 65th Avenue East across the realigned QE II corridor;
- the 65th Avenue corridor would be widened from its first-stage 4 lane cross-section to an ultimate 6-lane cross-section;
- further upgrades are envisioned as the 65th Avenue / 50th Street intersection which would convert to a 4-leg configuration and the 65th Avenue / Sparrow Drive intersection which would convert to a "T" configuration (where the south leg of the intersection will be closed) [See Annex "A", Page A-8, Plan R1204-PL008];
- the CP Railway crossing located to the east of the Sparrow Drive corridor would also require rail signal and gate improvements to accommodate a new widening that would support a 6-lane 65th Avenue corridor; and
- the maximum grade along the vertical profile of 65th Avenue is 3.4% on either side of the interchange bridge. Section 5.9 and Annex "C" address the option of developing a grade-separated 65th Avenue bridge over the existing CP Rail corridor. Under this option the maximum grades in the vicinity of the 65th Avenue interchange remain unchanged but east of the CP Rail corridor the grade would become 3.7%.

[5] The ultimate interchange requirements for the QE II Airport Road interchange envisioned a double QE II SB On-Loop Ramps and two QE II SB On-Ramps (one from the terminal and the other from Airport Road) all of which merge onto the QE II SB collector lanes. Hence the need for a 5 lane collector concept, two of which would be oriented to the 50th Street Off-Ramp.

5.5.5 The 50th Street Corridor Improvements

- The functional plans depict the widening of the existing 50th Street corridor for a distance 600m [250m on the south side of 65th Avenue and 350m on the north side of 65th Avenue] in the vicinity of the 65th Avenue corridor. The wideing would see the 50th Street corridor expanded from its 4-lane configuration to a 6-lane cross-section;
- The NB Slip Lane to the east of the roundabout would be widened to provide for a 2-lane configuration and the QE II EB/NB-NB On-Ramp would be realigned to accommodate the proposed realigned QE II NB collector lanes. The 2-lane configuration is to be protected as space is limited between the existing ROW and the slip ramp. It is critical to appreciate that without the double loop ramp at the 65th Avenue interchange being in place, or subject to later staging, the 2-lane configured slip ramp is definitely required; and
- Annex "A" [See Annex "A", Page A-8, R1204-PL008] also depicts the improvements to the 50th Street / 65th Avenue 4-leg intersection.

5.5.6 The EIA's Perimeter Road Corridor Improvements

- The interim stage calls for the southerly extension of the 4-lane Perimeter Road to 65th Avenue West at an intersection located approximately 500m from the CL of the existing QE II corridor. As the CL of the realigned QE II corridor would be shifted approximately 150m to the west, and with the advent of the new 65th Avenue interchange SB On/Off-Ramp configuration, this interim stage intersection would be required to be relocated.
- The ultimate stage envisions a new 4-leg Perimeter Road/65th Avenue West intersection. The new intersection would be located approximately
  - 1.3km west of the existing QE II CL;
  - 1.0 km west of the proposed 65th Avenue Interchange West Ramp Terminal intersection; and
  - 500m from the end of the SB-Off-Ramp taper.
- The new intersection would provide access to the future Aerotropolis lands on the south side of 65th Avenue West corridor and Port Alberta lands on the north side. The plans currently indicate the south leg of this intersection as Discovery Way however, City of Leduc plans could well see a connection to Bridgeport Blvd instead.
- Perimeter Road would be required to be extended further to the west to connect to the planned intersection. The alignment/configuration of the Perimeter Road intersection is beyond the study limits and remains to be determined.

5.6 Sub-Consultant Review of Functional Plans

Subsequent to the selection of the preferred interchange configuration and preparation of the functional plans, the historical, environmental, geotechnical and hydrological conditions for the impacted study area were evaluated. (See Appendix "A"). The following sections serve to

summarize the findings of the review of the functional plans undertaken by each of the sub-consultant disciplines.

5.6.1 Historical Evaluation

- As indicated in Section 2.10, eleven (11) archaeological sites were identified within the vicinity of the interchange. The Historical Resources Overview concluded that:

  "*The previously disturbed nature of the study area lands suggest that there is little potential for finding undisturbed historical resources sites and no further Historical Resources work is considered warranted for the 65th Avenue Functional Planning Study area*". [See Appendix "A-2"]

- The Statement of Justification concludes that all of the "Airport Lands" within the Leduc Functional Planning Study were subject to a Historical Resource Overview/Statement of Justification in 2008 by the Archeology Group and no further Historical Resource Assessment work was recommended. This recommendation was accepted by Alberta Culture and a clearance letter was received by the EIA.

- A letter forwarded by Alberta Culture and Tourism[6] to the City indicated that "depending on the nature and location of future developments in the area, Historical Resource Impact Assessment(s) (HRIA) may be required prior to development proceeding. This will require an application for clearance made through Alberta Culture and Tourism's On-Line Permitting and Clearance (OPaC) system.

5.6.2 Environmental Evaluation

The general findings of the environmental evaluation and site visit (undertaken on October 20th and 21st, 2014) indicated that no major issues or concerns were identified that would pose significant obstacles for the construction of the QE II / 65th Avenue interchange. This finding was later complimented by an comparative environmental review of the Interim and Ultimate stages (See Annex "A") which was conducted in December, 2015. This review focused on the environmental impact and cumulative effects. The following provides a brief synopsis.

- *Wildlife*: The review of both Interim and Ultimate Stages indicated that the functional plans will occur within "Sensitive Raptor" and "Sharp-tailed Grouse" wildlife areas. Recognizing the "*May be at risk*" and other "S*ensitive*" species that could potentially be found within the study area, a detailed wildlife survey, including amphibians and reptiles, should be conducted within the study area prior to construction to determine the presence or absence of special status species, wildlife habitat, habitat use and movement corridors.

- *Landforms/Soils*: A detailed soil survey should be completed following line locates in the project area to evaluate soils beyond 30 cm in depth at the proposed future interchange site. The detailed soil survey should delineate soil units and depth of topsoil and detailed mitigation for any soils of concern is recommended prior to construction.

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[6] February 18, 2015 From Alberta Culture and Tourism to Mr. Ryan Graham, City of Leduc. [See Appendix "A-2"]

- *Vegetation:* The review of both Interim and Ultimate Stages indicated that the functional plans impact no vegetation species of special concern. Although only two "*Non-sensitive element occurrence*" species were identified within the study area, this is not indicative of the absence of rare plants. Recognizing this a rare plant survey and detailed vegetation mapping is recommended prior to construction to ensure that no provincially rare vegetation species are impacted.
- *Wetlands*: The review of the Interim Stage by way of aerial photography identified six (6) wetland areas and the Ultimate Stage plans indicated an additional five (5) areas that will be directly impacted by the proposed functional plans. The largest wetland area would be located on either side of the 65th Avenue W corridor traversing both EIA and City of Leduc Lands. (See Appendix "A-1", Figures 9 and 10) It is expected that the wetland areas will be impacted during the construction and as such impacts could include changes in drainage patterns and loss of habitat for wildlife and vegetation not identified during this environmental review. It is recommended that a Qualified Wetland Aquatic Environment Specialist be retained to undertake a detailed site assessment of existing and planned wetland areas (water retention ponds) to classify each wetland and delineate area of impact for compensation associated with the *Water Act* approval purposes.
- *Fisheries*: The review of both Interim and Ultimate Stages indicated that the functional plans indicated that no fish bearing water bodies will be impacted. However, improvements to the QE II corridor and construction of the new 65th Avenue interchange have the potential to disrupt natural drainage patterns, affect ephemeral draws, risk contamination (leaks or spills) and sedimentation of water courses. Recognizing the presence of fish species (See Section 2.9) in Deer Creek and Telford Lake, a fish habitat assessment is recommended for the effected tributaries within the proposed development area.
- *Surface Water and Groundwater*: There is a potential for disruption of natural drainage patterns within the study area, therefore a storm water management plan is recommended to ensure manageable flows and adequate drainage structures are provided for storm water run-off and diversions. The hydrological resources in the vicinity of the future QE II and 65th Avenue interchange should be evaluated prior to construction with special attention paid to increased run-off attributed to the larger paved surface associated with the proposed interchange. Section 7 of this report addresses drainage concerns, provides potential estimates of run-off and recommends the steps which are required during the time of detailed design. [See Appendix "A-4", Page 15] Mitigation measures should be applied to account for greater surface area run-off. Groundwater wells within the area should be confirmed and groundwater quality and groundwater well water quality monitoring should be undertaken pre- and post-construction.

The study concluded that:

- *"The results of the Environmental Evaluation do not indicate any potential major environmental issues or concerns that would pose significant obstacles for the Functional Planning Study at this time"*.
- further analyses is required

- Adverse impacts can be alleviated with no further residual impacts on most resources by applying the suggested mitigation measures (as detailed within Appendix "A-1" for each eco-system component). .
- Prior to construction the following studies were recommended:
  - a rare plant survey and detailed vegetation mapping within area identified by "ACIMS search" as potentially having species of concern (this area is outside the project area for both the interim and ultimate stage);
  - a spring wildlife survey for raptors, sharp-tailed grouse, amphibians and reptiles to determine the presence or absence of special status species;
  - a watercourse and fish habitat assessment conducted by a Qualified Aquatic Environment Specialist (QAES) for DFO and Navigable Water applications; and
  - a qualified Wetland Science Practitioner (QWSP) detailed assessment of all wetland areas that will be impacted by the project.

5.6.3 Geotechnical Evaluation and Boreholes

- Appendix "A-3" contains the geotechnical desktop assessment carried out by Thurber Engineering Ltd. and reflects a revision[7] from the existing conditions overview dated November, 25, 2014. The assessment's purpose was to identify geotechnical constraints and provide preliminary geotechnical input to assist in developing design options for a future interchange. The conceptual plan/profile drawings in Annex "A" depicting the ultimate stage were reviewed. The assessment addressed surface conditions, sub-surface and bedrock conditions, groundwater conditions and provided a preliminary geotechnical evaluation and recommendations.

The preliminary assessment indicated that:

- a geotechnical investigation is warranted to more accurately assess the depth to solid bedrock at the proposed interchange foundation locations. Geology maps indicated a 20-to-60m depth to bedrock, yet test holes indicated surficial deposits to be only 6-to-7 m in thickness;
- the most feasible foundation types for the interchange bridge would likely be steel piles driven to practical refusal in the bedrock. For the purposes of this functional planning study it was assumed that this would occur at10 m (or less), below existing ground surface, however this remains to be substantiated through the above geotechnical investigation;
- a review of bridge file BF77994 (the existing 50th Street Flyover) and the inspection of the existing approach fills to this bridge indicated no signs of visible instability or distress;
- for functional planning purposes it could be assumed that the proposed bridge embankments could likely be constructed with 2H:1V head slopes and 3H:1V side slopes similar to bridge file BF77994, if suitable fill materials were to be used;
- At all embankment locations the fill design and construction must take into account the presence of glaciolacustrine clay and silt with low to medium strength and medium to

[7] Dated January 29, 2016 - File 19-5464-4

high compressibility, hence wick drains or staged construction could be required to allow excess pore water pressure generated by the high embankments to dissipate. The approach fills to the proposed bridges should be constructed in advance.

- The natural drainage condition was found poor, hence suitable drainage structures or facilities will be required in the interchange and approach road sub-grades. Water flow in roadway ditches should be evaluated and appropriate ditch erosion protection measures provided. [See Section 7.]
- the permanent cut and fill slopes should be top-soiled and re-vegetated as soon as possible to reduce potential slope instability; in the areas of deep cuts, erosion mats or other appropriate erosion control measures should be provided to limit erosion;
- air photo interpretation indicated the presence of organic materials and water bodies (sloughs and dugouts) with emphasis along the 65th Avenue W corridor. In these areas the organic materials and any underlying soft soil should be sub-excavated prior to embankment fill construction. These may be wet in Spring-time.

The preliminary assessment concluded that:

- the construction of the QE II/65th Avenue interchange and the associated highway realignment within the study area are feasible from a geotechnical point of view.
- A more thorough detailed site geo-technical investigation is considered essential and must be addressed at the time of the detailed design: The investigation should include:
  - the drilling of shallow test holes (2-to-6 m in depth) along each new road alignment (in intervals of approximately 200 m) to be used for pavement/roadway design;
  - the drilling of deep test holes at each proposed abutment and pier (20-to-30 m deep including coring), to provide increased certainty to the bridge foundation design;
  - confirmation of the underlying soils in the footprints of the proposed interchange bridges;
  - an assessment of the stability of any associated embankment fills or cuts;
  - an investigation of the suitability of potential borrow locations necessary to construct the planned infrastructure; and
  - (if possible) several readings of each groundwater levels in any available and/or new standpipes in order to provide a comparison with previously readings and provide information on potential variations that could impact the design of the structures.

5.6.4 Hydrological Evaluation

Appendix "A-4.1" contains a hydrological assessment of existing drainage characteristics (dated October 29th, 2015) [See Section 2.12]. Appendix "A-4.2" provides a conceptual stormwater management plan in the format of a technical memorandum (dated January 22nd, 2016). Both activities were undertaken by Golder Associates.

The stormwater management plan (SWMP), was intended to address the proposed interim and ultimate stages of the functional plans illustrated in Annex "A" in terms of:

- pre- and post-development drainage patterns, storage, and conveyance requirements;
- post-development run-off for 2-to-100 year storm events of 4-to-24-hour duration; and
- identification of affected water courses along with a comparison of the peak runoff rates between pre- and post-development conditions.
- The hydrological evaluation of the *interim stage* indicated the effects and proposed measures for consideration as regards the required culverts, ditches and flows. The evaluation indicated that:
  - in general the proposed infrastructure area is not expected to significantly alter the hydrological conditions and the drainage patterns within the study area; in fact these changes can be mitigated by maintaining the pre-existing flow paths and storage areas, installing new culverts, twinning existing culverts or replacing them with larger capacity culverts;
  - the proposed new roadways, (65th Ave West, Perimeter Road, along the QE II, along 50th Street) specifically the Airport Perimeter Road corridor, have the potential to change the pre-development drainage paths west of the QE II corridor and increase the flow to Whitemud Tributary 2; Appendix "A-4" provides recommendations for each of the new roadways noted above.
  - the road side ditches and culverts along this Perimeter Road corridor be designed to convey ruoff to the pond area (north of 65th Avenue), (or an equivalent area if this is removed.) which would in turn drain to Whitemud Tributary 1.
  - construction of Perimeter Road will likely require the affected natural wetland habitat areas to be protected or replaced.
  - the flows to Whitemud Tributary 3 and Blackmud Tributary would remain similar to the pre-existing conditions;
  - the modification of the QE II on/off ramps will increase the flows to Whitemud Tributary 1 and 2 (by 0.3 to 0.5 m^3/s), due to the increasing impervious areas; and
  - the construction of new storm-water management ponds is not recommended, primarily due to the numerous existing local run-off storage areas or natural depressions that attenuate flood flows.
- The hydrological evaluation for the *ultimate stage* indicated that:
  - the proposed re-alignments and new roadways have the potential to increase the impervious areas and change the existing drainage patterns; in fact the flows to Whitemud Tributary 1 and 2 are expected increase by 0.4-to-1.0 m^3/s and to Blackmud Tributary by 0.2-to-0.5 m^3/s;
  - the existing hydrological conditions will be altered by the proposed infrastructure; hence it is recommended to maintain the pre-existing flow paths and storage areas, construct new stormwater management facilities, install new culverts, twin existing culverts or replace them with larger capacity ones; and
  - a stormwater management facility will be required for the flows to Tributary 1 upstream of 65th Avenue.

During the time of detailed design for each stage (interim and ultimate) the recommendations contained in the Golder Associates (Jan. 22nd 2016) technical memorandum merit consideration

for adoption. As well, a biophysical impact assessment to determine the potential for Airport Perimeter Road construction to impact the existing wetland just north of the 65th Avenue corridor will be required to assess the requirements for the wetland habitat mitigation measures in terms of protection or replacement[8].

5.7 Access Management Strategy

The number, configuration, frequency, spacing, separation and distribution of accesses along a roadway corridor all combine to effect the safety and the traffic operational characteristics of the roadway, whether it be an arterial roadway or a freeway.

The objective of effective access management is to assure that the accessibility needs of the adjacent land uses can be satisfied, planned, arranged and permitted only where safety concerns have been addressed and consistency exists with the planned functional and operation requirements of the public roadway The following sub-sections address the access management provisions associated with the Province's QE II freeway corridor and the City of Leduc's 65th Avenue West corridor.

5.7.1 QE II Access Management Strategy

Alberta Transportation's access management strategies are aimed at preserving and improving safety highway performance and maintaining stable traffic flows, operating speeds and level of service throughout the Province's highway network.[9]

Since the QE II is designated as a Level 1 "freeway" corridor, the QE II;

- is subject to "*the highest level of access management"..."because of the strategic and functional importance of these routes to the provincial network*."[10]; and
- is to designed with "*totally restricted access"* ...which would be.."*only provided at interchange facilities*." [11]

The above implies that all other forms of access such as direct access-or-exit ramps, at-grade intersections and private accesses would not be permitted.

Alberta Transportations design guidelines:

- address interchange ramp terminal design characteristics such as preferred horizontal alignment, vertical profile, sight distance and signage characteristics;
- specify a 400m separation is required between a ramp terminal intersection and the nearest adjacent intersection - or - at least 150 m separation from the beginning-or-end of an interchange ramp taper to the adjacent intersection; and

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8 See Appendix "A-4.2", Golder Associated Technical Memorandum - Jan. 22nd 2016
9 Alberta Transportation. "*Highway Geometric Design Guide*" Chapter I. October 2005. Page I-6.
10 Alberta Transportation. "*Highway Geometric Design Guide"* Page I-19.
11 Ibid. Page I-23.

- indicate that direct access onto a development is not permitted from the freeway or from a freeway exit ramp[12]. (The 50th Street NB-EB Off-Ramp is non-compliant. See Section 11.8)

5.7.2 65th Avenue West Access Management Strategy

The Transportation Association of Canada (TAC) provides access management guidelines addressing both urban and rural roadway environments. These guidelines[13] define a seven level category system that ranging from local roadways (where driveway accesses are only limited by safety requirements and no operational requirements are applicable) to fully grade-separated roadways.

TAC's guidelines define: "*arterials as roads where traffic movement is the primary consideration while land access is a secondary function.*"[14] and segments the Arterials into "Minor" and "Major" categories as indicated in Table 5-2 which has been referenced from TAC literature. Common elements to both categories are:

- traffic flow should be un-interrupted except at traffic signals and cross-walks;
- transit service accommodation by way of express and local buses being permitted;
- cyclists accommodation may be provided by lane widening or desirably by way of separate facilities; and
- pedestrians accommodation may be provided by way of sidewalks.

Table 5-2: TAC Characteristics of Urban Roads - Arterial

	Minor	***Major***
Traffic Movement is a ...	Major Consideration	Primary Consideration
Land Service Access	Some access control	Rigid Access Control
Traffic Volume (vpd -typical)	5,000-to-20,000	10,000-to-30,000
Design Speed (km/h)	50-to-70	60-to-100
Average Running Speed (km/h off-peak)	40-to-60	50-to-90
Vehicle Type	All types	All Types up to 20% Trucks
Minimum Intersection Spacing	200	400

Source: "Geometric Design Guide for Canadian Roads, Table 1.3..4.2., Page 1.3.4.3 (TAC, Sept 1999)

Table 5-3 presents three levels of access limitation defined within TAC's GDGCR that are presented in order of increased access restriction. [Levels 1 and 2 are not presented as they are applicable to expressways and freeways.] Access level 5 favours increased accessibility at the cost of overall roadway mobility and lower traffic operational performance, while Level 3 is intended to assure greater mobility along the corridor.

12 Alberta Transportation. "*Highway Geometric Design Guide"* Pages I-23 and I-27.
13 Transportation Association of Canada. "*Geometric Design Guide for Canadian Roads"* Page 3.2.2.3
14 Transportation Association of Canada. "*Geometric Design Guide for Canadian Roads"* Page 3.2.3.2

Table 5-3: Arterial Category Access Levels[15]

Access Level	*Arterial*	*Arterial Access Limitations*
3	Major	Right-turn access driveways only.
4	Major	Right and left-turn access in, right-turn access out.
5	Minor	Right and left-turn access into and out of an activity centre: left-turn lanes required.

Source: : Geometric Design Guide for Canadian Roads, Table 3.2.2.2., Page 3.2.2.3 (TAC, Sept 1999)

For all of the factors indicated above, the 65th Avenue West corridor within the planned urbanized area of the City of Leduc should most likely be planned as a "major" east-west arterial route and would likely be similar in classification and function to the 50th Ave West corridor.[16]

As such, it would remain prudent to establish the urban portion of the 65th Avenue West corridor as being ultimately designed to:

- urban standards;
- be centre median divided;
- accommodate intersections spaced ideally a minimum of 400m apart from one another;
    - A typical desired minimum spacing between signalized intersections along an arterial with a progression speed of 50 km/h is approximately 400m (assuming a cycle length of 60 seconds). This is a standard that is often used as an engineering "rule of thumb" and is often observed along existing arterial roadway
    - It is thought that 65th Avenue West may well operate at a much higher operating speed, as it is being designed to accommodate an 80km/h design speed. This would lead to intersections being spaced farther apart to achieve the same appropriate signal phasing and progression opportunities[17].Assuming an average running speed of 70 km/h and traffic signal cycle lengths of 80 seconds would lead to a desirable spacing between signalized intersection of 780m. When the spacing between signalized intersections increases over 800 meters, the benefits to traffic signal progression are marginal. However, if needed from a land use and planning perspective, unsignalized intersections could "fill-the-gaps" at 400 meter intervals.
- have access driveways between intersections established with right-turn driveways only - with the exception where there is no reasonable alternative to do so, or where it may be considered in the general public interest to do so.
- assure that all other residential, retail centre or industrial park accesses would be oriented to have access onto adjacent collector designated roadways (e.g. the extension of Discovery Way or Bridgeport Blvd) which would then intersect with 65th Avenue West at major intersections.

[15] Ibid. Page 3.2.2.3
[16] 2013 City of Leduc "Current Roadway Network Map
[17] Ibid. Page. 2.3.1.17, Table 2.3.1.1

The rural portion of 65th Avenue West extends outside of the planned City of Leduc urban limits along the current Twp Rd 500 right-of-way and has been conceptually planned to divert to the south-west to connect with Hwy 39 (50th Ave) within the vicinity of Range Road 262. Current planning envisions a realignment of Hwy 39 to transition onto Twp Rd 500 and ultimately onto 65th Avenue. Current AT access management guidelines indicate a rural intersection spacing based on quarter-line positions of 1.6km with the potential for shared parallel service roadways between. A transition area of approximately 3km in length should be protected west of the urban boundary where it is envisioned that along the rural sections Hwy 39 would transition onto the 65th Avenue West corridor such that within the rural length of corridor no less than 800 meters. This remains consistent with the 2012 "*65th Avenue Functional Design Study*"[18] that envisioned similar intersection spacing along the 65th Avenue corridor with four intersections between Rge Rd 254 and the QE II / 65th Avenue Interchange (four intersections in approximately 3.2 km).

5.8 Right-of-Way Requirements

TAC suggests a typical right-of-way width for major arterials as 45m indicating that "*wider rights of way are often required to accommodate other facilities such as utilities, noise mitigation measures, cycling facilities and landscaping. For new streets the immediate provision of wider rights of way may be considered to accommodate such facilities.*"[19] Annex "B" provides the property requirements associated with the "ultimate" improvements in the form of Right-of-Way request plans that outline:

- a 50m width right-of-way designated to protect for a 6-lane divided urban arterial cross-section;
- the required Right-of-Way (ROW) needed to develop the "ultimate" 65th Avenue corridor, the QE II/65th Avenue interchange (measured in acres and hectares) and the Twin 50th Street bridge concept; and
- landowner information (for each of the impacted properties) inclusive of the Certificate of Title along with landowner names and addresses.
    - The "Yellow" shaded areas indicate property required by AT from the EIA to develop the future 65th Avenue interchange. (27.3 acres)
    - The "Blue" shaded areas indicate property required by the City from the EIA (3.0 acres) and Private owners (10.1 acres) needed to develop the future 65th Avenue West corridor. Additional "Blue" shaded areas exist along 50th Street in the vicinity of the proposed roundabout (0.13 acres) and the 50th Street / QE II NB-EB Off-Ramp intersection (0.4 acres) which would be required from Private owners; and

[18] ISL Engineering and Land Services. *"65th Avenue Functional Design Study"*. December 2012

[19] Transportation Association of Canada. "*Geometric Design Guide for Canadian Roads"* Page 1.3.4.3

- The "Red" shaded area (2.74 acres) indicate property that could be conveyed to the EIA from AT given the new alignment of the SB-EB/WB 50th Street Off-Ramp;

- Annex "B" does not indicate the property requirements associated with Perimeter Road as this corridor exists entirely within the EIA and would fall within their jurisdiction.

5.9 A Grade-Separated 65th Avenue East Corridor over CP Rail

Annex "C" illustrates an alternate "ultimate" option for the 65th Avenue East corridor that would provide for a grade-separated crossing over the CP Railway corridor.

A bridge structure (approximately 15m long) would provide the required separation between the 6-lane 65th Avenue corridor and the CP Rail corridor. The vertical profiles of 50th Street and 45th Street would have to be raised to match the new proposed 65th Avenue vertical profile.

Annex "C" illustrates a Right-of-Way plan associated with the grade-separated option and assumes the presence of retaining walls (Total length 700m : height varies 1m-to-8m) along the east side of 50th Street and the south side of 65th Avenue between 50th Street and the CP Rail corridor; these walls are highlighted in blue colour within Annex "C".

The concept assuming the above retaining walls requires the City to obtain additional property (+2.0 acres beyond that anticipated with the 6 lane at-grade widening) however, this could be further reduced with the advent of additional retaining walls.

Grade separation of the 65th Avenue over the CP Railway represents a major initiative for the Municipality. Section 11.10 details the potential timing for consideration of grade separation.

6.0 BRIDGE PLANNING

A bridge planning report[1] was commissioned as a component of this functional planning study. The following sections address the proposed modifications, construction requirements and identified issues for bridge structures within the study area, that address the:

- the *"Interim"* Twin 50th Street Bridge Stage; and
- the *"Ultimate"* 65th Avenue Interchange Stage.

It is emphasized that all drainage strategies associated with the planned bridges remain to be addressed at the time of detailed design and must consider the bridge deck's impact and adhere to AT's design and environmental guidelines.

6.1 Planning for the Proposed 50th Street Bridge Twinning

The existing single lane bridge flyover structure [BF 75522] crosses over the QE II thru-lanes and connects the southbound QE II lanes to the 50th Street corridor within the City of Leduc. The existing structure:

- was constructed in 1977 (almost 40 years old);
- provides for a grade separation of 50th Street over the QE II corridor;
- consists of three spans (57.9-64.0-42.7m);
- is positioned at a 30° angle with the QE II corridor;
- has a 2.4 m structural depth; and
- provides an existing vertical clearance ranging from 5.3m-to-5.57m. (The range is attributed to the existing QE II lanes super-elevation and bridge vertical profile.)

In terms of structural life:

- Communications with AT[2] staff indicated that rehabilitation of the existing bridge was undertaken during the 2014 / 2015 summer construction season; and
- The anticipated predicted lifespan range of the fly-over bridge structure is estimated at 25-30 years.

6.1.1 The "Interim" Stage Bridge Modifications

The "interim" stage depicted in Annex "A" [See Annex "A", Page A-4, Plan R1204-PL004] illustrates the existing 50th Street Fly-over bridge as converting to NB operation and a new 2-lane bridge developed to accommodate SB traffic. The trigger for this new twinned bridge would be the required additional capacity needed to accommodate forecast development between 50th Avenue and Airport Road.

The proposed structure of the new 50th Street Bridge would:

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1 See Appendix "A-5" for the Bridge Planning Report

2 Mr. Jeff Zhang (Bridge Manager, AT Barrhead)

- be located south of the existing 50th Street Bridge (6.4m south of the existing fly-over bridge);
- provide a new grade separation of 50th Street over the QE II corridor;
- consist of three spans (50.0-60.0-68.0 m) from west to east;
- be positioned at a 30° angle with QE II;
- have a proposed 2.7 m minimum structural depth;
- have a 2H:1V head slope and 4:1 side slope; and
- provide a 12.4 m clear roadway width which would consist of two 3.7 m wide traffic lanes, one 3.0 m right (south) shoulder and one 2.5 m left (north) shoulder.

The design speed on the 50th Street Bridge is 80 km/h. This speed requires at least a 2.0m wide shy line offset between the bridge barriers and the traffic lanes on either side. This is achieved in the proposed bridge cross-sections. [See Annex "A", Page A-18, Plan R1204-PL018.]

Recognizing the space is limited on the east side of the 50th Street bridge given the desired roundabout configuration and the future realigned QE II NB lanes, a structural depth as close as possible to that of the existing 50th Street Bridge was desired. During the time of detailed design further bridge analyses is suggested in that an optimum trade-off between structural depth, maintaining the same elevation of the two bridges, grades/profiles and retaining wall requirements of the bridge approaches remain to be finalized.

Given the different bridge lengths (new and existing) retaining walls will be required between the new and the existing abutments.

The east span of the new 50th Street bridge could be reduced from 65m-to-63m if the east abutment was supported on a MSE retaining wall instead of on a conventional headslope. However, the use of an MSE retaining wall approach would involve the retaining wall being constructed within the existing bridge approach fill to support the west abutment. This was perceived as being problematic and remains to be resolved during the time of detailed design.

The west side of the new 2-lane bridge extends beyond the existing flyover bridge. As such a tieback retaining wall was envisioned to support the embankment of the existing flyover on the EIA side of the bridge.

The east side of the new 2-lane bridge commences at a point west of the existing flyover bridge abutment. As such a retaining wall was envisioned to support the embankment of the new 2-lane bridge.

The construction costs associated with the Twinned 50th Street Bridge concept was estimated at:

- $11.9M for the bridge (assuming a unit cost of $4.500/m^2 and out-to-out fills of 197m x width of 13.4m);

- $0.5M for the tieback retaining wall; and
- $0.2M for the MSE retaining wall.

Approach fill construction, including construction of the required retaining walls, would ideally be carried out prior to bridge construction.

***Three Unbalanced Spans** (50.0-60.0-68.0 m from west to east)*

The bridge design calls for three unbalanced spans. Traditional design at the planning level for bridges often depicts equal spans on either side of the central spans to assure symmetry. This is done to avoid the potential for unbalanced moments (which may lead to longer approach spans, more complicated connection details; and a more complicated structural design which by convention cost more and may result in higher maintenance and operational concerns). However, in this particular project where the central objective involved developing a new bridge that would accommodate not only the existing QE II alignment but also a future realigned QE II realignment along with future core and collector lanes necessitated the consideration of unbalanced spans.

The ramifications of using unbalanced spans require an assessment at the time of detailed design. It remains possible to consider lengthening the shorter span (50m) by an additional 18m to assure equal spans on either side of the bridge, however, the cost of increasing the shorter length of span by another 18m at the planning level was thought unnecessary from an operational and cost perspective. At the time of detailed design the ramifications of using unbalanced spans as illustrated should be re-assessed.

A Three Lane Bridge

The concept of developing the equivalent of a 3-lane 50th Street SB bridge during the interim stage that would accommodate both directions of traffic in the ultimate plan (i.e. 2 lanes with wide shoulders until the existing structure is demolished, the bridge would then convert to 3 lanes with 2 SB and 1 NB lane) was considered. Exhibit 6-1 illustrates a 3-lane bridge concept that was evaluated.

- The marginal cost of a 3-lane bridge would be in the order of an additional $4.0-to-$5.0M that would be needed in the interim stage along with another $1-to-$2M to reconfigure the roundabout and intersections at the time the new bridge would convert to 3 lane operation. [The cost of a 2 lane bridge was estimated at $13M + 25% Eng & Cont. = $16.25M. The equivalent of a 3-lane bridge was estimated at $20-$21M]
- The cost of a new single lane replacement bridge was determined to be $12.4M.

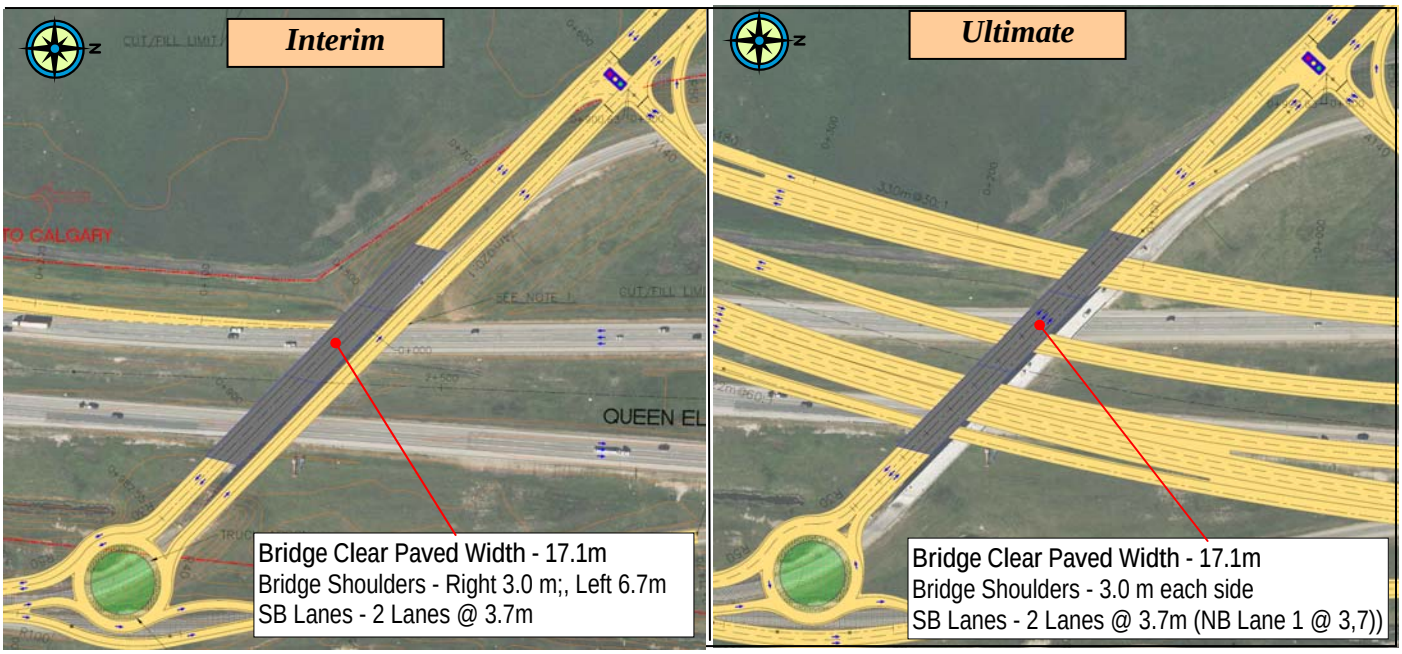

Exhibit 6-1: Three-Lane 50th Street Twin Bridge Concept.

- It was concluded that over the life-cycle of the project it remains more economical to construct a 3-lane bridge in the interim and simply remove the existing fly-over than build a 2nd bridge sometime in the future to replace the existing 50th Street fly-over. However, this assumes that 2 NB lanes will never be required.

It is recommended that at the time of detailed design a 3-lane configuration for the 50th Street Twin bridge be considered. At the time of detailed design, the validity of traffic forecasts should be re-confirmed to assure that a 4-lane cross section will never be required and the available funding also considered in determining the desirability of this option.

6.1.2 The "Ultimate" Stage Bridge Modifications

At the "ultimate" stage the existing 50th Street bridge would be required to be removed. (This corresponds to the 2035 time horizon or approximately 10 years prior to the anticipated structural life, however this depends highly on development growth.)

a) 50th Street Flyover Bridge Removal

The existing 50th Street Bridge [BF 75522] would be demolished by:

- saw cutting;
- removing the deck in pieces;
- unbolting and removing the steel girders in segments; and
- jack hammering out the pier; and abutments.

The need for removal of the bridge is triggered by the need to develop the 65th Avenue interchange, which in turn requires the realignment of the QE II corridor lanes. This bridge removal involves a construction staging strategy that would make use of the new 2-lane parallel bridge to operate with a single lane in each direction.

At the time of bridge removal the retaining wall located on the EIA side of the existing bridge build during the interim stage to support the embankment of the existing 50th Street Flyover bridge would be removed.

The estimated cost of demolishing/removing the existing 50th Street Flyover was calculated at $0.5M.

b) 50th Street Flyover Bridge Replacement

In the event that a three-lane bridge concept is not pursued, the Annex "A" plans [See Annex "A", Page A-10, Plan R1204-PL010] depicts a single lane replacement bridge to accommodate NB traffic flow to replace the demolished one. This structure would be the "twin" of the structure built during the "interim" stage and would:

- be located at the site of the existing 50th Street Flyover bridge [BF 75522];
- consist of three spans (50.0-65.0-68.0 m) from west to east;
- be positioned at a 30° angle with QE II;
- have a proposed 2.7 m structural depth;
- have a 2H:1V head slope and 4:1 side slope; and
- provide a 9.3 m clear roadway width which will be consist of one 4.8 m wide traffic lane, one 2.5 m right (north) shoulder and one 2.0 m left (south) shoulder.

Appendix "A-5" indicated as basic conditions regarding bridge planning that:

- standard bridge construction methods for both of the 50th Street Bridges be used; and
- construction detours and/or temporary lane shifts be used to assure that QE II traffic does not conflict with bridge construction activities.

The retaining wall under the east side of the new bridge installed during the interim stage that was needed to support the embankment of the new bridge would be buried by the additional fill required for the east headslope of the new bridge replacing the flyover bridge.

The bridge cost alone associated with this stage was estimated at $9.1M, assuming a single-lane replacement bridge at a unit cost of $4,500/$m^2$ (out-to-out fills of 197m x width of 10.3m). A 2-lane replacement bridge was estimated at $12.3M.

6.2 Planning for the Proposed New 65th Avenue Interchange Bridge

The "ultimate" stage plans depicted in Annex "A" provide for a new 65th Avenue Interchange bridge that serves east-west arterial traffic demands as well as provides access to, and egress from, the QE II corridor. The placement of the bridge accounts for the realignment of the QE II corridor.

This new 65th Avenue bridge would:

- create a connection between 65th Avenue west and east;
- provide a new grade separation over the QE II corridor;
- consist of three spans (55.0-50.0-39.0 m) based on MSE retaining wall abutments;
- accommodate a 40m CL-to-CL separation;
- be positioned at a 32° angle with the realigned QE II corridor;
- have a proposed 2.9 m structural depth;
- have a clear roadway width of approximately 36.5m at the west abutment;
- have a clear roadway width of approximately 42.5m at the east abutment;
- have a 2H:1V head slope and 4:1 side slope; and
- provide a 10.0 m clear zone for the QE II core-collector lanes and a 9.0 m clear zone for the QE II ramps;
- the bridge carriage way would accommodate:
  - three 3.7m wide traffic lanes in each direction;
  - a 6m wide centre median;
  - and tapers supporting auxiliary lanes;
  - a 2.0m WB shoulder; and
  - a 2.0m-to-3.0m EB shoulder providing access to the loop ramp.
- the interchange provides for an EB two-lane (2 x 3.7m) loop ramp that provides access to the NB QE II lanes. The double-loop ramp is protected for property purposes. At the time of detailed design, further assessment would be prudent to determine if the most easterly span is justified due to traffic operational issues or if the proposed configuration of the most easterly span of the bridge can be staged with an "interim" diamond configuration being appropriate.

The design speed along the 65th Avenue corridor and bridge is 80km/h. This speed requires at least a 2.0m shy line offset between the bridge barriers and the traffic lanes, which is achieved in the proposed bridge cross-sections. [See Annex "A", Page A-19, Plan R1204-PL019]

It is conceptually proposed to support the new 65th Avenue bridge abutments on MSE retaining walls. This solution would:

- reduce the required length of the west end span;

- provide for increased separation between the bridge abutment and the existing QE II southbound lanes; and
- improve the constructability of the new bridge.

Ideally the new 65th Avenue Interchange bridge:

- would be constructed within "green fields" prior to shifting the QE II traffic onto a portion of the newly realigned QE II corridor; and
- is illustrated in Annex "A" as being tapered from the south-west corner of the bridge to the south-east. However, tapered bridges are often less preferred than square ones (from a general safety, cost and design complexity perspective). The physical squaring of the bridge could be achieved by:
    a. maintaining the pavement markings as currently illustrated in Annex "A" such that only the bridge would be squared but the line tapers (pavement markings) would remain; or
    b. creating 5 continuous EB lanes across the entire bridge deck by extending the taper westward past the West Ramp Terminal.

    A note to this effect has been placed on R1204-PL019 of the Bridge plan. At the time of detailed design, the above options of tapering versus squaring of the bridge deck is to be resolved[3].

The bridge cost associated with the 65th Avenue Interchange bridge was estimated at $28.2M, assuming a unit cost of $4.000/m^2 (out-to-out fills of 174 m x width of 40.5 m).

***Three Unbalanced Spans** (55.0-50.0-39.0 m from west to east)*

The 65th Avenue Interchange bridge as depicted in Annex "A" calls for three unbalanced spans. Once again, traditional design at the planning level for bridges often depicts equal spans on either side of the central spans to assure symmetry and avoid the potential for unbalanced moments.

The reason behind the unequal spans of the new 65th Street bridge is that

- the pier abutments on the east side must be constructed outside of the existing QE II lanes which would remain operational during bridge construction and realignment construction.
- The need for a 3rd span on the east side is attributed to the need to accommodate a future double EB-NB loop ramp. The traffic from the loop ramp must not enter the core lanes as there would be a weave concern across the QE II collector approach lanes. This led to the desire to separate the loop traffic from the collector traffic until a point north of the 50th Street bridge.
- Moving the loop ramp closer to the collector lanes has the benefit of:
    - potentially eliminating the 3rd span entirely;
    - resulting in a cheaper 2-span bridge solution;

[3] At the time of report preparation, Alberta Transportation expressed a preference to having a square structure with four lanes (outside lane to single lane loop ramp).

- resulting in the overall bridge length being reduced by 15-to-20m.

However, moving the loop ramp closer to the collector lanes would also result in:

- an even more unbalanced bridge span arrangement (55m-70m); [This unbalance could be resolved by extending the 55m span by another 15m to achieve balance but at an additional cost and effect on operations.]; and
- loss of the barrier-free design aspect of the corridor in that a barrier design for at least 500m of barrier would be required separating the loop ramp entry lane from the NB collector lanes.

Conclusion: At the time of detailed design the ramifications of using unbalanced spans as illustrated should be reassessed.

7.0 DRAINAGE ASSESSMENT

The proposed construction associated with the "interim" and "ultimate" plans illustrated in Annex "A" will have the effect of increasing the overall paved surface within the study area. This section serves to highlight the existing drainage patterns and identify the extent to which the new infrastructure would increase storm-water run-off.

A hydrological assessment of the existing conditions, with consideration of the Annex "A" plans, was undertaken and stormwater management concepts developed for consideration. [See Appendix "A-4"]. This effort resulted in:

- drainage solutions being developed for the proposed stages of the project;
- impacts (if any) to the existing drainage patterns being determined within the study area result from the proposed improvements;
- storage and conveyance requirements being evaluated to confirm if post-development peak and volume runoff release rates are within allowable rates;
- potential problematic hydrological conditions or issues being identified that could have a potentially negative impact on the feasibility of the project or the project cost;
- additional runoff for the post Annex "A" plans conditions, assuming a 100-year storm event of the 24 hour duration (for each stage) being estimated;
- the approximate size and location of the culverts and the size of the Storm Water Management Facilities (if required) being estimated as necessary to accommodate the increased storm water runoff; and
- knowledge of the existing drainage patterns within an overall drainage plan needed to accommodate the proposed Annex "A" plans being incorporated into the study.

7.1 Existing Drainage Conditions

As indicated in Section 2.12, the hydrological assessment of the existing drainage conditions within the area of focus identified:

- numerous drainage ditches;
- 26 culverts; and
- four drainage areas (North Region, Central region, South-East Region and South-West Region) that flow northward to two tributaries being the Whitemud Creek on the west side of the QE II corridor and the Blackmud Creek on the east side of the QE II corridor.

7.2 Conceptual Drainage Management Plan

A stormwater management plan was developed considering the Annex "A" functional plans. [See Appendix "A-4"]. The following paragraphs compare the pre- and post-development conditions and the recommend drainage measures identified to accommodate the proposed plans.

The peak runoff rates (required for the stormwater management plan) at each culvert were calculated using the Rational Method. This method is appropriate for estimating peak discharges for small drainage areas (less than 80 hectares) with no significant flood storage. Each peak flow was calculated through the rational equation, based on runoff coefficient, rainfall intensity and the effective drainage area. The rainfall intensities were determined using the IDF (Intensity Duration Frequency) curves developed by Environment Canada (2014) for the Edmonton International Airport Station (Climate Station 3012205).

Surface water discharge to downstream watercourses generated as a result of the proposed new infrastructure should meet the requirements stipulated in:

- Stormwater Management Guidelines (Alberta Environment 1999);
- Drainage Guidelines for Highways Under Provincial Jurisdiction in Urban Areas (AT 2007); and
- Minimum Engineering Design Standards (City of Leduc 2006).

Exhibit 7-1: Post-Development Drainage Patterns at the Interim Stage

7.2.1 The "Interim" Stage Drainage Plan

During the "interim" stage the existing roadway alignments would remain similar to the pre-existing conditions. The changes would be related to the construction of the new roadways, including new and realigned ramps.

Exhibit 7-1 illustrates the location of Whitemud Creek tributaries (No. 1, No. 2 and No. 3) and the post-development drainage patterns at the interim stage.

- The proposed new roadways would have the potential to change the existing drainage patterns within the study area and increase the stormwater runoff. Appendix "A-4" highlights the impacts. Particular attention is paid to the construction of Airport Perimeter Road South. This corridor would have the potential to change the pre-development drainage paths to the west of the QE II corridor and increase the flow to the tributary (Tributary No. 2) leading to Whitemud Creek. To mitigate this flow increase, it is recommended that the road side ditches and culverts along the Airport Perimeter Road South corridor (which fall within the jurisdiction of the EIA) be designed to convey runoff to an existing pond area located to the north of 65th Avenue West. This pond area drains to a tributary (Tributary No 1.) which in turn drains to Whitemud Creek.
- The proposed new on/off ramps to the QE II corridor would slightly increase the runoff coefficients within their respective catchment areas due to the increase of the impervious land area. An estimate of the peak runoff rates to Whitemud Tributaries (No. 1 and No. 2) indicates an increase from 0.3-to-0.5 m^3/s in flow. It is anticipated that the flows to Whitemud Tributary No. 3 and Blackmud Tributary would remain similar to the pre-existing conditions.

The proposed infrastructure is not expected to significantly alter the hydrological conditions nor change the existing drainage patterns within the study area. Some peak flow increases to Whitemud Tributary No. 1 and No. 2 are anticipated due to the increase of impervious area and potential changes to local drainage patterns. These changes could be mitigated by maintaining the pre-existing flow paths and storage areas, installing new culverts, twinning existing culverts or replacing them with larger capacity culverts.

Construction of new stormwater management ponds may prove unnecessary to accommodate the Interim Stage plans. However, this conclusion is based on the presence of numerous existing local runoff storage areas or natural depressions that attenuate flood flows. During the construction of the new proposed roadways envisioned in the "interim" plan, affected natural wetland habitat should be protected or replaced. A review of the completed biophysical impact assessment of the wetlands is recommended to determine the nature of impacts posed by the highway and roadway drainage systems or the addition/reduction of contributing runoff during the time of detailed design. In addition, opportunities for developing a joint stormwater management facility that would accommodate the

requirements of both the EIA and the City of Leduc merit further study as part of the detailed hydrological evaluation.

7.2.2 The "Ultimate" Stage Drainage Plan

Exhibit 7-2 outlines the post-development drainage patterns during the "ultimate" stage of freeway development. During this stage the proposed QE II realignment and new roadways would have the potential to change the existing drainage patterns within the study area and increase the stormwater runoff. A coarse estimation of peak runoff rate indicated that flows to Whitemud Tributary No. 1 and No. 2 could increase from 0.4 to 1.0 m^3/s and to the Blackmud Tributary from 0.2 to 0.5 m^3/s.

]

Exhibit 7-2: Post-Development Drainage Patterns at the Ultimate Stage

The proposed ultimate stage is expected to alter the hydrological conditions, mainly through the increase of infrastructure impervious area due to the construction of new roadways and re-alignments. Some peak flow increases to the receiving tributaries were anticipated due to

the increase of impervious area and changes to some drainage paths. These changes could be mitigated by maintaining and re-constructing the pre-existing flow paths, maintaining the existing storage areas, constructing new stormwater management facilities (SWMF), installing new culverts, twinning existing culverts or replacing them with larger capacity culverts.

Additional stormwater storage facilities are envisioned to accommodate the increase in peak storm flows. A SWMF will be required for the flows to Whitemud Tributary No. 1 upstream of 65th Avenue. A conceptual-level estimate of the additional runoff generated due to the development during a 1:100 year, 24-hour storm event is approximately 12,000 m^3. The realignment of the QE-II might also provide an opportunity to manage inflows to Whitemud Tributary No. 1 from the upstream developed area in the City of Leduc. Some of the areas presently occupied by the existing QE II corridor might be redeveloped into a SWMF, upstream of the highway, to store and attenuate flood discharge. Since this would involve managing urban runoff from outside of the project area within the City of Leduc, responsibility for this should be examined and reviewed by the City of Leduc prior to consideration.

8.0 EXISTING UTILITY ASSESSMENT

The existing utility assessment:

- identified the approximate location[1] of all existing utilities both surface and subsurface along the QE II corridor, the proposed future 65th Avenue West corridor, the future QE II / 65th Avenue interchange and the twinned 50th Street interchange proposed for the City of Leduc;
- provided a summary of detail information of known utilities routed across or parallel to the future corridors and future QE II / 65th Avenue interchange; and
- identified any conflicts or impacts of the proposed infrastructure with these utilities.

8.1 Utilities

Twelve utilities were determined to cross or run parallel to the proposed 65th Avenue corridor and the QE II infrastructure improvements identified in Annex "A". These utilities were determined subsequent to a review of documentation provided by contacting each utility. Field investigation and detailed analysis of the utility corridors and identification of the necessary relocation and/or protection was not carried out in this stage of functional planning. These more detailed investigations would be undertaken at the start of detailed design phase.

The following utilities have been identified within the proposed development:

a. Airport Utility
b. Allstream
c. Altagas
d. Atco Pipelines
e. Bell Canada
f. Capital Region Southwest Water Services Commission
g. City of Leduc Sanitary Sewer
h. City of Leduc Storm Sewer
i. Alberta Products Pipe Line Ltd
l. Telus
m. Atco Gas
n. Alberta Transportation Power Lines

Exhibit 8-1 illustrates the approximate location of identified utilities in relation to the proposed 65th Avenue interchange and QE II corridor improvements.

[1] Prior to the commencement of detailed design, the location of all utilities should be confirmed by contacting the appropriate utility agencies and requesting a marking of buried utilities within the proposed construction site.

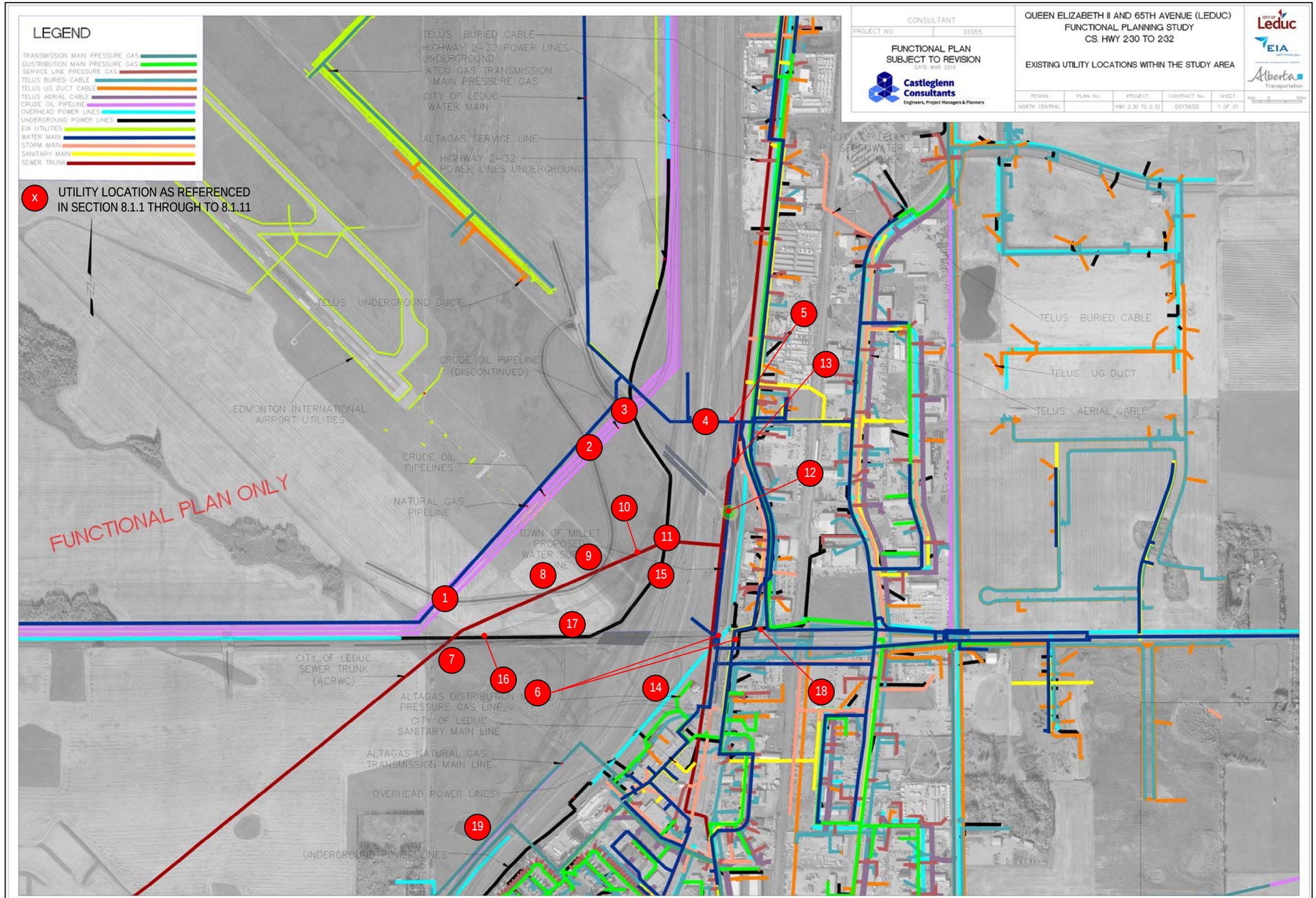

Exhibit 8-1: QE II and 65th Avenue (Leduc) Utility Corridors Identified within the Study Area

8.1.1 Pipelines

Two operational pipelines (Alberta Products Pipe Line Ltd, and Pembina Pipe Line Corporation - shaded in pink) cross the proposed Airport Perimeter Road South corridor and the QE II / 50th Street SB-EB/WB Off-Ramp at three separate locations. (See Exhibit 8-1: Points 1-thru-3) A third, but discontinues pipeline (also shaded in pink), owned by Pembina Pipeline Corporation, traverses the same three locations. These utilities cross directly under the proposed QE II / 50th Street SB-EB/WB Off-Ramp. These pipelines continue westward and run parallel to the proposed 65th Avenue West corridor.

It may be necessary to either relocate, or lower and protect, the portion of the pipeline that interfere with the proposed infrastructure to address these conflicts and accommodate the current design. Modification of the design to accommodate these utilities is problematic given the proximity of the planned Twinned 50th Street bridges and the proposed location of the QE II / 50th Street west ramp terminal.

The pipeline diameters are:

- Alberta Products Pipe Line Ltd: Gas Pipeline (273.1 mm diameter) - Operating;
- Pembina Pipeline Corporation: Crude oil (406.4 mm diameter) - Operating; and
- Pembina Pipeline Corporation: Crude oil (219.1 mm diameter) - Discontinued.

8.1.2 Water Main

Water services are the local distribution utility that cross the existing NB and SB QE II lanes, 65th Avenue, and 50th street, providing services to residential neighbourhoods and commercial areas on both sides of the QE II corridor.

Water services traverse the proposed infrastructure at seven (7) separate locations with a total of eleven (11) crossings:

- the NB and the SB QE II lanes and core lanes, just north of 50th Street Bridge (See Exhibit 8-1: Point 4) for a total of 4 crossings;
- the SB-EB/WB off-ramp connecting to Airport Perimeter Road (See Exhibit 8-1: Point 3);
- the 50th Street EB/NB-NB on-ramp at two separate locations (See Exhibit 8-1: Points 5 and 13);
- the 65th Avenue corridor on either side of the 50th Street intersection (See Exhibit 8-1: Point 6); and
- the Airport Perimeter Road at two separate positions (the first in the vicinity of the 65th Avenue corridor and the second in the vicinity of the 50th Street Bridge west embankment - See Exhibit 8-1: Points 1 and 2).

The measures necessary to protect and/or relocate water utilities will be required to be re-confirmed and refined during the detailed design phase.

8.1.3 Sanitary Main

Investigation has revealed that existing sanitary main lines servicing the City of Leduc crosses the existing roadway at one (1) location (just east of the intersection between 65th Avenue and 50th Street - See Exhibit 8-1: Point 6). Extension of the protection of the existing sanitary main may be required through the vicinity of this area.

8.1.4 Sewer Trunk

The sewer trunk is a large sewer line that is used to convey wastewater from main sewers to treatment or other disposal facilities. The sewer trunk traverses the proposed study area at eight (8) locations with a total of eleven (11) crossings. The crossings are located at:

- the 65th Avenue west corridor, just east of 54a Street (See Exhibit 8-1: Point 7);
- the Airport Perimeter Road at two different positions in the vicinity of the QE II / 65th Avenue SB-EB/WB off-ramp (See Exhibit 8-1: Points 8 and 9);
- the first section of the QE II SB-EB/WB off-ramp at 65th Avenue (See Exhibit 8-1: Point 10);
- the NB and SB QE II core and collector lanes and the proposed EB-NB on-loop ramp, north of the proposed 65th Avenue interchange (See Exhibit 8-1: Point 11);
- the proposed 50th Street roundabout (See Exhibit 8-1: Point 12);
- the QE II EB/NB-NB on-ramp north of the proposed roundabout (See Exhibit 8-1: Point 13); and
- the 65th Avenue corridor just west of the 65th Avenue / 50th Street intersection (See Exhibit 8-1: Point 6).

Relocation and/or lowering and protection of the existing sewer trunk line may be required prior to the construction phase.

8.1.5 Electrical Power Lines

There are several overhead and underground power lines, poles, and street lighting conduits located within the study area. High voltage (2.4 kV to 25 kV) underground and overhead powerlines run west of the QE II corridor along the proposed 65th Avenue alignment. Overhead/underground power lines crossings are identified at seven (7) locations with a total of ten (10) crossings:

- the QE II NB-EB off-ramp leading to 50th Street (See Exhibit 8-1: Point 14);
- the 65th Avenue / 50th Street intersection at two separate positions (See Exhibit 8-1: Point 6);
- the proposed 50th Street roundabout slip lane (See Exhibit 8-1: Point 12);
- the QE II SB-EB/WB off-ramp, west of the proposed 50th Street Bridge (See Exhibit 8-1: Point 3);

- the proposed QE II SB collector and SB and NB core lanes, between the 50th Street Bridges and the proposed 65th Avenue interchange (See Exhibit 8-1: Point 15);
- the QE II SB-EB/WB off-ramp to 65th Avenue (See Exhibit 8-1: Point 16); and
- the 65th Avenue corridor west of the proposed interchange bridge (See Exhibit 8-1: Point 17).

A long distance of underground power lines run along the realigned QE II corridor. Protection and/or relocation of the line may be required based on assessment of the as-built drawings from the original installation.

8.1.6 Communication Lines

Telus maintains numerous aerial cable, buried cable and duct structures within the study area. Telus buried cable crosses the proposed infrastructure at one (1) location:

- 65th Avenue and Sparrow Drive intersection (See Exhibit 8-1: Point 18).

8.1.7 Airport Utilities

No crossings between the EIA's utilities and the proposed infrastructure have been identified within the study limits highlighted in Annex "A".

8.1.8 AltaGas lines

Investigation has revealed that AltaGas high pressure natural gas transmission main line interferes with the proposed QE II corridor realignment at one (1) location, south of the proposed QE II / 65th Avenue interchange, with a total of four (4) crossings (See Exhibit 8-1: Point 19).

8.1.9 Bell Canada

Bell Canada maintains numerous buried and aerial cable in the City of Leduc. No conflict is identified with the proposed infrastructure.

8.1.10 ATCO Gas

ATCO high pressure gas locates to the west of the QE II corridor. There are no conflicts between the ATCO gas lines and the proposed infrastructure.

8.1.11 AllStream

Allstream maintains several aerial cable and duct structures in the vicinity of the study area. No conflicts have been identified between the Allstream lines and proposed infrastructure.

8.2 Utility Relocation - *Estimated Cost $1.2M*

The conflict mitigation cost estimate includes protection cost and/or relocation cost. The total estimated conceptual-level cost for utility relocation has been determined at approximately $1.2M.

Relocation cost associated with overhead power lines (approximately 1400m) have been conceptually estimated at $0.18M. Relocation cost associated with underground power lines (approximately 2,200m) have been conceptually estimated at $0.48M. For the protection/relocations of pipelines (three lines: PEMBINA, LTV, ALBERTA PRODUCTS), the conceptual cost estimate is $0.21M. It should be emphasized that the costs associated with pipelines protection/relocation are highly sensitive to individual requirements and heavily depends on the required mitigation measures demanded by the utility.

The estimated cost for relocation and protection of the City of Leduc water main (800m length) and the City of Leduc sewer trunks (900m length) is $0.12M.

Summary of the cost estimates is shown in Table 8-1. It is to be mentioned here that this estimated cost remains to be confirmed at the time of detailed design. Additional requests should be made at the time of detailed design to account for unidentified/unreported utilities which may conflict with the proposed infrastructure.

Table 8-1: Utility Relocation Costs

	Item Description	*Cost/unit*	*Length [m]*	*Total*
1	Overhead Power Line	$132.00	1,400	$184,800
2	Underground Power Line	$220.00	2,200	$484,000
3	Pipelines *	$220.00	960	$211,200
4	City of Leduc Water Main	$70.00	800	$56,000
5	City of Leduc Sewer Trunks	$70.00	900	$63,000
6	High Pressure Gas *	$220.00	750	$165,000
			Totals	$1,164,000

* The costs associated with relocation of pipelines is highly sensitive to individual requirements and can range from the 10's of $1,000's to $1M's depending on the required mitigation measure demanded by the utility.

9.0 COST ESTIMATES

The cost estimates for the proposed infrastructure were prepared in the concept comparison phase (See Chapter 4).

Subsequent to the production of the functional plans in Annex "A", a second round of cost estimates were prepared that saw the functional plans circulated to each of the sub-consultants involved in the study. The original cost estimates were updated and further refined. Particular attention was paid to bridge requirements, geotechnical impacts and stormwater management plan requirements. Other subtleties, such as staging impacts and costs were also accounted for.

9.1 Costing Assumptions

The following assumptions were adopted as part of the costing exercise that was undertaken as a component of this functional planning study and therefore merit review and consideration prior to adopting the estimates for budgetary purposes.

- Unit prices used to determine the project cost estimates were referenced from the *Alberta Infrastructure and Transportation North Central Region, Weighted Unit Price Averages Report* based on 2015 construction prices (costs not listed in the Provincial data were referenced from other sources including contractors and previous projects).
- The estimates provided are based upon the improvements illustrated within Annex "A". The limits illustrated within the functional plans were used as the designated cut-off limits for costing purposes[1].
- The cost estimate limits were outlined on the slides presented at the last Technical Review Committee meetings, held on June 25th and September 8th 2015. The same limits had been used for all of the three design options in order to have comparable estimates.
- All earthwork estimates were based upon approximations of required cut and fill materials and remain to be refined at the time of detailed design.
- The cost estimates accounted for construction costs only. Maintenance costs had not been estimated.
- The cost estimates did not include the costs of land acquisition.
- To provide the cost estimate of proposed bridges, the 2014 average price for *"All Alberta Bridges"* had been used, because only 1 record was available in the 2015 Unit Cost Report (1 record has been considered not statistically significant).
- The cost estimates assumed no sidewalks on the proposed bridges.
- The cost of relocation/protection of the existing utilities had been estimated in terms of $/m of relocation, also considering the type of utility (gas, power, water, etc.). The average

[1] See Annex "A": Functional Plans

costs were obtained by the analysis of a number of similar projects, developed by CastleGlenn, and located in the province of Alberta.

- The cost of protecting and/or relocating existing utilities has been estimated, however, this is to be refined at the time of detailed design by undertaking a utility audit intended to identify the precise location and verify the burial depth of all affected utilities. Individual utility agreements should also be reviewed to identify if the Province or the individual utility company would be responsible for utility relocation costs. For the purpose of this study, a worst-case assumption was made where all utility relocation costs were included within the cost estimate.
- The cost estimates assumed conventional traffic signal control at ramp terminals.
- Where possible, quantities had been taken from the 3D digital models of the proposed infrastructure (e.g. cuts, fills, pavements, drainage, etc.); all quantities were manually rounded. Where the use of 3D models was not possible, quantities had been estimated in terms of No./km or amount/km (e.g. signage, pavement messages, hydro seeding, etc.).
- Adopting a conservative approach, the cut material had generally not been considered reusable for fills.
- Where removals occurred, partial or total re-use had been considered instead of disposal where deemed possible (i.e., existing signs, existing traffic lights, etc.). Where re-use was not possible, the cost of disposal had been taken into account (e.g. existing culverts, existing asphalt pavement, etc.).
- A standard pavement structure had been considered for all of the proposed new roadways. This structure was made of the following layers:
  - 200 mm asphalt concrete pavement (mix type H1);
  - 450 mm granular base course, Des. 2, CL. 25; and
  - Subgrade surface preparation (where necessary).
- A 20% contingency and engineering fee and a 5% mobilization fee were applied to the conceptual construction cost estimates, which remain to be confirmed during detailed design.

9.2 The Total Project - *Estimated Cost: $160M*

The conceptual overall construction cost estimate[2] (see Table 9-1) for the proposed improvements identified within this FPS was determined to be $160M including provision for the eventual replacement of the existing 50th Street Flyover Bridge. In the absence of this bridge replacement the overall cost estimate was determined to be $145M (excluding property acquisition costs), which was comprised of the following elements:

- The QE II/65th Avenue interchange;
- The Twinning of the 50th Street Bridge corridor;

[2] See Appendix "D": Cost Estimates

- The new Airport Perimeter Road as illustrated between the designated study area limits;
- The future 65th Avenue / Discovery Way-Bridgeport Blvd Intersection;
- The demolition / removal of the existing 50th Street Bridge;
- The new 65th Avenue corridor as illustrated between the designated study limits;
- The QE II corridor realignment and upgrade inclusive of the new 2-lane core lanes in each direction; and
- the 50th Street Improvements as illustrated within the designated study limits.

The construction cost estimate of $145M....

- includes an adjustment of 20 percent to represent contingencies and design engineering requirements. In addition, another 5 percent was applied to represent mobilization requirements. (In all, the construction cost estimate was adjusted upward by an additional $32M.)
- excludes property costs. Annex "B" illustrates the required property and ownership. Property transfers between the Province, the EIA and the City remain to be resolved. The requirement for privately owned property effects primarily the City of Leduc along the 65th Avenue West corridor and 50th Street.

Chapter 5 of this document highlights the envisioned staging of this project that is intended to address the interim stage and ultimate stage requirements of the project.

- The overall conceptual cost estimate associated with achieving the interim stage was determined to be $53.7M.
- The costs associated with achieving the ultimate stage designation was determined to be an additional $91.2M.

Table 9 - 1: Final Conceptual Level Costing - Project Summary

Stage	Base Cost ($)	Mobilization ($)	Engineering/ Contingency ($)	Total ($)
Interim	42,927,000	2,146,350	8,585,400	53,660,000
Ultimate	72,975,000	3,648,750	14,595,000	91,220,000
Sub-Total	*115,902,000*	*5,795,100*	*23,180,400*	*144,880,000*
50th St Flyover Bridge (2 lanes)	13,160,000	658,000	2,632,000	16,450,000
Grand-Total	***129,062,000***	***6,453,100***	***25,812,400***	***161,330,000***

9.3 Interim Stage - *Estimated Cost: $53.7M*

The total construction cost of the Interim Stage was estimated at $53.7M (excluding the land acquisition costs); in detail the Interim Stage would involve the following cost components outlined on (Table 9-2):

- 178 m of a new 2-lane 50th Street Bridge paralleling the existing 50th Street Bridge (estimated at $13.0M);
- 0.7km of a new 2-lane EB/NB-NB on-ramp and widening of the existing 50th Street to connect 65th avenue East to the QE II NB lanes (estimated at $3.6M);

- 0.8km of a new Airport Perimeter Road inclusive of the 50th Street West Ramp Terminal (Estimated at $6.3M);
- 1.3km of a new Airport Perimeter Road South connecting the new 50th Street twinned bridges to the 65th Avenue west corridor (estimated at $5.6M);
- 0.9km of a new 65th Avenue West corridor (estimated at $3.5M);
- 3 new interchange ramps (2 SB off-ramps, 1 EB-SB on-ramp) and widening of an existing ramp (NB-EB off-ramp) (estimated at $6.7M);
- a new 65th Avenue / Discovery Way-Bridgeport Blvd Intersection (estimated at $2.8M);
- a lump sum for utility relocations (estimated at $1.2M);
- closure and removal works (estimated at $0.2M);
- contingencies and design engineering requirements (estimated at $8.6M);and
- mobilization requirements (estimated at $2.2M).

9.4 Ultimate Stage - *Estimated Cost: $91.2M*

The Ultimate Stage total construction costs were estimated at $91.2M (excluding land acquisition costs). The costs, outlined on table 9-3, includes:

- 1 new QE II / 65th Avenue interchange bridge (Estimated at $28.2M);
- 3.0km of the QE II collector realignment including the new core lanes within the designated study limits (estimated at $18.1M);
- removals (estimated at $6.7M);
- widening of the 65th Avenue Corridor to 6 lanes and construction of the new 65th Avenue bridge approaches (estimated $6.8M);
- 0.6km of Airport Perimeter Road South realignment (estimated at $2.8M);
- 4 new interchange ramps (EB-NB on-loop ramp, NB-EB off-ramp, SB off/on-ramps) and widening of an existing ramp (SB-EB/WB off-ramp at 50th Street) (estimated at $10.2M);
- widening of the 65th Avenue Corridor to 6-lane through the Discovery Way Intersection (estimated at $0.2M);
- contingencies and design engineering requirements (estimated at $14.6M);and
- mobilization requirements (estimated at $3.6M).

Table 9 - 2: Final Conceptual Level Costing - Interim Stage

"INTERIM" STAGE COST ESTIMATE

Queen Elizabeth II and 65th Avenue (Leduc) Functional Planning Study

ITEM	ITEM	TOTAL
A	**STRUCTURES**	
A.1	50th Street Twinned Bridge	$13,010,000
	SUB TOTAL	**$13,010,000**
B	**EAST RAMP TERMINAL, NB ON-RAMP AND 50TH ST. WIDENING**	
B.1	New Ramp Terminal, NB On-ramp and Widening of 50th St. to Connect to 65th Ave. East	$3,640,000
	SUB TOTAL	**$3,640,000**
C	**AIRPORT PERIMETER RD. NORTH AND WEST RAMP TERMINAL**	
C.1	Airport Perimeter Rd. North and West Ramp Terminal	$6,260,000
	SUB TOTAL	**$6,260,000**
D	**AIRPORT PERIMETER RD. SOUTH**	
D.1	Airport Perimeter Road S (Between West Ramp Terminal and 65th Ave. West)	$5,590,000
	SUB TOTAL	**$5,590,000**
E	**65TH AVENUE WEST**	
E.1	New 65th Avenue - West of the QE II Corridor	$3,500,000
	SUB TOTAL	**$3,500,000**
F	**RAMPS**	
F.1	Widening of Existing NB Off-Ramp at 50th Street	$715,000
F.2	New SB Off-Ramp at 65th Avenue West	$1,705,000
F.3	New SB On-Ramp at 65th Avenue West	$1,820,000
F.4	New SB Off-Ramp at 50th Street	$2,495,000
	SUB TOTAL	**$6,735,000**
E	**CLOSURES AND REMOVALS**	
E.1	Removal of NB On-Ramp at 60th Avenue	$97,000
E.2	54Ath Street Closure	$70,000
E.3	60th Street Closure	$60,000
	SUB TOTAL	**$227,000**
G	**DISCOVERY WAY INTERSECTION (INTERSECTION 4)**	
G.1	Discovery Way Intersection	$2,800,000
	SUB TOTAL	**$2,800,000**
H	**INTERCHANGE UTILITIES**	
H.1	Lump Sum	$1,165,000
	SUB TOTAL	**$1,165,000**
	TOTAL CONSTRUCTION SUBTOTAL	**$42,927,000**
	MOBILIZATION 5%	$2,146,350
	ENGINEERING AND CONTIGENCY 20%	$8,585,400
	TOTAL ROUNDED CONSTRUCTION COST	**$53,660,000**

Table 9 - 3: Final Conceptual Level Costing - Ultimate Stage

"ULTIMATE" STAGE COST ESTIMATE Queen Elizabeth II and 65th Avenue (Leduc) Functional Planning Study			
ITEM	**ITEM**		**TOTAL**
A	**REMOVALS**		
A.1	50th Street Bridge		$540,000
A.2	QE II SB Off-Ramp at 65th Avenue West		$325,000
A.3	QE II SB On-Ramp at 65th Avenue West		$425,000
A.4	Perimeter Road between West Terminal and 65th Avenue		$890,000
A.5	QE II NB Off-Ramp at 65th Avenue East		$265,000
A.6	Existing QE II Corridor		$4,230,000
		SUB TOTAL	**$6,675,000**
B	**STRUCTURES**		
B.1	Interchange structure		$28,200,000
		SUB TOTAL	**$28,200,000**
C	**QE II HIGHWAY REALIGNMENT**		
C.1	Realignment of the QE II Corridor (Core-Collector System)		$18,050,000
		SUB TOTAL	**$18,050,000**
D	**PERIMETER ROAD**		
D.1	Perimeter Road between West Terminal and Discovery Way Intersection		$2,765,000
		SUB TOTAL	**$2,765,000**
E	**65TH AVENUE**		
E.1	Extension of the 65th Avenue Corridor to the East		$6,850,000
		SUB TOTAL	**$6,850,000**
F	**RAMPS**		
F.1	NB On-Ramp at 50th Street		$1,400,000
F.2	New NB On-Loop at 65th Avenue		$2,965,000
F.3	New SB Off-Ramp at 65th Avenue West		$3,635,000
F.4	New SB On-Ramp at 65th Avenue West		$1,260,000
F.5	New NB Off-Ramp at 65th Avenue East		$985,000
		SUB TOTAL	**$10,245,000**
G	**DISCOVERY WAY INTERSECTION UPGRADE**		
G.1	Widening to 6 lanes of the 65th Avenue Corridor through the Intersection		$190,000
		SUB TOTAL	**$190,000**
	TOTAL CONSTRUCTION SUBTOTAL		**$72,975,000**
	MOBILIZATION 5%		$3,648,750
	ENGINEERING AND CONTIGENCY 20%		$14,595,000
	TOTAL ROUNDED CONSTRUCTION COST		**$91,220,000**

9.5 Replacement of existing 50th Street Bridge - *Estimated Cost: $12.4M-to-$16.5M*

The functional plan provides for the existing 50th Street Fly-over bridge to be replaced at the time when the QE II corridor realignment is required (20 years) or when the bridge reaches the end of its structural life (25-to-30 years), which ever occurs first.

- Table 9-4 estimates the costs associated with replacing the existing 50th Street Bridge with a single-lane structure that would offer 9.3m of clear roadway width, 3 spans (50.0-65.0-68.0 m) and a total length of 183m to be $12.4M.
- Table 9-5 outlines the costs associated with replacing the existing 50th Street bridge with a new NB 2-lane structure (12.9m width) to be $16.5M

Table 9 - 4: Cost Estimate for Replacing the 50th Street Bridge: Single-lane Bridge

COST ESTIMATE FOR REPLACING 50TH ST. BRIDGE (1 lane)
Queen Elizabeth II and 65th Avenue (Leduc) Functional Planning Study

ITEM	ITEM	TOTAL
A	**STRUCTURES**	
A.1	New Single Lane NB 50th Street Bridge	$9,135,000
	SUB TOTAL	**$9,135,000**
B	**ROADWORK**	
B.1	New Approaches to NB 50th St. Bridge	$750,000
	SUB TOTAL	**$750,000**
	TOTAL CONSTRUCTION SUBTOTAL	**$9,885,000**
	MOBILIZATION 5%	$494,250
	ENGINEERING AND CONTIGENCY 20%	$1,977,000
	TOTAL ROUNDED CONSTRUCTION COST	**$12,360,000**

Table 9 - 5: Cost Estimate for Replacing the 50th Street Bridge: Two-Lane Bridge

COST ESTIMATE FOR REPLACING 50TH ST. BRIDGE (2 lanes)
Queen Elizabeth II and 65th Avenue (Leduc) Functional Planning Study

ITEM	ITEM	TOTAL
A	**STRUCTURES**	
A.1	New 2-Lane NB 50th Street Bridge	$12,310,000
	SUB TOTAL	**$12,310,000**
B	**ROADWORK**	
B.1	New Approaches to NB 50th St. Bridge	$850,000
	SUB TOTAL	**$850,000**
	TOTAL CONSTRUCTION SUBTOTAL	**$13,160,000**
	MOBILIZATION 5%	$658,000
	ENGINEERING AND CONTIGENCY 20%	$2,632,000
	TOTAL ROUNDED CONSTRUCTION COST	**$16,450,000**

10.0 SUMMARY OF PUBLIC AND STAKEHOLDER INVOLVEMENT

10.1 Public Involvement

The following provides a synopsis of each of the public involvement activities undertaken as part of this functional planning study[1]. The Public Involvement process followed Provincial standards as outlined in Alberta Transportation's guidelines[2]. The public involvement process consisted of the following events held within the City of Leduc:

- three focus group meetings where property/business owners and effected residents were invited to attend. The focus groups were held in the Leduc Public Library [2 Alexandra Park, Leduc, Alberta, T9E 4C4]
  - Focus Groups No. 1, January 13th, 2015, from 10:00 a.m. to 12:00 a.m.;
  - Focus Groups No. 2, June 23rd, 2015, from 1:30 p.m. to 3:30; and
  - Focus Groups No. 3, September 15th 2015, from 3:00 p.m. to 5:00 p.m.

- two public open house events were organized, arranged and attended where the community at-large as well as stakeholders were invited to be a part of the functional planning process. The first public open house was held at the Leduc Recreation Centre (4330 Black Gold Drive, Leduc, Alberta, T9E 3C3] and the second at the Leduc Civic Centre [2 Alexandra Park, Leduc, Alberta, T9E 4C4]
  - Public Open House No. 1, January 13th, 2015, from 5:00 p.m. to 8:00 p.m.; and
  - Public Open House No. 2, September 16th 2015, from 4:00 p.m. to 7:00 p.m.

Land ownership information was obtained from contact information provided by the City of Leduc. Residents of the City were also informed of meetings through the media (advertisement in the Leduc Rep) as well as initiatives undertaken by the City staff (variable message signs, website advertising, etc.). In addition to property owners, the following organizations were contacted to obtain additional input regarding the proposed functional plans.

- City of Leduc Emergency Services (i.e. fire, ambulance);
- Leduc Hospital;
- Alberta Health Services (Leduc Public Health);
- RCMP Leduc Detachment; and
- Various developers.

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[1] Further information can be found in a separate document entitled "*Queen Elizabeth II and 65th Avenue Interchange (Leduc) Functional Planning Study Public Involvement Program*". The document provides a detailed account of the public consultation activities and includes all feedback provided by the public regarding the functional planning study. Alberta's Freedom of Information and Protection of Public Privacy (FOIPP) legislation restricts access to personal information contained within the document.

[2] Appendix "D" of "*Alberta Transportation's (AT) Engineering Consultant Guidelines for Highway and Bridge Projects*" (November 2011)

In addition, Leduc Council was invited to attend both focus groups and public open house events.

The Public Open Houses were intended to provide a venue that would inform the public-at-large about the functional planning study in an open format that included presentations that first addressed the study area constraints/existing conditions and evaluated options and alternatives. The second open house was used to present the consultant's preferred solution and obtain additional feedback needed to refine the solution. The public was informed about the Open Houses by way of advertisements placed in the Leduc Rep newspaper two weeks prior to each open house. In addition, individual letters of invitation addressed to individual property owners and anyone who provided an address or attended a previous event were mailed two-to-three weeks prior to each event.

The Focus Group meetings were held with landowners/property/business owners and effected residents located within the vicinity of the future 65th Avenue interchange and agencies/businesses that were identified as having an interest in the study. The meetings provided an opportunity to convene with individuals directly impacted by the proposed improvements and obtain feedback on specific project issues, constraints, as well as present alternative solutions and possible refinements.

10.1.1. January 2015: Focus Group Meeting No. 1 and Public Open House No. 1

Focus Group Meeting No. 1 and Public Open House No. 1 provided the opportunity to present the study objectives, existing conditions and conceptual interim and ultimate options. Approximately 30 individuals attended the first public open house and 10 individuals attended the first Focus Group meeting.

Some of the issues and concerns identified at the meetings included:

- the anticipated timing of the implementation/location of the future interim and ultimate plans;
- the access provided by the new infrastructure;
- emergency vehicle routing;
- impacts associated with the proposed new EIA commercial development;
- impacts to the City of Leduc Chamber Building/Information Centre; and
- the effect that the new infrastructure would have on Municipal truck routes.

A single (1) comment sheet was received during the weeks following the January 13th, 2015 meetings.

10.1.2. June 2015: Focus Group Meeting No. 2

Focus Group Meeting No. 2 provided the opportunity to present the consultant's preferred alignment for the interim and ultimate stages. Approximately 22 individuals attended this Focus Group meeting.

Some of the issues and concerns identified at the meeting included:

- the main differences between the presented options;
- the efficacy of roundabouts in reducing traffic congestion; and
- the impact of the proposed future Hwy 39 (which currently transitions onto 50th Avenue) realignment upon the 65th Avenue West corridor.

A total of seven (7) comment sheets were received during the weeks following the June 23rd meeting.

10.1.3. September 2015: Focus Group Meeting No. 3 and Public Open House No. 2

Focus Group Meeting No. 3 and Public Open House No. 2 provided the opportunity to present the consultant's preferred solution. Approximately 29 individuals attended the third public open house while approximately 18 individuals attended the focus group meeting.

Some of the issues and concerns identified at the meetings included:

- the study and construction timelines;
- traffic and congestion constraints;
- heavy vehicle turning movement requirements to accommodate double-trailer trucks (WB-36);
- construction costs and the obligation to the municipality; and
- the consultant's recommended solution.

A total of two (2) comment sheets were received during the weeks following the September 15th and 16th meetings. In general, attendees voiced support of the consultant's preferred solution.

10.2 Leduc Council Presentation and Endorsement

A Council Brief [See Appendix "E-1", page E -262-thru-E-276] was provided to the City Councillors at their December 8th, 2015 Leduc Regular City Council Meeting. A formal presentation [See Appendix "E-1", page E -284-thru-E-299] concerning this functional planning study was provided to Council. The presentation gave Council the opportunity to review the results and the

conclusions of the Queen Elizabeth II and 65th Avenue (Leduc) Functional Planning Study. A motion was carried unanimously to endorse the results and conclusions of the study. [See Appendix "E-1", page E -280]

10.3 NAV Canada

NAV Canada was formally approached on September 18th, 2015 through their "Land Use Program" submission process. The application concentrated on the preferred "ultimate" configuration of the proposed 65th Avenue interchange as illustrated in Annex "A".

The interim stage involving the Twinned 50th Street bridges was found to fall well outside of the outer edge of the take-off-and-approach slope and was determined not to be critical in terms of interference with the runway 12-30 OLS.

The official response from NAV Canada (received on December 8th, 2015) as regards the 65th Avenue interchange design indicated no objections to the proposed new 65th Avenue interchange as illustrated on the provided plans. NAV Canada's response letter is included in Appendix "E-5" and outlines that:

- *"Once additional details of the project are known, the proponent (Castleglenn Consultants Inc) must submit more detailed plans for a final assessment, which should include elevation and grading changes for the proposed airport Perimeter Road"*.
- NAV Canada's evaluation is valid for a period of 12 months (ending Dec. 8th 2016) and does not preclude the necessity for approvals from agencies such as Transport Canada and Industry Canada.
- The "additional details of the project" described within NAV Canada's response refer to the detailed design stage of the project, therefore a note has been included within Appendix C-3 (item l).

10.4 Edmonton International Airport (EIA)

Representatives of the Edmonton International Airport (EIA) were active stakeholders throughout the entire functional planning process being involved in all Technical Review Committee (TRC) meetings as well as being informed of functional planning as concepts developed and design conclusions as they were determined.

Appendix "E-2" provides relevant correspondence in regard to land use assumptions, the EIA's Master Plan, the applicability of clearance envelopes / obstacle surfaces and formal submissions to NAV Canada.

11.0 ANCILLARY ISSUES

11.1 Viability of an Interim (Temporary) Staged QE II Realignment

From the outset of this functional planning study it was recognized that the ultimate location of the future QE II / 65th Avenue Interchange should best consider the most desirable plan and profile for the QE II corridor. The following sections serve to document:

- the considerations associated with previous functional planning initiatives;
- what a staged QE II realignment must achieve;
- considerations adopted within this functional planning initiative;
- the costs of an interim QE II realignment strategy; and
- the requirements for the 50th Avenue interchange replacement.

Consideration of all of the above served to develop a conclusion that a temporary re-alignment of the QE II lanes to accommodate the existing 50th Street fly-over structure and the proposed 65th Avenue Interchange structure is not preferable course of action, but rather, a much simpler solution would have AT replace the existing 50th Street Fly-over with a new structure some time after the Twinned 50th Street bridge and the 65th Avenue Interchange is developed (after 2035) but before the 50th Avenue Interchange is considered. This would avoid significant reconstruction and staging costs.

11.1.1 Consideration in Previous FP Initiatives

The previous functional planning study considered an "ultimate" time frame that envisioned the most desirable plan (*"The QE II Highway alignment through the interchange runs along a radius of 2580 meters with a super-elevation of 3.2%."*)[1] and profile (*"The QE II Highway profile through the interchange is designed at an elevation lower than the existing grade of the QE II highway while maintaining positive drainage away from the highway."*)[2] for the QE II alignment. This plan positioned the crest of the 65th Avenue interchange approximately 310 meters[3] west of the 50th Street/65th Avenue intersection. However, achieving this ultimate alignment assumed that:

- the 50th Street Fly-Over structure would be have to be replaced with a 2-lane bridge; and
- the 50th Avenue interchange would have to be replaced and constructed as a new interchange where 50th Avenue would traverse over the QE II lanes.

Yet, from a cost and magnitude of construction perspective, AT recognized that it would be most beneficial to consider a staged approach to the QE II realignment that would assure:

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1 "*Queen Elizabeth II Highway: Ellerslie Road to South Leduc Functional Planning Study*" (Focus Group) Pg. 5-8
2 ibid, Pg. 5-8
3 ibid, as measured from Plan P-3376-044

- that the 65th Avenue Interchange would be developed in its ultimate position;
- that the existing 50th Street Fly-over could remain in place; and
- that the existing 50th Avenue interchange could also remain in place;

but would also permit modifications at a later stage that would still assure:

- that, if necessary, a replacement 50th Street bridge could be developed;
- that the new 50th Avenue interchange could be developed; and
- the ultimate core lanes could be developed.

The previous functional planning study considered a staging strategy and suggested four possible initial stages[4] involving the 50th Street Fly-over that envisioned:

1. *Rehabilitation and Retain the Existing 50th Street Bridge*. This involved building a staged QE II realignment involving a reverse curve of the SB collector lanes of 1700m leading to the 2,580m curve under the 65th Avenue interchange. The staged realignment would be "entirely throwaway"[5].

The remaining three staging alternatives considered would required all 50th Street Fly-over traffic to be diverted to the new 65th Avenue interchange. This would require a short-term construction stage that would see development of a construction-stage SB QE II alignment (3-lanes) (R750) and construction-stage SB Off-Ramp onto the new 65th Avenue interchange prior to removal of the existing fly-over. This would all be considered "throw-away". This is needed to provide access to Leduc in place of the removed fly-over. The ultimate QE II SB alignment (R2580) and SB Off-Ramp to 65th Avenue would be required to be constructed while the short-term detour (R750) is in place. The three remaining options included:

2. *Removal of the Existing 50th Street Fly-Over*; This option contemplates the development of the 65th Avenue Interchange and removal of the 50th Street Flyover. A new 50th Street Bridge could be initiated well after the development of the 65th Avenue interchange.
3. *Removal of the Existing 50th Street Fly-Over and Replacement with a new Two-lane Fly-Over*; This option envisions the replacement 2-lane fly-over bridge taking place in the immediate time frame after the development of the 65th Avenue interchange.
4. *Rehabilitation and Retaining the Existing 50th Street Fly-Over with Construction of a New Two-Lane Span Immediately to the West of the Existing Bridge.* The new two lane span is envisioned to be compatible with a future 2-lane Fly-over.

The previous FP study did not recommend or designate as desired any interim option to address the QE II staged realignment.

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4 ibid, Pg 5-9 and Appendix "A", QE II Interchange Layout Review, Drawing P-1245-thru-P-1248

5 ibid, Appendix "A", QE II Interchange Layout Review, Notes preceding options assessment.

It should be noted that all of the above options did not consider:

- an interim stage involving a twinned 50th Street bridge solution which would effect the ultimate alignment of the QE II corridor; and

and the following factors which would effect the 65th Avenue interchange placement:

- the EIA's requirement to extend Perimeter Road south to 65th Avenue W;
- the need to accommodate a future transit corridor to the south; and
- the desire to achieve improved drainage on the realigned QE II corridor which would involve adopting a higher vertical profile for the QE II, which in-turn would require a higher vertical profile for the 65th Avenue Bridge, which in-turn would be required to meet NAVCan's clearance requirements for Runway 12-30.

All of the above factors impact not only an interim stage of the QE II realignment but also the ultimate stage alignment requirements as well.

11.1.2 What a Staged QE II Realignment Must Achieve

A temporary or staged realignment of the QE II lanes was considered. Such a solution would be required to:

- not result in any change to the "existing" single lane SB 50th Street fly-over bridge and delay the need for this bridge replacement until such time as it is required for capacity or structural purposes to be replaced;
- accommodate a twinned 50th Street bridge solution as identified in the Value Planning exercise conducted on Feb. 3rd & 4th, 2015;
- desirably accommodate the ultimate core-collector arrangement extending to the 65th Avenue interchange without modification to the existing 50th Street single lane bridge;
- accommodate the new 65th Avenue interchange in its ultimate location; and
- transition onto the "existing" QE II corridor north of the 50th Avenue interchange with minor modifications to the transition points.

11.1.3 Considerations Adopted within this Functional Planning Initiative

The location of the new ultimate 65th Avenue Interchange would be affected by the desirability to maintain the existing 50th SB Street Flyover bridge (albeit reversed in direction), along with a new 2-lane twinned 50th Street bridge structure located immediately to the south as envisioned in the Value Planning exercise conducted on Feb. 3rd & 4th, 2015.

Technical Memorandum No. 1 (See Appendix C-5) identified the pier placement and bridge span requirements necessary to assure the QE II realignment could be designed to accommodate a Twinned 50th Street bridge arrangement. It was determined that an R1500 curve under the Twinned 50th Street bridges transitioning onto a 750m tangent followed by

an R2000 curve under the future 50th Avenue interchange would represent the optimum QE II alignment at the "ultimate" stage. This horizontal alignment differs significantly from the R2580 alignment proposed by within the previous FP initiative, but also takes into account:

- an interim stage involving a twinned 50th Street bridge solution;
- the EIA's requirement to extend Perimeter Road south to 65th Avenue W;
- potential accommodation of a future transit corridor to the south of 65th Avenue; and
- improved drainage along the realigned QE II corridor (by approximately 3m) which in-turn required a higher vertical profile for the 65th Avenue Bridge, and required NAVCan's clearance requirements for Runway 12-30 to be satisfied.

This functional planning study also considered the benefits associated with developing a temporary or staged realignment of the QE II that would provide for:

- the construction of the 65th Avenue Interchange;
- the twining of the 50th Street bridges;
- a realignment of the QE II corridor; and
- a transition onto the existing QE II corridor immediately to the north of the 50th Avenue interchange.

This solution would:

- delay the cost of improvements to the 50th Avenue corridor and interchange estimated in to cost in the tens of millions;
- would represent a logical construction stage in that traffic would be able to divert to the new 65th Avenue interchange during 50th Avenue reconstruction.
- delay the need to extend the QE II realignment south of 65th Avenue and north of 50th Avenue.
- avoid the need to complete the entire QE II corridor realignment in a single phase inclusive of the 50th Avenue interchange.

The development of the 65th Avenue Interchange (estimated to be necessary by the 2035 Horizon Year) would trigger traffic diversions from both the 50th Avenue interchange and the 50th Street Twinned bridges. The 65th Avenue Interchange would delay the need for:

- additional infrastructure investment in the 50th Street Twinned Bridge solution (i.e the need to twin the NB 50th Street bridge) and expand the intersections on either side of the twinned bridges;
- provide another route for Leduc residents to use other than 50th Avenue Interchange to access the QE II corridor. (i.e traffic using the 50th Avenue Interchange would have an additional corridor to divert to during construction / improvements to the 50th Avenue interchange); and
- diminish the demand serve to delay the need for the 50th Avenue interchange improvements.

Exhibits 11-1 and 11-2 illustrate a temporary QE II realignment concept that achieves all of the above objectives inclusive of retaining the existing 50th Street Fly-Over bridge.

- The "grey" highlighted segments represent the first stage of the temporary QE II realignment inclusive of the new 65th Avenue interchange which depicts the QE II transitioning onto the existing QE II lanes north of the 50th Avenue interchange; and
- The "yellow" highlighted segments represent the latter stage where the ultimate QE II realignment is envisioned which transitions onto the new 50th Avenue interchange and QE II corridor alignment.

The exhibits depict a situation where the existing 50th Street Fly-over is maintained. The "grey" first stage QE II realignment serves to delay to the maximum extent the need to replace the existing 50th Street Fly-Over. A review of the staged concept indicates that the transition from "grey"-"interim"-to-"yellow"-"ultimate" will require significant construction staging and traffic management efforts necessary to avoid replacing the 50th Street Fly-over bridge.

11.1.4 The Costs of an Interim QE II Realignment Stage

- The construction costs associated with completing the "yellow" ultimate corridor along the QE II was determined to be $32.8M.
- The construction cost of first developing the "grey" interim alignment and then transitioning to the "yellow" ultimate alignment was determined to be $45.9M excluding required additional traffic management and detour costs. Traffic management over these two construction stages (going from "grey" to "yellow") would be very difficult to accommodate without major disruptions to traffic; and
- The effective cost of staging in as depicted in Exhibits 11-1 and 11-2 was determined to be in excess of $13.1M (See Appendix D-3).

The cost of adopting a strategy that would include an Interim QE II realignment to maximize the structural life of the existing 50th Street Fly-over bridge was determined to be $13.1M. If the QE II realignment can be delayed until after the 50th Street Fly-over bridge is replaced, there would be no need to consider an Interim QE II realignment and incur the $13.1M of additional costs.

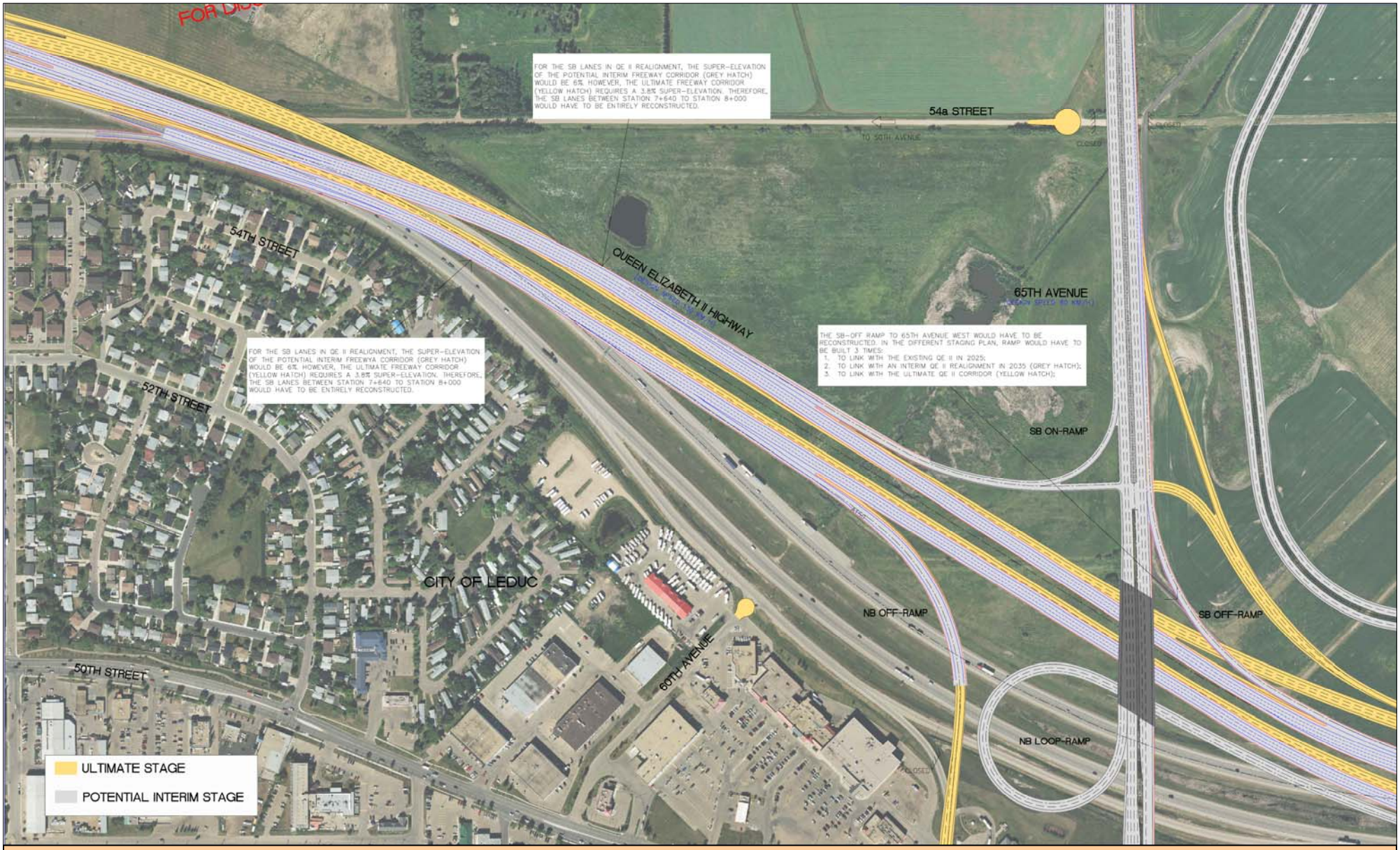

Exhibit 11- 1: Impact of Temporary QE II Corridor Realignment: South of 65th Avenue Interchange

Exhibit 11- 2: Impact of Temporary QE II Corridor Realignment: North of 65th Avenue Interchange

11.1.5 The Requirements for the 50th Avenue Interchange Replacement

It is worthwhile to emphasize that:

- Staging the QE II corridor (as exhibited in 11-1 and 11-2 which connects to an existing 50th Avenue interchange and preserves the 50th Street Flyover) makes little sense as the 50th Avenue ramp terminals are failing today;
- the 2 lane QE II configuration (in each direction) over 50th Avenue will be exceeded and require additional capacity long before the 20-year horizon;
- the timing between the "grey" and "yellow" stages was identified in terms of traffic demand as being quite short i.e. 7-to-10 years;
- The staged realignment could result in merge-diverge-weave concerns during the interim along the QE II corridor depending on demand.

Given the above there are numerous benefits associated with constructing the new 50th Avenue interchange at roughly the same time, or shortly after, the 65th Avenue interchange. The benefits are:

- much higher flexibility in terms of a traffic accommodation strategy;
- shorter disruption to the traffic and congestion problems, as the two interchanges would be addressed at more or less the same time;
- less throw away costs; and
- an opportunity to introduce the Core Lanes if and when warranted.

Conclusion:

Exhibits 11-1 and 11-2 depict a situation where the existing 50th Street Fly-over is maintained.

This study concludes that a temporary re-alignment of the QE II lanes to accommodate both the existing 50th Street fly-over structure and the proposed 65th Avenue Interchange structure (estimated to be necessary by 2035) is not preferable. This reconstruction and staging costs associated with this alternative were estimated at $13.1M excluding the costs related to complex traffic management and necessary detours.

Exhibit 11-3 illustrates a much simpler solution where AT would replace the existing 50th Street Fly-over with a new structure when the Twinned 50th Street bridge and the 65th Avenue Interchange is developed (2035) and before the 50th Avenue Interchange is considered. In this case the ultimate alignment can be constructed to a point south of the 65th Avenue interchange and only a transition from south of 65th to the existing QE II corridor north of 50th Avenue would be required.

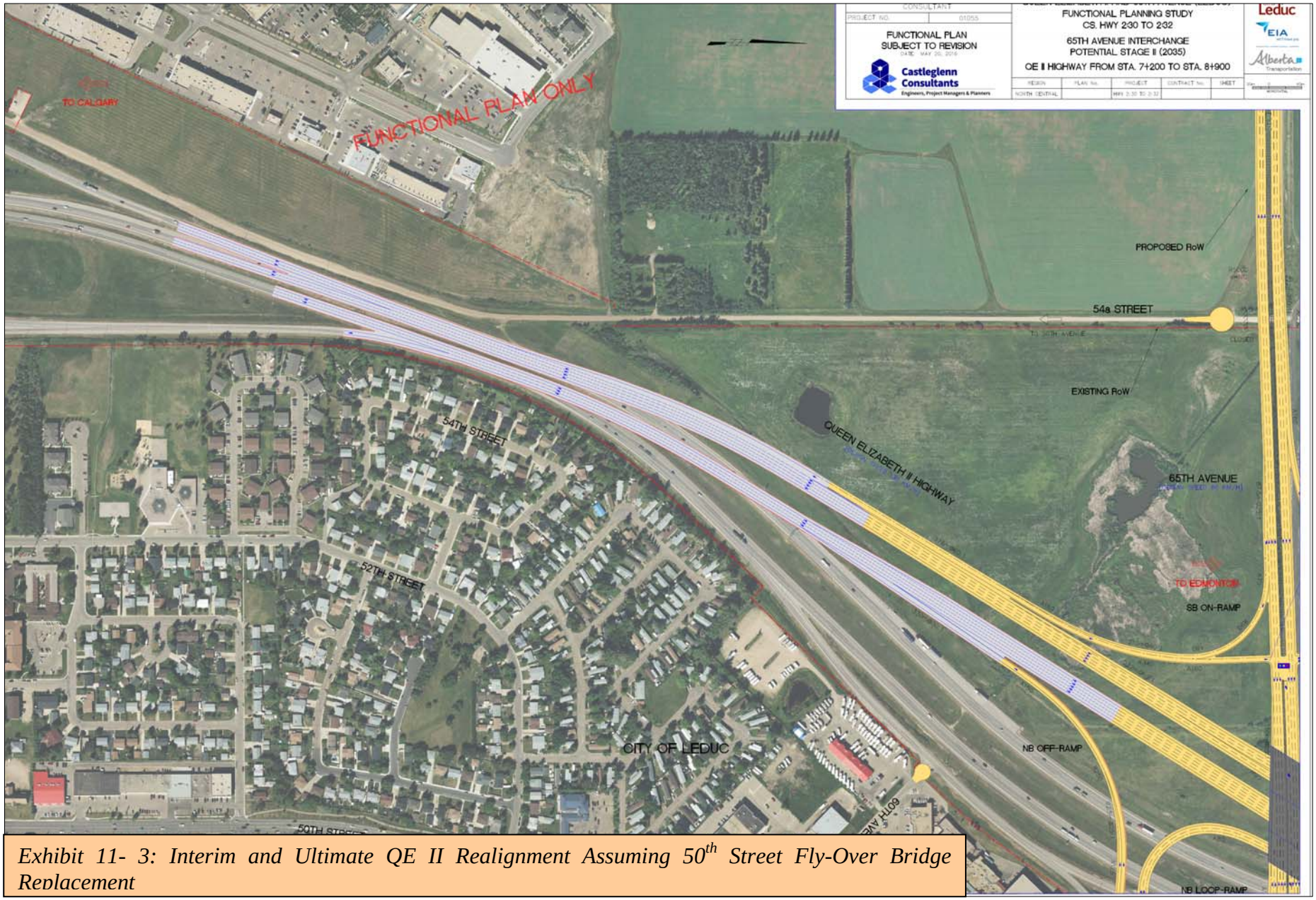

Exhibit 11- 3: Interim and Ultimate QE II Realignment Assuming 50th Street Fly-Over Bridge Replacement

11.2 Closure of the South Leg 65th Avenue East & Sparrow Drive Intersection

The 4-leg 65th Avenue/ Sparrow Drive intersection:

- is located roughly 110m east of the "T" configured 65th Avenue/50th Street intersection;
- is located approximately 110m west of the CP Rail corridor crossing where the 65th Avenue crossing is controlled by gates and signals;
- is currently traffic signal controlled;
- is characterized with a south leg that serves the L.A. Mazda Dealership. The roadway connects back to the 50th Street corridor opposite the QE II 50th Street Off-Ramp.
- is characterized by a separation distance of 80m between the EB STOP bar and the WB STOP bar of the 65th Avenue/50th Street intersection.

The plans illustrated in Annex "A" indicate that:

- with the interim development of the 50th Street Twinned Bridge solution, the section of 65th Avenue between Sparrow Drive and 50th Street is to be widened to accommodate a 6-lane cross-section; and
- with the ultimate development of the 65th Avenue Interchange, the 65th Avenue / 50th Street intersection is to convert to a 4-leg intersection, provide a direct connection linking 65th Avenue East and West and provide for the 6-lane widening of 65th Avenue corridor to continue eastward across the CP Rail corridor.[6]

Design Assessment

Current Transportation Association of Canada (TAC) standards indicate that:

- "*the minimum* intersection *spacing along arterial streets is 200m, only applicable in areas of intense existing development or restrictive physical controls where feasible alternatives do not exist.*" and
- "*200m spacing allows for the minimum length of back-to-back storage for left turning vehicles at adjacent intersections.*"[7]

Clearly, the separation distance between the two intersection falls short of the minimum standards.

Traffic Operations Assessment

E-mail correspondence[8] indicated the need to consider traffic management measures to address the potential impacts to the 65th Avenue/Sparrow Drive intersection in light of the

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6 The City of Leduc has, as part of its 2016 Master Transportation Plan Initiative has requested that functional plans be prepared that address the widening of 65th Avenue East from 50th Street through to Range Road 250, a distance of 2.3km.

7 "*Urban Supplement to the Geometric Design Guide for Canadian Roads*", Transportation Association of Canada, April 1995,. Page U.D.-13

8 From Castleglenn Consultants (E. Soardi) to City of Leduc: (R. Graham) - June 16th , 2015

twinned 50th Street bridges (interim) conversion and the (ultimate) 65th Avenue/50th Street intersection conversion to 4-leg traffic signal control connecting to a new 65th Avenue interchange.

As regards 2025 (interim) travel demands at the 65th Avenue/Sparrow Drive intersection:

- forecast afternoon peak hour traffic volumes indicated that the storage length requirements for the double WB-LT lanes needed to accommodate 930 veh/h would be approximately 100m for each of the two lanes.
- forecast morning peak hour traffic volumes indicated that the storage length requirements for the single EB-LT lane needed to accommodate a 480 veh/h turning volume would be approximately 25m.

Clearly, the available 80m separation between the two traffic signal controlled intersections renders a back-to-back left turn arrangement (WB-LT and EB-LT) infeasible.

Appendix B6.1 (Pg B6.1-7) indicates that if the 65th Avenue East / Sparrow Drive intersection continues to be configured as a full movement intersection. The following operating trends result from applying the 2025 Horizon Year traffic forecast:

- A full movement 65th Avenue / Sparrow Drive intersection must accommodate a total of 12 turning movements;
- During the morning peak hour, the shared EB-LT/Th/RT movement (1,428 veh/h) was found to operate near capacity with a v/c of 0.96; and the shared SB-Th/LT movement (130 veh/h) was found to exhibit failure levels-of-service "F"; and
- During the afternoon peak hour, the shared EB-LT-Th/RT movement (903 veh/h) was found to operate with a de-facto turning lane and a corresponding high v/c of 1.36.

The above points indicate that the inner shared EB-LT/Th lane operates as a dedicated EB-LT lane. This results in a throttling of the EB-Th movement.

All of the above, in concert with the requirements to accommodate the CP Rail train crossings (See Section 11.10) necessitates that the traffic signals from the west side of the QE II through to 45th Street along 65th Avenue be connected with the ability to communicate with one another so as to provide coordinated traffic signal phasing and timing. Providing this coordination is made all the more challenging when the physical separation between adjacent traffic signals is limited.

Required "Interim" Improvements

Exhibit 11-4 illustrates that the following improvements to the 65th Avenue East / Sparrow Drive intersection that was determined to be necessary to accommodate the interim 10-year (2025) travel demand forecasts:

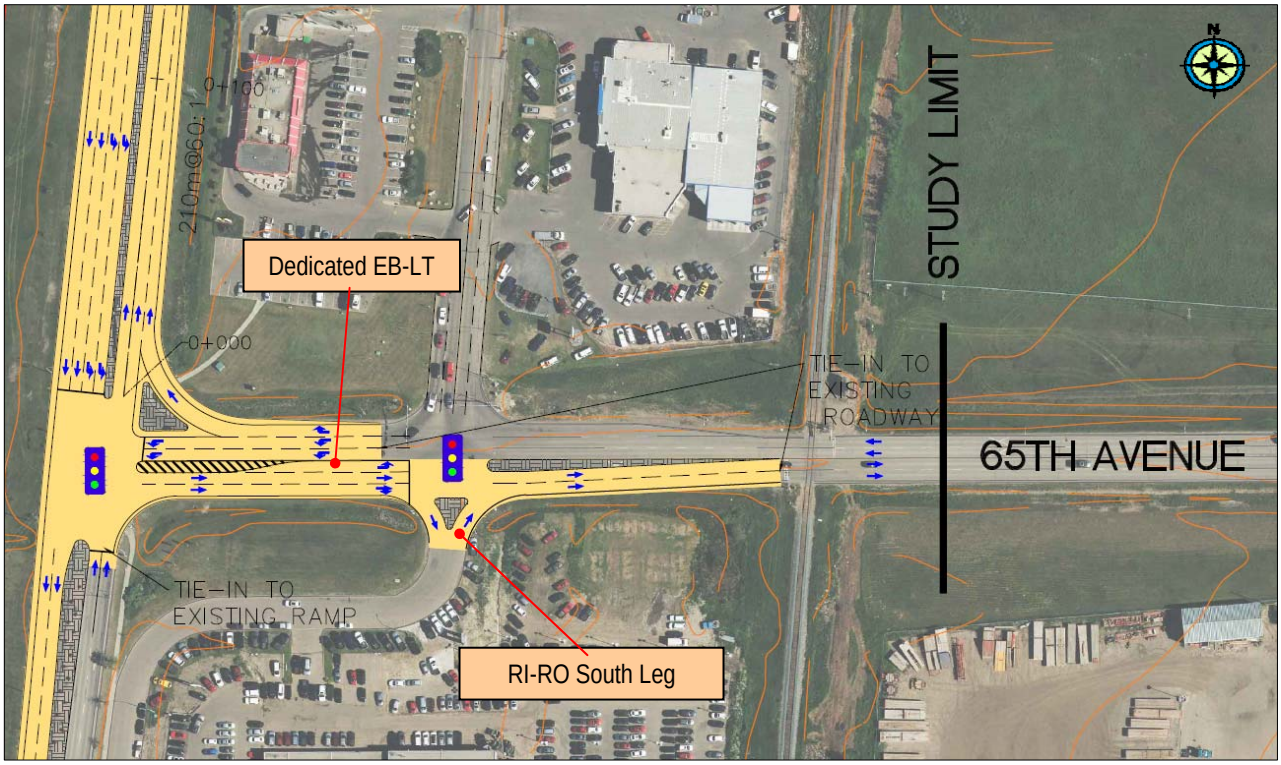

Exhibit 11- 4: 65th Avenue East / Sparrow Drive Intersection

The improvements include:

- *The conversion of the south leg to a right-in-right-out configuration to remove "conflicting" NB-Th movement which hinders operations of the EB-LT and SB-LT movement, and.*
- *The addition of a dedicated EB-LT turning lane.*

The interim RI-RO configuration would only require that 8 turning movements be accommodated by the traffic signal strategy as opposed to the 12 movements associated with a full-movement intersection..

The traffic operations analysis of 2035 (ultimate) travel demands at the time the 65th Avenue interchange and 6-lane widening was undertaken and it was determined that:

- the impact of continuing to permit the "interim" RI-RO solution at the 65th Avenue / Sparrow Drive South leg would result in additional turbulence effecting the outside lanes furthest away from the median;
- The SB-LT traffic that originates from the 50th Street flyover that wishes to access the RI at the Sparrow Drive South Leg will conflict with the NB-RT traffic volumes wishing to make the EB-LT onto Sparrow Drive N.; and
- A weaving situation would be created in the EB lanes furthest away from the median.
- when the "ultimate" 65th Avenue interchange is in place, the "turbulence" effect and storage requirements are likely worsen over time further deteriorating the EB traffic flow.

The above reasons substantiated the complete "closure" of the south leg of the 65th Avenue/ Sparrow Drive intersection at the time of the 65th Avenue interchange being developed. Removing the south leg of the intersection in its entirety by way of a cul-de-sac would require that only 6 turning movements be accommodated at the intersection simplifying traffic operations and offer the greatest flexibility to synchronize with the 65th Avenue/50th Street intersection traffic signal control.

Conclusion

Maintaining the 65th Avenue/Sparrow Drive 4-leg traffic signal controlled intersection configuration assuming the 6-lane widening and the proposed improvements was determined to:

- be inconsistent with current design standards;
- be unable to accommodate forecast travel demands;
- result in inefficient traffic signal progression;
- result in constrained E-W thru-traffic along the 65th Avenue corridor;
- result in a throttling effect impacting the lanes closest to the median;
- result in travel speed well below the design speed of the 6-lane arterial corridor; and
- result in a "choking point" effecting EB traffic flows between the two traffic signal controlled intersections.

Recognizing this, it is recommended that the south leg of the intersection be phased out progressing through permitted RI-RO operation at the interim stage and closure at the ultimate time frame.

11.3 Medevac Base at Edmonton International Airport

March 2013 saw the Edmonton International Airport (EIA) accommodate a new Alberta Health Service (AHS) Medevac base. The base:

- provides 3,600 square-metre patients facility (Patient transfers will be done inside);
- has available a dedicated ground ambulance fleet, based at the EIA, who could transport patients to and from hospitals;
- accommodates a six-bed patient transition area for stable patients where medical staff provide care to non-critical patients for short periods of time.
- promotes the development of compatible stretchers between ground ambulances, fixed wing air ambulances and helicopters, so a patient never has to be unbundled from their stretcher to be transferred;
- ensures a place where flights from northern Alberta could land during regular service and emergency; and
- ensures timely, high-quality care to northern patients in a medical emergency.

Exhibit 11-5 illustrates the approximate flying coverage range for helicopter emergency services when dispatched from new EIA base needed to service Alberta's rural communities and remote areas. Air travel time depends by the coordination between ground and air ambulance and the effectiveness of assuring linkages that provide optional routes.

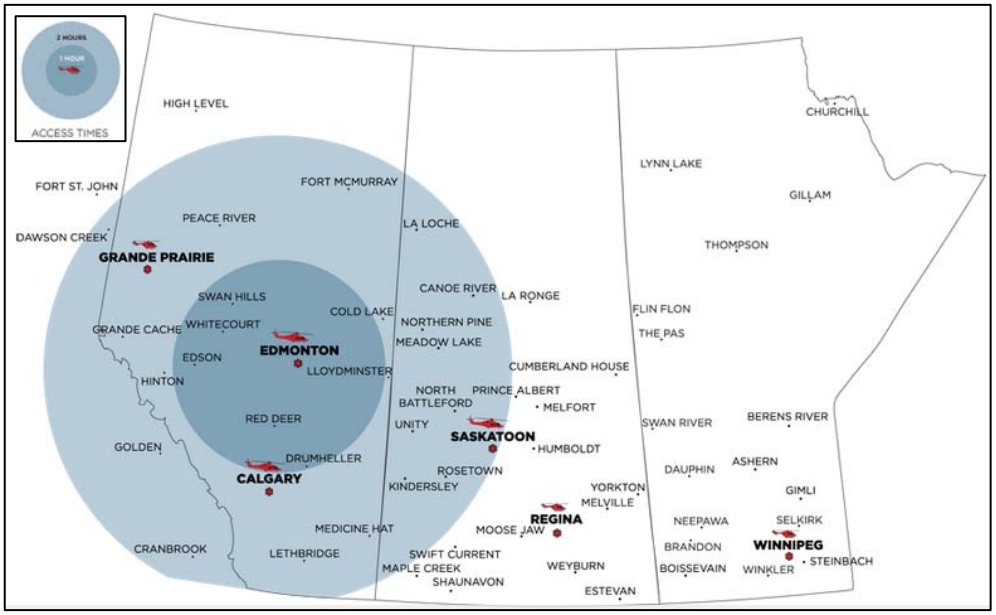

Exhibit 11- 5: Helicopter Fly-Time within Two Hours from Medevac Base at EIA

The advent of a Twinned 50th Street bridge solution will ensure an alternative "emergency access route" serving both the EIA and Leduc's medical services enhancing accessibility and security response times.

11.4 NAV Canada & Transport Canada Requirements

The proximity of the EIA's Runway 12-30 which is aligned SE and NW [3,109 m (10,200 ft) long and 61m (200 ft wide)] restricts the height and the placement of the 65th Avenue interchange given the permitted clearance envelope and distance between the runway threshold and the future interchange. This also applies to the Perimeter Road alignment located to the west of the new interchange and a future transit corridor that may be extended southward. Section 4.1.1 highlights the design implications associated with assuring compliance with Transport Canada's requirements.

- The interim stage involving the Twinned 50th Street bridges was found to fall well outside of, and pose no interference with, the outer edge of the runway 12-30 OLS (take-off-and-approach slope).
- The official response from NAV Canada (received on December 8th, 2015) as regards the 65th Avenue interchange design indicated no objections to the proposed new 65th Avenue

interchange as illustrated on the provided plans. (See Section 10.3 and Appendix E-5 for NAV Canada response.)

11.5 Core-Collector System Lane Requirements

A consensus at the Value Planning Session held on Feb. 2015 was used to determine if the core-collector system should terminate before 65th Avenue (as depicted in the Focus Group plan) or if it should be continued southward towards a new Hwy 2A interchange and potentially beyond. Whether future development is planned south of Leduc was identified as an item to be investigated.

The issue was raised for discussion at the VP session. It was identified by the VP team that the study should evaluate the need for the core-collector system to continue southward to the Hwy 2A interchange.

Subsequent to discussion with AT staff, it was determined that extending the core-collector system further south would give the false impression that significant capacity exists upstream along the QE II corridor beyond the planned ultimate QE II infrastructure. The QE II corridor will always have a constraint south of Ellerslie Road. Ending the core-collector system north of 65th Avenue would provide a natural throttle to northbound traffic and encourage the use of other north/south corridors that are to be developed sometime in the future. The existing right-of-way and costing of extending the core-collector system were also factors considered as part of the decision to commence the transition to a core-collector cross-section north of the future 65th Avenue Interchange.

11.6 What Happens if More EIA On-Site Development Occurs than Expected?

Appendix "B-7" serves to describe the results of a sensitivity analysis that was conducted to assess the impact of varying the traffic generation and distribution assumptions adopted within this functional planning study. The analysis varied the following assumption:

- *Port Alberta Lands (South-West EIA Development Area)*: The TIA assumed a total of 144 net acres of industrial development within the EIA SW lands by 2075. A sensitivity analysis was conducted that assumed a 220 acre or 10% development (89 hectares out of the total 890 total hectares in the SW) threshold by 2035 and a 50% threshold of 1,100 acres (445 hectares) by 2075.

The possibility of developing 10 times the growth anticipated by the EIA within the South-West Development Area, known as the Port Alberta lands by 2075, is remote. Despite this, sensitivity analysis indicated that:

- the additional 2035 traffic generated by a much more ambitious Port Alberta development within the EIA lands (220 acres by 2035) can be accommodated by the 65th Avenue Interchange;
- accommodating additional 2044 development (total 418 acres; an interpolated value) without the Terwillegar Drive South Extension in place was found to require consideration of the widening of the EB approach lanes to the 65th Avenue Bridge which can be accommodated by the functional plans should this level of growth be realized; and
- The combination of the 50th Street Twinned Bridges and the 65th Avenue Interchange with the Terwillegar Drive South Extension can accommodate the additional 2075 development of 1,100 acres.

11.7 When Sould the NB QE II Sparrow Crescent Off-Ramp be Closed?

The current QE II NB configuration accommodates two sequential NB Off-Ramps leading to Sparrow Crescent and the QE II Airport Road NB Off-Ramp.

The Sparrow Crescent Off-Ramp:

- provides convenient access to such developments as the Tim Horton's, various hotel/motels and other commercial land uses located along Sparrow Crescent and Sparrow Drive;
- is located approximately 450m south of the QE II Airport Road NB Off-Ramp;
- represents a constraint and a source of motorist confusion to those unfamiliar with the study area who generally expect freeway off-ramps to lead to an interchange rather than a commercial development; and
- has directional signage located at the initial point where the ramp taper begins. Normally such signage would be positioned well in advance of the ramp.
- does not comply with the requirements of the Highway Development and Protection Regulation, Freeway Access Designations Order (O.C. 587/2009).

Exhibit 11- 6: Current QE II NB / Sparrow Cres. Off-Ramp Signage

The following factors were evaluated as concerns the Sparrow Crescent Off-Ramp:

- The requirement for, and the impacts associated with, the widening of the NB QE II collector lanes between 50th Street and Airport Road;
- The requirement for, and the impacts associated with, the widening of the Airport Road NB Off-Ramp;
- The impacts associated with the development of the QE II NB Core Lanes and transfer lanes from the QE II NB collector lanes; and
- Signage considerations.

A) Widening of the NB QE II between 50th Street and Airport Road

- By the end of the next decade (2025), the AM Peak hour volume on the QE II NB corridor between the 50th Street On-Ramp and the Airport Road Off-ramp was forecast to reach 6,140 veh/h. This exceeds the existing 3 lane (LOS "C) threshold capacity of 1,900 veh/h/ln or 5,700 veh/h of the NB QE II corridor. The recommended solution as indicated in Annex "A" was to create a continuous 4th NB weave lane between the 50th Street On-Ramp and the Airport Road NB Off-ramp.
- The proposed 4th NB weave lane would require the space/width that is currently occupied by the existing Sparrow Crescent NB Off-Ramp diverge taper and lane.
- If one wishes to maintain the Sparrow Crescent NB Off-Ramp, the diverge lane would have to be rebuilt on the eastern side of the new weave lane between the 50th Street NB On-Ramp and the Airport Road NB Off-Ramp. The approximate distance between the 50th Street NB On-Ramp and the Sparrow Crescent NB Off-Ramp would remain essentially unchanged at 630 meters (2,067 ft).
    - The current geometric design of a Sparrow Crescent NB Off-Ramp linked to a 4th QE II NB weave lane would require redesign and reconstruction to comply to current design standards. This would likely involve culvert replacement and improvements to horizontal curvature and taper.
    - The TRB's "*Guideline for Ramp and Interchange Spacing*" indicates that for more closely spaced entry and exit ramps, "the incremental safety benefits of ramp spacing values greater than 1,600 feet (488m) are relatively minor"[9].
    - However, as 50th Street traffic continues to grow over the next decade, a point will be reached where the Sparrow Crescent Off-Ramp would cause interference, turbulence and congested operations between the 50th Street On-Ramp and the Sparrow Crescent Off-Ramp.

B) Timing of the Widening of the Airport Road NB Off-Ramp Exit.

- By the end of the next decade (2025), assuming the Sparrow Crescent NB Off-Ramp is closed, the forecast traffic volume on the Airport Road NB Exit Ramp is forecast to reach 1,720 veh/h during the AM peak hour. This is very near the 1,900 veh/h/ln (LOS "C)

[9] Transportation Research Board "*NCHRP Report 687: Guideline for Ramp and Interchange Spacing"*. Page 83.

threshold capacity of a single lane ramp and widening of the Airport Road Off-ramp would be encouraged. Hence, maintaining the Sparrow Crescent NB Off-Ramp would offer the benefit of delaying the need to widen the Airport Road NB Exit Ramp to accommodate a two lane exit.

- Assuming the Sparrow Crescent Off-Ramp would remain open, it was estimated that it would take the next 3 decades (2044) for the traffic on the Airport Road Off-Ramp to warrant twinning without the closure.
- Assuming the Sparrow Crescent NB Off-Ramp is closed, the volume on the Airport Road Off-Ramp is forecast to be 2,388 by 2044 (which includes the 250-to-300 veh/h diversion from a closed Sparrow Crescent NB Off-Ramp) which would trigger the twinning of the NB Exit Ramp onto Airport Road.

C) Development of the QE II Core Lanes

- Section 3.4.3 of this report outlines the implementation of the QE II core lanes which envisions the development of the core lanes within the following two phases:
  - Phase I of the NB core lanes was envisioned as having a transfer lane developed starting at a point south of the Airport Road interchange in the vicinity of the existing Sparrow Crescent Off-Ramp (which is to be closed). (This is envisioned to be warranted in the near future.)
  - Phase II of the NB core lanes would see the extension of the NB core lanes to their ultimate south transition point in the vicinity of the new 65th Avenue Interchange. (This is estimated to be necessary within the next two decades (by the 2035 Horizon Year) needed to maintain LOS "C" operations.)
- With the advent of the new core lanes being characterized by a left hand exit from the NB collector lanes onto the core lanes (within Phase I) and assuming the Sparrow Crescent Off-Ramp to remain open, motorists would be faced with multiple decisions within the 1.9km distance between the 50th Street On-Ramp and the Airport Road bridge, These decision points include:

  (a) accessing the NB core lanes;

  (b) remaining on the NB collector lanes;

  (c) exiting the QE II NB to the Sparrow Crescent NB Off-Ramp; or

  (d) exiting the QE II NB to the Airport Road Off-Ramp.

  The Transportation Research Board's (TRB) places emphasises on signing considerations and indicates that guidelines within the U.S. Manual on Uniform Traffic Control Devices suggest a maximum limit of three exit ramps per mile[10] (or 3-exits-per-1.6km).

  Clearly, this number of decision points within the short 1.9 km distance could be overwhelming to some motorists.

[10] Transportation Research Board "*NCHRP Report 687: Guideline for Ramp and Interchange Spacing*". Page 90.

D) Signage Considerations

TAC's "*Geometric Design Guide for Canadian Roads*" indicates that successive ramp terminals on freeways/expressways should be spaced to permit drivers to make decisions within sufficient time to assure safe manoeuvres. In the case of successive exits, the separation distance between successive exits is based on the provision of adequate advance signage.[11]

Current design guides[12] indicate that advanced guide signs should be placed at a distance of 2.0 km from the exit gore, with a distance of 3.0 km for left exits. The current arrangement afforded for both the Airport and Sparrow Crescent ramps do not meet this criteria.

With the advent of the NB transfer lane onto the QE II core lanes being configured as a left exit, it is very likely that the diagrammatic signage currently in place would be required to be further expanded. The Manual of Uniform Traffic Control Devices (MUTCD) indicates that diagrammatic signs remain an effective tool needed to address unexpected or unusual manoeuvres such as a left exits, or left exit in combination with a right exit, or a major fork[13].

It is likely that accommodating advance signage provisions within the short 1.9km distance between the 50th Street On-Ramp and the Airport Road bridge necessary to accommodate up to 4 exit choices can not be achieved while still adhering to current design standards even if the Airport and Sparrow Crescent Ramps were combined in a double two-lane off-ramp serving both.

Conclusion

Within a decade, a 4th NB lane (weave lane) was found to be warranted between the 50th Street NB On-Ramp and the Airport Road NB Off-Ramp. Consequently, the Sparrow Crescent NB Off-Ramp will in any case, have to be removed/reconfigured/reconstructed to diverge off of this new weave lane.

<u>Without the QE II / Sparrow Drive Off-Ramp:</u>

- there would be one less access to have to accommodate, and hence less motorist confusion and reduced routing decisions required;
- the design of the placement of the collector-core transfer lanes would be easier to implement should a transfer lane be required in the vicinity of the Airport Road interchange;
- there would be additional room to implement signage / way-finding resulting in easier navigation and clarity of understanding for motorists unfamiliar with the area; and
- less turbulence would be anticipated between the 50th Street On-Ramp and the Sparrow Crescent off-ramp, the Airport Road Off-Ramp and the future QE II transfer lane from the collector to the core lanes.

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11 Transportation Association of Canada, "*Geometric Design Guide for Canadian Roads*". Page 2.4.6.14

12 Transportation Association of Canada. *"Manual of Uniform Traffic Control Devices for Canada" (MUTCD)*. Section A5.5.2.

13 Transportation Association of Canada. *"Manual of Uniform Traffic Control Devices for Canada"*. Section A5.5.6.

With the QE II / Sparrow Drive Off-Ramp:

If one wishes to maintain the Sparrow Crescent Off-ramp functionality, it would in any case require reconstruction to accommodate the new 4th QE II NB weave lane. The Sparrow Crescent NB Off-Ramp could be designed to diverge off of the new weave lane. However, with the new Sparrow Crescent Off-ramp in place:

- 3 sequential exits (Sparrow Cres., Core Transfer Lane and Airport Road) would have to be accommodated with the 1.9 km distance between the 50th Street On-Ramp and the Airport Road bridge;
- Additional signage will be necessary which may provide an "excess" of information to drivers unfamiliar with the area, which is characterized by greater frequency due to the proximity to the Edmonton International Airport; and
- the need to twin the Airport Road Off-Ramp would be delayed;

Consequently, it was deemed prudent to consider the closure of the Sparrow Crescent NB Off-Ramp should the development of the QE II NB core transfer lanes south of the Airport Road Interchange (See Section 3.4.3) be warranted within the next decade (2025). As well, should implementation of the 4th NB Weave Lane between the 50th Street On-Ramp and the Airport Road Off-Ramp proceed; provisions for the required reconstruction of the Sparrow Crescent NB Off-Ramp should be considered "throw-away" given the eventual closure associated with the QE II core lanes.

11.8 Access Requirements to the 50th Street NB Off-Ramp

Exhibit 11-7 illustrates the current configuration of the 50th Street NB Off-Ramp which provides for accesses on both the north and south sides of the ramp. The accesses consist of:

(a) Full access to the Safeway / Leduc Towne Square retail development located on the south side of the Off-Ramp; and

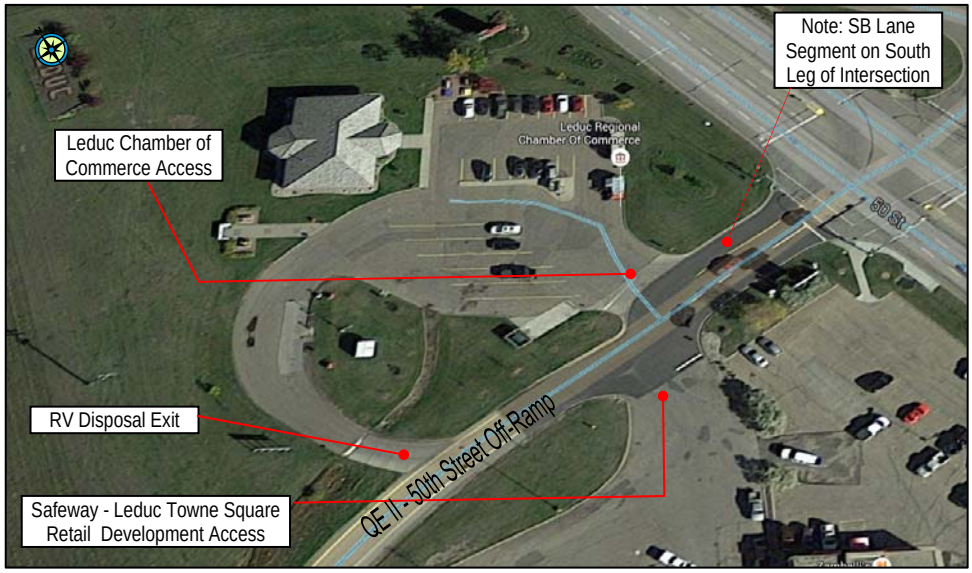

Exhibit 11- 7: QE II 50th Street Off-Ramp Accesses

(b) Full access to the Leduc Chamber of Commerce Site located on the north side of the Off-Ramp. As well, an exit-only access is provided from the RV Disposal site onto the ramp.

AT's current design standards prohibit development-related accesses onto, or off of freeway ramps. The Province, upon initiating the ultimate improvements to the QE II corridor, would most likely insist that such accesses be removed. However, the following challenges are highlighted for information purposes.

a) The Safeway - Leduc Towne Square Retail Development Access

Exhibit 11-8 illustrates the location of the Safeway loading docks in relation to the QE II 50th Street Off-Ramp. Currently, all delivery vehicles to the rear of the Leduc Town Square complex make use of the access for both exiting and entering the site. However, heavy vehicle traffic is required to use the direct ramp access as an exit as there is insufficient on-site property for heavy vehicles to effectively turn around within the site and exit toward the 60th Street entrance. A reconfiguration that would provide an alternative on-site heavy vehicle turn-around area would be required before the south access to the on-ramp could be closed. Subsequent to the application of heavy vehicle turning movement templates, it was determined that insufficient on-site property currently exists to provide an on-site truck turn-around area without reducing the current on-site parking supply.

Exhibit 11- 8: Safeway Loading Bays

An Interim Stage Alternative

The study team originally envisioned a concept that would see "interim" ramp modifications that relocated the entire ramp to form the 4th leg (west leg) of the 50th Street/65th Avenue intersection. This concept:

- would have provided more than sufficient room to develop a heavy vehicle turn-around area and permit closure of the current south ramp accesses arrangement. Subsequent to a TRC Review meeting, the concept was discounted as "throw-away" in that the relocated ramp would have to have been re-built when the 65th Avenue interchange was developed forecast for the 20 year (2035) time frame.
- Subsequent to the TRC meeting the "interim" stage drawings were modified to effect only minor modifications to the existing ramp (widening to 2-lanes was found to be required within the next decade) to limit the throwaway costs to the greatest extent possible.

Exhibit 11-9 illustrates a second "interim" stage alternative concept that was considered that would see ramp modification intended to:

- maximize the weaving distance between the 50th Avenue On-Ramp and the 50th Street Off-Ramp;
- potentially accommodate an on-site heavy-vehicle truck turn-around area; and
- effect the closure of the existing access onto the ramp.

This concept involved shifting the "interim" stage off-ramp gore further north on the QE II NB lanes to "free-up" additional room to develop the heavy-vehicle turn-around area. This concept would likely involve a property transfer from AT ownership to the development.

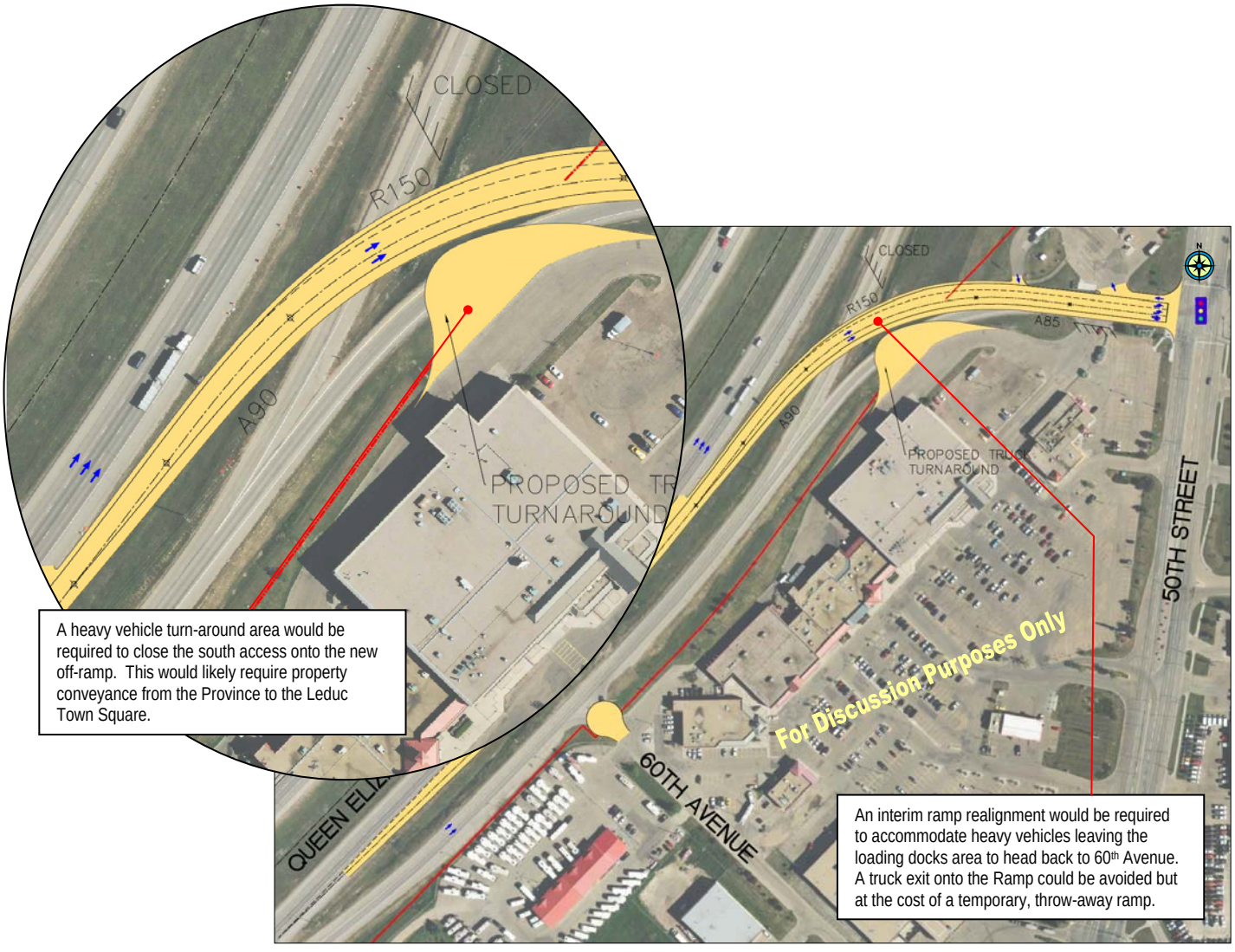

Exhibit 11- 9: Ramp Realignment Option

However, the concept illustrated in Exhibit 11-9 was found to be deficient in that:

- the ramp would be sub-standard as the controlling radius would be 150m which is less than the minimum 190m recommended for ramps; and
- a significant portion of the cost of the ramp relocation must be considered as "throw-away" as the ramp would require replacement at the time of the QE II realignment (2035).

In recognition of the above, the "interim" plans within Annex "A" suggest modifying the ramp to limit access to heavy vehicle egress movements only. This implied on-site curb modifications that prohibit other vehicle movements into and out of the main parking areas of the Leduc Town Square.

An Ultimate Stage Alternative

Exhibit 11-10 illustrates the "ultimate" ramp configuration proposed for the QE NB 50th Street Off-Ramp once the QE II collector lanes have been realigned to accommodate the ultimate 65th Avenue interchange. With the ultimate ramp realignment in place development a heavy vehicle turnaround area becomes viable, however, this would likely involve conveyance of public lands that currently lie within the QE II corridor.

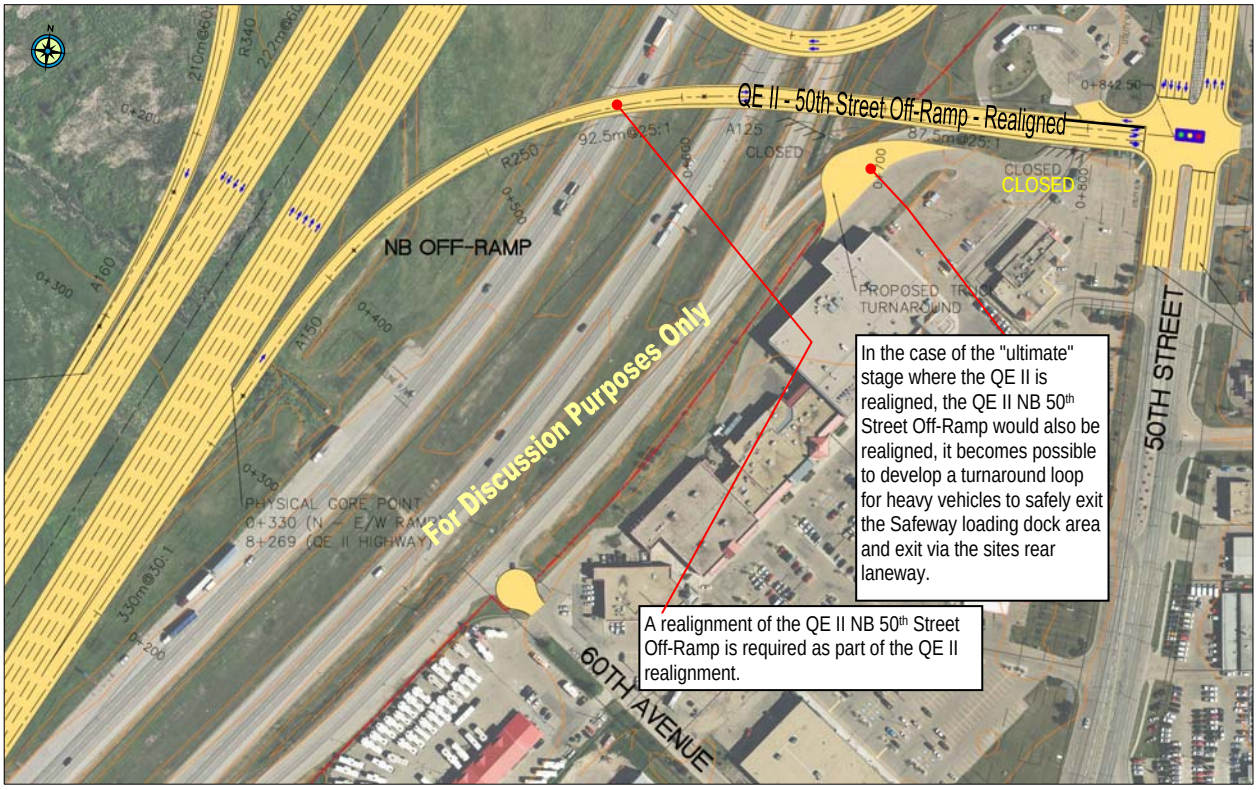

Exhibit 11- 10: Ultimate Ramp Realignment and Turnaround Bay

b) Leduc Chamber of Commerce Building

Exhibit 11-11 conceptually illustrates the partial closure of the access to the Leduc Chamber of Commerce and the RV disposal site with the advent of a RI-RO access onto 50th Street and a divided median separating the off-ramp from a dedicated entrance to the site. The concept:

- is presented only to initiate discussion in regard to minimizing impacts to the QE II ramp;
- suggests an alternate driveway arrangement/circulation and parking re-design / reconfiguration strategy for consideration;
- serves to clarify issues related to achieving alternate access to the site in the ultimate time frame;
- serves to highlight the property constraints involved with the site;
- would remove both EB-LT movements (from the Chamber building and the RV disposal site) from the QE II Off-Ramp; and
- remains to be validated by a formal site plan design process.

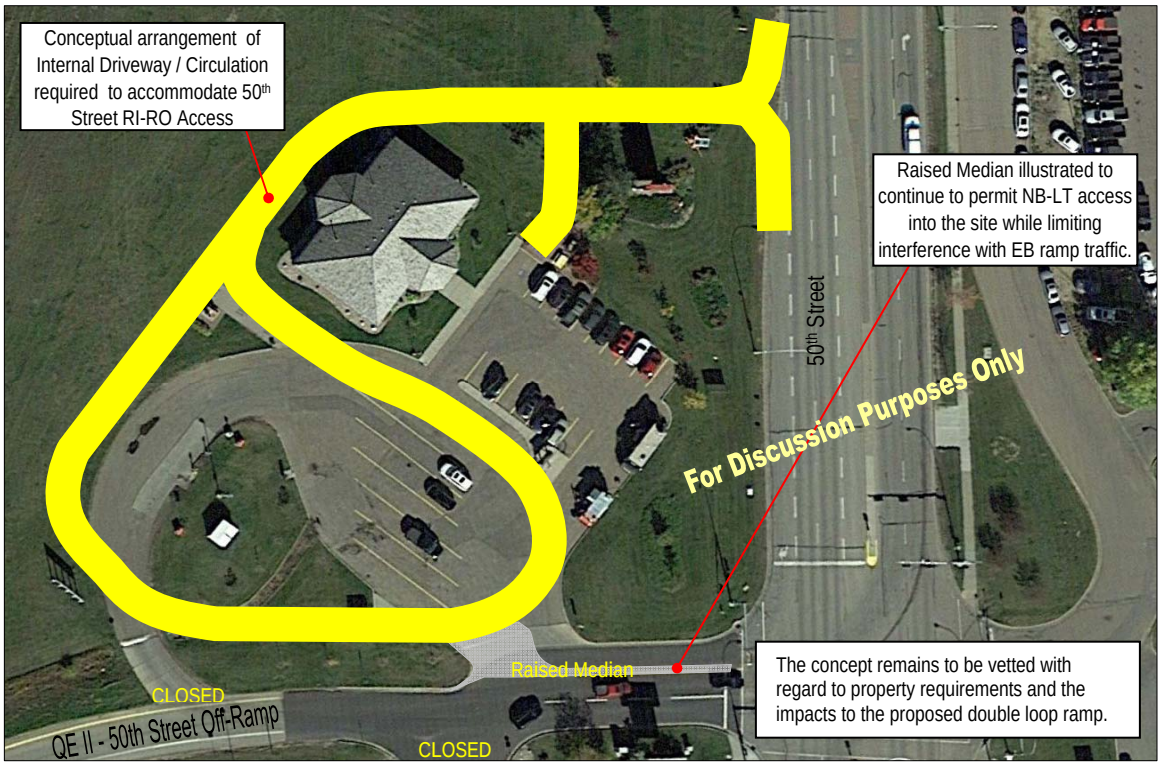

Exhibit 11- 11: Removal of Access will Require Leduc Chamber of Commerce Lot Reconfiguration

Although Exhibit 11-11 illustrates the implications associated with a re-designed revised circulation/driveway arrangement, it may well prove more cost-effective in "ultimate" time frame to simply arrange to acquire the complete site and relocate the land use. This re-assessment should ideally be made at the time of detailed design.

11.9 The QE II 50th Street SB Ramp Terminal and Perimeter Road

The QE II NB 50th Street Off-Ramp provides access to both the 50th Street Twin Bridges and the EIA's Perimeter Road. The following sections highlight the ramp terminal configuration and the EIA local intersection located adjacent to the ramp terminal.

11.9.1 The QE II 50th Street West Ramp Terminal

The initial evaluation assessed five alternative concepts (See Appendix "B-6.1, Exhibit 1-1) involving the QE II SB / 50th Street West Ramp Terminal:

1. a 4-leg roundabout configuration;
2. a 3-leg roundabout at the West Ramp terminal and a traffic signal controlled T intersection located approximately 350m to the north;
3. a 3-leg roundabout at the West Ramp terminal and a traffic signal controlled T intersection located approximately 350m to the north with a free-flow movement from Perimeter Road South onto the 50th Street SB bridge;
4. a 4-leg traffic signal controlled intersection; and
5. two offset "T" intersections with the West Ramp Terminal intersection on the south and an intersection formed by Perimeter Road and the new roadway connecting to 65th Avenue West, located approximately 350m to the north

Appendix B-6.3, Technical Memorandum No. 3, Section 3.2.5: 50th Avenue Interchange Requirements illustrates each of the above options and Table 4.1 provides a detailed analysis of the different configurations for the 50th Street Twinned Bridge West Junction. The analysis indicated superior traffic operations associated with two off-set "T" intersections which was recognized as the preferred alternative.

11.9.2 The EIA North Perimeter Road Intersection

However, a possibility exists that the north Perimeter Road intersection could convert to a 4-leg configuration, (rather than the "T" intersection depicted in Annex "A"), with access being provided to the south-east portion of the developing EIA commercial lands.

Exhibit 11-12 illustrates a concept depicting a 4-leg intersection configuration. The configuration has been developed based upon an appreciation of the land use forecast for the southern portion of the proposed EIA commercial development. The land use for subsequent phases beyond Phase I of the EIA development remain to be confirmed. Despite this, and using available traffic forecast information and assuming that roughly 30% of traffic originating, and destined, to the remaining development lands would use this access, traffic forecasts were developed (See Appendix B-6.5). Intersection capacity analysis assuming 2075 horizon year traffic volumes indicates that the 4-leg intersection would operate at an overall

LOS of "C" during the afternoon peak hour of travel demand when the development is fully built out.[14]

The interaction with the West Ramp Terminal (the next intersection to the south) was considered negligible as the 300m separation was found to be sufficient to accommodate queues and the lane arrangement permits a dedicated NB-RT lane that flows directly to the north intersections NB-RT lane. Despite these findings, the reader is cautioned that EIA's internal roadway network within the EIA lands south of the Phase I commercial development initiative remains to be confirmed and is subject to further refinement depending on the actual land use being proposed.

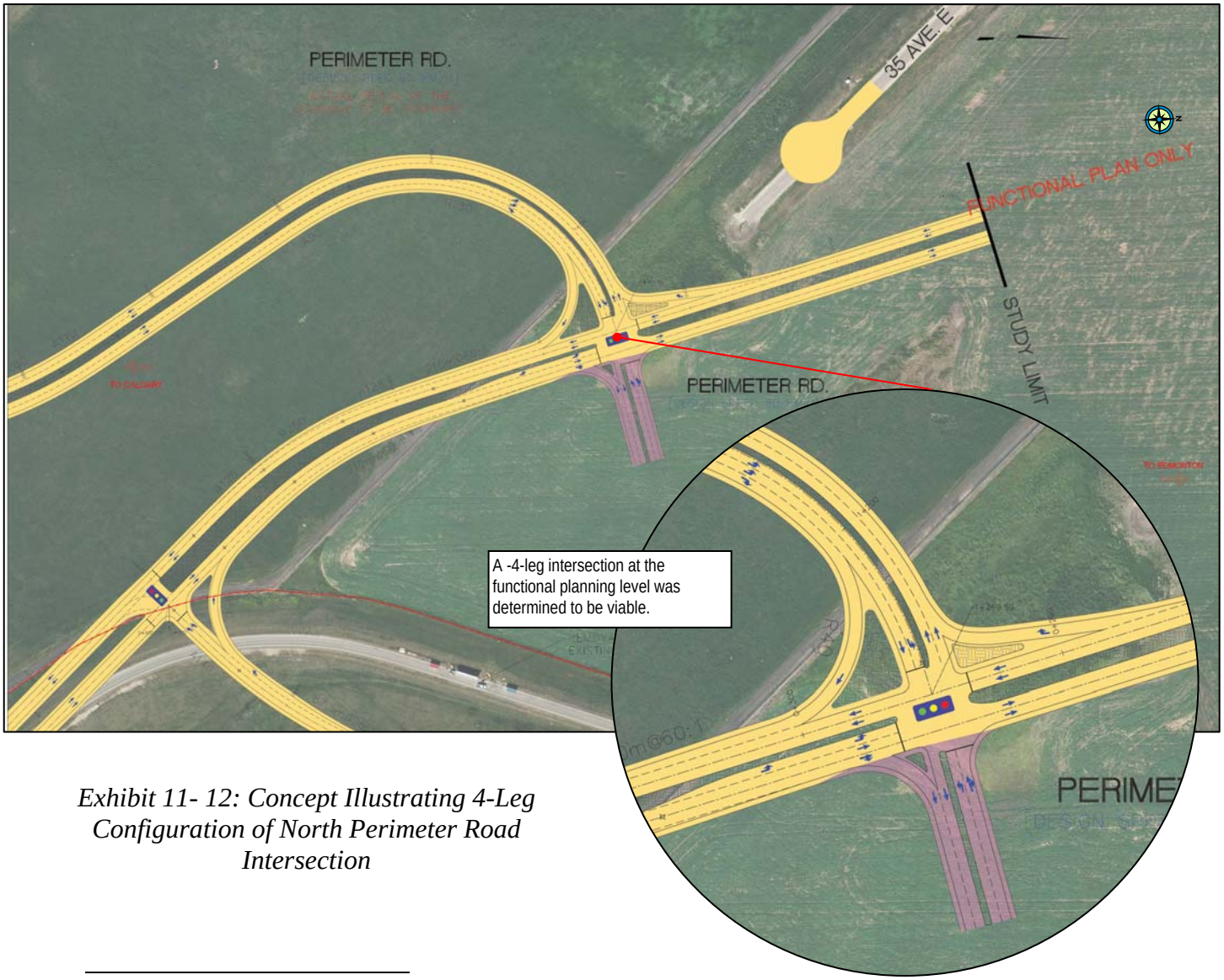

Exhibit 11- 12: Concept Illustrating 4-Leg Configuration of North Perimeter Road Intersection

[14] The worst-case movement was the EB-LT from the Perimeter Road Extension onto Perimeter Road North with a forecast volume of just over 400 veh/h and a v/c of 0.74

11.10 The Effects of the CP Rail Corridor Crossing 65th Avenue

- Current estimated freight train frequency[15] at this crossing is in the order of 9-to-14 freight trains on the track per day; 7 days a week. Train frequency fluctuates without notice due to the demands of CP's customers/business requirements. There is no fixed schedule when train traverse the crossing.
- A typical train has 2-to-4 engines and 125 railcars, although trains may be longer-or-shorter depending on CP's customer requirements.
- On June 24th, 2015 at 1:04 p.m a 94 car CP Rail train was measured as taking 2 minutes and 30 seconds (150 seconds in total) to travel across Airport Road from the time the rail gates went down to the time traffic could flow once again.

The most commonly used warrant for consideration of road-rail grade separation is referred to as the "cross product rule". This benchmark indicates that when the product of the AADT and the number of trains-per-day reaches 200,000, consideration of a grade separation should be undertaken[16]. Consideration of grade-separation usually involves a detailed engineering study.

Table 11- 1: Grade-Separation Cross Product: 65th Avenue CP Rail Crossing

Horizon Year	***Two-Way Peak Hour Volume [veh/h]***	***No. Lanes***	***Estimated AADT*** **[7.0-to-8.0 Pk Hr to AADT Conversion Factor]**	***No. of Trains per Day***	***Cross Product*** **[AADT * No. Trains per Day]**
Balanced 2013	AM: 840 PM: 1,100	4	5,880-to-8,800	10-to-14	58,800-to-123,200
Balanced 2014	AM: 980 PM: 1,300	4	6,860-to-10,400	10-to-14	68,600-to-145,600
2017	AM: 1,100 PM: 1,400	4	7,700-to-11,200	10-to-14	77,000-to-156,800
2025	AM: 1,800 PM: 2,400	4	12,600-to-19,200	10-to-14	126,000-to-268,800
2035	AM: 2,400 PM: 3,400	6	16,800-to-27,200	10-to-14	168,000-to-380,800
2045	AM: 3,100 PM: 4,300	6+	21,700-to-34,400	10-to-14	217,000-to-481,600
2075+	AM: 3,700 PM: 5,000	6+	25,900-to-40,000	10-to-14	259,000-to-560,000

[15] E-mail: CP Community Connect: Ms. Christine Brown, Tues June 16th, 2015.

[16] The Canadian Transportation Agency references the 200,000 benchmark for the cross-product rule as part of it's decisions, https://www.otc-cta.gc.ca/eng/ruling/617-r-2007 [Item 54].

Table 11-1 indicates that this threshold would be reached, assuming the "High Volume Scenario" by 2025 and the "Low-Volume Scenario prior to the thirty year horizon.

However, these results:

- assume 10-to-14 trains per day. Some of these train runs occur during the very late evening and early morning hours.
- In addition, both volume scenarios assume a 2.5% annual growth rate over the first decade (to 2025) and 1% annual growth rate afterwards. This may not be the case when the current downturn in the energy sector has been accounted for.
- underscore the need to accommodate traffic signal pre-emption requirements (connecting the rail gates/signals to the adjacent traffic signals) prior to the train reaching the 65th Avenue crossing. As well, specialized coordinated traffic signal phasing and timing need to be implemented to assure vehicle queues can quickly be cleared after trains have passed.

11.11 Should the Existing 50th Street Fly-Over be Replaced

With the advent of the new 65th Avenue interchange, forecast to be required by 2025, the function of the existing NB 50th Street fly-over bridge will become independent of the QE II corridor and would serve only a local function connecting Leduc's urban area to the EIA.

Table 11-2 below provides a comparison of two scenarios indicating 2035 forecast traffic volumes and intersection performance assuming the 65th Avenue interchange is in place. The two scenarios assume the presence, as well as the absence, of the "existing" 2-lane 50th Street bridge during this time horizon and provides an appreciation of the implications associated with removal / not replacing of the existing bridge.

Without the existing NB 50th Street bridge in place the NB QE II corridor between the QE II 50th Street On-Ramp and the QE II Airport Road Off-Ramp would be surcharged by an additional 655 veh/h (PM Peak Hour) over and above the 2035 PM forecast travel demand as local traffic will use the QE II NB lanes to access the EIA lands by way of the Airport Road interchange. This is forecast to...

- accelerate the requirement to widen the NB Airport Road Off-ramp to provide for a 2-lane exit; (2035 volumes are forecast to reach 2,605 veh/h).
- exceed the capacity of the double NB-LT's at the Airport Road East Ramp Terminal (NB-LT 2035 volumes are forecast to reach 917 veh/h - v/c = 0.96)
- accelerate the requirement for widening of the Airport Road bridge. (Forecast 2035 WB bridge volumes are forecast to reach 2,579 veh/h exceeding the rule of thumb estimate of a LOS "C" capacity of 1,200 veh/h per lane for arterial lanes.)

- result in poor levels of service for the Airport Road West Ramp Terminal for the critical SB-LT to Leduc/Nisku (NB-LT 2035 volumes are forecast to reach 1,516 veh/h - v/c = 0.95) and the WB-TH (v/c = 0.96) to the EIA terminal during the AM peak hour; and

Table 11-2: 2035 Forecast Traffic Volumes (veh/h)
(With and Without 50th Street NB Single Lane Bridge)

Link or Movement	*50th Street NB Bridge Remains*		*50th Street NB Bridge Removed*	
NB 50th Street NB Bridge (veh/h)	AM: 534	PM: 655	n/a	
QE II 50th Street NB On-Ramp (veh/h)	AM: 905	PM: 1,175	AM: 1,439	PM: 1,830
QE II NB Lanes between 50th Street and Airport Road (veh/h)	AM: 7,330	PM: 6,260	AM: 7,873	PM: 6,915
QE II / Airport Road NB Off-Ramp (veh/h)	AM: 2,062	PM: 1,327	AM: 2,605	PM: 1,982
QE II / Airport Road East Ramp Terminal - NB-LT Movement	AM: 273 veh/h: v/c = 0.86 Delay 41s Queue 53+m	PM: 262 veh/h v/c = 0.58 Delay 26s Queue 32m	AM: 807 veh/h v/c = **1.03** Delay 57s Queue 102m	PM: 917 veh/h **v/c = 0.96** Delay 41s Queue 98m
QE II / Airport Rd WB Bridge (2-lanes)	AM: 1,156	PM: 1,924	AM: 1,690	PM: ***2,579***
QE II Airport Road West Ramp Terminal - WB-Th Movement	WB-TH AM: 623 veh/h v/c = 0.58 Delay 13s Queue 32m	WB-TH PM: 753 veh/h v/c = 0.32 Delay 7s Queue 37m	WB-TH AM: 1,157 veh/h v/c = **0.96** Delay 28s Queue 84+m	WB-TH PM: 1,408 veh/h v/c = 0.60 Delay 10s Queue 103m
	SB-LT AM: 1,516 veh/h v/c = 0.88 Delay 20s Queue 125+m	SB-LT AM: 564 veh/h v/c = 0.80 Delay 53s Queue 88m	SB-LT AM: 1,516 veh/h **v/c = 0.95** Delay 29s Queue 132+m	SB-LT AM: 564 veh/h v/c = 0.80 Delay 53s Queue 88m
Airport Rd / Perimeter Rd WB-LT Movement	AM: 205 veh/h v/c = 0.59 Delay 53s Queue 36m	PM: 433 veh/h v/c = 0.86 Delay 60s Queue 82+m	AM: 433 veh/h v/c = 0.65 Delay 40s Queue 55m	PM: 897 veh/h v/c = **1.02** Delay 71s Queue 163+m
Airport Rd / Perimeter Rd	WB-TH AM: 1,678 WB-RT AM: 87 NB-LT AM: 207 NB-TH AM: 383	WB-TH: PM: 1,187 WB-RT PM: 46 NB-LT PM: 169 NB-TH PM: 398	WB-TH: AM: 1,821 WB-RT AM: 249 NB-LT AM: 64 NB-TH AM: 221	WB-TH: PM: 1,288 WB-RT PM: 138 NB-LT PM: 68 NB-TH PM: 306

- exceed the capacity of the double WB-LT's at the Airport Road / Perimeter Road intersection (WB-LT 2035 volumes are forecast to reach 897 veh/h - v/c 1.02)

It was concluded that:

- the existing 50th Street fly-over does not have to be replaced until the QE II is realigned and/or the 65th Avenue interchange is developed;
- the potential cost impacts associated with continued maintenance (as well as the timing and cost of the ultimate bridge replacement) of the existing 50th Street bridge versus the capital

outlay required to accommodate all of the above noted improvements remains to be determined.

- the decision to replace, or not replace, the existing 50th Street flyover bridge is at least two-decades away, and is dependent on how travel demand and infrastructure decisions unfold.

Given the above, it is suggested that all jurisdictions:

- monitor the impacts associated with the twinned 50th Street bridges;
- monitor changes that may be required with the Airport Road Interchange which depends on surrounding growth of the EIA and the Leduc/Nisku lands;
- monitor the timing requirements of the need to accommodate the proposed core lanes and QE II realignment; and
- reassess the implications of either the existing 50th Street bridge removal/replacement to best determine associated implications and ultimate jurisdictional responsibility for the existing 50th Street bridge.

The jurisdictional responsibility remains to be determined concerning:

- the ongoing operation and maintenance cost associated with a replacement bridge; and
- the financial obligation associated with replacement of the existing 50th Street fly-over bridge at the time of the 65th Avenue interchange and/or QE II realignment (which ever comes first).

12.0 FINDINGS AND RECOMMENDATIONS

12.1 Findings

The following sections summarize the findings of this Functional Planning Study.

12.1.1 Public and Stakeholder Involvement

a) Public Involvement

- The public consultation/involvement activities associated with this functional planning study included two public open house events and three focus group meetings involving land owners, business, residents and the public at-large. Throughout the entire process comments and concerns were recorded and responses provided.
    - *Focus Group Meetings No. 1 and Public Open House No. 1:* This provided the opportunity to present the study objectives, existing conditions and conceptual interim and ultimate options. Approximately 30 individuals attended the first public open house and 10 individuals attended the focus group meeting.
    - *Focus Group Meeting No. 2* provided the opportunity to present the consultant's preferred alignments for the interim and ultimate stages. Approximately 22 individuals attended the focus group meeting.
    - *Focus Group meeting No. 3 and Public Open House No. 2:* This provided the opportunity to present the consultant's preferred solution. Approximately 29 individuals attended the second public open house while approximately 18 individuals attended the third focus group meeting.

b) Stakeholders Involvement

- The *Edmonton International Airport* represented an active stakeholder throughout the planning process in relation to forecast land use assumptions, its Master Plan and the applicability of clearance envelopes/ obstacle surfaces and formal submissions to NAV Canada. The plans contained in Annex "A" have been reviewed by senior staff and presented as an information item to the EIA's Board of Directors.
- *NAV Canada* responding to a "Land Use Program" submission regarding the functional plans indicated no objection to the proposed new 65th Avenue interchange design.
- *Leduc City Council* was informed by way of a brief and presentation provided at the December 8th, 2015 Council Meeting where Council unanimously endorsed the results and conclusions of the study.

12.1.2 Existing Conditions

a) Land Uses

- The current land uses within the study area are for the most part urbanized within the City of Leduc's boundary and are characterized by mix of residential, commercial, retail, institutional and light industrial land uses on the east side of the QE II. The City's developments on the west side of the QE II are for the most part residential, retail and institutional.

- Significant un-developed lands within the City boundaries are located to the west of the QE II, and include the Aerotropolis lands and lands on either side of Rge Rd 254.
- The study area also includes the Edmonton International Airport (EIA) which accommodates over 8M passengers per year, and represents one of the fastest growing airports in Canada over the last decade. The EIA is in the process of developing a major commercial centre on its lands adjacent to the QE II corridor.

b) The 65th Avenue Corridor

- The existing 65th Avenue corridor extends from 50th Street eastward to the City of Leduc municipal boundary. The corridor serves to currently connect to the QE II SB by way of the 50th Street SB Fly-over SB-EB/WB Off-Ramp and the QE II NB by way of the 50th Street EB/NB-NB On-Ramp. The 50th Street Fly-over bridge was rehabilitated during the 2014/2015 construction season and was closed to SB traffic which was diverted to 50th Avenue.
- The City of Leduc municipal plans have long envisioned that the 65th Avenue corridor as extending westward across the QE II to the City's west municipal boundary. The future 65th Avenue West corridor is bounded by the Edmonton International Airport (EIA) to the north and is intended to service the future Aerotropolis and West Area Structure Plan lands within the City of Leduc as well as the EIA's southern lands. Ultimately, the corridor is envisioned as being extended further west through the County of Leduc to ultimately transition onto Highway 39 in the vicinity of Range Road 262.
- The 65th Avenue East corridor's current attributes are summarized as:
  - *Configuration:* 4-lane arterial - 50th Street-to- 45th Street and 2-lane rural cross-section east of 45th Street.
  - *Posted Speed*: 50 Km/h between 50th St. and 39th Street; 70 Km/h E of 39th Street.
  - *Traffic Volumes:* existing (2014) traffic volumes (AADT) along the east section of the 65th Avenue were approximately 12,000-to-13,000 vehicles-per-day.

c) The QE II Corridor

- The general study area encompassed an area of influence along the QE II corridor spanning approximately 4 km on either side of the future 65th Avenue corridor interchange from Hwy 19 on the north to the Hwy 2A interchange on the south.
- The section of the QE II corridor within the study area is classified as a "Level 1" highway that accommodates the movement of people, goods and services inter-provincially and internationally and is defined as a core route in the National Highway System (NHS).
- The corridor is a Long Combination Vehicle route accommodating Turnpike Double heavy vehicles up to 41 m in length; and over the greatest portion of its length accommodates posted speeds of 110 km/h on the mainline segments of the corridor.
- *Cross-Section:* Along the 8km length of the study area the existing QE II corridor's cross section varies from a 4-to-6-lane divided cross-section consisting of highway grades that vary from approximately 0-to-3 percent; pavement widths from 10-to-16.6 m; shoulder widths from 3.0-to-3.5m and a median transition from rural (22.6m) to urban (7.8m).

- *Interchanges, Ramps and Access:* the QE II corridor, within the vicinity of the study area currently offers access by way of:
  - 3 grade separated interchanges (Airport Road, 50th Avenue and Highway 2A);
  - 4 northbound direct ramps (50th Avenue NB-EB/WB Off-Ramp, 50th Street NB-EB Off-Ramp, 50th Street NB-NB On-Ramp and Sparrow Cres. NB-EB Off-Ramp);
  - a single SB 50th Street Fly-over Off-ramp; and
  - a median cross-over break located just south of the Airport Road interchange.
- *Collision Information:* Between 2008 and 2012, a total of 620 collisions were reported along the QE II corridor (within the 8.0 km segment in the vicinity of the 65th Avenue corridor). The highest frequency during this period was found to occur in the vicinity of the 50th Avenue interchange. It was confirmed with AT's Office of Traffic Safety that this 8 km section of the QE II corridor exhibits an overall collision frequency that is higher than the Provincial "rural" average for similar facilities.
- *Traffic Volumes:* Existing traffic volumes (AADT) along the QE II corridor were approximately
  - 50,000 vehicles-per-day (vpd) - north of 50th Avenue and south of 65th Avenue;
  - 60,000 vpd - north of 65th Avenue and south of Airport Road; and
  - 77,500 vpd - north of Airport Road
- *Intersection Capacity Analysis:* Nine (9) out of fourteen (14) intersections analyzed were found to currently either operate at congested, or failure, level of service during the peak hours of travel demand. Particularly, failure levels of service were exhibited at:
  - The QE II & Hwy 19 West & East Ramp Terminals;
  - The QE II & Airport Road West and East Ramp Terminals
  - The QE II & 50th Avenue West and East Ramp Terminals:
  - The Hwy 19/Sparrow Drive Intersection;
  - The Airport Road / Sparrow Drive Intersection; and
  - The 65th Avenue / 50th Street Intersection.
- *QE II Merge / Weave Analysis:* Two existing merge-diverge constraints were identified
  - Highway 19 SB-EB/WB Off-Ramp Diverge: The Hwy 19 twinning initiative proposed by AT includes the conversion of the existing QE II single-lane off-ramp exit to a two-lane exit configuration along with an additional (4th) QE II SB approach lanes intended to address this constrained operation.
  - *50th Avenue NB-EB/WB Off-Ramp Diverge*: The unsatisfactory diverge analysis was found to result from the presence of only two NB QE II lanes which are operating at capacity causing the diverge movement to queue. Resolving this constraint involves consideration of planned upgrades to the 50th Avenue interchange and consideration of the widening of the east bridge over Black Gold Drive and the CP Rail corridor located 350m south of the ramp gore.
- *Current and Short-Term Infrastructure Improvements*
  - The QE II / Hwy 19 ramp terminals are to be improved as part of the Hwy 19 Twinning initiative being undertaken by Alberta Transportation scheduled for completion by 2019;

- The QE II / Airport Road ramp terminals are proposed to be improved and traffic signal controlled as part of the EIA commercial development initiative that would widen Airport Road West to a 6-lane cross-section; and
- The County and City of Leduc are in the process of preparing plans to improve the Airport Road/Sparrow Drive intersection and widen the Airport Road East corridor to provide for an ultimate 6-lane cross-section.

d) The Existing Bridges

- The existing 50th Street Fly-over single lane bridge (BF 77994) was constructed in 1977, consists of 3-unbalanced-spans (57.9 - 64.0 - 42.7m) positioned at approximately a 40° angle with the QE II corridor, and provides a clear roadway width on the structure of 7.6m. (1x 4.0m lane, a 2.0m south shoulder and a 1.6m north shoulder.);
- The existing 50th Street Flyover was rehabilitated during the 2014/2015 construction seasons. This work is thought to have extended the structural life of the flyover to approximately 25-to-30 years (2040-to-2045).

12.1.3 Forecast Development Initiatives and Traffic Generation

a) Expanded Development Areas

- Adjacent development initiatives accounted for within this study included:
  - *the South Development Area* includes lands south of 65th Avenue and west of the QE II corridor inclusive of the planned Aerotropolis development. The entire developable area when built-out accounts for approximately in 2,600 gross acres of potential residential, commercial, business and public institutional development;
  - *the Edmonton International Airport (EIA)* development plans include a large commercial/retail development inclusive of offices, hotel and commercial uses south of Airport Road and west of the QE II. In addition growth in the areas of passengers travel, cargo demands and airport support services were accounted for;
  - *the North Development Area* is located north of the EIA lands and west of the QE II corridor and includes the proposed Crossroads development. The entire developable area when built-out accounts for approximately 3,600 acres of potential industrial, office and commercial development;
- The total morning and afternoon peak hour two-way traffic forecast to be generated from all of the land uses and development initiatives was estimated at:
  - Ten Year Horizon (2025): 4,810 AM Peak Hour / 8,770 PM Peak Hour
  - Twenty Year Horizon (2035): 9,950 AM Peak Hour / 16,650 PM Peak Hour
  - Thirty Year Horizon (2044): 16,350 AM Peak Hour / 25,390 PM Peak Hour
  - Sixty Year Horizon (2075): 22,700 AM Peak Hour / 32,550 PM Peak Hour

b) Historical Traffic Growth

- The 10-year average annual growth rate was determined to be:
  - 4-to-5 percent north of 50th Avenue; and
  - 3-to-4 percent south of 50th Avenue.

c) Forecast Traffic Growth

- The overall effect of the downturn in the energy sector has effected the pace of development;
  - Nisku's industrial development was particularly effected by the downturn;
  - a 66% decline in residential building permits was evidenced from 2014-to-2015;
  - a further 60% decline was evidenced in the first quarter of 2016.
  - EIA annual passenger travel declined by 2.5% from 8.2M to 8.0M passengers.

  The timelines noted within this functional planning study remain valid as milestones and whether or not the anticipated growth occurs in 2025 or 2035 or even 2045 remains somewhat irrelevant, in that growth will continue to occur and protection of the required lands necessary for such future infrastructure remains prudent.

d) Additional Traffic Growth Assumptions

- an average annual growth rate of 2% was applied to the QE II highway thru-traffic component attributable to the QE II corridor;
- Future developments on the east side of the QE II corridor were accounted for by applying a separate growth factor of 2.5% over the next decade followed by 1% growth thereafter to all movements generated from/to east of the QE II corridor.

e) Related Infrastructure Initiatives

Key pieces of infrastructure were determined to be required from a network planning perspective to accommodate long term traffic demands beyond the 30 year time horizon which would be in addition to the infrastructure requirements identified within this study. These included:

- *The Terwillegar South Extension* from its current location in Edmonton through to the future QE II interchange south of the City of Leduc; and
- *The Nisku Spine Road corridor* extending southward from 9th Street in Edmonton, looping to the east of Telford Lake and extending to the southwest to the future QE II interchange south of the City of Leduc.

12.1.4 Notes to Detailed Design

Appendix "C-3" contains a summary of notes which merit review during the time of detailed design.

12.1.5 The Design Characteristics

a) The Entire Planning Project Summarized

The project is envisioned to take place of two distinct stages.

- The "*Interim Stage"* includes:
  a. twinning of the existing 50th Street Fly-over bridge with a new 2-lane SB bridge located immediately to the south of the existing 50th Street fly-over;
  b. conversion of the existing single lane 50th Street Fly-over bridge to NB operation;

c. a connection linking the west side of the 50th Street twinned bridges to Perimeter Road within the EIA lands;

d. a new NS 4-lane 1.3km long arterial roadway with a design speed of 60 km/h that would extend south from the EIA lands to provide public access connecting the new 65th Avenue West corridor to Perimeter Road by way on a "T" intersection off-set from the QE II 50th Street SB-EB/WB Off-Ramp;

e. a reconfigured QE II SB 50th Street SB-EB/WB Off-ramp to a new double lane off-ramp terminating at a traffic signal controlled "T" intersection;

f. the widening of the QE II SB corridor to provide a 4th SB (weave) lane between the Airport Road Interchange WB-SB On-Loop and the new 2-lane 50th Street SB-EB/WB Off-Ramp;

g. a 3-leg roundabout on the east side of the twinned bridges that would connect the bridges to the QE II EB/NB-NB On-Ramp and the 50th Street / 65th Avenue East intersection;

h. the widening of the NB QE II corridor to provide a 4th NB (weave) lane from the 50th Street EB/NB-NB On-Ramp entrance to the Airport Road NB-EB/WB Off-ramp exit;

i. a 4-lane arterial 65th Avenue West corridor, characterized by a design speed of 80 km/h and a 6.0m raised median, linked to the QE II highway by way of SB-Off-Ramp and SB On-Ramp;

j. a new QE II SB-EB Off-Ramp and a new QE II SB-WB On-Ramp that would connect the QE SB to/from the new 65th Avenue West corridor at a time when warranted;

k. a modified QE II 50th Street NB-EB Off-Ramp to provide 2 approach lanes to 50th Street. The current access arrangement onto the ramp remains to be resolved. The proposed interim 2025 50th Street NB-EB Off-Ramp widening design is characterized by an 87.5m long 25:1 taper using the existing R130 horizontal curve. The purpose of the widening is to provide additional storage length to accommodate double EB-LT lanes and enhance the operations of the 50th Street ramp terminal. The weave distance between the 50th Avenue interchange and 50th Street NB-EB Off-Ramp were not intended to be addressed at this (interim 2025) stage as the entire QE II corridor is to be relocated in the future and any weave concern is not anticipated until after the interim stage. The weave concern, should it materialize, would be addressed in the following (ultimate 2035) stage. The design currently reflects the minimum work required to improve operation at the 50th Street intersection. Modifying the Off-Ramp above the interim stage being depicted, should weave distance becomes a documented concern as an additional 150m of weaving distance could potentially achieved recognizing the proposed cul-de-sac at the 60th Avenue intersection with the ramp. However, any additional monies spent in reconfiguring the ramp during the interim stage would be considered throw-away given the desire to ultimately realign the QE II corridor.

l. modification of the 65th Avenue / 50th Street "T" intersection such that:

- the east leg of the would be re-configured to provide a dedicated WB right turn lane onto 50th Street North;

- the north leg would be re-configured to provide dedicated double SB left turn lanes onto 65th Avenue East; and
- a 2nd NB thru lane would be added.

m. modification of the 65th Avenue / Sparrow Drive intersection such that:
- the south-leg would be reconfigured to provide right-in-right-out access; and
- the west leg would be reconfigured to provide a dedicated EB left turn lane onto Sparrow Drive North.

- The "Ultimate Stage" includes:

a. *Realignment of the QE II Corridor*: The QE II realignement consists of a R2000m curve (in the vicinity of the 50th Avenue interchange) followed by a 750m long tangent and a R1500m curve (in the vicinity of the Twin 50th Street bridges).; The R1500 curve represents the maximum curvature possible assuming the Twinned Bridge Interim solution where a new SB bridge pier span must meet the pier location requirements associated with the existing QE II corridor, and also the new realigned QE II corridor requirements.

Note: The ultimate stage envisions the new 65th Avenue Interchange (estimated to be required by 2035) and necessitates the QE II realignment. This in turn necessitates that the existing 50th Street fly-over bridge to be removed. (Section 11.1 assessed the option of developing an interim QE II realignment and concluded that it would not be preferred.)

b. 50th Street Fly-over Bridge Removal: It is anticipated that the QE II / 65th Avenue interchange and the QE II realignement will be required within the 20 year time horizon (2035). The existing 50th Street Fly-over bridge has a remaining structural life of 25-to-30 years (2040-to-2045). Hence, depending on timing and the pace of development, the 50th Street Fly-over may well have to be replaced before the end of its structural life. The staging strategy permits at first the removal of the existing bridge, which could be followed by the later replacement with either a single lane or two-lane twin structure. (Section 11.11 discusses replacement of the 50th Street Flyover.)

c. A new QE II / 65th Avenue Interchange:
- The 65th Avenue Bridge would be a 6-lane configuration with auxilliary turning lanes and characterized by approach slopes on either side of 3.4%;
- Provision is made for a 2-lane QE II EB-NB On-loop ramp to accommodate the demands of development originating from the 65th Avenue West corridor to the north. This loop ramp would likely be staged at a time where the capacity of the double WB-LT lanes from 65th Avenue onto 50th Street North is exhausted.
- Development of the new interchange in concert with the realigned QE II corridor (noted in "a" above), would require the QE II / 65th Avenue SB ramps developed during the interim stage to be replaced.

d. *65th Avenue Corridor improvements;* The 65th Avenue corridor would be widened from a 4-lane cross-section to an ultimate 6-lane cross-section;
- The 65th Avenue / 50th Street intersection which would convert to a 4-leg configuration;

- The 65th Avenue / Sparrow Drive intersection which would convert to a "T" configuration;
- the CP Railway crossing would be modified to accommodate a 6-lane corridor;
- the maximum grade along the vertical profile of 65th Avenue is 3.4% on either side of the interchange bridge; and
- Future flexibility exists to permit a grade-separated 65th Avenue bridge over the existing CP Rail corridor.

e. 50th Street Corridor improvements;

- 50th Street would be widended for a distance of 600m in the vicinity of the 65th Avenue intersection to accommodate a 6-lane cross-section;
- The NB Slip Lane to the east of the roundabout would be widened to provide for a 2-lane configuration
- The QE II NB 50th Street EB/NB-NB On-Ramp would be realigned to accommodate the proposed realigned QE II NB collector lanes noted in (a) above.

f. Perimeter Road Corridor improvements

- The interim stage calls for the southerly extension of the 4-lane Perimeter Road to 65th Avenue West at an intersection located approximately 500m from the CL of the existing QE II corridor. As the CL of the realigned QE II corridor would be shifted approximately 150m to the west, and with the advent of the new 65th Avenue interchange SB On/Off-Ramp configuration, this interim stage intersection would be required to be relocated.
- The Perimeter Road/65th Avenue West intersection would be relocated to a point 500m from the end of the new QE II SB-WB Off-Ramp taper. The new intersection would be a 4-leg configuration and provide access to the future Aerotropolis lands on the south side of 65th Avenue West corridor and Port Alberta lands on the north side.
- Perimeter Road would be required to be extended further to the west to connect to the planned intersection's location. The alignment/configuration of the Perimeter Road intersection is beyond the study limits and remains to be determined.

d. QE II Core Lanes: Flexibility exists to develop the core lanes as a separate stage which can be further expanded, if and when necessary, to a four (4) lane cross-section in each direction in the future. The transfer lanes between the core lanes and the collector lanes were envisioned to be located as follows:

- The SB transfer lane was envisioned to occur south of the QE II / Airport Road SB-EB/WB Off-Ramp and north of the Airport Road Bridge.
- The NB transfer lane was envisioned to occur south of the QE II / Airport Road interchange in the vicinity of the existing Sparrow Crescent Off-Ramp (which is to be closed).

e. 50th Street Fly-over Bridge Replacement: The staging strategy permits the later replacement of the fly-over bridge with either a single lane or two-lane twin structure. (Section 11.11 discusses replacement of the 50th Street Flyover.)

b) Bridge Planning

- *A New Twinned 50th Street Bridge:* The proposed interim strategy calls for a new 2 lane bridge characterized by:
  - a clear 13.9m roadway width on the structure that would accommodate two 3.7m SB lanes, a 3.0m right (south) shoulder and a 2.5m (north) left shoulder;
  - an arrangement consisting of 3 unbalanced spans (50.0-60.0-68.0m) with a total length of 197m; and
  - a 43° angle with the existing QE II corridor (30° angle with the realigned QE corridor);
- *A New 65th Avenue Bridge: :* The proposed ultimate strategy calls for a new bridge characterized by:
  - a clear (varying from 36.5-to-42.5m) roadway width on the structure accommodating three 3.7m lanes in each direction,
  - a right (EB) shoulder varying from 2.0-to-3.0m and a left (WB) shoulder of 2.0m;
  - an arrangement consisting of 3 unbalanced spans (55.0-50.0-39.0m) with a total of length of 174m; and
  - a 33° angle with the realigned QE II corridor.
- *The Existing 50th Street Single lane Fly-Over Bridge:* This bridge would be required to be removed at the time of the ultimate QE II re-alignment to accommodate the proposed core-collector network. The interchange staging illustrated in this functional planning study will maximize the lifespan of the existing structure.
- *The Replacement of the Existing 50th Street Fly-Over Bridge:* Once removed the existing 50th Street Fly-over bridge would be replaced by either:
  - a single lane bridge with a clear roadway width on the structure of 9.3 m accommodating one 4.8 m lane, a 2.5 m right (north) shoulder and a 2.0 m left (south) shoulder; or
  - a two-lane bridge with a clear roadway width on the structure 13.9m accommodating two 3.7m lanes, a 3.0m right (north) shoulder and a 2.5m left (south) shoulder.
  - The arrangement would consist of 3 spans (50.0-60.0-68.0 m) with a length of 197m; and
  - a 30° angle with the realigned QE II corridor. (Section 11.11 discusses replacement of the 50th Street Flyover.)

12.1.6 Conceptual Construction Costs

- The conceptual cost of the entire project was determined to be approximately $160M including the eventual replacement of the existing 50th Street Fly-Over bridge but excluding the cost of the property acquisition.
- Replacement of the existing 50th Avenue Fly-Over bridge with a single-lane structure including ancillary roadwork was estimated at an additional $12.4M and a double-lane structure was estimated at an additional $16.5M. Bridge costs alone were estimated at $9.1M for a single lane bridge and $12.3M for a 2-lane replacement bridge.

- Excluding the replacement of the existing 50th Avenue Fly-Over bridge an overall construction cost of $145M was determined excluding the cost of the property acquisition.
- The $145M cost would be staged with $53.7 representing the "interim" stage and $91.2M representing the "ultimate" stage excluding the 50th Avenue Fly-Over bridge replacement.

12.1.7 Issues and Their Resolution

a) Why and When is the New Twinned 50th Street Bridge Needed?

This Twinned 50th Street Bridge concept was found to be required to be in place sometime before the next decade (2025). The infrastructure:

- is required to accommodate the additional phases of the EIA commercial development beyond Phase I;
- provides an additional east-west corridor over the QE II (connecting 65th Avenue East and the future 65th Avenue West);
- assures alternate local access for Leduc residents to the EIA lands and EIA patrons to Leduc's downtown area;
- diverts traffic away from the QE II/Airport Road and the QE II/50th Avenue interchanges;
- provides the opportunity to provide a SB-WB Off-Ramp and a EB-SB On-Ramp connecting to a 65th Avenue West corridor, when warranted; and
- is intended to make the maximum use of existing infrastructure while providing enhanced connectivity supporting further economic development;

The concept of the Twinned 50th Street Bridge solution was found to:

- delay the need for the 65th Avenue interchange;
- delay the need to undertake QE II freeway realignment modifications prior to developing the QE II / 65th Avenue interchange;
- delay the neeed for widenings the Airport Road Interchange;
- delay the need for an QE II/50th Avenue Interchange improvements; and
- avoid the need to develop an ultimate 8-lane 65th Avenue Interchange.

b) Why and When is a New 65th Avenue Interchange Needed?

The new 65th Avenue interchange:

- was found to be required within a decade (2035) after the Twin 50th Street bridge solution is implemented, assuming significant development of the lands along the 65th Avenue west corridor is achieved;
- would provide enhanced east-west connectivity, providing additional access to the 65th Avenue west lands. Access to the QE II NB corridor would be improved and

traffic diverted from the QE II/Airport Road, the QE II Twin 50th Street bridges and QE II 50th Avenue interchanges.

- was envisioned as a 6-lane arterial bridge with auxiliary turning lanes; and
- could be staged to provide if, and when, warranted a double EB-NB On-loop Ramp with access the QE II NB lanes.

The ultimate stage also provides flexibility in that the core lane arrrangement/configuration can be implemented as a separate stage if, and when, warranted.

Transitioning from the interim stage to the ultimate stage would require modifications to the 65th Avenue West corridor which include:

- the relocation of EIA's Perimeter Road / 65th Avenue intersection to a new more westerly location to make way for the required new QE II / 65th Avenue interchange SB On/Off Ramps; and
- the removal/adjustment of the interim stage 65th Avenue West On/Off-Ramps, should they be implemented in advance of the interchange.

c) When Would the QE II Require Widening and Realignment Improvements?

The existing 3-lane-per-direction QE II freeway corridor north of 50th Avenue would require additional widening at a time when its capacity is exceeded. This study adopted a LOS "C" threshold of 1,900 vehicles-per-hour-per-lane (veh/h/ln) for each lane of the QE II corridor indicating that additional widening would be triggered when the three-lane capacity of 5,700 veh/h is exceeded. It was concluded that:

- An additional lane should be implemented along the QE II in both the SB and NB directions between the QE II / Airport Road and QE II / 50th Street Interchanges by the 2025 Horizon Year to service the forecast 6,140 NB AM and 6,280 SB PM vehicle-per-hour demands.

The development of the 65th Avenue Interchange would trigger "shortly after" the re-alignment and widening of the QE II corridor through the 50th Avenue Interchange.

d) When Would the QE II Core Lanes be Required?

Core lanes were deemed to be warranted when the LOS "C" 4-lane capacity of 7,600 veh/h would be exceeded. Consequently, the study found that the core lanes could be implemented as a two-stage process:

- Phase I would see the development of the core lanes to the vicinity of the QE II / Airport Road Interchange in the near future (A 2017 travel demand forecast indicated demand to be: NB 7,630 PM veh/h & SB 7,945 AM veh/h); and
- Phase II would see the "ultimate" core lane alignment extended to the vicinity of the QE II / 65th Avenue Interchange at the 20 year horizon (A 2035 travel demand forecast indicated demand to be: NB 7,330 AM veh/h / SB 7,650 PM veh/h); This would coincide with a realignment of the QE II corridor through the 65th Avenue Interchange area indicating that the core lanes would be requried soon after, or in concert with the realignment.

Implementation of the core lanes would require the removal of the existing 50th Street Fly-Over bridge.

d) When Should the Existing 50th Street Bridge be Replaced?

This study found that the "ultimate" 65th Avenue Interchange to be warranted within the 20-year (2035) time horizon and the development of QE II core lanes warranted soon after, or in concert with the 65th Avenue interchange. The development of the "ultimate" core lane arrangment to the 65th Avenue interchange would in turn trigger the need to replace the existing 50th Street Fly-Over Bridge as it is compatible with the core lane arrangement. (Section 11.11 discusses replacement of the 50th Street Flyover.)

e) What would happen if the Twinned 50th Street Bridge Solution is Not Implemented?

Without the advent of the Twinned 50th Street Bridge in place by the next decade (2025), the Airport Road Corridor and 50th Avenue Corridor were found to exhibit significant congestion well beyond the existing LOS "C" two-lane capacity of 2,400 veh/h per arterial direction. Forecast 2025 afternoon peak hour traffic volumes indicate that:

- the Airport Rd bridge is forecast to carry almost 3,000 veh/h eastbound exceeding the available 2-lane EB capacity on the QE II bridge; and
- the 50th Avenue underpass is forecast to be service almost 2,700 veh/h westbound exceeding the available 2-lane WB capacity under the QE II bridges.

Both crossings would require improvements widening to be advanced by at least a decade if the Twinned 50th Street bridge solution were not to take place.

f) Why Should the South Leg of the 65th Avenue / Sparrow Drive Intersection be Closed?

The 65th Avenue/ Sparrow Drive intersection is located roughly 110m east of the 65th Avenue/50th Street intersection and 110m west of the CP Rail corridor. Both intersections are traffic signal controlled and the roadway across the CP Rail corridor is controlled by gates and signals. The south leg of the 65th Avenue/Sparrow Drive intersection serves the L.A. Mazda Dealership and connects back to the 50th Street corridor opposite the QE II 50th Street NB-EB Off-Ramp.

Maintaining the 65th Avenue/Sparrow Drive 4-leg traffic signal controlled intersection configuration assuming the 6-lane widening and the proposed improvements was determined to:

- be inconsistent with current design standards;
- be unable to accommodate forecast travel demands;
- result in inefficient traffic signal progression;
- result in a constraint to E-W thru-traffic along the 65th Avenue corridor;
- result in a throttling effect impacting the lanes closest to the median;
- result in travel speed well below the design speed of the 6-lane arterial corridor; and
- result in a "choking point" effecting EB traffic flows between the two traffic signal controlled intersections.

Recognizing this, it is recommended that the south leg of the intersection be phased out progressing through permitted RI-RO operation at the interim stage and closure at the ultimate time frame.

g) When Should the NB-EB QE II Sparrow Crescent Off-Ramp be Closed?

- The closure of the Sparrow Crescent NB-EB Off-Ramp is recommended in order to conform with Alberta Transportation's Freeway Best Practice guidelines, and in order to comply with the requirements of the Highway Development and Protection Regulation, Freeway Access Designations Order (O.C. 587/2009).
- The study found that a 4th NB (weave lane) between the 50th Street EB/NB-NB On-Ramp and the Airport Road NB-EB/WB Off-Ramp would be required within the next decade (2025). The existing Sparrow Crescent NB-EB Off-Ramp would require reconstruction to accommodate this new lane. Such reconstruction should consider the need to accommodate the eventual 2-lane exit requirements to the Airport Road NB-EB/WB Off-Ramp and the future transfer lanes to the NB QE II core lanes. As such AT should consider such reconstruction effort as "throw-away".
- The timing of the Sparrow Crescent NB-EB Off-Ramp closure was determined to be a requirement on, or before, the development of the QE II NB core transfer lanes (should these be confirmed to be situated south of the Airport Road Interchange) which was also determined within this study to be within the next decade (2025).

h) Should the proposed QE II Core lanes be extended South of 65th Avenue?

It was determined that extending the core-collector system further south beyond 65th Avenue would give the false impression that significant capacity exists upstream along the QE II corridor beyond the planned ultimate QE II infrastructure. It was recognized that the QE II corridor would likely always have a constraint south of Ellerslie Road. Ending the core-collector system north of 65th Avenue would provide a natural throttle to northbound traffic and encourage the use of other north/south corridors that are to be developed sometime in the future.

i) What happens to the Accesses onto the QE II 50th Street NB-EB Off-Ramp?

The current configuration of the 50th Street NB-EB Off-Ramp provides for accesses on both the north and south sides of the ramp. The accesses consist of:

- a full access to the Safeway / Leduc Towne Square retail development located on the south side of the Off-Ramp; and
- a full access to the Leduc Chamber of Commerce Site located on the north side of the Off-Ramp.
- an exit-only access is provided from the RV Disposal site onto the ramp on the north side of the Off-Ramp.

In the ultimate time frame when the 50th Street NB-EB ramp is relocated:

- the south access can be closed with the advent of an alternate heavy vehicle-turn around area for use of Safeway / Leduc Towne Square operators which would direct traffic back to 60th Avenue. This solution will require a portion of the lands used by the existing ramp.

- A RI-RO configuration linking to 50th Street was considered as an alternate access for the site that would permit closure of the north ramp accesses, however, this was found to require a complete reconfiguration of the internal parking and driveway circulation network serving the site. It may, in the end, prove worthwhile to consider acquisition of the site and relocate the land use.

12.2 Recommendations

It is recommended that…

1. The infrastructure improvements outlined in the *Queen Elizabeth II and 65th Avenue (Leduc) Functional Planning Study* be received and approved by Alberta Transportation, the City of Leduc and the Edmonton International Airport.
2. All parties be informed that this *Functional Planning Study* represents a planning document and QE II improvements are not currently scheduled nor funded at this time.
3. All parties incorporate the *Functional Planning Study* infrastructure assumptions and conclusions within their respective planning documents (Municipal Development Plans, Transportation Master Plans and Area Structure Plans).
4. Alberta Transportation, the City of Leduc and the Edmonton International Airport pursue those initiatives necessary to confirm the detailed engineering feasibility of the proposed improvements. These activities would likely include, but not be limited to:
   a. Assuring that additional environmental review be undertaken in accordance with AT's new "Terms of Reference for Environmental Evaluation of Highway Infrastructure Projects" (September 2014)
   b. Seeking commitments and endorsement for those components of the functional plan that would proceed to detailed design;
   c. Responding to development driven initiatives to assure that access provisions are in accordance with the 65th Avenue W and QE II access management strategy presented within the Functional Plans; and
   d. Developing individual detailed construction staging plans that offer the flexibility to advance the proposed improvements when warranted.