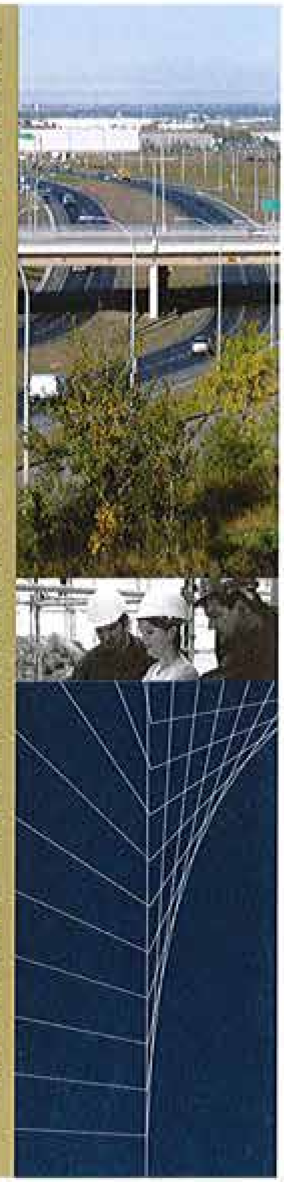
TRANSPORTATION MUNICIPAL/ENVIRONMENTAL STRUCTURAL
LAND DEVELOPMENT LANDSCAPE ARCHITECTURE
PLANNING/COMMUNICATIONS GIS/MAPPING



## City of St. Albert

Final Report

# Ray Gibbon Drive Functional Planning Study

April, 2009

ISL Engineering and Land Services

# RAY GIBBON DRIVE

## Functional Planning Study

## Final Report

April 28, 2009

ISL Engineering and Land Services

Steve Melton, P.Eng.
General Manager, Roadways Design and Construction

Date April 28th, 2009

The City of St. Albert

Accepted by:

Neil Jamieson, P.Eng.
General Manager, Planning and Engineering Division

Date April 29/09

Alberta Transportation

Accepted by:

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Regional Director, North Central Region

Date 09-06-18

Moh Lali Director, P.Eng.
Executive Director, Technical Standards Branch PLANNING

Date July 7, 2009

# Corporate Authorization

This document entitled "*Ray Gibbon Drive Functional Planning Study*" has been prepared by ISL Engineering and Land Services Ltd. (ISL) for the use of "*City of St. Albert*". The information and data provided herein represent ISL's professional judgement at the time of preparation. ISL denies any liability whatsoever to any other parties who may obtain this report and use it, or any of its contents, without the express written consent of ISL.

PROFESSIONAL ENGINEER ALBERTA
SHELLY MOULDS
April 28, 2009

S Moulds
Shelly Moulds, P.Eng.

**PERMIT TO PRACTICE**
*ISL Engineering and Land Services Ltd.*
Signature
Date April 28/2009
PERMIT NUMBER: P 4741
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

# Executive Summary

## 1. Introduction

Ray Gibbon Drive (formerly known as the West Regional Road) will ultimately extend from the north-western extent of the Edmonton's ring road (Anthony Henday Drive), at 137 Avenue in the south, up to Villeneuve Road (Highway 633) to the north. This roadway, which is currently functioning as a 2-lane arterial roadway west of St. Albert, has history that goes back to the 70's when plans for a west St. Albert bypass were first introduced. Construction of the first 2 lanes in both Stages 1 and 2 (between 137 Avenue and McKenney Avenue and between McKenney Avenue and Giroux Road) commenced in 2004 and was completed in 2007. During this time, the Province and the City began to look at the possibility of converting the arterial roadway to an ultimate 8-lane freeway. As an outcome of the meeting between Premier Ed Stelmach and the current mayor at the time, Mayor Paul Chalifoux on September 11, 2007, Alberta Transportation (AT) and the City of St. Albert (the City) completed an overall functional study (Ray Gibbon Drive Functional Planning Study, September 2008) that identifies the modifications required to convert the existing Ray Gibbon Drive from a two-lane arterial roadway to a freeway complete with interchanges at 137 Avenue, McKenney, Giroux, and Villeneuve Roads. This freeway, which the Alberta Transportation would assume responsibility of, would extend north beyond St. Albert and eventually connect with Highway 2.

## 2. Background

In the 1970's the City of St Albert and the Province planned to construct a high speed freeway on the western boundaries of the City. The Province secured 55 acres through River Lots 16 and 16A for the freeway. However, in the mid to late 1990's the City was advised that the road was no longer a priority for the Province and that the City, would be responsible for the full cost of any type of western boundary road. Due to continued development in the west sector of the community and the increasing congestion of St. Albert Road the City initiated the planning and construction of a 4-lane arterial road. This arterial was to provide relief for traffic travelling on St. Albert Road (Highway 2) and connect Anthony Henday Drive to Villeneuve Road with at-grade intersections at 137 Avenue, McKenney Avenue and Giroux Road. The arterial was designed to ultimately be a 4-lane divided roadway with a design speed of 70 km/h (60 km/h posted).

In 2001, when planning started in earnest, the roadway was divided into three sections to facilitate the staging of construction:

- Stage 1: Existing 137 Avenue to McKenney Avenue
- Stage 2: McKenney Avenue to Giroux Road with an at-grade CN Rail crossing
- Stage 3: Giroux Road to Villeneuve Road (shown on Exhibit 3).

Design and construction of Stage 1 commenced in 2004 with the construction of a bridge over the Sturgeon River closely followed by the roadway and drainage facilities between 137 Avenue and McKenney Avenue. Construction of this section was completed before discussions restarted between the City and AT, and consequently this was not designed nor constructed to ultimately become a freeway. However, detailed analysis demonstrates that Stage 1 can easily be converted to a freeway that meets Alberta Transportation standards.

Design and construction of Stage 2 commenced in 2006 and was completed in late 2007. During this period, the City and AT began to discuss the possibility of Ray Gibbon Drive becoming a new link between Morinville and the ring road (Anthony Henday Drive). Consequently, modifications to the City's original Stage 2 design plans were made where possible during final detailed design and construction to meet Alberta Transportation Standards.

Stage 3 design and alignment is near completion and meets all Alberta Transportation standards.

## 3. Design Standards

In order to convert Stages 1 and 2 Ray Gibbon Drive to an Alberta Transportation freeway standard with a design speed of 110 km/h it was necessary to revisit the Transportation Association of Canada (TAC) Geometric Design Guidelines used for the arterial and to review the Alberta Transportation Highway Design Guidelines for a freeway standard facility. A comparison is provided in Table 1 which outlines the design criteria for the existing arterial (UAD-27.4-70), and the proposed freeway (UFD-820.8-110/RFD-820.8-110) that needs to be achieved.

*Table 1: Design Criteria*

| **Design Criteria** | | | **Road Classification** | | |
|---|---|---|---|---|---|
| | | | **UAD-29.4-70** | **UFD-820.8-110** | **RFD-820.8-110** |
| Design Speed (km/h) | | | 70 | 110 | 110 |
| Horizontal Alignment | Minimum Curve Radius (m) | | 190 | 600 | 600 |
| | Spiral Parameter A | | 110 | 220 | 220 |
| Superelevatione | | | 0.06 | 0.06 | 0.06 |
| Vertical Alignment | Crest k | Passing sight distance | n/a | 585 | 585 |
| | | Minimum stopping sight | 22 | 100 | 100 |
| | Sag k | Minimum | 25 | 60 | 60 |
| | | Comfort minimum (Illumination sections only) | 15 | 30 | 30 |
| | Decision sight distance (m) | | 270 | 330-430 | 330-430 |
| Stopping Sight Distance (m) | | | 110 | 235 | 235 |
| Gradient – Desirable minimum % | | | 3 | 3 | 3 |
| Cross Section | Lane width (m) | | 2 @ 3.7 | 4 @ 3.7 | 4 @ 3.7 |
| | Right shoulder width (m) | | 1 | 3 | 3 |
| | Left shoulder width (m) | | 1 | 3 | 3 |
| | Finished pavement width (m) | | 9.4 | 2 @ 20.8 | 2 @ 20.8 |
| | Median width (m) | Rural | n/a | n/a | 23.2 (min) |
| | | Urban | n/a | 7.8 with median barrier | n/a |
| | Ditch width – rural (m) | | n/a | n/a | 4.0 (rounded) |
| | Side slope ratio | Normal | | 6:1 | 6:1 |
| | | On fills - maximum | | 3:1 over 6.5m | 3:1 over 6.5m |
| | Backslope Ratio | Normal | | 5:1 | 6:1 |
| | | Maximum | | 3:1 | 3:1 |

| **Design Criteria** | | **Road Classification** | | |
|---|---|---|---|---|
| | | **UAD-29.4-70** | **UFD-820.8-110** | **RFD-820.8-110** |
| Basic R/W Width (m) | Urban (minimum) | 22.5 | 70 | n/a |
| | Semi-Urban | n/a | n/a | 90 |
| | Rural | n/a | n/a | 100 |
| Cross Streets | Intersection Offset from Interchange Ramp Terminal | 400m | 400m | 400m |

A summary of modifications to the horizontal and vertical alignment that should be made during the conversion of the arterial roadway into a freeway for Stages 1 and 2 of Ray Gibbon Drive is provided in Table 2 below.

*Table 2 : Design Differences*

| Cross-Section Elements | Arterial Standards | Freeway Standards | Modifications Required |
|---|---|---|---|
| Lane Widths | 3.7m | 3.7m | None |
| Shoulders (inside/outside) (m) | 1/1 | 2/3 for 4-lanes<br>2.5/3 for 6-lanes<br>3/3 for 8-lanes | Existing shoulders can be widened during future construction |
| Cross-slopes | 2.5% | 2.0% | None |
| Superelevations | 6% | 6% | None |
| Curb and gutter | Barrier curbs | Semi-mountable/ Mountable | Existing curbs need to be replaced when speed is increased, estimated cost $3M |
| Ditches | N/A | 4m rounded (rural areas only) | None, part of future Stage 3 construction |
| Sideslopes | 10:1 | 6:1 | None |
| Shy lines | 1.7m | 2.8m | None, part of future widening to 8-lane construction |
| Allowable Posted Speed within Study Area | 60 km/h | 100 km/h | The Environmental Impact Assessment completed for Ray Gibbon Drive was completed using a posted speed of 60km/h. If AT wishes to increase the posted speed to 100 km/h, a new EIA will need to be completed. |

In addition, the Province has requested that the crest curve near McKenney be flattened, even though the curve is not sub-standard. Flattening this curve would result in 400m of additional throw-away costs with reconstruction estimated at $1,275,000.

## 4. Modifications/Exemptions Required

Areas that require design exemptions are discussed below:

- **Intersection Offset from Ramp Terminal on 137 Avenue**
  The South Riel Area Structure Plan (ASP) was approved on September 18, 2007 with an intersection located 270m from the proposed interchange ramp terminal.

Changing an approved ASP has serious legal implications and this area is presently under construction. Detailed Synchro analysis has demonstrated that the proximity of the intersection will not negatively impact the operation of the interchange or the freeway.

- **Cross-section at 137 Avenue**
  Due to the status of construction of the South Riel ASP, a retaining wall will be designed along the northeast ramp.

- **Vertical Alignment at Station 7+491**
  The existing crest curve has a k=97, which does not meet the Stopping Sight Distance requirements for 110km/h. The Stopping Sight Distance for 110km/h is k=100. Improving this curve to meet standard will be a negligible improvement.

- **Intersection Offset from Ramp Terminal on McKenney Avenue**
  The Timberlea Area Structure Plan was approved on November 21, 2005 with an intersection located 330m from the proposed interchange ramp terminal. Changing an approved Area Structure Plan has serious legal implications. Detailed Synchro analysis has demonstrated that the proximity of the intersection will not negatively impact the operation of the interchange or the freeway.

- **Intersection Offset from Ramp Terminal on Giroux Road**
  The Northwest Urban Village Area Structure Plan and the North Ridge Area Structure Plan were approved on July 4, 2006 and January 19, 2004, respectively. The ASP's share an intersection located 270m from the proposed ramp terminal. Changing an approved Area Structure Plan has serious legal implications. Detailed Synchro analysis has demonstrated that the proximity of the intersection will not negatively impact the operation of the interchange or the freeway.

These modifications replace the deficiencies table originally submitted in July, 2007.

## 5. Costs to Convert the Arterial to a Freeway

On October 30, 2007, in a letter from Minister Ouellette to Mayor Crouse, the province committed to reimburse the City for the difference in construction costs between an urban arterial standard within a 22.5m right-of-way and a freeway standard right-of-way. To that end, the tables on the next page are cost comparisons for the two roads.

To clarify the differences in the designs and the stages, the following drawings have been included at the back of the executive summary:

- Plan and Profiles for the freeway alignment (PP-01 to PP-03)
- Original 2-lane Arterial for Stage III (Exhibit 3)
- Proposed 2-lane highway for Stage III (construction 2009) (Exhibit 7)
- Overall Right-of-way plan (Exhibit 6)

Reimbursement costs to the City from the Province are equal to $45,418,000. Detailed cost estimates for each scenario have been included in Appendix H of this report.

*Table 3: Costs Incurred (to date) by St. Albert in Construction of Ray Gibbon Drive*

| Scenario 1 | Stage 1 | Stage 2 | Stage 3 | Total Cost | City Responsibility | AT Responsibility |
|---|---|---|---|---|---|---|
| | | | | | | |
| Construction - 2 lanes | $9,802,900 | $5,982,900 | $11,510,900 | $27,296,700 | $27,296,700 | |
| Storm | $3,826,600 | $1,644,500 | $1,769,500 | $7,240,600 | $7,240,600 | |
| Engineering | $2,864,000 | $846,300 | $1,106,700 | $4,817,000 | $4,817,000 | |
| ROW - 22.5 meters | $496,000 | $835,000 | $1,877,700 | $3,208,700 | $3,208,700 | |
| **Subtotal** | **$16,989,500** | **$9,308,700** | **$16,264,800** | **$42,563,000** | **$42,563,000** | |

*Table 4: Estimated Future Costs to Secure All Land Requirements and Construct Stage 3*

| Scenario 2 | Stage 1 | Stage 2 | Stage 3 | Total Cost | City Responsibility | AT Responsibility |
|---|---|---|---|---|---|---|
| Construction -2 lanes | $16,081,100 | $7,959,500 | $17,796,000 | $41,836,600 | $27,296,700 | $14,539,900 |
| Storm | $5,084,500 | $3,510,700 | $6,322,700 | $14,917,900 | $7,240,600 | $7,677,300 |
| Engineering | $4,205,400 | $1,490,800 | $2,097,300 | $7,793,500 | $4,817,000 | $2,976,500 |
| ROW 22.5 meters | $496,000 | | $5,540,000 | $6,036,000 | $3,208,700 | $2,827,300 |
| ROW Addt'l 22.5 meters | $496,000 | | $1,180,000 | $1,676,000 | $0 | $1,676,000 |
| ROW Addt'l 33 meters | $725,000 | $581,000 | $1,736,000 | $3,042,000 | $0 | $3,042,000 |
| ROW Interchanges ( 4 ) | $2,350,000 | $1,685,000 | $8,644,000 | $12,679,000 | $0 | $12,679,000 |
| **Subtotal** | **$29,438,000** | **$15,227,000** | **$43,316,000** | **$87,981,000** | **$42,563,000** | **$45,418,000** |

*Table 5: Estimated Future Costs to Construct Remaining Lanes to 14+600*

| Additional Widening | Stage 1 | Stage 2 | Stage 3 | Total Cost | City Responsibility | AT Responsibility |
|---|---|---|---|---|---|---|
| Widening to 4 lanes w/ bridge | $107,980,000 | $60,782,000 | $117,850,000 | $278,412,000 | $0 | $278,412,000 |
| Additional 2 lanes ( 6 lanes ) | $26,574,000 | $7,908,000 | $19,330,000 | $53,812,000 | $0 | $53,812,000 |
| Additional 2 lanes ( 8 lanes ) | $20,442,000 | $8,936,000 | $19,919,000 | $49,297,000 | $0 | $49,297,000 |
| **Subtotal** | **$154,996,000** | **$77,626,000** | **$157,099,000** | **$381,521,000** | $0 | **$381,521,000** |

**Notes:**

1. The land component for the first 22.5 meters in stage 3 is high due to the requirement to purchase 43 acres for a stormwater management facility.
2. The breakdown for the above is $4,360,000 for storm and $1,180,000 for the road.
3. The storm component is as well high in stage 3 as there is a requirement to extend the storm back into stage 2 which adds $2.4 million to the costs.
4. Land costs in stage 3 are higher as well due to the requirement to purchase land locked lands between the road and the existing North Ridge subdivision. These remnant lands cost approx. $3.3 million dollars.

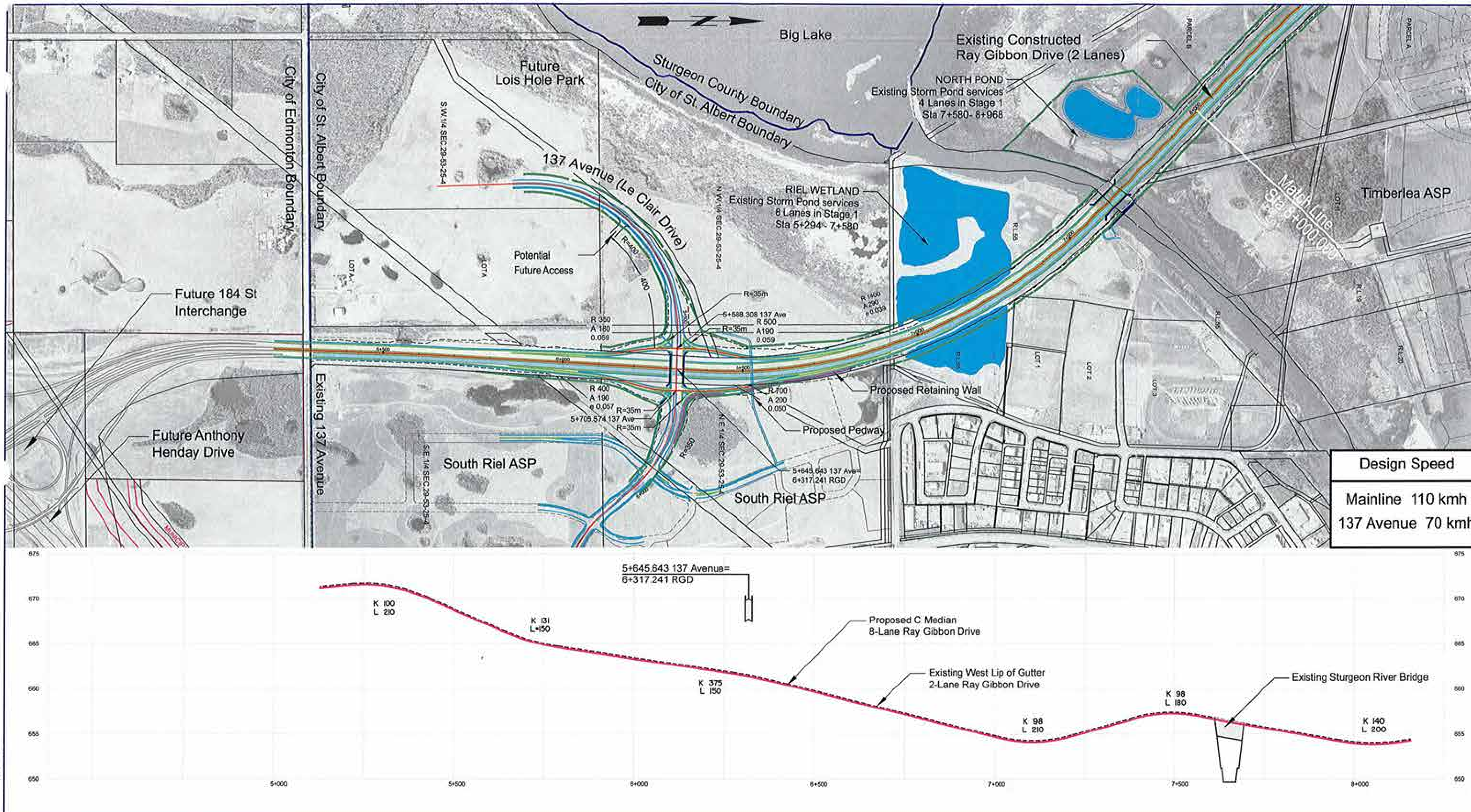
## 6. Noise

Road noise is defined as the sounds generated by vehicles operating on a roadway. This includes, but is not limited to engine/exhaust sounds and road contact sounds. For construction or improvements of highways through urban areas, Alberta Transportation has adopted a noise level of 65 dBa Leq24. Using a 10 year planning horizon, the province is committed to providing noise mitigation measures above the 65 dBa Leq24 threshold.

ACI Acoustical determined that noise attenuation will be required along the east side of Ray Gibbon Drive, from Villeneuve Road to just south of McKenney Avenue as a result of the higher operating speeds, the increased traffic volumes, and the alignment moving within 100m of existing residential development.

## 7. Conclusion and Recommendations

Even though some of Ray Gibbon Drive was designed and constructed prior to Alberta Transportation and the City resuming discussions, detailed analysis shows that the roadway can be easily converted to a freeway. It is recommended that a new Environmental Impact Assessment, as well as procurement of all remnant pieces of land required for Stage 3 be completed within the next year to minimize costs and ensure right-of-ways are obtained. The City is requesting a total reimbursement for $45,418,000 in 2008. This would include reimbursement of $14, 332,000 for work already completed on the Province's behalf in Stages 1 and 2, and an additional $31,086,000 to procure the remaining land in Stage 3 and construct the first two lanes for Stage 3. The additional $31,086,000 being the difference between the costs the City would be required to expend on an arterial standard, on an adjusted alignment versus the costs to upgrade the road to the Provincial freeway standard on the ultimate alignment including all land procurement.




Legend

| | |
|---|---|
| PROPOSED Ray Gibbon Drive | LIMIT OF CUT |
| PROPOSED R/W BDY | LIMIT OF FILL |
| CITY OF ST ALBERT ASP | PROPOSED NOISE WALL |
| EXISTING STORM POND | EXISTING LANDFILL SITE |
| CONSTRUCTED 2-LANE Ray Gibbon Drive | |

Key Plan

SCALE 1:10,000 HORIZONTAL

SCALE 1:400 VERTICAL

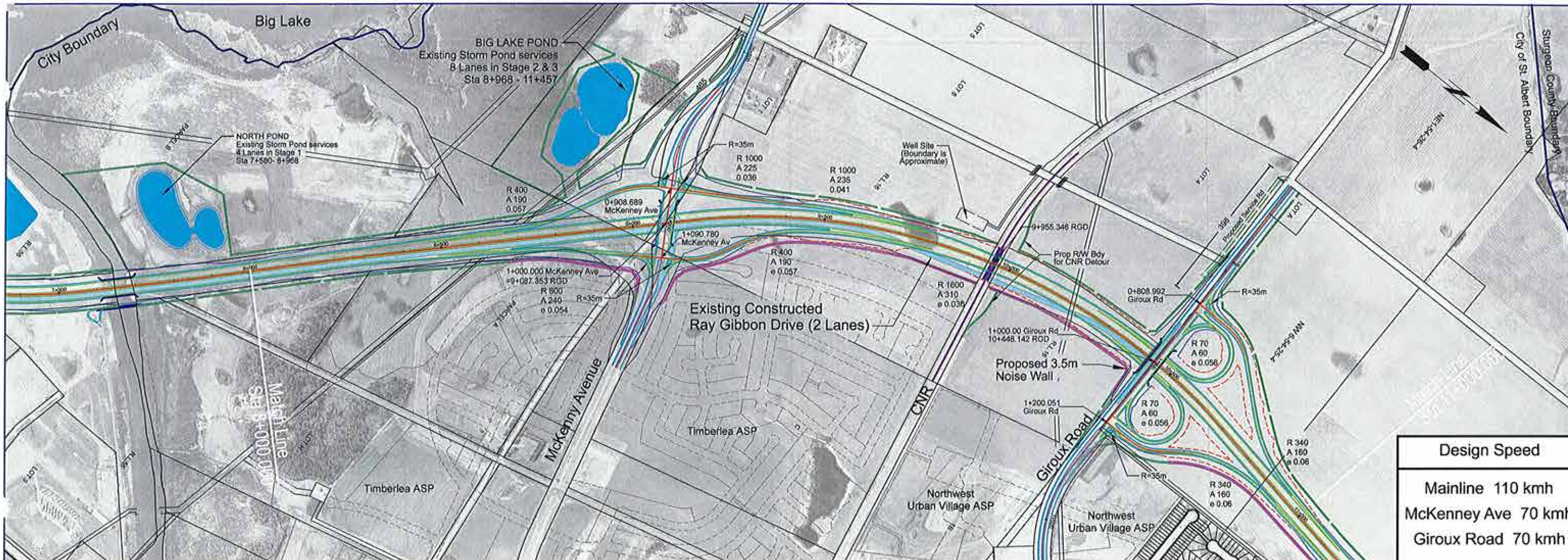
ISL Engineering and Land Services

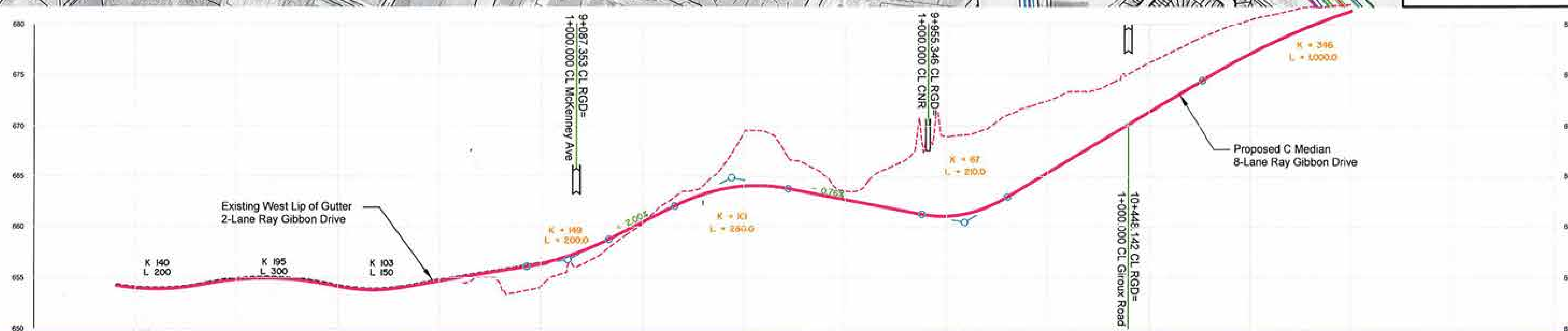
The City of St. Albert

Project: Ray Gibbon Drive

Title: Centreline Plan & Profile
Functional Planning Study
8-Lane Stage

Figure No. PP 01




**ISL** Engineering and Land Services

## Legend

| | | | |
|---|---|---|---|
| PROPOSED Ray Gibbon Drive | | LIMIT OF CUT | |
| PROPOSED R/W BDY | | LIMIT OF FILL | |
| CITY OF ST ALBERT ASP | | PROPOSED NOISE WALL | |
| EXISTING STORM POND | | EXISTING LANDFILL SITE | |
| CONSTRUCTED 2-LANE Ray Gibbon Drive | | | |

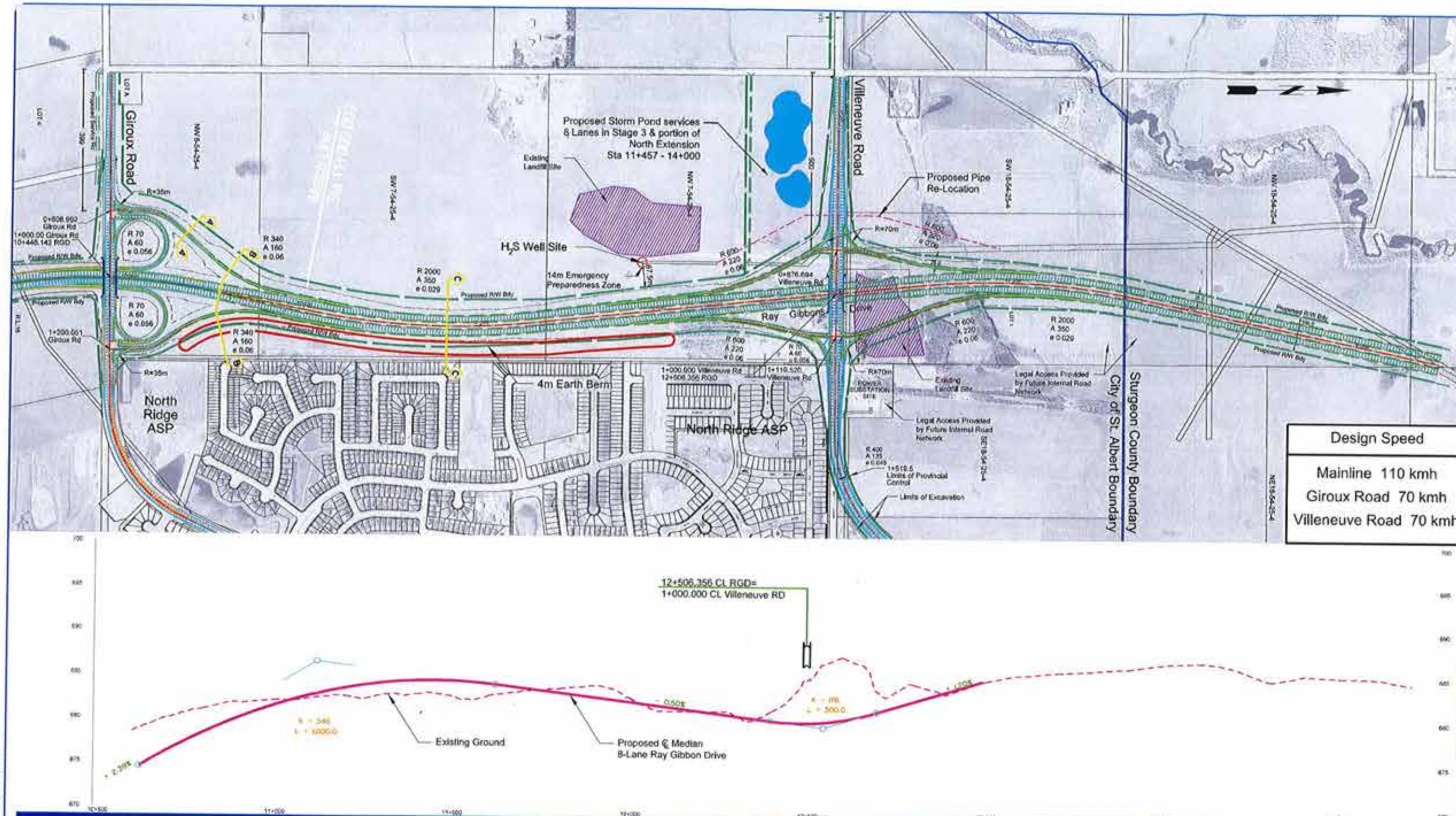
Key Plan

SCALE 1:10,000
100m 0 100m 200m
HORIZONTAL

SCALE 1:400
4m 0 4m 8m
VERTICAL

THE CITY OF St. Albert

| | |
|---|---|
| Project | Ray Gibbon Drive |
| Title | Centreline Plan & Profile<br>Functional Planning Study<br>8-Lane Stage |
| Figure No. | PP 02 |




**Legend**

| | |
|---|---|
| PROPOSED Ray Gibbon Drive | LIMIT OF CUT |
| PROPOSED R/W BDY | LIMIT OF FILL |
| CITY OF ST ALBERT ASP | PROPOSED NOISE WALL |
| EXISTING STORM POND | EXISTING LANDFILL SITE |
| CONSTRUCTED 2-LANE Ray Gibbon Drive | |

Key Plan

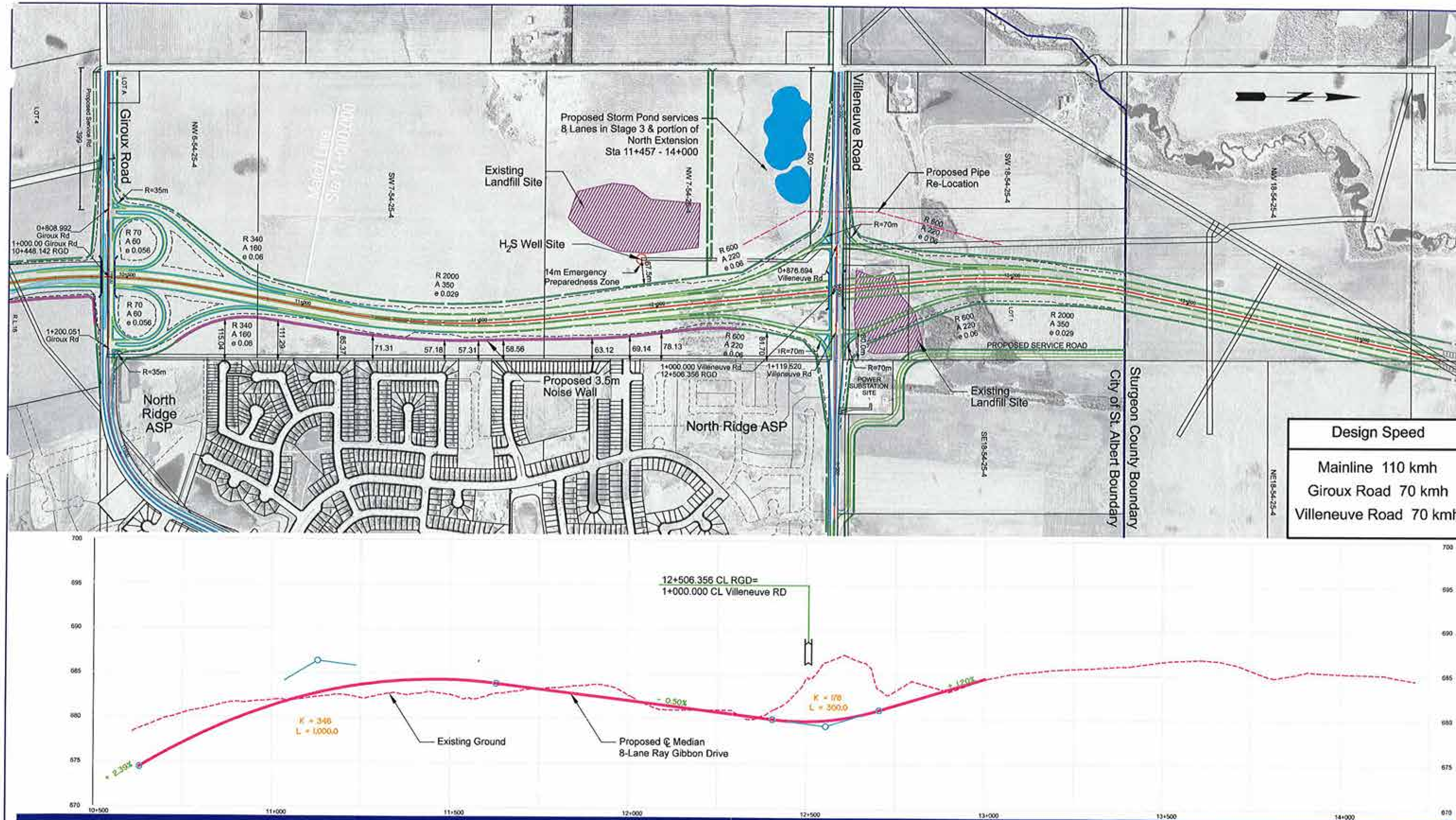
SCALE 1:10 000 — HORIZONTAL

SCALE 1:400 — VERTICAL

ISL Engineering and Land Services

City of St. Albert — Engineering Services

| | |
|---|---|
| Project | Ray Gibbon Drive |
| Title | Centreline Plan & Profile<br>Functional Planning Study<br>8-Lane Stage |
| Figure No. | PP 03 |




## Legend

| | |
|---|---|
| PROPOSED Ray Gibbon Drive | LIMIT OF CUT |
| PROPOSED R/W BDY | LIMIT OF FILL |
| CITY OF ST ALBERT ASP | PROPOSED NOISE WALL |
| EXISTING STORM POND | EXISTING LANDFILL SITE |
| CONSTRUCTED 2-LANE Ray Gibbon Drive | |

Key Plan

SCALE 1:10,000 HORIZONTAL

SCALE 1:400 VERTICAL

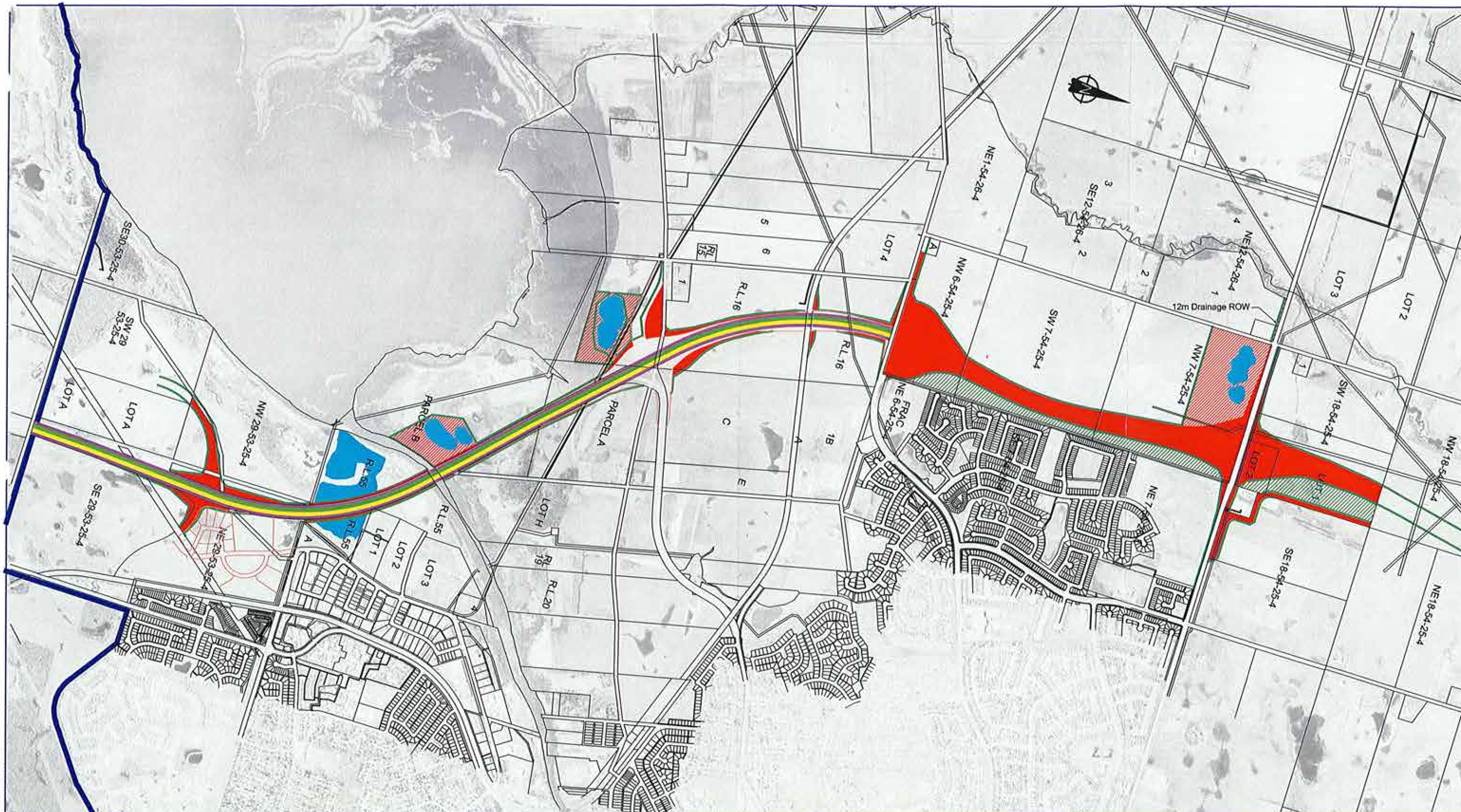
ISL Engineering and Land Services

THE CITY OF St. Albert

Project: Ray Gibbon Drive

Title: Centreline Plan & Profile
Functional Planning Study
8-Lane Stage

Figure No. PP 03




| | |
|---|---|
| 22.5m Right-of-Way | Storm Pond Right-of-Way |
| 45.0m Right-of-Way | Additional Right-of-Way for Berms |
| 78.0m Right-of-Way | |
| Ultimate Right-of-Way | |

SCALE 1:20,000
200m 0 200m 400m
HORIZONTAL

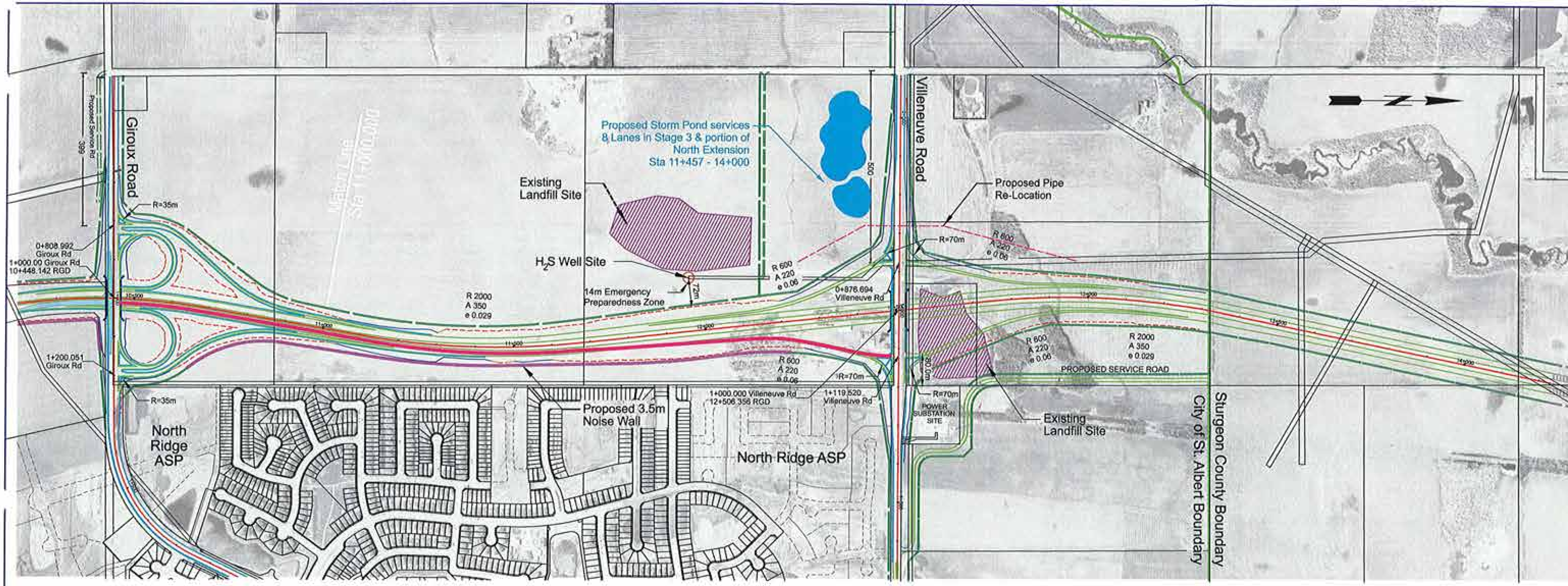
ISL Engineering and Land Services

THE CITY OF St. Albert

Project: Ray Gibbon Drive

Title: Functional Planning Study
Right-of-Way Requirements

Figure No. Exhibit 06




## Legend

| | | | |
|---|---|---|---|
| PROPOSED Ray Gibbon Drive | | PROPOSED 2009 CONSTRUCTION | |
| PROPOSED R/W BDY | | LIMIT OF CUT | |
| CITY OF ST ALBERT ASP | | LIMIT OF FILL | |
| EXISTING STORM POND | | PROPOSED NOISE WALL | |
| CONSTRUCTED 2-LANE Ray Gibbon Drive | | EXISTING LANDFILL SITE | |


SCALE 1:10,000
100m 0 100m 200m
HORIZONTAL

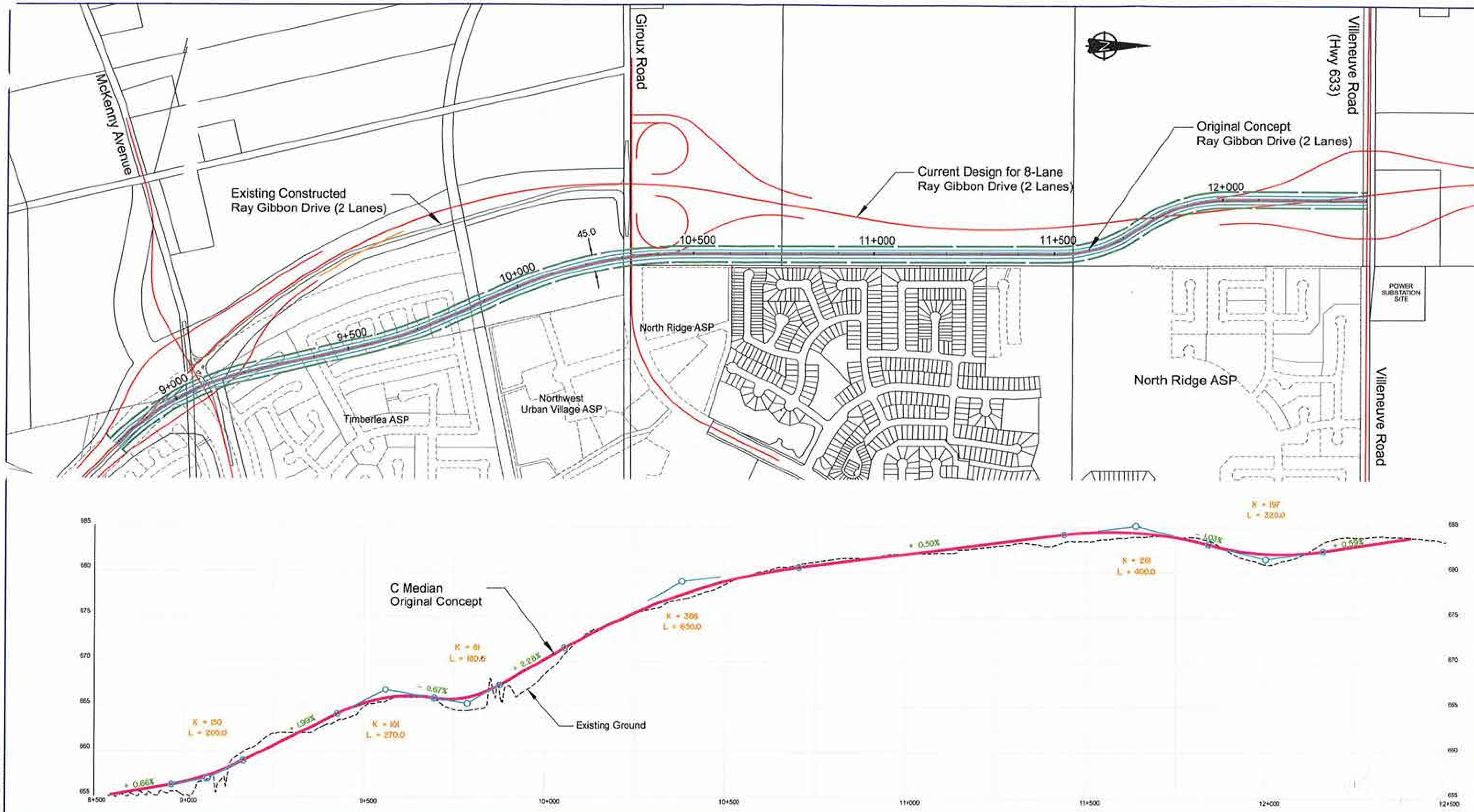
ISL Engineering and Land Services

THE CITY OF St. Albert

Project: Ray Gibbon Drive

Title: Proposed Stage III
Functional Planning Study
2009 Construction

Figure No. Exhibit 7




ISL Engineering and Land Services

SCALE 1:10,000
100m 0 100m 200m
HORIZONTAL

THE CITY OF St. Albert

Project: Ray Gibbon Drive

Title: Functional Planning Study
Original 2 Lane Concept

Figure No.: Exhibit 03

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## Appendices

## Tables



## Exhibits

SECTION 1

# 1.0 Introduction

Ray Gibbon Drive (formerly known as the West Regional Road) will ultimately extend from the north-western extent of the Edmonton's ring road (Anthony Henday Drive), at 137 Avenue in the south, up to Villeneuve Road (Highway 633) to the north. This arterial roadway, west of St. Albert, has history that goes back to the 70's when plans for a west St. Albert bypass were first introduced. Ray Gibbon Drive has recently begun to take shape with the construction of Stages 1 and 2 of this roadway (between 137 Avenue and McKenney Avenue and between McKenney Avenue and Giroux Road) over the past three years. As an outcome of the meeting between Premier Ed Stelmach and the current mayor at the time, Mayor Paul Chalifoux on September 11, 2007, Alberta Transportation and the City of St. Albert (the City) have resumed work on identifying the modifications required to convert the existing Ray Gibbon Drive from a two-lane arterial roadway to a freeway. This freeway, which Alberta Transportation would assume responsibility of, would extend north beyond St. Albert and eventually connect with Highway 2. This report reviews and outlines in detail the modifications that are required to facilitate the conversion.

## 1.1 Background

ISL Engineering and Land Services (ISL) have been involved in the planning and design of Ray Gibbon Drive along the western periphery of St. Albert since 2001. The original conceptual plans featured a four lane arterial roadway within a 58m right-of-way with a design speed of 70km/hour. During the development of the functional plan, the right-of-way was widened to 78m to allow for greater long-term flexibility. ISL also prepared the design and oversaw the construction of the first 2-lane stage of the roadway from Anthony Henday Drive at 137 Avenue to McKenney Avenue in 2004 to 2007 and from McKenney Avenue to Giroux Road in 2007.

To demonstrate the viability of converting the arterial roadway into an eight-lane freeway, the City retained ISL to prepare conceptual plans to transform at-grade intersections on Ray Gibbon Drive to interchanges, develop typical cross-sections for an eight-lane 110 km/h freeway, identify ultimate road right-of-way requirements, and identify ultimate drainage and alignment requirements. Conceptual plans were prepared with interchanges located at Villeneuve Road, Giroux Road, McKenney Avenue, and at 137 Avenue (which was realigned to the north of its present location). As this planning work was being completed, the detailed design and construction of the first two stages of the arterial road was also being finalized, and modifications were made to the design and the construction to easily accommodate the future modification to a freeway standard roadway.

Alberta Transportation also commissioned ISL Engineering and Land Services at the same time to develop functional plans for the extension of Ray Gibbon Drive north from Villeneuve Road north to Highway 2, just south of Morinville. This report does not address that study.

## 1.2 Scope

This report details the following:

- The scope of physical work necessary to facilitate the ultimate conversion of the recently completed urban arterial, Ray Gibbon Drive to an 8-lane freeway meeting Alberta Transportation's standards. This analysis also includes the ultimate right-of-way requirements so that the land can be purchased to protect for the conversion of the mainline from arterial to freeway.
- The cost be for the ultimate long term eight lane cross section freeway throughout the entire length from Anthony Henday Drive to Villeneuve Road (Highway 633). These costs will include the costs of all the elements including roadways, interchanges, drainage, lighting, staging, environmental considerations etc.
- The different construction staging scenarios that exist to facilitate the conversion.
- Required actions to be completed by Alberta Transportation including recommended timelines to ensure interests are adequately protected.

The future eight lane freeway has been preliminarily designed to Alberta Transportation standards and includes the following:

- A traffic analysis determining the type and size of the interchanges and their configurations, as well as identifying the requirements for an eventual eight lanes of traffic.
- The freeway has been planned for a design speed of 110km/h with all elements of the freeway design identified and meeting the Alberta Transportation Highway Geometric Design Guidelines for horizontal and vertical curves, stopping and decision sight distances, ultimate cross-sections, etc.
- The freeway will tie in with the ultimate Alberta Transportation's plans for Anthony Henday Drive at the TUC, the potential future extension north of Villeneuve Road, as well as the City of St. Albert road network at 137 Avenue, McKenney Avenue, Giroux Road and Villeneuve Road. Interchanges should be developed to accommodate expected long-term traffic demand.
- An ultimate grade-separated CN crossing. Initial assessments of the structures required for this and the interchanges have been completed.
- Drainage of the interchanges will be gravity based, without any reliance on lift stations.
- An assessment of utility impacts.
- An initial geotechnical assessment.
- Initial environmental, noise and historical assessments.
- Opinions of probable costs for each of the individual elements of the project.

SECTION 2

# 2.0 Traffic Analysis

A traffic analysis has been completed to determine the type and configuration of the interchanges at 137 Avenue, McKenney Avenue, Giroux Road and Villeneuve Road as well as the operation of Ray Gibbon Drive as a freeway. The following analyses were performed:

- Freeway lane requirements
- Cross street lane requirements
- Queuing at the ramp terminals
- Merge and Diverge requirements
- Weave requirements, and
- Proximity of intersections on the cross-streets to the interchanges

## 2.1 Projected Traffic Volumes

AT, in partnership with the City of Edmonton, maintains a regional traffic forecasting model for the greater Edmonton's region's transportation system and a west St. Albert bypass is included as part of this overall modelling. The long-range forecasts from the provincial 2.5 million population horizon model where used to assess the capacity requirements for Ray Gibbon Drive. The model provided PM peak hour volumes. AM volumes were derived by reversing the traffic movements and reducing the volumes by 5%. These volumes are shown in Exhibits 1 and 2 on the next page.

## 2.2 Freeway Lane Requirements

The data provided in Table 2.1 identifies the required service volumes by service level for an urban freeway with a design speed of 110 km/h:

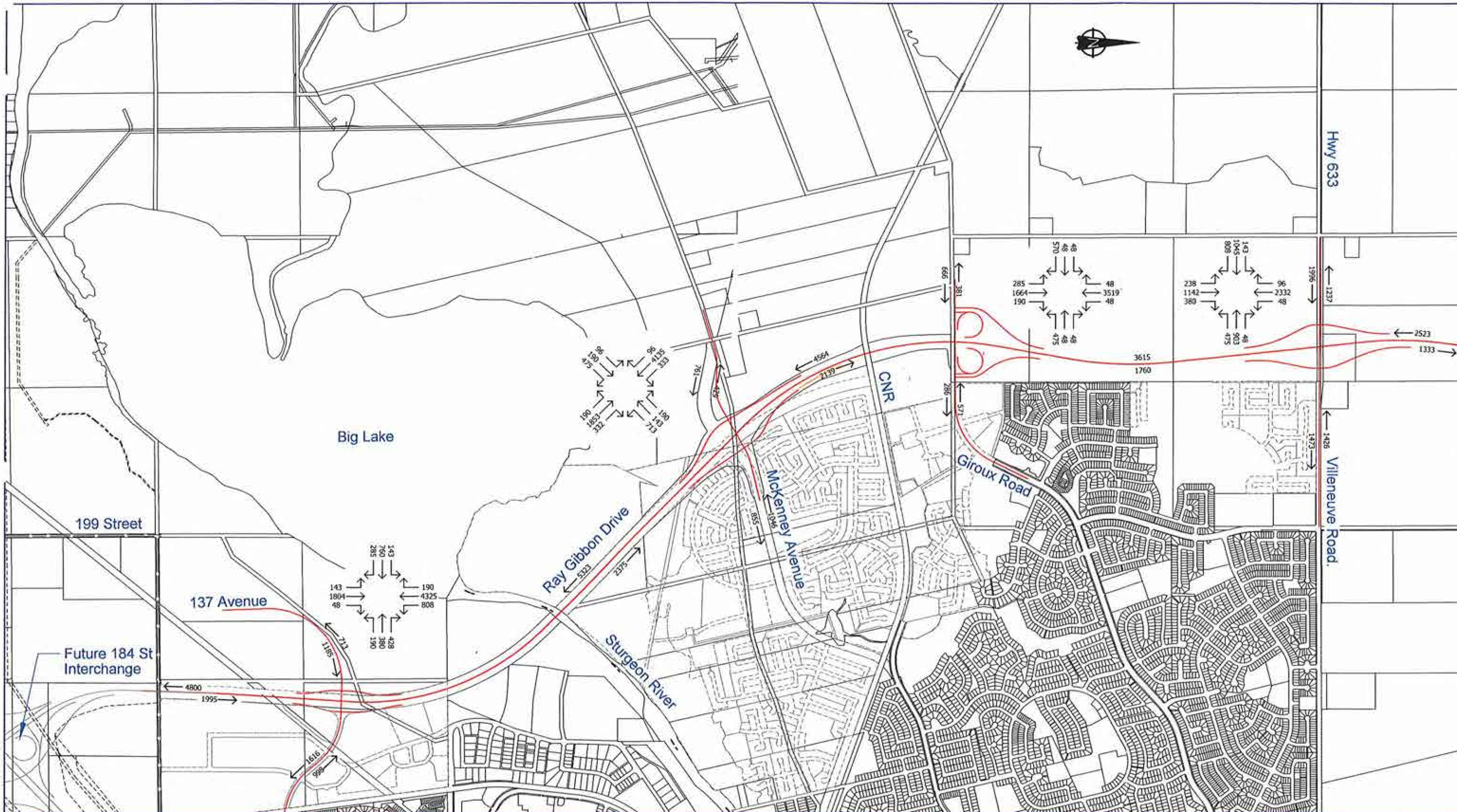
*Table 2.1: Service Levels for Urban Freeways*

| Number of Lanes | Service Volumes (veh/h) for LOS | | | | |
|---|---|---|---|---|---|
| | A | B | C | D | E |
| 2 | 1,230 | 1,940 | 2,820 | 3,680 | 4,110 |
| 3 | 1,900 | 2,980 | 4,340 | 5,570 | 6,200 |
| 4 | 2,590 | 4,070 | 5,920 | 7,500 | 8,310 |
| 5 | 3,320 | 5,210 | 7,550 | 9,450 | 10,450 |

Source: Exhibit 13-6 on page 13-13 of the Highway Capacity Manual 2000

Recent freeway planning by Alberta Transportation in the Edmonton area have strived to maintain a level of service "D" for ultimate long term traffic conditions and have in some cases accepted a service level "E". Accordingly, the same levels of service thresholds were applied to Ray Gibbon Drive.

On the basis of the projected traffic volumes illustrated in Exhibits 1 and 2, and the Level of Service thresholds identified in Table 2.1, the following lane requirements have been identified for a freeway standard Ray Gibbon Drive:

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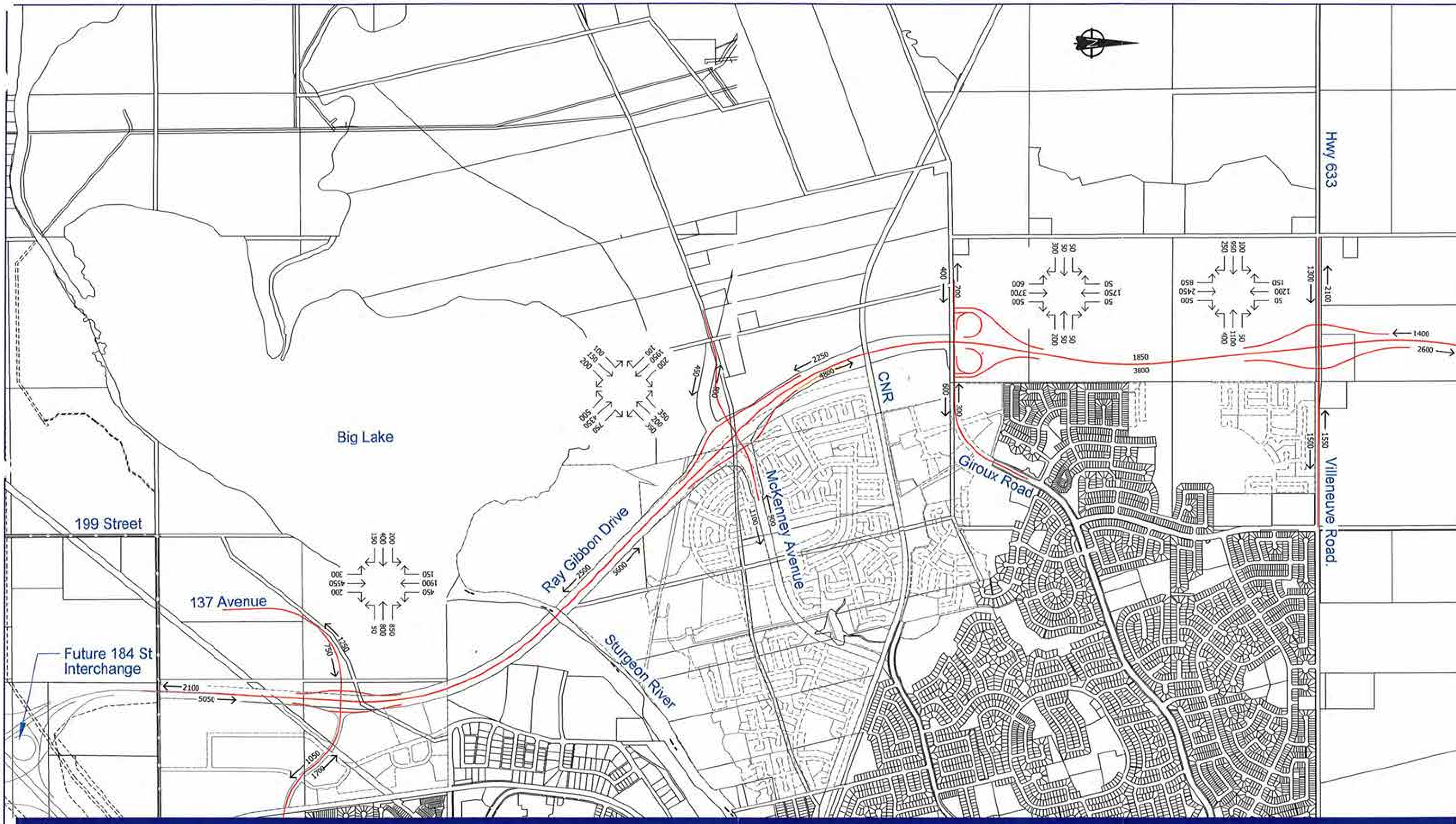
| Project | Ray Gibbon Drive |
| Title | Functional Planning Study<br>Long Term AM Peak Hour Volumes |
| Figure No. | Exhibit 01 |

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THE CITY OF St. Albert

Project: Ray Gibbon Drive

Title: Functional Planning Study
Long Term PM Peak Hour Volumes

Figure No.: Exhibit 02

*Table 2.2: Lane Requirements for Ray Gibbon Drive*

| Freeway Segment | Projected Long Term Peak Hour Volume in PM Peak Direction | Total 2-Way Lane Requirements (for LOS D or better) | Estimated Level of Service |
|---|---|---|---|
| Anthony Henday Dr. to 137 Ave | 5,050 | 6 | D |
| 137 Ave to McKenney Ave | 5,600 | 8 | C |
| McKenney Ave to Giroux Rd | 4,800 | 6 | D |
| Giroux Rd to Villeneuve Rd | 3,800 | 6 | C |

Ray Gibbon Drive has been ultimately designed for an eight-lane cross-section along its entire corridor and therefore will provide sufficient capacity for many years to come.

## 2.3 Lane Requirements on Cross Streets

The two-way volumes on the cross streets (from Exhibits 1 and 2) are shown in Table 2.3.

*Table 2.3: Lane Requirements for the Cross Streets along Ray Gibbon Drive*

| Cross Street | East of RGD | | West of RGD | |
|---|---|---|---|---|
| | AM Peak | PM Peak | AM Peak | PM Peak |
| 137 Avenue | 2,614 | 2,750 | 1,898 | 2,000 |
| McKenney Avenue | 1,901 | 2,000 | 1,190 | 1,250 |
| Giroux Road | 857 | 900 | 1,047 | 1,100 |
| Villeneuve Road | 2,899 | 3,050 | 3,233 | 3,400 |

Based on a lane capacity of 1,200 vehicles per hour per lane, the cross-streets will operate sufficiently with a four-lane cross section.

## 2.4 Interchange Configurations

Each of the three interchanges at 137 Avenue, McKenney and Villeneuve Road will be simple diamond interchanges. The interchange at Giroux Road will be a Parclo A-B, to provide more weaving distance between it and the interchange at McKenney Avenue.

## 2.5 Ramp Terminals

An analysis of the traffic operation at the ramp terminals of the above noted configurations were completed to determine acceptable level of service and to ensure that queuing does not back up and interfere with other traffic. The tables below show the volume to capacity ratios, the level-of-service (LOS), and the 95th percentile queue length for each movement during the peak hours calculated in Synchro. All turning movements are based on a single lane unless otherwise noted.

*Table 2.4: Traffic Analysis of 137 Avenue Simple Diamond Interchange, AM Peak*

| Movement | v/c | LOS | Queue (m) |
|---|---|---|---|
| **West Terminal** | | | |
| EB Through | 0.80 | C | 94 |
| EB Right | 0.19 | A | 0 |
| SB Left (double) | 0.62 | C | 84 |
| SB Right | 0.13 | A | 0 |
| WB Left | 0.73 | C | 44 |
| WB Through | 0.32 | B | 35 |
| **East Terminal** | | | |
| EB Left | 0.31 | A | 15 |
| EB Through | 0.73 | B | 85 |
| NB Left (double) | 0.18 | C | 18 |
| NB Right | 0.03 | A | 0 |
| WB Through | 0.26 | A | 21 |
| WB Right | 0.38 | A | 7 |

*Table 2.5: Traffic Analysis of 137 Avenue Simple Diamond Interchange, PM Peak*

| Movement | v/c | LOS | Queue (m) |
|---|---|---|---|
| **West Terminal** | | | |
| EB Through | 0.32 | A | 34 |
| EB Right | 0.10 | A | 0 |
| SB Left (double) | 0.43 | C | 43 |
| SB Right | 0.10 | A | 0 |
| WB Left | 0.14 | A | 8 |
| WB Through | 0.58 | A | 45 |
| **East Terminal** | | | |
| EB Left | 0.60 | B | 52 |
| EB Through | 0.38 | A | 41 |
| NB Left (double) | 0.44 | C | 34 |
| NB Right | 0.14 | A | 0 |
| WB Through | 0.38 | A | 8 |
| WB Right | 0.67 | A | 45 |

*Table 2.6: Traffic Analysis of McKenney Avenue -Simple Diamond Interchange AM Peak*

| Movement | v/c | LOS | Queue (m) |
|---|---|---|---|
| **West Terminal** | | | |
| EB Through | 0.44 | C | 27 |
| EB Right | 0.71 | A | 21 |
| SB Left (double) | 0.31 | B | 31 |
| SB Right | 0.17 | A | 10 |

| Movement | v/c | LOS | Queue (m) |
|---|---|---|---|
| West Terminal | | | |
| WB Left (double) | 0.75 | C | 65 |
| WB Through | 0.18 | A | 14 |
| East Terminal | | | |
| EB Left | 0.62 | C | 24# |
| EB Through | 0.39 | A | 23 |
| NB Left (double) | 0.14 | A | 10 |
| NB Right | 0.46 | A | 23 |
| WB Through | 0.64 | B | 49 |
| WB Right | 0.27 | A | 14m |

Note: The # footnote indicates that the volume for the 95th percentile cycle exceeds capacity. The m footnote indicates that volume for the 95th percentile queue is metered by an upstream signal.

*Table 2.7: Traffic Analysis of McKenney Avenue Simple Diamond Interchange PM Peak*

| Movement | v/c | LOS | Queue (m) |
|---|---|---|---|
| West Terminal | | | |
| EB Through | 0.40 | C | 20 |
| EB Right | 0.14 | A | 0 |
| SB Left (double) | 0.17 | B | 15 |
| SB Right | 0.07 | A | 0 |
| WB Left (double) | 0.51 | C | 23 |
| WB Through | 0.45 | B | 52 |
| East Terminal | | | |
| EB Left | 0.60 | C | 18 |
| EB Through | 0.35 | A | 18 |
| NB Left (double) | 0.28 | A | 27 |
| NB Right | 0.51 | A | 0 |
| WB Through | 0.55 | B | 31 |
| WB Right | 0.24 | A | 0 |

*Table 2.8: Traffic Analysis of Giroux Road Parclo AB Interchange, AM Peak*

| Movement | v/c | LOS | Queue (m) |
|---|---|---|---|
| West Terminal | | | |
| EB Through | 0.04 | A | 4 |
| EB Left | 0.73 | B | 54 |
| SB Right | 0.03 | A | 0 |
| SB Left (double) | 0.08 | C | 9 |
| WB Right | 0.50 | A | 40 |
| WB Through | 0.21 | B | 41 |
| | | | |

| Movement | v/c | LOS | Queue (m) |
|---|---|---|---|
| **East Terminal** | | | |
| EB Through | 0.07 | B | 12 |
| EB Left | 0.17 | A | 7 |
| SB Right | 0.40 | A | 18 |
| SB Left (double) | 0.27 | A | 20 |
| WB Right | 0.08 | A | 4 |
| WB Through | 0.40 | B | 25 |

*Table 2.9: Traffic Analysis of Giroux Road Parclo AB Interchange, PM Peak*

| Movement | v/c | LOS | Queue (m) |
|---|---|---|---|
| **West Terminal** | | | |
| EB Through | 0.04 | A | 6 |
| EB Left | 0.60 | B | 32 |
| SB Right | 0.13 | A | 9 |
| SB Left (double) | 0.07 | C | 9 |
| WB Right | 0.23 | A | 23 |
| WB Through | 0.38 | B | 55 |
| **East Terminal** | | | |
| EB Through | 0.10 | A | 6 |
| EB Left | 0.15 | B | 11 |
| SB Right | 0.65 | A | 37 |
| SB Left (double) | 0.58 | B | 53 |
| WB Right | 0.10 | A | 5 |
| WB Through | 0.24 | B | 16 |

*Table 2.10: Traffic Analysis of Villeneuve Road Simple Diamond Interchange, AM Peak*

| Movement | v/c | LOS | Queue (m) |
|---|---|---|---|
| **West Terminal** | | | |
| EB Through | 0.50 | B | 53 |
| EB Right | 0.55 | A | 0 |
| SB Left | 0.21 | C | 13 |
| SB Right | 0.06 | A | 0 |
| WB Left (double) | 0.64 | B | 38 |
| WB Through | 0.29 | A | 0 |
| **East Terminal** | | | |
| EB Left | 0.45 | B | 24 |
| EB Through | 0.34 | A | 0 |
| NB Left (double) | 0.42 | C | 21 |
| NB Right | 0.26 | A | 0 |
| WB Through | 0.54 | B | 56 |
| WB Right | 0.03 | A | 0 |

*Table 2.11: Traffic Analysis of Villeneuve Road Simple Diamond Interchange, PM Peak*

| Movement | v/c | LOS | Queue (m) |
|---|---|---|---|
| **West Terminal** | | | |
| EB Through | 0.42 | B | 43 |
| EB Right | 0.28 | A | 11 |
| SB Left | 0.22 | C | 13 |
| SB Right | 0.10 | A | 0 |
| WB Left (double) | 0.63 | C | 35 |
| WB Through | 0.50 | A | 45 |
| **East Terminal** | | | |
| EB Left | 0.39 | B | 12 |
| EB Through | 0.39 | A | 33 |
| NB Left (double) | 0.80 | C | 66 |
| NB Right | 0.34 | A | 0 |
| WB Through | 0.76 | B | 76 |
| WB Right | 0.03 | A | 0 |

Some concerns were raised regarding the sensitivity of the volumes at Giroux Road. A sensitivity analysis was performed at Giroux Road to determine if a 25% increase in traffic would affect the overall operation of the interchange. The results are shown in Tables 2.12 and 2.13.

*Table 2.12: Traffic Analysis of Giroux Road Parclo AB Interchange with Increased Traffic, AM Peak*

| Movement | v/c | LOS | Queue (m) |
|---|---|---|---|
| **West Terminal** | | | |
| EB Through | 0.05 | A | 6 |
| EB Left | 0.85 | B | 136 |
| SB Right | 0.04 | A | 0 |
| SB Left (double) | 0.11 | D | 16 |
| WB Right | 0.69 | C | 120 |
| WB Through | 0.30 | C | 89 |
| **East Terminal** | | | |
| EB Through | 0.11 | A | 6 |
| EB Left | 0.32 | B | 9 |
| SB Right | 0.52 | A | 32 |
| SB Left | 0.33 | A | 24 |
| WB Right | 0.11 | A | 4 |
| WB Through | 0.58 | B | 28 |

*Table 2.13: Traffic Analysis of Giroux Road Parclo AB Interchange with Increased Traffic, PM Peak*

| Movement | v/c | LOS | Queue (m) |
|---|---|---|---|
| West Terminal | | | |
| EB Through | 0.05 | A | 5 |
| EB Left | 0.74 | B | 50 |
| SB Right | 0.20 | B | 11 |
| SB Left (double) | 0.11 | C | 12 |
| WB Right | 0.28 | A | 73 |
| WB Through | 0.47 | B | 79 |
| East Terminal | | | |
| EB Through | 0.11 | B | 8 |
| EB Left | 0.20 | C | 20 |
| SB Right | 0.72 | A | 81 |
| SB Left | 0.67 | B | 124 |
| WB Right | 0.15 | A | 11 |
| WB Through | 0.38 | C | 44 |

The single movement at level-of-service "D" for the increased traffic scenario confirms that the Giroux Road interchange will operate at an acceptable level-of-service in the long-term even with an increase in traffic of 25%.

Therefore the interchange through roadways 137 Avenue, McKenney Avenue, Giroux Road and Villeneuve Road will operate at an acceptable level-of-service as configured with minimal queues that do not obstruct traffic on other legs of the interchange based on the traffic volumes provided.

## 2.6 Merges, Diverges, and Weaves on the Mainline

A merge and diverge analysis was completed using the Highway Capacity Software on the mainline of Ray Gibbon Drive to ensure that enough distance exists for vehicles to safely merge on and off of Ray Gibbon Drive from each of the interchange ramps. The merge and diverges from Anthony Henday Drive have not been included in the analysis since they are classified as a Major Merge and Major Diverge. The Highway Capacity Manual (HCM) classifies a Major Merge as an area in which two primary roadways, each having multiple lanes, merge together to form a single segment. Similarly, a Major Diverge is defined as an area that has a single segment that splits into two primary roadways, each having multiple lanes. Analysis of these areas is limited to confirming the capacity of each roadway on either side of the junction, which indicates that these areas will operate at an acceptable LOS.

The results of the merge and diverge analysis are shown below:

*Table 2.14: Level-of-Service for Merges and Diverges with Eight Lanes*

| Ramp Location | | Southbound | | Northbound | |
|---|---|---|---|---|---|
| | | AM | PM | AM | PM |
| Villeneuve | Diverge | A | B | B | A |
| | Merge | A | B | B | B |
| Giroux | Diverge | A | C | B | A |
| | Merge | A | B | B | B |
| McKenney | Diverge | B | C | C | A |
| | Merge | B | B | B | B |
| 137 Ave | Diverge | A | C | C | B |
| | Merge | B | C | B | A |

Weave analysis was also completed to ensure sufficient weaving distance between the exit and entrance gores of two adjacent interchanges. Highway Capacity Software limits weave sections to a maximum of 750m. More than this is considered to be merging and diverging sections with a freeway section in between. The results of the weaving analysis using this method are shown below for the mainline. This analysis assumed that 10% of the ramp traffic would exit at the next interchange.

*Table 2.15: Level-of-Service for Weaving Sections on the Mainline*

| Location | Southbound | | Northbound | |
|---|---|---|---|---|
| | AM | PM | AM | PM |
| Villeneuve | | | | |
| | 843m | | 852m | |
| Giroux | | | | |
| | 660m | | 654m | |
| | LOS C | LOS B | LOS B | **LOS D** |
| McKenney | | | | |
| | 1751m | | 1736m | |
| 137 Avenue | | | | |
| | 894m | | 788m | |
| Anthony Henday Drive | | | | |

The southbound weave between Giroux and McKenney will operate at an acceptable level-of-service. The northbound will operate at LOS D, which is still acceptable in the long-term.

The Parclo AB creates a weave on the bridge with a LOS A for both peak hours, based on the 1986 TAC method for weaves on an interchange.

## 2.7 Proximity of Intersections on Cross-Streets the to Interchanges

Alberta Transportation has a standard offset of 400m from a ramp terminal to an intersection to ensure that the interchange is not negatively affected by queues at the local intersection. There are currently three proposed intersections that are within 400m of the proposed interchange ramps along Ray Gibbon Drive at Giroux Road, McKenney Avenue, and 137 Avenue. Long-term traffic analysis for the peak hours in Synchro 7 have indicated that the intersections will not affect the interchange ramp terminals (refer to Synchro printouts in Appendix C). Based on this analysis, design exceptions have been requested at these locations. Decision sight distance for Ray Gibbon Drive exceeds 110km/h. Decision sight distance on the cross roads meets the minimum criteria for 60km/h.

### 2.7.1 Giroux Road

The North Ridge ASP is located north of Giroux Road and was approved by City Council on January 19, 2004. The south half of this ASP has been developed, except for a small parcel adjacent to Giroux Road. This area is intended for low to medium density residential and a park/stormwater facility. Access to this area is limited to two accesses along Giroux Road, the proposed intersection and one further east. There is no connection to the internal road network within the ASP.

The Northwest Urban Village ASP is located south of Giroux Road and was approved by City Council on July 4, 2006. This ASP is undeveloped, except for the Fire Hall that is located in the east corner along Giroux Road. Public access to this area is limited to the proposed intersection. Emergency access from the Fire Hall is located further east on Giroux Road.

The ASP's share an intersection on Giroux Road approximately 270m east of the of the ramp terminal for the Giroux Road interchange. Traffic analysis indicates that the intersection will operate at LOS A in the AM and PM peaks, with a maximum eastbound queue of 50m, assuming no left turn bay. This analysis assumes a 4-lane cross-section on Giroux Road and a 2-lane cross-section on the local road with left-turn bays.

### 2.7.2 McKenney Avenue

The Timberlea ASP is located east of the Ray Gibbon Drive between the CN Rail and the Sturgeon River and was approved by City Council on November 21, 2005. This ASP is currently undeveloped.

The ASP has an intersection located approximately 330m east of the ramp terminal for the McKenney interchange. Traffic analysis indicates that the intersection will operate at LOS B in the AM and PM peaks, with a maximum eastbound queue of 100m, assuming no left turn bay. This analysis assumes a 4-lane cross-section on McKenney and a 2-lane cross-section on the local road with left-turn bays.

### 2.7.3 137 Avenue

The South Riel ASP is located east of Ray Gibbon Drive was approved by City Council on September 18, 2007. This ASP is bordered to the west by Ray Gibbon Drive, to the south by the current 137 Avenue alignment (which will be closed once the Anthony Henday is constructed), to the east by the CN Rail line (approximately 675m from the east ramp terminal on Ray Gibbon Drive), and to the north by Levasseur Road. This ASP has mixed zoning with little industrial/commercial and residential proposed within its boundaries. Construction is scheduled for the spring of 2008.

The ASP has two intersections along 137 Avenue, located approximately 250m and 450m east of the ramp terminal for the 137 Avenue interchange. Traffic analysis indicates that the intersection closest to the interchange will operate at LOS B in the AM peak and LOS C in the PM peak, with a maximum eastbound queue of 60m, assuming a double left turn bay. This analysis assumes a 4-lane cross-section on 137 Avenue and a 4-lane cross-section (near the intersection) on the local road with left- and right-turn bays.

For discussion purposes, these intersections were combined together half way between Ray Gibbon Drive and the at-grade crossing of the CN line. The single intersection would operate at LOS C in the AM peak (2 movements at LOS D) and LOS D in the PM peak (with 1 movement at LOS D, 3 movements at LOS E, and 3 movements at LOS F). The maximum eastbound queue is expected to be 130m. As a single intersection operates with a much lower Level of Service than the proposed double intersection concept, the single intersection is expected to fail sooner.

### 2.7.4 Conclusion

The intersections identified in the ASP's along Ray Gibbon Drive will not affect the operation of the interchanges when constructed.

## 2.8 Overall Traffic Analysis

The traffic projections are based on the Provincial 2.5 million population model for the overall capital region. This model has been produced to provide some idea of global traffic volumes rather than at individual intersections/interchanges. As such, there is a fair level of uncertainty at this stage for actual turning movements at specific intersections/interchanges and therefore to provide an additional factor of safety the bridge structures and ramps have been planned with double left-turn bays to further increase the future capacity of the interchanges. The overall results of the traffic analysis are that Ray Gibbon Drive will operate at an acceptable level-of-service in the long-term for the 2.5 million population horizon.

SECTION 3

# 3.0 Freeway Geometric Design

The following section outlines the requirements of Alberta Transportation to convert Ray Gibbon Drive from a 70km/h arterial roadway to a 110 km/h freeway. The new freeway section will require additional right-of-way than what has already been secured, due to the wider cross section and especially at the interchanges and a focus on different elements than the arterial section.

## 3.1 The History of the Arterial Alignment

In the 1970's the City of St Albert and the Province planned to construct a high speed freeway on the western boundaries of the City. The Province secured 55 acres through River Lots 16 and 16A for the freeway. However, in the mid to late 1990's the City was advised that the road was no longer a priority for the Province and that the City, would be responsible for the full cost of any type of western boundary road. Due to continued development in the west sector of the community and the increasing congestion of St. Albert Road the City initiated the planning and construction of a 4-lane arterial road. This arterial was to provide relief for traffic travelling on St. Albert Road (Highway 2) and connect Anthony Henday Drive to Villeneuve Road with at-grade intersections at 137 Avenue, McKenney Avenue and Giroux Road. The arterial was designed to ultimately be a 4-lane divided roadway (with capability of expansion to 6-lanes) with a design speed of 70 km/h (60 km/h posted).

In 2001, when planning started in earnest, the roadway was divided into three sections to facilitate the staging of construction:

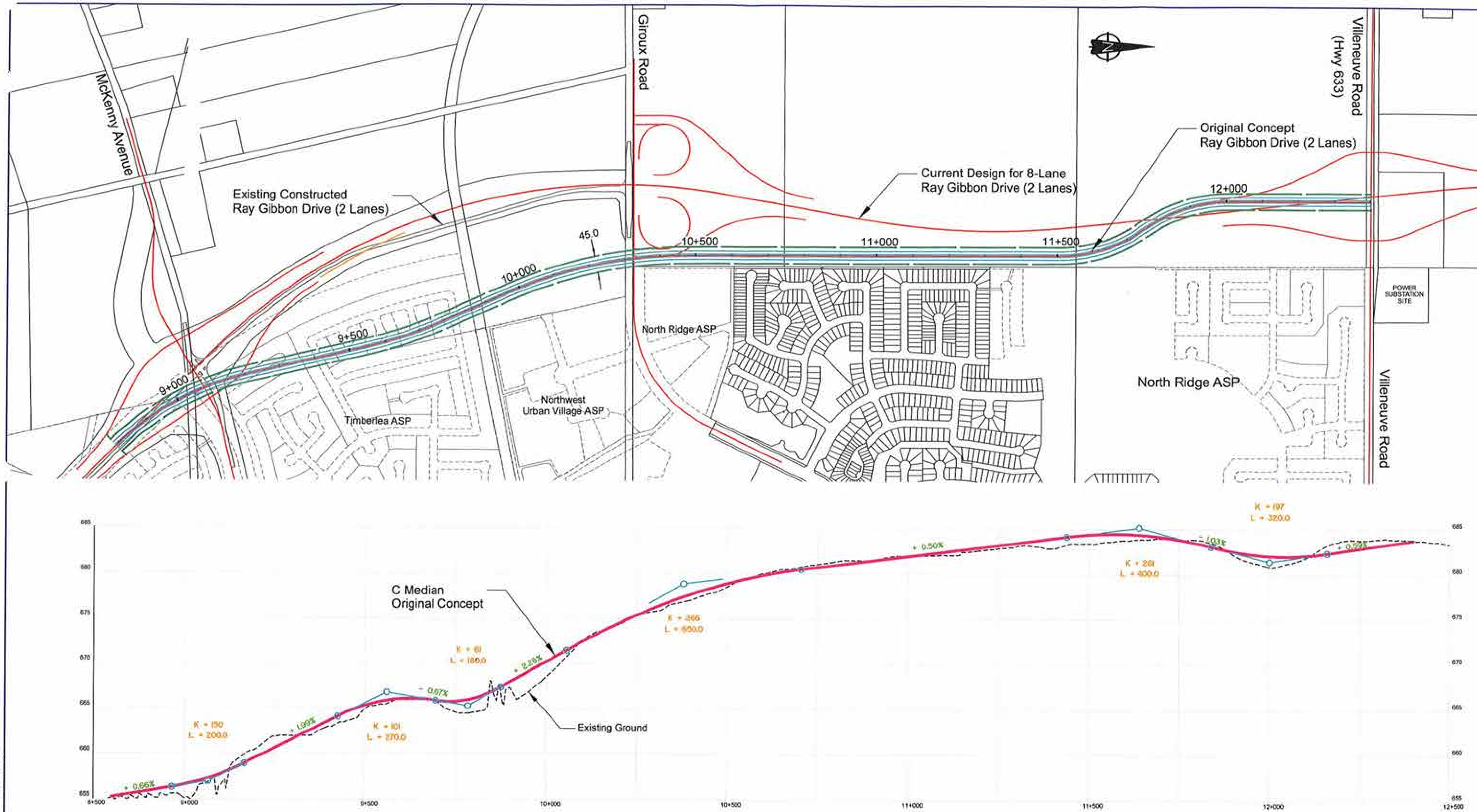
- Stage 1: Existing 137 Avenue to McKenney Avenue
- Stage 2: McKenney Avenue to Giroux Road with an at-grade CN Rail crossing
- Stage 3: Giroux Road to Villeneuve Road (shown on Exhibit 3).

Design and construction of Stage 1 commenced in 2004 with the construction of a bridge over the Sturgeon River closely followed by the roadway and drainage facilities between 137 Avenue and McKenney Avenue. Construction of this section was completed before discussions started between the City and AT, and consequently this was not designed nor constructed to ultimately become a freeway. However, detailed analysis demonstrates that Stage 1 can be converted to a freeway that meets Alberta Transportation standards (see 3.2 below).

The connector roadway, McKenney Avenue was designed and tendered in 2006, between Ray Gibbon Drive and Lacombe Lake Park at Morgan Crescent in the City, crossing the CN track at the park and facilitating the future development of the Timberlea area according to the approved Area Structure Plan.

Another contract was tendered in 2007 to complete Stage 2 between McKenney Avenue and Giroux Road. At the same time, the City and Alberta Transportation were seriously discussing the possibility of Ray Gibbon Dive becoming a new link between Morinville and the ring road (Anthony Henday Drive). Consequently, modifications to the City's original design plans were made during final detailed design and construction to facilitate the roadways eventual conversion to a freeway in the future. These modifications included:

- Modification of horizontal and vertical alignments on Stage 2 to meet the future design speed of 110 km/h
- Providing a detoured alignment at the CN tracks to allow for the future construction of an underpass on the future alignment




ISL Engineering and Land Services

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THE CITY OF St. Albert

| | |
|---|---|
| Project | Ray Gibbon Drive |
| Title | Functional Planning Study<br>Original 2 Lane Concept |
| Figure No. | Exhibit 03 |

- Shifting the horizontal alignment to the west between McKenney Avenue and Villeneuve Road to provide adequate space for future interchanges including a Parclo AB at Giroux Road and a diamond at Villeneuve Road
- Expanded road right-of-way where required to provide sufficient cutbacks.

Stage 3 design and alignment is near completion and meets all Alberta Transportation standards.

## 3.2 Freeway Design Guidelines

In order to convert Ray Gibbon Drive to an Alberta Transportation freeway standard with a design speed of 110 km/h it was necessary to revisit the Transportation Association of Canada (TAC) Geometric Design Guidelines used for the arterial and to review the Alberta Transportation Highway Design Guidelines for a freeway standard facility. A comparison is provided in Table 3.1 which outlines the design criteria for the existing arterial (UAD-27.4-70), and the proposed freeway (UFD-820.8-110/RFD-820.8-110) that needs to be achieved.

*Table 3.1: Design Criteria*

| Design Criteria | | | Road Classification | | |
|---|---|---|---|---|---|
| | | | UAD-29.4-70 | UFD-820.8-110 | RFD-820.8-110 |
| Design Speed (km/h) | | | 70 | 110 | 110 |
| Horizontal Alignment | Minimum Curve Radius (m) | | 190 | 600 | 600 |
| Horizontal Alignment | Spiral Parameter A | | 110 | 220 | 220 |
| Superelevation e | | | 0.06 | 0.06 | 0.06 |
| Vertical Alignment | Crest k | Passing sight distance | n/a | 585 | 585 |
| Vertical Alignment | Crest k | Minimum stopping sight | 22 | 100 | 100 |
| Vertical Alignment | Sag k | Minimum | 25 | 60 | 60 |
| Vertical Alignment | Sag k | Comfort minimum (Illumination sections only) | 15 | 30 | 30 |
| Vertical Alignment | Decision sight distance (m) | | 270 | 330-430 | 330-430 |
| Stopping Sight Distance (m) | | | 110 | 235 | 235 |
| Gradient – Desirable minimum % | | | 3 | 3 | 3 |
| Cross Section | Lane width (m) | | 2 @ 3.7 | 4 @ 3.7 | 4 @ 3.7 |
| Cross Section | Right shoulder width (m) | | 1 | 3 | 3 |
| Cross Section | Left shoulder width (m) | | 1 | 3 | 3 |
| Cross Section | Finished pavement width (m) | | 9.4 | 2 @ 20.8 | 2 @ 20.8 |
| Cross Section | Median width (m) | Rural | n/a | n/a | 23.2 (min) |
| Cross Section | Median width (m) | Urban | n/a | 7.8 with median barrier | n/a |
| Cross Section | Ditch width – rural (m) | | n/a | n/a | 4.0 (rounded) |
| Cross Section | Side slope ratio | Normal | | 6:1 | 6:1 |
| Cross Section | Side slope ratio | On fills - maximum | | 3:1 over 6.5m | 3:1 over 6.5m |
| Cross Section | Backslope Ratio | Normal | | 5:1 | 6:1 |
| Cross Section | Backslope Ratio | Maximum | | 3:1 | 3:1 |

| Design Criteria | | Road Classification | | |
|---|---|---|---|---|
| | | UAD-29.4-70 | UFD-820.8-110 | RFD-820.8-110 |
| Basic R/W Width (m) | Urban (minimum) | 22.5 | 70 | n/a |
| | Semi-Urban | n/a | n/a | 90 |
| | Rural | n/a | n/a | 100 |
| Cross Streets | Intersection Offset from Interchange Ramp Terminal | 400m | 400m | 400m |

A typical cross-section is shown in Exhibit 4. Additional cross-sections are provided in Appendix J.

### 3.2.1 Stopping Sight Distance

Stopping Sight Distance is required along the entire roadway to allow a vehicle, travelling at the assumed running speed (the design speed) to stop before reaching a stationary object in its path. From Table B.2.3 of Alberta's Highway Geometric Design (HGDG), the minimum stopping sight distance is 235m for a design speed of 110km/h.

Stopping Sight Distance is achieved along the entire roadway, except at the vertical curve located at 7+491. This crest curve is marginally below the minimum design criteria, but will have negligible impacts. Changes are not recommended.

### 3.2.2 Decision Sight Distance

Decision Sight Distance is required in areas where drivers must make complex instantaneous decisions, when information is difficult to perceive, or when unexpected or unusual manoeuvres are required, such as at interchanges and intersections. From Table B.2.6 on Alberta's HGDG, the decision sight distance is 330m for a design speed of 110km/h. Decision Sight Distance is achieved at the interchanges for a design speed of 110km/h; however, posted speeds will need to be reduced to 90 km/h or less near the McKenney intersection until the interchange is constructed to meet Decision Sight Distance requirements around the Jersey barrier, if the roadway is widened to the inside at 6 lanes. In addition, while the roadway is signalized, it is unlikely that the posted speed would be more than 70 km/h.

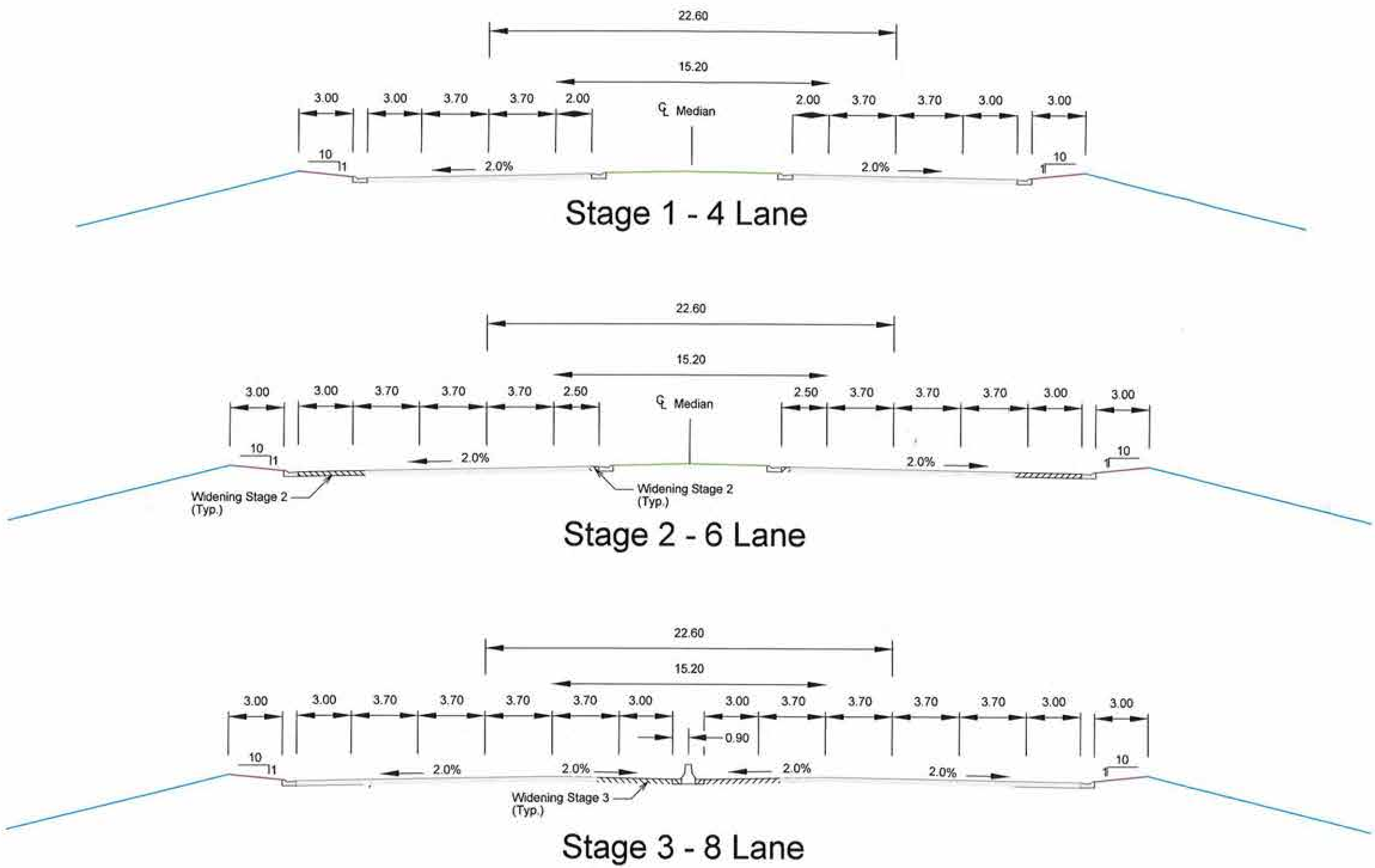
## 3.3 Horizontal Alignment

Ray Gibbon Drive from Anthony Henday Drive at 137 Avenue to Villeneuve Road was designed with horizontal curves as shown in Table 3.2:

*Table 3.2: Horizontal Curve Data*

| Station | Radius (m) | Spiral Data (A) |
|---|---|---|
| 7+100 | 1400 | 290 |
| 9+600 | 1600 | 310 |
| 11+350 | 2000 | 350 |
| 13+100 | 2000 | 350 |

The first two stages (from 137 Avenue to Giroux Road) were constructed with these horizontal curves. The third stage has been designed with these curves but not constructed yet.




# Ray Gibbon Drive

ISL Engineering and Land Services

SCALE 1:250

The City of St. Albert

Project: Ray Gibbon Drive

Title: Cross Section — 4 Lane - 8 Lane Staging

Figure No.: Exhibit 4

When the freeway is expanded to eight lanes, the intent is to widen to the centre by removing the wide median and replacing it with a median new jersey or F shaped barrier between the opposing traffic flows between 137 Avenue until the cross section becomes rural, just south of Villeneuve Road. The Jersey barrier proposed in the urban cross-section will reduce the driver's ability to see obstacles around the outside of horizontal curves and the requirements for stopping and decision sight distances discussed above were reviewed in these areas.

From Figure 8-3.9b of Alberta's HGDG, the lateral clearance requirements on a 1400m curve (smallest radius on the proposed alignment) is 4.93m. The ultimate cross-section provides 5.75m of lateral clearance from the Jersey barrier to the center of the inside driving lane; therefore, stopping sight distance is achievable along the entire alignment.

Using the formula on Figure B-3.9b of the HGDG, a minimum horizontal radius of 2,375m would be needed to accommodate intersections on curves for a design speed of 110km/h. If the McKenney Avenue interchange is not in place at the 6-lane stage (assuming widening to the inside), a maximum achievable posted speed of 90 km/h along Ray Gibbon Drive will be required near the intersection in the short-term to accommodate the lateral obstruction. Realistically, the posted speed would be 70 km/h until the signals are removed.

Stopping sight distance for 110km/h is achieved along the entire length of Ray Gibbon Drive. Decision site distance for 110km/h is adequate for exit ramps at the interchanges; however, it is only sufficient for 90km/h at the McKenney Avenue intersection. Ray Gibbon Drive should be posted at 70 km/h until the intersections are removed, which is consistent with normal practice for signalized intersections.

## 3.4 Vertical Alignment

Ray Gibbon Drive from Anthony Henday Drive at 137 Avenue to Villeneuve Road was designed with vertical curves as shown in Table 3.3:

*Table 3.3: Vertical Curve Data*

| Station | Crest/Sag | K Value |
|---|---|---|
| 5+700 | Sag | 131 |
| 6+200 | Crest | 375 |
| 7+100 | Sag | 98 |
| 7+500 | Crest | 98 |
| 8+050 | Sag | 140 |
| 8+300 | Crest | 195 |
| 8+600 | Sag | 103 |
| 9+000 | Sag | 149 |
| 9+500 | Crest | 101 |
| 10+000 | Sag | 67 |
| 11+100 | Crest | 346 |
| 12+600 | Sag | 176 |

The first two stages (from 137 Avenue to Giroux Road) were constructed with these vertical curves. The third stage has been designed with these curves but not constructed yet. The crest curve at 7+491 has a k value of 97.83 which is just short of the stopping sight distance requirements for 110 km/h of 100. However, this curve is already constructed and the positive benefits to modifying this vertical curve would be negligible.

## 3.5 Cross-Section Elements

### 3.5.1 Lane Widths

Stages 1 and 2 of Ray Gibbon Drive were constructed with 3.7m lanes, which meet Alberta Transportation standards for a design speed of 110 km/h. No changes are required.

### 3.5.2 Shoulders

Stages 1 and 2 of Ray Gibbon Drive were constructed with 1m shoulders. Alberta Transportation's standards require 2m inside shoulders and 3m outside shoulders at the 4-lane stage. These shoulders should be widened during twinning. Additional shoulder widening is required at the 6 and 8 –lane stages.

### 3.5.3 Cross Slopes and Superelevation

Stages 1 and 2 of Ray Gibbon Drive were constructed with a 2.5% cross slope and a superelevation of 6%. Alberta Transportation standards use a 2% cross slope and a superelevation of 6%. No changes are required.

### 3.5.4 Curb and Gutter

Stages 1 and 2 of Ray Gibbon Drive were constructed with barrier style curb and gutters, which is acceptable up to a design speed of 70 km/h. Semi-mountable or mountable curbs are required for higher speeds.

### 3.5.5 Ditches

Ray Gibbon Drive was originally designed as an urban arterial from 137 Avenue to Villeneuve Road. The plan was modified to transition to a rural cross-section between Giroux Road and Villeneuve Road to tie into the cross-section proposed to the north. The rural portion of the project was designed with a 4m rounded ditch bottom.

### 3.5.6 Sideslopes

Stages 1 and 2 of Ray Gibbon Drive were constructed with 10:1 sideslopes, which is sufficient in the urban areas. The rural section was designed with a 6:1 and a 5:1 backslope.

### 3.5.7 Shy Line Offsets

The shy line offset is defined as "the distance beyond which an object will not be perceived as an obstacle and result in motorists reducing speed or moving laterally away from the object". Median barriers and bridge railings should be placed beyond the shy line offset to ensure that the road operates at an acceptable level. The values in Table 3.4 were taken from Table 3.1.6.4 of the TAC manual. The HGDG does not identify shy line offsets requirements.

*Table 3.4: Shy Line Offsets*

| Design Speed (km/h) | Shy Line Offset (m) |
|---|---|
| 130 | 3.7 |
| 120 | 3.2 |
| 110 | 2.8 |
| 100 | 2.4 |
| 90 | 2.2 |
| 80 | 2.0 |
| 70 | 1.7 |
| 60 | 1.4 |
| 50 | 1.1 |

The proposed cross-section along the mainline places the median 3.0m from the driving lane, which meets the shy line offset for a design speed of 110 km/h. However, the Sturgeon River Bridge was designed with a 2.0m outside shoulder and 2.0m inside shoulder. Refer to Section 4.2 for details on modifying the cross-section across the bridge.

## 3.6 Summary of Modifications

A summary of modifications to the horizontal and vertical alignment that should be made during the conversion of the arterial roadway into a freeway for Stages 1 and 2 of Ray Gibbon Drive is provided in Table 3.5 below.

*Table 3:5: Design Differences*

| Cross-Section Elements | Arterial Standards | Freeway Standards | Modifications Required |
|---|---|---|---|
| Lane Widths | 3.7m | 3.7m | None |
| Shoulders (inside/outside) (m) | 1/1 | 2/3 for 4-lanes<br>2.5/3 for 6-lanes<br>3/3 for 8-lanes | Existing shoulders can be widened during future construction |
| Cross-slopes | 2.5% | 2.0% | None |
| Superelevations | 6% | 6% | None |
| Curb and gutter | Barrier curbs | Semi-mountable/ Mountable | Existing curbs need to be replaced when speed is increased, estimated cost $3M |
| Ditches | N/A | 4m rounded (rural areas only) | None, part of future Stage 3 construction |
| Sideslopes | 10:1 | 6:1 | None |
| Shy lines | 1.7m | 2.8m | None, part of future widening to 8-lane construction |
| Allowable Posted Speed within Study Area | 60 km/h | 100 km/h | The Environmental Impact Assessment completed for Ray Gibbon Drive was completed using a posted speed of 60km/h. If AT wishes to increase the posted speed to 100 km/h, a new EIA will need to be completed. |

In addition, the Province has requested that the crest curve near McKenney be flattened, even though the curve is not sub-standard. Flattening this curve would result in 400m of additional throw-away costs with reconstruction estimated at $1,275,000.

## 3.7 Modifications / Exemptions Required

Areas that require design exemptions are discussed below:

- **Intersection Offset from Ramp Terminal on 137 Avenue**
  The South Riel Area Structure Plan (ASP) was approved on September 18, 2007 with an intersection located 270m from the proposed interchange ramp terminal. Changing an approved ASP has serious legal implications and this area is presently under construction. Detailed Synchro analysis has demonstrated that the proximity of the intersection will not negatively impact the operation of the interchange or the freeway.

- **Cross-section at 137 Avenue**
  Due to the status of construction of the South Riel ASP, a retaining wall will be designed along the northeast ramp.

- **Vertical Alignment at Station 7+491**
  The existing crest curve has a k=97, which does not meet the Stopping Sight Distance requirements for 110km/h. The Stopping Sight Distance for 110km/h is k=100. Improving this curve to meet standard will be a negligible improvement.

- **Intersection Offset from Ramp Terminal on McKenney Avenue**
  The Timberlea Area Structure Plan was approved on November 21, 2005 with an intersection located 330m from the proposed interchange ramp terminal. Changing an approved Area Structure Plan has serious legal implications. Detailed Synchro analysis has demonstrated that the proximity of the intersection will not negatively impact the operation of the interchange or the freeway.

- **Intersection Offset from Ramp Terminal on Giroux Road**
  The Northwest Urban Village Area Structure Plan and the North Ridge Area Structure Plan were approved on July 4, 2006 and January 19, 2004, respectively. The ASP's share an intersection located 270m from the proposed ramp terminal. Changing an approved Area Structure Plan has serious legal implications. Detailed Synchro analysis has demonstrated that the proximity of the intersection will not negatively impact the operation of the interchange or the freeway.

These modifications replace the deficiencies table originally submitted in July, 2007.

## 3.8 137 Avenue Interchange

### 3.8.1 Interchange Design

Plans are under development for the realignment of 137 Avenue to provide access to lands between Ray Gibbon Drive and Levasseur Road, north of Anthony Henday Drive. 137 Avenue will ultimate pass through the Lois Hole Park and connect to 215 Street at Highway 16. From discussions between the City of St. Albert and the Province, a final interchange location was confirmed at 6+317, which was as far south as possible while respecting the province's desire to maintain an 800m weaving distance to the Anthony Henday Interchange.

The 137 Avenue interchange is planned as a diamond type interchange with Ray Gibbon Drive remaining depressed and the cross street being elevated slightly due to natural topography to provide the necessary clearances.

The South Riel Area Structure Plan (ASP) was approved by City Council on September 18, 2007 and has some implications on the proposed interchange. First, to upgrade Ray Gibbon Drive and the interchange to provincial freeway standards additional land is required beyond the footprint identified in the ASP. With construction on this ASP underway, development is expected on these lots before the province takes over Ray Gibbon Drive. The Province has agreed to construct a retaining wall along the northeast ramp of the interchange to minimize impacts to the developer. The wall, located at the edge of the clear zone, with a 5m maintenance corridor provided along the property line (where required), preserves 0.96 acres of the ASP that would be required using traditional sideslopes. Based on the grading proposed by the developer, the retaining walls would reach a height of 3.4m.

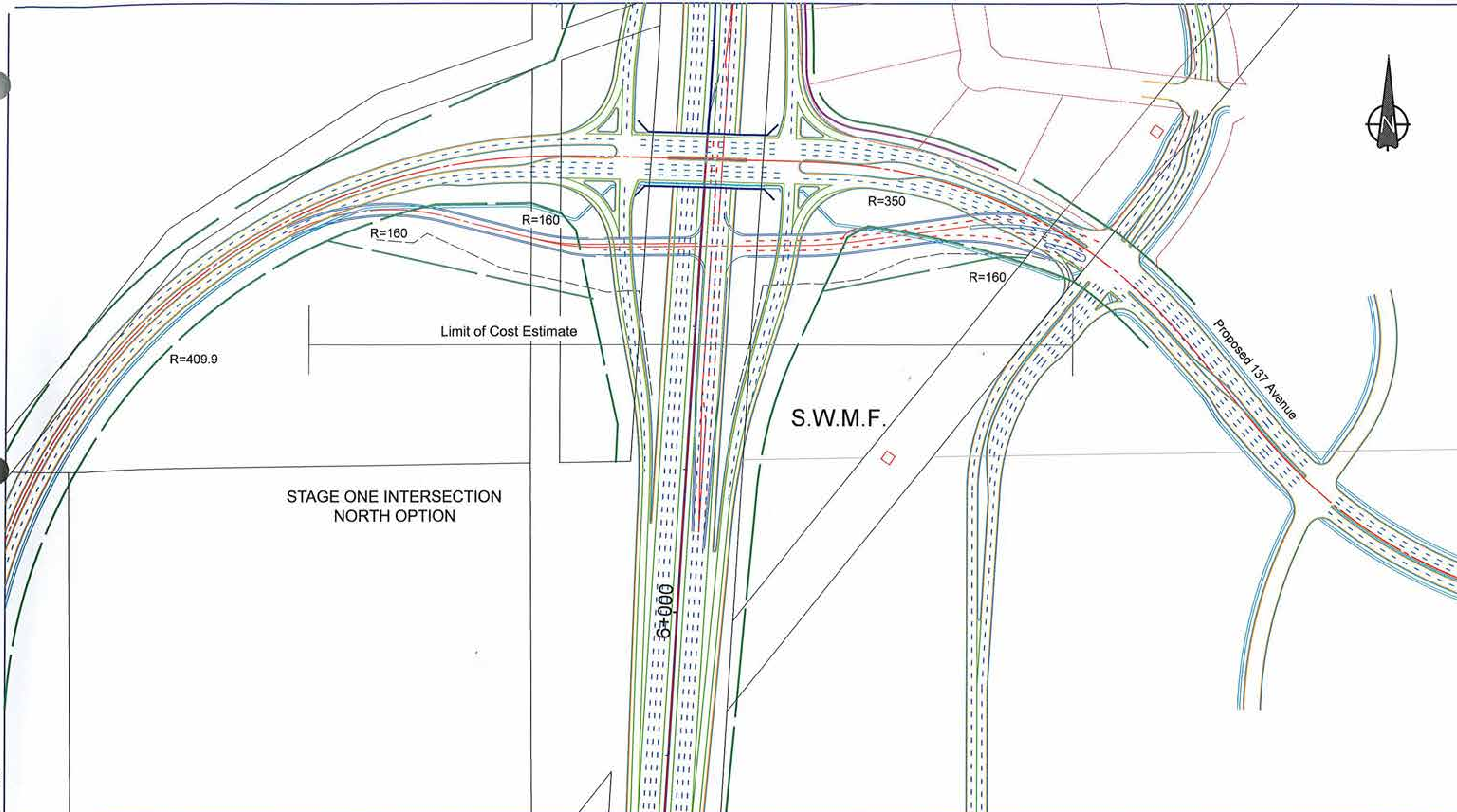
Second, the ASP has proposed an intersection within 250m on the east ramp terminal at the Ray Gibbon Drive interchange, although Alberta Transportation would prefer a 400m separation between interchange ramps and other intersections, so that queuing at the interchange ramps does not impact the freeway. While the interchange design will require a design exception, the impacts will not negatively affect operation on the interchange at its ultimate capacity. Analyses of the future traffic impacts at this interchange indicate that this will not be an issue. Traffic analysis has determined that the intersection will operate at Level-of-Service (LOS) B in the AM and LOS C in the PM, with a maximum eastbound queue of 60m, assuming a double left turn bay. There will be a need for ongoing discussions between Alberta Transportation and the developers to finalize the future staging of this interchange.

### 3.8.2 Interchange Staging

As the interchange is not likely to be constructed for some time it is necessary to provide temporary access to Ray Gibbon Drive for the Riel Park area. As a first stage, an at-grade intersection has been proposed between 137 Avenue and Ray Gibbon Drive at the approximate location of the future interchange. Four intersection location options were developed in relation to the interchange location:

- North of the structure. Due to the timing of development, this option was not feasible.
- At the bridge site requiring a detour during the future construction of the interchange.
- Use the east ramp terminal to create a T-Intersection. Due to the timing of Lois Hole Park opening, this option was not feasible.
- South of the structure.

From discussions with Alberta Transportation, the City, and the developers, the option of south of the intersection was selected as the only viable option. At the time of this report, preliminary design of the intersection at Ray Gibbon Drive was underway. Construction of the temporary 137 Avenue connection between Ray Gibbon Drive and Riel Drive is anticipated in the spring of 2009. Exhibit 5 shows the proposed alignment for the temporary connection.




ISL Engineering and Land Services

THE CITY OF St. Albert

Project: Ray Gibbon Drive

Title: Functional Planning Study
137th Avenue Intersection

Figure No. Exhibit 05

## 3.9 McKenney Avenue / Meadowview Drive Interchange

### 3.9.1 Interchange Design

The McKenney Avenue/Meadowview Drive interchange will ultimately be located at 9+087. The McKenney Avenue interchange is planned as a diamond type interchange with Ray Gibbon Drive remaining at the original ground elevation and the cross street elevated to accommodate underground drainage and to keep the interchange out of the 1:100 flood plain area for Big Lake.

To achieve the desired minimum 330m Decision Sight Distance required for the freeway, the southbound exit ramp at the interchange will need to be extend 180m north beyond a standard ramp length when the interchange is constructed. The weaving zone between Giroux and McKenney; will operate at LOS C and B, for the ultimate AM and PM peaks respectively.

The Timberlea Area Structure Plan (ASP) was approved by City Council on November 21, 2005. The ASP has an intersection located approximately 330m east of the ramp terminal for the McKenney interchange which is less than the Alberta Transportation standard offset of 400m. While the interchange design will require a design exception, the impacts will not negatively affect operation of the interchange at its ultimate capacity. Traffic analysis has determined that the intersection will operate at LOS B in the AM and PM peaks, with a maximum eastbound queue of 100m, assuming no left turn bay and this will not negatively affect the operation of the interchange.

### 3.9.2 Interchange Staging

An at-grade intersection between Ray Gibbon Drive and McKenney Avenue was constructed north of the original interchange alignment at 9+018 to allow the future construction of the interchange. However, the interchange location was shifted to the north to provide adequate offset distances from the ATCO pipelines that cross Ray Gibbon Drive at 8+640. As a result, a detour road will be required during the construction of the interchange.

Located just outside of the 1600m radius curve, the urban cross-section proposed for this area will create a lateral obstruction to this intersection at the six-lane stage if the interchange is not simultaneously constructed. Alternatively, the speed limit could be lowered to 90 km/h at this section until the interchange is put in place. From Figure B-3.9b of the HGDG, the lateral clearance for a six-lane cross-section (widening to the inside) is 5.75m, which corresponds to a Decision Sight Distance of 271m. With the addition of the 23m tangent section between the curve and the intersection, a distance of 293m is attainable. From Table B.2.6 of the HGDG, this corresponds to a design speed of 90km/h. Since urban style intersections are typically posted and operated at lower speeds, this will not create any problems. Once interchanges are in place, all ramp exits will meet the Decision Sight Distance requirements.

## 3.10 Giroux Road Interchange

### 3.10.1 Interchange Design

The Giroux Road interchange will ultimately be located at 10+448 and connects to the old McKenney Avenue alignment. Giroux Road occurs close to a high point in the natural ground along the alignment of Ray Gibbon Drive which will ultimately be excavated to provide a cut section through this area. Consequently, the Giroux Road interchange may be constructed with Giroux Road close to grade and Ray Gibbon Drive below grade.

The Giroux Road interchange is planned as a Parclo AB type interchange with all ramps located north of the Giroux Road structure due to the proximity of the CN overpass. A diamond interchange was not feasible because of the elevation difference between the structures, the grades between the mainline Ray Gibbon Drive and Giroux Road and poor location of the ramp gore points.

The Northwest Urban Village ASP is located southeast of the Ray Gibbon Drive on Giroux Road. The North Ridge ASP is located to the west of Ray Gibbon Drive between Giroux Road and Villeneuve Road. The ASP's were approved by City Council on July 4, 2006 and January 19, 2004, respectively. The ASP's share an intersection on Giroux Road, approximately 270m east of the ramp terminal for the Giroux Road interchange. While the interchange design will require a design exception, the impacts will not negatively affect operation of the interchange at its ultimate capacity. Traffic analysis has determined that the intersection will operate at LOS A in the AM and PM peaks, with a maximum eastbound queue of 50m, assuming no left turn bay. Although this spacing is less than the provinces standard offset of 400m, this will not negatively impact the operation of the interchange.

### 3.10.2 Interchange Staging

As a first stage, Ray Gibbon Drive was constructed as an at-grade intersection with Giroux Road. During the interchange construction, a detour will be required to allow the mainline of Ray Gibbon Drive to be lowered. No detours of the alignment were planned as a first stage. The detour designs and construction will have to be completed at the time of the construction of the interchanges.

## 3.11 Villeneuve Road Interchange

### 3.11.1 Interchange Design

The third stage of Ray Gibbon Drive between Giroux Road and Villeneuve Road (Highway 633) has not yet been constructed and this allowed the development of some variation in the original design of the ultimate location of the Villeneuve Road interchange. The alignment of Ray Gibbon Drive was shifted from the City's proposed intersection to the west to accommodate an interchange at Alberta Transportation's request. Five alignment alternatives, were developed and one selected by Alberta Transportation as the best location for the interchange. Details of the five alignment options and the final selection are also provided in Appendix D.

The preferred alignment will pass through the existing farmstead in NE7-54-25-W4M. Villeneuve Road occurs close to a high point in the natural ground along the alignment of Ray Gibbon Drive which will ultimately be excavated to provide a cut section through this area. Consequently, the proposed tight diamond interchange at Villeneuve Road may be constructed with Villeneuve Road close to grade and Ray Gibbon Drive underneath. The elevation of Ray Gibbon Drive at this location has been set to allow gravity drainage to Carrot Creek to occur.

### 3.11.2 Interchange Staging

As a first stage, Ray Gibbon Drive will be constructed as a two-lane roadway with an intersection located at Villeneuve Road, refer to Exhibit 7. During the interchange construction, a detour will need to be developed to allow the mainline of Ray Gibbon Drive to be lowered. The detour designs and construction will have to be completed at the time of the construction of the interchanges.

## 3.12 Pedestrian Accommodation

In 1991, the City adopted the Red Willow Park, a multi-faceted open-space that occupies the Sturgeon River corridor from St Albert's east end to the shore lands along Big Lake in the City's west end. The focus has been to incorporate and upgrade existing parks and provide a continuous trail system along the river banks.

As part of the Ray Gibbon Drive arterial road project, trails from the Riel Recreation Area were connected to the Sturgeon River crossing, with a pedestrian pathway under the structure for access to Big Lake. Alberta Transportation discourages pedestrian accommodation within the highway right-of-way, except at grade-separated crossings, so the pathways parallel to Ray Gibbon Drive will need to be modified. These issues are discussed below.

### 3.12.1 Pedestrians on Bridge Structures

To ensure that pedestrians have access to both sides of Ray Gibbon Drive, pedestrian accommodation facilities have been included in the overall functional plan. Alberta Transportation currently constructs two types of facilities:

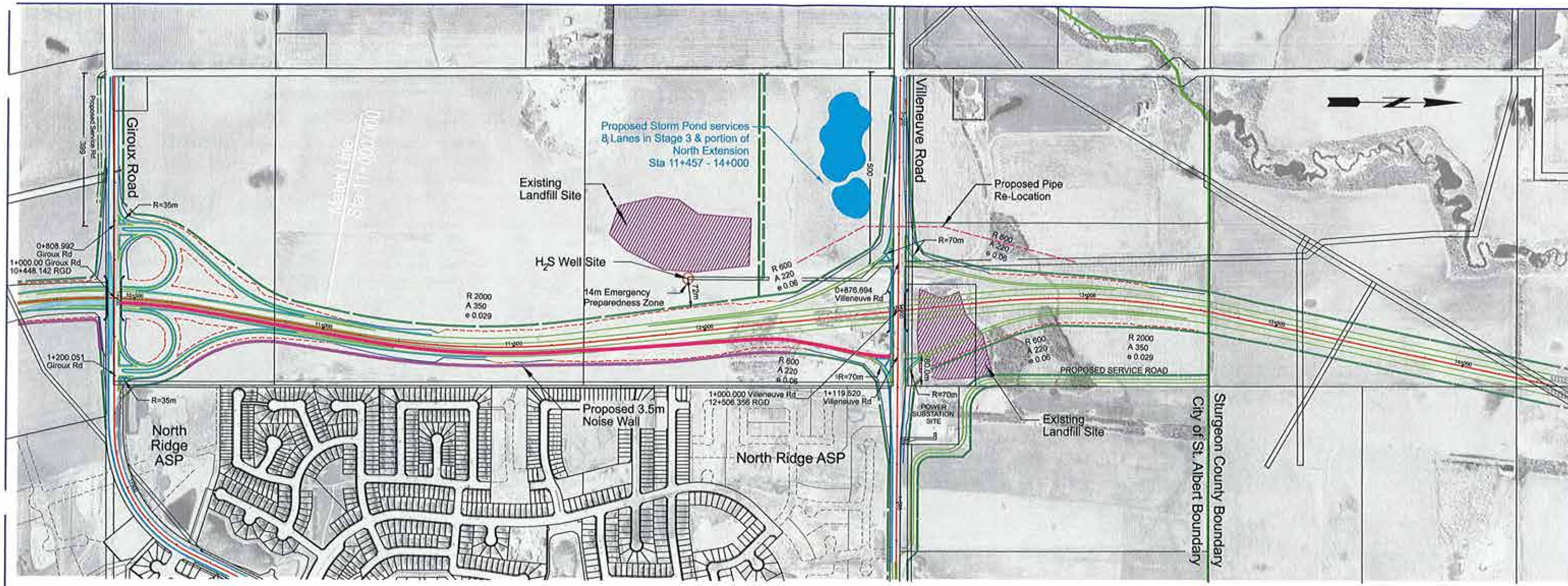
- Walkways are 2.5m wide and are allowed at interchanges
- Pathways are 3m wide (4.2m on structure) and are discouraged at interchanges

After reviewing the existing and proposed trail system for the study area, the following pedestrian accommodations will be required.

- A 3m multi-use trail crossing has been provided on the south/west side of Anthony Henday Drive at the re-aligned 137 Avenue crossing. It is recommended that this trail be continued on the north side on 137 Avenue to the interchange, where it should split into a walkway across the structure and a multi-use trail travelling to the proposed pedway (refer to Section 3.12.3).
- A multi-use trail within the Timberlea ASP travels parallel to Ray Gibbon Drive and connects to McKenney Avenue. A walkway is recommended across the south side of the interchange.
- To reduce pedestrian conflicts, a walkway on the south side of the Giroux Road interchange is recommended. Currently, there are no trails proposed in the immediate area.
- A multi-use trail within the North Ridge ASP travels to the southeast corner of the Villeneuve interchange. A walkway is recommended across the south side of the structure.

### 3.12.2 Pedestrian Accommodation Across the Sturgeon River

The Sturgeon River Bridge currently accommodates pedestrians on the east side of the structure. To meet the 110 km/h design standards, the lane configuration on the bridge will need to be modified, using up the walkway space (refer to Section 4.3). A separate pedestrian bridge structure crossing is required outside of the road right-of-way with a connection to the future trail proposed in the Timberlea ASP.





ISL Engineering and Land Services

THE CITY OF St. Albert

Project: Ray Gibbon Drive

Title: Proposed Stage III
Functional Planning Study
2009 Construction

Figure No. Exhibit 7

### 3.12.3 Proposed Multi-Use Trail Overpass

The developers of South Riel are considering a multi-use trail pedway across Ray Gibbon Drive between 137 Avenue and the Riel storm ponds. Through consultation with the developer, the pedway bridge is proposed at 6 + 540. This will allow for a direct connection to the South Riel ASP that will connect to the proposed trail system along 137 Avenue and the existing trail along Levasseur Road. The proposed overpass funding is outside the scope of this freeway project.

SECTION 4

# 4.0 Structures

Preliminary structure outline drawings were completed for seven proposed bridge structures for the selected plan, and the following design parameters are evaluated and discussed below for each bridge structure to ensure that they met acceptable standards:

- Overall Proposed Structure
- Sight distance
- Geometrics
- Underpass versus overpass
- Possible span arrangements
- Geotechnical concerns
- Deck Drainage considerations
- Construction Staging
- Cost Estimate.

Refer to Appendix B for bridge drawings.

## 4.1 New Bridge File - 137 Avenue Interchange at 6+317

### 4.1.1 Proposed Structure (2° LHF Skew)

The proposed structure is based on a preliminary out to out length of 82.3m associated with the ultimate eight lane facility of Ray Gibbon Drive. It is necessary to construct the ultimate structure length in the initial four lane stage to avoid costly reconstructions. A preliminary two span structure with spans of 35.0m and 37.0m is being proposed. Refer to the preliminary structure outline drawing No. ST01.

The preliminary length maybe revised as required upon obtaining field survey information and an accurate reading on the skew angle during the design phase of the project. Assuming that the structure will consist of two spans, the longest being 37m, a tentative structure depth of 2.1m maybe used for preliminary design purposes.

### 4.1.2 Sight Distance

Sight distance for this tight diamond interchange does not meet the minimum requirements for a design speed of 70 km/h. Consequently, the proposed tight diamond interchange intersections must be signalized on opening day.

### 4.1.3 Geotechnical

The proposed out to out length of the structure is based on 2:1 headslopes. However, a geotechnical assessment will need to be undertaken during the detail design phase to verify the 2:1 assumption.

### 4.1.4 Deck Drainage

The structure is on a K37.6 vertical crest curve with a slight shift of the PVI to the east. The preliminary grades at the ends on the structure are 2.75% and 0.56%. Since the proposed grade at the east end of the proposed bridge is slightly less than the absolute minimum of 0.6%, the final profile of 137 Avenue may require a slight adjustment during detailed design.

### 4.1.5 Staging

The following staging sequence will likely apply at this interchange structure:

a) Stage 1 – will consist of a four lane arrangement on Ray Gibbon Drive with the ultimate length of structure constructed.
b) Stage 2 – the stage 1 Ray Gibbon Drive facility is expanded to the outside by one lane in each direction.
c) Stage 3 – the stage 2 Ray Gibbon Drive facility is expanded to the inside by one lane in each direction.

### 4.1.6 Estimated Construction Costs

Costs for the structure is estimated to be $9.3M before contingency and engineering fees, based on 2008 dollars.

## 4.2 Existing Bridge File - Sturgeon River Crossing at 7+653

### 4.2.1 Existing River Bridge (Built 2004/2005)

Construction of the existing bridge was completed in 2007 by the City of St. Albert. The bridge consists of a three span arrangement with span lengths of 16m – 20m – 16m with an overall out to out length of 82.1m that is based on a 6° RHF skew. The headslopes are 3:1 due to the extremely poor geotechnical conditions at this site.

The bridge is on a tangent alignment with the super elevation run off at the south approach in advance of the structure.

The bridge currently has a 3.0m sidewalk on the east side that will need to be removed in the proposed four lane stage. The sidewalk will be accommodated on a separate structure located beyond the future right-of-way boundary on the east side of the existing structure. Refer to the preliminary structure outline drawings No. ST02 and ST03.

### 4.2.2 Proposed Construction

The proposal is to reconstruct the existing bridge to accommodate a future 4, 6 and 8 lane Ray Gibbon Drive facilities, without having major river works in every stage of reconstruction.

A staging sequence has been developed that requires major river works only in the 6 lane stage. The structure outline drawing for the Sturgeon River Bridge illustrates a possible staging sequence for the future proposed three stages of Ray Gibbon Drive. The next section of this report also briefly addresses the staging sequencing strategy.

Reconstruction of the structure in the 6 lane stage will reduce the amount of freeboard approximately 0.2m; however, we still maintain the required 1m of freeboard. In addition, there is no drift on this river.

### 4.2.3 Preferred Staging Sequence

***Stage One – 4 lane stage (possibly required by 2015)***

- Construct a 4 lane facility by completing the super structure for the south bound carriageway and shifting the centerline on the bridge to the east by 1.9m, as shown on the structure outline drawing.

- Reconstruct the northbound carriageway by removing the sidewalk from the east bridge and constructing a separate pedestrian bridge to the east, as shown on the structure outline drawing. Refer to Section 4.3 for details on the proposed pedestrian crossing.
- All construction on the eastbound and westbound carriageways can be completed without constructing any works in the river.

***Stage Two – 6 lane stage (possibly required by 2040)***

At the 6 lane stage, interchanges will have been constructed at all the cross road intersections. It is a possibility that even in the 4 lane stage some of the interchanges may have already been constructed.

- With the interchange being constructed, the widening to 6 lanes of Ray Gibbon Drive at the Sturgeon River Bridge should preferably be to the outside, as shown on the structure outline drawing.
- The widening to the outside would require major river works to isolate the piers with coffer dams, etc.
- Transport Canada (NWPA), DFO, Alberta Environment and Alberta Sustainable Resources Development environmental approvals would be required well in advance with respect to the proposed river works for the 6 lane stage.

***Stage Three – 8 lane stage (possibly required by 2070)***

- At the 8 lane stage, widening of the existing Sturgeon River Structures would occur to the inside in both directions.
- The proposed in stream works would not be extensive since the foundation for the pier columns were constructed in the initial 2 lane stage.
- Environmental approvals would still be required, however, would not be as onerous as in the 6 lane stage. An assessment would be required to determine if the bridge should be replace instead of being modified due to it's age.

### 4.2.4 Sight Distance

Sight distance is adequate at the existing and proposed structures for all stages of construction.

### 4.2.5 Deck Drainage

The 0.7% grade on the existing and proposed structures exceeds AT's minimum of 0.6%. In any event, the grade lane is fixed across the existing and proposed structures and therefore the 0.7% grade will need to be accommodated for all stages of construction.

### 4.2.6 Geotechnical

The proposed out to out length of the existing and proposed structures is based on 3:1 headslopes. Thurber Engineering undertook extensive geotechnical testing at this site and produced a comprehensive geotechnical assessment and report for this river crossing. This geotechnical information is available for any further foundation work that is required at this site. In summary, the geotechnical conditions are extremely poor through this area and need to be addressed in extreme detail.

#### 4.2.7 Estimated Construction Costs

Costs for reconstructing the different stages of the structure are estimated as follow:

- Stage one – 4 lane stage - $4.4M
- Stage two – 6 lane stage - $7.6M
- Stage three – 8 lane stage - $3.6M

The above estimates are in 2008 dollars, before contingency and engineering fees.

### 4.3 New Bridge File - Pedestrian Crossing Across the Sturgeon River

#### 4.3.1 Proposed Structure

The proposed structure consists of a preliminary out to out length of 161.0m which is based on a preliminary 3-span girder arrangement (32m – 70m – 32m). The proposal is to locate the structure beyond the proposed Ray Gibbon Drive right-of-way and at the same time retain as much of the existing sidewalk system as possible. The proposed bridge is on a tangent alignment that is offset approximately 50m to the east of the existing Sturgeon River Bridge, as shown on the attached structure outline drawing No. ST04.

By proposing a 70m center span on the bridge, the in stream river works required to construct the piers is minimized. Adjustments to the span arrangement may be required to provide the optimum solution. A tentative structure depth of 2.5m for the proposed 70m span is preliminary and will need to be verified at the preliminary engineering phase of this project.

#### 4.3.2 Geotechnical

The proposed out to out length of the proposed structure is based on 3:1 headslopes. Thurber Engineering undertook extensive testing at this site and produced a comprehensive geotechnical assessment and report for this site. The information is available for any further foundation work that may be required at this site. The geotechnical conditions are extremely poor through this area; consequently, the additional foundation work required for the proposed sidewalk structure may require further test holes and assessment.

#### 4.3.3 Environmental Approvals

Environmental approvals will be required from Transport Canada (NWPA), DFO, Alberta Environment (Code of Practice) and Alberta Sustainable Resource Development.

#### 4.3.4 Estimated Construction Costs

Costs for the structure is estimated to be $1.9M before contingency and engineering fees, based on 2008 dollars.

### 4.4 New Bridge File - McKenney Avenue Interchange at 9+018

#### 4.4.1 Proposed Structure (14.1° RHF Skew)

The proposed structure is based on a preliminary out to out length of 101.9m associated with the ultimate eight lane facility of Ray Gibbon Drive. It is necessary to construct the ultimate structure length in the initial four lane stage to avoid costly reconstructions. A preliminary two span structure with spans of 45.0m and 41.0m is being proposed. Refer to the preliminary structure outline drawing No. ST05.

The preliminary length may be revised as required upon obtaining field survey information and an accurate reading on the skew angle during the design phase of the project. Assuming that the structure will consist of two spans, the longest being 45m, a tentative structure depth of 2.4m may be used for preliminary design purposes.

### 4.4.2 Sight Distance

Sight distance for this tight diamond interchange does not meet the minimum requirements for a design speed of 70 km/h. Consequently, the proposed tight diamond interchange intersections must be signalized on opening day unless adequate signal distance is provided.

### 4.4.3 Geotechnical

The proposed out to out length of the structure is based on 3:1 headslopes. The proposed 3:1 headslopes may need to be flattened at this interchange due to the poor soil conditions through this area. A detail geotechnical assessment will be required prior to establishing the final slope. A flatter headslope will shift both ends of the structure closer to the intersections.

### 4.4.4 Deck Drainage

The structure is on a K58.8 vertical crest curve with the PVI offset to the west side. The preliminary grades at the ends of the structure are 0.64% and 2.38%. Since the proposed grade at the west end of the proposed bridge meets than the absolute minimum of 0.6%, the profile of McKenney Avenue is considered to be acceptable.

### 4.4.5 Staging

The following staging sequence will likely apply at this interchange structure:

a) Stage 1 – will consist of a four lane arrangement on Ray Gibbon Drive with the ultimate length of structure constructed.
b) Stage 2 – the stage 1 Ray Gibbon Drive facility is expanded to the outside by one lane in each direction.
c) Stage 3 – the stage 2 Ray Gibbon Drive facility is expanded to the inside by one lane in each direction.

### 4.4.6 Estimated Construction Costs

Costs for the structure is estimated to be $11.5M before contingency and engineering fees, based on 2008 dollars.

## 4.5 New Bridge File - CN Rail Crossing at 9+955

### 4.5.1 Introduction

The proposed CN subway will be located within the City of St Albert limits on Ray Gibbon Drive at 9+955. The ultimate stage of Ray Gibbon Drive at the proposed crossing is on an R1600m horizontal curve. The proposed railway structure will be on a tangent alignment except for about 20m on the west end. The CNR mainline is presently a single track through this area and is on a 0.8% grade through the crossing. The existing at-grade crossing at CNR Mile 6.70 Sangudo Subdivision consists of flashing lights, bell, and gates with a concrete surface.

### 4.5.2 Proposed Construction

The proposal is to construct a subway grade separation with a preliminary theoretical 84.1m out to out of fill length. The subway structure will need to accommodate an ultimate 8-lane urban freeway facility. Initially, only a 4-lane urban facility is required; however, the structure will need to be constructed to accommodate the ultimate 8-lane facility since it is a subway structure.

Maintaining rail traffic on this mainline track during construction of the subway will be essential. Consequently, a railway diversion around the site will be required to accommodate the construction of the subway structure. The railway diversion has been shown on the preliminary structure outline drawing to carry a temporary track around the construction site on the north side. This will need to be confirmed prior to detailed design of the subway commencing. An offset of approximately 25m from centerline of the subway structure to the centerline of the railway diversion is considered to be adequate in this preliminary phase.

The railway diversion will require that the existing at-grade crossing on the temporary road be relocated to the new temporary crossing, as shown on the attached structure outline drawing. A possible staging sequence to construct the subway is listed below:

- Construct the railway detour
- Construct the temporary at-grade crossing on existing Ray Gibbon Drive and the temporary detour, the existing crossing should remain in place
- Shift train traffic to the detour
- Construct the subway structure
- Shift train traffic onto the subway structure and resume using the original at-grade crossing. Remove the railway detour and temporary at-grade crossing.
- Construct the first half (southbound lanes) of Ray Gibbon Drive, which may require retaining walls
- Shift the traffic from the temporary road onto the southbound lanes of Ray Gibbon Drive
- Construct the northbound lanes of Ray Gibbon Drive.

The proposed subway structure will require a center pier to reduce the length of the railway span. Based on the two 27m span arrangement, the preliminary overall depth of structure from the top of rail to the underside of the girder is estimated at 2.5m. CNR will need to be contacted to determine their requirements prior to more detailed plans being developed. Refer to the preliminary structure outline drawing No. ST06.

### 4.5.3 Railway Traffic

CNR have advised that there were 6 trains/day on average at this location in 2007, travelling at a train speed of 30 mph (48 km/h).

### 4.5.4 Cost Apportionment Strategy for Construction of a Future Grade Separation

CNR is senior at the existing at-grade crossing; consequently, the Road Authority is responsible for the maintenance of the crossing surface. If the crossing is in existence for three years, the crossing is considered to be established. With the construction of a grade separation at any time after the crossing has become established, the railway are required to share in the construction costs. At this stage, it is our opinion that the minimum cost share from the railway would be 15% of the total basic grade separation costs even though the cross-product may be less than 200,000.

#### 4.5.5 Project Approvals

A notice of works must be forwarded to the Railway, Transport Canada, the Canadian Transportation Agency, and the existing landowners in the four quadrants, the City, and Alberta Transportation.

Also, an agreement must be executed between CNR and the Province prior to construction of the grade separation commencing. A copy of the agreement must be filed with the Canadian Transportation Agency in Ottawa.

Submissions to the Canadian Transportation Agency may also be required if there are issues that require resolution by a third party.

#### 4.5.6 Estimated Construction Costs

Costs for the structure, the railway detour, and the relocation of the at-grade crossing is estimated to be $2.6M before contingency and engineering fees, based on 2008 dollars.

### 4.6 New Bridge File - Giroux Road Interchange at 10+448

#### 4.6.1 Proposed Structure (2° LHF Skew)

The proposed structure is based on a preliminary out to out length of 103.4m associated with the ultimate eight lane facility of Ray Gibbon Drive. It is necessary to construct the ultimate structure length in the initial four lane stage to avoid costly reconstructions. A two span structure with spans of 45.0m and 47.0m is being proposed. Refer to the preliminary structure outline drawing No. ST07.

The preliminary length maybe revised as required upon obtaining field survey information and an accurate reading on the skew angle during the design phase of the project. Assuming that the structure will consist of two spans, the longest being 47m, a tentative structure depth of 2.4m may be used for preliminary design purposes.

#### 4.6.2 Sight Distance

Intersection sight distance for this Parclo AB Interchange should be adequate on both sides. However, on the west side, the sight distance associated with the k 35.1 vertical curve needs to be confirmed for traffic turning easterly onto Giroux Road for the south to east movement upon determination of the final interchange geometrics, and parameters. On the east side, the sight distance is adequate due to the proposed 1.245% grade on the structure and approach road.

#### 4.6.3 Geotechnical

The proposed out to out length of the structure is based on 2:1 headslopes. However, a geotechnical assessment will need to be undertaken during the detail design phase to verify the 2:1 assumption.

#### 4.6.4 Deck Drainage

The structure is on a partial K35.1 vertical crest curve with the PVI offset to the west side. The preliminary grades at the ends on the structure are 0.22% and 1.25%. Since the proposed grade at the west end of the proposed bridge is less than the absolute minimum of 0.6%, the final profile of Giroux Road may require some adjustments during detailed design.

#### 4.6.5 Staging

The following staging sequence will likely apply at this interchange structure:

a) Stage 1 – will consist of a four lane arrangement on Ray Gibbon Drive with the ultimate length of structure constructed.
b) Stage 2 – the stage 1 Ray Gibbon Drive facility is expanded to the outside by one lane in each direction.
c) Stage 3 – the stage 2 Ray Gibbon Drive facility is expanded to the inside by one lane in each direction.

#### 4.6.6 Estimated Construction Costs

Costs for the structure is estimated to be $13.9M before contingency and engineering fees, based on 2008 dollars.

### 4.7 New Bridge File - Villeneuve Road Interchange at 12+506

#### 4.7.1 Proposed Structure (6° RHF Skew)

The proposed structure is based on a preliminary out to out length of 104.5m associated with the ultimate eight lane facility of Ray Gibbon Drive. It is necessary to construct the ultimate structure length in the initial four lane stage to avoid costly reconstructions. A two span structure with spans of 45.0m and 47.0m is being proposed. Refer to the preliminary structure outline drawing No. ST08.

The preliminary length maybe revised as required upon obtaining field survey information and an accurate reading on the skew angle during the design phase of the project. Assuming that the structure will consist of two spans, the longest being 47m, a tentative structure depth of 2.4m maybe used for preliminary design purposes.

#### 4.7.2 Sight Distance

Sight distance for this tight diamond interchange does not meet the minimum requirements for a design speed of 70 km/h. Consequently, the proposed tight diamond interchange intersections must be signalized on opening day.

#### 4.7.3 Geotechnical

The proposed out to out length of the structure is based on 2:1 headslopes. However, a geotechnical assessment will need to be undertaken during the detail design phase to verify the 2:1 assumption.

#### 4.7.4 Deck Drainage

The structure is on a K69.6 vertical crest curve with the PVI offset to the east side. The preliminary grades at the ends of the structure are 1.88% and 0.61%. Since the minimum grade across the bridge will not be less than 0.6%, deck drainage is considered to be adequate.

#### 4.7.5 Staging

The following staging sequence will likely apply at this interchange structure:

a) Stage 1 – will consist of a four lane arrangement on Ray Gibbon Drive with the ultimate length of structure constructed.

b) Stage 2 – the stage 1 Ray Gibbon Drive facility is expanded to the outside by one lane in each direction.

c) Stage 3 – the stage 2 Ray Gibbon Drive facility is expanded to the inside by one lane in each direction.

#### 4.7.6 Estimated Construction Costs

Costs for the structure is estimated to be $11.8M before contingency and engineering fees, based on 2008 dollars.

SECTION 5

# 5.0 Utility Impacts

The following utilities were considered during this project:

- High and medium pressure gas pipelines
- Well Sites
- Electric Power
- Telephone and cable television
- Existing storm and sanitary sewers
- Water lines.

## 5.1 Pipelines

There are numerous pipelines within the vicinity of Ray Gibbon Drive; there are three located near Villeneuve Road, and a multiple pipeline crossings at 8+640 near McKenney Avenue. Using the arterial alignment, the pipelines would have remained in place, below the roadway; however, these will now have to be relocated or abandoned as part of the construction of the interchange.

The Energy and Utilities Board (EUB) has a standard offset (for sour gas lines) of 15m plus the Emergency Planning Zone (EPZ) from pipelines. Alberta Transportation's Utility Guidance Manual has a standard offset of 30m from the edge of right-of-way, except at a crossing. At a crossing the minimum depth of cover over a pipeline where it crosses the right-of-way of a highway and within 30m each side of the boundary shall be 1.4m under the lowest point of the cross-section. There are two existing pipelines that will be affected by the expansion of Ray Gibbon Drive from a 4-lane arterial to an 8-lane freeway.

### 5.1.1 Gibson Energy Pipeline

The first pipeline, owned by Gibson Energy, crosses Ray Gibbon Drive at Villeneuve Road on the north of Villeneuve Road. Discussions between ISL and Gibson Energy have determined that the pipeline will be abandoned in the spring of 2008 and will therefore not be affected by the interchange construction. Future work will be required to ensure that Gibson removes the pipeline and obtains a Conservation and Reclamation Certificate to ensure that there has been no contamination to the adjacent soil prior to a licensing change through the ERCB. If contamination has occurred, Gibson will be responsible for processing the soil according to governing regulations, as long as they retain ownership.

### 5.1.2 Sifton Energy Pipeline

The second pipeline, owned by Sifton Energy, runs parallel to Ray Gibbon Drive for approximately 2km to access the well site discussed in Section 5.2. The pipeline currently crosses Villeneuve Road approximately 1.5m to 2m below grade and will have to be relocated. Sifton Energy developed two alternatives for the pipeline:

- Directional drill from a point on the existing right-of-way south of Villeneuve Road to a point on the existing right-of-way north of Villeneuve Road. To place the entry and exit locations beyond the required setbacks would require approximately 1.0km of new pipe and is estimated to cost $0.5M.
- Obtain new right-of-way and re-locate the pipeline using conventional weld and ditch installation. This would require approximately 1.2km of new pipe and is estimated to cost $0.25M, subject to land negotiations.

If the pipeline is still required to serve the well site prior to interchange construction, the pipeline should be relocated. A proposed realignment is shown on drawing PP03 (see Appendix A), but needs to be confirmed with detailed design prior to land acquisition.

### 5.1.3 ATCO Pipeline

A third pipeline, owned by ATCO Pipelines, crosses Ray Gibbon Drive at 8+640, south of McKenney Avenue. The existing crossing contains two 323mm and one 273mm high pressure natural gas pipelines, located approximately 2m below grade. No modifications to the pipelines themselves are anticipated at Ray Gibbon Drive; however, modifications to Crossing Agreement AP05/0727 will likely be required.

To the west of the interchange, McKenney Avenue travels across the pipeline right-of-way for approximately 400m. Although this is on the minor road, most of these pipelines would be buried under the interchange embankment, and is subject to Alberta Transportation guidelines.

To achieve the minimum 30m offset from the pipeline to the edge of road right-of-way, two options were considered:

1. Relocate the 3 pipelines to meet the offset requirements. Due to the proximity of the storm pond located in the southwest quadrant of the McKenney Avenue interchange, the pipelines would need to be repositioned on the south side of the pond. Relocating approximately 1km of these pipes is expected to cost $5M.
2. Shift McKenney Avenue to the north to achieve the offset requirements. The realignment of the interchange requires a skewed bridge structure, some additional right-of-way, and the construction of a temporary detour road during bridge construction.

To ensure adequate right-of-way was identified by this study, Option 2 is shown on the plan and profile drawings. During detailed design, both options should be reviewed in greater detail.

### 5.1.4 ATCO Gas Pipeline

A fourth pipeline, owned by ATCO Gas, crosses Ray Gibbon Drive at approximately 12+490. The line is a small intermediate line that carrier polyethylene.

### 5.1.5 Gibson Oil Pipeline

A fifth pipeline, owned by Gibson Oil, used to run east-west on the north side of the CNR track and parallel to Giroux Road at 10+250. This pipeline was abandoned and removed from within the right-of-way during construction of Ray Gibbon Drive in the summer of 2007. Due to additional right-of-way requirements, more pipe may need to be removed prior to road construction.

## 5.2 Well Sites

There are two well sites that are within the vicinity of Ray Gibbon Drive. The first one is located at 9+850 near the CN rail crossing, and the second one is located at 12+000 near Villeneuve Road. Using the arterial alignment, the wells were offset 340m and 100m, respectively, from the road right-of-way.

The Energy and Utilities Board (EUB) has a standard setback of 40m from a well; unless the well is sour (produces H2S). If the well is sour, a minimum of 40m plus the Emergency Preparedness Zone (EPZ) is required. Alberta Transportation has a standard offset of 60m from the highway right-of-way.

The first well site is located on R.L.16, southwest of the CN Rail crossing, approximately 48m east of the highway right-of-way (prior to the CN Rail grade-separation). The site has two well heads, one owned by Daylight Oil that is suspended, and one owned by Imperial Oil that is abandoned. Daylight Oil has stated that their well will also be abandoned in 2008.

The second well site, owned by Sifton Energy, is located on NW7 54-25-W4M, approximately 72m west of the highway right-of-way. This is a sour gas well with an EPZ of 14m. Presently, Sifton does not operate under an operating agreement and has stated that they will keep the well active until it is no longer economical to do so. **The well is within the minimum offset requirements for Alberta Transportation by 2m and this will need to be addressed during detailed design.**

## 5.3 Power Lines and Street Lighting

### 5.3.1 Power Substation

A power substation, owned by Alta Link Management Ltd., is located on the northeast quadrant of the intersection of Ray Gibbon Drive and Villeneuve Road. Alberta Transportation's policy requires a minimum setback of 105 metres from the centerline of the median of a rural divided highway to the edge of the power substation right-of-way. Discussions with Alberta Transportation determined that a setback of 80m from the interchange ramp to the power substation was sufficient. The interchange at Villeneuve Road was designed to meet this criterion.

### 5.3.2 Transmission Line

There are currently three existing Trans Alta transmission lines that cross Ray Gibbon Drive. Alberta Transportation has a minimum offset of 30m from a transmission tower to the edge of highway right-of-way.

The first crossing, a 905L line located at 5+900, has towers 85m and 30m from the east and west right-of-way limits, respectively. No modifications are required.

The second crossing, a 747L line located at 6+920, has double poles 1m and 47m from the east and west right-of-way limits, respectively. The east pole will need to be relocated; however, the City, Sustainable Resources and Alta Link are currently examining the feasibility of relocating this line due to its proximity to Lois Hole Provincial Park. Any future relocation alternatives should respect the 30m offset requirements.

The third crossing, located at 10+450, is on double poles. This line will need to be relocated prior to interchange construction.

Vertical clearances will need to be confirmed at all three locations prior to construction.

### 5.3.3 Power Lines

There is power line that runs east-west on the north side of Villeneuve Road that will be affected by the interchange construction. This line will need to be relocated prior to interchange construction.

### 5.3.4 Lighting

Street lighting for Ray Gibbon Drive was originally designed by Magna IV for a two-lane cross-section. The existing lighting will be sufficient for northbound lanes in the four-lane cross-section. The poles for the southbound lanes in the four-lane cross-section should mirror the northbound locations; however, the copper wiring for these poles should be placed in its ultimate 8-lane location. Street light standards will be mounted on galvanized screw anchor bases, which would allow the poles to be moved as the roadway is widened to its 6-lane configuration, reducing trenching costs. This would require the southbound lanes to be pre-graded with an additional lane in the four-lane cross-section.

At the 6-lane cross-section, for Stages 1 and 2, the northbound poles and underground wiring will have to be relocated to accommodate the additional lane. In the southbound direction, the screw based poles will be removed from the temporary location and refastened at the ultimate location. The wires to the temporary location will be pulled out of the conduit and re-feed up the poles, and the conduit to the temporary pole location will be abandoned. Minor adjustments to the lights/ballasts may be required to ensure adequate lighting for the additional lanes.

For Stage 3, the wires should be placed in their ultimate location with connections to the temporary pole locations for the 4-lane cross-section. Modifications for the six-lane stage will be similar to Stages 1 and 2. For all three stages, lighting within the center median will not be required until the 8-lane cross-section.

Improvements to the lighting plans have been included in the cost estimates based on 13m high galvanized poles with break-away bases with 2.5m davits and 310W copper lighting along the roadway and at the interchanges. High mask lighting is also possible within the corridor at the 6 and 8 lane cross-sections, but will require pre-planning to ensure that the bases are below grade early on.

## 5.4 Telephone and Cable Television

There is an existing telephone cable in the south ditch along the old McKenney Avenue alignment that will need to be addressed prior to interchange construction.

## 5.5 Existing Storm and Sanitary Sewers and Water Lines

There are currently no existing water, storm, or sewer lines that cross Ray Gibbon Drive. Future work for the Timberlea subdivision north of McKenney Avenue includes a number of utility crossings; however, these are all conceptual at this time and need to be developed to respect the ultimate vertical alignment of Ray Gibbon Drive. Sleeves should be considered at the crossing locations to reduce future disruptions.

SECTION 6

# 6.0 Drainage Design

The Stage 1 drainage system for Ray Gibbon Drive, from 137 Avenue to McKenney Avenue, is designed for a four lane roadway in a 78m road right-of-way. The Stage 2 drainage system, from McKenney Avenue to Giroux Road, is designed to accommodate a six lane roadway with grade separation from the crest south of Villeneuve Road (approximate station 11+500). The drainage system for Stage 3, from Giroux Road to Villeneuve Road, has not yet been constructed. The ultimate proposed design for this roadway is eight lanes with grade separation and a larger road right-of-way. A review of the existing drainage systems was completed to determine what modifications or additions would be required to service the ultimate roadway design.

For Stages 1 and 2 the change in vertical clearance for the catch basins is 20.1cm. If necessary a higher grade pipe could be used on the extension or the pipe could be insulated.

## 6.1 Stage 1 Drainage System

The existing Stage 1 urban drainage system does not have enough capacity to accommodate flows from the ultimate proposed roadway. To accommodate these flows it is recommended that the existing drainage system be left in placed and drain the future northbound lanes. The 100 year storm event data was used for the calculations for the existing system and for the proposed system.

A second urban storm system is proposed to be constructed to drain the future southbound lanes. Catch basin manholes were constructed on the future east lip of gutter to drain the pre-graded area. When the second storm system is installed these catch basin manholes will be required to be disconnected from the existing storm system and removed. The new system will range in pipe sizes from 375 to 1200mm. The basin, approximately 400m south of McKenney Avenue, located between stations 8+060 to 8+900 is unable to accommodate the flows from the northbound lanes due to the added catchment area from the proposed interchange and ramps at McKenney Ave and Ray Gibbon Drive as such any runoff north of MH402 is required to directed toward the second drainage system.

## 6.2 Stage 2 Drainage System

Currently the existing Stage 2 drainage system is constructed to MH115 just south of the railway tracks. This system was designed for a 78m road right-of-way, 6 lanes and grade separation. With the addition of road right-of-way and two more lanes this pipe system reaches capacity in three pipe segments between manholes 114 to 117. These pipe segments do not meet the design standards and are at 101, 102 and 105% capacity respectively. As these pipes are already constructed it is recommended that they remain in place. In a large storm event these pipes may surcharge. This is not anticipated to be an issue but the hydraulic grade line should be checked.

## 6.3 Stage 3 Drainage Systems

The road south of the crest located at approximately 11+500 will drain through an urban system and tie into the Stage 2 system that is currently constructed. As this system has not yet been constructed there are no issues anticipated with its construction. It should be noted that a sanitary trunk sewer is proposed to cross the road right-of-way just north of the railway tracks at approximately station 10+185.

The road south of the crest is proposed to be a rural cross section with ditch drainage. The sag in the profile is located near the interchange at Villeneuve Road. Runoff from the interchange ramps and other portions of road will be conveyed through culverts to an inlet location where the water will enter a pipe system connected to a storm water management facility located to the southwest of the interchange. It should be noted that this pipe system will cross the Sifton Energy Gas Line. An outfall to Carrot Creek is proposed.

## 6.4 Stormwater Management Facilities

Currently three stormwater management facilities are constructed; Riel Wetland, Stage 1 North Pond, and Stage 2 Big Lake Pond. As the catchment areas for all of these ponds increases the settings on the release gates should be adjusted. A review of each facility's capacity was completed to determine the impacts of the proposed roadway.

Riel Wetland will not require any major adjustments due to the increased areas. The high water level for East Riel will be increase to 652.69m (+0.06m) and West Riel will be increase to 650.46m (+0.01m). No adjustment to the orifice openings will be required.

The Stage 1 North Pond will require the Gabion Weir to be raised by 0.25m to accommodate a 1-in-2 year storm event and a 100 $m^3$ spill. With this adjustment, the new high water level in the fore bay will be 652.59 (+ 0.33m) and the pond high water level will be 652.50m (+0.26m).

The Stage 2 Big Lake Pond will not require any modifications, however during a 1:100 year storm event the gabion weir will overtop. A 1-in-2 year storm and 100$m^3$ spill will still be isolated in the fore bay. For a 1:100 year storm the new high water level will be 653.56m.

The proposed Stage 3 pond will require a fore bay storage volume of 6,900$m^3$ and a pond storage volume of 20,900$m^3$. The minimum normal water level that may be used is 676.2m. This elevation is based on the design of the outlet.

# SECTION 7

# 7.0 Right-of-Way Requirements

## 7.1 Required Right-of-Way

The additional right-of-way needed to upgrade Ray Gibbon Drive to a freeway, with interchanges, is listed in Table 7.1 and shown on Exhibit 6. Detailed right-of-way requests are included in Appendix K. Costs are based on an assumed rate of $247,100/ha.

*Table 7.1: Right-of-Way Requirements*

| Land Description | Area Required (ha) | Land Costs |
|---|---|---|
| NW 29-53-25-W4 | 0.32 | $79,072 |
| NE 29-53-25-4 | 2.15 | $531,265 |
| Powerline ROW Plan 2648 MC | 0.09 | $22,239 |
| Plan 082 8697 - Blk 2 - Lot B | 0.85 | $210,035 |
| Lot A - Block 1 - Plan 082 8697 (Hole's) | 0.07 | $17,297 |
| Lot A - Block 1 - Plan 082 8697 (without Hole's) | 0.80 | $197,680 |
| R.L. 55 | 1.62 | $400,302 |
| LOT 1 - Plan 842 0559 | 0.03 | $7,413 |
| LOT H - 6525 NY | 0.09 | $22,239 |
| PARCEL B - Plan 3032 RS | 9.2 | $2,273,320 |
| R.L. 16 | 7.21 +2.76 +1.34 | $2,794,701 |
| R.L. 16 for CN Detour | 0.43 | $106,253 |
| PARCEL A - Plan 3032 RS | 0.94 | $232,274 |
| Plan 992 6483 - Lot 4 | 0.01 | $2,471 |
| Plan 992 2031 - Block 1B | 0.01 | $2,471 |
| Plan 932 1471 - Lot A | 0.25 | $61,775 |
| Block C - 1798 AN | 0.15 | $37,065 |
| NW 6-54-25-4 | 16.2 | $4,003,020 |
| NE 6-54-25-4 | 0.05 | $12,355 |
| SW 7-54-25-4 | 13.34 | $3,296,314 |
| Block 1 - Plan 952 1983 | 0.19 | $46,949 |
| NE 12-54-26-4 | 0.11 | $27,181 |
| NE 7-54-25-4 | 0.40 | $98,840 |
| NW 7-54-25-4 | 36.87 | $9,110,577 |
| SW 18-54-25-4 | 0.39 | $96,369 |
| LOT 1-Block 1 - Plan 042 6146 | 9.79 | $2,419,109 |
| LOT 2 - Block 1 - Plan 042 6146 | 3.97 | $980,987 |
| Lot 1 - Block 2 - Plan 052 5581 | 2.24 | $553,504 |
| Power Sub-Station Site R/W - Plan 762 0332 | 0.32 | $79,072 |
| SE 18-54-25-4 | 0.79 | $195,209 |

## 7.2 Remnant Parcels

In addition to the right-of-way listed in Table 7.1, there are some parcels of land that will have to be purchased as part of the Ray Gibbon Drive project.

### 7.2.1 Properties between Giroux Road and Villeneuve Road

The provision of a Parclo AB interchange at Giroux Road and a minimum offset from the power substation at Villeneuve Road creates a 11.35ha remnant parcel between the freeway and the North Ridge subdivision immediately to the east. Access to this parcel was originally accommodated for in the North Ridge Area Structure Plan; however, if the remnant parcel of land is not developable (refer to Bokenfohr landfill in Section 9.4), this access may be removed and the parcel would become land locked. Due to the required noise wall/berm in this area, the right-of-way has been included to be purchased.

### 7.2.2 Parcels North of Villeneuve Road

The provision for the power substation offset at Villeneuve Road creates three remnant parcels to the north. Access to these parcels is provided via a service road, but will have limited development opportunities unless they are incorporated into the site plan with SE 18-54-25-4 and NE 18-54-25-4.


ISL Engineering and Land Services

22.5m Right-of-Way
45.0m Right-of-Way
78.0m Right-of-Way
Ultimate Right-of-Way
Storm Pond Right-of-Way
Future Right-of-Way Requirements

SCALE 1:20,000
200m 0 200m 400m
HORIZONTAL

THE CITY OF St. Albert

**Project** Ray Gibbon Drive

**Title** Functional Planning Study
Right-of-Way Requirements

**Figure No.** Exhibit 06

SECTION 8

# 8.0 Geotechnical Impacts

Many geotechnical studies have been undertaken for this area these include:

- West Regional Road Over Sturgeon River Geotechnical and Environmental Investigation, 2003, Thurber Engineering Ltd.
- West Regional Road Over Sturgeon River Approximate Limit of Former Landfill, 2004, Thurber Engineering Ltd.
- West Regional Road Alignment Soil Survey North of 137 Avenue Additional Geotechnical Investigation, 2005, Thurber Engineering Ltd.
- Leachate Level Monitoring in St Albert at the West Regional Road During Road Construction, 2006, Thurber Engineering Ltd.
- Proposed Grade Widening, Geotechnical Assessment and Design of Permanent Erosion and Sedimentation Control Plan, West Regional Road, Stages 2 and 3, Meadowview Road to Villeneuve Avenue, 2007, EBA Engineering Consultants Ltd.
- Holden Landfill Assessment (SW Sec 18-54-25-W4M) North of Villeneuve Road, St Albert, 2007, EBA Engineering Consultants Ltd.
- Preliminary Geotechnical Assessment for the West Regional Road North Extension, North of St Albert to Morinville Road Network Review, 2006, Thurber Engineering Ltd.
- Proposed Storm Water Pond Geotechnical Assessment for the West Regional Road, South of Meadowview Road, 2007, EBA Engineering Consultants Ltd.

The following section discusses areas that require additional work to convert Ray Gibbon Drive to a freeway.

## 8.1 Interchange Location Assessment

EBA Engineering completed a geotechnical assessment for each interchange site as part of this study. A brief discussion of each of the proposed structures (overpass or underpass) are presented below with a summary of the major geotechnical issues and concerns that need to be addressed for the design of the structure. It is recommended that additional geotechnical work will be undertaken prior to finalizing design for the structures. For details see the original geotechnical report, included in Appendix E.

### 8.1.1 Sub-Surface Conditions

Assuming that the all the waste is removed from the landfill site located north of Villeneuve Road, there are no significant development issues at this site. Subsurface conditions at Giroux Road are also considered favourable for the proposed structure with no major concerns associated with development at this location.

The two southerly proposed interchange locations are dramatically different than the two northerly locations. At the 137 Avenue and McKenney Avenue locations the subgrade is primarily silt and sand, and bedrock or a competent bearing strata was not encountered. Foundations at these two locations will likely comprise relatively long friction piles. Due to the soft silt identified at all four locations, there is a concern with long-term settlement associated with the placement of the approach fills, particularly at McKenney Avenue. It is likely that the use of wick drains or similar methods of accelerating consolidation settlement will be required at McKenney Avenue to dissipate pore pressures, which is similar to the approach adopted for the Sturgeon River Bridge.

Driven steel piles are currently used for most Alberta Transportation bridge structures. Driven steel, dynamically cast-in-place concrete and cast-in-place concrete piles are considered feasible foundation types for the proposed bridge structures at Villeneuve Road and Giroux Road. At 137 Avenue and McKenney Avenue driven steel piles are likely the most feasible considering the subsurface conditions. Preliminary recommendations for these pile foundation options are presented in the following sections.

### 8.1.2 Cast-in-Place Concrete Piles

Cast-in-place concrete piles are a common foundation type used in the Edmonton area and are presented as feasible foundation alternatives for the proposed structures at Villeneuve Road and Giroux Road. Piles may be designed on a combination of both skin friction and end bearing.

At Villeneuve Road end bearing belled piles could be installed in the glacial clay till at a depth of approximately 9 m. However, the underlying bedrock is at a depth of 10.5 m and would provide much higher end bearing for cast-in-place concrete piles. It is believed that a rock socket pile within the bedrock with end bearing at a depth of 13 m would also provide a cost effective foundation option. The silt layer overlying the clay till may generate some problems and could require temporary casing during pile installation to a depth of approximately 8 m.

At Giroux Road a very stiff to hard clay till stratum was identified at a depth of 6 m. The upper portion of the clay till was hard in consistency. Below 15 m, the clay till becomes softer in consistency, but still provides a good bearing strata. It is envisaged that belled piles founded at a depth of approximately 9 m below grade would provide the most economical foundation option.

In areas where new fill material will be placed for approach fills, or if any existing fill materials are left in place, negative skin friction will need to be addressed in the pile design.

Bell diameters should be a minimum of two and a maximum of three times the shaft diameter. The ratio of the depth to bell base and bell diameter should be a minimum of 2.5.

Design for belled piles may consider both end bearing and shaft friction. Shaft friction should be neglected for the top 1.5 m of the pile length and within one shaft diameter above the top of the bell.

Bell formation may be difficult within the bedrock stratum. Therefore, if end-bearing resistance is necessary to support the downward loading and belling is not possible, a special cleaning bucket should be used to clean the bottom of a straight shaft pile bore in the bedrock stratum, creating a "rock-socket" pile. It should be noted that the end-bearing diameter of the base of a rock-socket pile is slightly smaller than the shaft diameter. In calculating the end-bearing area for a rock-socket pile, a pile base diameter that is 5 percent smaller than the shaft diameter should be adopted.

The bases of all end-bearing piles must be thoroughly cleaned of all loosened material by mechanical or, if necessary, hand methods. Following drilling and cleaning, pile bores should be inspected to ensure that an adequate bearing surface has been prepared at an appropriate depth.

### 8.1.3 Dynamically Cast-in-Place Concrete Piles

Dynamically cast-in-place (compacto) piles are considered feasible for the proposed structures at Villeneuve Road and Giroux Road and possibly 137 Avenue. At Villeneuve Road the piles could be based in the clay till at a depth of approximately 9 m and at a depth of 8 m at Giroux Road. At the proposed 137 Avenue interchange, compacto piles founded in the sand at a depth of approximately 13 m may be feasible.

The one drawback with this pile type is nominal reinforcing, which limits their lateral capacity. Providing a suitable bearing stratum is available for basing the compacto piles, typical design load capacities for varying shaft diameters are as follows:

*Table 8.1: Typical Dynamically Cast-in-Place Pile Capacities*

| Shaft Diameter (mm) | Typical Allowable Static Load in Compression (kN) |
|---|---|
| 400 | 800 |
| 500 | 1100 |
| 600 | 1550 |

Although preliminary design information has been provided for this foundation alternative, it should be noted that a specialist foundation contractor usually completes the final pile foundation design. The following information should be considered in the foundation design.

Experience has found that dynamically cast, "zero slump" concrete is inherently a much more variable material than conventional plastic concrete. The quality and compressive strength of zero slump concrete is highly sensitive to moisture content. Consequently, proper moisture conditioning of the concrete mix is essential to producing high quality concrete. The concrete mix should be re-tempered as required to produce a compatible mix. Given the potential for high variability, the average compressive strength of zero slump concrete should be significantly higher than the design requirement. Low early age (3 and 7-day) compressive strengths indicate possible problems with achieving the design strength. Consequently, 7-day compressive strengths that are more than 3 MPa less than the design strength should be investigated immediately.

Dynamically cast-in-place pile bases can also be used in combination with plastic concrete shafts. Plastic concrete can be produced without the high variability of compacted shaft concrete, and permits the use of higher fly ash contents for greater mix efficiency.

### 8.1.4 Driven Steel Piles

The use of driven steel H-piles or pipe piles is considered feasible alternatives for all four sites. Such piles may be designed using both skin friction and end-bearing. At the Villeneuve Road interchange piles would likely encounter refusal at a depth of approximately 15 m. At the Giroux Road interchange the driven steel piles would likely penetrate through the upper hard clay till and terminate in the bedrock. Estimated pile lengths are approximately 30 m below existing grade.

At both the 137 Avenue and McKenney Avenue interchange locations, driven steel piles will be feasible. It is anticipated that pile capacities at 137 Avenue should be slightly higher than McKenney Avenue based on the limited drilling conducted. It is known that several open ended pipe piles were installed and tested using a Pile Driving Analyzer

(PDA) at the Sturgeon River bridge site. Pile diameters of 600 mm and 12.7 m wall thickness driven to a depth of 35 m were designed with an ultimate capacity of 3600 kN. It is speculated that similar capacities would be achievable for piles installed at the McKenney Avenue interchange. Piles installed to a similar length at 137 Avenue should be capable of slightly higher capacity.

### 8.1.5 Downdrag and Negative Skin Friction

The issue of negative skin friction and down drag are not considered to be a major concern at the Villeneuve and Giroux Road locations. However, this will be an issue at the McKenney and 137 Avenue interchanges. In particular, the soft sediments at the McKenney Avenue will be a greater concern.

If adequate time for settlement of the approach fills is not permitted, the upper portion of the pile shaft installed for the abutments will have to be designed for downdrag associated with long-term settlement of the approach fills. Any portion of the pile shaft that is located within the approach fills for the abutments should incorporate a negative shaft friction. These negative shaft friction issues do not apply to the piles supporting centre piers.

The use of wick drains will likely be required at the McKenney and 137 Avenue interchanges. Wick drains will greatly improve the rate of consolidation at both these locations. It is understood that wick drains were installed at the Sturgeon River Bridge. Details of the performance of the settlement are not known, however this historical data will provide valuable insight regarding the rate of settlement and rate of pore pressure dissipation.

If sufficient time is not permitted for approach fill settlement, it is recommended not to utilize battered piles in the abutment. These piles would be subjected to non-uniform stresses and strains as the soil below the piles settles away from the underside of a battered pile.

### 8.1.6 Stability of Approach Fills

Typically, head slope angles for the approach fills are between 2 and 2.5H:1V and the sideslopes at 4H:1V. It is assumed that similar geometry will be adopted for the proposed new overpass structures, except at McKenney where a 3H:1V is recommended. It must be noted that the stability of the approach fills is a function of soil type used to construct the embankments. Once the material type for the fills has been confirmed the analyses must be reviewed.

Pore pressures can generate within the underlying native strata and have a significant impact on the stability of the approach fills. Therefore design of the approach fills must consider this aspect in the analysis. In some instances the rate of fill placement is dictated by the pore pressures generated beneath the approach fills.

The concern with stability is primarily associated with the interchanges proposed at McKenney and 137 Avenue. One of the tools used to improve stability is the use of wick drains to dissipate excess pore pressure that is generated during fill placement. As discussed in the previous section, valuable data would have been gathered during the construction of the approach fills for the Sturgeon River Bridge. A detailed review of the data would assist in optimizing the design for wick drain spacing. A wick drain spacing of 1.5m was used for the Sturgeon River Bridge and is considered a reasonable estimate for the proposed McKenney and 137 Avenue interchanges.

### 8.1.7 Settlement of Approach Fills

Fill settlement comprises a combination of elastic settlement, which occurs immediately during construction, and a consolidation component, which is time dependant and requires the expulsion of pore water from the native subsoil. To calculate the elastic and consolidation settlements at this preliminary stage is beyond the limits of this report. Settlements in the order of 500mm would not be unreasonable. However, the data obtained from the Sturgeon River bridge construction would be able to provide a more accurate estimate of settlement.

If adequate time for settlement is not permitted, there is concern with any piping or surface utilities that may run through or along the approach fill. Due to the long-term settlements, it must be anticipated that there could be distress in these utilities. Therefore, some form of flexible connection should be designed.

In order to accelerate the settlement process, it is recommended that a surcharge be placed on top of the approach fills. In general the greater the surcharge, the greater the impact on increasing the rate of settlement and reducing the long-term settlement that will occur after construction completion. Care must be taken not to place too great a surcharge, as a slope failure may be generated. A fill surcharge of 25 to 50% of the fill height may be feasible, providing instrumentation that is installed within the approach fills indicates favourable performance of the approach fill.

### 8.1.8 Grading and Fill Material

It is assumed that the majority of the borrow used for construction of the ramps and approach fills will comprise native borrow from within the limits of the RGD project. Standard specifications typically require compaction to a minimum of 95 percent of Standard Proctor maximum dry density at optimum moisture content.

Topsoil, organics and any vegetation should be excavated and removed prior to placement of any fill. Care should be taken not to permit moisture content too high above optimum, as material strength is related to the moisture content of the fill. Typically, as the moisture content increases, the shear strength of the fill decreases. Another concern with moisture contents above optimum is that there is a potential for generating pore pressures during fill placement. High pore pressures with the embankment fills can lead to a lower factor of safety during construction. It should be noted that this issue of pore pressure generation is primarily for clay fill. Sands and silts are much more permeable and have a lower tendency to generate pore pressures. If clay is used as fill for the embankment, care must be taken to assess whether this is an issue.

At locations where wick drains are anticipated, an initial layer of free-draining sand (approximately one metre thick) will be required at the base of the approach fills. This granular layer is required to permit the drainage of water that will be collected by the wick drains as excess pore pressure forces water to be expelled from the native soils.

### 8.1.9 Monitoring Program

During construction of the proposed embankments, it is critical that the subsoil response to embankment loading be monitored to assess slope stability and confirm completion of consolidation and settlement. As a minimum, it is recommended that a grid of survey hubs be installed on the surface of the approach fills to monitor on-going settlements. Vertical inclinometers could also be installed in the headslope to monitor stability of the approach fills. At sites where wick drains are installed, it is common to install piezometers to record the dissipation of porewater pressures.

## 8.2 McKenney Avenue to Villeneuve Road

The 2007 EBA study obtained 19 borehole samples, ranging in depths between 2.3m to 11.4m below grade. This data was sufficient for the at-grade arterial originally planned; however, to meet the Decision Sight Distance requirements for the 110km/h freeway, the profile was lowered near the CN Rail Bridge after the drilling program was completed. Existing borehole data is not deep enough to reach the proposed depths of the storm water pipes. Additional boreholes are recommended to identify geotechnical conditions for the new profile.

## 8.3 Bokenfohr Landfill

Although the 2007 EBA borehole samples did not identify any debris along the arterial alignment, Alberta Transportation would like additional soil testing to confirm that soil adjacent to the landfill has not been contaminated. A series of boreholes around the edge of the landfill and at the proposed pond location is recommended.

## 8.4 North of Villeneuve Road

No geotechnical testing has been completed north of Villeneuve Road; however, a Landfill Assessment for the Holden site was conducted in June 2007 that included borehole samples. The drilling program determined that the depth of the waste material is approximately 1.5m thick and has been capped with 1.22m to 1.59m of clay fill material of clay. Beneath the landfill material a layer of clay and some silt deposits were observed at depths ranging from 7.62 to 12.20 meters below grade. At the perimeter of the landfill, clay, silt deposits and sand lenses were observed at various depths ranging from 0 to 10.55 meters below grade.

The profile of Ray Gibbon Drive passes through the landfill with a 4.5m cut, which means that the waste material would be completely removed from the site. Due to the unknown bearing capacity of the waste material, the excavation material can not used to built the ramps for the interchange; however, it may be used on the side slopes or berms (subject to Alberta Environments approvals). If this option is not accepted, the material will have to be shipped to an off-site containment facility. For the purposes of estimating, the project assumes that the entire landfill (33,658m$^2$) would be excavated to a depth of 3.5m and hauled to a landfill off-site, and clean fill would be used to refilled hole, as required.

SECTION 9

# 9.0 Environmental, Historical and Noise Impacts

Much environmental work has been completed for the Ray Gibbon Drive (formerly West Regional Road) corridor in the past including:

- 2002 Groundwater Monitoring Report for the Former Dry Waste Site – Riel Drive, St Albert, 2002, EBA Engineering Consultants Ltd.
- Environmental Impact Assessment Summary Report for the West Regional Road, 2003, Spencer Environmental Management Services Ltd.
- West Regional Road Environmental Impact Assessment Final Report Volume I, 2003, Spencer Environmental Management Services Ltd.
- West Regional Road Environmental Impact Assessment Final Report Volume II, 2003, Spencer Environmental Management Services Ltd.
- West Regional Road Environmental Impact Assessment Final Report Volume III, 2003, Spencer Environmental Management Services Ltd.
- Cumulative Effects Assessment and Environmental Protection Plan for the West Regional Road Environmental Impact Assessment Final Report Volume IV, 2003, Spencer Environmental Management Services Ltd.
- Supplement to West Regional Road Environmental Impact Assessment: Response to Department of Fisheries and Oceans Canada Request for Additional Information, 2004, Spencer Environmental Management Services Ltd.
- Construction Management Plan for Landfill Leachate for the West Regional Road, 2004, Spencer Environmental Management Services Ltd.
- Leachate Level Monitoring in St Albert at the West Regional Road During Road Construction, 2006, Thurber Engineering Ltd.
- Assessment of the Fisheries Resources and Habitat of Drainage Ditch Terminating in the Sturgeon River in St Albert, 2006, Pisces Environmental
- Wetland Assessment for the McKenney Avenue Extension: Lacombe Lake Park to West Regional Road, 2006, Spencer Environmental Management Services Ltd.
- Timberlea Neighbourhood Wet Land Compensation, 2006, UMA Engineering Ltd.
- Environmental Overview for the West Regional Road North Extension, 2006, Spencer Environmental Management Services Ltd.
- West Regional Road Stage 2 – Letter of Advice Information Package, 2007, Spencer Environmental Management Services Ltd.
- Application under the Water Act for Approvals and/or Licences, 2007, Spencer Environmental Management Services Ltd.
- West Regional Road Stage 2 – Wetland Assessment and Compensation Plan, 2007, Spencer Environmental Management Services Ltd.
- West Regional Road Stage 2 – Water Act Application and Alberta Environmental Protection and Enhancement Act Notification, 2007, Spencer Environmental Management Services Ltd.

The following section discusses areas that require additional work to convert Ray Gibbon Drive to a freeway.

## 9.1 Environmental Assessment

In 2003, an Environmental Impact Assessment was conducted by Spencer Environmental Management Ltd. as part of the original application for Ray Gibbon Drive from existing 137 Avenue to the CN Rail crossing. This report states that the roadway will have a posted speed of 70km/hour, with a 58m wide right-of-way and at-grade intersections.

In 2007, Spencer was asked to identify future environmental reviews and permitting requirements to expand Ray Gibbon Drive to a freeway standard. The study identified the following issues:

- New approvals or amendments to existing approvals will be needed including:
  - Navigable Waters Protection Act,
  - Fisheries Act,
  - Public Lands Act,
  - Water Act,
  - Wetland Policy (if wetlands are removed),
  - EPEA registration of stormwater drainage.

- There are potential triggers for an EIA under CEAA including Navigable Waters Permitting, CTA approval of rail crossing, and DFO authorizations – it is not known if another EIA will be required but it is possible given these triggers and changes to the project

- If CÉAA is triggered, expanded environmental studies (beyond what was already done for WRR) will be required including
  - Rare bryophyte survey
  - Fisheries assessments at Carrot Creek and (potentially) Sturgeon River
  - Review of previous noise studies
  - Wildlife and vegetation survey at Carrot Creek
  - Wetland assessments if within disturbance area.

- Public consultation will likely be required – whether CEAA is triggered or not, it is often part of the Alberta Transportation planning process

The full report has been included in Appendix F.

## 9.2 Wetland Transfer

A small wetland at 9+800 was removed during Stage 2 of construction. This area was compensated for near Big Lake. Documentation of this transfer has been included in Appendix F.

## 9.3 Holden Landfill

The freeway alignment of Ray Gibbon Drive passes directly though the Holden Landfill located north of Villeneuve Road on the SW18 54-25-W4M. In June of 2007, EBA Engineering completed a landfill assessment of this property to determine if Alberta Environments standard 300m development setback could be reduced or eliminated. The limits of the landfill are shown on drawing No. PP03 (see Appendix A).

According to previous records and information provided by the City of St. Albert, the Holden Landfill was approved to accept dry waste material. The drilling program confirmed that the landfill contains dry waste including various types of wood (plywood, pallets), some metal debris (tin, wires), and some textiles (rugs, twine). No household or municipal waste was observed during the investigation. The depth of the waste material is approximately 1.5m thick and has been capped with 1.22m to 1.59m of clay fill material of clay. Due to the non-hazardous nature of the material located within the landfill, the study concluded that a 30m development offset was reasonable.

The profile of Ray Gibbon Drive passes through the landfill with a 4.5m cut, which means that the waste material would be completely removed from the site. Due to the unknown bearing capacity of the waste material, the excavation material can not used to built the ramps for the interchange; however, it may be used on the side slopes or berms (subject to Alberta Environments approvals). If this option is not accepted, the material will have to be shipped to an off-site containment facility. For the purposes of estimating, the project assumes that the entire landfill (33,658m$^2$) would be excavated to a depth of 3.5m and hauled off-site, and clean fill would be used to refilled hole, as required.

## 9.4 Bokenfohr Landfill

The freeway alignment of Ray Gibbon Drive passes along the edge of the Bokenfohr Landfill located south of Villeneuve Road on the NW7 54-25-W4M. Municipal records indicate that the landfill was operated by Provincial Sanitation Ltd. in a reclaimed sand pit between 1994 and at least 1997. There are no records of landfill decommissioning or reclamation in the municipal records. In March, 2006, the site was still in records with Sturgeon County under the Land Use Bylaw as a landfill site. A landfill assessment has not been completed to date as the current landowner refuses access to the site.

The landfill was approved to accept only non-putrescible and non-hazardous waste including dry construction and demolition waste. However, in the municipal records, there is a record of charges laid July 15, 1997 on six counts of contravention of the Waste Management Regulation of the Public Health Act including acceptance of putrescible waste and permitting waste blowing from site. In addition, there is record that the landfill accepted environmentally hazardous waste, potassium super oxide which rapidly oxidizes in contact with water. As there is no record of appropriate remediation and reclamation of the landfill site, and indication that the landfill accepted environmentally hazardous wastes, it is recommended that a landfill assessment be completed when possible.

Approximate extent of the landfill was determined by aerial photographs and available sketches on record. Refer to drawing No. PP03 in Appendix A.

The information and records search on the Bokenfohr property and landfill has included information requests to the Environmental Law Centre and Alberta Environment's Freedom of Information and Protection of Privacy (FOIP) Office. The Environmental Law Centre maintains a database of Environmental Enforcement actions and Wellsite Reclamation records. The search was based on the legal land location and the property owner's name (Carl Bokenfohr, deceased).

Available records regarding enforcement actions are limited to those pursuant to the current Alberta Environmental Protection and Enhancement Act, and the predecessors the Hazardous Chemicals Act, Agricultural Chemicals Act, Clean Water Act, Clean Air Act, and/or pursuant to the current Water Act. Based on the legal land location and property owner's name; there were no enforcement actions issued under the above. The database does not include Clean Up Orders issued under the Litter Act or Environmental Protection Orders respecting unsightly property issued under EPEA.

The Wellsite Reclamation database is limited to the following reclamation actions: Reclamation Certificates (applied for, issued, and cancelled), Reclamation Orders, and Conservation and Reclamation Notices. Information is limited to wellsites, oil production sites, pipelines, compressor sites and some sand and gravel operations on private lands. The search was based on the legal land location of the Bokenforh landfill in an attempt to search for potential reclamation information on the landfill. A reclamation certificate was issued to Central-Del Rio Oils Limited in 1968; no other reclamation actions were found for the land location.

Alberta Environment was contacted in late January 2008 to initiate a records search on the Bokenforh landfill. The request was directed to the Alberta Environment FOIP Office. A general FOIP request was submitted, which triggers a search for internal government information or correspondence. A Routine Disclosure request was also submitted, which triggers a search for technical information and reports. The following is a summary of pertinent documents provided under the Routine Disclosure Request:

December 8, 1995 : "Hazmat reported incident to Alberta Environmental Protection", Kanata Environmental Services contracted Hazmat to haul 14 tonnes potassium super oxide waste within canisters (CHEMOX canisters) from CFB in Esquimalt, BC and haul back to Alberta. Kanata accepted the waste at the Bokenfohr Landfill.

December 21, 1995: Letter from Alberta Environmental Protection to Provincial Sanitation directing proper handling of canisters and including information describing the canisters as a dangerous good.

February 9, 1996: Enforcement Order under Environmental Protection and Enhancement Act to Kanata Environmental Services for removal and proper disposal of the untreated and buried CHEMOX canisters. Investigators noted some of the substance had leaked from the canisters. Provincial Sanitation is mentioned on the Order as the operator of the landfill.

February 12, 1996: Letter from Alberta Environmental Protection to Provincial Sanitation stating AEP hired CEDA Environmental Services to handle and remove canisters and neutralize any damaged canisters on site. Provincial Sanitation to supply equipment (track hoe, cat, back hoe) and operators for work necessary to remove canisters and backfill.

February 12, 1996: Fax from Provincial Sanitation to AEP confirming equipment and operators would be supplied.

February 29, 1996: Inspection record by Alberta Environment Land Conservation and Reclamation. Determined that reclamation work was progressing, including placing sub-soils and topsoil over fill as directed. (Inspection seems to be independent of and does not mention the canister issue).

July 8, 1996: Order under Public Health Act to Provincial Sanitation and the Bokenfohrs. Stated Provincial Sanitation had breached their permit by accepting putrescibile and other non-dry wastes and placing waste outside approved area. Ordered to close landfill immediately and comply with order and conditions of permit (this is related to the Charges laid under the Provincial Health Act against Provincial Sanitation and the Bokenfohrs July 1997. Seems they did not comply with the Order issued July 1996. There is no copy of the Charges in the documentation from AENV).

September 19, 1996: Letter from Alberta Environmental Protection to Provincial Sanitation stating removal of canisters is expected to be completed by October 15, 1996.

November 12, 1996: Letter from Alberta Environmental Protection to Carl Bokenfohr confirming canisters were removed from the landfill on October 30, 1996.

The following is a summary of pertinent documents provided under the FOIP Request:

Updated
PCD Inspector's Notes
Summary of CHEMOX canister delivery, handling and removal. PDC (this acronym is never defined) investigators are told that some of the canisters had holes in them and an unnamed source observed some liquids boiling. The canisters could result in a potential adverse effect on the environment if untreated.

January 4, 1996: Memo from Alberta Environmental Protection (AEP) Industrial Wastes Branch to AEP Investigation Branch advising that empty containers are not considered hazardous waste. Containers that are not empty would need to be tested to determine if they are hazardous following an appended procedure.

February 9, 1996: Enforcement Order under Environmental Protection and Enhancement Act to Provincial Sanitation Ltd. for acceptance of hazardous waste. Ordered to remove and properly dispose of the untreated and buried CHEMOX canisters.

Feb 15, 1996: Alberta Environmental Protection, Investigation Diary
Notes that CEDA removed 6366 canisters however approximately 80 could not be found and remained in landfill. CEDA reacted 31 canisters on site; water was contained and removed from site. Efforts to find and remove remaining canisters were stopped.
Note: From this document, it seems that there may be approximately 80 CHEMOX canisters remaining in the landfill. Alberta Environmental Protection deemed this file closed.

Undated
Background Information Document, unnamed source.
Information on CHEMOX canister manufacturer, normal use, hazards and removal rationale.

June 18, 1996: Alberta Environment, Environmental Management System, Incident Details
Public Complaint Incident Comment: Provincial Sanitation has a dry landfill in the County of Sturgeon where caller was instructed to dump acid, oil, paint thinners. Restaurant refuse is also dumped at the dry landfill.
Note: From this public incident report there may be a risk of encountering hazardous wastes including hydrochemicals and acid.

Undated
Summary of landfill status and CHEMOX canisters incident.
Landfill is permitted through the Aspen Health Unit. Aspen Health Unit issued an order on July 8, 1996 which closed the facility and required them to remove all non-approved waste from the landfill.

Based on the above information and the hazardous nature of the landfill material, it is expected that Alberta Environments standard offset of 300m will be required as a minimum. This offset will have significant impacts on development opportunities on the remnant land to the east of Ray Gibbon Drive. Recommendations for offset and required mitigation or remediation will be detailed in a future landfill assessment.

## 9.5 Additional Testholes Required

Although the 2007 EBA borehole samples did not identify any debris along the arterial alignment, Alberta Transportation would like additional soil testing to confirm that soil adjacent to the landfill has not been contaminated. A series of boreholes around the edge of the landfill and at the proposed pond location is recommended.

## 9.6 Historical Impacts

In 2002, a Historical Resources Impact Assessment was completed by Altamira Consulting Ltd. along the original alignment of Ray Gibbon Drive, between existing 137 Avenue and Villeneuve Road. One new archaeological site was found during the survey, but the information potential offered by the site was considered to be minimal. The study recommended that no further ássessment was warranted for the study area.

In 2003, a Historical Resources Impact Assessment was completed by Altamira Consulting Ltd. for borrow pit sites for Ray Gibbon Drive. The borrow pits were located in 29-53-25-W4M and 31-53-25-W4M. The study concluded that these lands did not contain any archaeological, paleontological or historical period sites that are of historical importance and recommended that no further assessment was warranted for the study area.

In 2007, the Environmental Overview for the Ray Gibbon Drive north extension did not identify any known historical resources and concluded that a Historical Resources Impact Assessment would not be required.

Additional studies are not required.

## 9.7 Noise

Road noise is defined as the sounds generated by vehicles operating on a roadway. This includes, but is not limited to engine/exhaust sounds and road contact sounds. For construction or improvements of highways through urban areas, Alberta Transportation has adopted a noise level of 65 dBa Leq24. Using a 10 year planning horizon, the province is committed to providing noise mitigation measures above the 65 dBa Leq24 threshold.

### 9.7.1 Arterial Road Noise

In 2003, HFP Acoustical Consultants Corp. completed a "Baseline Environmental Noise Survey" for the proposed Ray Gibbon Drive arterial, between existing 137 Avenue and McKenney Avenue. The primary concern related to traffic noise impacts were the effects on wildlife using nearby natural areas, particularly waterfowl, as well as community enjoyment of Red Willow Park and nearby natural areas. Of specific concern were the effects of ambient noise on the audibility of bird sounds among birds, and between birds and bird watchers. There was also concern regarding the impact of road traffic noise on an existing outdoor recreational facility located to the east of the road.

The results of the study indicate that there would be noticeable increases in ambient sound levels at most locations on the east and north shores of Big Lake, at the sports facility and in the white spruce stand. However, traffic noise contributions from the road would generally be within the recommended guideline sound level limit for road traffic noise. Traffic noise would increase with increasing proximity to the road and with increasing traffic volume. The worst-case scenario for traffic noise contributions occurs for the greatest road traffic volumes. For this scenario, traffic sound levels were still expected to be within the recommended sound level limit in all areas beyond 250 metres from the road and in many areas as close as100 metres to the road.

The potential effects of future residential development adjacent to the proposed road will result in further increases in ambient noise in the Big Lake area, although the affected areas will be mainly within a distance of approximately 1 kilometre of the residential areas.

### 9.7.2 Freeway Road Noise

The conversion of Ray Gibbon Drive to a freeway required the noise models to be revisited. In addition to higher operating speeds and increased traffic volumes, the highway alignment was brought within 100m of existing residential development between Giroux Road and Villeneuve Road. ACI Acoustical was asked to review the proposed plan and profile for the freeway. Refer to Appendix G for the full report.

The results of the noise modeling for Future Conditions on Ray Gibbon Drive indicated noise levels in excess of the Alberta Transportation guideline criteria of 65 dBa Leq24 at many locations directly adjacent to the roadway, indicating that noise mitigation would be required. In particular, some locations were as high as 69 dBa Leq24. As such, noise mitigation barriers were added to the model with the intent of meeting two design criteria:

1. A total noise level less than 65 dBa Leq24.
2. A minimum reduction (relative to the baseline case) of 5 dBa with the installation of a noise wall.

Using these two criteria, noise barriers were modeled at the highway right-of-way limits since this could be at the rear property line of development. The modeling indicated that a height of 3.5m relative to grade would be required at most locations. In particular:

1. Starting from the southwest residential lot in Timberlea (south of McKenney) and wrapping around along the south edge for at least 2 lots and then continuing until approximately 120m south of McKenney Avenue.
2. Starting from approximately 100m north of McKenney Avenue in Timberlea and continuing until the CN Rail right-of-way then wrapping around adjacent to the CN Rail right-of-way for at least two lots from Ray Gibbon Drive.
3. Starting from north of the CN Rail right-of-way (and also wrapping around adjacent to the CN Rail right-of-way for at least two lots from Ray Gibbon Drive) and continuing on until just south of Giroux Road and extending east to approximately 75m east of Ray Gibbon Drive.
4. Starting at approximately 250m north of Giroux Road and continuing along until approximately 260m south of Villeneuve Road.

North of this, a barrier height of 1.8m can be used starting from 260m south of Villeneuve Road and continuing north then turning east until approximately 400m east of Ray Gibbon Drive.

For all barriers taller than 1.83m, it is possible to exchange berm height for fence height and vice-versa; as long as the centerline of the fence does not change (i.e. it remains at the current proposed property line). The key is that the total height has to be that listed above. For cost estimating purposes, a $5.3M noise wall was included in Section 10.

Alberta Transportation will provide noise attenuation according to its current noise guidelines. Areas that are subdivided with no development are viewed as undeveloped and therefore noise attenuation would be the responsibility of the developers and/or the City.

SECTION 10

# 10.0 Costs to Convert the Arterial to a Freeway

On October 30, 2007, in a letter from Minister Ouellette to Mayor Crouse, the province committed to reimburse the City for the difference in construction costs between an urban arterial standard within a 22.5m right-of-way and a freeway standard right-of-way. To that end, the tables on the next page are cost comparisons for the two roads.

Reimbursement costs to the City from the Province are equal to $45,418,000. Detailed cost estimates for each scenario, including all assumptions, have been included in Appendix H.

*Table 10.1: Costs Incurred (to date) by St Albert in Construction of Ray Gibbon Drive*

| Costs | Stage 1 | Stage 2 | Stage 3 | Total | City | Province | Notes |
|---|---|---|---|---|---|---|---|
| 22.5m ROW & construction of 2 lanes | $18,999,000 | $7,299,000 | $0 | $26,298,000 | $26,298,000 | $0 | 1,2,3 |
| Additional 22.5m ROW & pre-construction preparation (grading, ect.) | $5,417,000 | $1,561,000 | $0 | $6,978,000 | $0 | $6,978,000 | 1,2,3 |
| Additional 33m ROW (grading, ect.) | $2,672,000 | $4,101,000 | $0 | $6,773,000 | $0 | $6,773,000 | 4 |
| Interchange ROW (McKenney Avenue) | $0 | $581,000 | $0 | $581,000 | $0 | $581,000 | 5 |
| **Total** | **$27,088,000** | **$13,542,000** | **$0** | **$40,630,000** | **$26,298,000** | **$14,332,000** | |

*Table 10.2: Estimated Future Costs to Secure All Land Requirements and Construct Stage 3*

| Section | Stage 1 | Stage 2 | Stage 3 | Total | City | Province | Notes |
|---|---|---|---|---|---|---|---|
| 22.5m ROW & construction of 2 lanes | $0 | $0 | $31,756,000 | $31,756,000 | $16,265,000 | $15,491,000 | |
| Additional 22.5m ROW | $0 | $0 | $1,180,000 | $1,180,000 | $0 | $1,180,000 | |
| Additional 33m ROW | $0 | $0 | $1,736,000 | $1,736,000 | $0 | $1,736,000 | |
| Interchange ROW (137th Avenue, McKenney Avenue, Giroux Road & Villeneuve Road) and Remnant Parcels | $2,350,000 | $1,685,000 | $8,644,000 | $12,679,000 | $0 | $12,679,000 | |
| **Total** | **$2,350,000** | **$1,685,000** | **$43,316,000** | **$47,351,000** | **$16,265,000** | **$31,086,000** | |

*Table 10.3: Estimated Future Costs to Construct Remaining Lanes to 14+600*

| Section | Stage 1 | Stage 2 | Expanded Stage 3 | Total | City | Province | Notes |
|---|---|---|---|---|---|---|---|
| Construct additional 2 lanes with bridge structures (4 lanes total) | $106,180,000 | $55,482,000 | $116,750,000 | $278,412,000 | $0 | $278,412,000 | 6 |
| Construct additional 2 lanes (6 lanes total) | $26,574,000 | $7,908,000 | $19,330,000 | $53,812,000 | $0 | $53,812,000 | |
| Construct additional 2 lanes (8 lanes total) | $20,442,000 | $8,936,000 | $19,919,000 | $49,297,000 | $0 | $49,297,000 | |
| **Total** | **$153,196,000** | **$72,326,000** | **$155,999,000** | **$381,521,000** | **$0** | **$381,521,000** | |

Notes

1) Includes additional bridge piers for future widening, purchased land, grading, and engineering
2) Stage 2 lands from the Province not included in calculations (55 acres, March 2007)
3) City owned lands not included in calculations (+/- 70 acres)
4) Additional $2,818,000 due to extra cuts to accommodate future alignment and storm pond expansion for six lanes
5) Additional interchange lands at McKenney
6) Includes full interchange construction costs

# 11.0 Conclusions and Recommendations

## 11.1 Conclusions

During initial talks between the City and the Province, a number of action items were identified for this study. These are listed below:

1. Identify future right-of-way requirements for the interchanges
2. Modification to the curves at stations 6+341, 11+286 and 12+300
3. Modify taper lengths and ramp radii to meet the Province's standards at interchanges
4. Identify size, ultimate locations, and right-of-way requirements for storm water management ponds
5. Insure adequate Stopping Sight Distance along the corridor
6. Identify cut and fill limits for the 8-lane cross-section
7. Develop typical cross-sections with Alberta Transportation's standard shoulder requirements, curb widths, median widths, and vertical clearances for catch basin leads
8. Confirm the existing bridge at the Sturgeon River is sufficient for 110km/h

Even though some of Ray Gibbon Drive was designed and constructed prior to Alberta Transportation and the City resuming discussions, detailed analysis shows that the roadway can be converted to a freeway.

Areas that require design exemptions are discussed below:

- ***Intersection Offset from Ramp Terminal on 137th Avenue***
  The South Riel Area Structure Plan (ASP) was approved on September 18, 2007 with an intersection located 270m from the proposed interchange ramp terminal. Changing an approved ASP has serious legal implications and this area is presently under construction. Detailed Synchro analysis has demonstrated that the proximity of the intersection will not negatively impact the operation of the interchange or the freeway.

- ***Cross-section at 137th Avenue***
  Due to the status of construction of the South Riel ASP, a retaining wall will be designed along the northeast ramp.

- ***Vertical Alignment at Station 7+491***
  The existing crest curve has a k=97, which does not meet the Stopping Sight Distance requirements for 110km/h. The Stopping Sight Distance for 110km/h is k=100. Improving this curve to meet standard will be a negligible improvement.

- ***Intersection Offset from Ramp Terminal on McKenney Avenue***
  The Timberlea Area Structure Plan was approved on November 21, 2005 with an intersection located 330m from the proposed interchange ramp terminal. Changing an approved Area Structure Plan has serious legal implications. Detailed Synchro analysis has demonstrated that the proximity of the intersection will not negatively impact the operation of the interchange or the freeway.

- ***Intersection Offset from Ramp Terminal on Giroux Road***
  The Northwest Urban Village Area Structure Plan and the North Ridge Area Structure Plan were approved on July 4, 2006 and January 19, 2004, respectively. The ASP's share an intersection located 270m from the proposed

ramp terminal. Changing an approved Area Structure Plan has serious legal implications. Detailed Synchro analysis has demonstrated that the proximity of the intersection will not negatively impact the operation of the interchange or the freeway.

These modifications replace the deficiencies table originally submitted in July, 2007.

## 11.2 Recommendations and Suggested Timelines

This report identifies the tasks required for the Province to convert Ray Gibbon Drive to a freeway. The key action items for the Province to complete are shown in Table 11.1.

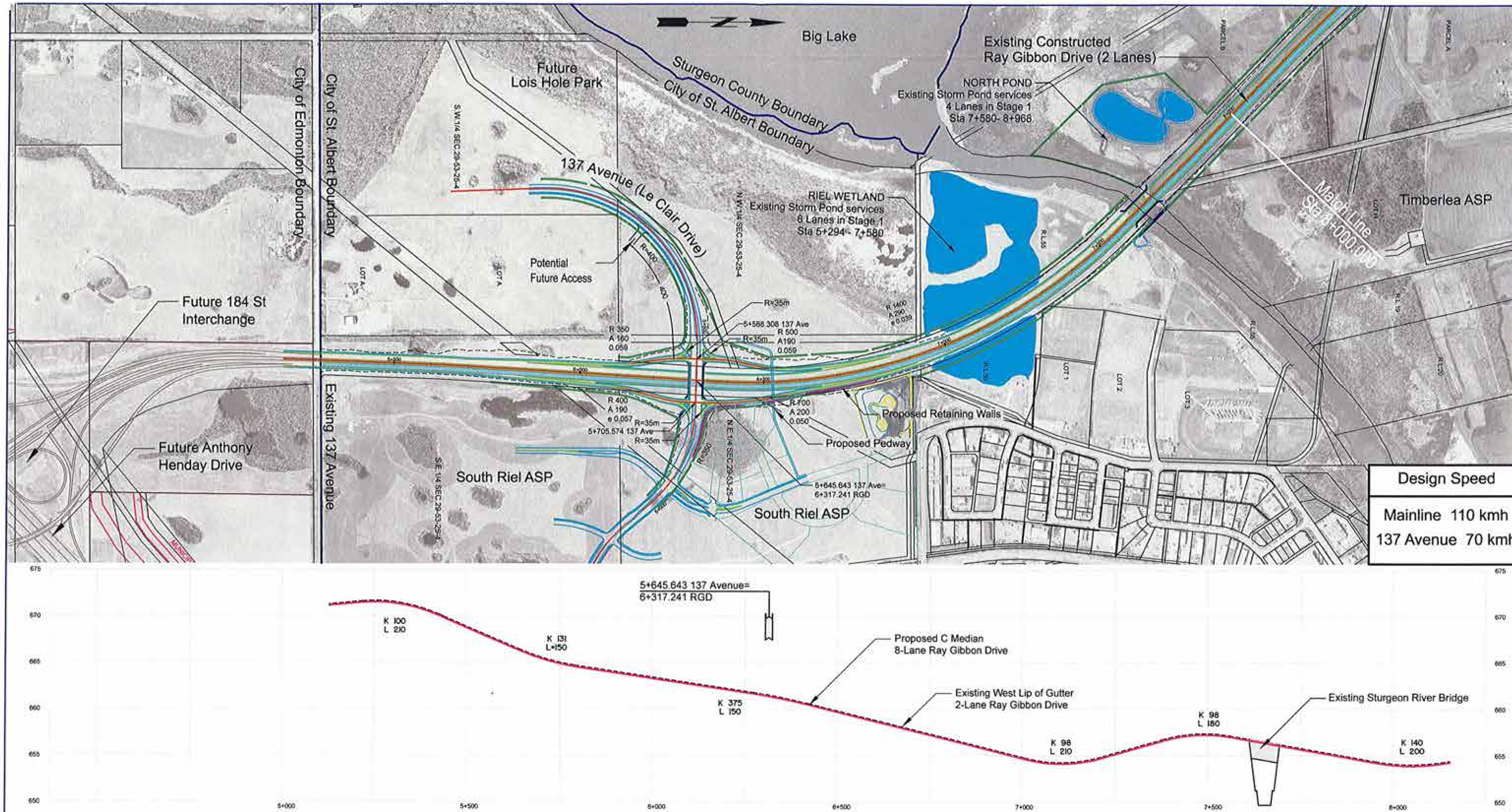
*Table 11.1: Future Action Items*

| Recommendation | Timeline |
|---|---|
| Complete additional geotechnical testing for the proposed roadway, particularly near the Bokenfohr landfill and the proposed storm water pond at Villeneuve | As soon as possible - prior to land acquisition |
| Secure additional right-of-way required | As soon as possible |
| Work with CN to develop a grade-separated crossing agreement | As soon as possible |
| Maintain speed limit at McKenney intersection to 90 km/h when inside lane is added | Until interchange constructed |
| Develop detour plans including temporary CN rail | Complete within three years or two years prior to twinning |
| Initiate Environmental Impact Assessment | As soon as possible |
| Work with Alta Link to develop relocation plans for the power transmission line crossings | One/two years before twinning |
| Install sleeves at long-term crossings to reduce future traffic disruptions | During twinning |

# APPENDIX A

# Appendix A

## Plan and Profile Drawings




Legend

| | |
|---|---|
| PROPOSED Ray Gibbon Drive | LIMIT OF CUT |
| PROPOSED R/W BDY | LIMIT OF FILL |
| CITY OF ST ALBERT ASP | PROPOSED NOISE WALL |
| EXISTING STORM POND | EXISTING LANDFILL SITE |
| CONSTRUCTED 2-LANE Ray Gibbon Drive | |

Key Plan

SCALE 1:10,000 — HORIZONTAL (100m 0 100m 200m)

SCALE 1:400 — VERTICAL (4m 0 4m 8m)

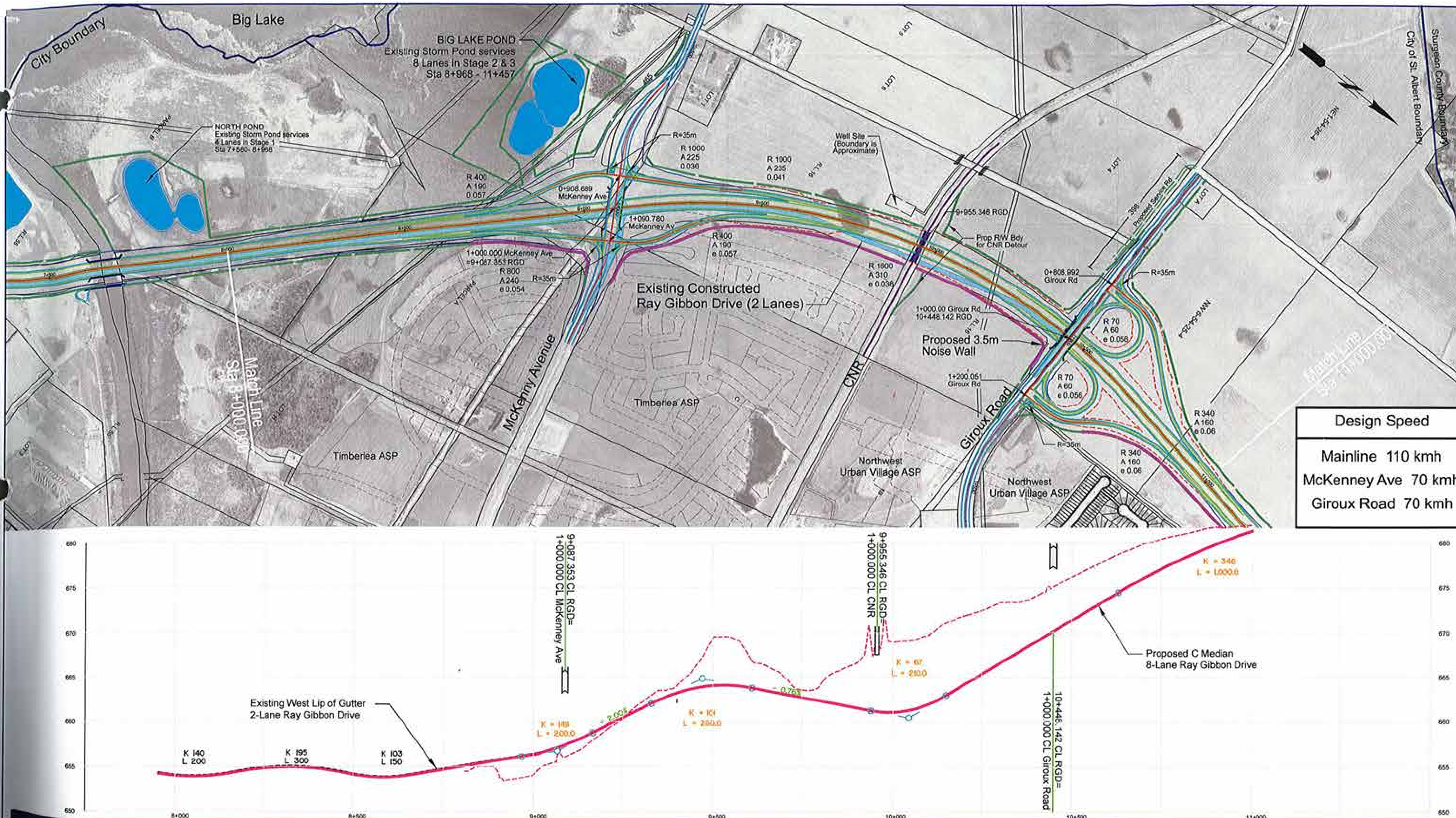
ISL Engineering and Land Services

THE CITY OF St. Albert

Project: Ray Gibbon Drive

Title: Centreline Plan & Profile — Functional Planning Study — 8-Lane Stage

Figure No. PP 01




## Legend

| | | | |
|---|---|---|---|
| PROPOSED Ray Gibbon Drive | | LIMIT OF CUT | |
| PROPOSED R/W BDY | | LIMIT OF FILL | |
| CITY OF ST ALBERT ASP | | PROPOSED NOISE WALL | |
| EXISTING STORM POND | | EXISTING LANDFILL SITE | |
| CONSTRUCTED 2-LANE Ray Gibbon Drive | | | |

Key Plan

SCALE 1:10,000
100m 0 100m 200m
HORIZONTAL

SCALE 1:400
4m 0 4m 8m
VERTICAL

ISL Engineering and Land Services

THE CITY OF St. Albert

Project: Ray Gibbon Drive

Title: Centreline Plan & Profile
Functional Planning Study
8-Lane Stage

Figure No. PP 02



**Legend**

| | | | |
|---|---|---|---|
| PROPOSED Ray Gibbon Drive | | LIMIT OF CUT | |
| PROPOSED R/W BDY | | LIMIT OF FILL | |
| CITY OF ST ALBERT ASP | | PROPOSED NOISE WALL | |
| EXISTING STORM POND | | EXISTING LANDFILL SITE | |
| CONSTRUCTED 2-LANE Ray Gibbon Drive | | | |

ISL Engineering and Land Services

SCALE 1:10,000
100m 0 100m 200m
HORIZONTAL

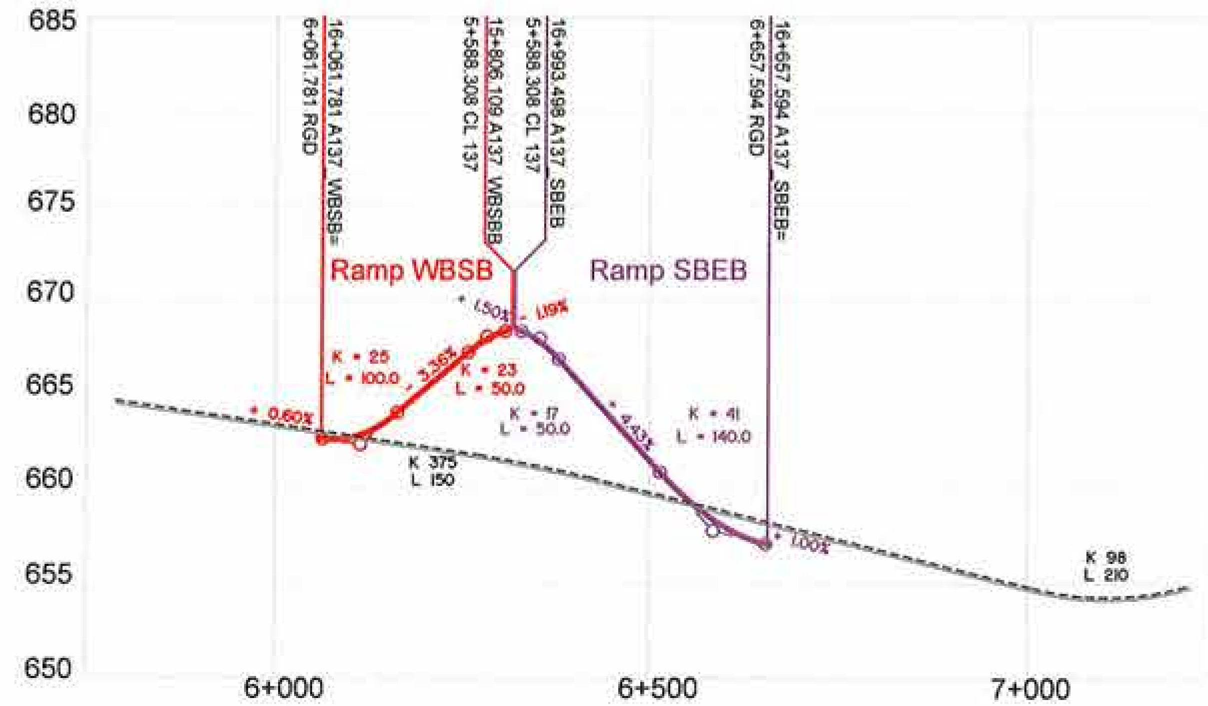
SCALE 1:400
4m 0 4m 8m
VERTICAL

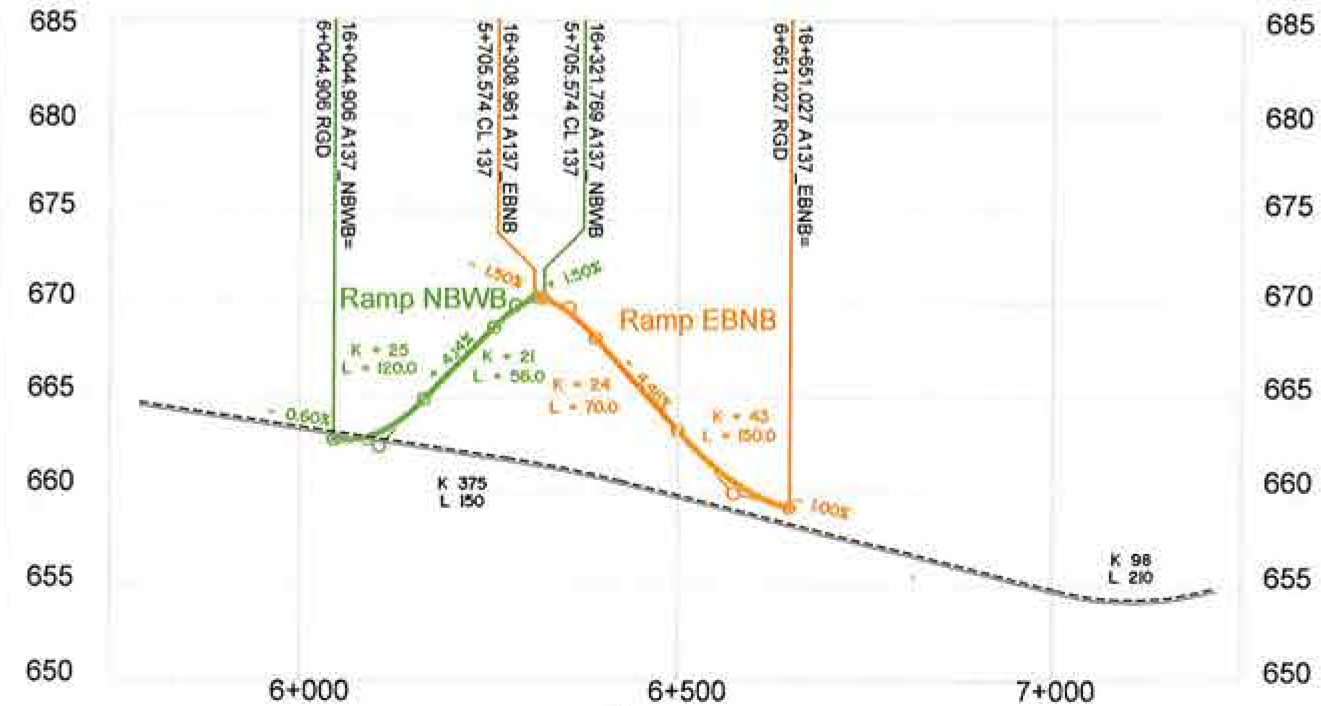
THE CITY OF St. Albert

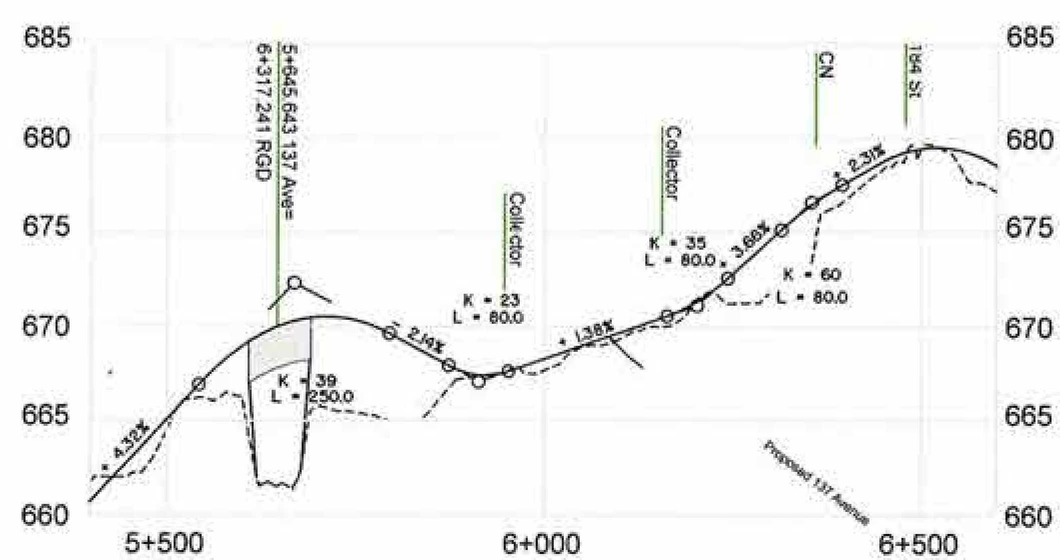
Project: Ray Gibbon Drive

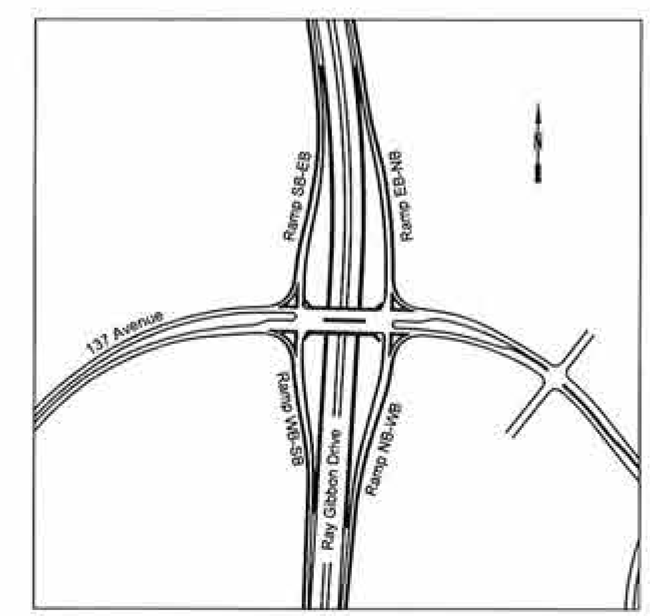
Title: Centreline Plan & Profile
Functional Planning Study
8-Lane Stage

Figure No. PP 03

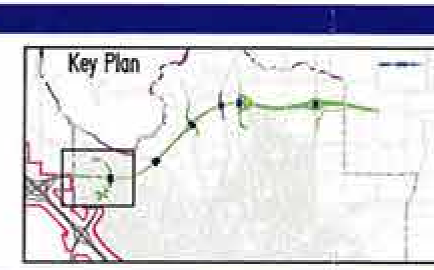



ISL Engineering and Land Services

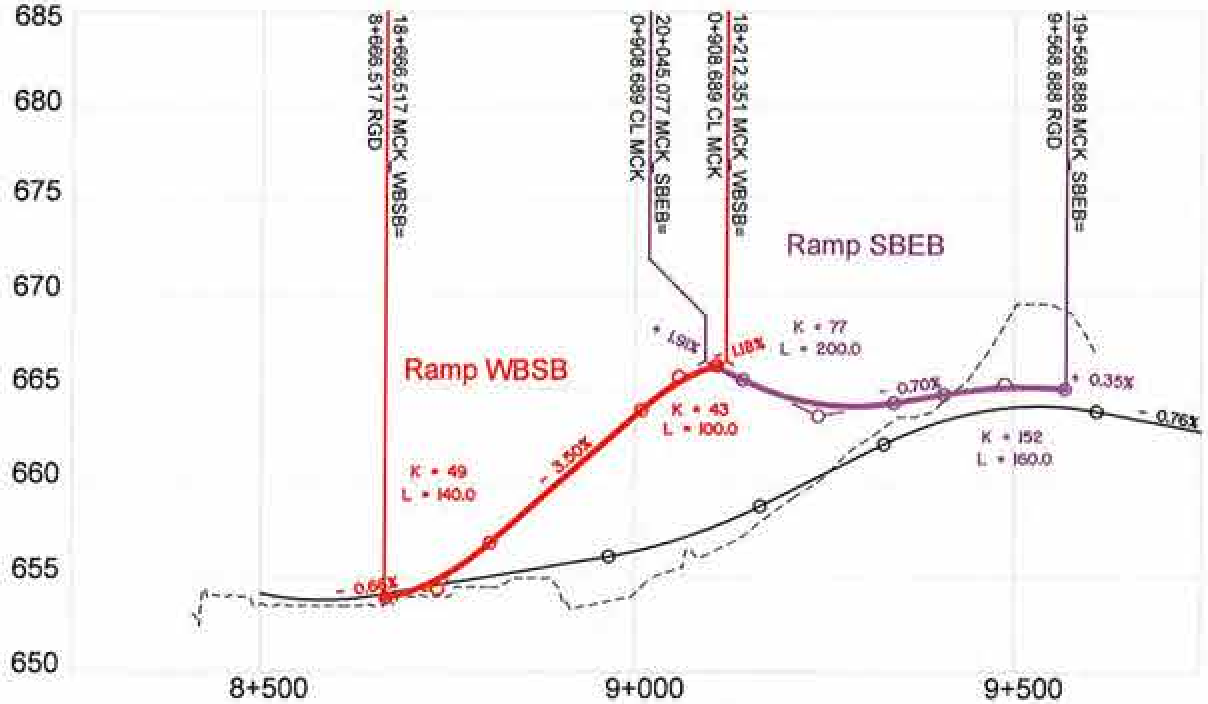


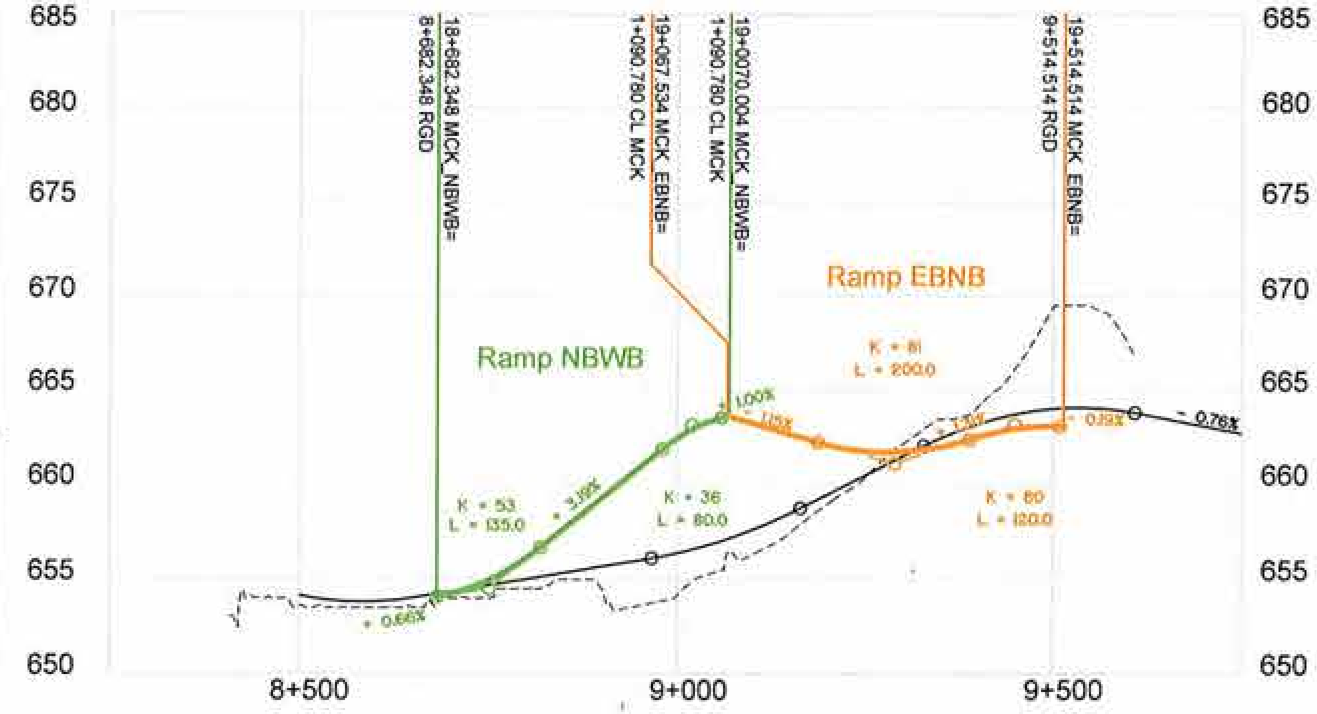

SCALE 1:10,000
100m 0 100m 200m
HORIZONTAL

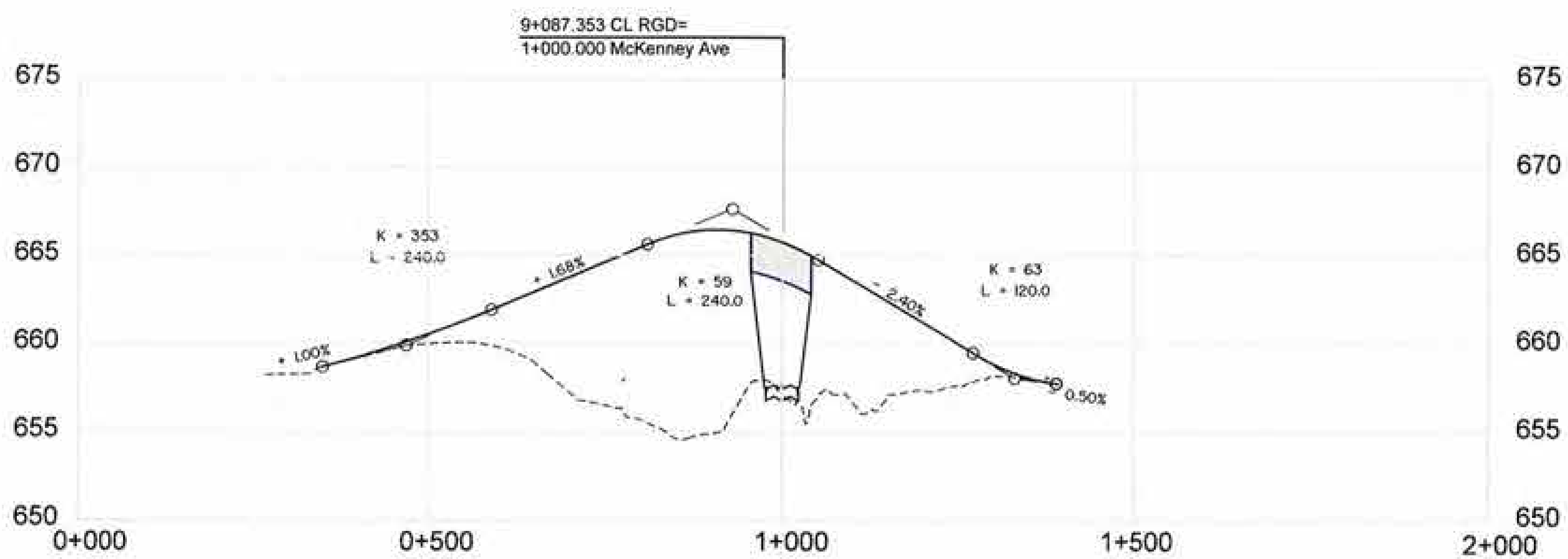
SCALE 1:400
4m 0 4m 8m
VERTICAL

THE CITY OF St. Albert

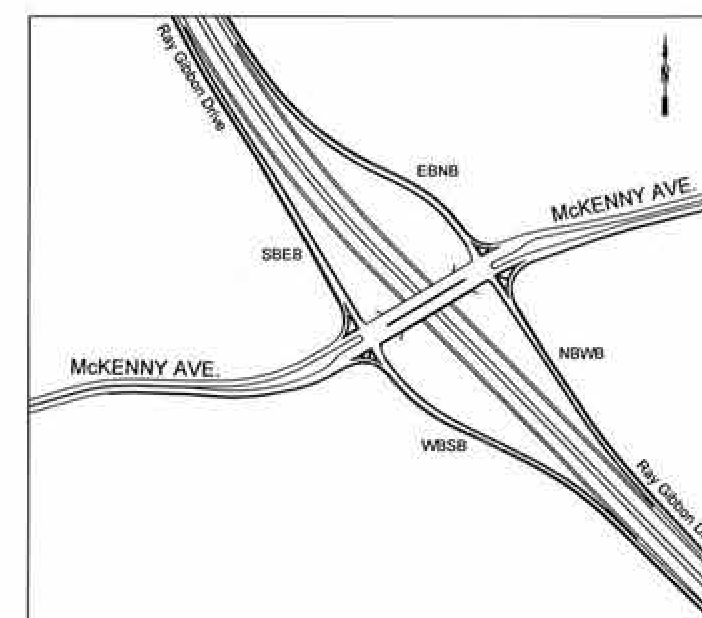
| | |
|---|---|
| Project | Ray Gibbon Drive |
| Title | Interchange Ramp Profiles<br>Functional Planning Study<br>137 Ave Interchange |
| Figure No. | 12436 PP 04 |




McKenney Ave



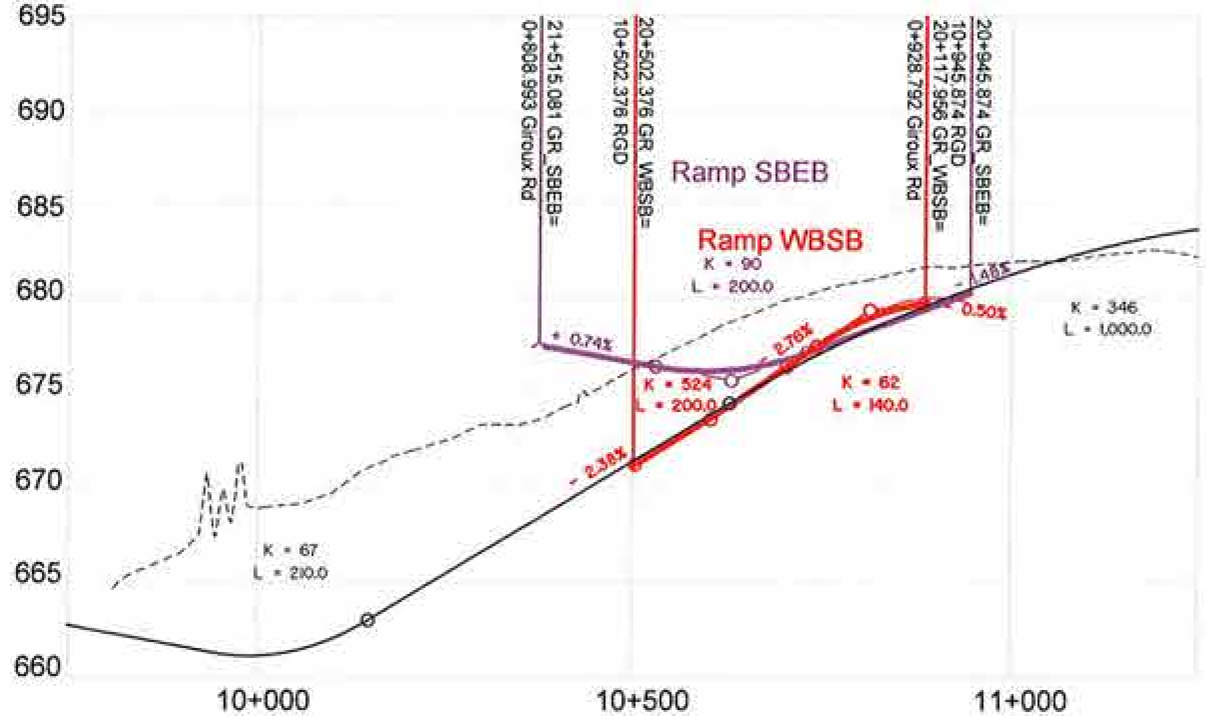

ISL Engineering and Land Services

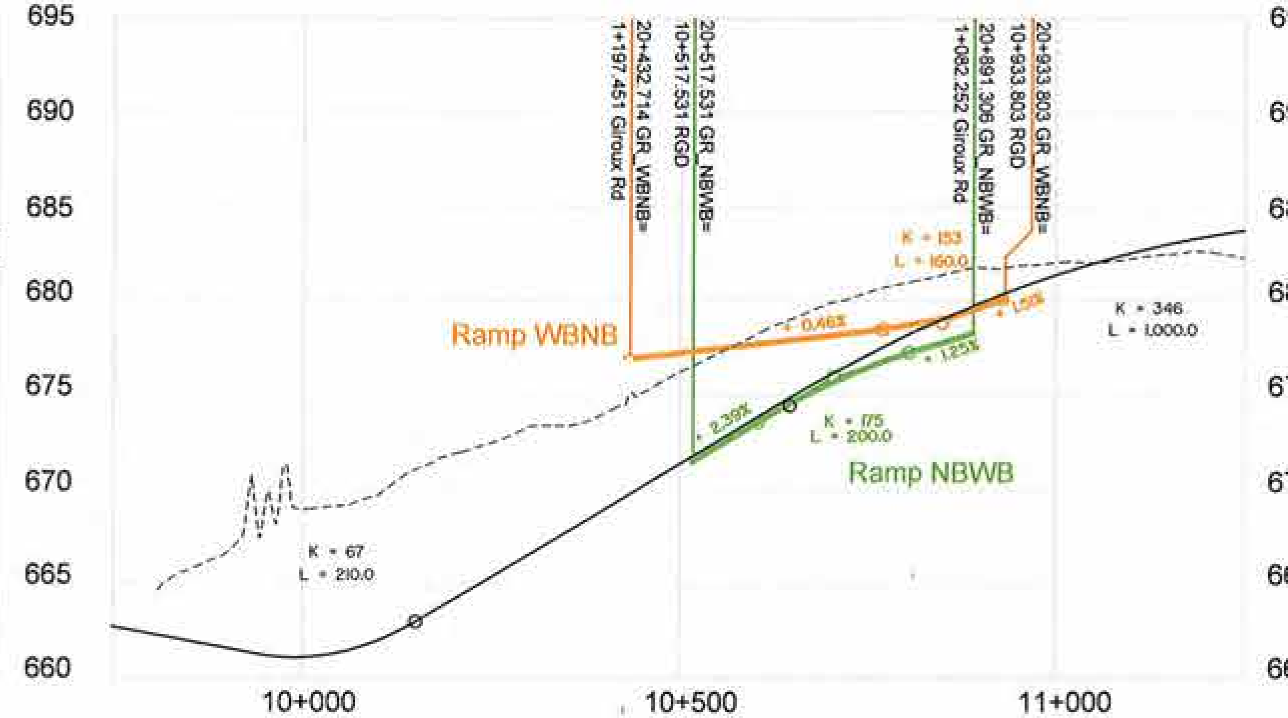

SCALE 1:10,000
100m 0 100m 200m
HORIZONTAL

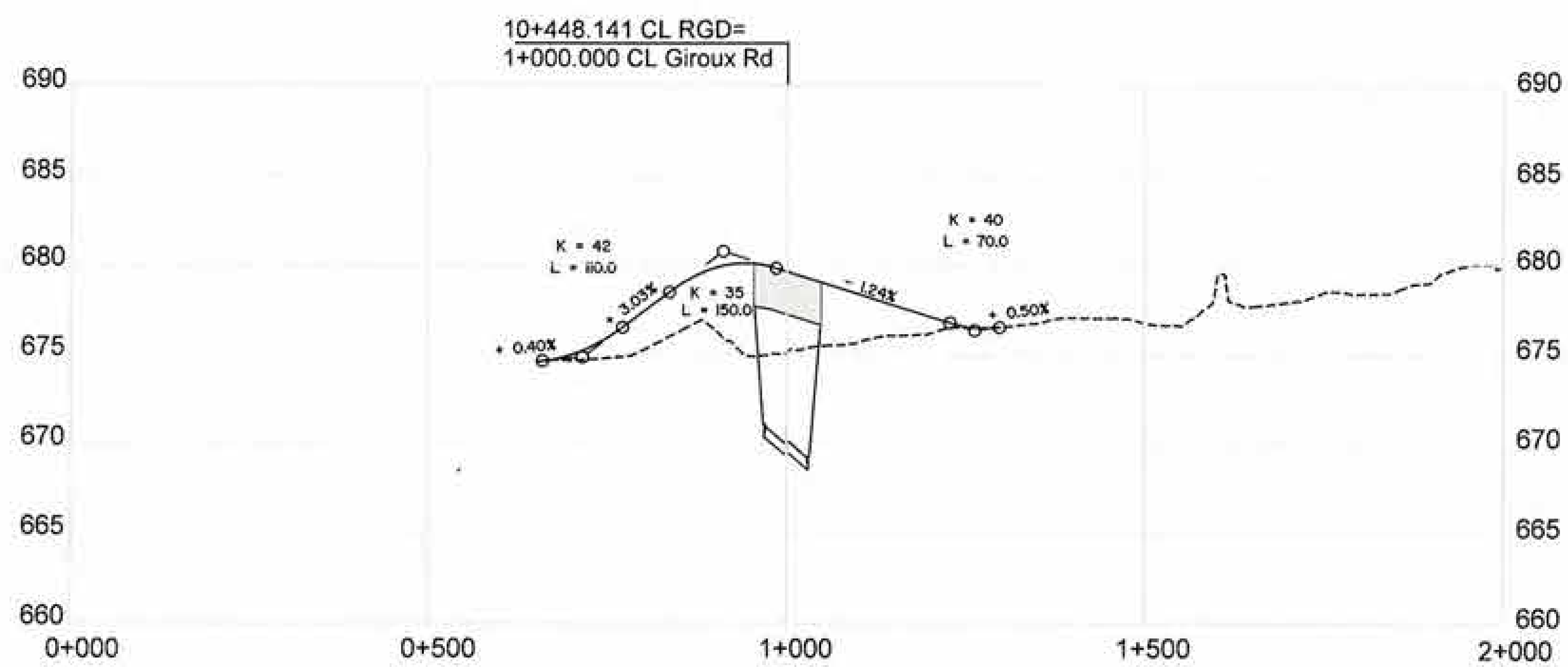
SCALE 1:400
4m 0 4m 8m
VERTICAL

THE CITY OF St. Albert

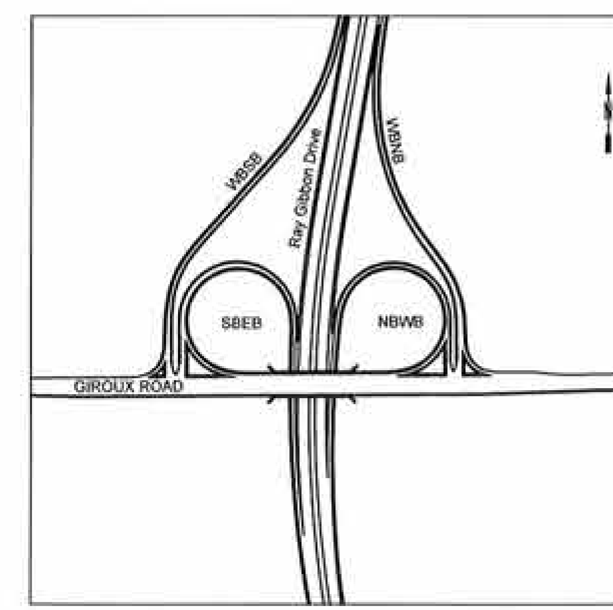
| | |
|---|---|
| Project | Ray Gibbon Drive |
| Title | Interchange Ramp Profiles<br>Functional Planning Study<br>McKenney Ave. Interchnage |
| Figure No. | 12436 PP 05 |




Giroux Rd




**ISL** Engineering and Land Services


SCALE 1:10,000
100m 0 100m 200m
HORIZONTAL

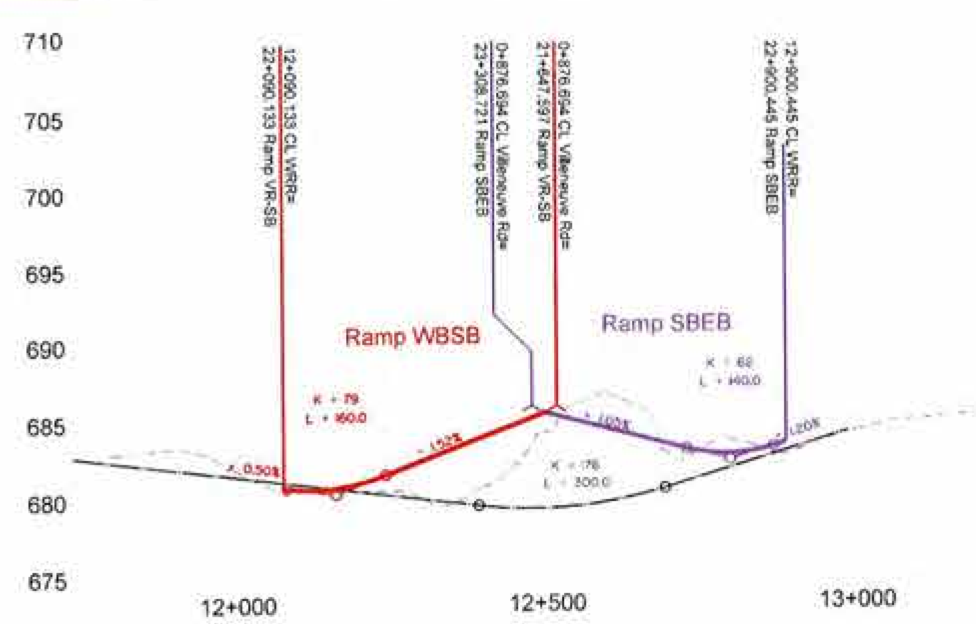
SCALE 1:400
4m 0 4m 8m
VERTICAL

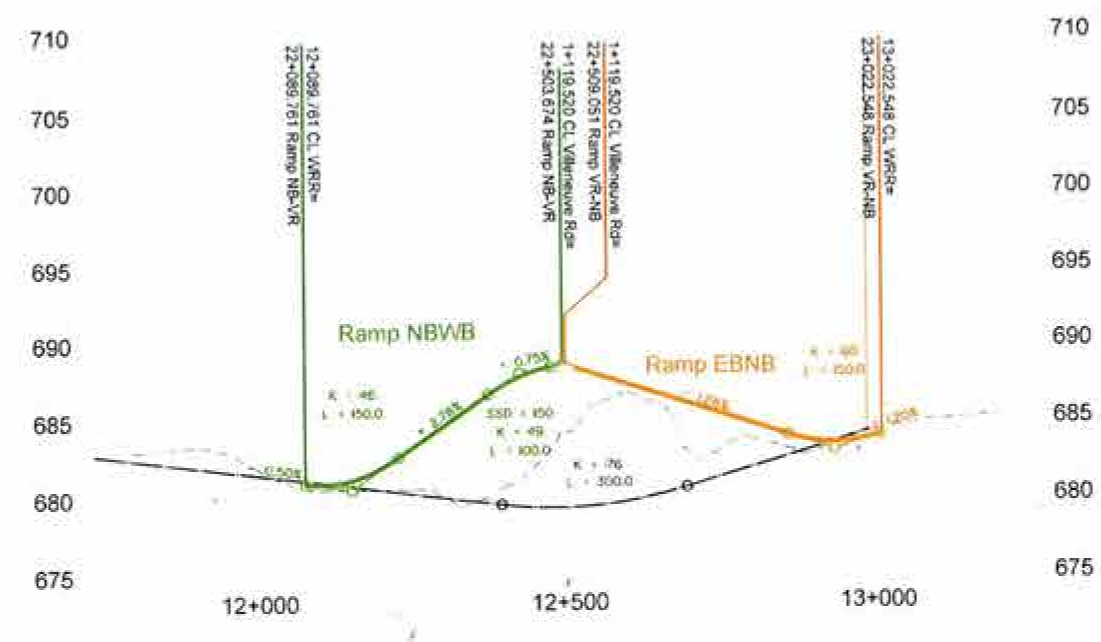
THE CITY OF St. Albert

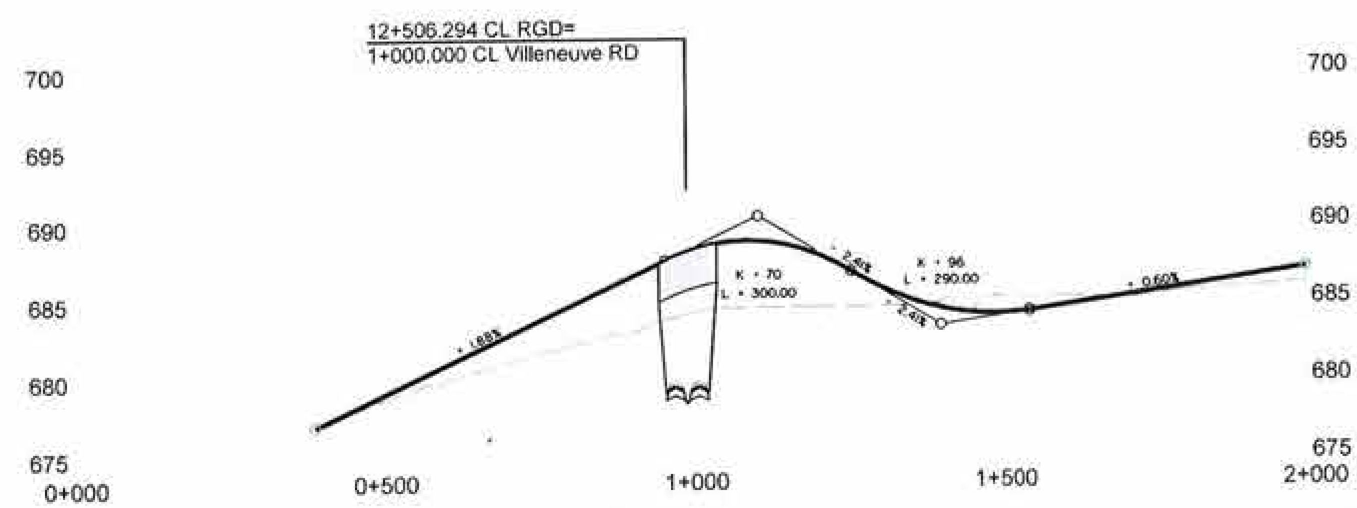
Project: Ray Gibbon Drive

Title: Interchange Ramp Profiles
Functional Planning Study
Giroux Rd. Interchange

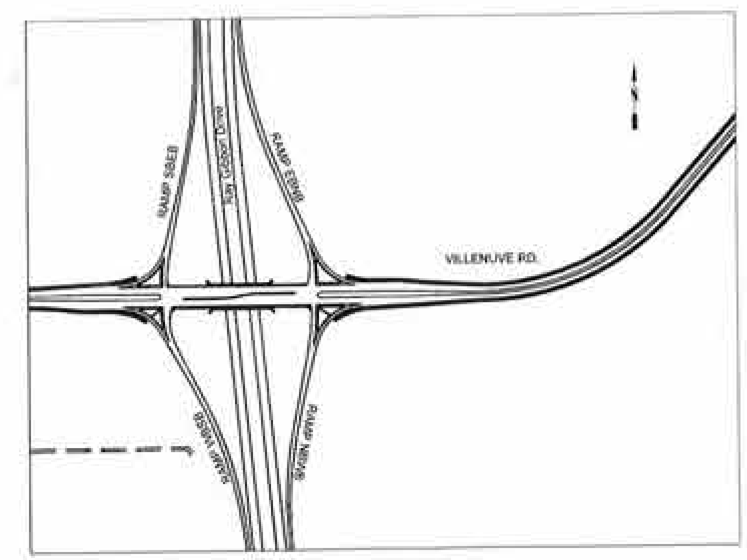
Figure No. 12436 PP 06



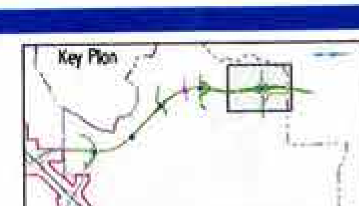




Villeneuve Rd




ISL Engineering and Land Services

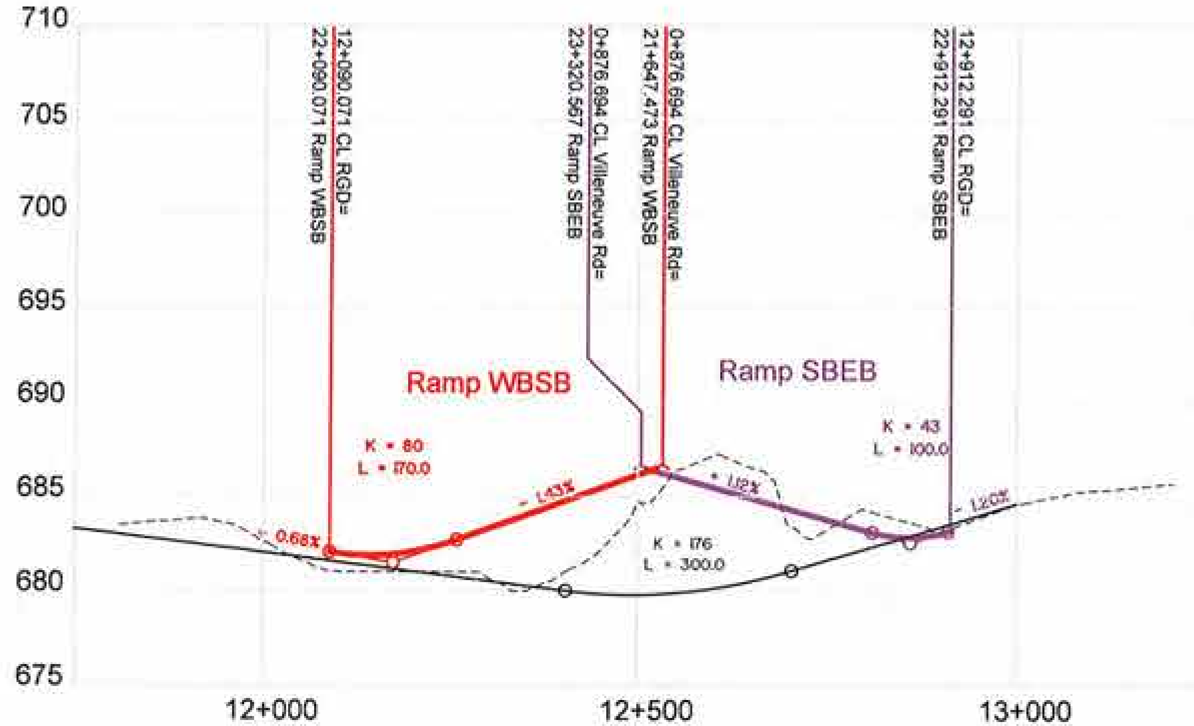


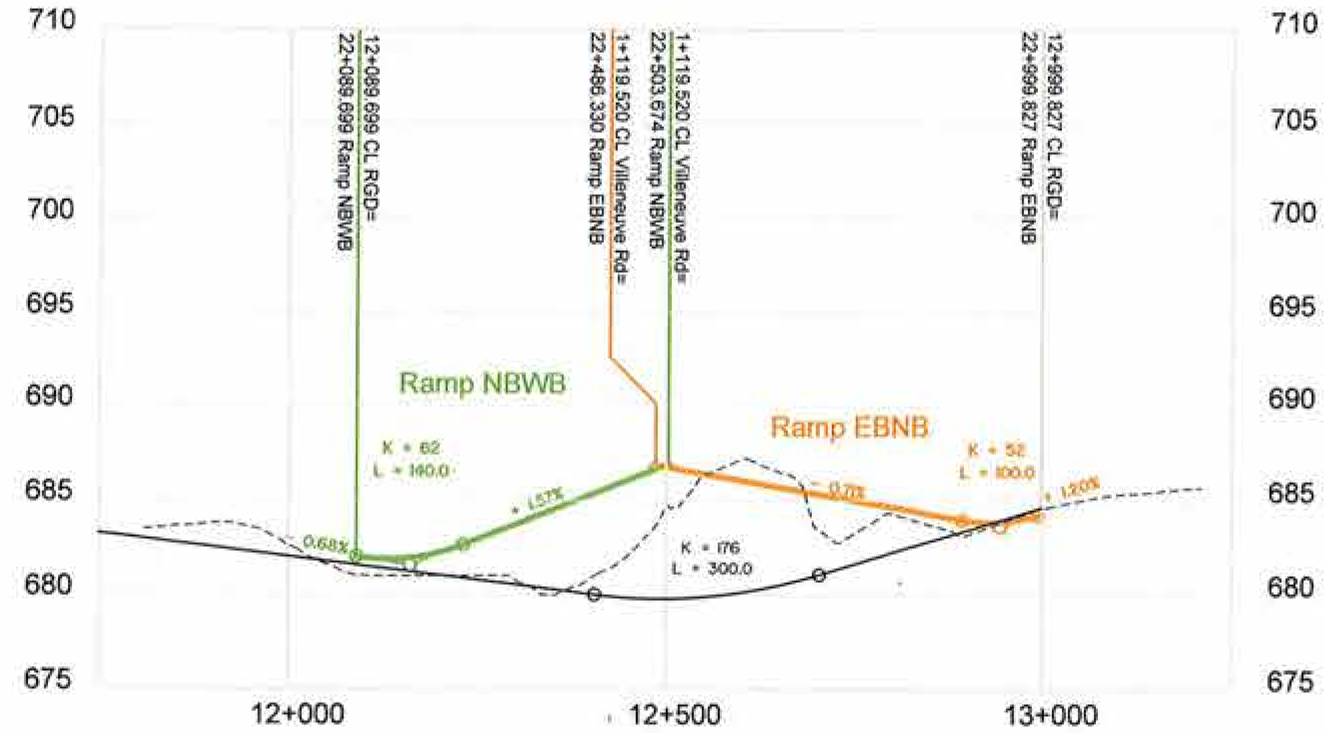

SCALE 1:10 000 HORIZONTAL

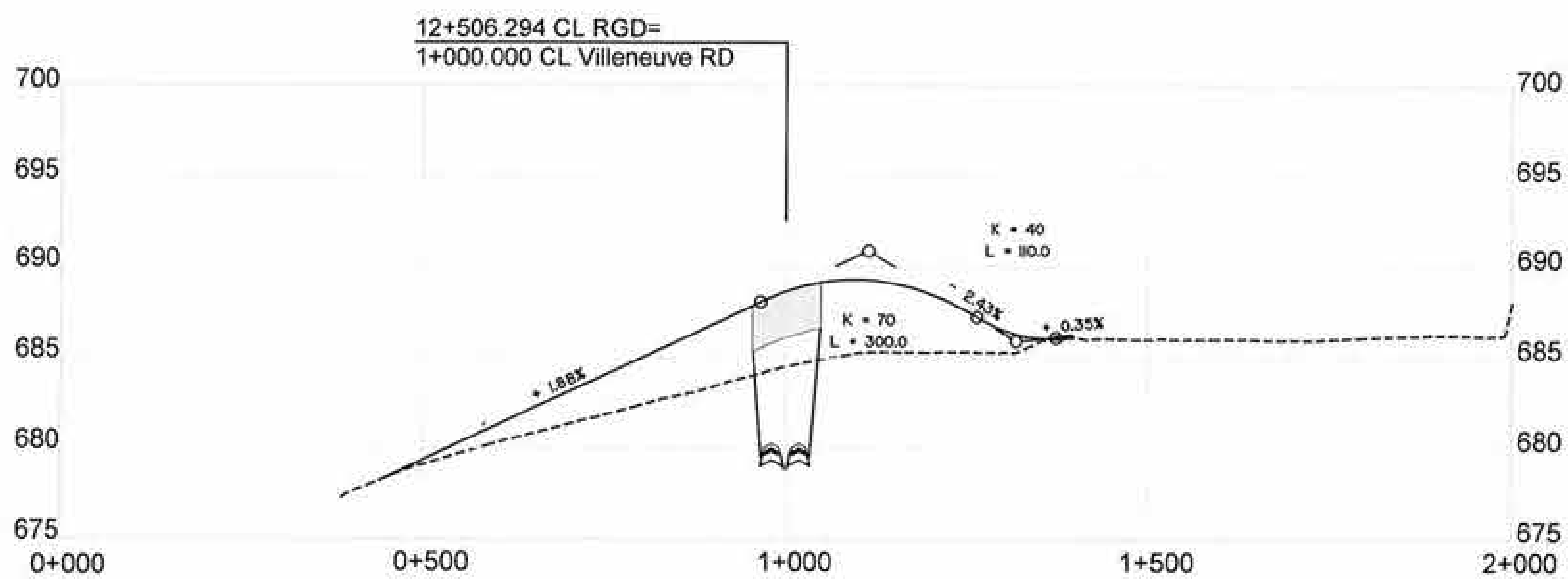
SCALE 1:400 VERTICAL

City of St. Albert Engineering Services

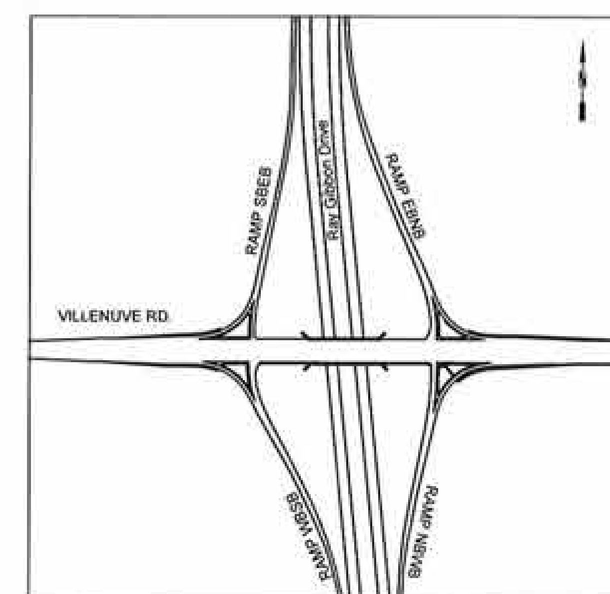
| | |
|---|---|
| Project | Ray Gibbon Drive |
| Title | Interchange Ramp Profiles<br>Functional Planning Study<br>Villeneuve Rd. Interchange |
| Figure No. | 12436 PP 07 |



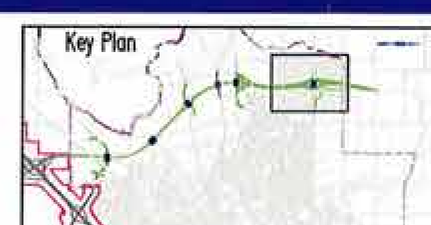




## Villeneuve Rd




ISL Engineering and Land Services




SCALE 1:10,000
HORIZONTAL
SCALE 1:400
VERTICAL

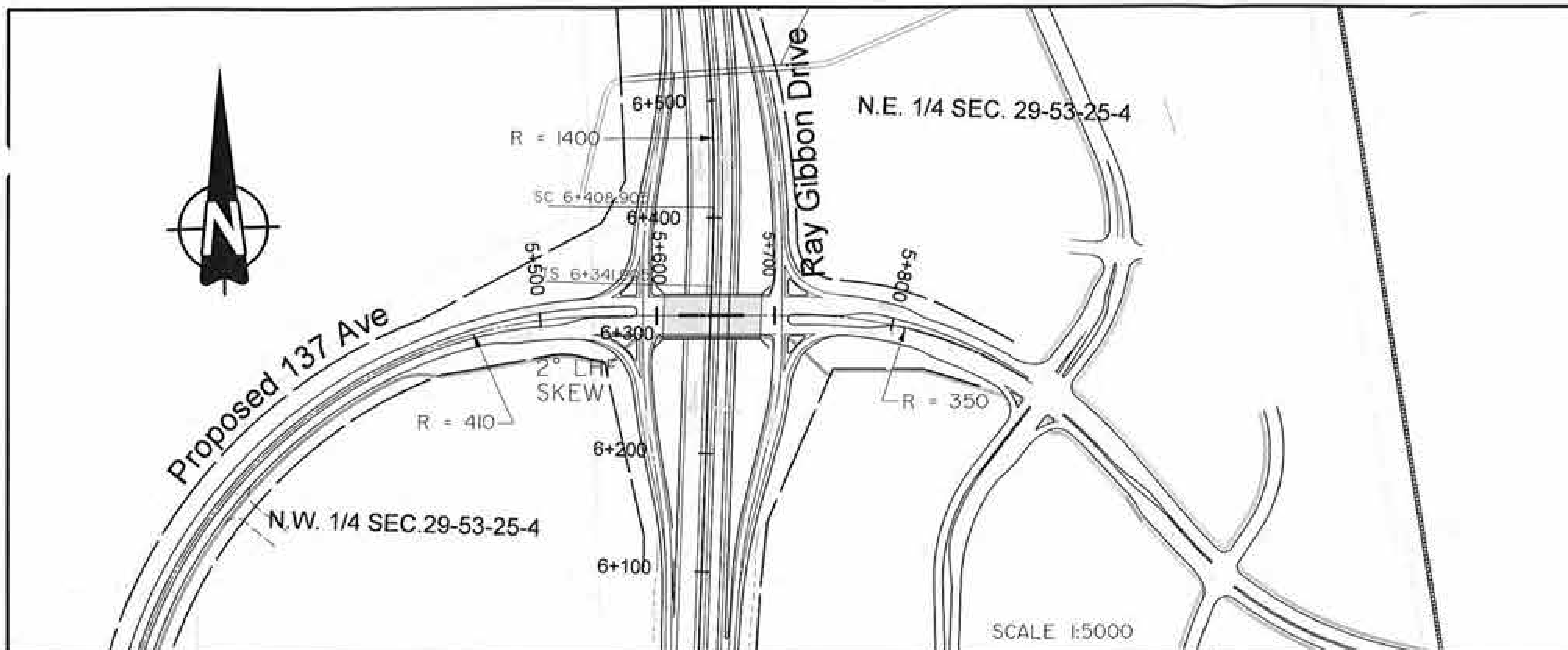
THE CITY OF St. Albert

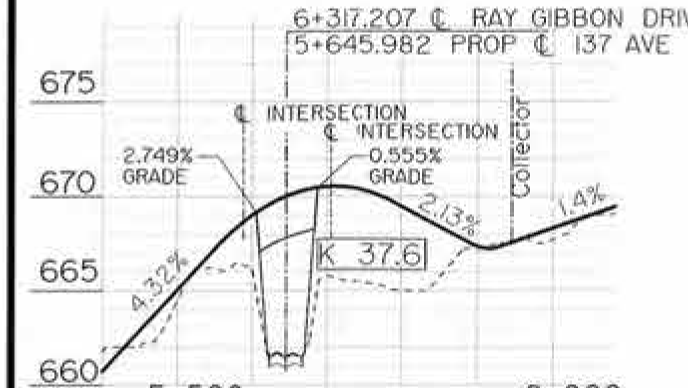
| | |
|---|---|
| Project | Ray Gibbon Drive |
| Title | Interchange Ramp Profiles<br>Functional Planning Study<br>Villenuve Rd. Interchange |
| Figure No. | 12436 PP 07 |

# APPENDIX B

# Appendix B

## Structural Drawings

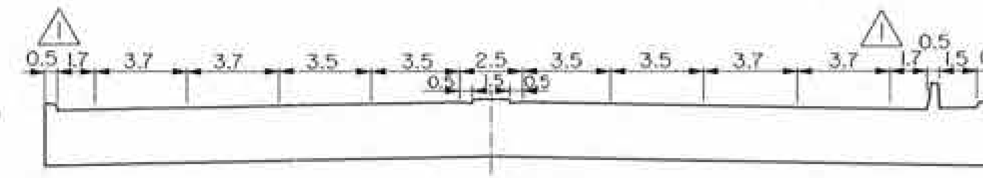



137 AVENUE PROFILE

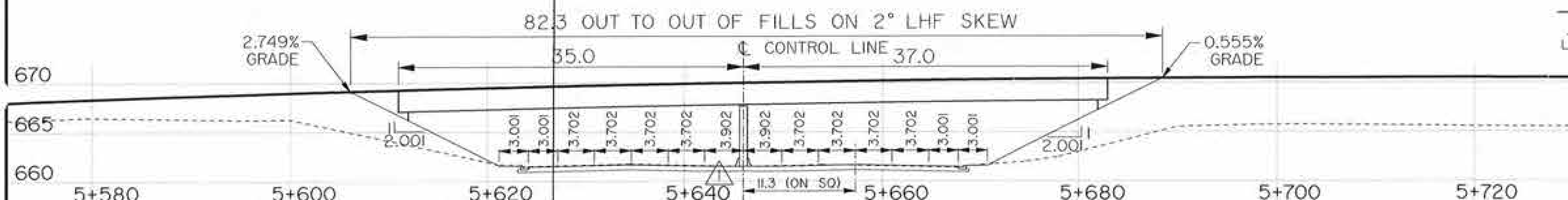
LOOKING NORTHERLY H 1:10 000 V 1:400


KEY PLAN




137 AVENUE CROSS-SECTION

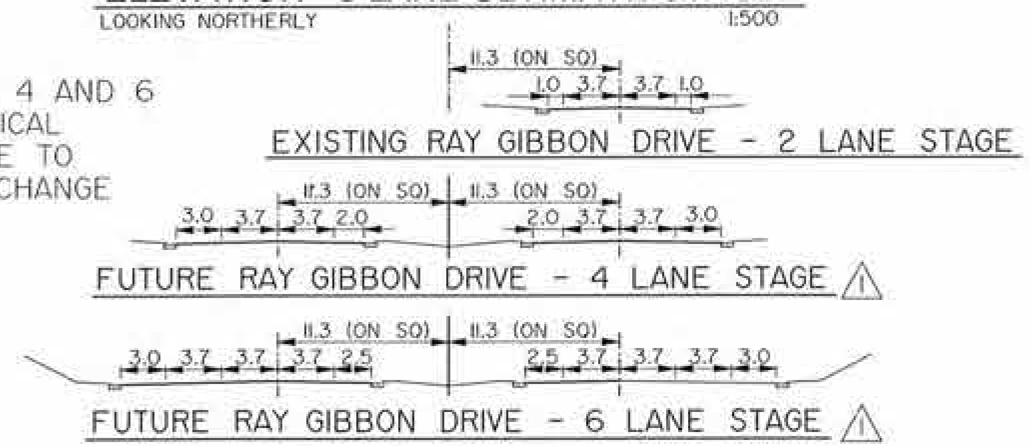
LOOKING EASTERLY 1:300




ELEVATION - 8 LANE ULTIMATE STAGE

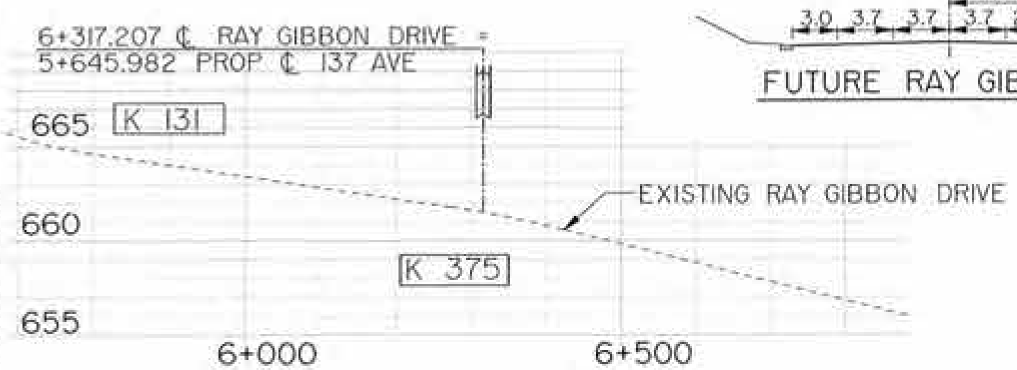
LOOKING NORTHERLY 1:500

NOTE:
THE EXISTING 2 LANE AND FUTURE 4 AND 6 LANE STAGING SEQUENCES ARE TYPICAL FROM THE 137 AVENUE INTERCHANGE TO NORTH OF THE GIROUX ROAD INTERCHANGE




## NOTES

- STRUCTURE IS ON A TANGENT ALIGNMENT
- DESIGN SPEED FOR RAY GIBBON DRIVE = 110 km/hr
- DESIGN SPEED FOR 137 AVENUE = 70 km/hr
- SPAN ARRANGEMENT IS TENTATIVE AND SUBJECT TO CHANGE
- (2) ASSUME 1.0 m PIER THICKNESS
- OUT TO OUT LENGTH IS TO BE CONFIRMED DURING THE PRELIMINARY ENGINEERING DESIGN OF THE PROJECT. THE LENGTH IS BASED ON A 2 SPAN ARRANGEMENT WITH A PRELIMINARY STRUCTURE DEPTH OF 2.1 m AND 2:1 HEADSLOPES
- MINIMUM VERTICAL CLEARANCE FROM TOP OF RAY GIBBON DRIVE TO THE UNDERSIDE OF THE STRUCTURE IS 5.65 m
- THE PROPOSED TIGHT DIAMOND INTERSECTIONS MUST BE SIGNALIZED IN THE INITIAL STAGE SINCE SIGHT DISTANCE IS NOT ADEQUATE




RAY GIBBON DRIVE PROFILE

LOOKING WESTERLY H 1:10 000 V 1:400

ISL Engineering and Land Services

| REV | DATE | REVISIONS | BY |
|---|---|---|---|
| 2 | 2009-02-27 | PIER THICKNESS INCREASED | WWK |
| 1 | 2009-01-16 | SHOULDERS AND SHY DISTANCE | WWK |
| | 2008-03-05 | REPORT SUBMISSION | WWK |

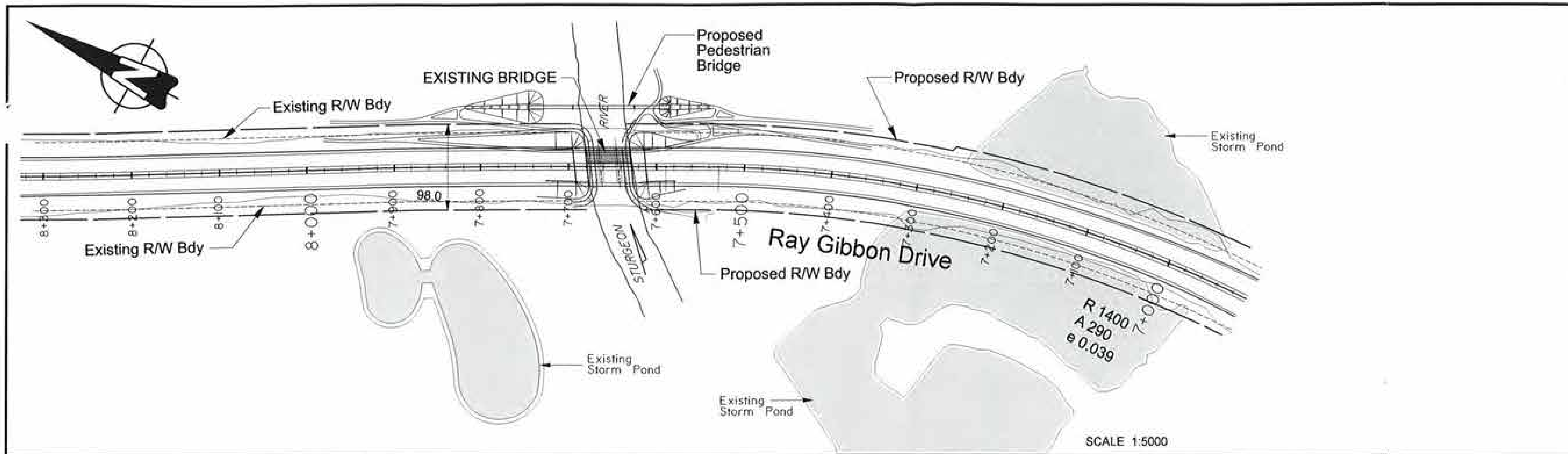
PRELIMINARY

DESIGNER DATE — CHECKER DATE

Alberta Transportation

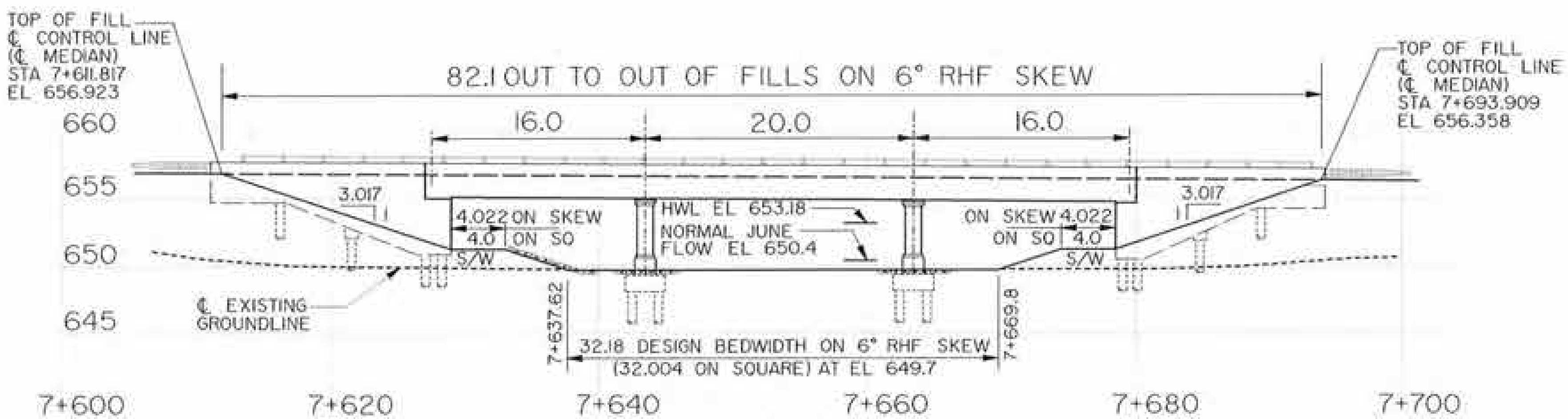
137 AVENUE OVERPASS OVER RAY GIBBON DRIVE STRUCTURE OUTLINE DRAWING

| DEPARTMENT BAR CODE | DATE | STREAM | LOCATION | HIGHWAY | FILE | SHEET | DRAWING |
|---|---|---|---|---|---|---|---|
| | | RAY GIBBON DRIVE | INE 29-53-25-4 | 137 AVENUE | | OF | 12436ST01 |



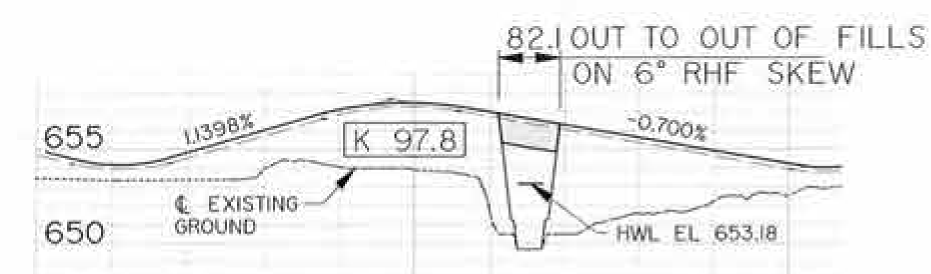


KEY PLAN




ELEVATION

LOOKING WESTERLY 1:500




RAY GIBBON DRIVE PROFILE

LOOKING WESTERLY H 1:10 000 V 1:400

## NOTES

- CONSTRUCTION FOR THE EXISTING 2 LANE BRIDGE AND THE PIERS FOR THE FUTURE 4 LANE STRUCTURE WERE COMPLETED IN 2007. CONSEQUENTLY, THE SPAN ARRANGEMENT IS FIXED
- THE STRUCTURE IS ON A TANGENT ALIGNMENT AND ON AN APPROXIMATE 6° RHF SKEW
- THE BRIDGE IS ON A 0.7% GRADE
- DESIGN SPEED FOR RAY GIBBON DRIVE = 110 km/hr
- OUT TO OUT LENGTH IS SET AND IS SHOWN ALONG THE CENTRELINE MEDIAN (CONTROL LINE)
- THE EXISTING SIDEWALK IS TO BE REMOVED FROM THE EXISTING STRUCTURE IN THE 4 LANE STAGE AND A SEPARATE PEDESTRIAN BRIDGE WILL BE CONSTRUCTED BEYOND THE PROPOSED RIGHT-OF-WAY. THE EXACT LOCATION FOR THE NEWLY PROPOSED SIDEWALK STRUCTURE WILL NEED TO BE RESOLVED WITH THE CITY OF ST. ALBERT
- ENVIRONMENTAL APPROVALS WILL NEED TO BE OBTAINED WITH THE PROPOSED SIX AND EIGHT LANE STAGES OF CONSTRUCTION

ISL Engineering and Land Services

| REV | DATE | REVISIONS | BY |
|---|---|---|---|
| | 2008-03-05 | REPORT SUBMISSION | WWK |

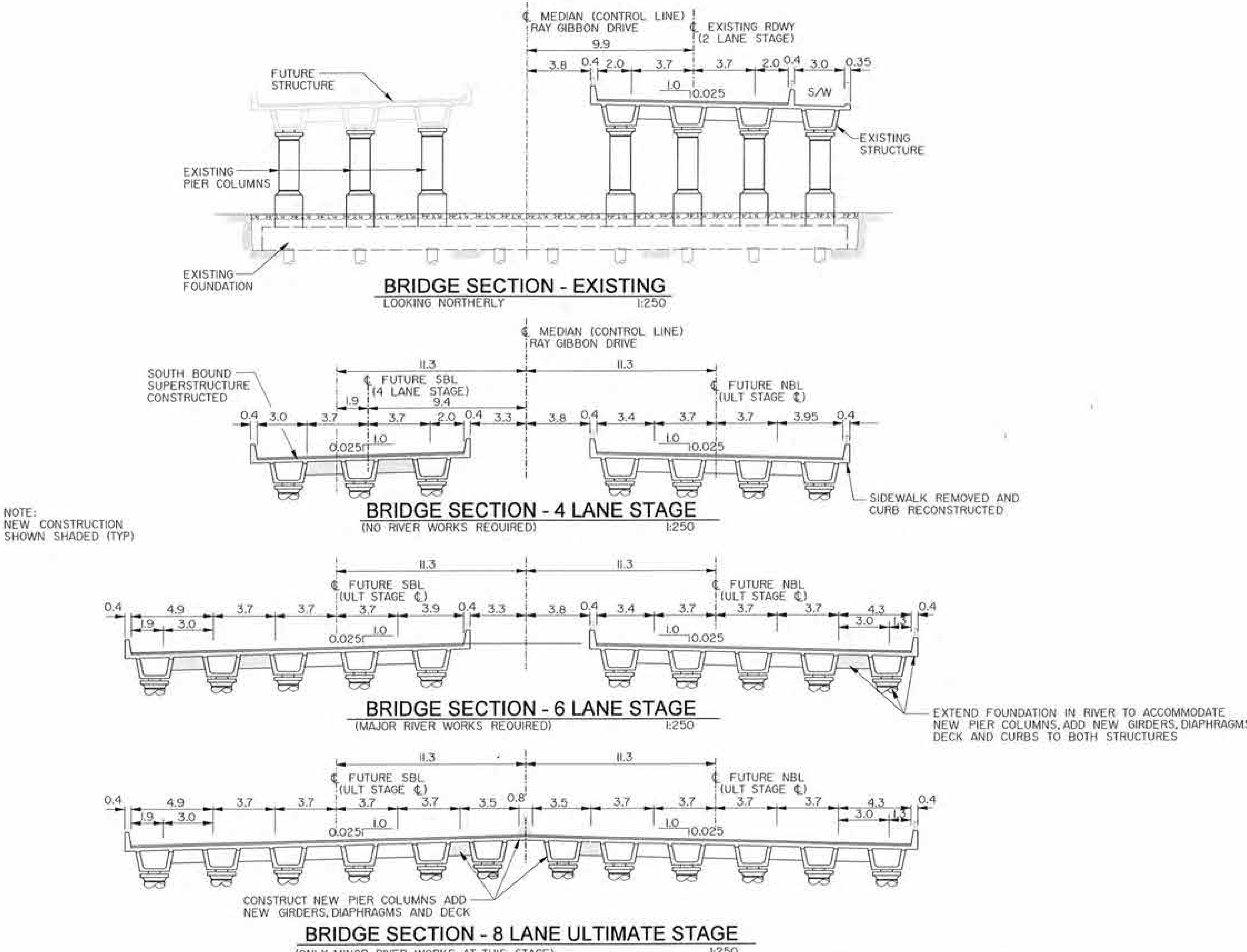
PRELIMINARY

DESIGNER · DATE | CHECKER · DATE

Alberta Transportation

RAY GIBBON DRIVE
OVER THE STURGEON RIVER
STRUCTURAL OUTLINE DRAWING 1 OF 2

| DEPARTMENT BAR CODE | DATE | STREAM | LOCATION | HIGHWAY | FILE | SHEET | DRAWING |
|---|---|---|---|---|---|---|---|
| | | STURGEON RIVER | ISW 32-53-25-4 | RAY GIBBON DRIVE | | OF | 12436ST02 |




ISL Engineering and Land Services

| REV | DATE | REVISIONS | BY |
|---|---|---|---|
| | 2008-03-05 | REPORT SUBMISSION | WWK |

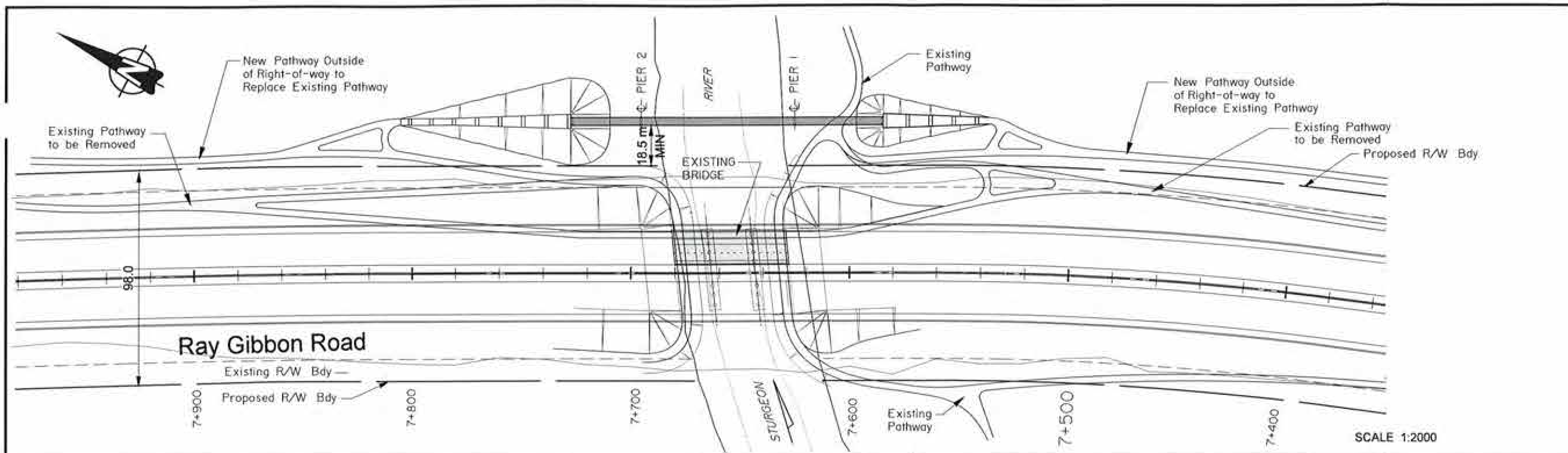
PRELIMINARY

DESIGNER / CHECKER / DATE

Alberta Transportation

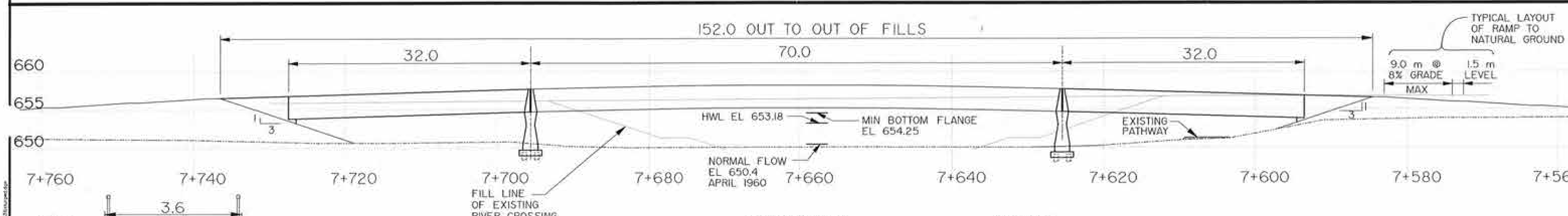
RAY GIBBON DRIVE
OVER THE STURGEON RIVER
STRUCTURAL OUTLINE DRAWING 2 OF 2

| DEPARTMENT BAR CODE | DATE | STREAM | LOCATION | HIGHWAY | FILE | SHEET | DRAWING |
|---|---|---|---|---|---|---|---|
| | | STURGEON RIVER | ISW 32-53-25-4 | RAY GIBBON DRIVE | | OF | 12436ST03 |



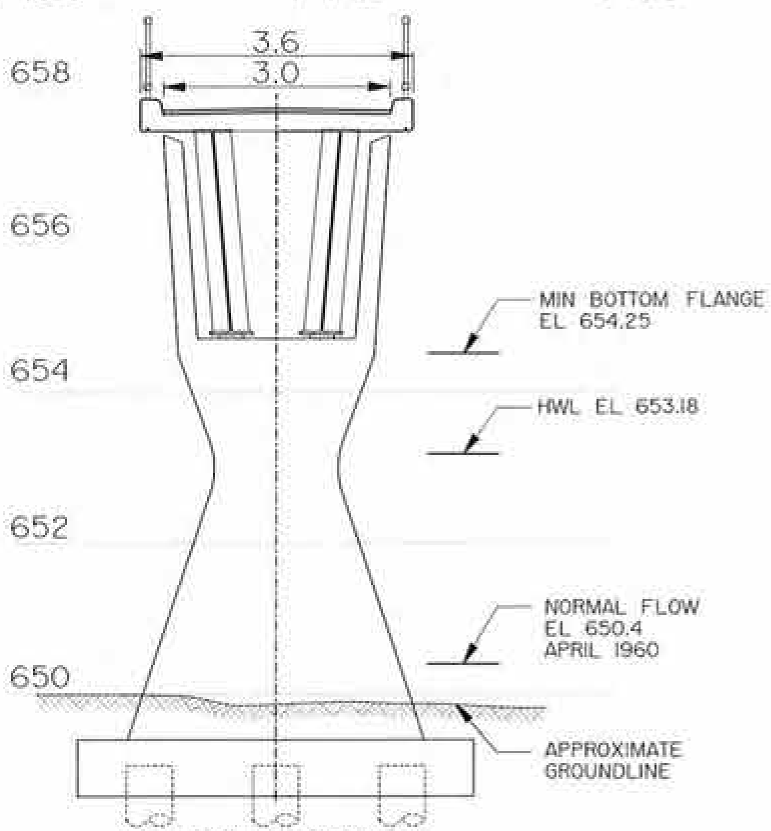


## KEY PLAN




## ELEVATION

LOOKING EASTERLY 1:500




## BRIDGE SECTION

LOOKING NORTHERLY 1:100

## NOTES

- THE STRUCTURE IS ON A TANGENT ALIGNMENT
- THE SPAN ARRANGEMENT IS TENTATIVE AND SUBJECT TO CHANGE
- THE FINAL LOCATION OF THE PEDESTRIAN STRUCTURE AND PATHWAY SYSTEM NEEDS TO BE COORDINATED WITH THE CITY OF ST. ALBERT PRIOR TO PRELIMINARY ENGINEERING BEING FINALIZED
- OUT TO OUT LENGTH IS TO BE CONFIRMED DURING THE PRELIMINARY ENGINEERING DESIGN OF THE PROJECT. THE LENGTH IS BASED ON A 3 SPAN ARRANGEMENT WITH A PRELIMINARY STRUCTURE DEPTH OF 3.0 m AND 3:1 HEADSLOPES
- ENVIRONMENTAL APPROVALS ARE REQUIRED FROM TRANSPORT CANADA (NWPA), DFO, ALBERTA ENVIRONMENT (CODE OF PRACTICE) AND ALBERTA SUSTAINABLE RESOURCE DEVELOPMENT

ISL Engineering and Land Services

| REV | DATE | REVISIONS | BY |
|---|---|---|---|
| | 2008-03-05 | REPORT SUBMISSION | WWK |

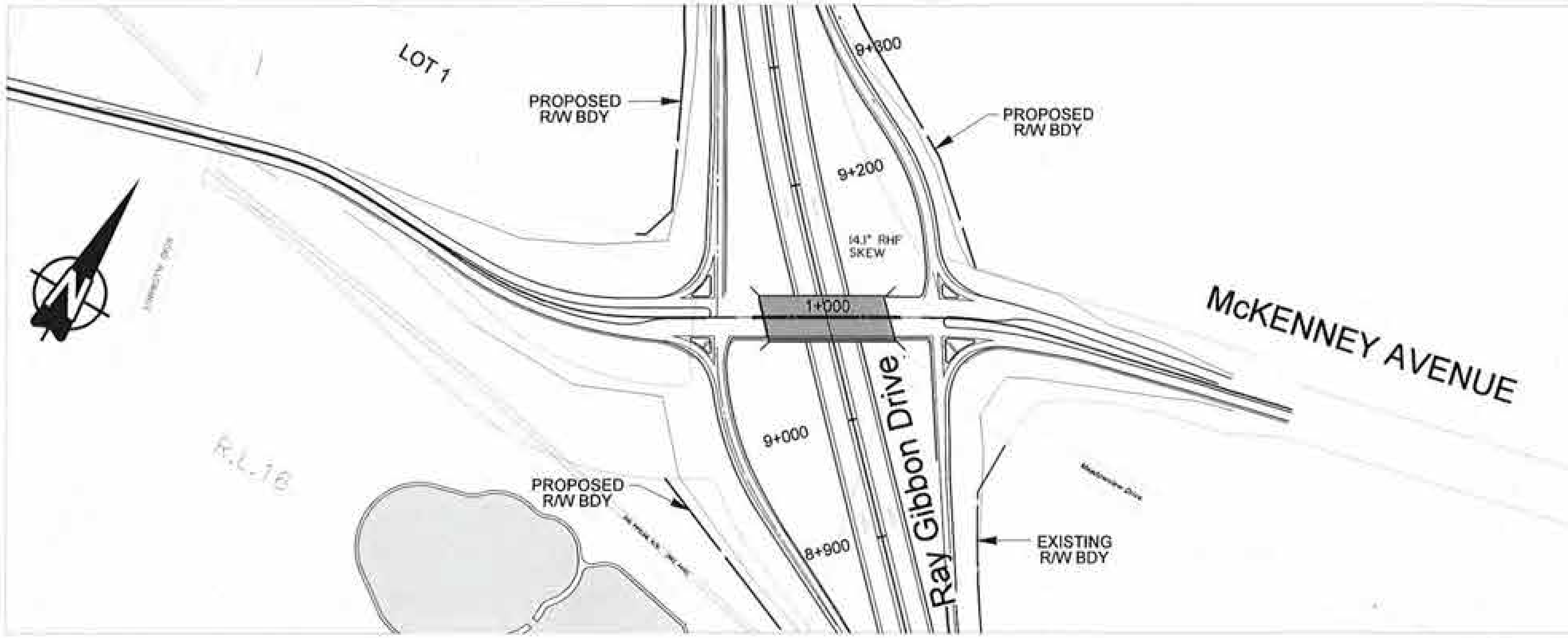
PRELIMINARY

DESIGNER / DATE — CHECKER / DATE

Alberta Transportation

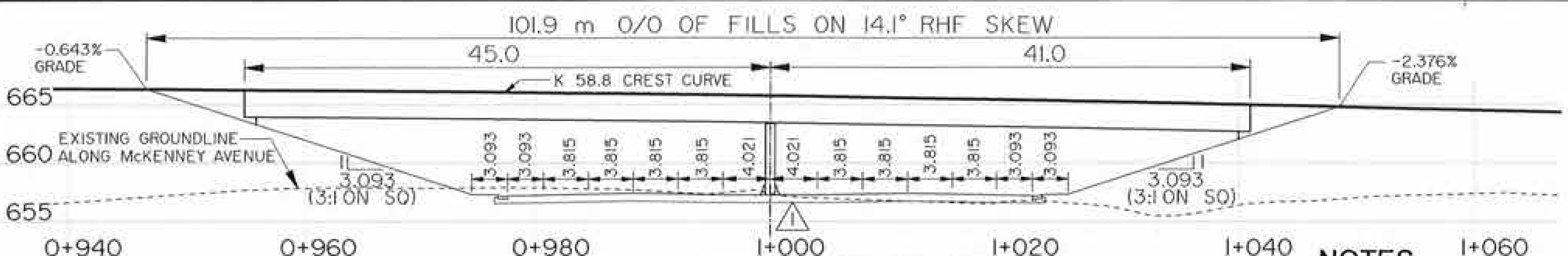
PEDESTRIAN OVERPASS OVER THE STURGEON RIVER
STRUCTURAL OUTLINE DRAWING

| DEPARTMENT BAR CODE | DATE | STREAM | LOCATION | HIGHWAY | FILE | SHEET | DRAWING |
|---|---|---|---|---|---|---|---|
| | | STURGEON RIVER | ISW 32-53-25-4 | PEDESTRIAN | | OF | 12436ST04 |





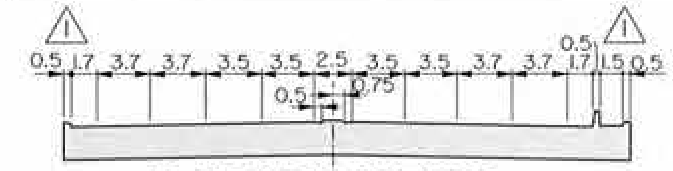
KEY PLAN




NOTE:
THE PROPOSED 3:1 HEADSLOPES MAY NEED TO BE FLATTENED AT THIS INTERCHANGE DUE TO POOR SOIL CONDITIONS THROUGH THIS AREA. A DETAILED GEOTECHNICAL ASSESSMENT WILL BE REQUIRED PRIOR TO ESTABLISHING THE FINAL SLOPE.

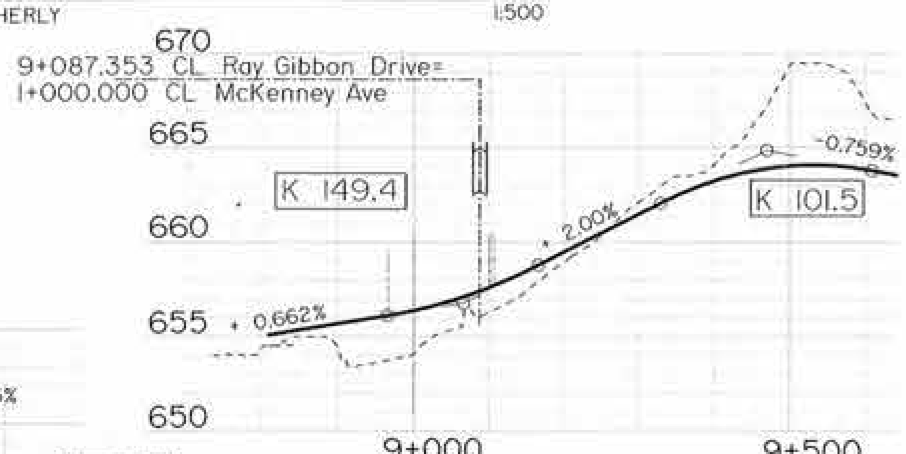
ELEVATION - 8 LANE ULTIMATE STAGE

LOOKING NORTHERLY 1:500




McKENNEY AVENUE CROSS-SECTION

LOOKING EASTERLY 1:500

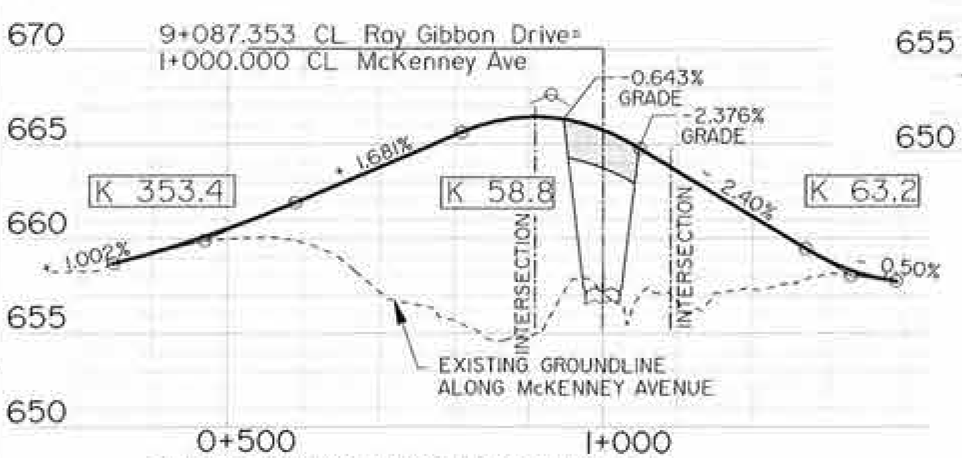



RAY GIBBON DRIVE PROFILE

LOOKING WESTERLY H 1:10 000 V 1:400

## NOTES

- STRUCTURE IS ON A TANGENT ALIGNMENT
- DESIGN SPEED FOR RAY GIBBON DRIVE = 110 km/hr
- DESIGN SPEED FOR McKENNEY AVENUE = 70 km/hr
- SPAN ARRANGEMENT IS TENTATIVE AND SUBJECT TO CHANGE
- ASSUME 1.0 m PIER THICKNESS (2)
- OUT TO OUT LENGTH IS TO BE CONFIRMED DURING THE PRELIMINARY ENGINEERING DESIGN OF THE PROJECT. THE LENGTH IS BASED ON A 2 SPAN ARRANGEMENT WITH A PRELIMINARY STRUCTURE DEPTH OF 2.4 m AND 3:1 HEADSLOPES
- MINIMUM VERTICAL CLEARANCE FROM TOP OF RAY GIBBON DRIVE TO THE UNDERSIDE OF THE STRUCTURE IS 5.65 m
- THE PROPOSED TIGHT DIAMOND INTERSECTIONS MUST BE SIGNALIZED IN THE INITIAL STAGE SINCE SIGHT DISTANCE IS NOT ADEQUATE
- REFER TO THE 137 AVENUE STRUCTURE OUTLINE DRAWING FOR THE EXISTING 2 LANE AND FUTURE 4 AND 6 LANE STAGING SEQUENCES OF RAY GIBBON DRIVE, FROM THE 137 AVENUE INTERCHANGE TO NORTH OF THE GIROUX ROAD INTERCHANGE




McKENNEY AVENUE PROFILE

LOOKING NORTHERLY H 1:10 000 V 1:400

ISL Engineering and Land Services

| REV | DATE | REVISIONS | BY |
|---|---|---|---|
| 5 | | | |
| 4 | | | |
| 3 | | | |
| 2 | 2009-02-27 | PIER THICKNESS INCREASED | WWK |
| 1 | 2009-01-16 | SHY LINE DISTANCES ADDED | WWK |
| | 2008-03-28 | REPORT SUBMISSION | WWK |

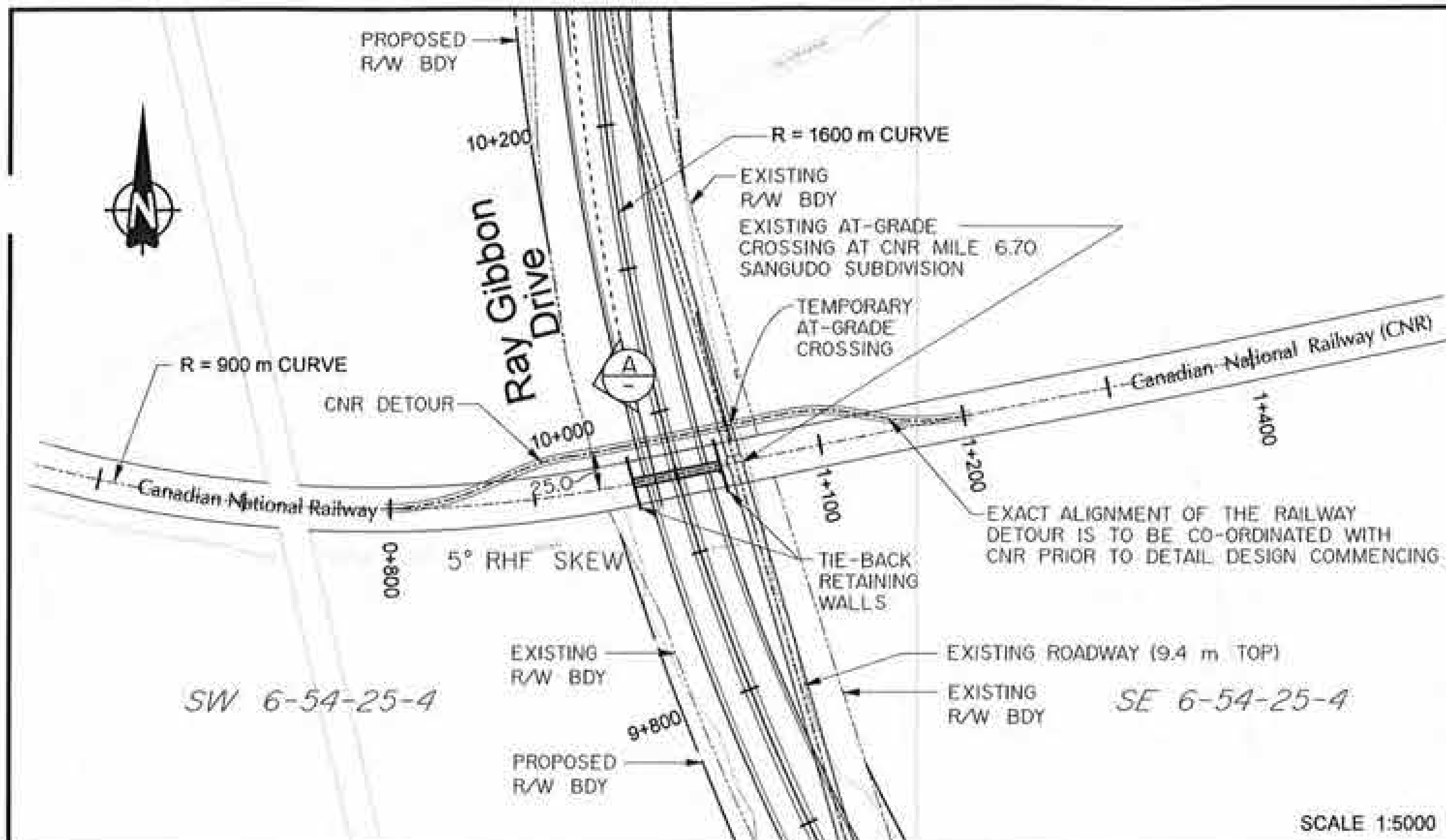
PRELIMINARY

DESIGNER DATE / CHECKER DATE

Alberta Transportation

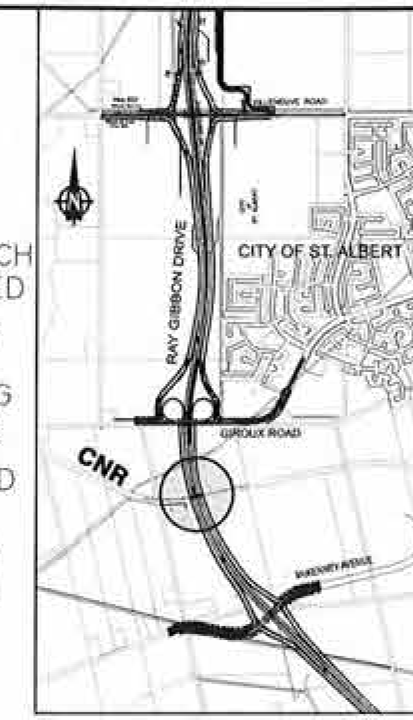
McKENNEY AVENUE OVERPASS OVER RAY GIBBON DRIVE STRUCTURE OUTLINE DRAWING

| DEPARTMENT BAR CODE | DATE | STREAM | LOCATION | HIGHWAY | FILE | SHEET | DRAWING |
|---|---|---|---|---|---|---|---|
| | | RAY GIBBON DRIVE | INE 30-53-26-4 | McKENNEY AVENUE | | OF | 12436ST05 |

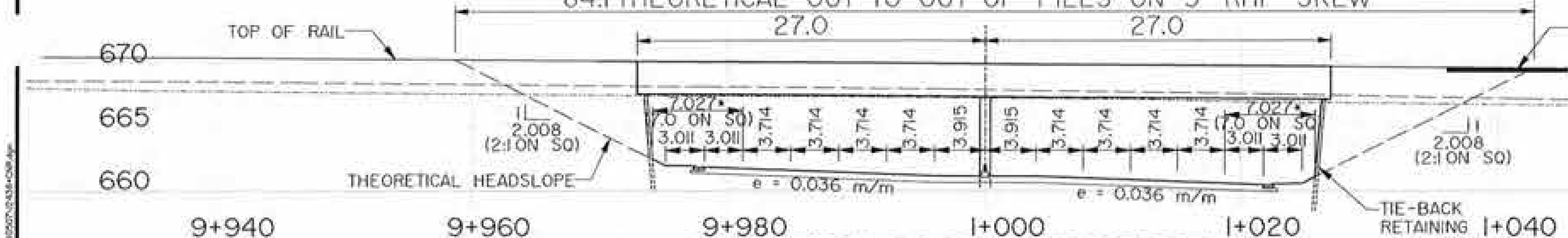



## NOTES

- STRUCTURE HAS A SPIRAL ALIGNMENT ON THE WEST END. EAST END IS ON A TANGENT ALIGNMENT
- PROVISION HAS BEEN MADE FOR A ONE TRACK FACILITY. THERE WERE 6 TRAINS PER DAY ON AVERAGE USING THE CROSSING IN 2007 TRAVELLING AT A TRAIN SPEED OF 30 mph (48 km/h)
- RAY GIBBON DRIVE IS ON A 1600 m RADIUS HORIZONTAL CURVE WHICH REQUIRES A 0.036 m/m SUPERELEVATION AT 110 km/h DESIGN SPEED
- CNR IS PRESENTLY SENIOR AT THE PROPOSED CROSSING. TRANSFER OF SENIORITY WOULD BE REQUIRED FROM AN EXISTING AT GRADE CROSSING FOR THE ROAD AUTHORITY TO BE SENIOR AT THE CROSSING
- DESIGN SPEED FOR RAY GIBBON DRIVE = 110 km/hr AT THE CROSSING
- THE SPAN ARRANGEMENT AND STRUCTURE DEPTH ARE TENTATIVE AND SUBJECT TO CHANGE
- OUT TO OUT LENGTH IS TO BE CONFIRMED DURING THE PRELIMINARY ENGINEERING DESIGN OF THE PROJECT. THE LENGTH IS BASED ON A 2 SPAN ARRANGEMENT WITH A PRELIMINARY STRUCTURE DEPTH OF 2.5 m WITH 2:1 HEADSLOPES AND TIE-BACK RETAINING WALLS
- MINIMUM VERTICAL CLEARANCE FROM TOP OF THE ROADWAY TO THE UNDERSIDE OF THE STRUCTURE IS 5.65 m. SOME ADDITIONAL VERTICAL CLEARANCE, IF REQUIRED, MAY BE ACHIEVABLE BY REQUESTING CNR TO RE-BALLAST THEIR TRACK, THROUGH THE STRUCTURE AREA.
- THE EXISTING AT-GRADE CROSSING AT CNR MILE 6.70 SANGUDO SUBDIVISION CONSISTS OF FLASHING LIGHTS, BELL AND GATES WITH A CONCRETE SURFACE. REFER TO DRAWING No. 12034RR01 DATED OCTOBER 10, 2006 FOR DETAILS OF THE CROSSING



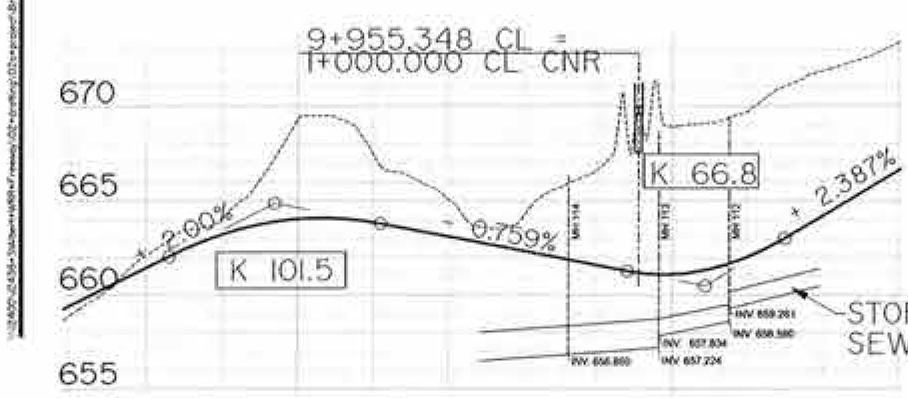

KEY PLAN




## ELEVATION - 8 LANE ULTIMATE STAGE

LOOKING NORTHERLY 1:500

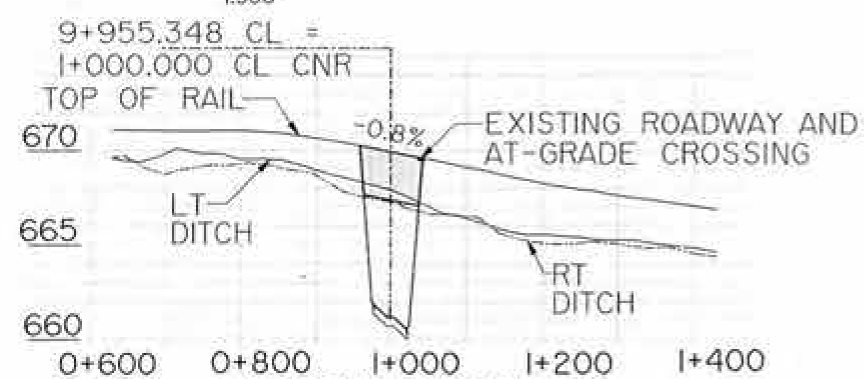
NOTE:
REFER TO THE 137 AVENUE STRUCTURE OUTLINE DRAWING FOR THE EXISTING 2 LANE AND FUTURE 4 AND 6 LANE STAGING SEQUENCES OF RAY GIBBON DRIVE, FROM THE 137 AVENUE INTERCHANGE TO NORTH OF THE GIROUX ROAD INTERCHANGE




## RAY GIBBON DRIVE PROFILE

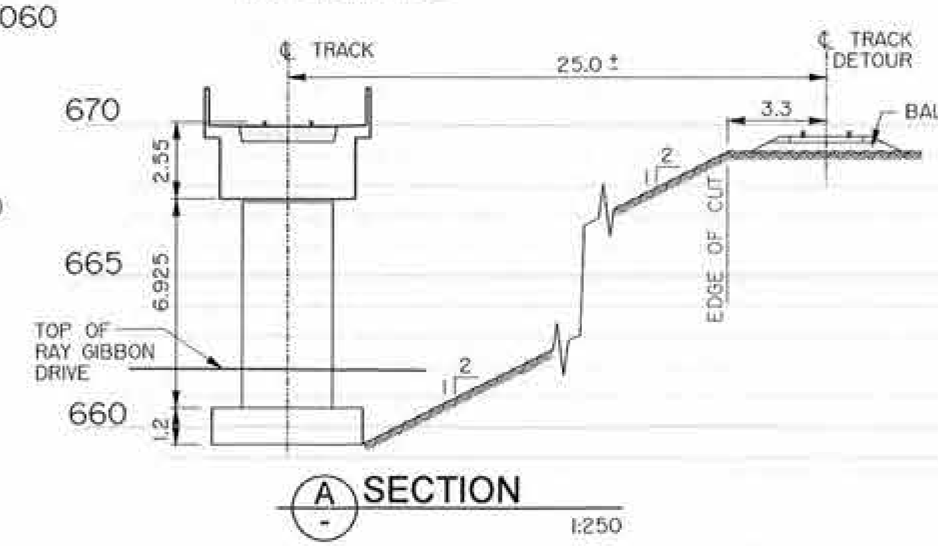
LOOKING WESTERLY H 1:10 000 V 1:400

NOTE:
PROFILE THROUGH THIS AREA CAN NOT BE LOWERED DUE TO MINIMUM COVER REQUIRED OVER STORM SEWERS.




## CNR PROFILE

LOOKING NORTHERLY H 1:10 000 V 1:400




## (A) SECTION

1:250

| | | |
|---|---|---|
| 2008-03-05 | REPORT SUBMISSION | WWK |
| REV DATE | REVISIONS | BY |

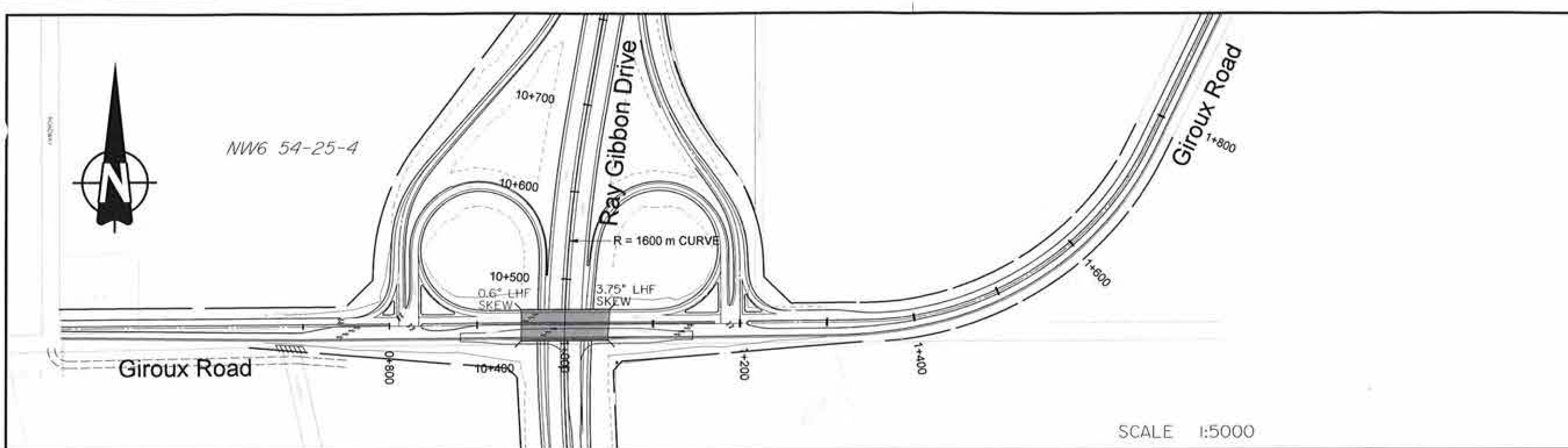
ISL Engineering and Land Services

PRELIMINARY

Alberta Transportation

CN RAILWAY OVER RAY GIBBON DRIVE STRUCTURE OUTLINE DRAWING

| STREAM | LOCATION | HIGHWAY | FILE | SHEET | DRAWING |
|---|---|---|---|---|---|
| RAY GIBBON DRIVE | ISW 6-54-25-4 | CNR | | of | 12436ST06 |

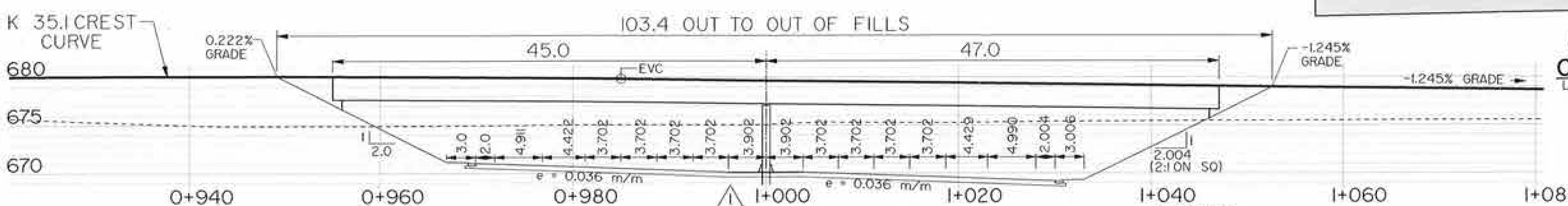




KEY PLAN

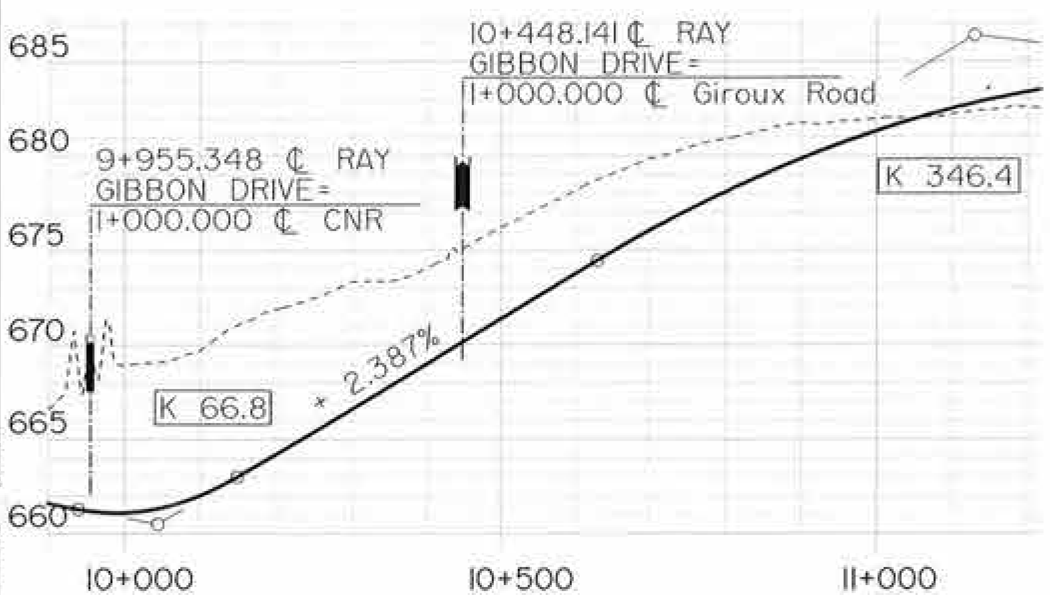

GIROUX ROAD CROSS-SECTION

LOOKING EASTERLY 1:250



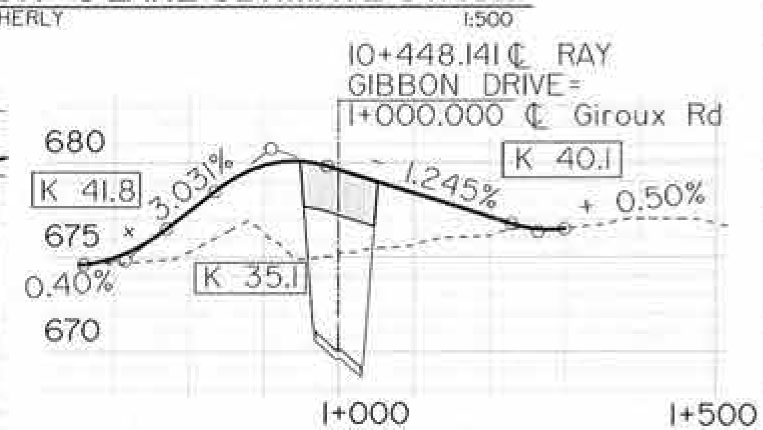

ELEVATION - 8 LANE ULTIMATE STAGE

LOOKING NORTHERLY 1:500




RAY GIBBON DRIVE PROFILE

LOOKING WESTERLY H 1:10 000 V 1:400




GIROUX ROAD PROFILE

LOOKING NORTHERLY H 1:10 000 V 1:400

## NOTES

- STRUCTURE IS ON A TANGENT ALIGNMENT
- DESIGN SPEED FOR RAY GIBBON DRIVE = 110 km/hr
- DESIGN SPEED FOR GIROUX ROAD = 70 km/hr
- SPAN ARRANGEMENT IS TENTATIVE AND SUBJECT TO CHANGE
- ASSUME 1.0 m PIER THICKNESS ⚠2
- OUT TO OUT LENGTH IS TO BE CONFIRMED DURING PRELIMINARY ENGINEERING DESIGN OF THE PROJECT. THE LENGTH IS BASED ON A 2 SPAN ARRANGEMENT WITH A PRELIMINARY STRUCTURE DEPTH OF 2.4 m AND 2:1 HEADSLOPES
- MINIMUM VERTICAL CLEARANCE FROM TOP OF HWY 2 TO THE UNDERSIDE OF THE STRUCTURE IS 5.65 m
- REFER TO THE 137 AVENUE STRUCTURE OUTLINE DRAWING FOR THE EXISTING 2 LANE AND FUTURE 4 AND 6 LANE STAGING SEQUENCES OF RAY GIBBON DRIVE, FROM THE 137 AVENUE INTERCHANGE TO NORTH OF THE GIROUX ROAD INTERCHANGE

ISL Engineering and Land Services

| REV | DATE | REVISIONS | BY |
|---|---|---|---|
| 5 | | | |
| 4 | | | |
| 3 | | | |
| 2 | 2009-02-27 | PIER THICKNESS INCREASED | WWK |
| 1 | 2009-01-16 | SHY LINE DISTANCES ADDED | WWK |
| | 2008-03-05 | REPORT SUBMISSION | WWK |

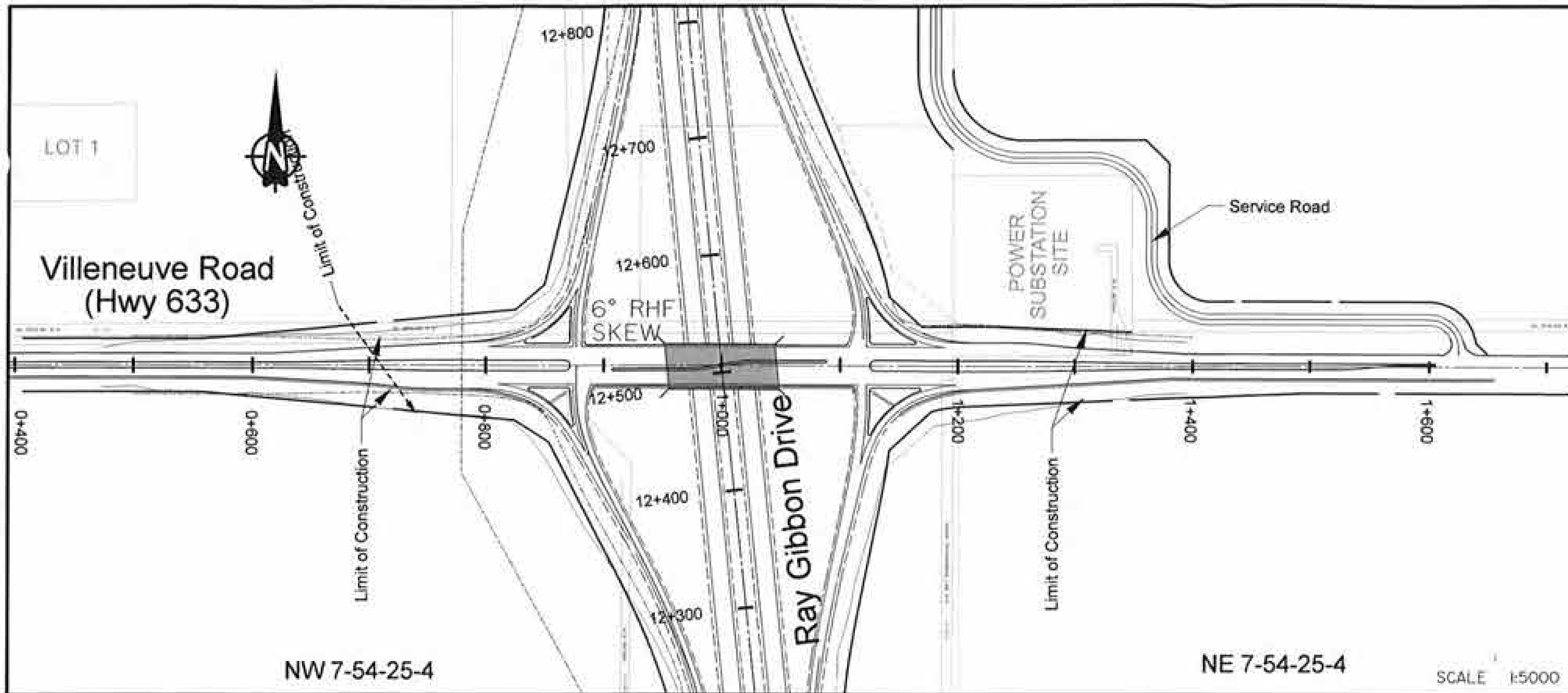
PRELIMINARY

DESIGNER DATE — CHECKER DATE

Alberta Transportation

GIROUX ROAD OVERPASS OVER RAY GIBBON DRIVE STRUCTURE OUTLINE DRAWING

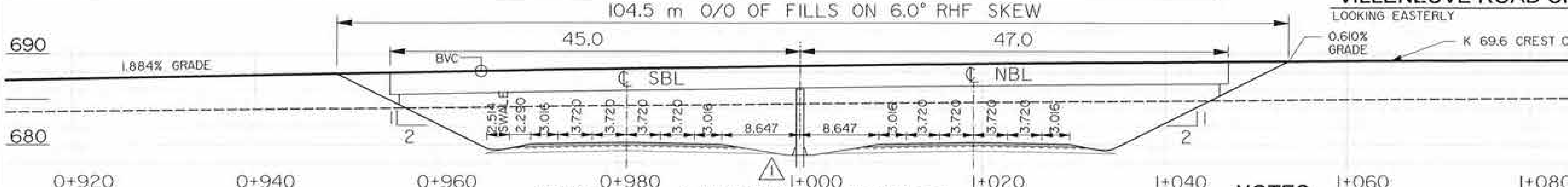
| DEPARTMENT BAR CODE | DATE | STREAM | LOCATION | HIGHWAY | FILE | SHEET | DRAWING |
|---|---|---|---|---|---|---|---|
| | | RAY GIBBON DRIVE | INW 6-54-25-4 | GIROUX ROAD | | of | 12436ST07 |



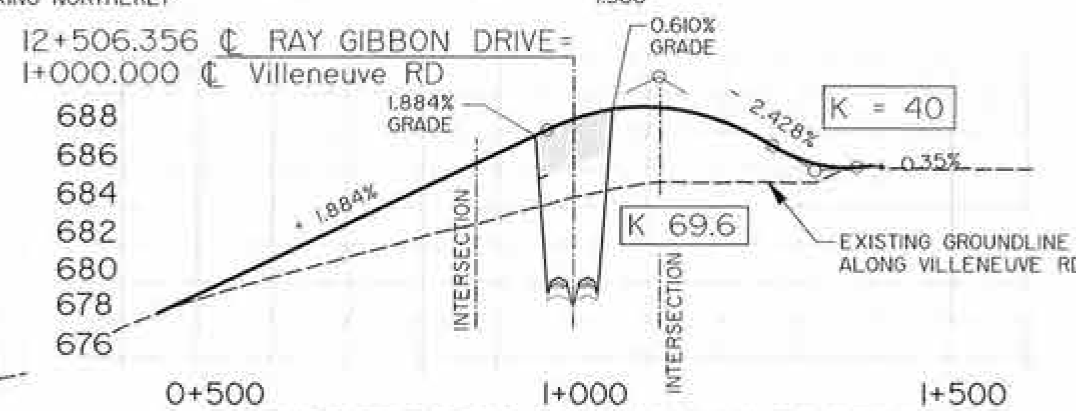


KEY PLAN

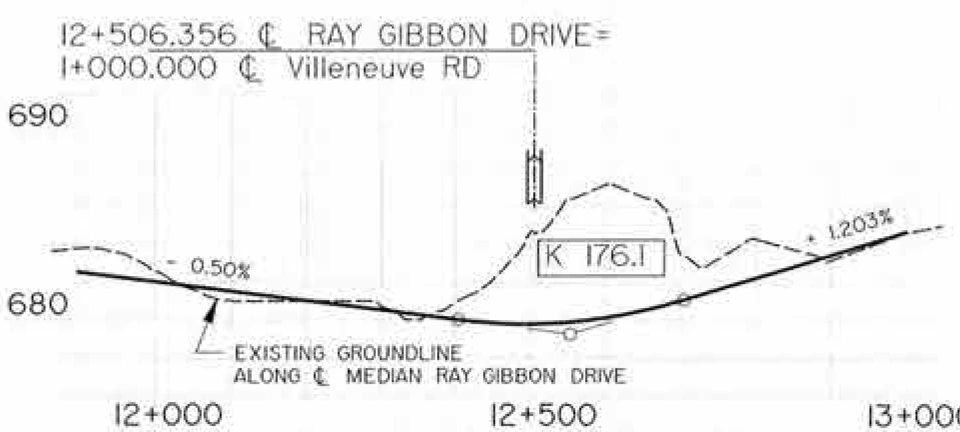

VILLENEUVE ROAD CROSS-SECTION
LOOKING EASTERLY 1:300




ELEVATION - 8 LANE ULTIMATE STAGE
LOOKING NORTHERLY 1:500




VILLENEUVE ROAD (HWY 633) PROFILE
LOOKING NORTHERLY H 1:10 000 V 1:400




RAY GIBBON DRIVE PROFILE
LOOKING WESTERLY H 1:10 000 V 1:400

## NOTES

- STRUCTURE IS ON A TANGENT ALIGNMENT
- DESIGN SPEED FOR RAY GIBBON DRIVE = 110 km/hr
- DESIGN SPEED FOR VILLENEUVE ROAD = 70 km/hr
- SPAN ARRANGEMENT IS TENTATIVE AND SUBJECT TO CHANGE
- ASSUME 1.0 m PIER THICKNESS (2)
- OUT TO OUT LENGTH IS TO BE CONFIRMED DURING THE PRELIMINARY ENGINEERING DESIGN OF THE PROJECT. THE LENGTH IS BASED ON A 2 SPAN ARRANGEMENT WITH A PRELIMINARY STRUCTURE DEPTH OF 2.4 m AND 2:1 HEADSLOPES
- MINIMUM VERTICAL CLEARANCE FROM TOP OF RAY GIBBON DRIVE TO UNDERSIDE OF THE STRUCTURE IS 5.65 m
- THE PROPOSED TIGHT DIAMOND INTERSECTIONS MUST BE SIGNALIZED IN THE INITIAL STAGE SINCE SIGHT DISTANCE IS NOT ADEQUATE

ISL Engineering and Land Services

| REV | DATE | REVISIONS | BY |
|---|---|---|---|
| 5 | | | |
| 4 | | | |
| 3 | | | |
| 2 | 2009-02-27 | PIER THICKNESS INCREASED | WWK |
| 1 | 2009-01-16 | SHY LINE DISTANCES ADDED | WWK |
| | 2008-03-05 | REPORT SUBMISSION | WWK |

PRELIMINARY

DESIGNER DATE — CHECKER DATE

Alberta Transportation

VILLENEUVE ROAD OVERPASS
OVER RAY GIBBON DRIVE
STRUCTURAL OUTLINE DRAWING

| DEPARTMENT BAR CODE | DATE | STREAM | LOCATION | HIGHWAY | FILE | SHEET | DRAWING |
|---|---|---|---|---|---|---|---|
| | | RAY GIBBON DRIVE | INW 7-54-25-4 | VILLENEUVE ROAD | | OF | 12436ST08 |

# APPENDIX C

# Appendix C

## Traffic Analysis

## Intersections near Ramp Terminals

### Introduction

Ray Gibbon Drive is currently a two-lane arterial within the City of St Albert. Alberta Infrastructure and Transportation has plans to take over Ray Gibbon Drive and ultimately designate this roadway as a freeway. The reclassification of Ray Gibbon Drive as a freeway has resulted some design constraints.

Alberta Infrastructure and Transportation has a standard offset of 400m from a ramp terminal to an intersection to ensure that the interchange is not negatively affected by queues at the local intersection. There are currently three proposed intersections that are within 400m of the proposed interchange ramps along Ray Gibbon Drive at Giroux Road, McKenney Avenue, and 137$^{th}$ Avenue (refer to attached drawings in Appendix A). Long-term traffic analysis for the peak hours in Synchro 7 have indicated that the intersections will not affect the interchange ramp terminals (refer to Synchro printouts in Appendix B). Based on this analysis, design exceptions are requested at these locations.

### Giroux Road

The North Ridge ASP is located north of Giroux Road and was approved by City Council on January 19, 2004. The south half of this ASP has been developed, except for a small parcel adjacent to Giroux Road. This area is intended for low to medium density residential and a park/storm water facility. Access to this area is limited to two accesses along Giroux Road, the proposed intersection and one further east. There is no connection to the internal road network within the ASP.

The Northwest Urban Village ASP is located south of Giroux Road and was approved by City Council on July 4, 2006. This ASP is undeveloped, except for the Fire Hall that is located in the east corner along Giroux Road. Public access to this area is limited to the proposed intersection. Emergency access from the Fire Hall is located further east on Giroux Road.

The ASP's share an intersection on Giroux Road approximately 270m east of the of the ramp terminal for the Giroux Road interchange. Traffic analysis indicates that the intersection will operate at LOS A in the AM and PM peaks, with a maximum eastbound queue of 50m, assuming no left turn bay. This analysis assumes a 4-lane cross-section on Giroux Road and a 2-lane cross-section on the local road with left-turn bays.

### McKenney Avenue

The Timberlea ASP is located east of the West Regional Road between the CN Rail and the Sturgeon River and was approved by City Council on November 21, 2005. This ASP is currently undeveloped.

The ASP has an intersection located approximately 360m east of the ramp terminal for the McKenney interchange. Traffic analysis indicates that the intersection will operate at LOS B in the AM and PM peaks, with a maximum eastbound queue of 100m, assuming no left turn bay. This analysis assumes a 4-lane cross-section on McKenney and a 2-lane cross-section on the local road with left-turn bays.

137th Avenue

The South Riel ASP is located east of the West Regional Road was approved by City Council on September 18, 2007. This ASP is bordered to the west by the West Regional Road, to the south by the current 137th Avenue alignment (which will be closed once the Anthony Henday is constructed), to the east by the CN Rail line (approximately 675m from the east ramp terminal on the West Regional Road), and to the north by Levasseur Road. This ASP has mixed zoning with little industrial/commercial and residential proposed within its boundaries. Construction is scheduled for the spring of 2008.

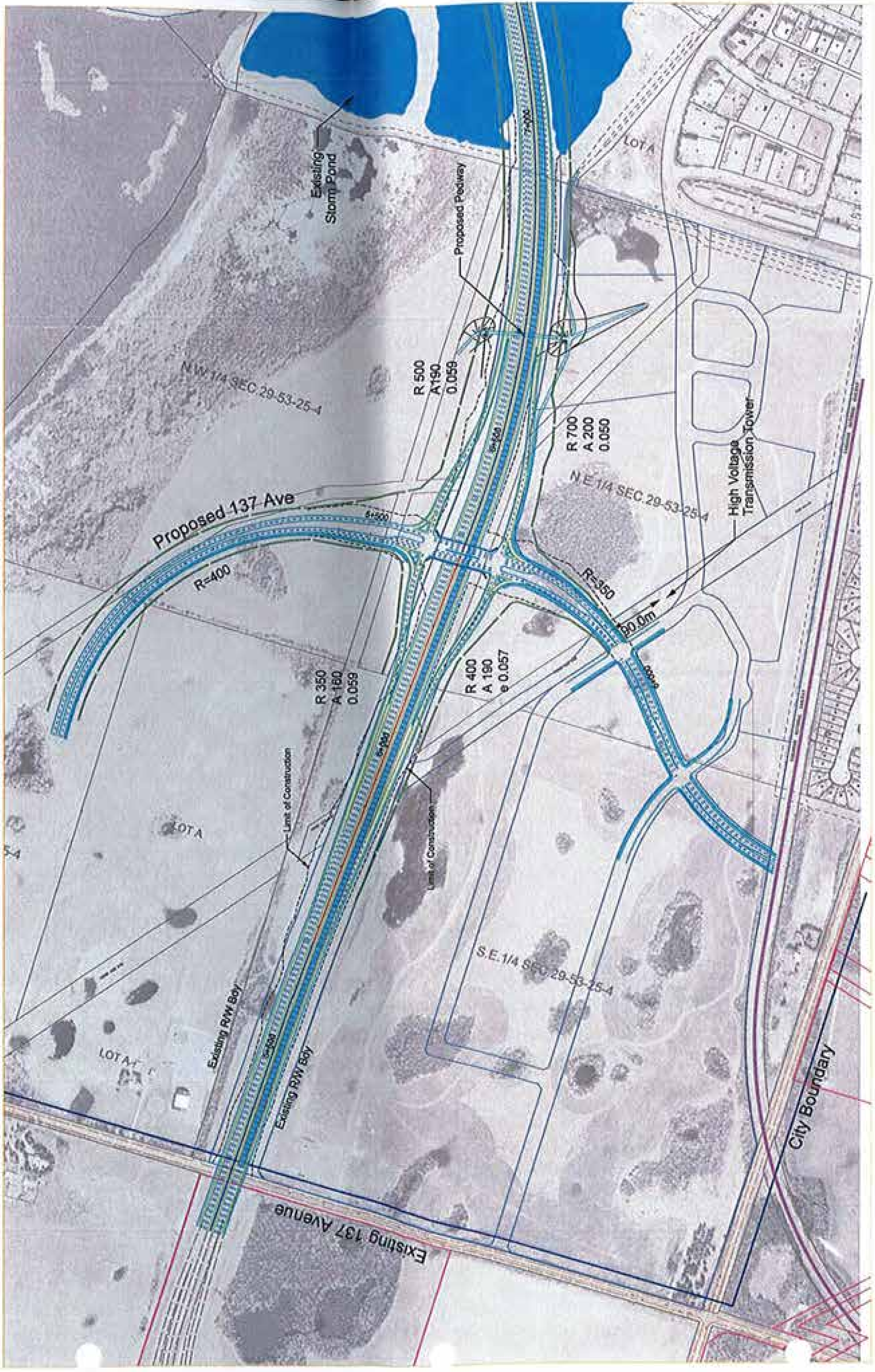
The ASP has two intersections along 137th Avenue, located approximately 250m and 450m east of the ramp terminal for the 137 Avenue interchange. Traffic analysis indicates that the intersection closest to the interchange will operate at LOS B in the AM peak and LOS C in the PM peak, with a maximum eastbound queue of 60m, assuming a double left turn bay. This analysis assumes a 4-lane cross-section on 137th Avenue and a 4-lane cross-section (near the intersection) on the local road with left- and right-turn bays.

For discussion purposes, these intersections were combined together half way between the West Regional Road and the at-grade crossing of the CN line. The single intersection would operate at LOS C in the AM peak (2 movements at LOS D) and LOS D in the PM peak (with 1 movement at LOS D, 3 movements at LOS E, and 3 movements at LOS F). The maximum eastbound queue is expected to be 130m. This intersection fails operationally and is not a viable alternative.

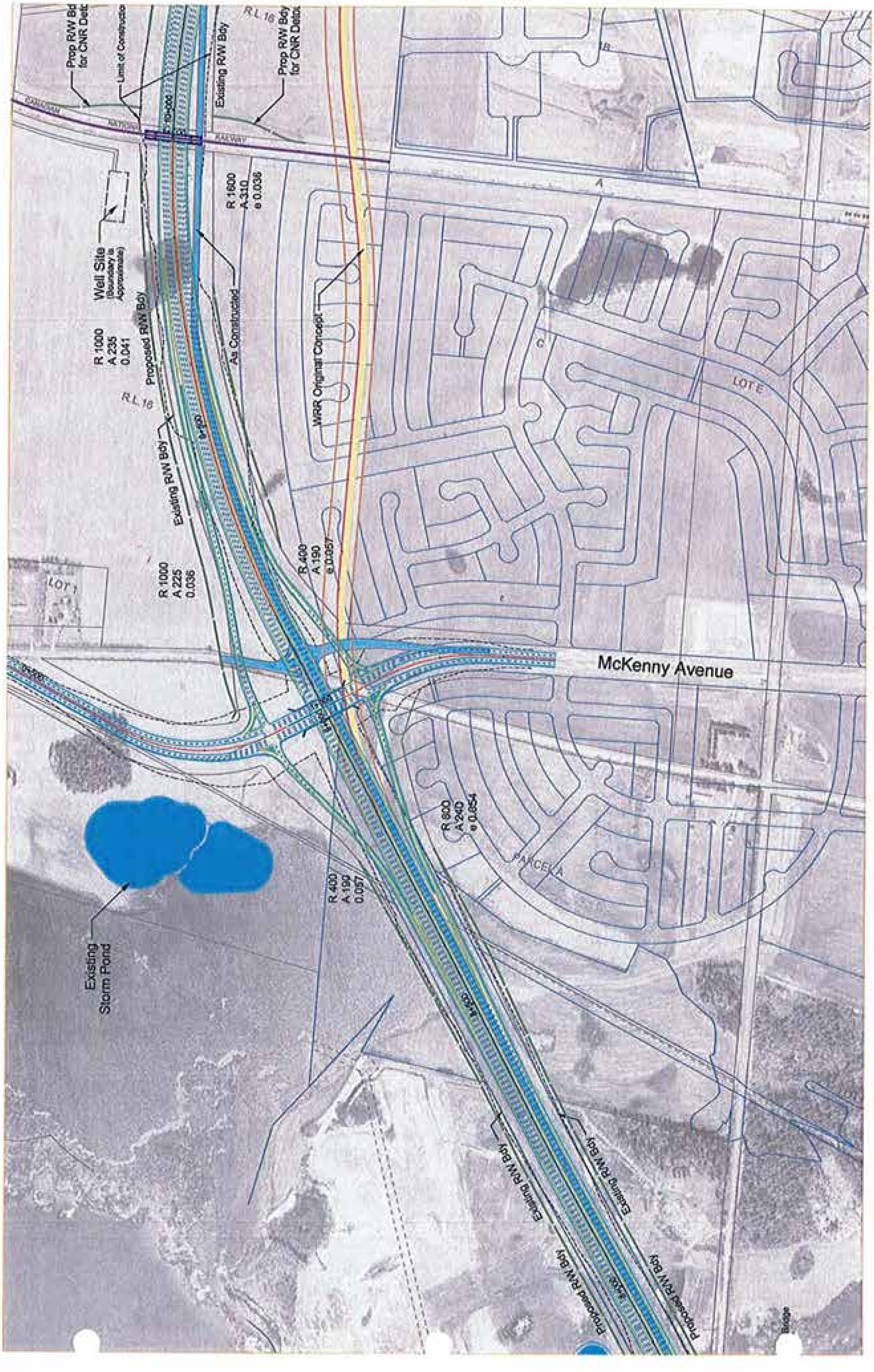
Conclusion

The intersections identified in the ASP's along the West Regional Road will not affect the operation of the interchanges and should be allowed to proceed.

Appendix A – Intersection Configurations



Existing Storm Pond
Proposed Piedway
LOT A
N.W.1/4 SEC.29-53-25-4
R 500
A190
0.059
R 700
A 200
0.050
High Voltage Transmission Tower
N.E.1/4 SEC.29-53-25-4
Proposed 137 Ave
R=400
R=350
60.0m
R 350
A 160
0.059
R 400
A 190
e 0.057
Limit of Construction
Limit of Construction
LOT A
S.E.1/4 SEC.29-53-25-4
Existing R/W Bdy
Existing R/W Bdy
City Boundary
Existing 137 Avenue

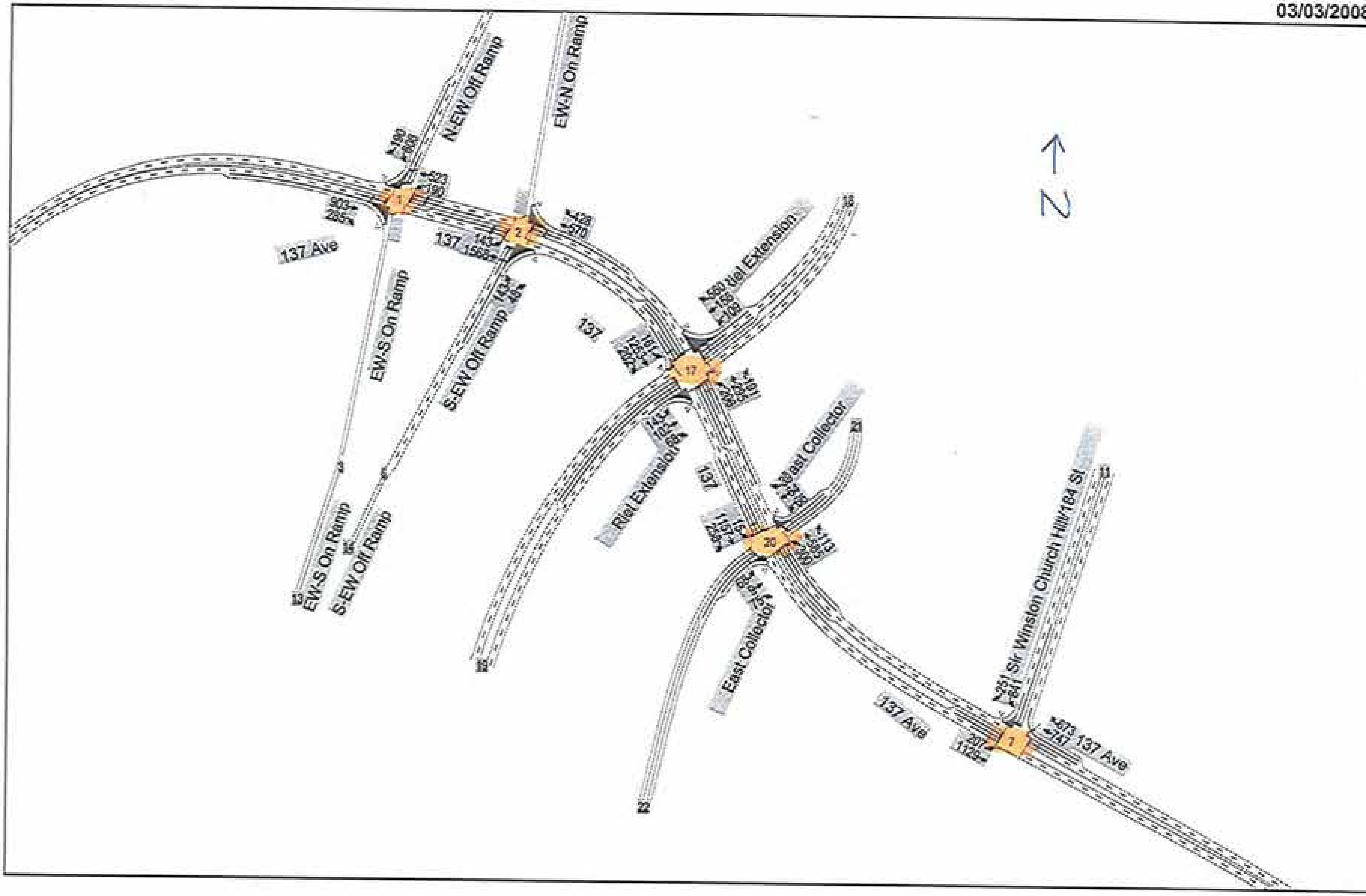


Limit of Construction
Existing R/W Bdy
Prop R/W Bdy for CNR Detour
R.L. 16
R 1600
A-310
e 0.036
Well Site
R 1000
A 235
0.041
Proposed R/W Bdy
As Constructed
WRR Original Concept
Existing R/W Bdy
R 1000
A 225
0.036
R 400
A 190
e 0.057
LOT 1
LOT E
McKenny Avenue
R 800
A 240
e 0.054
PARCEL A
R 400
A 190
0.057
Existing Storm Pond
Existing R/W Bdy
Proposed R/W Bdy
Existing R/W Bdy
Proposed R/W Bdy

# Appendix B – Synchro Reports

137 Ave

03/03/2008



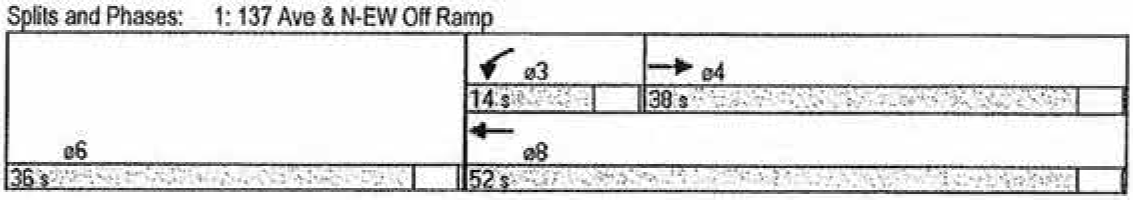
| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | ↑↑ | ↱ | ↰ | ↑↑ | | | | | ↰↰ | | ↱ |
| Volume (vph) | 0 | 903 | 285 | 190 | 523 | 0 | 0 | 0 | 0 | 808 | 0 | 190 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Storage Length (m) | 0.0 | | 150.0 | 70.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | | 100.0 |
| Storage Lanes | 0 | | 1 | 1 | | 0 | 0 | | 0 | 2 | | 1 |
| Taper Length (m) | 7.5 | | 7.5 | 7.5 | | 7.5 | 7.5 | | 7.5 | 7.5 | | 7.5 |
| Lane Util. Factor | 1.00 | 0.95 | 1.00 | 1.00 | 0.95 | 1.00 | 1.00 | 1.00 | 1.00 | 0.97 | 1.00 | 1.00 |
| Frt | | | 0.850 | | | | | | | | | 0.850 |
| Flt Protected | | | | 0.950 | | | | | | 0.950 | | |
| Satd. Flow (prot) | 0 | 3579 | 1601 | 1789 | 3579 | 0 | 0 | 0 | 0 | 3471 | 0 | 1601 |
| Flt Permitted | | | | 0.117 | | | | | | 0.950 | | |
| Satd. Flow (perm) | 0 | 3579 | 1601 | 220 | 3579 | 0 | 0 | 0 | 0 | 3471 | 0 | 1601 |
| Right Turn on Red | | | Yes | | | Yes | | | Yes | | | Yes |
| Satd. Flow (RTOR) | | | 310 | | | | | | | | | 207 |
| Link Speed (k/h) | | 50 | | | 50 | | | 50 | | | 50 | |
| Link Distance (m) | | 481.1 | | | 115.3 | | | 257.4 | | | 209.7 | |
| Travel Time (s) | | 34.6 | | | 8.3 | | | 18.5 | | | 15.1 | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 0 | 982 | 310 | 207 | 568 | 0 | 0 | 0 | 0 | 878 | 0 | 207 |
| Shared Lane Traffic (%) | | | | | | | | | | | | |
| Lane Group Flow (vph) | 0 | 982 | 310 | 207 | 568 | 0 | 0 | 0 | 0 | 878 | 0 | 207 |
| Enter Blocked Intersection | No | No | No | No | No | No | No | No | No | No | No | No |
| Lane Alignment | Left | Left | Right | Left | Left | Right | Left | Left | Right | Left | Left | Right |
| Median Width(m) | | 3.7 | | | 7.4 | | | 7.4 | | | 7.4 | |
| Link Offset(m) | | 0.0 | | | 0.0 | | | 0.0 | | | 0.0 | |
| Crosswalk Width(m) | | 4.8 | | | 4.8 | | | 4.8 | | | 4.8 | |
| Two way Left Turn Lane | | | | | | | | | | | | |
| Headway Factor | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 |
| Turning Speed (k/h) | 24 | | 25 | 24 | | 14 | 24 | | 14 | 24 | | 14 |
| Number of Detectors | | 2 | 2 | 2 | 2 | | | | | 2 | | 2 |
| Detector Template | | | | | | | | | | | | |
| Leading Detector (m) | | 15.2 | 15.2 | 15.2 | 15.2 | | | | | 15.2 | | 15.2 |
| Trailing Detector (m) | | 0.0 | 0.0 | 0.0 | 0.0 | | | | | 0.0 | | 0.0 |
| Detector 1 Position(m) | | 0.0 | 0.0 | 0.0 | 0.0 | | | | | 0.0 | | 0.0 |
| Detector 1 Size(m) | | 1.8 | 1.8 | 1.8 | 1.8 | | | | | 1.8 | | 1.8 |
| Detector 1 Type | | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | | | | | Cl+Ex | | Cl+Ex |
| Detector 1 Channel | | | | | | | | | | | | |
| Detector 1 Extend (s) | | 0.0 | 0.0 | 0.0 | 0.0 | | | | | 0.0 | | 0.0 |
| Detector 1 Queue (s) | | 0.0 | 0.0 | 0.0 | 0.0 | | | | | 0.0 | | 0.0 |
| Detector 1 Delay (s) | | 0.0 | 0.0 | 0.0 | 0.0 | | | | | 0.0 | | 0.0 |
| Detector 2 Position(m) | | 13.4 | 13.4 | 13.4 | 13.4 | | | | | 13.4 | | 13.4 |
| Detector 2 Size(m) | | 1.8 | 1.8 | 1.8 | 1.8 | | | | | 1.8 | | 1.8 |
| Detector 2 Type | | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | | | | | Cl+Ex | | Cl+Ex |
| Detector 2 Channel | | | | | | | | | | | | |
| Detector 2 Extend (s) | | 0.0 | 0.0 | 0.0 | 0.0 | | | | | 0.0 | | 0.0 |
| Turn Type | | | Free | pm+pt | | | | | | custom | | Free |
| Protected Phases | | 4 | | 3 | 8 | | | | | | | |
| Permitted Phases | | | Free | 8 | | | | | | 6 | | Free |
| Detector Phase | | 4 | | 3 | 8 | | | | | 6 | | |

| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Switch Phase | | | | | | | | | | | | |
| Minimum Initial (s) | | 4.0 | | 4.0 | 4.0 | | | | | 4.0 | | |
| Minimum Split (s) | | 20.0 | | 8.0 | 20.0 | | | | | 20.0 | | |
| Total Split (s) | 0.0 | 38.0 | 0.0 | 14.0 | 52.0 | 0.0 | 0.0 | 0.0 | 0.0 | 36.0 | 0.0 | 0.0 |
| Total Split (%) | 0.0% | 43.2% | 0.0% | 15.9% | 59.1% | 0.0% | 0.0% | 0.0% | 0.0% | 40.9% | 0.0% | 0.0% |
| Maximum Green (s) | | 34.0 | | 10.0 | 48.0 | | | | | 32.0 | | |
| Yellow Time (s) | | 3.5 | | 3.5 | 3.5 | | | | | 3.5 | | |
| All-Red Time (s) | | 0.5 | | 0.5 | 0.5 | | | | | 0.5 | | |
| Lost Time Adjust (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Lost Time (s) | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| Lead/Lag | | Lag | | Lead | | | | | | | | |
| Lead-Lag Optimize? | | Yes | | Yes | | | | | | | | |
| Vehicle Extension (s) | | 3.0 | | 3.0 | 3.0 | | | | | 3.0 | | |
| Recall Mode | | None | | None | None | | | | | C-Max | | |
| Walk Time (s) | | 5.0 | | | 5.0 | | | | | 5.0 | | |
| Flash Dont Walk (s) | | 11.0 | | | 11.0 | | | | | 11.0 | | |
| Pedestrian Calls (#/hr) | | 0 | | | 0 | | | | | 0 | | |
| Act Effct Green (s) | | 30.2 | 88.0 | 43.9 | 43.9 | | | | | 36.1 | | 88.0 |
| Actuated g/C Ratio | | 0.34 | 1.00 | 0.50 | 0.50 | | | | | 0.41 | | 1.00 |
| v/c Ratio | | 0.80 | 0.19 | 0.73 | 0.32 | | | | | 0.62 | | 0.13 |
| Control Delay | | 31.5 | 0.3 | 31.7 | 13.2 | | | | | 23.7 | | 0.2 |
| Queue Delay | | 0.0 | 0.0 | 0.0 | 0.0 | | | | | 0.0 | | 0.0 |
| Total Delay | | 31.5 | 0.3 | 31.7 | 13.2 | | | | | 23.7 | | 0.2 |
| LOS | | C | A | C | B | | | | | C | | A |
| Approach Delay | | 24.0 | | | 18.1 | | | | | | | |
| Approach LOS | | C | | | B | | | | | | | |

**Intersection Summary**

Area Type: Other
Cycle Length: 88
Actuated Cycle Length: 88
Offset: 0 (0%), Referenced to phase 2: and 6:SBL, Start of Green
Natural Cycle: 50
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.80
Intersection Signal Delay: 20.9 — Intersection LOS: C
Intersection Capacity Utilization 84.5% — ICU Level of Service E
Analysis Period (min) 15

Splits and Phases: 1: 137 Ave & N-EW Off Ramp



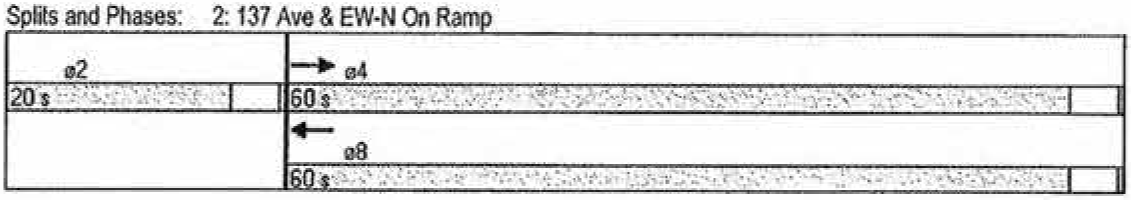
| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | ↰ | ↑↑ | | | ↑↑ | ↱ | ↰↰ | | ↱ | | | |
| Volume (vph) | 143 | 1568 | 0 | 0 | 570 | 428 | 143 | 0 | 48 | 0 | 0 | 0 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Storage Length (m) | 70.0 | | 0.0 | 0.0 | | 100.0 | 0.0 | | 100.0 | 0.0 | | 0.0 |
| Storage Lanes | 1 | | 0 | 0 | | 1 | 2 | | 1 | 0 | | 0 |
| Taper Length (m) | 7.5 | | 7.5 | 7.5 | | 7.5 | 7.5 | | 7.5 | 7.5 | | 7.5 |
| Lane Util. Factor | 1.00 | 0.95 | 1.00 | 1.00 | 0.95 | 1.00 | 0.97 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Frt | | | | | | 0.850 | | | 0.850 | | | |
| Flt Protected | 0.950 | | | | | | 0.950 | | | | | |
| Satd. Flow (prot) | 1789 | 3579 | 0 | 0 | 3579 | 1601 | 3471 | 0 | 1601 | 0 | 0 | 0 |
| Flt Permitted | 0.400 | | | | | | 0.950 | | | | | |
| Satd. Flow (perm) | 753 | 3579 | 0 | 0 | 3579 | 1601 | 3471 | 0 | 1601 | 0 | 0 | 0 |
| Right Turn on Red | | | Yes | | | Yes | | | Yes | | | Yes |
| Satd. Flow (RTOR) | | | | | | 465 | | | 52 | | | |
| Link Speed (k/h) | | 50 | | | 50 | | | 50 | | | 50 | |
| Link Distance (m) | | 115.3 | | | 212.1 | | | 260.3 | | | 243.0 | |
| Travel Time (s) | | 8.3 | | | 15.3 | | | 18.7 | | | 17.5 | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 155 | 1704 | 0 | 0 | 620 | 465 | 155 | 0 | 52 | 0 | 0 | 0 |
| Shared Lane Traffic (%) | | | | | | | | | | | | |
| Lane Group Flow (vph) | 155 | 1704 | 0 | 0 | 620 | 465 | 155 | 0 | 52 | 0 | 0 | 0 |
| Enter Blocked Intersection | No | No | No | No | No | No | No | No | No | No | No | No |
| Lane Alignment | Left | Left | Right | Left | Left | Right | Left | Left | Right | Left | Left | Right |
| Median Width(m) | | 7.4 | | | 7.4 | | | 7.4 | | | 7.4 | |
| Link Offset(m) | | 0.0 | | | 0.0 | | | 0.0 | | | 0.0 | |
| Crosswalk Width(m) | | 4.8 | | | 4.8 | | | 4.8 | | | 4.8 | |
| Two way Left Turn Lane | | | | | | | | | | | | |
| Headway Factor | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 |
| Turning Speed (k/h) | 24 | | 14 | 24 | | 25 | 24 | | 25 | 24 | | 14 |
| Number of Detectors | 2 | 2 | | | 2 | 2 | 2 | | 2 | | | |
| Detector Template | | | | | | | | | | | | |
| Leading Detector (m) | 15.2 | 15.2 | | | 15.2 | 15.2 | 15.2 | | 15.2 | | | |
| Trailing Detector (m) | 0.0 | 0.0 | | | 0.0 | 0.0 | 0.0 | | 0.0 | | | |
| Detector 1 Position(m) | 0.0 | 0.0 | | | 0.0 | 0.0 | 0.0 | | 0.0 | | | |
| Detector 1 Size(m) | 1.8 | 1.8 | | | 1.8 | 1.8 | 1.8 | | 1.8 | | | |
| Detector 1 Type | Cl+Ex | Cl+Ex | | | Cl+Ex | Cl+Ex | Cl+Ex | | Cl+Ex | | | |
| Detector 1 Channel | | | | | | | | | | | | |
| Detector 1 Extend (s) | 0.0 | 0.0 | | | 0.0 | 0.0 | 0.0 | | 0.0 | | | |
| Detector 1 Queue (s) | 0.0 | 0.0 | | | 0.0 | 0.0 | 0.0 | | 0.0 | | | |
| Detector 1 Delay (s) | 0.0 | 0.0 | | | 0.0 | 0.0 | 0.0 | | 0.0 | | | |
| Detector 2 Position(m) | 13.4 | 13.4 | | | 13.4 | 13.4 | 13.4 | | 13.4 | | | |
| Detector 2 Size(m) | 1.8 | 1.8 | | | 1.8 | 1.8 | 1.8 | | 1.8 | | | |
| Detector 2 Type | Cl+Ex | Cl+Ex | | | Cl+Ex | Cl+Ex | Cl+Ex | | Cl+Ex | | | |
| Detector 2 Channel | | | | | | | | | | | | |
| Detector 2 Extend (s) | 0.0 | 0.0 | | | 0.0 | 0.0 | 0.0 | | 0.0 | | | |
| Turn Type | Perm | | | | | Perm | custom | | Free | | | |
| Protected Phases | | 4 | | | 8 | | | | | | | |
| Permitted Phases | 4 | | | | | 8 | 2 | | Free | | | |
| Detector Phase | 4 | 4 | | | 8 | 8 | 2 | | | | | |

| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Switch Phase | | | | | | | | | | | | |
| Minimum Initial (s) | 4.0 | 4.0 | | | 4.0 | 4.0 | 4.0 | | | | | |
| Minimum Split (s) | 20.0 | 20.0 | | | 20.0 | 20.0 | 20.0 | | | | | |
| Total Split (s) | 60.0 | 60.0 | 0.0 | 0.0 | 60.0 | 60.0 | 20.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Split (%) | 75.0% | 75.0% | 0.0% | 0.0% | 75.0% | 75.0% | 25.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Maximum Green (s) | 56.0 | 56.0 | | | 56.0 | 56.0 | 16.0 | | | | | |
| Yellow Time (s) | 3.5 | 3.5 | | | 3.5 | 3.5 | 3.5 | | | | | |
| All-Red Time (s) | 0.5 | 0.5 | | | 0.5 | 0.5 | 0.5 | | | | | |
| Lost Time Adjust (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Lost Time (s) | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| Lead/Lag | | | | | | | | | | | | |
| Lead-Lag Optimize? | | | | | | | | | | | | |
| Vehicle Extension (s) | 3.0 | 3.0 | | | 3.0 | 3.0 | 3.0 | | | | | |
| Recall Mode | None | None | | | None | None | C-Max | | | | | |
| Walk Time (s) | 5.0 | 5.0 | | | 5.0 | 5.0 | 5.0 | | | | | |
| Flash Dont Walk (s) | 11.0 | 11.0 | | | 11.0 | 11.0 | 11.0 | | | | | |
| Pedestrian Calls (#/hr) | 0 | 0 | | | 0 | 0 | 0 | | | | | |
| Act Effct Green (s) | 52.4 | 52.4 | | | 52.4 | 52.4 | 19.6 | | 80.0 | | | |
| Actuated g/C Ratio | 0.66 | 0.66 | | | 0.66 | 0.66 | 0.24 | | 1.00 | | | |
| v/c Ratio | 0.31 | 0.73 | | | 0.26 | 0.38 | 0.18 | | 0.03 | | | |
| Control Delay | 7.2 | 11.0 | | | 5.8 | 1.4 | 26.2 | | 0.0 | | | |
| Queue Delay | 0.0 | 3.1 | | | 0.0 | 0.0 | 0.0 | | 0.0 | | | |
| Total Delay | 7.2 | 14.1 | | | 5.8 | 1.4 | 26.2 | | 0.0 | | | |
| LOS | A | B | | | A | A | C | | A | | | |
| Approach Delay | | 13.5 | | | 3.9 | | | | | | | |
| Approach LOS | | B | | | A | | | | | | | |

**Intersection Summary**

Area Type: Other
Cycle Length: 80
Actuated Cycle Length: 80
Offset: 0 (0%), Referenced to phase 2:NBL and 6:, Start of Green
Natural Cycle: 60
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.73
Intersection Signal Delay: 10.6 Intersection LOS: B
Intersection Capacity Utilization 84.5% ICU Level of Service E
Analysis Period (min) 15

Splits and Phases: 2: 137 Ave & EW-N On Ramp



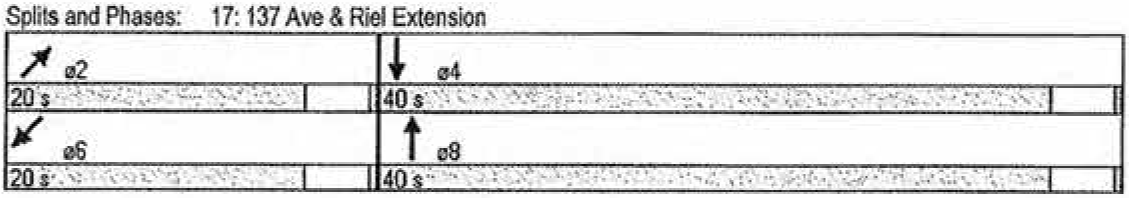
| Lane Group | NBL | NBT | NBR | SBL | SBT | SBR | NEL | NET | NER | SWL | SWT | SWR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | ↰↰ | ↑↑ | ↱ | ↰↰ | ↑↑ | ↱ | ↰↰ | ↑↑ | ↱ | ↰ | ↑↑ | ↱ |
| Volume (vph) | 206 | 295 | 191 | 161 | 1253 | 202 | 143 | 102 | 68 | 109 | 156 | 560 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Storage Length (m) | 60.0 | | 105.0 | 60.0 | | 40.0 | 160.0 | | 40.0 | 60.0 | | 60.0 |
| Storage Lanes | 2 | | 1 | 2 | | 1 | 2 | | 1 | 1 | | 1 |
| Taper Length (m) | 7.5 | | 7.5 | 7.5 | | 7.5 | 7.5 | | 7.5 | 7.5 | | 7.5 |
| Lane Util. Factor | 0.97 | 0.95 | 1.00 | 0.97 | 0.95 | 1.00 | 0.97 | 0.95 | 1.00 | 1.00 | 0.95 | 1.00 |
| Frt | | | 0.850 | | | 0.850 | | | 0.850 | | | 0.850 |
| Flt Protected | 0.950 | | | 0.950 | | | 0.950 | | | 0.950 | | |
| Satd. Flow (prot) | 3124 | 3221 | 1441 | 3124 | 3221 | 1441 | 3124 | 3221 | 1441 | 1610 | 3221 | 1441 |
| Flt Permitted | 0.134 | | | 0.557 | | | 0.644 | | | 0.682 | | |
| Satd. Flow (perm) | 441 | 3221 | 1441 | 1832 | 3221 | 1441 | 2118 | 3221 | 1441 | 1156 | 3221 | 1441 |
| Right Turn on Red | | | Yes | | | Yes | | | Yes | | | Yes |
| Satd. Flow (RTOR) | | | 208 | | | 220 | | | 52 | | | 549 |
| Link Speed (k/h) | | 70 | | | 70 | | | 60 | | | 60 | |
| Link Distance (m) | | 178.2 | | | 212.1 | | | 346.2 | | | 222.7 | |
| Travel Time (s) | | 9.2 | | | 10.9 | | | 20.8 | | | 13.4 | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 224 | 321 | 208 | 175 | 1362 | 220 | 155 | 111 | 74 | 118 | 170 | 609 |
| Shared Lane Traffic (%) | | | | | | | | | | | | |
| Lane Group Flow (vph) | 224 | 321 | 208 | 175 | 1362 | 220 | 155 | 111 | 74 | 118 | 170 | 609 |
| Enter Blocked Intersection | No | No | No | No | No | No | No | No | No | No | No | No |
| Lane Alignment | Left | Left | Right | Left | Left | Right | Left | Left | Right | Left | Left | Right |
| Median Width(m) | | 7.4 | | | 7.4 | | | 7.4 | | | 7.4 | |
| Link Offset(m) | | 0.0 | | | 0.0 | | | 0.0 | | | 0.0 | |
| Crosswalk Width(m) | | 4.8 | | | 4.8 | | | 4.8 | | | 4.8 | |
| Two way Left Turn Lane | | | | | | | | | | | | |
| Headway Factor | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 |
| Turning Speed (k/h) | 24 | | 14 | 24 | | 14 | 24 | | 14 | 24 | | 14 |
| Number of Detectors | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 1 |
| Detector Template | Left | Thru | Right | Left | Thru | Right | Left | Thru | Right | Left | Thru | Right |
| Leading Detector (m) | 2.0 | 10.0 | 2.0 | 2.0 | 10.0 | 2.0 | 2.0 | 10.0 | 2.0 | 2.0 | 10.0 | 2.0 |
| Trailing Detector (m) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Position(m) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Size(m) | 2.0 | 0.6 | 2.0 | 2.0 | 0.6 | 2.0 | 2.0 | 0.6 | 2.0 | 2.0 | 0.6 | 2.0 |
| Detector 1 Type | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex |
| Detector 1 Channel | | | | | | | | | | | | |
| Detector 1 Extend (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Queue (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Delay (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 2 Position(m) | | 9.4 | | | 9.4 | | | 9.4 | | | 9.4 | |
| Detector 2 Size(m) | | 0.6 | | | 0.6 | | | 0.6 | | | 0.6 | |
| Detector 2 Type | | Cl+Ex | | | Cl+Ex | | | Cl+Ex | | | Cl+Ex | |
| Detector 2 Channel | | | | | | | | | | | | |
| Detector 2 Extend (s) | | 0.0 | | | 0.0 | | | 0.0 | | | 0.0 | |
| Turn Type | Perm | | Perm | Perm | | Perm | Perm | | Perm | Perm | | Perm |
| Protected Phases | | 8 | | | 4 | | | 2 | | | 6 | |
| Permitted Phases | 8 | | 8 | 4 | | 4 | 2 | | 2 | 6 | | 6 |
| Detector Phase | 8 | 8 | 8 | 4 | 4 | 4 | 2 | 2 | 2 | 6 | 6 | 6 |

| Lane Group | NBL | NBT | NBR | SBL | SBT | SBR | NEL | NET | NER | SWL | SWT | SWR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Switch Phase | | | | | | | | | | | | |
| Minimum Initial (s) | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| Minimum Split (s) | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 |
| Total Split (s) | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 |
| Total Split (%) | 66.7% | 66.7% | 66.7% | 66.7% | 66.7% | 66.7% | 33.3% | 33.3% | 33.3% | 33.3% | 33.3% | 33.3% |
| Maximum Green (s) | 36.0 | 36.0 | 36.0 | 36.0 | 36.0 | 36.0 | 16.0 | 16.0 | 16.0 | 16.0 | 16.0 | 16.0 |
| Yellow Time (s) | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 |
| All-Red Time (s) | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| Lost Time Adjust (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Lost Time (s) | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| Lead/Lag | | | | | | | | | | | | |
| Lead-Lag Optimize? | | | | | | | | | | | | |
| Vehicle Extension (s) | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |
| Recall Mode | C-Max | C-Max | C-Max | C-Max | C-Max | C-Max | Max | Max | Max | Max | Max | Max |
| Walk Time (s) | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 |
| Flash Dont Walk (s) | 11.0 | 11.0 | 11.0 | 11.0 | 11.0 | 11.0 | 11.0 | 11.0 | 11.0 | 11.0 | 11.0 | 11.0 |
| Pedestrian Calls (#/hr) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Act Effct Green (s) | 36.0 | 36.0 | 36.0 | 36.0 | 36.0 | 36.0 | 16.0 | 16.0 | 16.0 | 16.0 | 16.0 | 16.0 |
| Actuated g/C Ratio | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.27 | 0.27 | 0.27 | 0.27 | 0.27 | 0.27 |
| v/c Ratio | 0.85 | 0.17 | 0.22 | 0.16 | 0.70 | 0.23 | 0.27 | 0.13 | 0.18 | 0.38 | 0.20 | 0.77 |
| Control Delay | 41.2 | 4.9 | 1.1 | 5.8 | 10.9 | 1.6 | 19.0 | 17.3 | 9.3 | 22.4 | 17.8 | 11.7 |
| Queue Delay | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Delay | 41.2 | 4.9 | 1.1 | 5.8 | 10.9 | 1.6 | 19.0 | 17.3 | 9.3 | 22.4 | 17.8 | 11.7 |
| LOS | D | A | A | A | B | A | B | B | A | C | B | B |
| Approach Delay | | 14.6 | | | 9.2 | | | 16.3 | | | 14.3 | |
| Approach LOS | | B | | | A | | | B | | | B | |

**Intersection Summary**

Area Type: CBD
Cycle Length: 60
Actuated Cycle Length: 60
Offset: 47 (78%), Referenced to phase 4:SBTL and 8:NBTL, Start of Green
Natural Cycle: 60
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.85
Intersection Signal Delay: 12.1 Intersection LOS: B
Intersection Capacity Utilization 68.4% ICU Level of Service C
Analysis Period (min) 15

Splits and Phases: 17: 137 Ave & Riel Extension



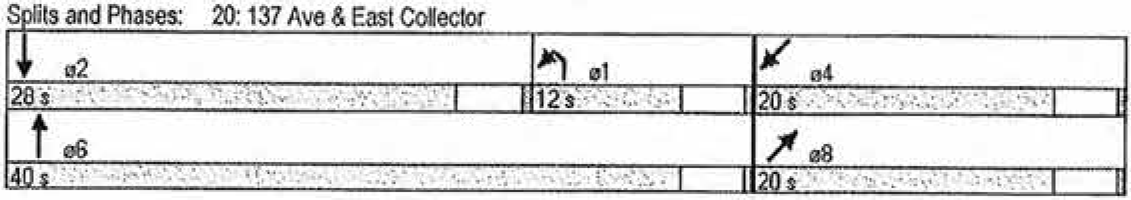
| Lane Group | NBL | NBT | NBR | SBL | SBT | SBR | NEL | NET | NER | SWL | SWT | SWR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (vph) | 300 | 585 | 113 | 15 | 1157 | 258 | 68 | 9 | 75 | 66 | 64 | 39 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Storage Length (m) | 80.0 | | 80.0 | 80.0 | | 80.0 | 80.0 | | 50.0 | 50.0 | | 50.0 |
| Storage Lanes | 1 | | 1 | 1 | | 1 | 1 | | 1 | 1 | | 1 |
| Taper Length (m) | 7.5 | | 7.5 | 7.5 | | 7.5 | 7.5 | | 7.5 | 7.5 | | 7.5 |
| Lane Util. Factor | 1.00 | 0.95 | 1.00 | 1.00 | 0.95 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Frt | | | 0.850 | | | 0.850 | | | 0.850 | | | 0.850 |
| Flt Protected | 0.950 | | | 0.950 | | | 0.950 | | | 0.950 | | |
| Satd. Flow (prot) | 1789 | 3579 | 1601 | 1789 | 3579 | 1601 | 1789 | 1883 | 1601 | 1789 | 1883 | 1601 |
| Flt Permitted | 0.148 | | | 0.410 | | | 0.711 | | | 0.751 | | |
| Satd. Flow (perm) | 279 | 3579 | 1601 | 772 | 3579 | 1601 | 1339 | 1883 | 1601 | 1414 | 1883 | 1601 |
| Right Turn on Red | | | Yes | | | Yes | | | Yes | | | Yes |
| Satd. Flow (RTOR) | | | 123 | | | 280 | | | 82 | | | 42 |
| Link Speed (k/h) | | 70 | | | 70 | | | 60 | | | 60 | |
| Link Distance (m) | | 298.4 | | | 178.2 | | | 283.5 | | | 144.3 | |
| Travel Time (s) | | 15.3 | | | 9.2 | | | 17.0 | | | 8.7 | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 326 | 636 | 123 | 16 | 1258 | 280 | 74 | 10 | 82 | 72 | 70 | 42 |
| Shared Lane Traffic (%) | | | | | | | | | | | | |
| Lane Group Flow (vph) | 326 | 636 | 123 | 16 | 1258 | 280 | 74 | 10 | 82 | 72 | 70 | 42 |
| Enter Blocked Intersection | No | No | No | No | No | No | No | No | No | No | No | No |
| Lane Alignment | Left | Left | Right | Left | Left | Right | Left | Left | Right | Left | Left | Right |
| Median Width(m) | | 7.4 | | | 7.4 | | | 3.7 | | | 3.7 | |
| Link Offset(m) | | 0.0 | | | 0.0 | | | 0.0 | | | 0.0 | |
| Crosswalk Width(m) | | 4.8 | | | 4.8 | | | 4.8 | | | 4.8 | |
| Two way Left Turn Lane | | | | | | | | | | | | |
| Headway Factor | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 |
| Turning Speed (k/h) | 24 | | 14 | 24 | | 14 | 24 | | 14 | 24 | | 14 |
| Number of Detectors | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 1 |
| Detector Template | Left | Thru | Right | Left | Thru | Right | Left | Thru | Right | Left | Thru | Right |
| Leading Detector (m) | 2.0 | 10.0 | 2.0 | 2.0 | 10.0 | 2.0 | 2.0 | 10.0 | 2.0 | 2.0 | 10.0 | 2.0 |
| Trailing Detector (m) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Position(m) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Size(m) | 2.0 | 0.6 | 2.0 | 2.0 | 0.6 | 2.0 | 2.0 | 0.6 | 2.0 | 2.0 | 0.6 | 2.0 |
| Detector 1 Type | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex |
| Detector 1 Channel | | | | | | | | | | | | |
| Detector 1 Extend (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Queue (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Delay (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 2 Position(m) | | 9.4 | | | 9.4 | | | 9.4 | | | 9.4 | |
| Detector 2 Size(m) | | 0.6 | | | 0.6 | | | 0.6 | | | 0.6 | |
| Detector 2 Type | | Cl+Ex | | | Cl+Ex | | | Cl+Ex | | | Cl+Ex | |
| Detector 2 Channel | | | | | | | | | | | | |
| Detector 2 Extend (s) | | 0.0 | | | 0.0 | | | 0.0 | | | 0.0 | |
| Turn Type | pm+pt | | Perm | Perm | | Perm | Perm | | Perm | Perm | | Perm |
| Protected Phases | 1 | 6 | | | 2 | | | 8 | | | 4 | |
| Permitted Phases | 6 | | 6 | 2 | | 2 | 8 | | 8 | 4 | | 4 |
| Detector Phase | 1 | 6 | 6 | 2 | 2 | 2 | 8 | 8 | 8 | 4 | 4 | 4 |

| Lane Group | NBL | NBT | NBR | SBL | SBT | SBR | NEL | NET | NER | SWL | SWT | SWR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Switch Phase | | | | | | | | | | | | |
| Minimum Initial (s) | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| Minimum Split (s) | 8.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 |
| Total Split (s) | 12.0 | 40.0 | 40.0 | 28.0 | 28.0 | 28.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 |
| Total Split (%) | 20.0% | 66.7% | 66.7% | 46.7% | 46.7% | 46.7% | 33.3% | 33.3% | 33.3% | 33.3% | 33.3% | 33.3% |
| Maximum Green (s) | 8.0 | 36.0 | 36.0 | 24.0 | 24.0 | 24.0 | 16.0 | 16.0 | 16.0 | 16.0 | 16.0 | 16.0 |
| Yellow Time (s) | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 |
| All-Red Time (s) | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| Lost Time Adjust (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Lost Time (s) | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| Lead/Lag | Lag | | | Lead | Lead | Lead | | | | | | |
| Lead-Lag Optimize? | Yes | | | Yes | Yes | Yes | | | | | | |
| Vehicle Extension (s) | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |
| Recall Mode | None | C-Max | C-Max | C-Max | C-Max | C-Max | None | None | None | None | None | None |
| Walk Time (s) | | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 |
| Flash Dont Walk (s) | | 11.0 | 11.0 | 11.0 | 11.0 | 11.0 | 11.0 | 11.0 | 11.0 | 11.0 | 11.0 | 11.0 |
| Pedestrian Calls (#/hr) | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Act Effct Green (s) | 45.2 | 46.0 | 46.0 | 33.2 | 33.2 | 33.2 | 8.7 | 8.7 | 8.7 | 8.7 | 8.7 | 8.7 |
| Actuated g/C Ratio | 0.75 | 0.77 | 0.77 | 0.55 | 0.55 | 0.55 | 0.14 | 0.14 | 0.14 | 0.14 | 0.14 | 0.14 |
| v/c Ratio | 0.79 | 0.23 | 0.10 | 0.04 | 0.64 | 0.28 | 0.38 | 0.04 | 0.27 | 0.35 | 0.26 | 0.16 |
| Control Delay | 32.1 | 3.2 | 1.0 | 5.1 | 6.6 | 0.6 | 28.0 | 20.4 | 8.4 | 26.9 | 24.0 | 9.1 |
| Queue Delay | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Delay | 32.1 | 3.2 | 1.0 | 5.1 | 6.6 | 0.6 | 28.0 | 20.4 | 8.4 | 26.9 | 24.0 | 9.1 |
| LOS | C | A | A | A | A | A | C | C | A | C | C | A |
| Approach Delay | | 11.6 | | | 5.5 | | | 17.9 | | | 21.7 | |
| Approach LOS | | B | | | A | | | B | | | C | |

**Intersection Summary**

Area Type: Other
Cycle Length: 60
Actuated Cycle Length: 60
Offset: 0 (0%), Referenced to phase 2:SBTL and 6:NBTL, Start of Green
Natural Cycle: 60
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.79
Intersection Signal Delay: 9.4 — Intersection LOS: A
Intersection Capacity Utilization 69.0% — ICU Level of Service C
Analysis Period (min) 15

Splits and Phases: 20: 137 Ave & East Collector



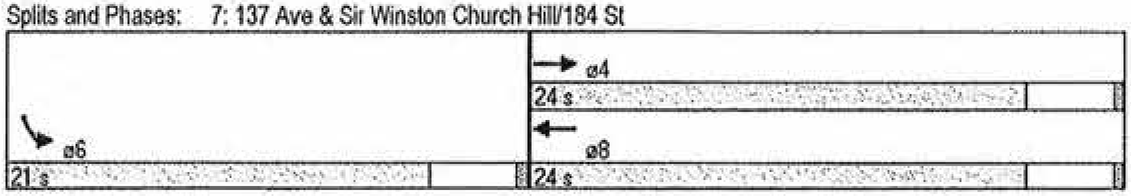
| Lane Group | EBL | EBT | WBT | WBR | SBL | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations | ↰↰ | ↑↑ | ↑↑ | ↱↱ | ↰↰ | ↱ |
| Volume (vph) | 207 | 1129 | 747 | 673 | 841 | 251 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Storage Length (m) | 50.0 | | | 50.0 | 100.0 | 0.0 |
| Storage Lanes | 2 | | | 2 | 1 | 1 |
| Taper Length (m) | 7.5 | | | 7.5 | 7.5 | 7.5 |
| Lane Util. Factor | 0.97 | 0.95 | 0.95 | 0.88 | 0.97 | 1.00 |
| Frt | | | | 0.850 | | 0.850 |
| Flt Protected | 0.950 | | | | 0.950 | |
| Satd. Flow (prot) | 3471 | 3579 | 3579 | 2818 | 3471 | 1601 |
| Flt Permitted | 0.277 | | | | 0.950 | |
| Satd. Flow (perm) | 1012 | 3579 | 3579 | 2818 | 3471 | 1601 |
| Right Turn on Red | | | | Yes | | Yes |
| Satd. Flow (RTOR) | | | | 732 | | 97 |
| Link Speed (k/h) | | 50 | 70 | | 50 | |
| Link Distance (m) | | 298.4 | 364.0 | | 269.6 | |
| Travel Time (s) | | 21.5 | 18.7 | | 19.4 | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 225 | 1227 | 812 | 732 | 914 | 273 |
| Shared Lane Traffic (%) | | | | | | |
| Lane Group Flow (vph) | 225 | 1227 | 812 | 732 | 914 | 273 |
| Enter Blocked Intersection | No | No | No | No | No | No |
| Lane Alignment | Left | Left | Left | Right | Left | Right |
| Median Width(m) | | 7.4 | 7.4 | | 7.4 | |
| Link Offset(m) | | 0.0 | 0.0 | | 0.0 | |
| Crosswalk Width(m) | | 4.8 | 4.8 | | 4.8 | |
| Two way Left Turn Lane | | | | | | |
| Headway Factor | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 |
| Turning Speed (k/h) | 24 | | | 14 | 24 | 14 |
| Number of Detectors | 1 | 2 | 2 | 1 | 1 | 1 |
| Detector Template | Left | Thru | Thru | Right | Left | Right |
| Leading Detector (m) | 2.0 | 10.0 | 10.0 | 2.0 | 2.0 | 2.0 |
| Trailing Detector (m) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Position(m) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Size(m) | 2.0 | 0.6 | 0.6 | 2.0 | 2.0 | 2.0 |
| Detector 1 Type | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex |
| Detector 1 Channel | | | | | | |
| Detector 1 Extend (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Queue (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Delay (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 2 Position(m) | | 9.4 | 9.4 | | | |
| Detector 2 Size(m) | | 0.6 | 0.6 | | | |
| Detector 2 Type | | Cl+Ex | Cl+Ex | | | |
| Detector 2 Channel | | | | | | |
| Detector 2 Extend (s) | | 0.0 | 0.0 | | | |
| Turn Type | Perm | | | Perm | | Perm |
| Protected Phases | | 4 | 8 | | 6 | |
| Permitted Phases | 4 | | | 8 | | 6 |
| Detector Phase | 4 | 4 | 8 | 8 | 6 | 6 |

| Lane Group | EBL | EBT | WBT | WBR | SBL | SBR |
|---|---|---|---|---|---|---|
| Switch Phase | | | | | | |
| Minimum Initial (s) | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| Minimum Split (s) | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 |
| Total Split (s) | 24.0 | 24.0 | 24.0 | 24.0 | 21.0 | 21.0 |
| Total Split (%) | 53.3% | 53.3% | 53.3% | 53.3% | 46.7% | 46.7% |
| Maximum Green (s) | 20.0 | 20.0 | 20.0 | 20.0 | 17.0 | 17.0 |
| Yellow Time (s) | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 |
| All-Red Time (s) | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| Lost Time Adjust (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Lost Time (s) | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| Lead/Lag | | | | | | |
| Lead-Lag Optimize? | | | | | | |
| Vehicle Extension (s) | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |
| Recall Mode | None | None | None | None | Max | Max |
| Walk Time (s) | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 |
| Flash Dont Walk (s) | 11.0 | 11.0 | 11.0 | 11.0 | 11.0 | 11.0 |
| Pedestrian Calls (#/hr) | 0 | 0 | 0 | 0 | 0 | 0 |
| Act Effct Green (s) | 19.1 | 19.1 | 19.1 | 19.1 | 17.0 | 17.0 |
| Actuated g/C Ratio | 0.43 | 0.43 | 0.43 | 0.43 | 0.38 | 0.38 |
| v/c Ratio | 0.51 | 0.79 | 0.52 | 0.45 | 0.68 | 0.40 |
| Control Delay | 14.1 | 15.6 | 10.6 | 1.8 | 14.8 | 8.8 |
| Queue Delay | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Delay | 14.1 | 15.6 | 10.6 | 1.8 | 14.8 | 8.8 |
| LOS | B | B | B | A | B | A |
| Approach Delay | | 15.3 | 6.4 | | 13.4 | |
| Approach LOS | | B | A | | B | |

**Intersection Summary**

Area Type: Other
Cycle Length: 45
Actuated Cycle Length: 44.2
Natural Cycle: 45
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.79
Intersection Signal Delay: 11.5 — Intersection LOS: B
Intersection Capacity Utilization 61.9% — ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 7: 137 Ave & Sir Winston Church Hill/184 St



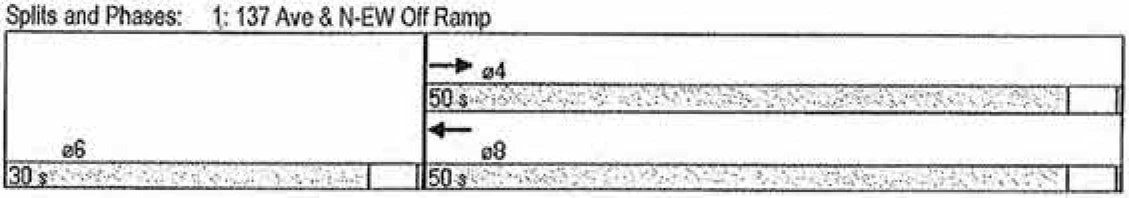
| | ↗ | → | ↘ | ↙ | ← | ↖ | ↖ | ↑ | ↗ | ↘ | ↓ | ↙ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations | | ↑↑ | ↱ | ↰ | ↑↑ | | | | | ↰↰ | | ↱ |
| Volume (vph) | 0 | 600 | 150 | 50 | 1100 | 0 | 0 | 0 | 0 | 450 | 0 | 150 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Storage Length (m) | 0.0 | | 150.0 | 70.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | | 100.0 |
| Storage Lanes | 0 | | 1 | 1 | | 0 | 0 | | 0 | 2 | | 1 |
| Taper Length (m) | 7.5 | | 7.5 | 7.5 | | 7.5 | 7.5 | | 7.5 | 7.5 | | 7.5 |
| Lane Util. Factor | 1.00 | 0.95 | 1.00 | 1.00 | 0.95 | 1.00 | 1.00 | 1.00 | 1.00 | 0.97 | 1.00 | 1.00 |
| Frt | | | 0.850 | | | | | | | | | 0.850 |
| Flt Protected | | | | 0.950 | | | | | | 0.950 | | |
| Satd. Flow (prot) | 0 | 3579 | 1601 | 1789 | 3579 | 0 | 0 | 0 | 0 | 3471 | 0 | 1601 |
| Flt Permitted | | | | 0.369 | | | | | | 0.950 | | |
| Satd. Flow (perm) | 0 | 3579 | 1601 | 695 | 3579 | 0 | 0 | 0 | 0 | 3471 | 0 | 1601 |
| Right Turn on Red | | | Yes | | | Yes | | | Yes | | | Yes |
| Satd. Flow (RTOR) | | | 163 | | | | | | | | | 163 |
| Link Speed (k/h) | | 50 | | | 50 | | | 50 | | | 50 | |
| Link Distance (m) | | 481.1 | | | 115.3 | | | 257.4 | | | 209.7 | |
| Travel Time (s) | | 34.6 | | | 8.3 | | | 18.5 | | | 15.1 | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 0 | 652 | 163 | 54 | 1196 | 0 | 0 | 0 | 0 | 489 | 0 | 163 |
| Shared Lane Traffic (%) | | | | | | | | | | | | |
| Lane Group Flow (vph) | 0 | 652 | 163 | 54 | 1196 | 0 | 0 | 0 | 0 | 489 | 0 | 163 |
| Enter Blocked Intersection | No | No | No | No | No | No | No | No | No | No | No | No |
| Lane Alignment | Left | Left | Right | Left | Left | Right | Left | Left | Right | Left | Left | Right |
| Median Width(m) | | 3.7 | | | 7.4 | | | 7.4 | | | 7.4 | |
| Link Offset(m) | | 0.0 | | | 0.0 | | | 0.0 | | | 0.0 | |
| Crosswalk Width(m) | | 4.8 | | | 4.8 | | | 4.8 | | | 4.8 | |
| Two way Left Turn Lane | | | | | | | | | | | | |
| Headway Factor | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 |
| Turning Speed (k/h) | 24 | | 25 | 24 | | 14 | 24 | | 14 | 24 | | 14 |
| Turn Type | | | Free | Perm | | | | | | custom | | Free |
| Protected Phases | | 4 | | | 8 | | | | | | | |
| Permitted Phases | | | Free | 8 | | | | | | 6 | | Free |
| Minimum Split (s) | | 20.0 | | 20.0 | 20.0 | | | | | 20.0 | | |
| Total Split (s) | 0.0 | 50.0 | 0.0 | 50.0 | 50.0 | 0.0 | 0.0 | 0.0 | 0.0 | 30.0 | 0.0 | 0.0 |
| Total Split (%) | 0.0% | 62.5% | 0.0% | 62.5% | 62.5% | 0.0% | 0.0% | 0.0% | 0.0% | 37.5% | 0.0% | 0.0% |
| Maximum Green (s) | | 46.0 | | 46.0 | 46.0 | | | | | 26.0 | | |
| Yellow Time (s) | | 3.5 | | 3.5 | 3.5 | | | | | 3.5 | | |
| All-Red Time (s) | | 0.5 | | 0.5 | 0.5 | | | | | 0.5 | | |
| Lost Time Adjust (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Lost Time (s) | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| Lead/Lag | | | | | | | | | | | | |
| Lead-Lag Optimize? | | | | | | | | | | | | |
| Walk Time (s) | | 5.0 | | 5.0 | 5.0 | | | | | 5.0 | | |
| Flash Dont Walk (s) | | 11.0 | | 11.0 | 11.0 | | | | | 11.0 | | |
| Pedestrian Calls (#/hr) | | 0 | | 0 | 0 | | | | | 0 | | |
| Act Effct Green (s) | | 46.0 | 80.0 | 46.0 | 46.0 | | | | | 26.0 | | 80.0 |
| Actuated g/C Ratio | | 0.58 | 1.00 | 0.58 | 0.58 | | | | | 0.32 | | 1.00 |
| v/c Ratio | | 0.32 | 0.10 | 0.14 | 0.58 | | | | | 0.43 | | 0.10 |
| Control Delay | | 9.4 | 0.1 | 8.8 | 8.5 | | | | | 22.7 | | 0.1 |

| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Queue Delay | | 0.0 | 0.0 | 0.0 | 0.5 | | | | | 0.0 | | 0.0 |
| Total Delay | | 9.4 | 0.1 | 8.8 | 9.0 | | | | | 22.7 | | 0.1 |
| LOS | | A | A | A | A | | | | | C | | A |
| Approach Delay | | 7.5 | | | 9.0 | | | | | | | |
| Approach LOS | | A | | | A | | | | | | | |

**Intersection Summary**

Area Type: Other
Cycle Length: 80
Actuated Cycle Length: 80
Offset: 52 (65%), Referenced to phase 2: and 6:SBL, Start of Green
Natural Cycle: 40
Control Type: Pretimed
Maximum v/c Ratio: 0.58
Intersection Signal Delay: 10.5 Intersection LOS: B
Intersection Capacity Utilization 82.3% ICU Level of Service E
Analysis Period (min) 15

Splits and Phases: 1: 137 Ave & N-EW Off Ramp



| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | ↰ | ↑↑ | | | ↑↑ | ↱ | ↰↰ | | ↱ | | | |
| Volume (vph) | 200 | 850 | 0 | 0 | 850 | 850 | 300 | 0 | 200 | 0 | 0 | 0 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Storage Length (m) | 70.0 | | 0.0 | 0.0 | | 100.0 | 0.0 | | 100.0 | 0.0 | | 0.0 |
| Storage Lanes | 1 | | 0 | 0 | | 1 | 2 | | 1 | 0 | | 0 |
| Taper Length (m) | 7.5 | | 7.5 | 7.5 | | 7.5 | 7.5 | | 7.5 | 7.5 | | 7.5 |
| Lane Util. Factor | 1.00 | 0.95 | 1.00 | 1.00 | 0.95 | 1.00 | 0.97 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Frt | | | | | | 0.850 | | | 0.850 | | | |
| Flt Protected | 0.950 | | | | | | 0.950 | | | | | |
| Satd. Flow (prot) | 1789 | 3579 | 0 | 0 | 3579 | 1601 | 3471 | 0 | 1601 | 0 | 0 | 0 |
| Flt Permitted | 0.280 | | | | | | 0.950 | | | | | |
| Satd. Flow (perm) | 527 | 3579 | 0 | 0 | 3579 | 1601 | 3471 | 0 | 1601 | 0 | 0 | 0 |
| Right Turn on Red | | | Yes | | | Yes | | | Yes | | | Yes |
| Satd. Flow (RTOR) | | | | | | 924 | | | 217 | | | |
| Link Speed (k/h) | | 50 | | | 50 | | | 50 | | | 50 | |
| Link Distance (m) | | 115.3 | | | 212.1 | | | 260.3 | | | 243.0 | |
| Travel Time (s) | | 8.3 | | | 15.3 | | | 18.7 | | | 17.5 | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 217 | 924 | 0 | 0 | 924 | 924 | 326 | 0 | 217 | 0 | 0 | 0 |
| Shared Lane Traffic (%) | | | | | | | | | | | | |
| Lane Group Flow (vph) | 217 | 924 | 0 | 0 | 924 | 924 | 326 | 0 | 217 | 0 | 0 | 0 |
| Enter Blocked Intersection | No | No | No | No | No | No | No | No | No | No | No | No |
| Lane Alignment | Left | Left | Right | Left | Left | Right | Left | Left | Right | Left | Left | Right |
| Median Width(m) | | 7.4 | | | 7.4 | | | 7.4 | | | 7.4 | |
| Link Offset(m) | | 0.0 | | | 0.0 | | | 0.0 | | | 0.0 | |
| Crosswalk Width(m) | | 4.8 | | | 4.8 | | | 4.8 | | | 4.8 | |
| Two way Left Turn Lane | | | | | | | | | | | | |
| Headway Factor | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 |
| Turning Speed (k/h) | 24 | | 14 | 24 | | 25 | 24 | | 25 | 24 | | 14 |
| Turn Type | Perm | | | | | Perm | custom | | Free | | | |
| Protected Phases | | 4 | | | 8 | | | | | | | |
| Permitted Phases | 4 | | | | | 8 | 2 | | Free | | | |
| Minimum Split (s) | 20.0 | 20.0 | | | 20.0 | 20.0 | 20.0 | | | | | |
| Total Split (s) | 59.0 | 59.0 | 0.0 | 0.0 | 59.0 | 59.0 | 21.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Split (%) | 73.8% | 73.8% | 0.0% | 0.0% | 73.8% | 73.8% | 26.3% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Maximum Green (s) | 55.0 | 55.0 | | | 55.0 | 55.0 | 17.0 | | | | | |
| Yellow Time (s) | 3.5 | 3.5 | | | 3.5 | 3.5 | 3.5 | | | | | |
| All-Red Time (s) | 0.5 | 0.5 | | | 0.5 | 0.5 | 0.5 | | | | | |
| Lost Time Adjust (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Lost Time (s) | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| Lead/Lag | | | | | | | | | | | | |
| Lead-Lag Optimize? | | | | | | | | | | | | |
| Walk Time (s) | 5.0 | 5.0 | | | 5.0 | 5.0 | 5.0 | | | | | |
| Flash Dont Walk (s) | 11.0 | 11.0 | | | 11.0 | 11.0 | 11.0 | | | | | |
| Pedestrian Calls (#/hr) | 0 | 0 | | | 0 | 0 | 0 | | | | | |
| Act Effct Green (s) | 55.0 | 55.0 | | | 55.0 | 55.0 | 17.0 | | 80.0 | | | |
| Actuated g/C Ratio | 0.69 | 0.69 | | | 0.69 | 0.69 | 0.21 | | 1.00 | | | |
| v/c Ratio | 0.60 | 0.38 | | | 0.38 | 0.67 | 0.44 | | 0.14 | | | |
| Control Delay | 22.0 | 4.8 | | | 5.8 | 3.0 | 29.6 | | 0.2 | | | |

| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Queue Delay | 0.0 | 0.2 | | | 0.0 | 0.0 | 0.0 | | 0.0 | | | |
| Total Delay | 22.0 | 5.0 | | | 5.8 | 3.0 | 29.6 | | 0.2 | | | |
| LOS | C | A | | | A | A | C | | A | | | |
| Approach Delay | | 8.2 | | | 4.4 | | | | | | | |
| Approach LOS | | A | | | A | | | | | | | |

**Intersection Summary**

Area Type: Other
Cycle Length: 80
Actuated Cycle Length: 80
Offset: 0 (0%), Referenced to phase 2:NBL and 6:, Start of Green
Natural Cycle: 60
Control Type: Pretimed
Maximum v/c Ratio: 0.67
Intersection Signal Delay: 7.7 — Intersection LOS: A
Intersection Capacity Utilization 82.3% — ICU Level of Service E
Analysis Period (min) 15

Splits and Phases: 2: 137 Ave & EW-N On Ramp

| ø2 | ø4 |
|---|---|
| 21 s | 59 s |
| | ø8 |
| | 59 s |

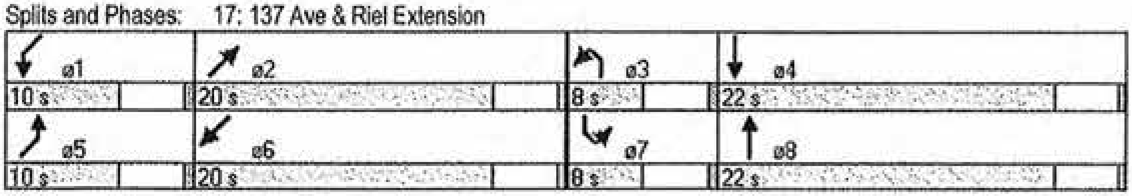
| Lane Group | NBL | NBT | NBR | SBL | SBT | SBR | NEL | NET | NER | SWL | SWT | SWR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | ↰↰ | ↑↑ | ↱ | ↰↰ | ↑↑ | ↱ | ↰↰ | ↑↑ | ↱ | ↰ | ↑↑ | ↱ |
| Volume (vph) | 303 | 785 | 120 | 274 | 197 | 579 | 528 | 493 | 329 | 99 | 416 | 387 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Storage Length (m) | 60.0 | | 105.0 | 60.0 | | 40.0 | 160.0 | | 40.0 | 60.0 | | 60.0 |
| Storage Lanes | 2 | | 1 | 2 | | 1 | 2 | | 1 | 1 | | 1 |
| Taper Length (m) | 7.5 | | 7.5 | 7.5 | | 7.5 | 7.5 | | 7.5 | 7.5 | | 7.5 |
| Lane Util. Factor | 0.97 | 0.95 | 1.00 | 0.97 | 0.95 | 1.00 | 0.97 | 0.95 | 1.00 | 1.00 | 0.95 | 1.00 |
| Frt | | | 0.850 | | | 0.850 | | | 0.850 | | | 0.850 |
| Flt Protected | 0.950 | | | 0.950 | | | 0.950 | | | 0.950 | | |
| Satd. Flow (prot) | 3124 | 3221 | 1441 | 3124 | 3221 | 1441 | 3124 | 3221 | 1441 | 1610 | 3221 | 1441 |
| Flt Permitted | 0.618 | | | 0.233 | | | 0.388 | | | 0.382 | | |
| Satd. Flow (perm) | 2032 | 3221 | 1441 | 766 | 3221 | 1441 | 1276 | 3221 | 1441 | 648 | 3221 | 1441 |
| Right Turn on Red | | | Yes | | | Yes | | | Yes | | | Yes |
| Satd. Flow (RTOR) | | | 130 | | | 356 | | | 358 | | | 176 |
| Link Speed (k/h) | | 70 | | | 70 | | | 60 | | | 60 | |
| Link Distance (m) | | 178.2 | | | 212.1 | | | 346.2 | | | 222.7 | |
| Travel Time (s) | | 9.2 | | | 10.9 | | | 20.8 | | | 13.4 | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 329 | 853 | 130 | 298 | 214 | 629 | 574 | 536 | 358 | 108 | 452 | 421 |
| Shared Lane Traffic (%) | | | | | | | | | | | | |
| Lane Group Flow (vph) | 329 | 853 | 130 | 298 | 214 | 629 | 574 | 536 | 358 | 108 | 452 | 421 |
| Enter Blocked Intersection | No | No | No | No | No | No | No | No | No | No | No | No |
| Lane Alignment | Left | Left | Right | Left | Left | Right | Left | Left | Right | Left | Left | Right |
| Median Width(m) | | 7.4 | | | 7.4 | | | 7.4 | | | 7.4 | |
| Link Offset(m) | | 0.0 | | | 0.0 | | | 0.0 | | | 0.0 | |
| Crosswalk Width(m) | | 4.8 | | | 4.8 | | | 4.8 | | | 4.8 | |
| Two way Left Turn Lane | | | | | | | | | | | | |
| Headway Factor | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 |
| Turning Speed (k/h) | 24 | | 14 | 24 | | 14 | 24 | | 14 | 24 | | 14 |
| Number of Detectors | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 1 |
| Detector Template | Left | Thru | Right | Left | Thru | Right | Left | Thru | Right | Left | Thru | Right |
| Leading Detector (m) | 2.0 | 10.0 | 2.0 | 2.0 | 10.0 | 2.0 | 2.0 | 10.0 | 2.0 | 2.0 | 10.0 | 2.0 |
| Trailing Detector (m) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Position(m) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Size(m) | 2.0 | 0.6 | 2.0 | 2.0 | 0.6 | 2.0 | 2.0 | 0.6 | 2.0 | 2.0 | 0.6 | 2.0 |
| Detector 1 Type | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex |
| Detector 1 Channel | | | | | | | | | | | | |
| Detector 1 Extend (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Queue (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Delay (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 2 Position(m) | | 9.4 | | | 9.4 | | | 9.4 | | | 9.4 | |
| Detector 2 Size(m) | | 0.6 | | | 0.6 | | | 0.6 | | | 0.6 | |
| Detector 2 Type | | Cl+Ex | | | Cl+Ex | | | Cl+Ex | | | Cl+Ex | |
| Detector 2 Channel | | | | | | | | | | | | |
| Detector 2 Extend (s) | | 0.0 | | | 0.0 | | | 0.0 | | | 0.0 | |
| Turn Type | pm+pt | | Perm | pm+pt | | Perm | pm+pt | | Perm | pm+pt | | Perm |
| Protected Phases | 3 | 8 | | 7 | 4 | | 5 | 2 | | 1 | 6 | |
| Permitted Phases | 8 | | 8 | 4 | | 4 | 2 | | 2 | 6 | | 6 |
| Detector Phase | 3 | 8 | 8 | 7 | 4 | 4 | 5 | 2 | 2 | 1 | 6 | 6 |

| Lane Group | NBL | NBT | NBR | SBL | SBT | SBR | NEL | NET | NER | SWL | SWT | SWR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Switch Phase | | | | | | | | | | | | |
| Minimum Initial (s) | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| Minimum Split (s) | 8.0 | 20.0 | 20.0 | 8.0 | 20.0 | 20.0 | 8.0 | 20.0 | 20.0 | 8.0 | 20.0 | 20.0 |
| Total Split (s) | 8.0 | 22.0 | 22.0 | 8.0 | 22.0 | 22.0 | 10.0 | 20.0 | 20.0 | 10.0 | 20.0 | 20.0 |
| Total Split (%) | 13.3% | 36.7% | 36.7% | 13.3% | 36.7% | 36.7% | 16.7% | 33.3% | 33.3% | 16.7% | 33.3% | 33.3% |
| Maximum Green (s) | 4.0 | 18.0 | 18.0 | 4.0 | 18.0 | 18.0 | 6.0 | 16.0 | 16.0 | 6.0 | 16.0 | 16.0 |
| Yellow Time (s) | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 |
| All-Red Time (s) | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| Lost Time Adjust (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Lost Time (s) | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| Lead/Lag | Lead | Lag | Lag | Lead | Lag | Lag | Lead | Lag | Lag | Lead | Lag | Lag |
| Lead-Lag Optimize? | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Vehicle Extension (s) | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |
| Recall Mode | None | C-Max | C-Max | None | C-Max | C-Max | None | Max | Max | None | Max | Max |
| Walk Time (s) | | 5.0 | 5.0 | | 5.0 | 5.0 | | 5.0 | 5.0 | | 5.0 | 5.0 |
| Flash Dont Walk (s) | | 11.0 | 11.0 | | 11.0 | 11.0 | | 11.0 | 11.0 | | 11.0 | 11.0 |
| Pedestrian Calls (#/hr) | | 0 | 0 | | 0 | 0 | | 0 | 0 | | 0 | 0 |
| Act Effct Green (s) | 22.0 | 18.0 | 18.0 | 22.0 | 18.0 | 18.0 | 22.8 | 18.0 | 18.0 | 21.9 | 16.0 | 16.0 |
| Actuated g/C Ratio | 0.37 | 0.30 | 0.30 | 0.37 | 0.30 | 0.30 | 0.38 | 0.30 | 0.30 | 0.36 | 0.27 | 0.27 |
| v/c Ratio | 0.40 | 0.88 | 0.25 | 0.68 | 0.22 | 0.92 | 0.86 | 0.55 | 0.52 | 0.33 | 0.53 | 0.82 |
| Control Delay | 13.2 | 33.2 | 5.0 | 21.2 | 16.5 | 31.7 | 29.6 | 21.2 | 5.7 | 13.4 | 21.4 | 27.9 |
| Queue Delay | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Delay | 13.2 | 33.2 | 5.0 | 21.2 | 16.5 | 31.7 | 29.6 | 21.2 | 5.7 | 13.4 | 21.4 | 27.9 |
| LOS | B | C | A | C | B | C | C | C | A | B | C | C |
| Approach Delay | | 25.4 | | | 26.1 | | | 20.7 | | | 23.3 | |
| Approach LOS | | C | | | C | | | C | | | C | |

**Intersection Summary**

Area Type: CBD
Cycle Length: 60
Actuated Cycle Length: 60
Offset: 0 (0%), Referenced to phase 4:SBTL and 8:NBTL, Start of Green
Natural Cycle: 60
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.92
Intersection Signal Delay: 23.7 Intersection LOS: C
Intersection Capacity Utilization 77.5% ICU Level of Service D
Analysis Period (min) 15

Splits and Phases: 17: 137 Ave & Riel Extension



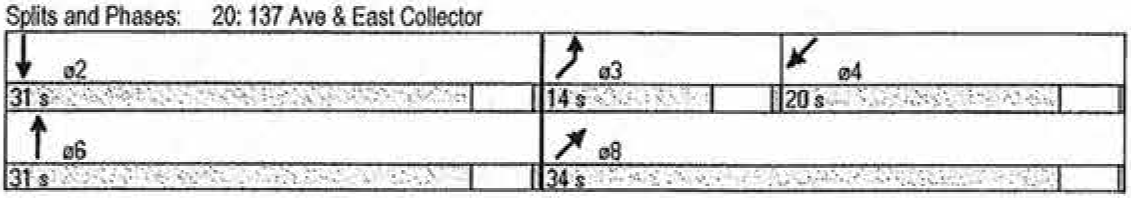
| Lane Group | NBL | NBT | NBR | SBL | SBT | SBR | NEL | NET | NER | SWL | SWT | SWR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (vph) | 227 | 858 | 35 | 141 | 384 | 100 | 326 | 42 | 430 | 68 | 17 | 24 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Storage Length (m) | 80.0 | | 80.0 | 80.0 | | 80.0 | 80.0 | | 50.0 | 50.0 | | 50.0 |
| Storage Lanes | 1 | | 1 | 1 | | 1 | 1 | | 1 | 1 | | 1 |
| Taper Length (m) | 7.5 | | 7.5 | 7.5 | | 7.5 | 7.5 | | 7.5 | 7.5 | | 7.5 |
| Lane Util. Factor | 1.00 | 0.95 | 1.00 | 1.00 | 0.95 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Frt | | | 0.850 | | | 0.850 | | | 0.850 | | | 0.850 |
| Flt Protected | 0.950 | | | 0.950 | | | 0.950 | | | 0.950 | | |
| Satd. Flow (prot) | 1789 | 3579 | 1601 | 1789 | 3579 | 1601 | 1789 | 1883 | 1601 | 1789 | 1883 | 1601 |
| Flt Permitted | 0.506 | | | 0.244 | | | 0.493 | | | 0.727 | | |
| Satd. Flow (perm) | 953 | 3579 | 1601 | 460 | 3579 | 1601 | 929 | 1883 | 1601 | 1369 | 1883 | 1601 |
| Right Turn on Red | | | Yes | | | Yes | | | Yes | | | Yes |
| Satd. Flow (RTOR) | | | 38 | | | 109 | | | 296 | | | 26 |
| Link Speed (k/h) | | 70 | | | 70 | | | 60 | | | 60 | |
| Link Distance (m) | | 292.3 | | | 178.2 | | | 282.3 | | | 144.3 | |
| Travel Time (s) | | 15.0 | | | 9.2 | | | 16.9 | | | 8.7 | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 247 | 933 | 38 | 153 | 417 | 109 | 354 | 46 | 467 | 74 | 18 | 26 |
| Shared Lane Traffic (%) | | | | | | | | | | | | |
| Lane Group Flow (vph) | 247 | 933 | 38 | 153 | 417 | 109 | 354 | 46 | 467 | 74 | 18 | 26 |
| Enter Blocked Intersection | No | No | No | No | No | No | No | No | No | No | No | No |
| Lane Alignment | Left | Left | Right | Left | Left | Right | Left | Left | Right | Left | Left | Right |
| Median Width(m) | | 7.4 | | | 7.4 | | | 3.7 | | | 3.7 | |
| Link Offset(m) | | 0.0 | | | 0.0 | | | 0.0 | | | 0.0 | |
| Crosswalk Width(m) | | 4.8 | | | 4.8 | | | 4.8 | | | 4.8 | |
| Two way Left Turn Lane | | | | | | | | | | | | |
| Headway Factor | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 |
| Turning Speed (k/h) | 24 | | 14 | 24 | | 14 | 24 | | 14 | 24 | | 14 |
| Number of Detectors | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 1 |
| Detector Template | Left | Thru | Right | Left | Thru | Right | Left | Thru | Right | Left | Thru | Right |
| Leading Detector (m) | 2.0 | 10.0 | 2.0 | 2.0 | 10.0 | 2.0 | 2.0 | 10.0 | 2.0 | 2.0 | 10.0 | 2.0 |
| Trailing Detector (m) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Position(m) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Size(m) | 2.0 | 0.6 | 2.0 | 2.0 | 0.6 | 2.0 | 2.0 | 0.6 | 2.0 | 2.0 | 0.6 | 2.0 |
| Detector 1 Type | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex |
| Detector 1 Channel | | | | | | | | | | | | |
| Detector 1 Extend (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Queue (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Delay (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 2 Position(m) | | 9.4 | | | 9.4 | | | 9.4 | | | 9.4 | |
| Detector 2 Size(m) | | 0.6 | | | 0.6 | | | 0.6 | | | 0.6 | |
| Detector 2 Type | | Cl+Ex | | | Cl+Ex | | | Cl+Ex | | | Cl+Ex | |
| Detector 2 Channel | | | | | | | | | | | | |
| Detector 2 Extend (s) | | 0.0 | | | 0.0 | | | 0.0 | | | 0.0 | |
| Turn Type | Perm | | Perm | Perm | | Perm | pm+pt | | Perm | Perm | | Perm |
| Protected Phases | | 6 | | | 2 | | 3 | 8 | | | 4 | |
| Permitted Phases | 6 | | 6 | 2 | | 2 | 8 | | 8 | 4 | | 4 |
| Detector Phase | 6 | 6 | 6 | 2 | 2 | 2 | 3 | 8 | 8 | 4 | 4 | 4 |

| Lane Group | NBL | NBT | NBR | SBL | SBT | SBR | NEL | NET | NER | SWL | SWT | SWR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Switch Phase | | | | | | | | | | | | |
| Minimum Initial (s) | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| Minimum Split (s) | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 8.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 |
| Total Split (s) | 31.0 | 31.0 | 31.0 | 31.0 | 31.0 | 31.0 | 14.0 | 34.0 | 34.0 | 20.0 | 20.0 | 20.0 |
| Total Split (%) | 47.7% | 47.7% | 47.7% | 47.7% | 47.7% | 47.7% | 21.5% | 52.3% | 52.3% | 30.8% | 30.8% | 30.8% |
| Maximum Green (s) | 27.0 | 27.0 | 27.0 | 27.0 | 27.0 | 27.0 | 10.0 | 30.0 | 30.0 | 16.0 | 16.0 | 16.0 |
| Yellow Time (s) | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 |
| All-Red Time (s) | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| Lost Time Adjust (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Lost Time (s) | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| Lead/Lag | | | | | | | Lead | | | Lag | Lag | Lag |
| Lead-Lag Optimize? | | | | | | | Yes | | | Yes | Yes | Yes |
| Vehicle Extension (s) | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |
| Recall Mode | C-Max | C-Max | C-Max | C-Max | C-Max | C-Max | None | None | None | None | None | None |
| Walk Time (s) | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 |
| Flash Dont Walk (s) | 11.0 | 11.0 | 11.0 | 11.0 | 11.0 | 11.0 | | 11.0 | 11.0 | 11.0 | 11.0 | 11.0 |
| Pedestrian Calls (#/hr) | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |
| Act Effct Green (s) | 36.0 | 36.0 | 36.0 | 36.0 | 36.0 | 36.0 | 21.0 | 21.0 | 21.0 | 8.9 | 8.9 | 8.9 |
| Actuated g/C Ratio | 0.55 | 0.55 | 0.55 | 0.55 | 0.55 | 0.55 | 0.32 | 0.32 | 0.32 | 0.14 | 0.14 | 0.14 |
| v/c Ratio | 0.47 | 0.47 | 0.04 | 0.60 | 0.21 | 0.12 | 0.82 | 0.08 | 0.65 | 0.39 | 0.07 | 0.11 |
| Control Delay | 14.4 | 10.9 | 3.7 | 26.5 | 8.8 | 2.7 | 34.2 | 13.2 | 10.6 | 30.9 | 23.2 | 10.9 |
| Queue Delay | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Delay | 14.4 | 10.9 | 3.7 | 26.5 | 8.8 | 2.7 | 34.2 | 13.2 | 10.6 | 30.9 | 23.2 | 10.9 |
| LOS | B | B | A | C | A | A | C | B | B | C | C | B |
| Approach Delay | | 11.4 | | | 11.8 | | | 20.4 | | | 25.3 | |
| Approach LOS | | B | | | B | | | C | | | C | |

**Intersection Summary**

Area Type: Other
Cycle Length: 65
Actuated Cycle Length: 65
Offset: 0 (0%), Referenced to phase 2:SBTL and 6:NBTL, Start of Green
Natural Cycle: 60
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.82
Intersection Signal Delay: 14.8 — Intersection LOS: B
Intersection Capacity Utilization 66.3% — ICU Level of Service C
Analysis Period (min) 15

Splits and Phases: 20: 137 Ave & East Collector



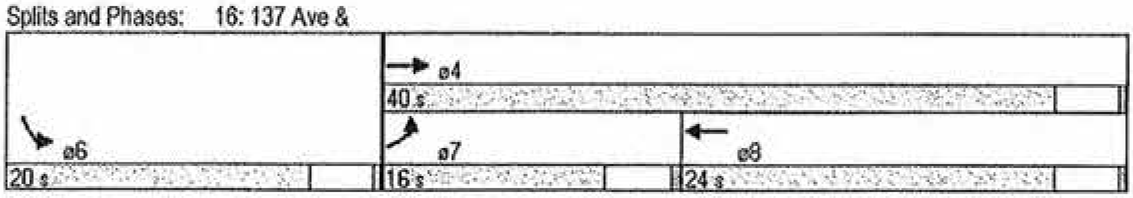
| Lane Group | EBL | EBT | WBT | WBR | SBL | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Volume (vph) | 735 | 164 | 1005 | 975 | 676 | 77 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Storage Length (m) | 65.0 | | | 50.0 | 100.0 | 0.0 |
| Storage Lanes | 2 | | | 2 | 1 | 1 |
| Taper Length (m) | 7.5 | | | 7.5 | 7.5 | 7.5 |
| Lane Util. Factor | 0.97 | 0.95 | 0.95 | 0.88 | 0.97 | 1.00 |
| Frt | | | | 0.850 | | 0.850 |
| Flt Protected | 0.950 | | | | 0.950 | |
| Satd. Flow (prot) | 3471 | 3579 | 3579 | 2818 | 3471 | 1601 |
| Flt Permitted | 0.167 | | | | 0.950 | |
| Satd. Flow (perm) | 610 | 3579 | 3579 | 2818 | 3471 | 1601 |
| Right Turn on Red | | | | Yes | | Yes |
| Satd. Flow (RTOR) | | | | 1060 | | 84 |
| Link Speed (k/h) | | 60 | 60 | | 60 | |
| Link Distance (m) | | 292.3 | 424.4 | | 231.0 | |
| Travel Time (s) | | 17.5 | 25.5 | | 13.9 | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 799 | 178 | 1092 | 1060 | 735 | 84 |
| Shared Lane Traffic (%) | | | | | | |
| Lane Group Flow (vph) | 799 | 178 | 1092 | 1060 | 735 | 84 |
| Enter Blocked Intersection | No | No | No | No | No | No |
| Lane Alignment | Left | Left | Left | Right | Left | Right |
| Median Width(m) | | 7.4 | 7.4 | | 7.4 | |
| Link Offset(m) | | 0.0 | 0.0 | | 0.0 | |
| Crosswalk Width(m) | | 4.8 | 4.8 | | 4.8 | |
| Two way Left Turn Lane | | | | | | |
| Headway Factor | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 |
| Turning Speed (k/h) | 24 | | | 14 | 24 | 14 |
| Number of Detectors | 1 | 2 | 2 | 1 | 1 | 1 |
| Detector Template | Left | Thru | Thru | Right | Left | Right |
| Leading Detector (m) | 2.0 | 10.0 | 10.0 | 2.0 | 2.0 | 2.0 |
| Trailing Detector (m) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Position(m) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Size(m) | 2.0 | 0.6 | 0.6 | 2.0 | 2.0 | 2.0 |
| Detector 1 Type | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex |
| Detector 1 Channel | | | | | | |
| Detector 1 Extend (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Queue (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Delay (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 2 Position(m) | | 9.4 | 9.4 | | | |
| Detector 2 Size(m) | | 0.6 | 0.6 | | | |
| Detector 2 Type | | Cl+Ex | Cl+Ex | | | |
| Detector 2 Channel | | | | | | |
| Detector 2 Extend (s) | | 0.0 | 0.0 | | | |
| Turn Type | pm+pt | | | Perm | | Perm |
| Protected Phases | 7 | 4 | 8 | | 6 | |
| Permitted Phases | 4 | | | 8 | | 6 |
| Detector Phase | 7 | 4 | 8 | 8 | 6 | 6 |

| Lane Group | EBL | EBT | WBT | WBR | SBL | SBR |
|---|---|---|---|---|---|---|
| Switch Phase | | | | | | |
| Minimum Initial (s) | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| Minimum Split (s) | 8.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 |
| Total Split (s) | 16.0 | 40.0 | 24.0 | 24.0 | 20.0 | 20.0 |
| Total Split (%) | 26.7% | 66.7% | 40.0% | 40.0% | 33.3% | 33.3% |
| Maximum Green (s) | 12.0 | 36.0 | 20.0 | 20.0 | 16.0 | 16.0 |
| Yellow Time (s) | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 |
| All-Red Time (s) | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| Lost Time Adjust (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Lost Time (s) | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| Lead/Lag | Lead | | Lag | Lag | | |
| Lead-Lag Optimize? | Yes | | Yes | Yes | | |
| Vehicle Extension (s) | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |
| Recall Mode | None | None | None | None | Max | Max |
| Walk Time (s) | | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 |
| Flash Dont Walk (s) | | 11.0 | 11.0 | 11.0 | 11.0 | 11.0 |
| Pedestrian Calls (#/hr) | | 0 | 0 | 0 | 0 | 0 |
| Act Effct Green (s) | 36.0 | 36.0 | 20.0 | 20.0 | 16.0 | 16.0 |
| Actuated g/C Ratio | 0.60 | 0.60 | 0.33 | 0.33 | 0.27 | 0.27 |
| v/c Ratio | 0.85 | 0.08 | 0.92 | 0.64 | 0.79 | 0.17 |
| Control Delay | 21.9 | 5.2 | 33.3 | 3.3 | 28.5 | 5.9 |
| Queue Delay | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Delay | 21.9 | 5.2 | 33.3 | 3.3 | 28.5 | 5.9 |
| LOS | C | A | C | A | C | A |
| Approach Delay | | 18.8 | 18.5 | | 26.2 | |
| Approach LOS | | B | B | | C | |

**Intersection Summary**

Area Type: Other
Cycle Length: 60
Actuated Cycle Length: 60
Natural Cycle: 60
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.92
Intersection Signal Delay: 20.2 Intersection LOS: C
Intersection Capacity Utilization 78.0% ICU Level of Service D
Analysis Period (min) 15

Splits and Phases: 16: 137 Ave &



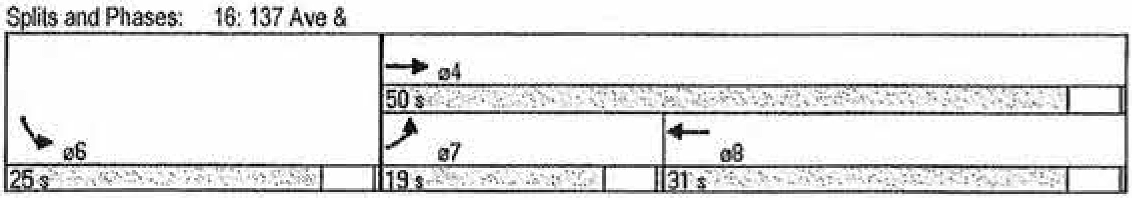
| Lane Group | EBL | EBT | WBT | WBR | SBL | SBR |
|---|---|---|---|---|---|---|
| | ↗ | → | ← | ↖ | ↘ | ↙ |
| Lane Configurations | ↰↰ | ↑↑ | ↑↑ | ↱↱ | ↰↰ | ↱ |
| Volume (vph) | 735 | 184 | 1042 | 975 | 676 | 77 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Storage Length (m) | 65.0 | | | 50.0 | 100.0 | 0.0 |
| Storage Lanes | 2 | | | 2 | 1 | 1 |
| Taper Length (m) | 7.5 | | | 7.5 | 7.5 | 7.5 |
| Lane Util. Factor | 0.97 | 0.95 | 0.95 | 0.88 | 0.97 | 1.00 |
| Frt | | | | 0.850 | | 0.850 |
| Flt Protected | 0.950 | | | | 0.950 | |
| Satd. Flow (prot) | 3471 | 3579 | 3579 | 2818 | 3471 | 1601 |
| Flt Permitted | 0.129 | | | | 0.950 | |
| Satd. Flow (perm) | 471 | 3579 | 3579 | 2818 | 3471 | 1601 |
| Right Turn on Red | | | | Yes | | Yes |
| Satd. Flow (RTOR) | | | | 1011 | | 84 |
| Link Speed (k/h) | | 60 | 60 | | 60 | |
| Link Distance (m) | | 358.2 | 424.4 | | 231.0 | |
| Travel Time (s) | | 21.5 | 25.5 | | 13.9 | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 799 | 200 | 1133 | 1060 | 735 | 84 |
| Shared Lane Traffic (%) | | | | | | |
| Lane Group Flow (vph) | 799 | 200 | 1133 | 1060 | 735 | 84 |
| Enter Blocked Intersection | No | No | No | No | No | No |
| Lane Alignment | Left | Left | Left | Right | Left | Right |
| Median Width(m) | | 7.4 | 7.4 | | 7.4 | |
| Link Offset(m) | | 0.0 | 0.0 | | 0.0 | |
| Crosswalk Width(m) | | 4.8 | 4.8 | | 4.8 | |
| Two way Left Turn Lane | | | | | | |
| Headway Factor | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 |
| Turning Speed (k/h) | 24 | | | 14 | 24 | 14 |
| Number of Detectors | 1 | 2 | 2 | 1 | 1 | 1 |
| Detector Template | Left | Thru | Thru | Right | Left | Right |
| Leading Detector (m) | 2.0 | 10.0 | 10.0 | 2.0 | 2.0 | 2.0 |
| Trailing Detector (m) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Position(m) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Size(m) | 2.0 | 0.6 | 0.6 | 2.0 | 2.0 | 2.0 |
| Detector 1 Type | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex |
| Detector 1 Channel | | | | | | |
| Detector 1 Extend (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Queue (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Delay (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 2 Position(m) | | 9.4 | 9.4 | | | |
| Detector 2 Size(m) | | 0.6 | 0.6 | | | |
| Detector 2 Type | | Cl+Ex | Cl+Ex | | | |
| Detector 2 Channel | | | | | | |
| Detector 2 Extend (s) | | 0.0 | 0.0 | | | |
| Turn Type | pm+pt | | | Perm | | Perm |
| Protected Phases | 7 | 4 | 8 | | 6 | |
| Permitted Phases | 4 | | | 8 | | 6 |
| Detector Phase | 7 | 4 | 8 | 8 | 6 | 6 |

| Lane Group | EBL | EBT | WBT | WBR | SBL | SBR |
|---|---|---|---|---|---|---|
| Switch Phase | | | | | | |
| Minimum Initial (s) | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| Minimum Split (s) | 8.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 |
| Total Split (s) | 19.0 | 50.0 | 31.0 | 31.0 | 25.0 | 25.0 |
| Total Split (%) | 25.3% | 66.7% | 41.3% | 41.3% | 33.3% | 33.3% |
| Maximum Green (s) | 15.0 | 46.0 | 27.0 | 27.0 | 21.0 | 21.0 |
| Yellow Time (s) | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 |
| All-Red Time (s) | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| Lost Time Adjust (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Lost Time (s) | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| Lead/Lag | Lead | | Lag | Lag | | |
| Lead-Lag Optimize? | Yes | | Yes | Yes | | |
| Vehicle Extension (s) | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |
| Recall Mode | None | None | None | None | C-Max | C-Max |
| Walk Time (s) | | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 |
| Flash Dont Walk (s) | | 11.0 | 11.0 | 11.0 | 11.0 | 11.0 |
| Pedestrian Calls (#/hr) | | 0 | 0 | 0 | 0 | 0 |
| Act Effct Green (s) | 46.0 | 46.0 | 27.0 | 27.0 | 21.0 | 21.0 |
| Actuated g/C Ratio | 0.61 | 0.61 | 0.36 | 0.36 | 0.28 | 0.28 |
| v/c Ratio | 0.90 | 0.09 | 0.88 | 0.64 | 0.76 | 0.17 |
| Control Delay | 31.8 | 6.1 | 32.3 | 3.8 | 30.5 | 6.2 |
| Queue Delay | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Delay | 31.8 | 6.1 | 32.3 | 3.8 | 30.5 | 6.2 |
| LOS | C | A | C | A | C | A |
| Approach Delay | | 26.7 | 18.5 | | 28.0 | |
| Approach LOS | | C | B | | C | |

**Intersection Summary**

Area Type: Other
Cycle Length: 75
Actuated Cycle Length: 75
Offset: 48 (64%), Referenced to phase 2: and 6:SBL, Start of Green
Natural Cycle: 60
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.90
Intersection Signal Delay: 22.5 — Intersection LOS: C
Intersection Capacity Utilization 79.1% — ICU Level of Service D
Analysis Period (min) 15

Splits and Phases: 16: 137 Ave &



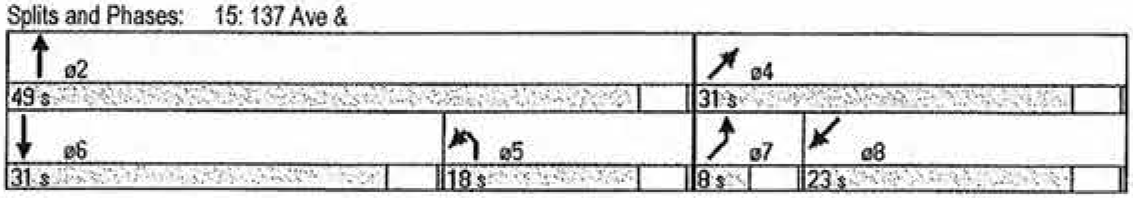
| Lane Group | NBL | NBT | NBR | SBL | SBT | SBR | NEL | NET | NER | SWL | SWT | SWR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | ↰↰ | ↑↑ | ↱ | ↰↰ | ↑↑ | ↱ | ↰↰ | ↑ | ↱ | ↰ | ↑ | ↱ |
| Volume (vph) | 506 | 197 | 295 | 176 | 1045 | 395 | 202 | 120 | 143 | 110 | 285 | 599 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Storage Length (m) | 85.0 | | 125.0 | 110.0 | | 110.0 | 80.0 | | 80.0 | 90.0 | | 90.0 |
| Storage Lanes | 2 | | 1 | 2 | | 1 | 2 | | 1 | 1 | | 1 |
| Taper Length (m) | 7.5 | | 7.5 | 7.5 | | 7.5 | 7.5 | | 7.5 | 7.5 | | 7.5 |
| Lane Util. Factor | 0.97 | 0.95 | 1.00 | 0.97 | 0.95 | 1.00 | 0.97 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Frt | | | 0.850 | | | 0.850 | | | 0.850 | | | 0.850 |
| Flt Protected | 0.950 | | | 0.950 | | | 0.950 | | | 0.950 | | |
| Satd. Flow (prot) | 3471 | 3579 | 1601 | 3471 | 3579 | 1601 | 3471 | 1883 | 1601 | 1789 | 1883 | 1601 |
| Flt Permitted | 0.950 | | | 0.618 | | | 0.256 | | | 0.674 | | |
| Satd. Flow (perm) | 3471 | 3579 | 1601 | 2258 | 3579 | 1601 | 935 | 1883 | 1601 | 1269 | 1883 | 1601 |
| Right Turn on Red | | | Yes | | | Yes | | | Yes | | | Yes |
| Satd. Flow (RTOR) | | | 321 | | | 225 | | | 155 | | | 622 |
| Link Speed (k/h) | | 70 | | | 70 | | | 50 | | | 50 | |
| Link Distance (m) | | 357.6 | | | 318.3 | | | 153.1 | | | 171.0 | |
| Travel Time (s) | | 18.4 | | | 16.4 | | | 11.0 | | | 12.3 | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 550 | 214 | 321 | 191 | 1136 | 429 | 220 | 130 | 155 | 120 | 310 | 651 |
| Shared Lane Traffic (%) | | | | | | | | | | | | |
| Lane Group Flow (vph) | 550 | 214 | 321 | 191 | 1136 | 429 | 220 | 130 | 155 | 120 | 310 | 651 |
| Enter Blocked Intersection | No | No | No | No | No | No | No | No | No | No | No | No |
| Lane Alignment | Left | Left | Right | Left | Left | Right | Left | Left | Right | Left | Left | Right |
| Median Width(m) | | 7.4 | | | 7.4 | | | 7.4 | | | 7.4 | |
| Link Offset(m) | | 0.0 | | | 0.0 | | | 0.0 | | | 0.0 | |
| Crosswalk Width(m) | | 4.8 | | | 4.8 | | | 4.8 | | | 4.8 | |
| Two way Left Turn Lane | | | | | | | | | | | | |
| Headway Factor | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 |
| Turning Speed (k/h) | 24 | | 14 | 24 | | 14 | 24 | | 14 | 24 | | 14 |
| Number of Detectors | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 1 |
| Detector Template | Left | Thru | Right | Left | Thru | Right | Left | Thru | Right | Left | Thru | Right |
| Leading Detector (m) | 2.0 | 10.0 | 2.0 | 2.0 | 10.0 | 2.0 | 2.0 | 10.0 | 2.0 | 2.0 | 10.0 | 2.0 |
| Trailing Detector (m) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Position(m) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Size(m) | 2.0 | 0.6 | 2.0 | 2.0 | 0.6 | 2.0 | 2.0 | 0.6 | 2.0 | 2.0 | 0.6 | 2.0 |
| Detector 1 Type | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex |
| Detector 1 Channel | | | | | | | | | | | | |
| Detector 1 Extend (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Queue (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Delay (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 2 Position(m) | | 9.4 | | | 9.4 | | | 9.4 | | | 9.4 | |
| Detector 2 Size(m) | | 0.6 | | | 0.6 | | | 0.6 | | | 0.6 | |
| Detector 2 Type | | Cl+Ex | | | Cl+Ex | | | Cl+Ex | | | Cl+Ex | |
| Detector 2 Channel | | | | | | | | | | | | |
| Detector 2 Extend (s) | | 0.0 | | | 0.0 | | | 0.0 | | | 0.0 | |
| Turn Type | Prot | | Perm | Perm | | Perm | pm+pt | | Perm | Perm | | Perm |
| Protected Phases | 5 | 2 | | | 6 | | 7 | 4 | | | 8 | |
| Permitted Phases | | | 2 | 6 | | 6 | 4 | | 4 | 8 | | 8 |
| Detector Phase | 5 | 2 | 2 | 6 | 6 | 6 | 7 | 4 | 4 | 8 | 8 | 8 |

| Lane Group | NBL | NBT | NBR | SBL | SBT | SBR | NEL | NET | NER | SWL | SWT | SWR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Switch Phase | | | | | | | | | | | | |
| Minimum Initial (s) | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| Minimum Split (s) | 8.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 8.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 |
| Total Split (s) | 18.0 | 49.0 | 49.0 | 31.0 | 31.0 | 31.0 | 8.0 | 31.0 | 31.0 | 23.0 | 23.0 | 23.0 |
| Total Split (%) | 22.5% | 61.3% | 61.3% | 38.8% | 38.8% | 38.8% | 10.0% | 38.8% | 38.8% | 28.8% | 28.8% | 28.8% |
| Maximum Green (s) | 14.0 | 45.0 | 45.0 | 27.0 | 27.0 | 27.0 | 4.0 | 27.0 | 27.0 | 19.0 | 19.0 | 19.0 |
| Yellow Time (s) | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 |
| All-Red Time (s) | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| Lost Time Adjust (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Lost Time (s) | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| Lead/Lag | Lag | | | Lead | Lead | Lead | Lead | | | Lag | Lag | Lag |
| Lead-Lag Optimize? | Yes | | | Yes | Yes | Yes | Yes | | | Yes | Yes | Yes |
| Vehicle Extension (s) | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |
| Recall Mode | None | None | None | None | None | None | None | C-Max | C-Max | C-Max | C-Max | C-Max |
| Walk Time (s) | | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 |
| Flash Dont Walk (s) | | 11.0 | 11.0 | 11.0 | 11.0 | 11.0 | | 11.0 | 11.0 | 11.0 | 11.0 | 11.0 |
| Pedestrian Calls (#/hr) | | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |
| Act Effct Green (s) | 14.0 | 45.0 | 45.0 | 27.0 | 27.0 | 27.0 | 27.0 | 27.0 | 27.0 | 19.0 | 19.0 | 19.0 |
| Actuated g/C Ratio | 0.18 | 0.56 | 0.56 | 0.34 | 0.34 | 0.34 | 0.34 | 0.34 | 0.34 | 0.24 | 0.24 | 0.24 |
| v/c Ratio | 0.91 | 0.11 | 0.31 | 0.25 | 0.94 | 0.62 | 0.50 | 0.20 | 0.24 | 0.40 | 0.69 | 0.76 |
| Control Delay | 44.0 | 8.3 | 2.4 | 20.3 | 42.1 | 14.7 | 23.2 | 20.0 | 4.5 | 30.4 | 37.3 | 10.0 |
| Queue Delay | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Delay | 44.0 | 8.3 | 2.4 | 20.3 | 42.1 | 14.7 | 23.2 | 20.0 | 4.5 | 30.4 | 37.3 | 10.0 |
| LOS | D | A | A | C | D | B | C | B | A | C | D | A |
| Approach Delay | | 24.6 | | | 33.0 | | | 16.6 | | | 20.1 | |
| Approach LOS | | C | | | C | | | B | | | C | |

**Intersection Summary**

Area Type: Other
Cycle Length: 80
Actuated Cycle Length: 80
Offset: 8 (10%), Referenced to phase 4:NETL and 8:SWTL, Start of Green
Natural Cycle: 80
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.94
Intersection Signal Delay: 25.9 — Intersection LOS: C
Intersection Capacity Utilization 77.4% — ICU Level of Service D
Analysis Period (min) 15

Splits and Phases: 15: 137 Ave &



McKenney

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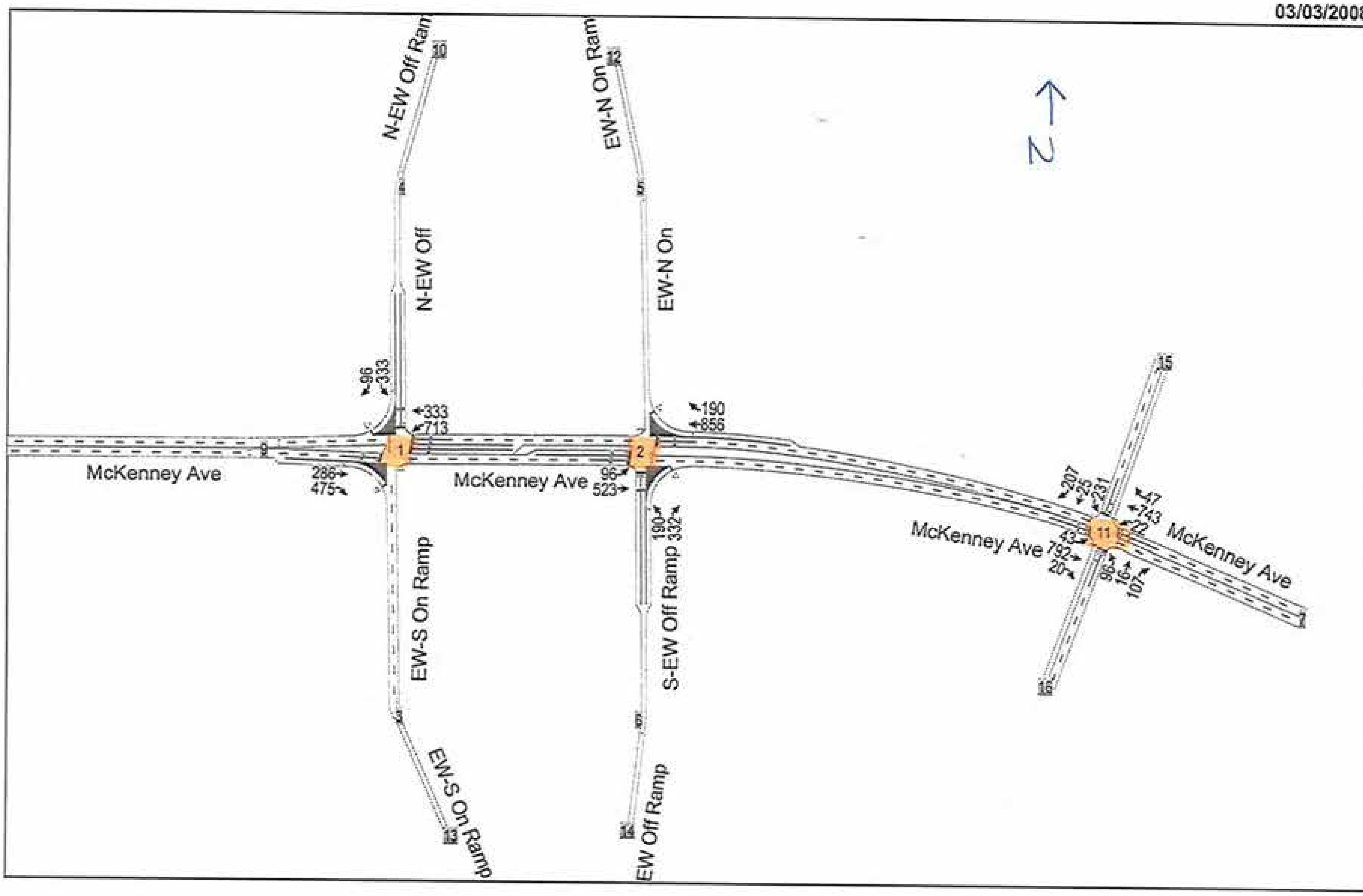


| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ↗ | → | ↘ | ↙ | ← | ↖ | ↖ | ↑ | ↗ | ↘ | ↓ | ↙ |
| Lane Configurations | | ↑↑ | ↱ | ↰↰ | ↑↑ | | | | | ↰↰ | | ↱ |
| Volume (vph) | 0 | 286 | 475 | 713 | 333 | 0 | 0 | 0 | 0 | 333 | 0 | 96 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Storage Length (m) | 0.0 | | 100.0 | 75.0 | | 0.0 | 0.0 | | 0.0 | 100.0 | | 100.0 |
| Storage Lanes | 0 | | 1 | 2 | | 0 | 0 | | 0 | 1 | | 1 |
| Taper Length (m) | 7.5 | | 7.5 | 7.5 | | 7.5 | 7.5 | | 7.5 | 7.5 | | 7.5 |
| Lane Util. Factor | 1.00 | 0.95 | 1.00 | 0.97 | 0.95 | 1.00 | 1.00 | 1.00 | 1.00 | 0.97 | 1.00 | 1.00 |
| Frt | | | 0.850 | | | | | | | | | 0.850 |
| Flt Protected | | | | 0.950 | | | | | | 0.950 | | |
| Satd. Flow (prot) | 0 | 3579 | 1601 | 3471 | 3579 | 0 | 0 | 0 | 0 | 3471 | 0 | 1601 |
| Flt Permitted | | | | 0.950 | | | | | | 0.950 | | |
| Satd. Flow (perm) | 0 | 3579 | 1601 | 3471 | 3579 | 0 | 0 | 0 | 0 | 3471 | 0 | 1601 |
| Right Turn on Red | | | Yes | | | Yes | | | Yes | | | Yes |
| Satd. Flow (RTOR) | | | 516 | | | | | | | | | 104 |
| Link Speed (k/h) | | 50 | | | 50 | | | 50 | | | 50 | |
| Link Distance (m) | | 102.0 | | | 179.6 | | | 199.6 | | | 198.0 | |
| Travel Time (s) | | 7.3 | | | 12.9 | | | 14.4 | | | 14.3 | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 0 | 311 | 516 | 775 | 362 | 0 | 0 | 0 | 0 | 362 | 0 | 104 |
| Shared Lane Traffic (%) | | | | | | | | | | | | |
| Lane Group Flow (vph) | 0 | 311 | 516 | 775 | 362 | 0 | 0 | 0 | 0 | 362 | 0 | 104 |
| Enter Blocked Intersection | No | No | No | No | No | No | No | No | No | No | No | No |
| Lane Alignment | Left | Left | Right | Left | Left | Right | Left | Left | Right | Left | Left | Right |
| Median Width(m) | | 7.4 | | | 7.4 | | | 7.4 | | | 7.4 | |
| Link Offset(m) | | 0.0 | | | 0.0 | | | 0.0 | | | 0.0 | |
| Crosswalk Width(m) | | 4.8 | | | 4.8 | | | 4.8 | | | 4.8 | |
| Two way Left Turn Lane | | | | | | | | | | | | |
| Headway Factor | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 |
| Turning Speed (k/h) | 24 | | 25 | 24 | | 14 | 24 | | 14 | 24 | | 25 |
| Number of Detectors | | 2 | 2 | 2 | 2 | | | | | 2 | | 2 |
| Detector Template | | | | | | | | | | | | |
| Leading Detector (m) | | 15.2 | 15.2 | 15.2 | 15.2 | | | | | 15.2 | | 15.2 |
| Trailing Detector (m) | | 0.0 | 0.0 | 0.0 | 0.0 | | | | | 0.0 | | 0.0 |
| Detector 1 Position(m) | | 0.0 | 0.0 | 0.0 | 0.0 | | | | | 0.0 | | 0.0 |
| Detector 1 Size(m) | | 1.8 | 1.8 | 1.8 | 1.8 | | | | | 1.8 | | 1.8 |
| Detector 1 Type | | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | | | | | Cl+Ex | | Cl+Ex |
| Detector 1 Channel | | | | | | | | | | | | |
| Detector 1 Extend (s) | | 0.0 | 0.0 | 0.0 | 0.0 | | | | | 0.0 | | 0.0 |
| Detector 1 Queue (s) | | 0.0 | 0.0 | 0.0 | 0.0 | | | | | 0.0 | | 0.0 |
| Detector 1 Delay (s) | | 0.0 | 0.0 | 0.0 | 0.0 | | | | | 0.0 | | 0.0 |
| Detector 2 Position(m) | | 13.4 | 13.4 | 13.4 | 13.4 | | | | | 13.4 | | 13.4 |
| Detector 2 Size(m) | | 1.8 | 1.8 | 1.8 | 1.8 | | | | | 1.8 | | 1.8 |
| Detector 2 Type | | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | | | | | Cl+Ex | | Cl+Ex |
| Detector 2 Channel | | | | | | | | | | | | |
| Detector 2 Extend (s) | | 0.0 | 0.0 | 0.0 | 0.0 | | | | | 0.0 | | 0.0 |
| Turn Type | | | Perm | Prot | | | | | | custom | | custom |
| Protected Phases | | 2 | | 1 | 6 | | | | | | | |
| Permitted Phases | | | 2 | | | | | | | 8 | | 4 |
| Detector Phase | | 2 | 2 | 1 | 6 | | | | | 8 | | 4 |

| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | ↰ | ↑↑ | | | ↑↑ | ↱ | ↰↰ | | ↱ | | | |
| Volume (vph) | 96 | 523 | 0 | 0 | 856 | 190 | 190 | 0 | 332 | 0 | 0 | 0 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Storage Length (m) | 70.0 | | 0.0 | 0.0 | | 100.0 | 100.0 | | 100.0 | 0.0 | | 0.0 |
| Storage Lanes | 1 | | 0 | 0 | | 1 | 1 | | 1 | 0 | | 0 |
| Taper Length (m) | 7.5 | | 7.5 | 7.5 | | 7.5 | 7.5 | | 7.5 | 7.5 | | 7.5 |
| Lane Util. Factor | 1.00 | 0.95 | 1.00 | 1.00 | 0.95 | 1.00 | 0.97 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Frt | | | | | | 0.850 | | | 0.850 | | | |
| Flt Protected | 0.950 | | | | | | 0.950 | | | | | |
| Satd. Flow (prot) | 1789 | 3579 | 0 | 0 | 3579 | 1601 | 3471 | 0 | 1601 | 0 | 0 | 0 |
| Flt Permitted | 0.219 | | | | | | 0.950 | | | | | |
| Satd. Flow (perm) | 412 | 3579 | 0 | 0 | 3579 | 1601 | 3471 | 0 | 1601 | 0 | 0 | 0 |
| Right Turn on Red | | | Yes | | | Yes | | | Yes | | | Yes |
| Satd. Flow (RTOR) | | | | | | 207 | | | 205 | | | |
| Link Speed (k/h) | | 50 | | | 50 | | | 50 | | | 50 | |
| Link Distance (m) | | 179.6 | | | 354.8 | | | 201.6 | | | 199.0 | |
| Travel Time (s) | | 12.9 | | | 25.5 | | | 14.5 | | | 14.3 | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 104 | 568 | 0 | 0 | 930 | 207 | 207 | 0 | 361 | 0 | 0 | 0 |
| Shared Lane Traffic (%) | | | | | | | | | | | | |
| Lane Group Flow (vph) | 104 | 568 | 0 | 0 | 930 | 207 | 207 | 0 | 361 | 0 | 0 | 0 |
| Enter Blocked Intersection | No | No | No | No | No | No | No | No | No | No | No | No |
| Lane Alignment | Left | Left | Right | Left | Left | Right | Left | Left | Right | Left | Left | Right |
| Median Width(m) | | 7.4 | | | 7.4 | | | 7.4 | | | 7.4 | |
| Link Offset(m) | | 0.0 | | | 0.0 | | | 0.0 | | | 0.0 | |
| Crosswalk Width(m) | | 4.8 | | | 4.8 | | | 4.8 | | | 4.8 | |
| Two way Left Turn Lane | | | | | | | | | | | | |
| Headway Factor | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 |
| Turning Speed (k/h) | 24 | | 14 | 24 | | 25 | 24 | | 25 | 24 | | 14 |
| Number of Detectors | 2 | 2 | | | 2 | 2 | 2 | | 2 | | | |
| Detector Template | | | | | | | | | | | | |
| Leading Detector (m) | 15.2 | 15.2 | | | 15.2 | 15.2 | 15.2 | | 15.2 | | | |
| Trailing Detector (m) | 0.0 | 0.0 | | | 0.0 | 0.0 | 0.0 | | 0.0 | | | |
| Detector 1 Position(m) | 0.0 | 0.0 | | | 0.0 | 0.0 | 0.0 | | 0.0 | | | |
| Detector 1 Size(m) | 1.8 | 1.8 | | | 1.8 | 1.8 | 1.8 | | 1.8 | | | |
| Detector 1 Type | Cl+Ex | Cl+Ex | | | Cl+Ex | Cl+Ex | Cl+Ex | | Cl+Ex | | | |
| Detector 1 Channel | | | | | | | | | | | | |
| Detector 1 Extend (s) | 0.0 | 0.0 | | | 0.0 | 0.0 | 0.0 | | 0.0 | | | |
| Detector 1 Queue (s) | 0.0 | 0.0 | | | 0.0 | 0.0 | 0.0 | | 0.0 | | | |
| Detector 1 Delay (s) | 0.0 | 0.0 | | | 0.0 | 0.0 | 0.0 | | 0.0 | | | |
| Detector 2 Position(m) | 13.4 | 13.4 | | | 13.4 | 13.4 | 13.4 | | 13.4 | | | |
| Detector 2 Size(m) | 1.8 | 1.8 | | | 1.8 | 1.8 | 1.8 | | 1.8 | | | |
| Detector 2 Type | Cl+Ex | Cl+Ex | | | Cl+Ex | Cl+Ex | Cl+Ex | | Cl+Ex | | | |
| Detector 2 Channel | | | | | | | | | | | | |
| Detector 2 Extend (s) | 0.0 | 0.0 | | | 0.0 | 0.0 | 0.0 | | 0.0 | | | |
| Turn Type | Perm | | | | | Perm | custom | | custom | | | |
| Protected Phases | | 2 | | | 6 | | | | | | | |
| Permitted Phases | 2 | | | | | 6 | 4 | | 8 | | | |
| Detector Phase | 2 | 2 | | | 6 | 6 | 4 | | 8 | | | |

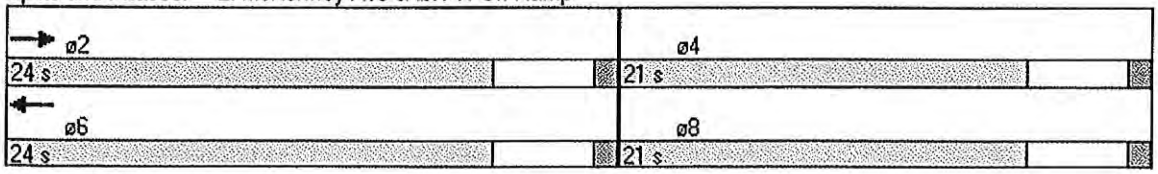
| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Switch Phase | | | | | | | | | | | | |
| Minimum Initial (s) | 4.0 | 4.0 | | | 4.0 | 4.0 | 4.0 | | 4.0 | | | |
| Minimum Split (s) | 21.0 | 21.0 | | | 21.0 | 21.0 | 21.0 | | 21.0 | | | |
| Total Split (s) | 24.0 | 24.0 | 0.0 | 0.0 | 24.0 | 24.0 | 21.0 | 0.0 | 21.0 | 0.0 | 0.0 | 0.0 |
| Total Split (%) | 53.3% | 53.3% | 0.0% | 0.0% | 53.3% | 53.3% | 46.7% | 0.0% | 46.7% | 0.0% | 0.0% | 0.0% |
| Maximum Green (s) | 19.0 | 19.0 | | | 19.0 | 19.0 | 16.0 | | 16.0 | | | |
| Yellow Time (s) | 4.0 | 4.0 | | | 4.0 | 4.0 | 4.0 | | 4.0 | | | |
| All-Red Time (s) | 1.0 | 1.0 | | | 1.0 | 1.0 | 1.0 | | 1.0 | | | |
| Lost Time Adjust (s) | -1.0 | -1.0 | 0.0 | 0.0 | -1.0 | -1.0 | -1.0 | 0.0 | -1.0 | 0.0 | 0.0 | 0.0 |
| Total Lost Time (s) | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| Lead/Lag | | | | | | | | | | | | |
| Lead-Lag Optimize? | | | | | | | | | | | | |
| Vehicle Extension (s) | 3.0 | 3.0 | | | 3.0 | 3.0 | 3.0 | | 3.0 | | | |
| Recall Mode | None | None | | | None | None | C-Max | | C-Max | | | |
| Walk Time (s) | 5.0 | 5.0 | | | 5.0 | 5.0 | 5.0 | | 5.0 | | | |
| Flash Dont Walk (s) | 11.0 | 11.0 | | | 11.0 | 11.0 | 11.0 | | 11.0 | | | |
| Pedestrian Calls (#/hr) | 0 | 0 | | | 0 | 0 | 0 | | 0 | | | |
| Act Effct Green (s) | 18.3 | 18.3 | | | 18.3 | 18.3 | 18.7 | | 18.7 | | | |
| Actuated g/C Ratio | 0.41 | 0.41 | | | 0.41 | 0.41 | 0.42 | | 0.42 | | | |
| v/c Ratio | 0.62 | 0.39 | | | 0.64 | 0.27 | 0.14 | | 0.46 | | | |
| Control Delay | 30.8 | 10.0 | | | 15.3 | 6.1 | 9.3 | | 6.9 | | | |
| Queue Delay | 0.0 | 0.0 | | | 0.0 | 0.0 | 0.0 | | 0.0 | | | |
| Total Delay | 30.8 | 10.0 | | | 15.3 | 6.1 | 9.3 | | 6.9 | | | |
| LOS | C | A | | | B | A | A | | A | | | |
| Approach Delay | | 13.2 | | | 13.6 | | | | | | | |
| Approach LOS | | B | | | B | | | | | | | |
| Queue Length 50th (m) | 5.7 | 14.5 | | | 35.1 | 3.7 | 5.1 | | 7.9 | | | |
| Queue Length 95th (m) | #23.8 | 22.7 | | | 49.3 | m14.4 | 10.1 | | 23.0 | | | |
| Internal Link Dist (m) | | 155.6 | | | 330.8 | | | 177.6 | | | 175.0 | |
| Turn Bay Length (m) | 70.0 | | | | | 100.0 | 100.0 | | 100.0 | | | |
| Base Capacity (vph) | 183 | 1591 | | | 1591 | 827 | 1444 | | 786 | | | |
| Starvation Cap Reductn | 0 | 0 | | | 0 | 0 | 0 | | 0 | | | |
| Spillback Cap Reductn | 0 | 0 | | | 0 | 0 | 0 | | 0 | | | |
| Storage Cap Reductn | 0 | 0 | | | 0 | 0 | 0 | | 0 | | | |
| Reduced v/c Ratio | 0.57 | 0.36 | | | 0.58 | 0.25 | 0.14 | | 0.46 | | | |

**Intersection Summary**

Area Type: Other
Cycle Length: 45
Actuated Cycle Length: 45
Offset: 0 (0%), Referenced to phase 4:NBL and 8:NBR, Start of Green
Natural Cycle: 45
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.64
Intersection Signal Delay: 12.1 Intersection LOS: B
Intersection Capacity Utilization 69.3% ICU Level of Service C
Analysis Period (min) 15
# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 2: McKenney Ave & EW-N On Ramp



| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | ↰↑↑↱ | | | ↰↑↑↱ | | | ↰↑ | ↱ | | ↰↑ | ↱ |
| Volume (vph) | 43 | 792 | 20 | 22 | 743 | 47 | 96 | 16 | 107 | 231 | 25 | 207 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Lane Util. Factor | 0.95 | 0.95 | 0.95 | 0.95 | 0.95 | 0.95 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Frt | | 0.996 | | | 0.991 | | | | 0.850 | | | 0.850 |
| Flt Protected | | 0.997 | | | 0.999 | | | 0.959 | | | 0.957 | |
| Satd. Flow (prot) | 0 | 3554 | 0 | 0 | 3543 | 0 | 0 | 1806 | 1601 | 0 | 1802 | 1601 |
| Flt Permitted | | 0.870 | | | 0.914 | | | 0.609 | | | 0.663 | |
| Satd. Flow (perm) | 0 | 3101 | 0 | 0 | 3241 | 0 | 0 | 1147 | 1601 | 0 | 1249 | 1601 |
| Right Turn on Red | | | Yes | | | Yes | | | Yes | | | Yes |
| Satd. Flow (RTOR) | | 6 | | | 16 | | | | 61 | | | 74 |
| Link Speed (k/h) | | 50 | | | 50 | | | 50 | | | 50 | |
| Link Distance (m) | | 354.8 | | | 162.1 | | | 123.0 | | | 137.4 | |
| Travel Time (s) | | 25.5 | | | 11.7 | | | 8.9 | | | 9.9 | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 47 | 861 | 22 | 24 | 808 | 51 | 104 | 17 | 116 | 251 | 27 | 225 |
| Shared Lane Traffic (%) | | | | | | | | | | | | |
| Lane Group Flow (vph) | 0 | 930 | 0 | 0 | 883 | 0 | 0 | 121 | 116 | 0 | 278 | 225 |
| Enter Blocked Intersection | No | No | No | No | No | No | No | No | No | No | No | No |
| Lane Alignment | Left | Left | Right | Left | Left | Right | Left | Left | Right | Left | Left | Right |
| Median Width(m) | | 0.0 | | | 0.0 | | | 0.0 | | | 0.0 | |
| Link Offset(m) | | 0.0 | | | 0.0 | | | 0.0 | | | 0.0 | |
| Crosswalk Width(m) | | 4.8 | | | 4.8 | | | 4.8 | | | 4.8 | |
| Two way Left Turn Lane | | | | | | | | | | | | |
| Headway Factor | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 |
| Turning Speed (k/h) | 24 | | 14 | 24 | | 14 | 24 | | 14 | 24 | | 14 |
| Turn Type | Perm | | | Perm | | | Perm | | Perm | Perm | | Perm |
| Protected Phases | | 4 | | | 8 | | | 2 | | | 6 | |
| Permitted Phases | 4 | | | 8 | | | 2 | | 2 | 6 | | 6 |
| Minimum Split (s) | 21.0 | 21.0 | | 21.0 | 21.0 | | 21.0 | 21.0 | 21.0 | 21.0 | 21.0 | 21.0 |
| Total Split (s) | 23.0 | 23.0 | 0.0 | 23.0 | 23.0 | 0.0 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 |
| Total Split (%) | 51.1% | 51.1% | 0.0% | 51.1% | 51.1% | 0.0% | 48.9% | 48.9% | 48.9% | 48.9% | 48.9% | 48.9% |
| Maximum Green (s) | 18.0 | 18.0 | | 18.0 | 18.0 | | 17.0 | 17.0 | 17.0 | 17.0 | 17.0 | 17.0 |
| Yellow Time (s) | 4.0 | 4.0 | | 4.0 | 4.0 | | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| All-Red Time (s) | 1.0 | 1.0 | | 1.0 | 1.0 | | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| Lost Time Adjust (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Lost Time (s) | 5.0 | 5.0 | 4.0 | 5.0 | 5.0 | 4.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 |
| Lead/Lag | | | | | | | | | | | | |
| Lead-Lag Optimize? | | | | | | | | | | | | |
| Walk Time (s) | 5.0 | 5.0 | | 5.0 | 5.0 | | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 |
| Flash Dont Walk (s) | 11.0 | 11.0 | | 11.0 | 11.0 | | 11.0 | 11.0 | 11.0 | 11.0 | 11.0 | 11.0 |
| Pedestrian Calls (#/hr) | 0 | 0 | | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 |
| Act Effct Green (s) | | 18.0 | | | 18.0 | | | 17.0 | 17.0 | | 17.0 | 17.0 |
| Actuated g/C Ratio | | 0.40 | | | 0.40 | | | 0.38 | 0.38 | | 0.38 | 0.38 |
| v/c Ratio | | 0.75 | | | 0.68 | | | 0.28 | 0.18 | | 0.59 | 0.35 |
| Control Delay | | 16.4 | | | 14.1 | | | 12.0 | 6.2 | | 17.4 | 8.6 |
| Queue Delay | | 0.0 | | | 0.0 | | | 0.0 | 0.0 | | 0.0 | 0.0 |
| Total Delay | | 16.4 | | | 14.1 | | | 12.0 | 6.2 | | 17.4 | 8.6 |
| LOS | | B | | | B | | | B | A | | B | A |

...

| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Delay | | 16.4 | | | 14.1 | | | 9.1 | | | 13.5 | |
| Approach LOS | | B | | | B | | | A | | | B | |

**Intersection Summary**

Area Type: Other
Cycle Length: 45
Actuated Cycle Length: 45
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 45
Control Type: Pretimed
Maximum v/c Ratio: 0.75
Intersection Signal Delay: 14.3 Intersection LOS: B
Intersection Capacity Utilization 79.7% ICU Level of Service D
Analysis Period (min) 15

Splits and Phases: 11: McKenney Ave &

| | |
|---|---|
| ø2 22 s | ø4 23 s |
| ø6 22 s | ø8 23 s |

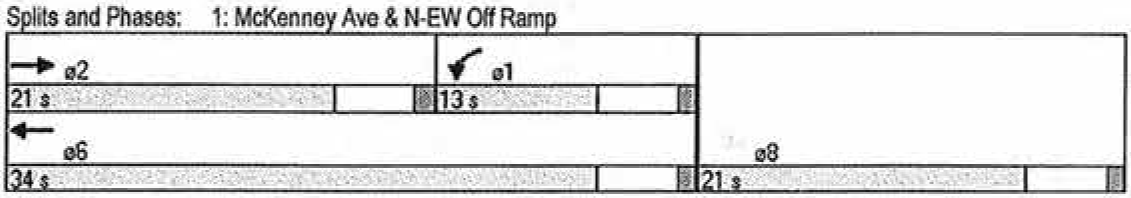
| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | ↑↑ | ↱ | ↰↰ | ↑↑ | | | | | ↰↰ | | ↱ |
| Volume (vph) | 0 | 250 | 200 | 350 | 700 | 0 | 0 | 0 | 0 | 200 | 0 | 100 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Storage Length (m) | 0.0 | | 100.0 | 75.0 | | 0.0 | 0.0 | | 0.0 | 100.0 | | 100.0 |
| Storage Lanes | 0 | | 1 | 2 | | 0 | 0 | | 0 | 1 | | 1 |
| Taper Length (m) | 7.5 | | 7.5 | 7.5 | | 7.5 | 7.5 | | 7.5 | 7.5 | | 7.5 |
| Lane Util. Factor | 1.00 | 0.95 | 1.00 | 0.97 | 0.95 | 1.00 | 1.00 | 1.00 | 1.00 | 0.97 | 1.00 | 1.00 |
| Frt | | | 0.850 | | | | | | | | | 0.850 |
| Flt Protected | | | | 0.950 | | | | | | 0.950 | | |
| Satd. Flow (prot) | 0 | 3579 | 1601 | 3471 | 3579 | 0 | 0 | 0 | 0 | 3471 | 0 | 1601 |
| Flt Permitted | | | | 0.950 | | | | | | 0.950 | | |
| Satd. Flow (perm) | 0 | 3579 | 1601 | 3471 | 3579 | 0 | 0 | 0 | 0 | 3471 | 0 | 1601 |
| Right Turn on Red | | | Yes | | | Yes | | | Yes | | | Yes |
| Satd. Flow (RTOR) | | | 217 | | | | | | | | | 109 |
| Link Speed (k/h) | | 50 | | | 50 | | | 50 | | | 50 | |
| Link Distance (m) | | 102.0 | | | 179.6 | | | 199.6 | | | 198.0 | |
| Travel Time (s) | | 7.3 | | | 12.9 | | | 14.4 | | | 14.3 | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 0 | 272 | 217 | 380 | 761 | 0 | 0 | 0 | 0 | 217 | 0 | 109 |
| Shared Lane Traffic (%) | | | | | | | | | | | | |
| Lane Group Flow (vph) | 0 | 272 | 217 | 380 | 761 | 0 | 0 | 0 | 0 | 217 | 0 | 109 |
| Enter Blocked Intersection | No | No | No | No | No | No | No | No | No | No | No | No |
| Lane Alignment | Left | Left | Right | Left | Left | Right | Left | Left | Right | Left | Left | Right |
| Median Width(m) | | 7.4 | | | 7.4 | | | 7.4 | | | 7.4 | |
| Link Offset(m) | | 0.0 | | | 0.0 | | | 0.0 | | | 0.0 | |
| Crosswalk Width(m) | | 4.8 | | | 4.8 | | | 4.8 | | | 4.8 | |
| Two way Left Turn Lane | | | | | | | | | | | | |
| Headway Factor | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 |
| Turning Speed (k/h) | 24 | | 25 | 24 | | 14 | 24 | | 14 | 24 | | 25 |
| Number of Detectors | | 2 | 2 | 2 | 2 | | | | | 2 | | 2 |
| Detector Template | | | | | | | | | | | | |
| Leading Detector (m) | | 15.2 | 15.2 | 15.2 | 15.2 | | | | | 15.2 | | 15.2 |
| Trailing Detector (m) | | 0.0 | 0.0 | 0.0 | 0.0 | | | | | 0.0 | | 0.0 |
| Detector 1 Position(m) | | 0.0 | 0.0 | 0.0 | 0.0 | | | | | 0.0 | | 0.0 |
| Detector 1 Size(m) | | 1.8 | 1.8 | 1.8 | 1.8 | | | | | 1.8 | | 1.8 |
| Detector 1 Type | | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | | | | | Cl+Ex | | Cl+Ex |
| Detector 1 Channel | | | | | | | | | | | | |
| Detector 1 Extend (s) | | 0.0 | 0.0 | 0.0 | 0.0 | | | | | 0.0 | | 0.0 |
| Detector 1 Queue (s) | | 0.0 | 0.0 | 0.0 | 0.0 | | | | | 0.0 | | 0.0 |
| Detector 1 Delay (s) | | 0.0 | 0.0 | 0.0 | 0.0 | | | | | 0.0 | | 0.0 |
| Detector 2 Position(m) | | 13.4 | 13.4 | 13.4 | 13.4 | | | | | 13.4 | | 13.4 |
| Detector 2 Size(m) | | 1.8 | 1.8 | 1.8 | 1.8 | | | | | 1.8 | | 1.8 |
| Detector 2 Type | | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | | | | | Cl+Ex | | Cl+Ex |
| Detector 2 Channel | | | | | | | | | | | | |
| Detector 2 Extend (s) | | 0.0 | 0.0 | 0.0 | 0.0 | | | | | 0.0 | | 0.0 |
| Turn Type | | | Free | Prot | | | | | | custom | | Free |
| Protected Phases | | 2 | | 1 | 6 | | | | | | | |
| Permitted Phases | | | Free | | | | | | | 8 | | Free |
| Detector Phase | | 2 | | 1 | 6 | | | | | 8 | | |

| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Switch Phase | | | | | | | | | | | | |
| Minimum Initial (s) | | 4.0 | | 4.0 | 4.0 | | | | | 4.0 | | |
| Minimum Split (s) | | 21.0 | | 9.0 | 21.0 | | | | | 21.0 | | |
| Total Split (s) | 0.0 | 21.0 | 0.0 | 13.0 | 34.0 | 0.0 | 0.0 | 0.0 | 0.0 | 21.0 | 0.0 | 0.0 |
| Total Split (%) | 0.0% | 38.2% | 0.0% | 23.6% | 61.8% | 0.0% | 0.0% | 0.0% | 0.0% | 38.2% | 0.0% | 0.0% |
| Maximum Green (s) | | 16.0 | | 8.0 | 29.0 | | | | | 16.0 | | |
| Yellow Time (s) | | 4.0 | | 4.0 | 4.0 | | | | | 4.0 | | |
| All-Red Time (s) | | 1.0 | | 1.0 | 1.0 | | | | | 1.0 | | |
| Lost Time Adjust (s) | 0.0 | -1.0 | 0.0 | -1.0 | -1.0 | 0.0 | 0.0 | 0.0 | 0.0 | -1.0 | 0.0 | 0.0 |
| Total Lost Time (s) | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| Lead/Lag | | Lead | | Lag | | | | | | | | |
| Lead-Lag Optimize? | | Yes | | Yes | | | | | | | | |
| Vehicle Extension (s) | | 3.0 | | 3.0 | 3.0 | | | | | 3.0 | | |
| Recall Mode | | None | | None | None | | | | | C-Max | | |
| Walk Time (s) | | 5.0 | | | 5.0 | | | | | 5.0 | | |
| Flash Dont Walk (s) | | 11.0 | | | 11.0 | | | | | 11.0 | | |
| Pedestrian Calls (#/hr) | | 0 | | | 0 | | | | | 0 | | |
| Act Effct Green (s) | | 10.4 | 55.0 | 11.7 | 26.2 | | | | | 20.8 | | 55.0 |
| Actuated g/C Ratio | | 0.19 | 1.00 | 0.21 | 0.48 | | | | | 0.38 | | 1.00 |
| v/c Ratio | | 0.40 | 0.14 | 0.51 | 0.45 | | | | | 0.17 | | 0.07 |
| Control Delay | | 20.9 | 0.2 | 9.7 | 10.3 | | | | | 12.9 | | 0.1 |
| Queue Delay | | 0.0 | 0.0 | 0.0 | 0.0 | | | | | 0.0 | | 0.0 |
| Total Delay | | 20.9 | 0.2 | 9.7 | 10.3 | | | | | 12.9 | | 0.1 |
| LOS | | C | A | A | B | | | | | B | | A |
| Approach Delay | | 11.7 | | | 10.1 | | | | | | | |
| Approach LOS | | B | | | B | | | | | | | |

**Intersection Summary**

Area Type: Other
Cycle Length: 55
Actuated Cycle Length: 55
Offset: 54 (98%), Referenced to phase 4: and 8:SBL, Start of Green
Natural Cycle: 55
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.51
Intersection Signal Delay: 10.3 Intersection LOS: B
Intersection Capacity Utilization 45.0% ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 1: McKenney Ave & N-EW Off Ramp



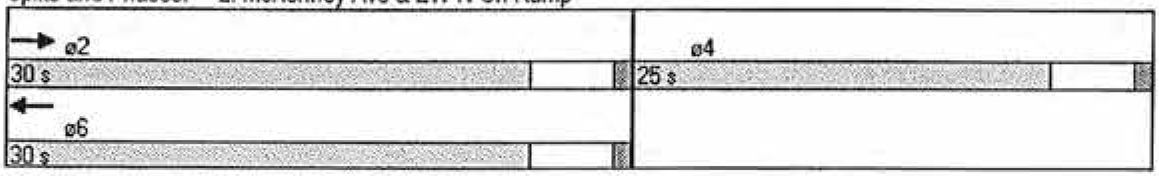
| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | ↰ | ↑↑ | | | ↑↑ | ↱ | ↰↰ | | ↱ | | | |
| Volume (vph) | 100 | 350 | 0 | 0 | 550 | 350 | 500 | 0 | 750 | 0 | 0 | 0 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Storage Length (m) | 70.0 | | 0.0 | 0.0 | | 100.0 | 100.0 | | 100.0 | 0.0 | | 0.0 |
| Storage Lanes | 1 | | 0 | 0 | | 1 | 1 | | 1 | 0 | | 0 |
| Taper Length (m) | 7.5 | | 7.5 | 7.5 | | 7.5 | 7.5 | | 7.5 | 7.5 | | 7.5 |
| Lane Util. Factor | 1.00 | 0.95 | 1.00 | 1.00 | 0.95 | 1.00 | 0.97 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Frt | | | | | | 0.850 | | | 0.850 | | | |
| Flt Protected | 0.950 | | | | | | 0.950 | | | | | |
| Satd. Flow (prot) | 1789 | 3579 | 0 | 0 | 3579 | 1601 | 3471 | 0 | 1601 | 0 | 0 | 0 |
| Flt Permitted | 0.320 | | | | | | 0.950 | | | | | |
| Satd. Flow (perm) | 603 | 3579 | 0 | 0 | 3579 | 1601 | 3471 | 0 | 1601 | 0 | 0 | 0 |
| Right Turn on Red | | | Yes | | | Yes | | | Yes | | | Yes |
| Satd. Flow (RTOR) | | | | | | 380 | | | 699 | | | |
| Link Speed (k/h) | | 50 | | | 50 | | | 50 | | | 50 | |
| Link Distance (m) | | 179.6 | | | 360.2 | | | 201.6 | | | 199.0 | |
| Travel Time (s) | | 12.9 | | | 25.9 | | | 14.5 | | | 14.3 | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 109 | 380 | 0 | 0 | 598 | 380 | 543 | 0 | 815 | 0 | 0 | 0 |
| Shared Lane Traffic (%) | | | | | | | | | | | | |
| Lane Group Flow (vph) | 109 | 380 | 0 | 0 | 598 | 380 | 543 | 0 | 815 | 0 | 0 | 0 |
| Enter Blocked Intersection | No | No | No | No | No | No | No | No | No | No | No | No |
| Lane Alignment | Left | Left | Right | Left | Left | Right | Left | Left | Right | Left | Left | Right |
| Median Width(m) | | 7.4 | | | 7.4 | | | 7.4 | | | 7.4 | |
| Link Offset(m) | | 0.0 | | | 0.0 | | | 0.0 | | | 0.0 | |
| Crosswalk Width(m) | | 4.8 | | | 4.8 | | | 4.8 | | | 4.8 | |
| Two way Left Turn Lane | | | | | | | | | | | | |
| Headway Factor | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 |
| Turning Speed (k/h) | 24 | | 14 | 24 | | 25 | 24 | | 25 | 24 | | 14 |
| Number of Detectors | 2 | 2 | | | 2 | 2 | 2 | | 2 | | | |
| Detector Template | | | | | | | | | | | | |
| Leading Detector (m) | 15.2 | 15.2 | | | 15.2 | 15.2 | 15.2 | | 15.2 | | | |
| Trailing Detector (m) | 0.0 | 0.0 | | | 0.0 | 0.0 | 0.0 | | 0.0 | | | |
| Detector 1 Position(m) | 0.0 | 0.0 | | | 0.0 | 0.0 | 0.0 | | 0.0 | | | |
| Detector 1 Size(m) | 1.8 | 1.8 | | | 1.8 | 1.8 | 1.8 | | 1.8 | | | |
| Detector 1 Type | Cl+Ex | Cl+Ex | | | Cl+Ex | Cl+Ex | Cl+Ex | | Cl+Ex | | | |
| Detector 1 Channel | | | | | | | | | | | | |
| Detector 1 Extend (s) | 0.0 | 0.0 | | | 0.0 | 0.0 | 0.0 | | 0.0 | | | |
| Detector 1 Queue (s) | 0.0 | 0.0 | | | 0.0 | 0.0 | 0.0 | | 0.0 | | | |
| Detector 1 Delay (s) | 0.0 | 0.0 | | | 0.0 | 0.0 | 0.0 | | 0.0 | | | |
| Detector 2 Position(m) | 13.4 | 13.4 | | | 13.4 | 13.4 | 13.4 | | 13.4 | | | |
| Detector 2 Size(m) | 1.8 | 1.8 | | | 1.8 | 1.8 | 1.8 | | 1.8 | | | |
| Detector 2 Type | Cl+Ex | Cl+Ex | | | Cl+Ex | Cl+Ex | Cl+Ex | | Cl+Ex | | | |
| Detector 2 Channel | | | | | | | | | | | | |
| Detector 2 Extend (s) | 0.0 | 0.0 | | | 0.0 | 0.0 | 0.0 | | 0.0 | | | |
| Turn Type | Perm | | | | | Free | custom | | Free | | | |
| Protected Phases | | 2 | | | 6 | | | | | | | |
| Permitted Phases | 2 | | | | | Free | 4 | | Free | | | |
| Detector Phase | 2 | 2 | | | 6 | | 4 | | | | | |

| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Switch Phase | | | | | | | | | | | | |
| Minimum Initial (s) | 4.0 | 4.0 | | | 4.0 | | 4.0 | | | | | |
| Minimum Split (s) | 21.0 | 21.0 | | | 21.0 | | 21.0 | | | | | |
| Total Split (s) | 30.0 | 30.0 | 0.0 | 0.0 | 30.0 | 0.0 | 25.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Split (%) | 54.5% | 54.5% | 0.0% | 0.0% | 54.5% | 0.0% | 45.5% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Maximum Green (s) | 25.0 | 25.0 | | | 25.0 | | 20.0 | | | | | |
| Yellow Time (s) | 4.0 | 4.0 | | | 4.0 | | 4.0 | | | | | |
| All-Red Time (s) | 1.0 | 1.0 | | | 1.0 | | 1.0 | | | | | |
| Lost Time Adjust (s) | -1.0 | -1.0 | 0.0 | 0.0 | -1.0 | 0.0 | -1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Lost Time (s) | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| Lead/Lag | | | | | | | | | | | | |
| Lead-Lag Optimize? | | | | | | | | | | | | |
| Vehicle Extension (s) | 3.0 | 3.0 | | | 3.0 | | 3.0 | | | | | |
| Recall Mode | None | None | | | None | | C-Max | | | | | |
| Walk Time (s) | 5.0 | 5.0 | | | 5.0 | | 5.0 | | | | | |
| Flash Dont Walk (s) | 11.0 | 11.0 | | | 11.0 | | 11.0 | | | | | |
| Pedestrian Calls (#/hr) | 0 | 0 | | | 0 | | 0 | | | | | |
| Act Effct Green (s) | 16.6 | 16.6 | | | 16.6 | 55.0 | 30.4 | | 55.0 | | | |
| Actuated g/C Ratio | 0.30 | 0.30 | | | 0.30 | 1.00 | 0.55 | | 1.00 | | | |
| v/c Ratio | 0.60 | 0.35 | | | 0.55 | 0.24 | 0.28 | | 0.51 | | | |
| Control Delay | 25.2 | 8.8 | | | 17.5 | 0.3 | 7.9 | | 1.2 | | | |
| Queue Delay | 0.0 | 0.0 | | | 0.0 | 0.0 | 0.0 | | 0.0 | | | |
| Total Delay | 25.2 | 8.8 | | | 17.5 | 0.3 | 7.9 | | 1.2 | | | |
| LOS | C | A | | | B | A | A | | A | | | |
| Approach Delay | | 12.5 | | | 10.9 | | | | | | | |
| Approach LOS | | B | | | B | | | | | | | |
| Queue Length 50th (m) | 2.9 | 11.9 | | | 26.6 | 0.0 | 12.3 | | 0.0 | | | |
| Queue Length 95th (m) | 18.4 | 17.9 | | | 31.1 | 0.0 | 26.9 | | 0.0 | | | |
| Internal Link Dist (m) | | 155.6 | | | 336.2 | | | 177.6 | | | 175.0 | |
| Turn Bay Length (m) | 70.0 | | | | | 100.0 | 100.0 | | 100.0 | | | |
| Base Capacity (vph) | 285 | 1692 | | | 1692 | 1601 | 1921 | | 1601 | | | |
| Starvation Cap Reductn | 0 | 0 | | | 0 | 0 | 0 | | 0 | | | |
| Spillback Cap Reductn | 0 | 0 | | | 0 | 0 | 0 | | 0 | | | |
| Storage Cap Reductn | 0 | 0 | | | 0 | 0 | 0 | | 0 | | | |
| Reduced v/c Ratio | 0.38 | 0.22 | | | 0.35 | 0.24 | 0.28 | | 0.51 | | | |

**Intersection Summary**

Area Type: Other
Cycle Length: 55
Actuated Cycle Length: 55
Offset: 0 (0%), Referenced to phase 4:NBL and 8:, Start of Green, Master Intersection
Natural Cycle: 45
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.60
Intersection Signal Delay: 7.8 Intersection LOS: A
Intersection Capacity Utilization 45.0% ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 2: McKenney Ave & EW-N On Ramp



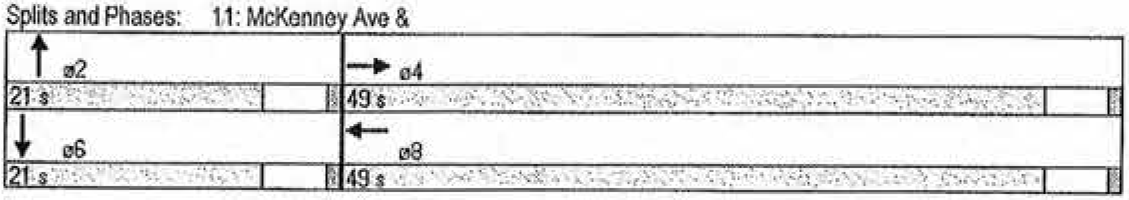
| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | ↰↑↱ | | | ↰↑↱ | | | ↰↑ | ↱ | ↰ | ↑↱ | |
| Volume (vph) | 168 | 855 | 77 | 86 | 780 | 187 | 38 | 23 | 43 | 92 | 18 | 82 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Storage Length (m) | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | | 60.0 | 60.0 | | 0.0 |
| Storage Lanes | 0 | | 0 | 0 | | 0 | 0 | | 1 | 1 | | 0 |
| Taper Length (m) | 7.5 | | 7.5 | 7.5 | | 7.5 | 7.5 | | 7.5 | 7.5 | | 7.5 |
| Lane Util. Factor | 0.95 | 0.95 | 0.95 | 0.95 | 0.95 | 0.95 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Frt | | 0.989 | | | 0.973 | | | | 0.850 | | 0.878 | |
| Flt Protected | | 0.992 | | | 0.996 | | | 0.970 | | 0.950 | | |
| Satd. Flow (prot) | 0 | 3511 | 0 | 0 | 3468 | 0 | 0 | 1827 | 1601 | 1789 | 1654 | 0 |
| Flt Permitted | | 0.572 | | | 0.721 | | | 0.788 | | 0.714 | | |
| Satd. Flow (perm) | 0 | 2024 | 0 | 0 | 2510 | 0 | 0 | 1484 | 1601 | 1345 | 1654 | 0 |
| Right Turn on Red | | | Yes | | | Yes | | | Yes | | | Yes |
| Satd. Flow (RTOR) | | 21 | | | 70 | | | | 47 | | 89 | |
| Link Speed (k/h) | | 50 | | | 50 | | | 50 | | | 50 | |
| Link Distance (m) | | 360.2 | | | 130.6 | | | 127.4 | | | 151.0 | |
| Travel Time (s) | | 25.9 | | | 9.4 | | | 9.2 | | | 10.9 | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 183 | 929 | 84 | 93 | 848 | 203 | 41 | 25 | 47 | 100 | 20 | 89 |
| Shared Lane Traffic (%) | | | | | | | | | | | | |
| Lane Group Flow (vph) | 0 | 1196 | 0 | 0 | 1144 | 0 | 0 | 66 | 47 | 100 | 109 | 0 |
| Enter Blocked Intersection | No | No | No | No | No | No | No | No | No | No | No | No |
| Lane Alignment | Left | Left | Right | Left | Left | Right | Left | Left | Right | Left | Left | Right |
| Median Width(m) | | 0.0 | | | 0.0 | | | 3.7 | | | 3.7 | |
| Link Offset(m) | | 0.0 | | | 0.0 | | | 0.0 | | | 0.0 | |
| Crosswalk Width(m) | | 4.8 | | | 4.8 | | | 4.8 | | | 4.8 | |
| Two way Left Turn Lane | | | | | | | | | | | | |
| Headway Factor | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 |
| Turning Speed (k/h) | 24 | | 14 | 24 | | 14 | 24 | | 14 | 24 | | 14 |
| Turn Type | Perm | | | Perm | | | Perm | | Perm | Perm | | |
| Protected Phases | | 4 | | | 8 | | | 2 | | | 6 | |
| Permitted Phases | 4 | | | 8 | | | 2 | | 2 | 6 | | |
| Minimum Split (s) | 21.0 | 21.0 | | 21.0 | 21.0 | | 21.0 | 21.0 | 21.0 | 21.0 | 21.0 | |
| Total Split (s) | 49.0 | 49.0 | 0.0 | 49.0 | 49.0 | 0.0 | 21.0 | 21.0 | 21.0 | 21.0 | 21.0 | 0.0 |
| Total Split (%) | 70.0% | 70.0% | 0.0% | 70.0% | 70.0% | 0.0% | 30.0% | 30.0% | 30.0% | 30.0% | 30.0% | 0.0% |
| Maximum Green (s) | 44.0 | 44.0 | | 44.0 | 44.0 | | 16.0 | 16.0 | 16.0 | 16.0 | 16.0 | |
| Yellow Time (s) | 4.0 | 4.0 | | 4.0 | 4.0 | | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | |
| All-Red Time (s) | 1.0 | 1.0 | | 1.0 | 1.0 | | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | |
| Lost Time Adjust (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Lost Time (s) | 5.0 | 5.0 | 4.0 | 5.0 | 5.0 | 4.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 4.0 |
| Lead/Lag | | | | | | | | | | | | |
| Lead-Lag Optimize? | | | | | | | | | | | | |
| Walk Time (s) | 5.0 | 5.0 | | 5.0 | 5.0 | | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | |
| Flash Dont Walk (s) | 11.0 | 11.0 | | 11.0 | 11.0 | | 11.0 | 11.0 | 11.0 | 11.0 | 11.0 | |
| Pedestrian Calls (#/hr) | 0 | 0 | | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | |
| Act Effct Green (s) | | 44.0 | | | 44.0 | | | 16.0 | 16.0 | 16.0 | 16.0 | |
| Actuated g/C Ratio | | 0.63 | | | 0.63 | | | 0.23 | 0.23 | 0.23 | 0.23 | |
| v/c Ratio | | 0.93 | | | 0.71 | | | 0.19 | 0.12 | 0.33 | 0.24 | |
| Control Delay | | 27.2 | | | 11.3 | | | 23.7 | 8.2 | 26.1 | 9.2 | |

| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Queue Delay | | 0.0 | | | 0.0 | | | 0.0 | 0.0 | 0.0 | 0.0 | |
| Total Delay | | 27.2 | | | 11.3 | | | 23.7 | 8.2 | 26.1 | 9.2 | |
| LOS | | C | | | B | | | C | A | C | A | |
| Approach Delay | | 27.2 | | | 11.3 | | | 17.2 | | | 17.3 | |
| Approach LOS | | C | | | B | | | B | | | B | |

**Intersection Summary**

Area Type: Other
Cycle Length: 70
Actuated Cycle Length: 70
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 70
Control Type: Pretimed
Maximum v/c Ratio: 0.93
Intersection Signal Delay: 19.2 Intersection LOS: B
Intersection Capacity Utilization 85.3% ICU Level of Service E
Analysis Period (min) 15

Splits and Phases: 11: McKenney Ave &



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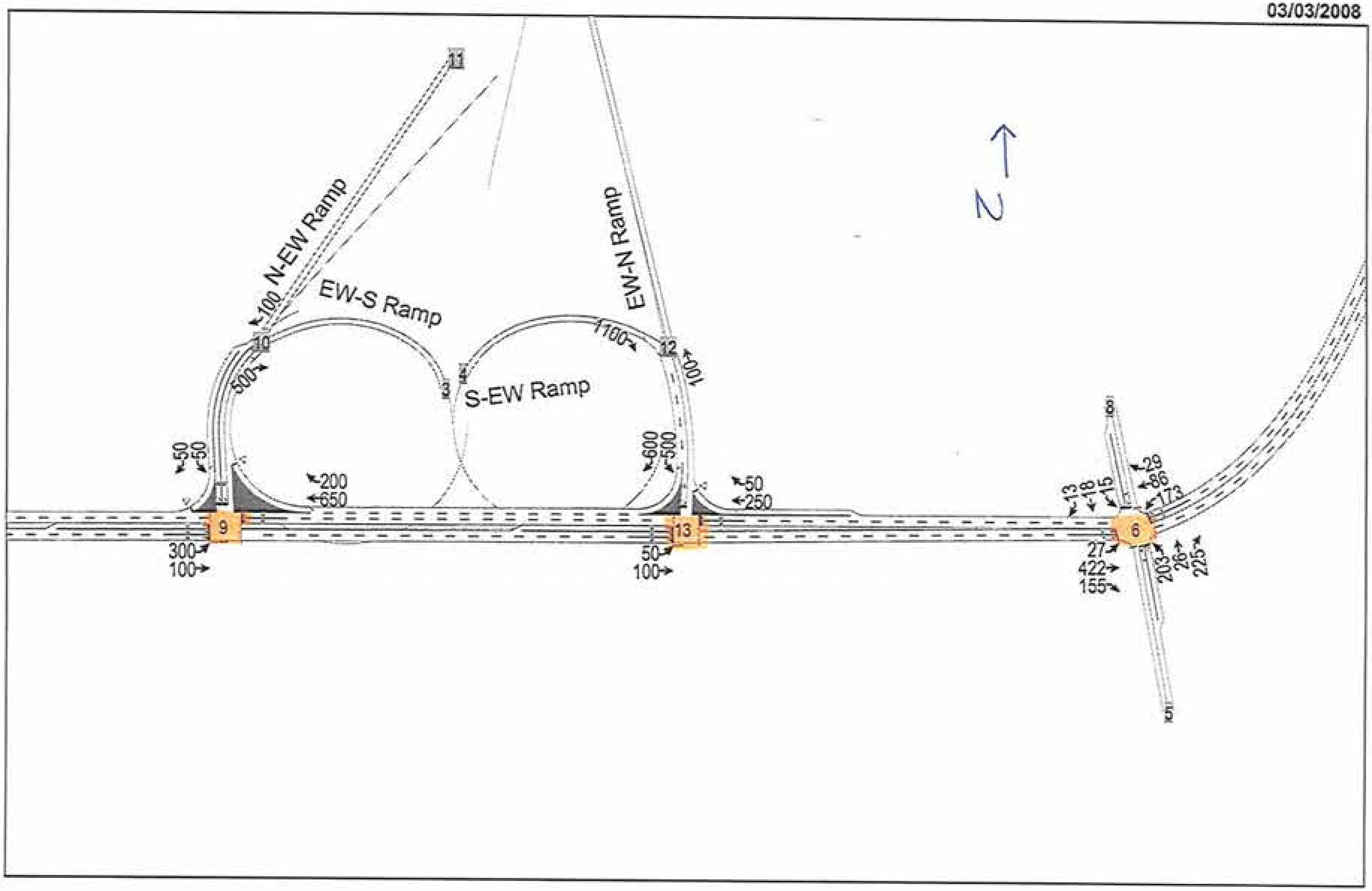


Node #9

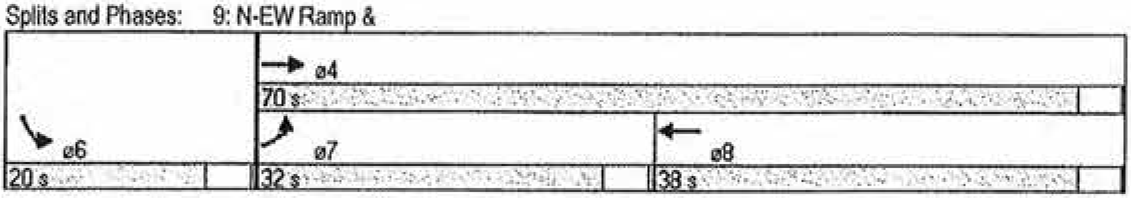
| Lane Group | EBL | EBT | WBT | WBR | SBL | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations | ↰ | ↑↑ | ↑↑ | ↱ | ↰↰ | ↱ |
| Volume (vph) | 570 | 96 | 333 | 475 | 48 | 48 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Storage Length (m) | 100.0 | | | 0.0 | 100.0 | 100.0 |
| Storage Lanes | 1 | | | 1 | 1 | 1 |
| Taper Length (m) | 7.5 | | | 7.5 | 7.5 | 7.5 |
| Lane Util. Factor | 1.00 | 0.95 | 0.95 | 1.00 | 0.97 | 1.00 |
| Frt | | | | 0.850 | | 0.850 |
| Flt Protected | 0.950 | | | | 0.950 | |
| Satd. Flow (prot) | 1789 | 3579 | 3579 | 1601 | 3471 | 1601 |
| Flt Permitted | 0.471 | | | | 0.950 | |
| Satd. Flow (perm) | 887 | 3579 | 3579 | 1601 | 3471 | 1601 |
| Right Turn on Red | | | | Yes | | Yes |
| Satd. Flow (RTOR) | | | | 516 | | 52 |
| Link Speed (k/h) | | 50 | 50 | | 40 | |
| Link Distance (m) | | 204.6 | 302.7 | | 129.5 | |
| Travel Time (s) | | 14.7 | 21.8 | | 11.7 | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 620 | 104 | 362 | 516 | 52 | 52 |
| Shared Lane Traffic (%) | | | | | | |
| Lane Group Flow (vph) | 620 | 104 | 362 | 516 | 52 | 52 |
| Enter Blocked Intersection | No | No | No | No | No | No |
| Lane Alignment | Left | Left | Left | Right | Left | Right |
| Median Width(m) | | 3.7 | 3.7 | | 7.4 | |
| Link Offset(m) | | 0.0 | 0.0 | | 0.0 | |
| Crosswalk Width(m) | | 4.8 | 4.8 | | 4.8 | |
| Two way Left Turn Lane | | | | | | |
| Headway Factor | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 |
| Turning Speed (k/h) | 24 | | | 40 | 24 | 14 |
| Number of Detectors | 2 | 2 | 2 | 2 | 2 | 2 |
| Detector Template | | | | | | |
| Leading Detector (m) | 15.2 | 15.2 | 15.2 | 15.2 | 15.2 | 15.2 |
| Trailing Detector (m) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Position(m) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Size(m) | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 |
| Detector 1 Type | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex |
| Detector 1 Channel | | | | | | |
| Detector 1 Extend (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Queue (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Delay (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 2 Position(m) | 13.4 | 13.4 | 13.4 | 13.4 | 13.4 | 13.4 |
| Detector 2 Size(m) | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 |
| Detector 2 Type | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex |
| Detector 2 Channel | | | | | | |
| Detector 2 Extend (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Turn Type | pm+pt | | | Perm | | Free |
| Protected Phases | 7 | 4 | 8 | | 6 | |
| Permitted Phases | 4 | | | 8 | | Free |
| Detector Phase | 7 | 4 | 8 | 8 | 6 | |

| Lane Group | EBL | EBT | WBT | WBR | SBL | SBR |
|---|---|---|---|---|---|---|
| Switch Phase | | | | | | |
| Minimum Initial (s) | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | |
| Minimum Split (s) | 8.0 | 20.0 | 20.0 | 20.0 | 20.0 | |
| Total Split (s) | 32.0 | 70.0 | 38.0 | 38.0 | 20.0 | 0.0 |
| Total Split (%) | 35.6% | 77.8% | 42.2% | 42.2% | 22.2% | 0.0% |
| Maximum Green (s) | 28.0 | 66.0 | 34.0 | 34.0 | 16.0 | |
| Yellow Time (s) | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | |
| All-Red Time (s) | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | |
| Lost Time Adjust (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Lost Time (s) | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| Lead/Lag | Lead | | Lag | Lag | | |
| Lead-Lag Optimize? | Yes | | Yes | Yes | | |
| Vehicle Extension (s) | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | |
| Recall Mode | None | C-Max | C-Max | C-Max | Max | |
| Walk Time (s) | | 5.0 | 5.0 | 5.0 | 5.0 | |
| Flash Dont Walk (s) | | 11.0 | 11.0 | 11.0 | 11.0 | |
| Pedestrian Calls (#/hr) | | 0 | 0 | 0 | 0 | |
| Act Effct Green (s) | 66.0 | 66.0 | 42.7 | 42.7 | 16.0 | 90.0 |
| Actuated g/C Ratio | 0.73 | 0.73 | 0.47 | 0.47 | 0.18 | 1.00 |
| v/c Ratio | 0.73 | 0.04 | 0.21 | 0.50 | 0.08 | 0.03 |
| Control Delay | 10.7 | 3.4 | 16.5 | 9.0 | 31.4 | 0.0 |
| Queue Delay | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Delay | 10.7 | 3.4 | 16.5 | 9.0 | 31.4 | 0.0 |
| LOS | B | A | B | A | C | A |
| Approach Delay | | 9.7 | 12.1 | | 15.7 | |
| Approach LOS | | A | B | | B | |

**Intersection Summary**

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 90
Offset: 48 (53%), Referenced to phase 4:EBTL and 8:WBT, Start of Green
Natural Cycle: 60
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.73
Intersection Signal Delay: 11.3 Intersection LOS: B
Intersection Capacity Utilization 67.7% ICU Level of Service C
Analysis Period (min) 15

Splits and Phases: 9: N-EW Ramp &



Node #13

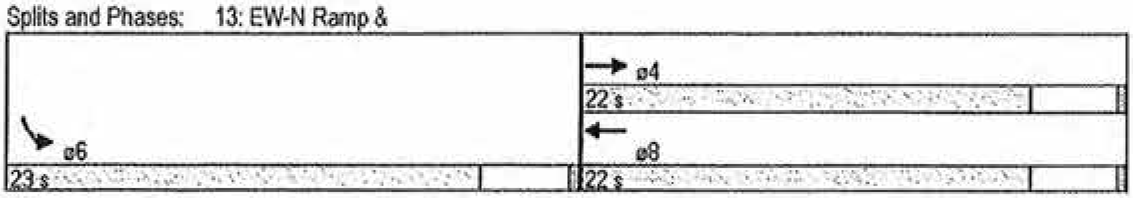
| Lane Group | EBL | EBT | WBT | WBR | SBL | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations | ↰ | ↑↑ | ↑↑ | ↱ | ↰ | ↱ |
| Volume (vph) | 48 | 96 | 523 | 48 | 190 | 285 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Storage Length (m) | 100.0 | | | 100.0 | 0.0 | 0.0 |
| Storage Lanes | 1 | | | 1 | 1 | 1 |
| Taper Length (m) | 7.5 | | | 7.5 | 7.5 | 7.5 |
| Lane Util. Factor | 1.00 | 0.95 | 0.95 | 1.00 | 1.00 | 1.00 |
| Frt | | | | 0.850 | | 0.850 |
| Flt Protected | 0.950 | | | | 0.950 | |
| Satd. Flow (prot) | 1789 | 3579 | 3579 | 1601 | 1789 | 1601 |
| Flt Permitted | 0.405 | | | | 0.950 | |
| Satd. Flow (perm) | 763 | 3579 | 3579 | 1601 | 1789 | 1601 |
| Right Turn on Red | | | | Yes | | Yes |
| Satd. Flow (RTOR) | | | | 52 | | 169 |
| Link Speed (k/h) | | 50 | 50 | | 40 | |
| Link Distance (m) | | 302.7 | 299.5 | | 122.1 | |
| Travel Time (s) | | 21.8 | 21.6 | | 11.0 | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 52 | 104 | 568 | 52 | 207 | 310 |
| Shared Lane Traffic (%) | | | | | | |
| Lane Group Flow (vph) | 52 | 104 | 568 | 52 | 207 | 310 |
| Enter Blocked Intersection | No | No | No | No | No | No |
| Lane Alignment | Left | Left | Left | Right | Left | Right |
| Median Width(m) | | 3.7 | 3.7 | | 3.7 | |
| Link Offset(m) | | 0.0 | 0.0 | | 0.0 | |
| Crosswalk Width(m) | | 4.8 | 4.8 | | 4.8 | |
| Two way Left Turn Lane | | | | | | |
| Headway Factor | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 |
| Turning Speed (k/h) | 24 | | | 14 | 24 | 40 |
| Number of Detectors | 2 | 2 | 2 | 2 | 2 | 2 |
| Detector Template | | | | | | |
| Leading Detector (m) | 15.2 | 15.2 | 15.2 | 15.2 | 15.2 | 15.2 |
| Trailing Detector (m) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Position(m) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Size(m) | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 |
| Detector 1 Type | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex |
| Detector 1 Channel | | | | | | |
| Detector 1 Extend (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Queue (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Delay (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 2 Position(m) | 13.4 | 13.4 | 13.4 | 13.4 | 13.4 | 13.4 |
| Detector 2 Size(m) | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 |
| Detector 2 Type | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex |
| Detector 2 Channel | | | | | | |
| Detector 2 Extend (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Turn Type | Perm | | | Perm | | Perm |
| Protected Phases | | 4 | 8 | | 6 | |
| Permitted Phases | 4 | | | 8 | | 6 |
| Detector Phase | 4 | 4 | 8 | 8 | 6 | 6 |

| Lane Group | EBL | EBT | WBT | WBR | SBL | SBR |
|---|---|---|---|---|---|---|
| Switch Phase | | | | | | |
| Minimum Initial (s) | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| Minimum Split (s) | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 |
| Total Split (s) | 22.0 | 22.0 | 22.0 | 22.0 | 23.0 | 23.0 |
| Total Split (%) | 48.9% | 48.9% | 48.9% | 48.9% | 51.1% | 51.1% |
| Maximum Green (s) | 18.0 | 18.0 | 18.0 | 18.0 | 19.0 | 19.0 |
| Yellow Time (s) | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 |
| All-Red Time (s) | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| Lost Time Adjust (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Lost Time (s) | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| Lead/Lag | | | | | | |
| Lead-Lag Optimize? | | | | | | |
| Vehicle Extension (s) | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |
| Recall Mode | C-Max | C-Max | C-Max | C-Max | Max | Max |
| Walk Time (s) | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 |
| Flash Dont Walk (s) | 11.0 | 11.0 | 11.0 | 11.0 | 11.0 | 11.0 |
| Pedestrian Calls (#/hr) | 0 | 0 | 0 | 0 | 0 | 0 |
| Act Effct Green (s) | 18.0 | 18.0 | 18.0 | 18.0 | 19.0 | 19.0 |
| Actuated g/C Ratio | 0.40 | 0.40 | 0.40 | 0.40 | 0.42 | 0.42 |
| v/c Ratio | 0.17 | 0.07 | 0.40 | 0.08 | 0.27 | 0.40 |
| Control Delay | 8.4 | 14.4 | 10.7 | 3.6 | 9.8 | 6.1 |
| Queue Delay | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Delay | 8.4 | 14.4 | 10.7 | 3.6 | 9.8 | 6.1 |
| LOS | A | B | B | A | A | A |
| Approach Delay | | 12.4 | 10.1 | | 7.5 | |
| Approach LOS | | B | B | | A | |

**Intersection Summary**

Area Type: Other
Cycle Length: 45
Actuated Cycle Length: 45
Offset: 0 (0%), Referenced to phase 4:EBTL and 8:WBT, Start of Green, Master Intersection
Natural Cycle: 40
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.40
Intersection Signal Delay: 9.3 Intersection LOS: A
Intersection Capacity Utilization 38.8% ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 13: EW-N Ramp &



Node #6

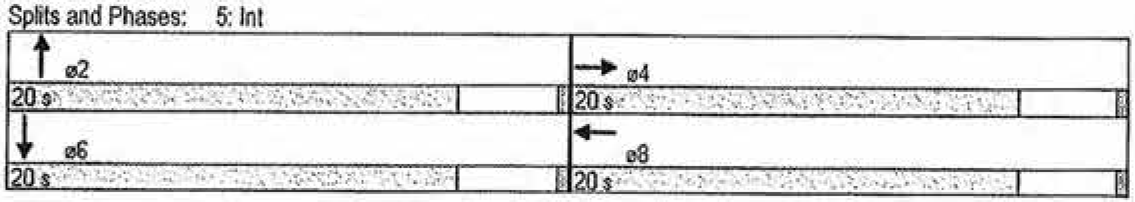
| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | ↰↑↑↱ | | | ↰↑↑↱ | | | ↰↑ | ↱ | | ↰↑ | ↱ |
| Volume (vph) | 6 | 98 | 182 | 202 | 388 | 6 | 154 | 18 | 171 | 23 | 23 | 29 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Storage Length (m) | 0.0 | | 50.0 | 50.0 | | 0.0 | 0.0 | | 50.0 | 0.0 | | 50.0 |
| Storage Lanes | 0 | | 0 | 0 | | 0 | 0 | | 1 | 0 | | 1 |
| Taper Length (m) | 7.5 | | 7.5 | 7.5 | | 7.5 | 7.5 | | 7.5 | 7.5 | | 7.5 |
| Lane Util. Factor | 0.95 | 0.95 | 0.95 | 0.95 | 0.95 | 0.95 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Frt | | 0.905 | | | 0.998 | | | | 0.850 | | | 0.850 |
| Flt Protected | | 0.999 | | | 0.983 | | | 0.957 | | | 0.976 | |
| Satd. Flow (prot) | 0 | 3235 | 0 | 0 | 3511 | 0 | 0 | 1802 | 1601 | 0 | 1838 | 1601 |
| Flt Permitted | | 0.940 | | | 0.748 | | | 0.729 | | | 0.862 | |
| Satd. Flow (perm) | 0 | 3044 | 0 | 0 | 2671 | 0 | 0 | 1373 | 1601 | 0 | 1624 | 1601 |
| Right Turn on Red | | | Yes | | | Yes | | | Yes | | | Yes |
| Satd. Flow (RTOR) | | 198 | | | 3 | | | | 186 | | | 32 |
| Link Speed (k/h) | | 50 | | | 50 | | | 50 | | | 50 | |
| Link Distance (m) | | 299.5 | | | 355.8 | | | 123.6 | | | 83.3 | |
| Travel Time (s) | | 21.6 | | | 25.6 | | | 8.9 | | | 6.0 | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 7 | 107 | 198 | 220 | 422 | 7 | 167 | 20 | 186 | 25 | 25 | 32 |
| Shared Lane Traffic (%) | | | | | | | | | | | | |
| Lane Group Flow (vph) | 0 | 312 | 0 | 0 | 649 | 0 | 0 | 187 | 186 | 0 | 50 | 32 |
| Enter Blocked Intersection | No | No | No | No | No | No | No | No | No | No | No | No |
| Lane Alignment | Left | Left | Right | Left | Left | Right | Left | Left | Right | Left | Left | Right |
| Median Width(m) | | 0.0 | | | 0.0 | | | 0.0 | | | 0.0 | |
| Link Offset(m) | | 0.0 | | | 0.0 | | | 0.0 | | | 0.0 | |
| Crosswalk Width(m) | | 4.8 | | | 4.8 | | | 4.8 | | | 4.8 | |
| Two way Left Turn Lane | | | | | | | | | | | | |
| Headway Factor | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 |
| Turning Speed (k/h) | 24 | | 14 | 24 | | 14 | 24 | | 14 | 24 | | 14 |
| Number of Detectors | 1 | 2 | | 1 | 2 | | 1 | 2 | 1 | 1 | 2 | 1 |
| Detector Template | Left | Thru | | Left | Thru | | Left | Thru | Right | Left | Thru | Right |
| Leading Detector (m) | 2.0 | 10.0 | | 2.0 | 10.0 | | 2.0 | 10.0 | 2.0 | 2.0 | 10.0 | 2.0 |
| Trailing Detector (m) | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Position(m) | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Size(m) | 2.0 | 0.6 | | 2.0 | 0.6 | | 2.0 | 0.6 | 2.0 | 2.0 | 0.6 | 2.0 |
| Detector 1 Type | Cl+Ex | Cl+Ex | | Cl+Ex | Cl+Ex | | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex |
| Detector 1 Channel | | | | | | | | | | | | |
| Detector 1 Extend (s) | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Queue (s) | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Delay (s) | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 2 Position(m) | | 9.4 | | | 9.4 | | | 9.4 | | | 9.4 | |
| Detector 2 Size(m) | | 0.6 | | | 0.6 | | | 0.6 | | | 0.6 | |
| Detector 2 Type | | Cl+Ex | | | Cl+Ex | | | Cl+Ex | | | Cl+Ex | |
| Detector 2 Channel | | | | | | | | | | | | |
| Detector 2 Extend (s) | | 0.0 | | | 0.0 | | | 0.0 | | | 0.0 | |
| Turn Type | Perm | | | Perm | | | Perm | | Perm | Perm | | Perm |
| Protected Phases | | 4 | | | 8 | | | 2 | | | 6 | |
| Permitted Phases | 4 | | | 8 | | | 2 | | 2 | 6 | | 6 |
| Detector Phase | 4 | 4 | | 8 | 8 | | 2 | 2 | 2 | 6 | 6 | 6 |

| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Switch Phase | | | | | | | | | | | | |
| Minimum Initial (s) | 4.0 | 4.0 | | 4.0 | 4.0 | | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| Minimum Split (s) | 20.0 | 20.0 | | 20.0 | 20.0 | | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 |
| Total Split (s) | 20.0 | 20.0 | 0.0 | 20.0 | 20.0 | 0.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 |
| Total Split (%) | 50.0% | 50.0% | 0.0% | 50.0% | 50.0% | 0.0% | 50.0% | 50.0% | 50.0% | 50.0% | 50.0% | 50.0% |
| Maximum Green (s) | 16.0 | 16.0 | | 16.0 | 16.0 | | 16.0 | 16.0 | 16.0 | 16.0 | 16.0 | 16.0 |
| Yellow Time (s) | 3.5 | 3.5 | | 3.5 | 3.5 | | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 |
| All-Red Time (s) | 0.5 | 0.5 | | 0.5 | 0.5 | | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| Lost Time Adjust (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Lost Time (s) | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| Lead/Lag | | | | | | | | | | | | |
| Lead-Lag Optimize? | | | | | | | | | | | | |
| Vehicle Extension (s) | 3.0 | 3.0 | | 3.0 | 3.0 | | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |
| Recall Mode | None | None | | None | None | | C-Min | C-Min | C-Min | Min | Min | Min |
| Walk Time (s) | 5.0 | 5.0 | | 5.0 | 5.0 | | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 |
| Flash Dont Walk (s) | 11.0 | 11.0 | | 11.0 | 11.0 | | 11.0 | 11.0 | 11.0 | 11.0 | 11.0 | 11.0 |
| Pedestrian Calls (#/hr) | 0 | 0 | | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 |
| Act Effct Green (s) | | 14.3 | | | 14.3 | | | 17.7 | 17.7 | | 17.7 | 17.7 |
| Actuated g/C Ratio | | 0.36 | | | 0.36 | | | 0.44 | 0.44 | | 0.44 | 0.44 |
| v/c Ratio | | 0.26 | | | 0.68 | | | 0.31 | 0.23 | | 0.07 | 0.04 |
| Control Delay | | 3.9 | | | 14.5 | | | 10.0 | 2.7 | | 7.9 | 3.9 |
| Queue Delay | | 0.0 | | | 0.0 | | | 0.0 | 0.0 | | 0.0 | 0.0 |
| Total Delay | | 3.9 | | | 14.5 | | | 10.0 | 2.7 | | 7.9 | 3.9 |
| LOS | | A | | | B | | | B | A | | A | A |
| Approach Delay | | 3.9 | | | 14.5 | | | 6.4 | | | 6.3 | |
| Approach LOS | | A | | | B | | | A | | | A | |

**Intersection Summary**

Area Type: Other
Cycle Length: 40
Actuated Cycle Length: 40
Offset: 0 (0%), Referenced to phase 2:NBTL, Start of Green
Natural Cycle: 40
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.68
Intersection Signal Delay: 9.5 Intersection LOS: A
Intersection Capacity Utilization 51.7% ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 5: Int



Node #9

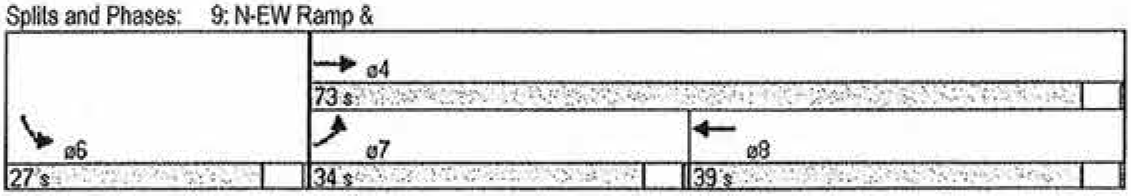
| Lane Group | EBL | EBT | WBT | WBR | SBL | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations | ↰ | ↑↑ | ↑↑ | ↱ | ↰↰ | ↱ |
| Volume (vph) | 300 | 100 | 650 | 200 | 50 | 50 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Storage Length (m) | 100.0 | | | 0.0 | 100.0 | 100.0 |
| Storage Lanes | 1 | | | 1 | 1 | 1 |
| Taper Length (m) | 7.5 | | | 7.5 | 7.5 | 7.5 |
| Lane Util. Factor | 1.00 | 0.95 | 0.95 | 1.00 | 0.97 | 1.00 |
| Frt | | | | 0.850 | | 0.850 |
| Flt Protected | 0.950 | | | | 0.950 | |
| Satd. Flow (prot) | 1789 | 3579 | 3579 | 1601 | 3471 | 1601 |
| Flt Permitted | 0.297 | | | | 0.950 | |
| Satd. Flow (perm) | 559 | 3579 | 3579 | 1601 | 3471 | 1601 |
| Right Turn on Red | | | | Yes | | Yes |
| Satd. Flow (RTOR) | | | | 217 | | 54 |
| Link Speed (k/h) | | 50 | 50 | | 40 | |
| Link Distance (m) | | 204.6 | 302.7 | | 129.5 | |
| Travel Time (s) | | 14.7 | 21.8 | | 11.7 | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 326 | 109 | 707 | 217 | 54 | 54 |
| Shared Lane Traffic (%) | | | | | | |
| Lane Group Flow (vph) | 326 | 109 | 707 | 217 | 54 | 54 |
| Enter Blocked Intersection | No | No | No | No | No | No |
| Lane Alignment | Left | Left | Left | Right | Left | Right |
| Median Width(m) | | 3.7 | 3.7 | | 7.4 | |
| Link Offset(m) | | 0.0 | 0.0 | | 0.0 | |
| Crosswalk Width(m) | | 4.8 | 4.8 | | 4.8 | |
| Two way Left Turn Lane | | | | | | |
| Headway Factor | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 |
| Turning Speed (k/h) | 24 | | | 40 | 24 | 14 |
| Number of Detectors | 2 | 2 | 2 | 2 | 2 | 2 |
| Detector Template | | | | | | |
| Leading Detector (m) | 15.2 | 15.2 | 15.2 | 15.2 | 15.2 | 15.2 |
| Trailing Detector (m) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Position(m) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Size(m) | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 |
| Detector 1 Type | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex |
| Detector 1 Channel | | | | | | |
| Detector 1 Extend (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Queue (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Delay (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 2 Position(m) | 13.4 | 13.4 | 13.4 | 13.4 | 13.4 | 13.4 |
| Detector 2 Size(m) | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 |
| Detector 2 Type | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex |
| Detector 2 Channel | | | | | | |
| Detector 2 Extend (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Turn Type | pm+pt | | | Perm | | Perm |
| Protected Phases | 7 | 4 | 8 | | 6 | |
| Permitted Phases | 4 | | | 8 | | 6 |
| Detector Phase | 7 | 4 | 8 | 8 | 6 | 6 |

| Lane Group | EBL | EBT | WBT | WBR | SBL | SBR |
|---|---|---|---|---|---|---|
| Switch Phase | | | | | | |
| Minimum Initial (s) | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| Minimum Split (s) | 8.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 |
| Total Split (s) | 34.0 | 73.0 | 39.0 | 39.0 | 27.0 | 27.0 |
| Total Split (%) | 34.0% | 73.0% | 39.0% | 39.0% | 27.0% | 27.0% |
| Maximum Green (s) | 30.0 | 69.0 | 35.0 | 35.0 | 23.0 | 23.0 |
| Yellow Time (s) | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 |
| All-Red Time (s) | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| Lost Time Adjust (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Lost Time (s) | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| Lead/Lag | Lead | | Lag | Lag | | |
| Lead-Lag Optimize? | Yes | | Yes | Yes | | |
| Vehicle Extension (s) | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |
| Recall Mode | None | C-Max | C-Max | C-Max | Max | Max |
| Walk Time (s) | | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 |
| Flash Dont Walk (s) | | 11.0 | 11.0 | 11.0 | 11.0 | 11.0 |
| Pedestrian Calls (#/hr) | | 0 | 0 | 0 | 0 | 0 |
| Act Effct Green (s) | 69.0 | 69.0 | 52.0 | 52.0 | 23.0 | 23.0 |
| Actuated g/C Ratio | 0.69 | 0.69 | 0.52 | 0.52 | 0.23 | 0.23 |
| v/c Ratio | 0.60 | 0.04 | 0.38 | 0.23 | 0.07 | 0.13 |
| Control Delay | 10.8 | 5.0 | 14.7 | 4.2 | 30.5 | 9.6 |
| Queue Delay | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Delay | 10.8 | 5.0 | 14.7 | 4.2 | 30.5 | 9.6 |
| LOS | B | A | B | A | C | A |
| Approach Delay | | 9.3 | 12.2 | | 20.1 | |
| Approach LOS | | A | B | | C | |

**Intersection Summary**

Area Type: Other
Cycle Length: 100
Actuated Cycle Length: 100
Offset: 92 (92%), Referenced to phase 4:EBTL and 8:WBT, Start of Green
Natural Cycle: 55
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.60
Intersection Signal Delay: 11.9 Intersection LOS: B
Intersection Capacity Utilization 47.9% ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 9: N-EW Ramp &



Node 13

| Lane Group | EBL | EBT | WBT | WBR | SBL | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations | ↰ | ↑↑ | ↑↑ | ↱ | ↰ | ↱ |
| Volume (vph) | 50 | 100 | 250 | 50 | 500 | 600 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Storage Length (m) | 100.0 | | | 100.0 | 0.0 | 0.0 |
| Storage Lanes | 1 | | | 1 | 1 | 1 |
| Taper Length (m) | 7.5 | | | 7.5 | 7.5 | 7.5 |
| Lane Util. Factor | 1.00 | 0.95 | 0.95 | 1.00 | 1.00 | 1.00 |
| Frt | | | | 0.850 | | 0.850 |
| Flt Protected | 0.950 | | | | 0.950 | |
| Satd. Flow (prot) | 1789 | 3579 | 3579 | 1601 | 1789 | 1601 |
| Flt Permitted | 0.584 | | | | 0.950 | |
| Satd. Flow (perm) | 1100 | 3579 | 3579 | 1601 | 1789 | 1601 |
| Right Turn on Red | | | | Yes | | Yes |
| Satd. Flow (RTOR) | | | | 54 | | 363 |
| Link Speed (k/h) | | 50 | 50 | | 40 | |
| Link Distance (m) | | 302.7 | 299.5 | | 122.1 | |
| Travel Time (s) | | 21.8 | 21.6 | | 11.0 | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 54 | 109 | 272 | 54 | 543 | 652 |
| Shared Lane Traffic (%) | | | | | | |
| Lane Group Flow (vph) | 54 | 109 | 272 | 54 | 543 | 652 |
| Enter Blocked Intersection | No | No | No | No | No | No |
| Lane Alignment | Left | Left | Left | Right | Left | Right |
| Median Width(m) | | 3.7 | 3.7 | | 3.7 | |
| Link Offset(m) | | 0.0 | 0.0 | | 0.0 | |
| Crosswalk Width(m) | | 4.8 | 4.8 | | 4.8 | |
| Two way Left Turn Lane | | | | | | |
| Headway Factor | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 |
| Turning Speed (k/h) | 24 | | | 40 | 24 | 40 |
| Number of Detectors | 2 | 2 | 2 | 2 | 2 | 2 |
| Detector Template | | | | | | |
| Leading Detector (m) | 15.2 | 15.2 | 15.2 | 15.2 | 15.2 | 15.2 |
| Trailing Detector (m) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Position(m) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Size(m) | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 |
| Detector 1 Type | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex |
| Detector 1 Channel | | | | | | |
| Detector 1 Extend (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Queue (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Delay (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 2 Position(m) | 13.4 | 13.4 | 13.4 | 13.4 | 13.4 | 13.4 |
| Detector 2 Size(m) | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 |
| Detector 2 Type | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex |
| Detector 2 Channel | | | | | | |
| Detector 2 Extend (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Turn Type | Perm | | | Perm | | Perm |
| Protected Phases | | 4 | 8 | | 6 | |
| Permitted Phases | 4 | | | 8 | | 6 |
| Detector Phase | 4 | 4 | 8 | 8 | 6 | 6 |

| Lane Group | EBL | EBT | WBT | WBR | SBL | SBR |
|---|---|---|---|---|---|---|
| Switch Phase | | | | | | |
| Minimum Initial (s) | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| Minimum Split (s) | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 |
| Total Split (s) | 20.0 | 20.0 | 20.0 | 20.0 | 30.0 | 30.0 |
| Total Split (%) | 40.0% | 40.0% | 40.0% | 40.0% | 60.0% | 60.0% |
| Maximum Green (s) | 16.0 | 16.0 | 16.0 | 16.0 | 26.0 | 26.0 |
| Yellow Time (s) | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 |
| All-Red Time (s) | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| Lost Time Adjust (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Lost Time (s) | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| Lead/Lag | | | | | | |
| Lead-Lag Optimize? | | | | | | |
| Vehicle Extension (s) | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |
| Recall Mode | C-Max | C-Max | C-Max | C-Max | Max | Max |
| Walk Time (s) | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 |
| Flash Dont Walk (s) | 11.0 | 11.0 | 11.0 | 11.0 | 11.0 | 11.0 |
| Pedestrian Calls (#/hr) | 0 | 0 | 0 | 0 | 0 | 0 |
| Act Effct Green (s) | 16.0 | 16.0 | 16.0 | 16.0 | 26.0 | 26.0 |
| Actuated g/C Ratio | 0.32 | 0.32 | 0.32 | 0.32 | 0.52 | 0.52 |
| v/c Ratio | 0.15 | 0.10 | 0.24 | 0.10 | 0.58 | 0.65 |
| Control Delay | 16.1 | 9.1 | 13.2 | 5.0 | 11.5 | 7.2 |
| Queue Delay | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Delay | 16.1 | 9.1 | 13.2 | 5.0 | 11.5 | 7.2 |
| LOS | B | A | B | A | B | A |
| Approach Delay | | 11.4 | 11.8 | | 9.1 | |
| Approach LOS | | B | B | | A | |

**Intersection Summary**

Area Type: Other
Cycle Length: 50
Actuated Cycle Length: 50
Offset: 0 (0%), Referenced to phase 4:EBTL and 8:WBT, Start of Green, Master Intersection
Natural Cycle: 45
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.65
Intersection Signal Delay: 9.9 Intersection LOS: A
Intersection Capacity Utilization 50.7% ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 13: EW-N Ramp &

Node #6

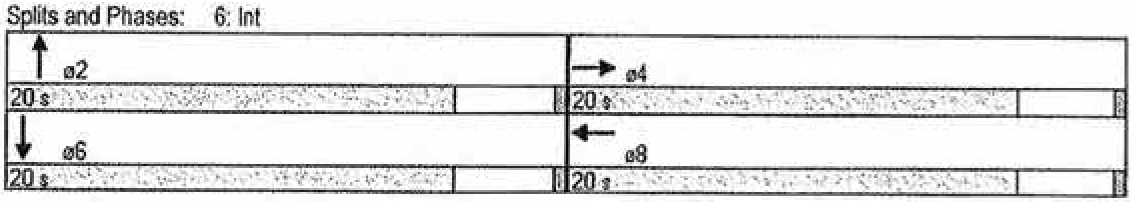
| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | ↰↑↱ | | | ↰↑↱ | | | ↰ | ↱ | | ↰ | ↱ |
| Volume (vph) | 27 | 422 | 155 | 173 | 86 | 29 | 203 | 26 | 225 | 15 | 18 | 13 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Storage Length (m) | 0.0 | | 50.0 | 50.0 | | 0.0 | 0.0 | | 50.0 | 0.0 | | 50.0 |
| Storage Lanes | 0 | | 0 | 0 | | 0 | 0 | | 1 | 0 | | 1 |
| Taper Length (m) | 7.5 | | 7.5 | 7.5 | | 7.5 | 7.5 | | 7.5 | 7.5 | | 7.5 |
| Lane Util. Factor | 0.95 | 0.95 | 0.95 | 0.95 | 0.95 | 0.95 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Frt | | 0.962 | | | 0.985 | | | | 0.850 | | | 0.850 |
| Flt Protected | | 0.998 | | | 0.971 | | | 0.958 | | | 0.978 | |
| Satd. Flow (prot) | 0 | 3436 | 0 | 0 | 3423 | 0 | 0 | 1804 | 1601 | 0 | 1842 | 1601 |
| Flt Permitted | | 0.930 | | | 0.664 | | | 0.729 | | | 0.882 | |
| Satd. Flow (perm) | 0 | 3202 | 0 | 0 | 2341 | 0 | 0 | 1373 | 1601 | 0 | 1661 | 1601 |
| Right Turn on Red | | | Yes | | | Yes | | | Yes | | | Yes |
| Satd. Flow (RTOR) | | 142 | | | 32 | | | | 245 | | | 14 |
| Link Speed (k/h) | | 50 | | | 50 | | | 50 | | | 50 | |
| Link Distance (m) | | 299.5 | | | 355.8 | | | 123.6 | | | 83.3 | |
| Travel Time (s) | | 21.6 | | | 25.6 | | | 8.9 | | | 6.0 | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 29 | 459 | 168 | 188 | 93 | 32 | 221 | 28 | 245 | 16 | 20 | 14 |
| Shared Lane Traffic (%) | | | | | | | | | | | | |
| Lane Group Flow (vph) | 0 | 656 | 0 | 0 | 313 | 0 | 0 | 249 | 245 | 0 | 36 | 14 |
| Enter Blocked Intersection | No | No | No | No | No | No | No | No | No | No | No | No |
| Lane Alignment | Left | Left | Right | Left | Left | Right | Left | Left | Right | Left | Left | Right |
| Median Width(m) | | 0.0 | | | 0.0 | | | 0.0 | | | 0.0 | |
| Link Offset(m) | | 0.0 | | | 0.0 | | | 0.0 | | | 0.0 | |
| Crosswalk Width(m) | | 4.8 | | | 4.8 | | | 4.8 | | | 4.8 | |
| Two way Left Turn Lane | | | | | | | | | | | | |
| Headway Factor | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 |
| Turning Speed (k/h) | 24 | | 14 | 24 | | 14 | 24 | | 14 | 24 | | 14 |
| Number of Detectors | 1 | 2 | | 1 | 2 | | 1 | 2 | 1 | 1 | 2 | 1 |
| Detector Template | Left | Thru | | Left | Thru | | Left | Thru | Right | Left | Thru | Right |
| Leading Detector (m) | 2.0 | 10.0 | | 2.0 | 10.0 | | 2.0 | 10.0 | 2.0 | 2.0 | 10.0 | 2.0 |
| Trailing Detector (m) | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Position(m) | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Size(m) | 2.0 | 0.6 | | 2.0 | 0.6 | | 2.0 | 0.6 | 2.0 | 2.0 | 0.6 | 2.0 |
| Detector 1 Type | Cl+Ex | Cl+Ex | | Cl+Ex | Cl+Ex | | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex |
| Detector 1 Channel | | | | | | | | | | | | |
| Detector 1 Extend (s) | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Queue (s) | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Delay (s) | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 2 Position(m) | | 9.4 | | | 9.4 | | | 9.4 | | | 9.4 | |
| Detector 2 Size(m) | | 0.6 | | | 0.6 | | | 0.6 | | | 0.6 | |
| Detector 2 Type | | Cl+Ex | | | Cl+Ex | | | Cl+Ex | | | Cl+Ex | |
| Detector 2 Channel | | | | | | | | | | | | |
| Detector 2 Extend (s) | | 0.0 | | | 0.0 | | | 0.0 | | | 0.0 | |
| Turn Type | Perm | | | Perm | | | Perm | | Perm | Perm | | Perm |
| Protected Phases | | 4 | | | 8 | | | 2 | | | 6 | |
| Permitted Phases | 4 | | | 8 | | | 2 | | 2 | 6 | | 6 |
| Detector Phase | 4 | 4 | | 8 | 8 | | 2 | 2 | 2 | 6 | 6 | 6 |

| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Switch Phase | | | | | | | | | | | | |
| Minimum Initial (s) | 4.0 | 4.0 | | 4.0 | 4.0 | | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| Minimum Split (s) | 20.0 | 20.0 | | 20.0 | 20.0 | | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 |
| Total Split (s) | 20.0 | 20.0 | 0.0 | 20.0 | 20.0 | 0.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 |
| Total Split (%) | 50.0% | 50.0% | 0.0% | 50.0% | 50.0% | 0.0% | 50.0% | 50.0% | 50.0% | 50.0% | 50.0% | 50.0% |
| Maximum Green (s) | 16.0 | 16.0 | | 16.0 | 16.0 | | 16.0 | 16.0 | 16.0 | 16.0 | 16.0 | 16.0 |
| Yellow Time (s) | 3.5 | 3.5 | | 3.5 | 3.5 | | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 |
| All-Red Time (s) | 0.5 | 0.5 | | 0.5 | 0.5 | | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| Lost Time Adjust (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Lost Time (s) | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| Lead/Lag | | | | | | | | | | | | |
| Lead-Lag Optimize? | | | | | | | | | | | | |
| Vehicle Extension (s) | 3.0 | 3.0 | | 3.0 | 3.0 | | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |
| Recall Mode | None | None | | None | None | | C-Min | C-Min | C-Min | Min | Min | Min |
| Walk Time (s) | 5.0 | 5.0 | | 5.0 | 5.0 | | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 |
| Flash Dont Walk (s) | 11.0 | 11.0 | | 11.0 | 11.0 | | 11.0 | 11.0 | 11.0 | 11.0 | 11.0 | 11.0 |
| Pedestrian Calls (#/hr) | 0 | 0 | | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 |
| Act Effct Green (s) | | 12.2 | | | 12.2 | | | 19.8 | 19.8 | | 19.8 | 19.8 |
| Actuated g/C Ratio | | 0.30 | | | 0.30 | | | 0.50 | 0.50 | | 0.50 | 0.50 |
| v/c Ratio | | 0.61 | | | 0.90dl | | | 0.37 | 0.27 | | 0.04 | 0.02 |
| Control Delay | | 11.3 | | | 11.0 | | | 9.5 | 2.4 | | 6.9 | 4.3 |
| Queue Delay | | 0.0 | | | 0.0 | | | 0.0 | 0.0 | | 0.0 | 0.0 |
| Total Delay | | 11.3 | | | 11.0 | | | 9.5 | 2.4 | | 6.9 | 4.3 |
| LOS | | B | | | B | | | A | A | | A | A |
| Approach Delay | | 11.3 | | | 11.0 | | | 6.0 | | | 6.2 | |
| Approach LOS | | B | | | B | | | A | | | A | |

**Intersection Summary**

Area Type: Other
Cycle Length: 40
Actuated Cycle Length: 40
Offset: 0 (0%), Referenced to phase 2:NBTL, Start of Green
Natural Cycle: 40
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.61
Intersection Signal Delay: 9.3 Intersection LOS: A
Intersection Capacity Utilization 56.3% ICU Level of Service B
Analysis Period (min) 15
dl Defacto Left Lane. Recode with 1 though lane as a left lane.

Splits and Phases: 6: Int



# APPENDIX D

# Appendix D

## Alignment Options Near Villeneuve

## Alignment Options Near Villeneuve Road

During the initial stages of this freeway conversion process, the alignment of Ray Gibbon Drive was shifted form the City's proposed intersection to the west to accommodate an interchange. Five alignment alternatives were developed:

- Purple option - the highway curves to the east from Giroux Road, then curves west to pass between the Bokenfohr landfill, the well site, and the farmstead. There is minimal impact on the Holden landfill.
- Red option – the highway travels directly north from the interchange at Giroux. This alignment does not affect the Bokenfohr landfill or the well site, but removes the farmstead and the Holden landfill.
- Blue option – the highway shifts west after the Giroux interchange and bisects the Bokenfohr landfill and does not meet the minimum offset requirements to the well site. The farmstead and the Holden landfill are not affected.
- Orange option – the highway shifts to the east from the Giroux interchange then curves east to pass through the farmstead and the Holden landfill. The Bokenfohr landfill and the well site are not affected.
- Green option – the highway curves to the east from the Giroux interchange, then curves west to pass between the Bokenfohr landfill, the well site, and the farmstead. There are minimal impacts to the Holden landfill. This is the only option that uses an urban cross-section with a jersey barrier in the median.

These options were evaluated in the matrix shown on the next page. No alignments went further west since that would impact the local road network and Carrot Creek.

The orange alignment was selected as the preferred alignment for the following reasons:

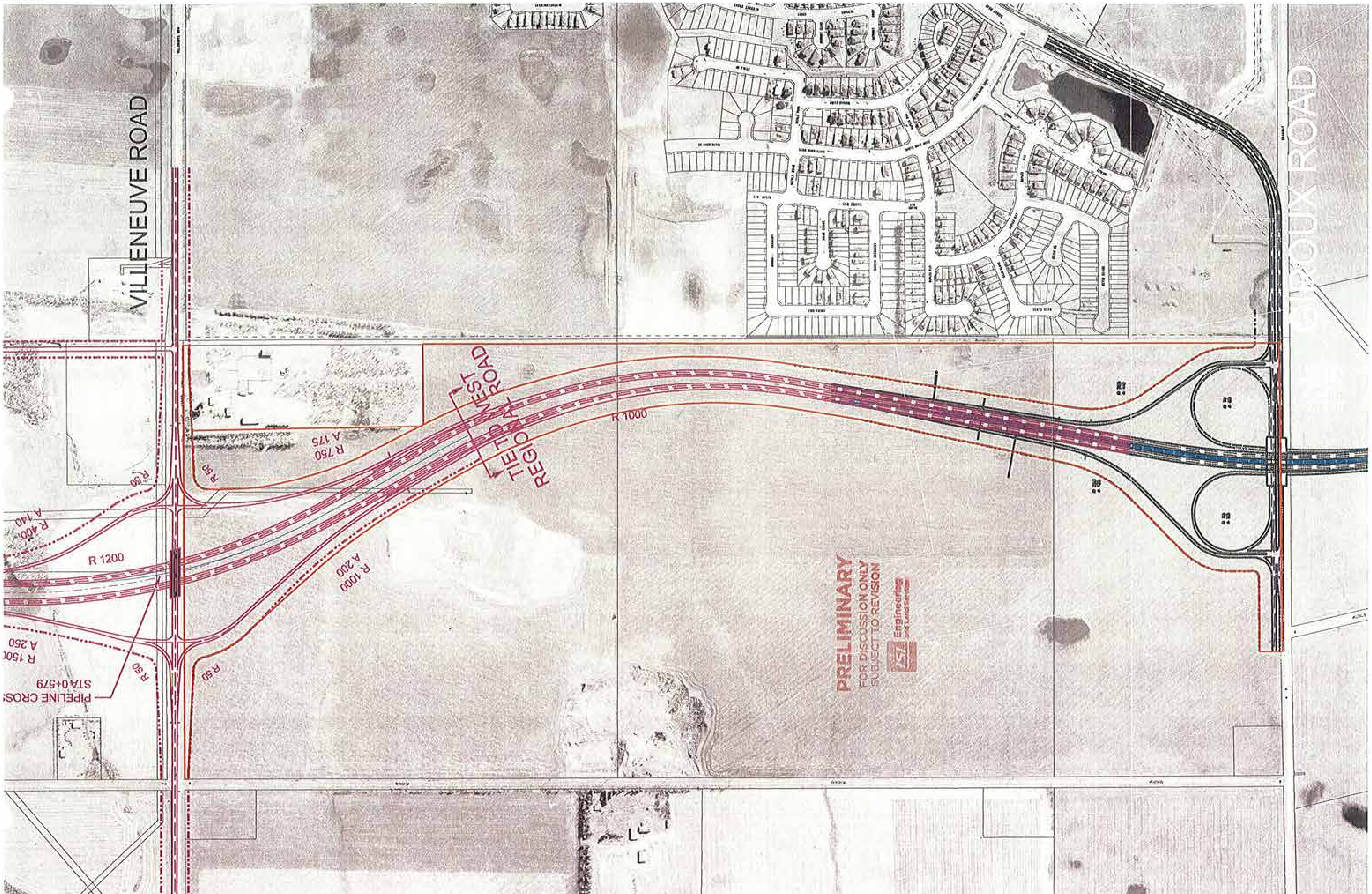
- Accommodates a rural cross-section
- Avoids the Bokenfohr landfill
- Avoids the well site
- Meets minimum power sub station offsets
- Minimizes right-of-way requirements and land remnants.

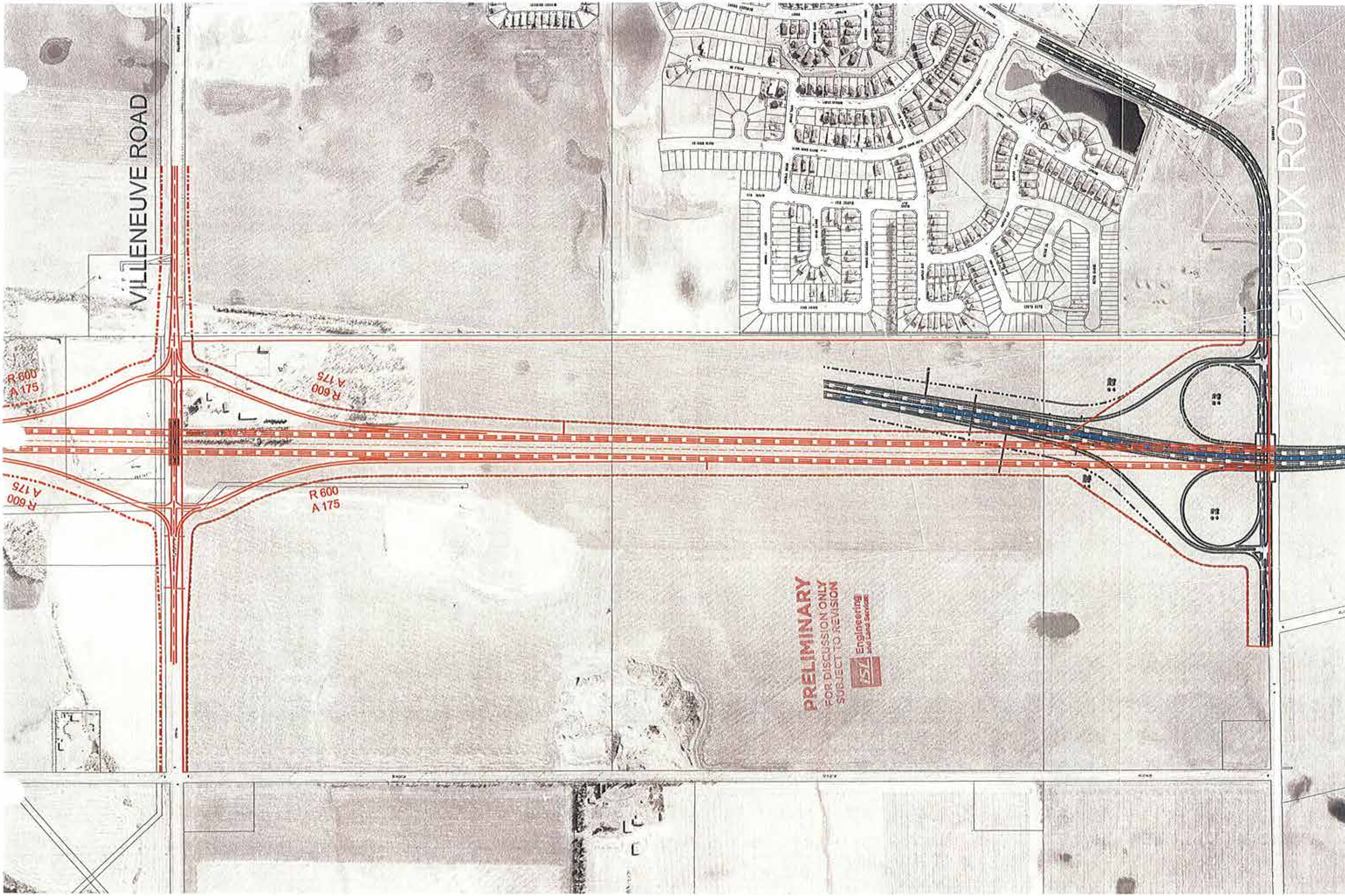
**Ray Gibbon Drive Alignment Options Near Villeneuve Road**

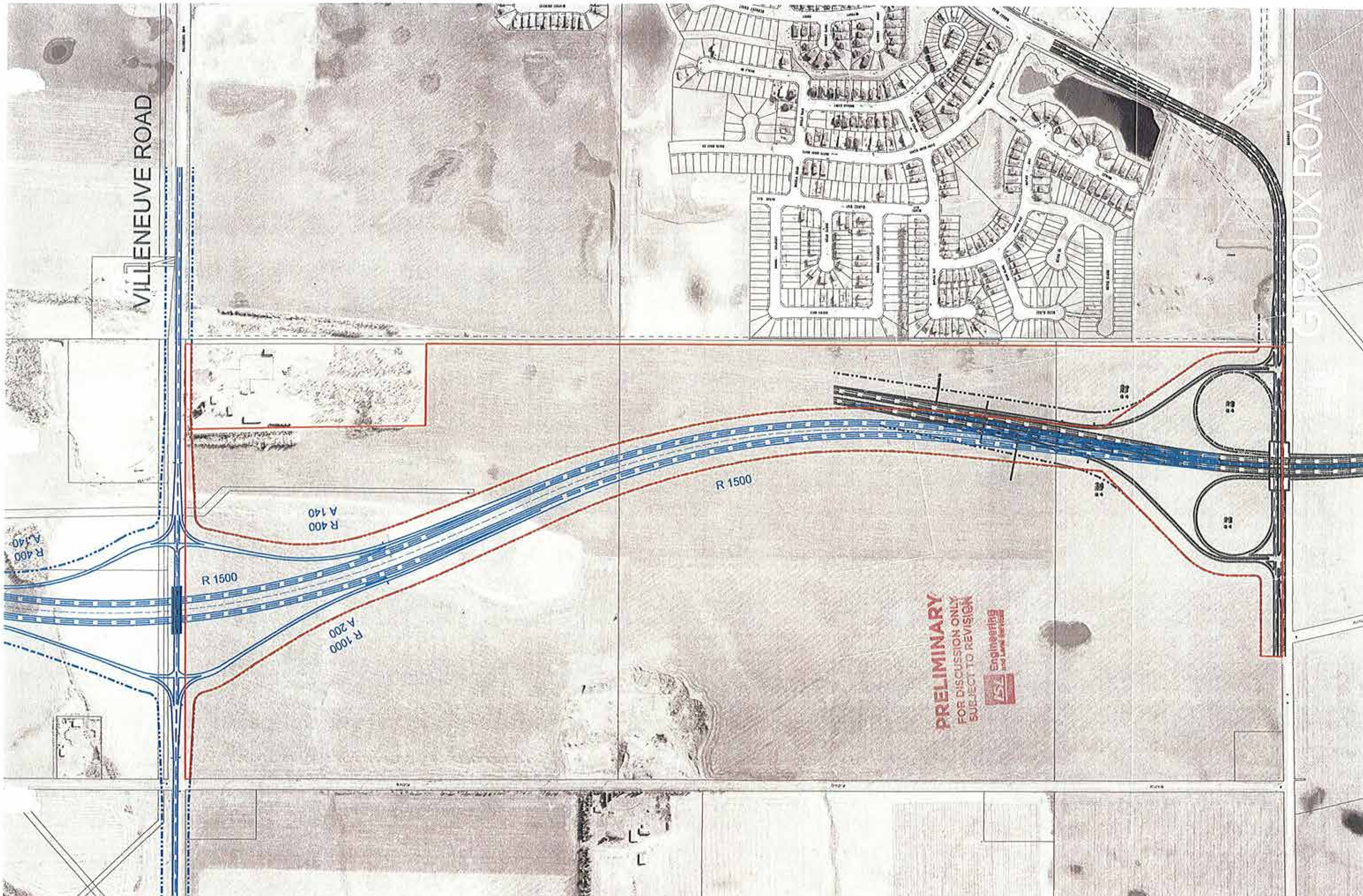
| | Base Case | | Option 1 | | Option 2 | | Option 3 | | Option 4 | |
|---|---|---|---|---|---|---|---|---|---|---|
| Colour Option | Purple | | Red | | Blue | | Orange | | Green | |
| Description | Highway curves to the east, avoiding farmstead, oilwell & landfill | | Highway straightened through farmstead | | Highway curves to the west through landfill | | Highway curves to the east through farmstead | | Highway curves to the east, avoiding farmstead, oilwell & landfill | |
| **Geometry** | | | | | | | | | | |
| Radii | 1000m | 5 | n/a | 1 | 1500m | 3 | 2000m | 2 | 1500m | 3 |
| Center Median Treatment | Depressed | 1 | Depressed | 1 | Depressed | 1 | Depressed | 1 | Jersey Barrier | 5 |
| Access to Compost Site | n/a | 1 | May need to be relocated east | 2 | n/a | 1 | May need to be relocated east | 2 | n/a | 1 |
| Access To Range Road | Relocated to the west | 3 | n/a | 1 | Relocated to the west | 3 | n/a | 1 | May need to be relocated west | 2 |
| Meets AIT standards | yes | 1 | yes | 1 | yes | 1 | yes | 1 | yes | 2 |
| **Environmental Issues** | | | | | | | | | | |
| N/S Pipeline Impacts | Pipeline covered by east ramps | 5 | Pipeline covered by west ramps | 5 | Pipeline crosses east ramps | 1 | Pipeline covered by west ramps | 5 | Pipeline covered by east ramps | 5 |
| E/W Pipline Impacts | Parallel to Villeneuve Road | 3 | Parallel to Villeneuve Road | 3 | Parallel to Villeneuve Road | 3 | Parallel to Villeneuve Road | 3 | Parallel to Villeneuve Road | 3 |
| Oil Well Impacts | n/a | 1 | Near edge of ROW | 3 | Edge of ROW - Possibly offset issues | 5 | n/a | 1 | n/a | 1 |
| Power Substation Impacts | n/a | 1 | Minimal | 3 | n/a | 1 | Minimal | 3 | n/a | 1 |
| North Landfill Impacts | Minimal | 2 | Passes through it | 5 | n/a | 1 | Passes through it | 5 | Impacts SW corner | 3 |
| South Landfill Impacts | n/a | 1 | n/a | 1 | Passes through it | 5 | n/a | 1 | n/a | 1 |
| **Social Issues** | | | | | | | | | | |
| Right-of-way Requirements (acres) | 83 | | 84 | | 83 | | 79 | | 74 | |
| Land Remnants (acres) | 24 | | 61 | | 74 | | 34 | | 29 | |
| Impacts to Farmstead | n/a | 1 | Passes through it | 5 | n/a | 1 | Passes through it | 5 | n/a | 1 |
| **Right-of-way Costs ($M)** | | | | | | | | | | |
| Right-of-way Requirements | $9.9 | 3 | $10.1 | 5 | $9.9 | 3 | $9.5 | 2 | $8.9 | 1 |
| Remnants | $2.9 | 1 | $7.3 | 5 | $8.8 | 5 | $4.1 | 2 | $3.5 | 2 |
| | | **29** | | 41 | | 34 | | 34 | | 31 |

1 = Best 2=Good 3=Ok 4=Poor 5=Worst

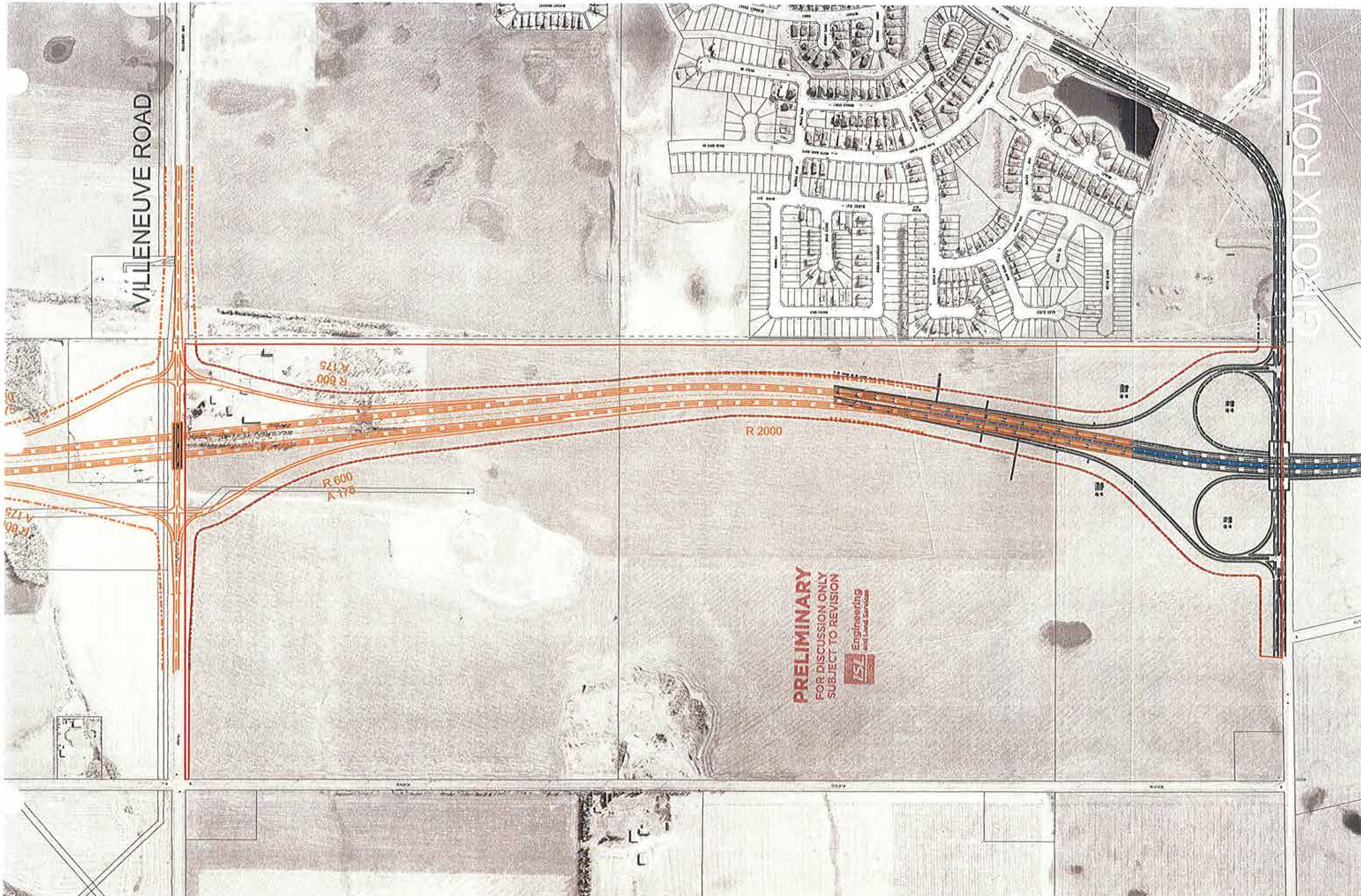
Notes:
- Land Costs are for area between Giroux Road and Villeneuve Road only.
- Land costs are estimated at $120,000/acre.

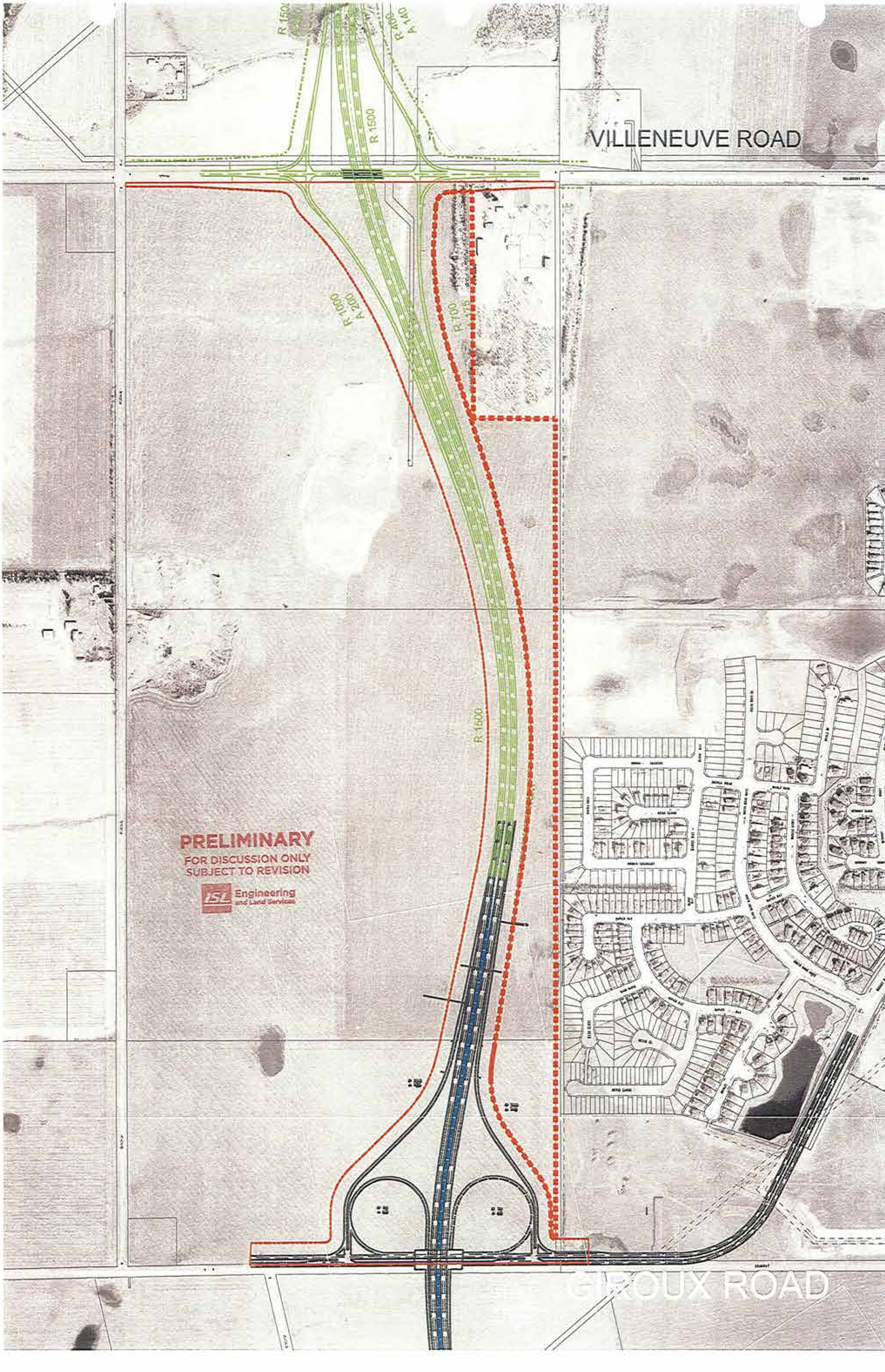

VILLENEUVE ROAD
GIROUX ROAD
TETD WEST REGIONAL ROAD
R 1000
R 750
A 175
R 50
R 1200
R 400
A 140
R 1000
A 200
R 1500
A 250
PIPELINE CROSS
STA 0+579
PRELIMINARY
FOR DISCUSSION ONLY
SUBJECT TO REVISION
ISL Engineering and Land Services


VILLENEUVE ROAD
GIROUX ROAD
R 600
A 175
R 600
A 175
R 600
A 175
R 600
A 175
PRELIMINARY
FOR DISCUSSION ONLY
SUBJECT TO REVISION
ISL Engineering and Land Services



VILLENEUVE ROAD
GIROUX ROAD
R 1500
R 400
A 140
R 1500
R 400
A 140
R 1000
A 200
PRELIMINARY
FOR DISCUSSION ONLY
SUBJECT TO REVISION
ISL Engineering and Land Services


VILLENEUVE ROAD
GIROUX ROAD
R 600
A 175
R 2000
R 600
A 175
PRELIMINARY
FOR DISCUSSION ONLY
SUBJECT TO REVISION
ISL Engineering and Land Services



VILLENEUVE ROAD
GIROUX ROAD
R 1500
A 200
R 1000
R 700
R 400
A 140
R 1500
PRELIMINARY
FOR DISCUSSION ONLY
SUBJECT TO REVISION
ISL Engineering and Land Services

APPENDIX E

# Appendix E

## Geotechnical Report

**ISL Engineering and Land Services Ltd.**

# PRELIMINARY GEOTECHNICAL EVALUATION
# PROPOSED OVERPASS STRUCTURES
# RAY GIBBON DRIVE
# ST. ALBERT, ALBERTA

**E12201227**

**March 2008**

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14940 - 123 Avenue • Edmonton, Alberta T5V 1B4 • CANADA

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### FIGURES



### APPENDICES

# 1.0 INTRODUCTION

## 1.1 GENERAL

This report presents the results of a preliminary geotechnical evaluation conducted by EBA Engineering Consultants Ltd. (EBA) for four proposed overpass structures along Ray Gibbon Drive (formerly known as the West Regional Bypass Road) in St. Albert, Alberta. The objective of this study was to identify geotechnical issues that may impact the design and construction of the proposed structures. This work is being undertaken as part of a functional planning study being undertaken by ISL Engineering and Land Services Ltd. (ISL) for the proposed alignment of the Ray Gibbon Drive. Authorization to conduct this geotechnical evaluation was provided by Mr. Steve Melton, P.Eng. of ISL.

The proposed alignment of the Ray Gibbon Drive extends north from 137 Avenue to Villeneuve Road, along the west edge of St. Albert. At present this roadway is partially constructed (2 lanes) from 137 Avenue to Giroux Road. The intent is to extend the road in a future phase to Villeneuve Road. The roadway will also be widened to a maximum of 8 lanes in its ultimate configuration. A plan and profile drawing of the proposed roadway realignment (prepared by ISL) is attached as Figure 1.

## 1.2 PROJECT DETAILS

The existing gradeline alignment of the Ray Gibbon Drive drops in elevation from 137 Avenue towards the Sturgeon River then rises in elevation up to Villeneuve Road (as illustrated on Figure 1). A total of four new interchanges are proposed along this section of roadway. At each proposed interchange the proposed gradeline for the intersecting roadways are elevated over the Ray Gibbon Drive.

The future 137 Avenue interchange will be situated approximately one kilometre north of the existing intersection of Ray Gibbon Drive and 137 Avenue. At this proposed location 137 Avenue will cross over the Ray Gibbon Drive with total approach fill heights varying from 7 to 8.5 m. Based on the profile information provided, it appears that along this portion of the alignment, the existing Ray Gibbon Drive gradeline has been lowered approximately 4 m. Therefore, the additional fill height that will be needed varies from 3 to 4.5 m.

At the future McKenney Avenue intersection, the future roadway will require 8 to 9 m high approach fills over the final Ray Gibbon Drive gradeline. Overall fill heights along McKenney Avenue are up to 12 m.

The proposed Giroux Road interchange incorporates Giroux Road crossing over the Ray Gibbon Drive with two on/off-ramps on the north side of the overpass. Based on the profile provided by ISL, the Ray Gibbon Drive gradeline will be depressed approximately 5 m below existing grade. Fill heights are 3.5 to 5 m high, with overall headslope heights of approximately 11 m.

The proposed Villeneuve Road interchange will have Villeneuve Road crossing over the Ray Gibbon Drive. The proposed Ray Gibbon Drive alignment includes a cut up to 10 m just north of Villeneuve Road. Due to the raised grade along this portion of the alignment, the fill heights are approximately 4 m. Total approach fills are approximately 9 m above final roadway level.

No specifics have been provided for headslope and sideslopes for the proposed interchanges. However, headslope angles for an overpass are typically 2 to 2.5 horizontal (H) to 1.0 vertical (V), with approach fill side slopes of 4H:1V.

## 2.0 FIELD AND LABORATORY WORK

One borehole was drilled at each proposed interchange location. Borehole locations are presented on Figures 2, 3, 4 and 5 for the four sites. Drilling was undertaken with a truck-mounted B-61 dry auger drill rig equipped with solid and hollow stem augers. Boreholes were drilled to depths between 13.4 and 33.2 m, between October 29 and 31, 2007.

Sampling during drilling comprised Standard Penetration Tests (SPTs) at 1.5 to 3 m intervals in all four boreholes. Open standpipe piezometers were installed in all boreholes upon completion of drilling. Details of the piezometer installations are shown on the borehole logs in Appendix B.

Surveying of the borehole locations and elevations was provided by ISL.

## 3.0 SITE CONDITIONS

### 3.1 SURFACE CONDITIONS

The ground surface of the proposed roadway alignment generally slopes down from north to south towards the Sturgeon River then gradually rises south of the river towards 137 Avenue. Ground surface profiles of the existing and proposed gradelines are presented on Figure 1. The ground surface was clear of trees or vegetation at all four locations.

One item of note is the presence of a former solid waste landfill on the north side of Villeneuve Road that is referred to as the Holden Landfill. The landfill is situated in the northeast quadrant of the intersection. Based on discussions with ISL, it is understood that all the waste in the landfill will be excavated and removed as part of the grading operation for interchange construction.

### 3.2 SUBSURFACE CONDITIONS

#### 3.2.1 General

The general geology of the Edmonton area is summarized as follows. Prior to glaciation, the surface of the Edmonton area consisted of a well developed drainage system, which is similar to that of today. The preglacial valleys were generally wide and drained to the northeast. Alluvial sediments were deposited by preglacial rivers known locally as the Saskatchewan Sands and Gravels. During glaciation, glacial till sheets were deposited over the Saskatchewan Sands and Gravels or the bedrock (where exposed). As the glaciers retreated to the northeast, they stagnated north of Edmonton resulting in the formation of a large proglacial lake called glacial Lake Edmonton, which extended from Fort Saskatchewan to Drayton Valley. A large delta was formed where the meltwaters from the glacier entered the lake near Stony Plain. Further away from the delta, the finer silt and clay sediments were deposited.

The study area is situated on the edge of the former glacial Lake Edmonton. Consequently, the subsurface soils comprise a combination of deltaic sands and silts, overlain by a deposit of glaciolacustrine clays and silts. Based on the "Urban Geology of Edmonton" by Kathol and McPherson (Alberta Research Council, Bulletin 32) the Ray Gibbon Drive alignment crosses a buried preglacial valley. The north end of the alignment corresponds with the crest of the buried channel (referred to as the Beverly Valley), resulting in fairly shallow bedrock. As the alignment runs to the south the bedrock drops off and is estimated to be 50 to 60 m deep at the thalweg of the preglacial valley. Boreholes and Cone Penetration Testing (CPT) from a previous investigation at the Sturgeon River bridge (by Thurber Engineering Ltd., 2003) did not encounter bedrock at termination depths of 47.5 m.

In the study area, the subsurface conditions vary dramatically due to the presence of the preglacial valley. At the north end, the subsurface stratigraphy comprises glaciolacustrine clay and silt overlying clay till, which was underlain by bedrock at a depth of 10.5 m. At Giroux Road the bedrock drops to a depth of over 27 m below existing ground surface at the borehole location. At the McKenney Avenue and future 137 Avenue interchanges, drilling was terminated at a depth of 33.2 m without encountering bedrock. Based on the literature by Kathol and McPherson, both of these future interchanges are situated in close proximity of the preglacial valley thalweg. Detailed subsoil conditions are presented on the borehole logs in Appendix B and are discussed in the following subsections.

### 3.2.2 Villeneuve Road

At the proposed Villeneuve Road interchange, the near surface lacustrine deposit comprises a medium to high plastic clay overlying silt at a depth of approximately 3 m. The clay is very stiff to hard near the surface and becomes siltier, softer and wetter with depth. The silt is typically soft to firm and interbedded with clay and sand layers. The clay layers are high plastic and the sand layers are generally wet.

Glacial clay till was encountered underlying the lacustrine deposits at a depth of 7.5 m. The glacial till strata underlying the lacustrine deposit comprises a heterogeneous mixture of clay, silt and sand, with occasional particles of gravel and coal. The till is typically of very stiff consistency, low to medium plastic and grey in colour. The thickness of the till deposit at Villeneuve Road is only 3 m thick.

Bedrock, comprising interbedded sandstone and clay shale, was encountered beneath the till at a depth of 10.5 m. Relative to the soil strata above, the bedrock has a consistency of hard (for the clay shale) and very dense (for the sandstone). The clay shale is typically high plastic, while the sandstone can be poorly cemented or bonded. Both the clay shale and sandstone were medium grey to grey in colour. SPT 'N' values in the bedrock were over 100 blows/300 mm. It is common to have a weathered surface within the upper 2 to 3 m of the bedrock surface, however, this weathered zone was not apparent at this borehole location.

#### 3.2.3 Giroux Road

The upper soils consist of a lacustrine deposit comprising primarily clay. A layer of clay fill (reworked clay) approximately 500 mm thick was identified overlying the native clay. The native clay is typically silty, damp, hard, high plastic and greyish brown in colour. At a depth of 3 m the clay becomes moist to wet, soft to firm in consistency and medium plastic.

Glacial clay till was encountered underlying the lacustrine deposit at a depth of 6 m and extended to a depth of 21.5 m. The till is typically of hard consistency in the upper 10 m, low to medium plastic and grey in colour. Below 16 m the clay till is of very stiff consistency. A thick layer of sand was identified between a depth of 21.5 and 27.2 m. This sand was fine to medium grained, saturated, dense to very dense, and interbedded with clay layers.

Bedrock, comprising clay shale was encountered beneath the sand at a depth of 27.2 m. Similar to the bedrock identified at Villeneuve Road, it was relatively hard with SPT blow counts over 100 blows/300 mm. Drilling was terminated at a depth of 30.1 m.

#### 3.2.4 McKenney Avenue

The subsoil stratigraphy at McKenney Avenue varies dramatically from the first two locations presented above. The near surface glaciolacustrine deposit overlies alluvial sediments to a significant depth. Neither clay till nor bedrock was identified at this site.

A thin layer of asphalt was identified overlying sand and gravel fill underlain by clay fill to a depth of 500 mm. The upper native subsoil comprises glaciolacustrine clay to a depth of 6.9 m. This clay deposit is similar to other two locations comprising an upper stiff high plastic crust that becomes more silty, softer and wetter with depth.

The glaciolacustrine deposit grades into an alluvial deposit comprising silt and sand. The silt is low to medium plastic, saturated, wet to saturated, loose to very loose, with occasional clay layers and coal inclusions. SPT blow counts (N values) in the lower clay and upper silt are in range of 2 to 5 blows/300 mm. Due to the drilling technique employed (hollow stem auger), sampling was only undertaken at 3 m intervals below a depth of 12 m. Therefore a detailed description of this layer is difficult.

It appears that the alluvial deposit comprises primarily silt between 7 and 20 m. Below 20 m the alluvial deposit consists of alternating layers of silt and sand to 27 m. Below a depth of 27 m the deposit comprises primarily fine grained sand with some silt, compact in relative density (N = 21 to 25) and saturated. Copies of particle size analyses of the sand are presented in Appendix B, after the borehole logs.

This general subsurface stratigraphy at McKenney Avenue is similar to the subsoil conditions identified at the Sturgeon River bridge during a previous evaluation by Thurber Engineering Ltd. The ground surface elevation at McKenney Avenue is approximately 5 m higher. Testholes at the Sturgeon River bridge were extended to a depth of 47.5 m and identified sand to the termination depth of the testholes. It is understood that the drilling of the deep boreholes at the Sturgeon River bridge was undertaken using a cone penetration testing (CPT) drill, which permitted much greater penetration of the alluvial deposit. The depth to top of bedrock was not identified at the Sturgeon River.

### 3.2.5 Future 137 Avenue

The subsurface stratigraphy at the future 137 Avenue interchange is similar to the conditions identified at the McKenney Avenue interchange location. In general, there is an upper clay layer that grades into silt, which in turn is underlain by sand.

There is a 1.4 m thick layer of clay fill that is silty, stiff, medium plastic and dark greyish brown in colour. The underlying native glaciolacustrine deposit consists of a stiff, medium plastic silty clay, which is similar in composition to the overlying fill.

At a depth of 3.8 m, the clay grades into a clayey silt that is sandy, damp, of compact relative density, low plastic, with interbedded sand layers. With depth the silt becomes wet and softer. The silt grades into a fine to medium grained sand at 11.5 m.

The sand is saturated and loose in terms of relative density. With depth the sand becomes compact to dense. Blow counts in the sand below 15 m are typically between 25 and 35 blows/300 mm. At this location bedrock is estimated to be 50 to 60 m below existing grade.

## 3.3 GROUNDWATER CONDITIONS

Groundwater levels were measured upon completion of drilling and then again on November 9, 2007. Table 1 summarizes these groundwater level measurements.

**TABLE 1: GROUNDWATER OBSERVATIONS**

| Borehole | Depth of Tip of Standpipe (m) | Groundwater Level – Depth Below Grade (m) | Groundwater Elevation* (m) |
|---|---|---|---|
| | | November 9, 2007 | |
| E12201227-01 | 8.1 | 4.45 | 676.28 |
| E12201227-02 | 4.5 | Dry | N/A |
| E12201227-03 | 9.5 | 4.3 | 647.5 |
| E12201227-04 | 11.6 | 8.2 | 649.1 |

* Geodetic

It should be noted that groundwater levels will fluctuate seasonally and in response to climatic conditions. Accordingly, groundwater levels should be monitored periodically if there is an interest in the long-term groundwater levels at these sites.

# 4.0 DISCUSSION AND RECOMMENDATIONS

## 4.1 GENERAL

The following presents a discussion of geotechnical issues that may impact the design and construction of the four proposed overpass structures. It is assumed that additional geotechnical work will be undertaken prior to finalizing design for the structures.

Assuming that the all the waste is removed from the landfill site located north of Villeneuve Road, there are no significant development issues at this site. Subsurface conditions at Giroux Road are also considered favourable for the proposed structure with no major concerns other than stability of the headslope due to the proposed cut at this location, which will expose the upper lacustrine deposit.

The two southerly proposed interchange locations are significantly different than the two northerly locations. At the 137 Avenue and McKenney Avenue locations the subgrade is primarily silt and sand, and bedrock or a competent bearing strata was not encountered. Foundations at these two locations will likely comprise relatively long friction piles. Due to the soft silt identified at all four locations, there is a concern with long-term settlement associated with the placement of the approach fills, particularly at McKenney Avenue. It is likely that the use of wick drains or similar methods of accelerating consolidation settlement will be required at McKenney Avenue to dissipate pore pressures, which is similar to the approach adopted for the Sturgeon River bridge.

Driven steel, dynamically cast-in-place concrete and cast-in-place concrete piles are considered feasible foundation types for the proposed bridge structures at Villeneuve Road and Giroux Road. Due to the proposed depth of cut at Giroux Road and the fact that a hard clay till was identified at a depth of 6 m, there is also the possibility of placing the centre pier on a spread footing foundation. The depth of the clay till at Villeneuve Road is greater and the clay till not as competent, therefore the possibility of a spread footing for the centre pier is less likely at the proposed Villeneuve Road location. At 137 Avenue and McKenney Avenue driven steel piles are likely the most feasible considering the subsurface conditions. Preliminary recommendations for these foundation options are presented in the following sections.

## 4.2 FOUNDATIONS

### 4.2.1 Cast-in-Place Concrete Piles

Cast-in-place concrete piles are a common foundation type used in the Edmonton area and are presented as feasible foundation alternatives for the proposed structures at Villeneuve

Road and Giroux Road. Piles may be designed on a combination of both skin friction and end bearing.

At Villeneuve Road end bearing belled piles could be installed in the glacial clay till at a depth of approximately 9 m. However, the underlying bedrock is at a depth of 10.5 m and would provide much higher end bearing for cast-in-place concrete piles. It is believed that a rock socket pile within the bedrock with end bearing at a depth of 13 m would also provide a cost effective foundation option. The silt layer overlying the clay till may generate some problems and could require temporary casing during pile installation to a depth of approximately 8 m.

At Giroux Road a very stiff to hard clay till stratum was identified at a depth of 6 m. The upper portion of the clay till was hard in consistency. Below 15 m, the clay till becomes softer in consistency, but still provides a good bearing strata. It is envisaged that belled piles founded at a depth of approximately 9 m below existing grade would provide the most economical foundation option.

In areas where new fill material will be placed for approach fills, or if any existing fill materials are left in place, negative skin friction will need to be addressed in the pile design.

Bell diameters should be a minimum of 2 and a maximum of 3 times the shaft diameter. The ratio of the depth to bell base and bell diameter should be a minimum of 2.5.

Design for belled piles may consider both end bearing and shaft friction. Shaft friction should be neglected for the top 1.5 m of the pile length and within one shaft diameter above the top of the bell.

Bell formation may be difficult within the bedrock stratum. Therefore, if end-bearing resistance is necessary to support the downward loading and belling is not possible, a special cleaning bucket should be used to clean the bottom of a straight shaft pile bore in the bedrock stratum, creating a "rock-socket" pile. It should be noted that the end-bearing diameter of the base of a rock-socket pile is slightly smaller than the shaft diameter. In calculating the end-bearing area for a rock-socket pile, a pile base diameter that is 5 percent smaller than the shaft diameter should be adopted.

The bases of all end-bearing piles must be thoroughly cleaned of all loosened material by mechanical or, if necessary, hand methods. Following drilling and cleaning, pile bores should be inspected to ensure that an adequate bearing surface has been prepared at an appropriate depth.

### 4.2.2 Dynamically Cast-in-Place Concrete Piles

Dynamically cast-in-place (compacto) piles are considered feasible for the proposed structures at Villeneuve Road and Giroux Road and possibly 137 Avenue. At Villeneuve Road the piles could be based in the clay till at a depth of approximately 9 m and at a depth of 8 m at Giroux Road. At the proposed 137 Avenue interchange, compacto piles founded in the sand at a depth of approximately 13 m may be feasible.

Due to the depth of cut and relatively shallow hard clay till at Giroux Road location, the use of compacto piles may not be feasible for the centre pier.

One drawback with this pile type is nominal reinforcing, which limits their lateral capacity. Providing a suitable bearing strata is available for basing the compacto piles, typical allowable design load capacities for varying shaft diameters are as follows:

| TABLE 2 : TYPICAL DYNAMICALLY CAST-IN-PLACE PILE CAPACITIES | |
|---|---|
| **Shaft Diameter (mm)** | **Typical Allowable Static Load in Compression (kN)** |
| 400 | 800 |
| 500 | 1100 |
| 600 | 1550 |

Although preliminary design information has been provided for this foundation alternative, it should be noted that a specialist foundation contractor usually completes the final pile foundation design. The following information should be considered in the foundation design.

Experience has found that dynamically cast, "zero slump" concrete is inherently a much more variable material than conventional plastic concrete. The quality and compressive strength of zero slump concrete is highly sensitive to moisture content. Consequently, proper moisture conditioning of the concrete mix is essential to producing high quality concrete. The concrete mix should be re-tempered as required to produce a compatible mix. Given the potential for high variability, the average compressive strength of zero slump concrete should be significantly higher than the design requirement. Low early age (3 and 7-day) compressive strengths indicate possible problems with achieving the design strength. Consequently, 7-day compressive strengths that are more than 3 MPa less than the design strength should be investigated immediately.

Dynamically cast-in-place pile bases can also be used in combination with plastic concrete shafts. Plastic concrete can be produced without the high variability of compacted shaft concrete, and permits the use of higher fly ash contents for greater mix efficiency.

### 4.2.3 Driven Steel Piles

The use of driven steel H-piles or pipe piles are considered feasible alternatives for all four sites. Such piles may be designed using both skin friction and end-bearing. At the Villeneuve Road interchange piles would likely encounter refusal at a depth of approximately 15 m. At the Giroux Road interchange the driven steel piles would likely penetrate through the upper hard clay till and terminate in the bedrock. Estimated pile lengths are approximately 30 m below existing grade.

At both the 137 Avenue and McKenney Avenue interchange locations, driven steel piles will be feasible. It is anticipated that pile capacities at 137 Avenue should be slightly higher than McKenney Avenue based on the limited drilling conducted. It is known that several open ended pipe piles were installed and tested using a Pile Driving Analyzer (PDA) at the Sturgeon River bridge site. Pile diameters of 600 mm and 12.7 m wall thickness driven to a depth of 35 m were designed with an ultimate capacity of 3600 kN. It is speculated that similar capacities would be achievable for piles installed at the McKenney Avenue interchange. Piles installed to a similar length at 137 Avenue should be capable of slightly higher capacity.

### 4.2.4 Spread Footings

The use of a spread footing foundation is considered primarily feasible for the centre pier at the Giroux Road interchange. The proposed alignment for Ray Gibbon Drive will necessitate a cut of approximately 5 m and a hard clay till layer was encountered at a depth of 6 m. Typical depth of burial for footings would necessitate excavating approximately 2.5 m which would place the base of a footing approximately 1.5 m into the clay till.

Spread footing foundations may also be feasible for the Villeneuve Road interchange, however, the clay till is slightly deeper and is only of very stiff consistency. The final decision will be dictated to a large degree by the depth of cut required for the roadway gradeline and elevation of the clay till relative to the roadway elevation of Ray Gibbon Drive.

## 4.3 DOWNDRAG AND NEGATIVE SKIN FRICTION

The issue of negative skin friction and down drag are not considered to be a major concern at the Villeneuve and Giroux Road locations. However, this will be an issue at the McKenney and 137 Avenue interchanges. In particular, the soft sediments at the McKenney Avenue will be a greater concern.

If adequate time for settlement of the approach fills is not permitted, the upper portion of the pile shaft installed for the abutments will have to be designed for downdrag associated with long-term settlement of the approach fills. Any portion of the pile shaft that is located within the approach fills for the abutments should incorporate negative shaft friction. The issues of negative shaft friction do not apply to the piles supporting centre piers.

The use of wick drains will likely be required at the McKenney and 137 Avenue interchanges. Wick drains will greatly improve the rate of consolidation at both these locations. It is understood that wick drains were installed at the Sturgeon River bridge. Details of the performance of the settlement are not known, however this historical data will provide valuable insight regarding the rate of settlement and rate of pore pressure dissipation.

If sufficient time is not permitted for approach fill settlement, it is recommended not to utilize battered piles in the abutments. Battered piles would be subjected to non-uniform stresses and strains as the soil below the piles settles away from the underside of a battered pile.

## 4.4 STABILITY OF APPROACH FILLS

Typically, head slope angles for the approach fills are between 2 and 2.5H:1V and the sideslopes at 4H:1V. It is assumed that similar geometry will be adopted for the proposed new overpass structures. It must be noted that the stability of the approach fills is a function of soil type used to construct the embankments. Once the material type for the fills has been confirmed the analyses must be reviewed.

Pore pressures can generate within the underlying native strata and have a significant impact on the stability of the approach fills. Therefore design of the approach fills must consider this aspect in the analysis. In some instances the rate of fill placement is dictated by the pore pressures generated beneath the approach fills.

The concern with stability is primarily associated with the interchanges proposed at McKenney and 137 Avenue. It is anticipated that a flatter headslope in the order of 3H:1V will be required at both these locations. Another technique used to improve stability is the installation of wick drains to dissipate excess pore pressure that is generated during fill placement. As discussed in the previous section, valuable data would have been gathered during the construction of the approach fills for the Sturgeon River bridge. A detailed review of the data would assist in optimizing the design for wick drain spacing. A wick drain spacing of 1.5 m was used for the Sturgeon River bridge and is considered a reasonable estimate for the proposed McKenney and 137 Avenue interchanges.

At the proposed Giroux Road interchange the depth of cut will be approximately 5 m, which will expose the majority of the lacustrine deposit at this location. With depth the lacustrine deposit becomes softer, the analysis of a possible failure surface daylighting near the toe of the headslope will require detailed analysis. Slightly flatter headslopes may be required to ensure an adequate factor of safety.

## 4.5 SETTLEMENT OF APPROACH FILLS

Fill settlement comprises a combination of elastic settlement, which occurs immediately during construction, and a consolidation component, which is time dependant and requires the expulsion of pore water from the native subsoil. To calculate the elastic and consolidation settlements at this preliminary stage is beyond the limits of this report. Settlements in the order of 500 mm would not be unreasonable. However, the data obtained from the Sturgeon River bridge construction would be able to provide a more accurate estimate of settlement.

If adequate time for settlement is not permitted, there is concern with any piping or surface utilities that may run through or along the approach fill. Due to the long-term settlements, it must be anticipated that there could be distress in these utilities. Therefore, some form of flexible connection should be designed.

In order to accelerate the settlement process, it is recommended that a surcharge be placed on top of the approach fills. In general the greater the surcharge, the greater the impact on increasing the rate of settlement and reducing the long-term settlement that will occur after construction completion. Care must be taken not to place too great a surcharge, as a slope failure may be generated. A fill surcharge of 25 to 50% of the fill height may be feasible, providing instrumentation that is installed within the approach fills indicates favourable performance of the approach fill.

## 4.6 GRADING AND FILL MATERIAL

It is assumed that the majority of the borrow used for construction of the ramps and approach fills will comprise native borrow from within the limits of the Ray Gibbon Drive right-of-way. Standard specifications typically require compaction to a minimum of 95 percent of Standard Proctor maximum dry density at optimum moisture content.

Topsoil, organics and any vegetation should be excavated and removed prior to placement of any fill. Care should be taken not to permit moisture content too high above optimum, as material strength is related to the moisture content of the fill. Typically, as the moisture content increases, the shear strength of the fill decreases. Another concern with moisture contents above optimum is that there is a potential for generating pore pressures during fill placement. High pore pressures with the embankment fills can lead to a lower factor of safety during construction. It should be noted that this issue of pore pressure generation is primarily for clay fill. Sands and silts are much more permeable and have a lower tendency to generate pore pressures. If clay is used as fill for the embankment, care must be taken to assess whether this is an issue.

At locations where wick drains are anticipated, an initial layer of free-draining sand (approximately one metre thick) will be required at the base of the approach fills. This granular layer is required to permit the drainage of water that will be collected by the wick drains as excess pore pressure forces water to be expelled from the native soils.

## 4.7 MONITORING PROGRAM

During construction of the proposed embankments, it is critical that the subsoil response to embankment loading be monitored to assess slope stability and confirm completion of consolidation and settlement. As a minimum, it is recommended that a grid of survey hubs be installed on the surface of the approach fills to monitor on-going settlements. Vertical inclinometers could also be installed in the headslope to monitor stability of the approach fills. At sites where wick drains are installed, it is common to install piezometers to record the dissipation of porewater pressures.

## 5.0 LIMITATIONS

Recommendations presented herein are based on a geotechnical evaluation of the findings in four boreholes. It is assumed that more detailed investigations will be required at all four proposed interchange locations in the future. The conditions encountered during the fieldwork are considered to be generally representative of the sites.

This report has been prepared for the exclusive use of ISL Engineering and Land Services Ltd. for specific application to the development described in this report. It has been prepared in accordance with generally accepted geotechnical engineering practices. No other warranty is made, either expressed or implied. For further limitations, reference should be made to the General Conditions in Appendix A.

## 6.0 CLOSURE

We trust this report meets your present requirements. Should you have any specific questions or concerns regarding this report, please contact our office at your convenience.

EBA Engineering Consultants Ltd.

PROFESSIONAL ENGINEER
A. F. RUBAN
ALBERTA

2008-03-18

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PERMIT TO PRACTICE
EBA ENGINEERING CONSULTANTS LTD.
Signature
Date 2008-03-18
PERMIT NUMBER: P245
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

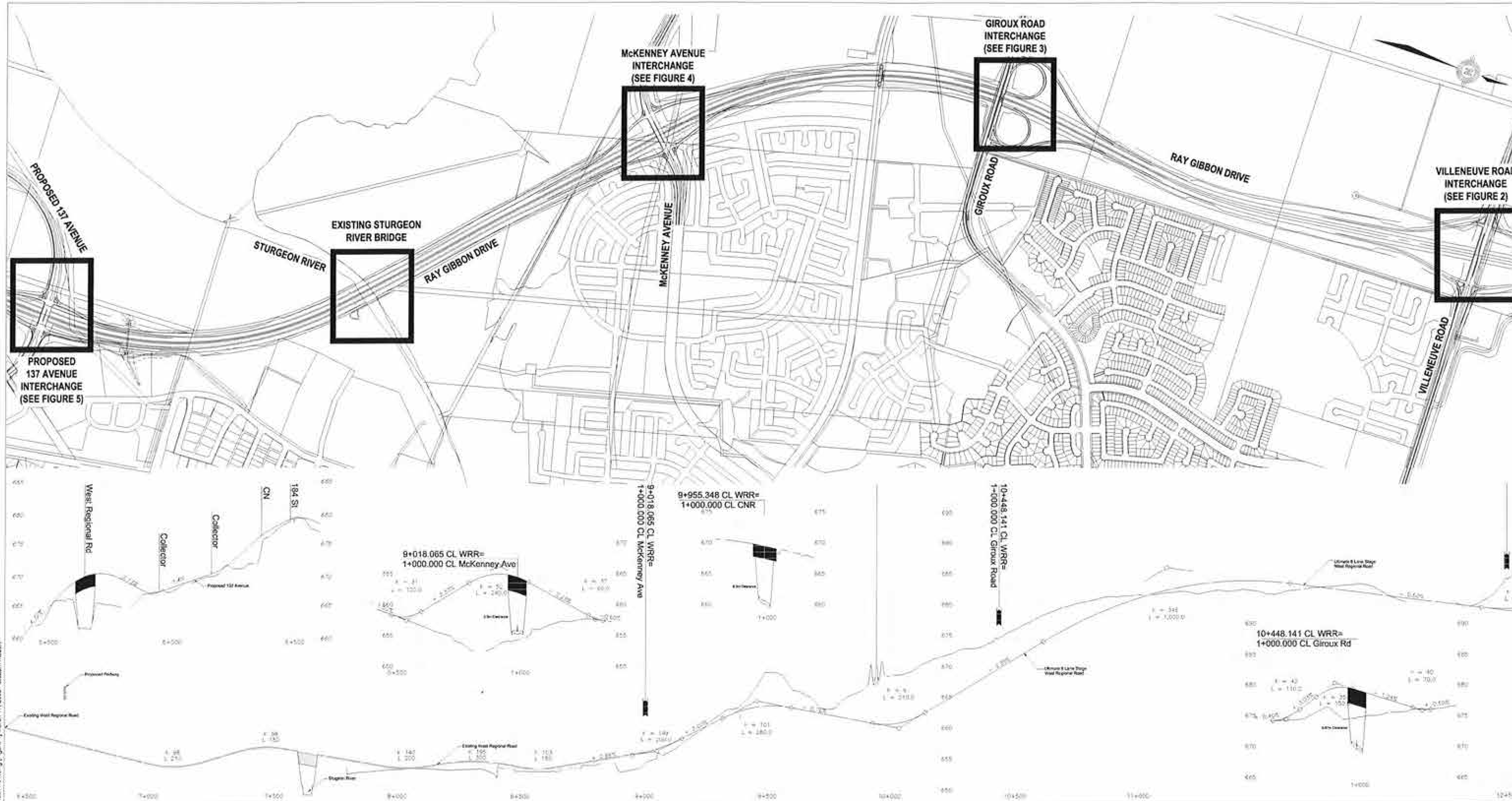
## REFERENCES

Kathol, C.P. and McPherson, R.A., 1975. "Urban Geology of Edmonton", Alberta Research Council, Bulletin 32.

Thurber Engineering Ltd., 2003. West Regional Road Over Sturgeon River Geotechnical and Environmental Investigation. Prepared for Infrastructure Systems Ltd., dated September 12, 2003 (File No. 19-598-118).

Urkkada Technology Ltd., 2005. Dynamic Testing and Analysis of Piles (Report 2), Sturgeon River Bridge, St. Albert, Alberta, dated February 7, 2005 (File No. 0412DH427).

# FIGURES




NOTE:

BASED ON DRAWING PROVIDED BY ISL ENGINEERING AND LAND SERVICES LTD

0 500

Scale 1: 15 000 (metres)

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CLIENT

ISL Engineering and Land Services Ltd.

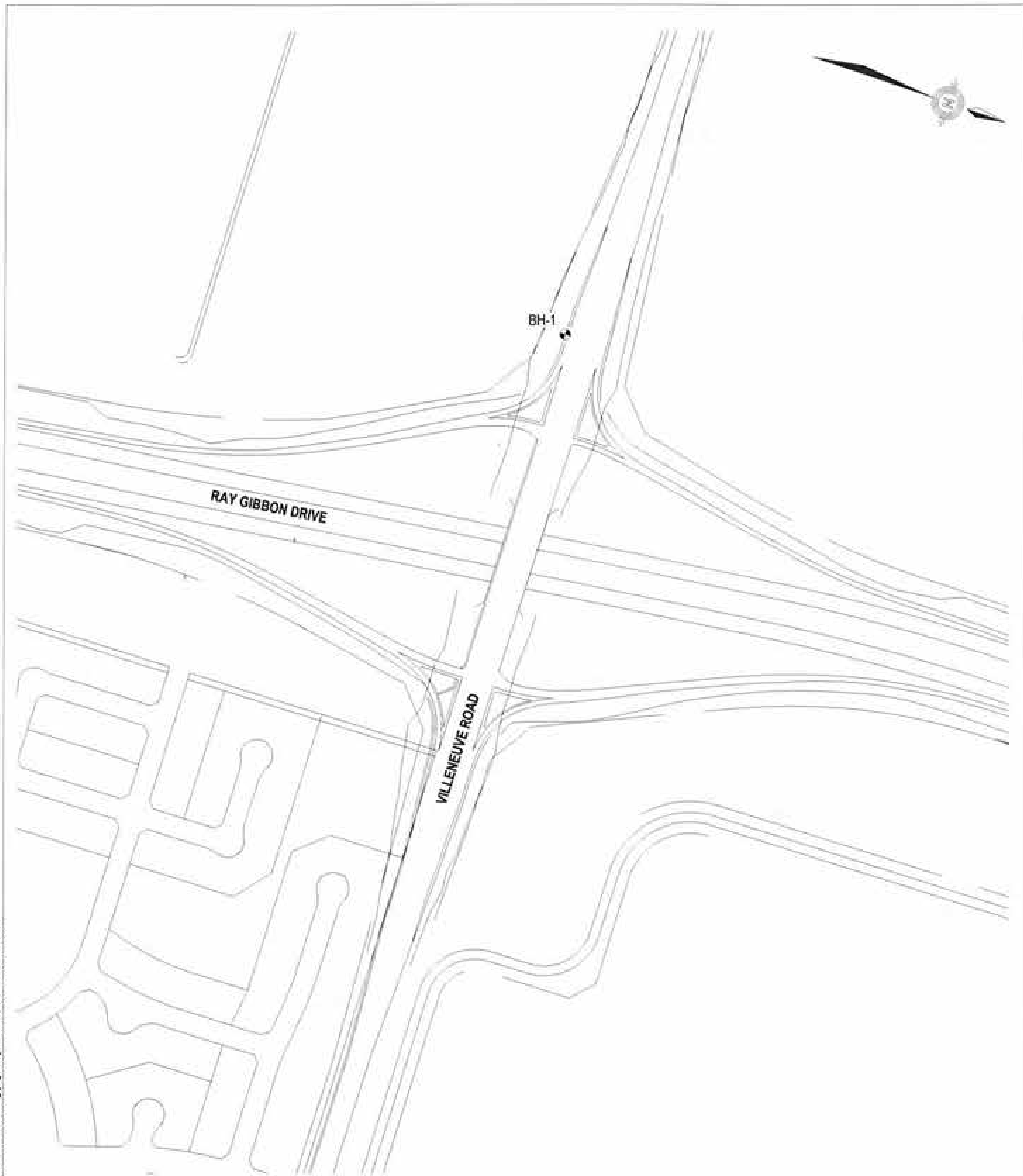
EBA Engineering Consultants Ltd.

**West Regional Bypass Road**
**St. Albert, Alberta**

**General Site Location Plan**

| PROJECT NO./FILE NO. | DWN | CKD | REV |
|---|---|---|---|
| E12201227 E12201227H01a.dwg | RH | APR | 0 |
| OFFICE | DATE | | |
| EBA-EDM | February 2008 | | |

**Figure 1**




NOTE:
BASED ON DRAWING PROVIDED BY ISL ENGINEERING AND LAND SERVICES LTD

LEGEND:
- BOREHOLE LOCATION

0 250
Scale: 1: 5 000 (metres)

CLIENT

ISL Engineering and Land Services Ltd.

EBA Engineering Consultants Ltd.

**West Regional Bypass Road**
**St. Albert, Alberta**

**Villeneuve Road Interchange**
**Site Plan and Borehole Location**

| PROJECT NO./FILE NO. | DWN | CKD | REV |
|---|---|---|---|
| E12201227 E12201227H01a.dwg | RH | APR | 0 |
| OFFICE EBA-EDM | DATE February 2008 | | |

**Figure 2**


NOTE:
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LEGEND:
- BOREHOLE LOCATION

0 250
Scale: 1: 5 000 (metres)

CLIENT

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EBA Engineering Consultants Ltd.

## West Regional Bypass Road
## St. Albert, Alberta

### Giroux Road Interchange
### Site Plan and Borehole Location

| PROJECT NO./FILE NO. | DWN | CKD | REV |
|---|---|---|---|
| E12201227<br>E12201227H01a.dwg | RH | APR | 0 |
| OFFICE | DATE | | |
| EBA-EDM | February 2008 | | |

Figure 3

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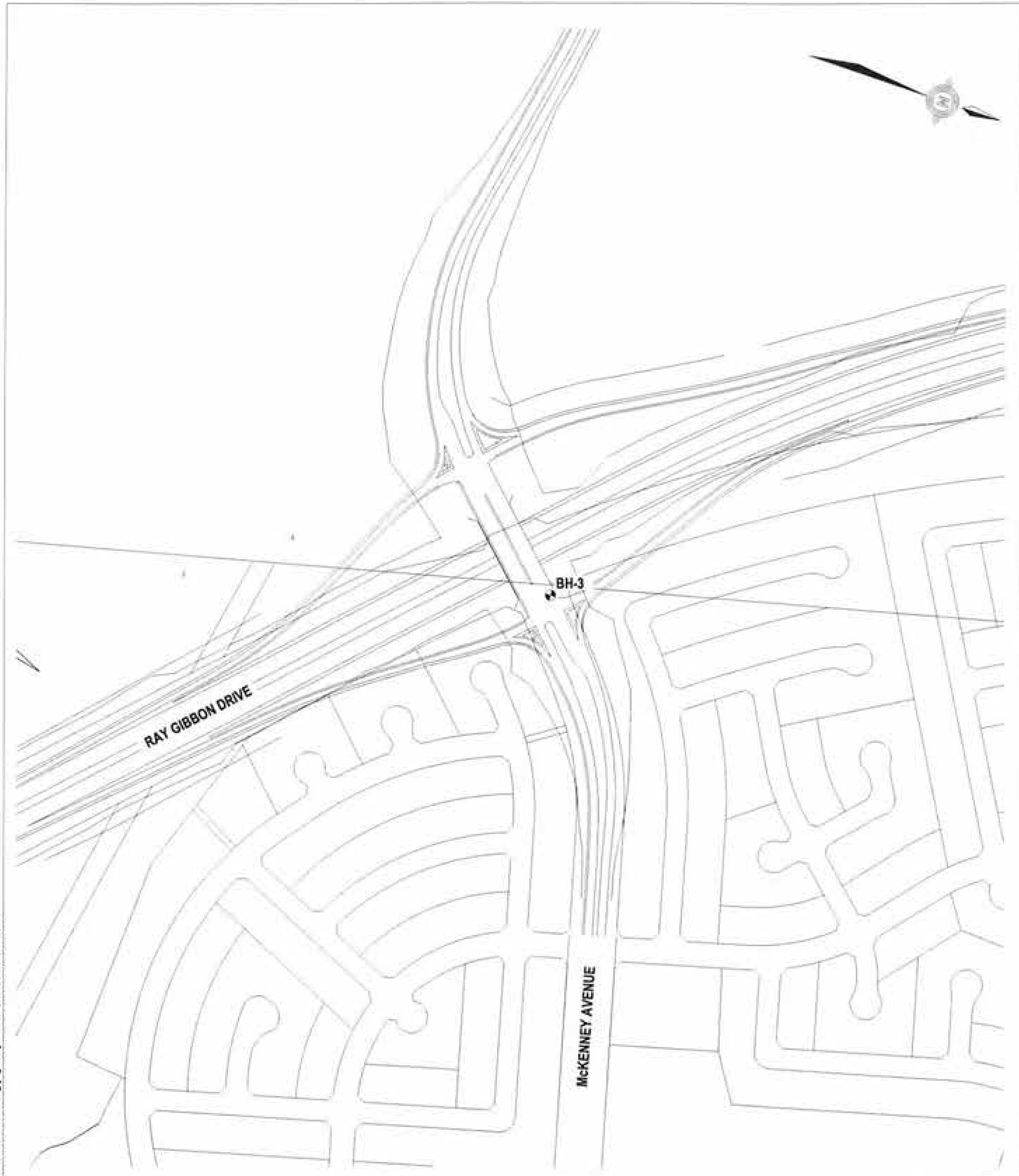


NOTE:
BASED ON DRAWING PROVIDED BY ISL ENGINEERING AND LAND SERVICES LTD

LEGEND:
- BOREHOLE LOCATION

0 250
Scale: 1: 5 000 (metres)

CLIENT

ISL Engineering and Land Services Ltd.

EBA Engineering Consultants Ltd.

**West Regional Bypass Road**
**St. Albert, Alberta**

**McKenney Avenue Interchange**
**Site Plan and Borehole Location**

| PROJECT NO./FILE NO. | DWN | CKD | REV |
|---|---|---|---|
| E12201227<br>E12201227H01a.dwg | RH | APR | 0 |
| OFFICE | DATE | | |
| EBA-EDM | February 2008 | | |

**Figure 4**

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NOTE:
BASED ON DRAWING PROVIDED BY ISL ENGINEERING AND LAND SERVICES LTD

LEGEND:
- BOREHOLE LOCATION

0 250
Scale: 1: 5 000 (metres)

CLIENT

ISL Engineering and Land Services Ltd.

EBA Engineering Consultants Ltd.

**West Regional Bypass Road**
**St. Albert, Alberta**

**Proposed 137 Avenue Interchange**
**Site Plan and Borehole Location**

| PROJECT NO./FILE NO. | DWN | CKD | REV |
|---|---|---|---|
| E12201227<br>E12201227H01a.dwg | RH | APR | 0 |
| OFFICE | DATE | | |
| EBA-EDM | February 2008 | | |

**Figure 5**

# APPENDIX

## APPENDIX A GENERAL CONDITIONS

## GEOTECHNICAL REPORT – GENERAL CONDITIONS

This report incorporates and is subject to these "General Conditions".

### 1.0 USE OF REPORT AND OWNERSHIP

This geotechnical report pertains to a specific site, a specific development and a specific scope of work. It is not applicable to any other sites nor should it be relied upon for types of development other than that to which it refers. Any variation from the site or development would necessitate a supplementary geotechnical assessment.

This report and the recommendations contained in it are intended for the sole use of EBA's client. EBA does not accept any responsibility for the accuracy of any of the data, the analyses or the recommendations contained or referenced in the report when the report is used or relied upon by any party other than EBA's client unless otherwise authorized in writing by EBA. Any unauthorized use of the report is at the sole risk of the user.

This report is subject to copyright and shall not be reproduced either wholly or in part without the prior, written permission of EBA. Additional copies of the report, if required, may be obtained upon request.

### 2.0 NATURE AND EXACTNESS OF SOIL AND ROCK DESCRIPTIONS

Classification and identification of soils and rocks are based upon commonly accepted systems and methods employed in professional geotechnical practice. This report contains descriptions of the systems and methods used. Where deviations from the system or method prevail, they are specifically mentioned.

Classification and identification of geological units are judgmental in nature as to both type and condition. EBA does not warrant conditions represented herein as exact, but infers accuracy only to the extent that is common in practice.

Where subsurface conditions encountered during development are different from those described in this report, qualified geotechnical personnel should revisit the site and review recommendations in light of the actual conditions encountered.

### 3.0 LOGS OF TESTHOLES

The testhole logs are a compilation of conditions and classification of soils and rocks as obtained from field observations and laboratory testing of selected samples. Soil and rock zones have been interpreted. Change from one geological zone to the other, indicated on the logs as a distinct line, can be, in fact, transitional. The extent of transition is interpretive. Any circumstance which requires precise definition of soil or rock zone transition elevations may require further investigation and review.

### 4.0 STRATIGRAPHIC AND GEOLOGICAL INFORMATION

The stratigraphic and geological information indicated on drawings contained in this report are inferred from logs of test holes and/or soil/rock exposures. Stratigraphy is known only at the locations of the test hole or exposure. Actual geology and stratigraphy between test holes and/or exposures may vary from that shown on these drawings. Natural variations in geological conditions are inherent and are a function of the historic environment. EBA does not represent the conditions illustrated as exact but recognizes that variations will exist. Where knowledge of more precise locations of geological units is necessary, additional investigation and review may be necessary.

### 5.0 SURFACE WATER AND GROUNDWATER CONDITIONS

Surface and groundwater conditions mentioned in this report are those observed at the times recorded in the report. These conditions vary with geological detail between observation sites; annual, seasonal and special meteorologic conditions; and with development activity. Interpretation of water conditions from observations and records is judgmental and constitutes an evaluation of circumstances as influenced by geology, meteorology and development activity. Deviations from these observations may occur during the course of development activities.

### 6.0 PROTECTION OF EXPOSED GROUND

Excavation and construction operations expose geological materials to climatic elements (freeze/thaw, wet/dry) and/or mechanical disturbance which can cause severe deterioration. Unless otherwise specifically indicated in this report, the walls and floors of excavations must be protected from the elements, particularly moisture, desiccation, frost action and construction traffic.

### 7.0 SUPPORT OF ADJACENT GROUND AND STRUCTURES

Unless otherwise specifically advised, support of ground and structures adjacent to the anticipated construction and preservation of adjacent ground and structures from the adverse impact of construction activity is required.

## 8.0 INFLUENCE OF CONSTRUCTION ACTIVITY

There is a direct correlation between construction activity and structural performance of adjacent buildings and other installations. The influence of all anticipated construction activities should be considered by the contractor, owner, architect and prime engineer in consultation with a geotechnical engineer when the final design and construction techniques are known.

## 9.0 OBSERVATIONS DURING CONSTRUCTION

Because of the nature of geological deposits, the judgmental nature of geotechnical engineering, as well as the potential of adverse circumstances arising from construction activity, observations during site preparation, excavation and construction should be carried out by a geotechnical engineer. These observations may then serve as the basis for confirmation and/or alteration of geotechnical recommendations or design guidelines presented herein.

## 10.0 DRAINAGE SYSTEMS

Where temporary or permanent drainage systems are installed within or around a structure, the systems which will be installed must protect the structure from loss of ground due to internal erosion and must be designed so as to assure continued performance of the drains. Specific design detail of such systems should be developed or reviewed by the geotechnical engineer. Unless otherwise specified, it is a condition of this report that effective temporary and permanent drainage systems are required and that they must be considered in relation to project purpose and function.

## 11.0 BEARING CAPACITY

Design bearing capacities, loads and allowable stresses quoted in this report relate to a specific soil or rock type and condition. Construction activity and environmental circumstances can materially change the condition of soil or rock. The elevation at which a soil or rock type occurs is variable. It is a requirement of this report that structural elements be founded in and/or upon geological materials of the type and in the condition assumed. Sufficient observations should be made by qualified geotechnical personnel during construction to assure that the soil and/or rock conditions assumed in this report in fact exist at the site.

## 12.0 SAMPLES

EBA will retain all soil and rock samples for 30 days after this report is issued. Further storage or transfer of samples can be made at the client's expense upon written request, otherwise samples will be discarded.

## 13.0 STANDARD OF CARE

Services performed by EBA for this report have been conducted in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practising under similar conditions in the jurisdiction in which the services are provided. Engineering judgement has been applied in developing the conclusions and/or recommendations provided in this report. No warranty or guarantee, express or implied, is made concerning the test results, comments, recommendations, or any other portion of this report.

## 14.0 ENVIRONMENTAL AND REGULATORY ISSUES

Unless stipulated in the report, EBA has not been retained to investigate, address or consider and has not investigated, addressed or considered any environmental or regulatory issues associated with development on the subject site.

## 15.0 ALTERNATE REPORT FORMAT

Where EBA submits both electronic file and hard copy versions of reports, drawings and other project-related documents and deliverables (collectively termed EBA's instruments of professional service), the Client agrees that only the signed and sealed hard copy versions shall be considered final and legally binding. The hard copy versions submitted by EBA shall be the original documents for record and working purposes, and, in the event of a dispute or discrepancies, the hard copy versions shall govern over the electronic versions. Furthermore, the Client agrees and waives all future right of dispute that the original hard copy signed version archived by EBA shall be deemed to be the overall original for the Project.

The Client agrees that both electronic file and hard copy versions of EBA's instruments of professional service shall not, under any circumstances, no matter who owns or uses them, be altered by any party except EBA. The Client warrants that EBA's instruments of professional service will be used only and exactly as submitted by EBA.

The Client recognizes and agrees that electronic files submitted by EBA have been prepared and submitted using specific software and hardware systems. EBA makes no representation about the compatibility of these files with the Client's current or future software and hardware systems.

# APPENDIX

## APPENDIX B BOREHOLE LOGS

## TERMS USED ON BOREHOLE LOGS

### TERMS DESCRIBING CONSISTENCY OR CONDITION

COARSE GRAINED SOILS (major portion retained on 0.075mm sieve): includes (1) clean gravels and sands, and (2) silty or clayey gravels and sands. Condition is rated according to relative density, as inferred from laboratory or in situ tests.

| DESCRIPTIVE TERM | RELATIVE DENSITY | N (blows per 0.3m) |
|---|---|---|
| Very Loose | 0 to 20% | 0 to 4 |
| Loose | 20 to 40% | 4 to 10 |
| Compact | 40 to 75% | 10 to 30 |
| Dense | 75 to 90% | 30 to 50 |
| Very Dense | 90 to 100% | greater than 50 |

The number of blows, N, on a 51mm O.D. split spoon sampler of a 63.5kg weight falling 0.76m, required to drive the sampler a distance of 0.3m from 0.15m to 0.45m.

---

FINE GRAINED SOILS (major portion passing 0.075mm sieve): includes (1) inorganic and organic silts and clays, (2) gravelly, sandy, or silty clays, and (3) clayey silts. Consistency is rated according to shearing strength, as estimated from laboratory or in situ tests.

| DESCRIPTIVE TERM | UNCONFINED COMPRESSIVE STRENGTH (kPa) |
|---|---|
| Very Soft | Less Than 25 |
| Soft | 25 to 50 |
| Firm | 50 to 100 |
| Stiff | 100 to 200 |
| Very Stiff | 200 to 400 |
| Hard | Greater Than 400 |

NOTE: Slickensided and fissured clays may have lower unconfined compressive strengths than shown above, because of planes of weakness or cracks in the soil.

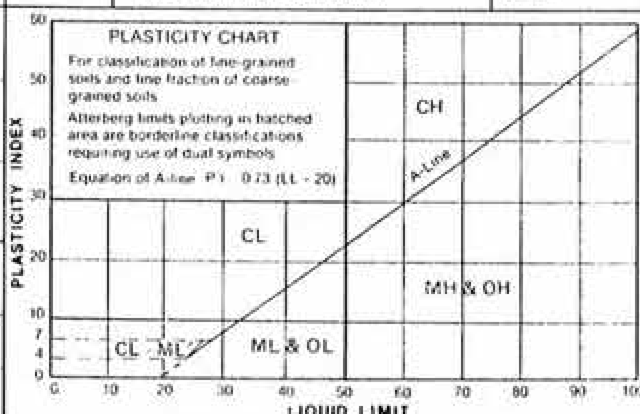
### GENERAL DESCRIPTIVE TERMS

| | |
|---|---|
| Slickensided | - having inclined planes of weakness that are slick and glossy in appearance. |
| Fissured | - containing shrinkage cracks, frequently filled with fine sand or silt; usually more or less vertical. |
| Laminated | - composed of thin layers of varying colour and texture. |
| Interbedded | - composed of alternate layers of different soil types. |
| Calcareous | - containing appreciable quantities of calcium carbonate. |
| Well Graded | - having wide range in grain sizes and substantial amounts of intermediate particle sizes. |
| Poorly graded | - predominantly of one grain size, or having a range of sizes with some intermediate size missing. |

eba

# UNIFIED SOIL CLASSIFICATION †

| MAJOR DIVISIONS | | | GROUP SYMBOLS | TYPICAL NAMES | CLASSIFICATION CRITERIA | | |
|---|---|---|---|---|---|---|---|
| COARSE-GRAINED SOILS More than 50% retained on No. 200 sieve* | GRAVELS 50% or more of coarse fraction retained on No. 4 sieve | CLEAN GRAVELS | GW | Well-graded gravels and gravel-sand mixtures little or no fines | Classification on basis of percentage of fines: Less than 5% Pass No. 200 sieve: GW, GP, SW, SP; More than 12% Pass No. 200 sieve: GM, GC, SM, SC; 5% to 12% Pass No. 200 sieve: Borderline Classification requiring use of dual symbols | $C_u = D_{60}/D_{10}$ Greater than 4; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3 | |
| | | | GP | Poorly graded gravels and gravel-sand mixtures, little or no fines | | Not meeting both criteria for GW | |
| | | GRAVELS WITH FINES | GM | Silty gravels, gravel-sand-silt mixtures | | Atterberg limits plot below "A" line or plasticity index less than 4 | Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols |
| | | | GC | Clayey gravels, gravel-sand-clay mixtures | | Atterberg limits plot above "A" line and plasticity index greater than 7 | |
| | SANDS More than 50% of coarse fraction passes No. 4 sieve | CLEAN SANDS | SW | Well-graded sands and gravelly sands, little or no fines | | $C_u = D_{60}/D_{10}$ Greater than 6; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3 | |
| | | | SP | Poorly graded sands and gravelly sands, little or no fines | | Not meeting both criteria for SW | |
| | | SANDS WITH FINES | SM | Silty sands, sand-silt mixtures | | Atterberg limits plot below "A" line or plasticity index less than 4 | Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols |
| | | | SC | Clayey sands, sand-clay mixtures | | Atterberg limits plot above "A" line and plasticity index greater than 7 | |
| FINE-GRAINED SOILS 50% or more passes No. 200 sieve* | SILTS AND CLAYS Liquid limit 50% or less | | ML | Inorganic silts, very fine sands, rock flour, silty or clayey fine sands | | | |
| | | | CL | Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays | | | |
| | | | OL | Organic silts and organic silty clays of low plasticity | | | |
| | SILTS AND CLAYS Liquid limit greater than 50% | | MH | Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts | | | |
| | | | CH | Inorganic clays of high plasticity, fat clays | | | |
| | | | OH | Organic clays of medium to high plasticity | | | |
| HIGHLY ORGANIC SOILS | | | Pt | Peat, muck and other highly organic soils | | | |




* Based on the material passing the 3-in. (75-mm) sieve
† ASTM Designation D 2487

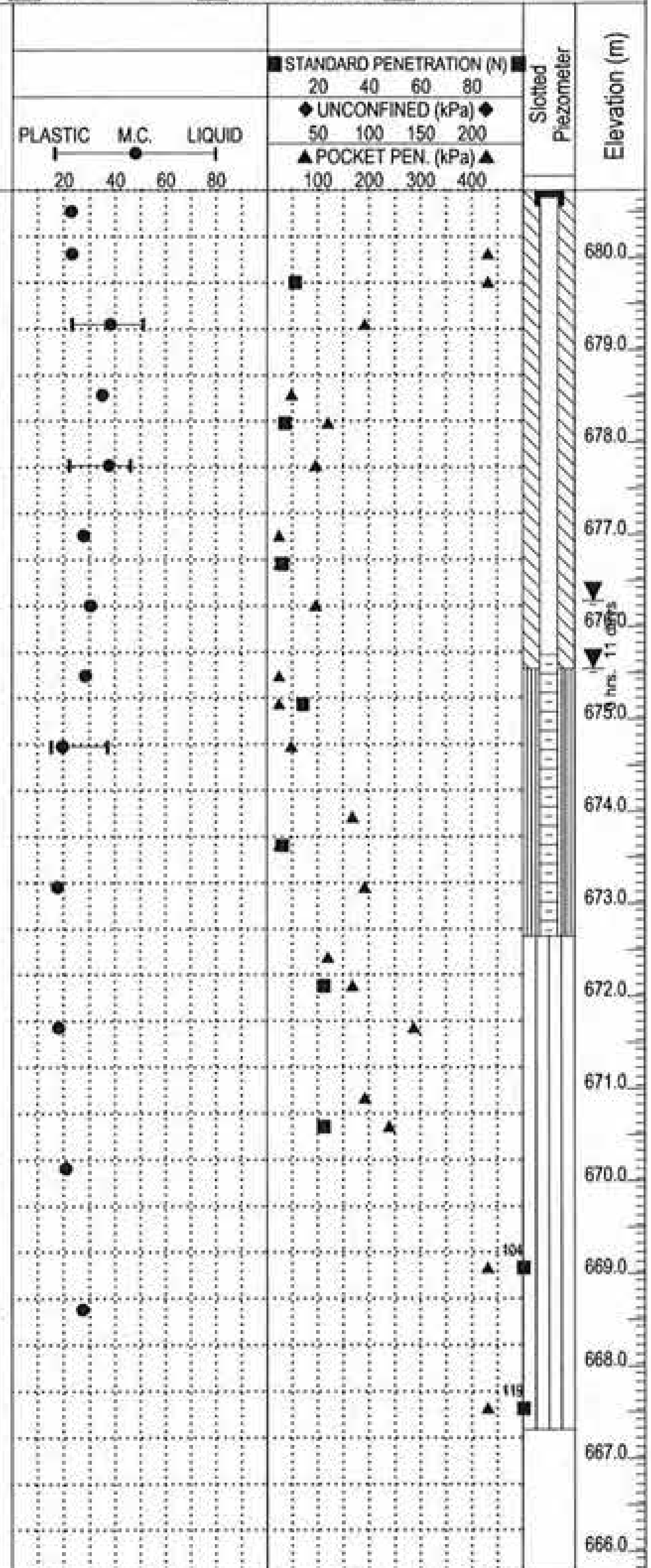
| WRR BYPASS - PROPOSED INTERCHANGES | ISL ENGINEERING & LAND SERVICES LTD. | PROJECT NO. - BOREHOLE NO. |
|---|---|---|
| VILLENEUVE ROAD | DRILL: SOLID STEM AUGER | E12201227-01 |
| ST. ALBERT, ALBERTA | 947281N; 20971E | ELEVATION: 680.73m |

SAMPLE TYPE: DISTURBED · NO RECOVERY · SPT · A-CASING · SHELBY TUBE · CORE

BACKFILL TYPE: BENTONITE · PEA GRAVEL · SLOUGH · GROUT · DRILL CUTTINGS · SAND

| Depth (m) | SOIL DESCRIPTION | SPT (N) | MOISTURE CONTENT |
|---|---|---|---|
| 0 | TOPSOIL - clayey, damp, black, rootlets, (150mm thick) | | 22.7 |
| | CLAY - silty, damp, hard, high plastic, greyish brown | | 23 |
| 1 | - very stiff | 11 | |
| | - siltier layers, moist, medium plastic | | 38 |
| | - silt layers, wet, firm, oxide staining | | |
| 2 | | | 34.9 |
| | | 7 | |
| 3 | SILT - clayey, wet, medium plastic, greyish brown | | 37.6 |
| | - clayier layers | | |
| | - iron nodules | | |
| | - sand layers, saturated | | 27.7 |
| 4 | - clay layers, high plastic | 6 | |
| | - rapid dilatancy | | 30.3 |
| 5 | | | 28.4 |
| | | 14 | |
| 6 | - small sand layers | | 19.5 |
| | - 200mm thick clay (till) layer | | |
| 7 | | 6 | |
| | CLAY (TILL) - silty, sandy, moist, stiff, medium plastic, dark grey | | 17.6 |
| 8 | - coal inclusions | | |
| | - small sand layers, saturated | 22 | |
| 9 | - very stiff | | 18 |
| 10 | | 22 | |
| | CLAY SHALE - silty, moist, hard, high plastic, grey | | 20.7 |
| 11 | - small interbedded sandstone layers | | |
| | | 104 | |
| 12 | | | 27.3 |
| | SANDSTONE - silty, clayey, medium grained, moist, very dense, light grey | | |
| 13 | | 119 | |
| | END OF BOREHOLE (13.41 metres) | | |
| | slough - 5.18 metres at 0 hrs. | | |
| | water - trace at 0 hrs. | | |
| 14 | - 4.45 metres at 11 days | | |
| | Standpipe installed to 8.08 metres | | |
| 15 | | | |

Water level markers (depth column): 0 hrs, 11 days

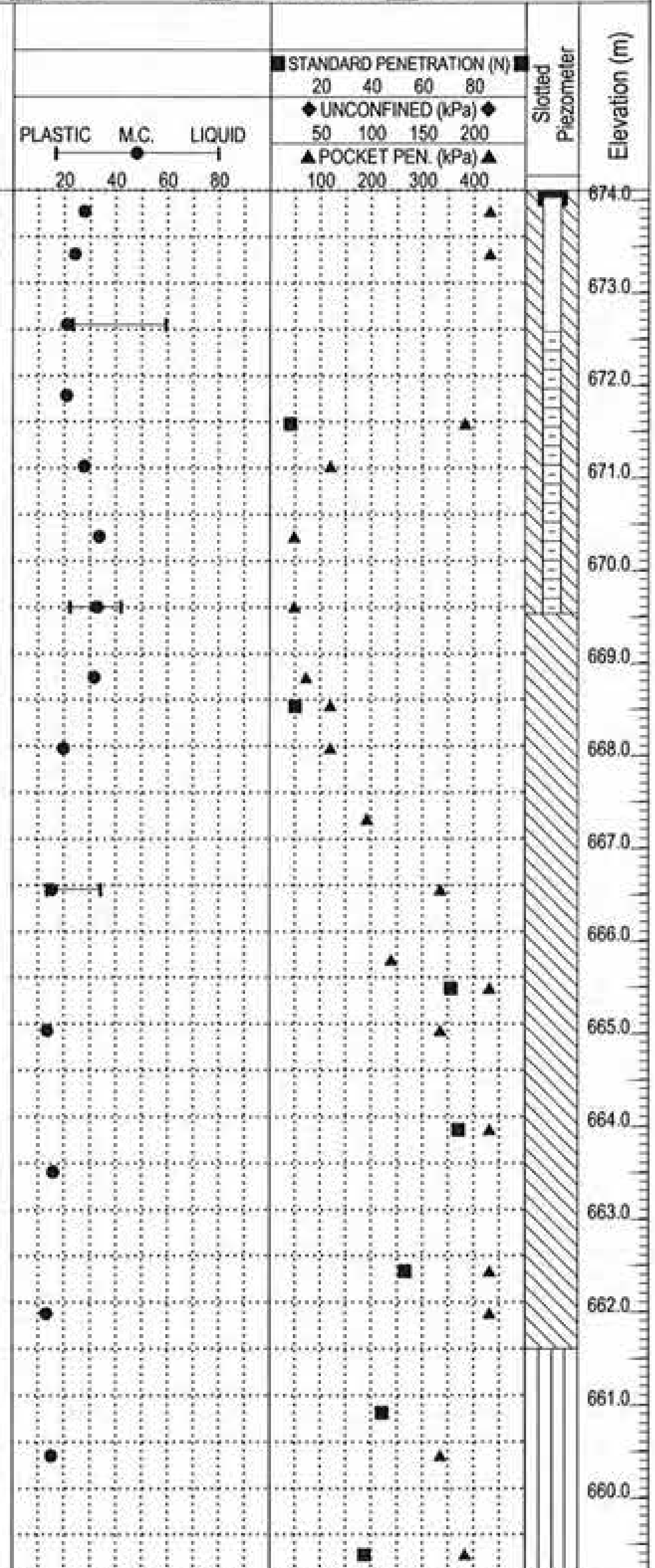



| EBA Engineering Consultants Ltd. | LOGGED BY: DJK | COMPLETION DEPTH: 13.41m |
|---|---|---|
| | REVIEWED BY: AFR | COMPLETE: 07/10/29 |
| | DRAWING NO: 12201227-01 | Page 1 of 1 |

| WRR BYPASS - PROPOSED INTERCHANGES | ISL ENGINEERING & LAND SERVICES LTD. | PROJECT NO. - BOREHOLE NO. |
|---|---|---|
| GIROUX ROAD | DRILL: SOLID STEM AUGER | E12201227-02 |
| ST. ALBERT, ALBERTA | 945225N; 21141E | ELEVATION: 674.11m |

| | | | | | | |
|---|---|---|---|---|---|---|
| SAMPLE TYPE | DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE |
| BACKFILL TYPE | BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND |

| SOIL DESCRIPTION | SPT (N) | MOISTURE CONTENT |
|---|---|---|
| CLAY (REWORKED), silty, organics, damp, hard, medium plastic, black | | 27.6 |
| CLAY - silty, damp, hard, high plastic, greyish brown | | 23.9 |
| - siltier layers, medium plastic, light greyish brown | | |
| - crumbly | | 20.8 |
| - very stiff to hard | | 20.7 |
| | 8 | |
| - moist, stiff, greyish brown | | 27.7 |
| - wet, firm | | 33.5 |
| | | 32.6 |
| | | 31.6 |
| - clay (till) pockets, stiff | 10 | |
| CLAY (TILL) - silty, sandy, moist to wet, stiff, medium plastic, dark grey, coal inclusions | | 19.6 |
| - sand pockets, moist | | |
| - sand pockets, wet | | 15.1 |
| - very stiff | | |
| - sandier layers | | |
| - difficult drilling | 71 | |
| | | 13.3 |
| - hard | | |
| - some sand, medium to high plastic | | |
| | 74 | |
| | | 15.7 |
| | 53 | |
| | | 13 |
| | 44 | |
| - very stiff to hard | | 14.9 |
| | 37 | |




Depth (m): 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

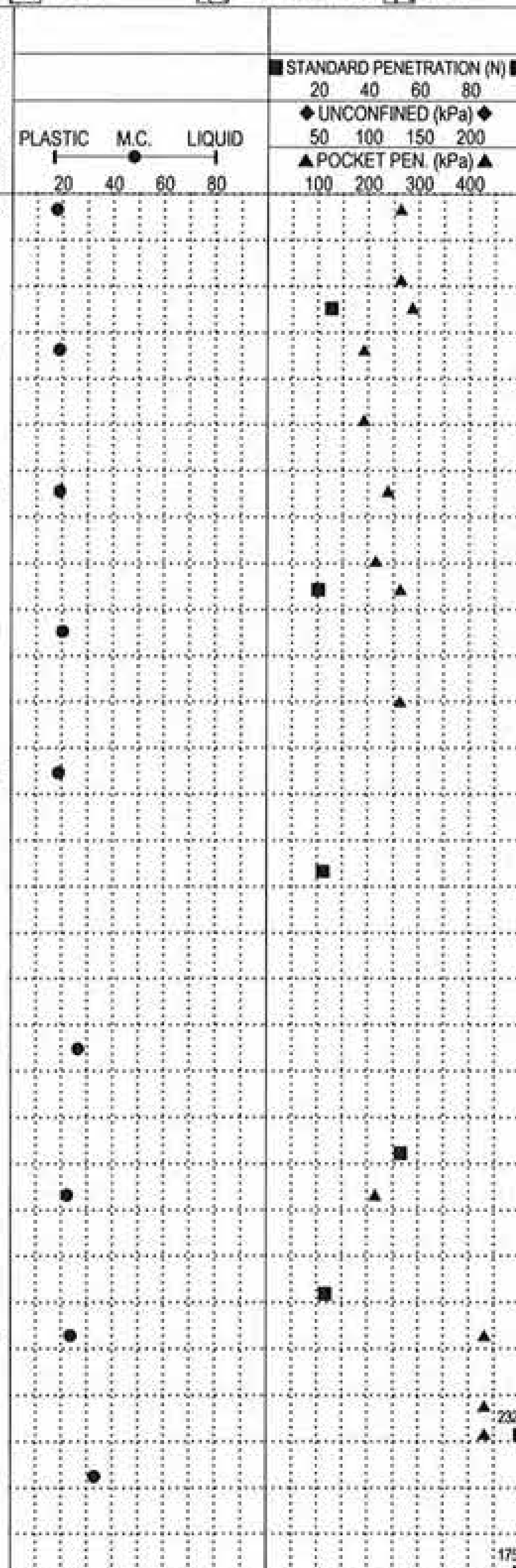
| EBA Engineering Consultants Ltd. | LOGGED BY: DJK | COMPLETION DEPTH: 30.1m |
|---|---|---|
| | REVIEWED BY: AFR | COMPLETE: 07/10/29 |
| | DRAWING NO: 12201227-02 | Page 1 of 3 |

| WRR BYPASS - PROPOSED INTERCHANGES | ISL ENGINEERING & LAND SERVICES LTD. | PROJECT NO. - BOREHOLE NO. |
|---|---|---|
| GIROUX ROAD | DRILL: SOLID STEM AUGER | E12201227-02 |
| ST. ALBERT, ALBERTA | 945225N; 21141E | ELEVATION: 674.11m |

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

| Depth (m) | SOIL DESCRIPTION | SPT (N) | MOISTURE CONTENT | Elevation (m) |
|---|---|---|---|---|
| 15 | - very stiff | | 17.6 | 659.0 |
| 16 | | 25 | | 658.0 |
| 17 | - stiff to very stiff | | 18.7 | 657.0 |
| 18 | - very stiff | | 18.9 | 656.0 |
| 19 | | 20 | | 655.0 |
| 20 | | | 20.1 | 654.0 |
| 21 | | | 18.6 | 653.0 |
| 22 | SAND - clean, trace of silt, fine to medium grained, saturated, dark grey<br>- dense to very dense<br>- small interbedded clay layers<br>- auger washed clean from 22.10 to 25.15 metres | 22 | | 652.0 |
| 23 | | | | 651.0 |
| 24 | | | 26.4 | 650.0 |
| 25 | | 53 | | 649.0 |
| 26 | - 450mm thick clay layer, moist, very stiff, high plastic, dark grey | | 22.1 | 648.0 |
| 27 | | 23 | | 647.0 |
| | CLAY SHALE - silty, moist, hard, medium plastic, light grey | | 23.5 | |
| 28 | - high plastic, dark grey to light grey | 232 | | 646.0 |
| 29 | - coal inclusions | | 32.9 | 645.0 |
| 30 | | 175/225mm | | |




Slotted Piezometer

| EBA Engineering Consultants Ltd. | LOGGED BY: DJK | COMPLETION DEPTH: 30.1m |
|---|---|---|
| | REVIEWED BY: AFR | COMPLETE: 07/10/29 |
| | DRAWING NO: 12201227-02 | Page 2 of 3 |

| WRR BYPASS - PROPOSED INTERCHANGES | ISL ENGINEERING & LAND SERVICES LTD. | PROJECT NO. - BOREHOLE NO. |
|---|---|---|
| GIROUX ROAD | DRILL: SOLID STEM AUGER | E12201227-02 |
| ST. ALBERT, ALBERTA | 945225N; 21141E | ELEVATION: 674.11m |

SAMPLE TYPE: DISTURBED, NO RECOVERY, SPT, A-CASING, SHELBY TUBE, CORE

BACKFILL TYPE: BENTONITE, PEA GRAVEL, SLOUGH, GROUT, DRILL CUTTINGS, SAND

| Depth (m) | SOIL DESCRIPTION | SAMPLE TYPE | SPT (N) | MOISTURE CONTENT | PLASTIC / M.C. / LIQUID (20 40 60 80) | STANDARD PENETRATION (N) 20 40 60 80; UNCONFINED (kPa) 50 100 150 200; POCKET PEN. (kPa) 100 200 300 400 | Slotted Piezometer | Elevation (m) |
|---|---|---|---|---|---|---|---|---|
| 30 | END OF BOREHOLE (30.10 metres)<br>slough - necking at 12.50 metres at 0 hrs.<br>water - dry at 0 hrs.<br>- dry at 11 days<br>Standpipe installed to 4.57 metres | | | | | | | 644.0 |
| 31 | | | | | | | | 643.0 |
| 32 | | | | | | | | 642.0 |
| 33 | | | | | | | | 641.0 |
| 34 | | | | | | | | 640.0 |
| 35 | | | | | | | | 639.0 |
| 36 | | | | | | | | 638.0 |
| 37 | | | | | | | | 637.0 |
| 38 | | | | | | | | 636.0 |
| 39 | | | | | | | | 635.0 |
| 40 | | | | | | | | 634.0 |
| 41 | | | | | | | | 633.0 |
| 42 | | | | | | | | 632.0 |
| 43 | | | | | | | | 631.0 |
| 44 | | | | | | | | 630.0 |
| 45 | | | | | | | | |

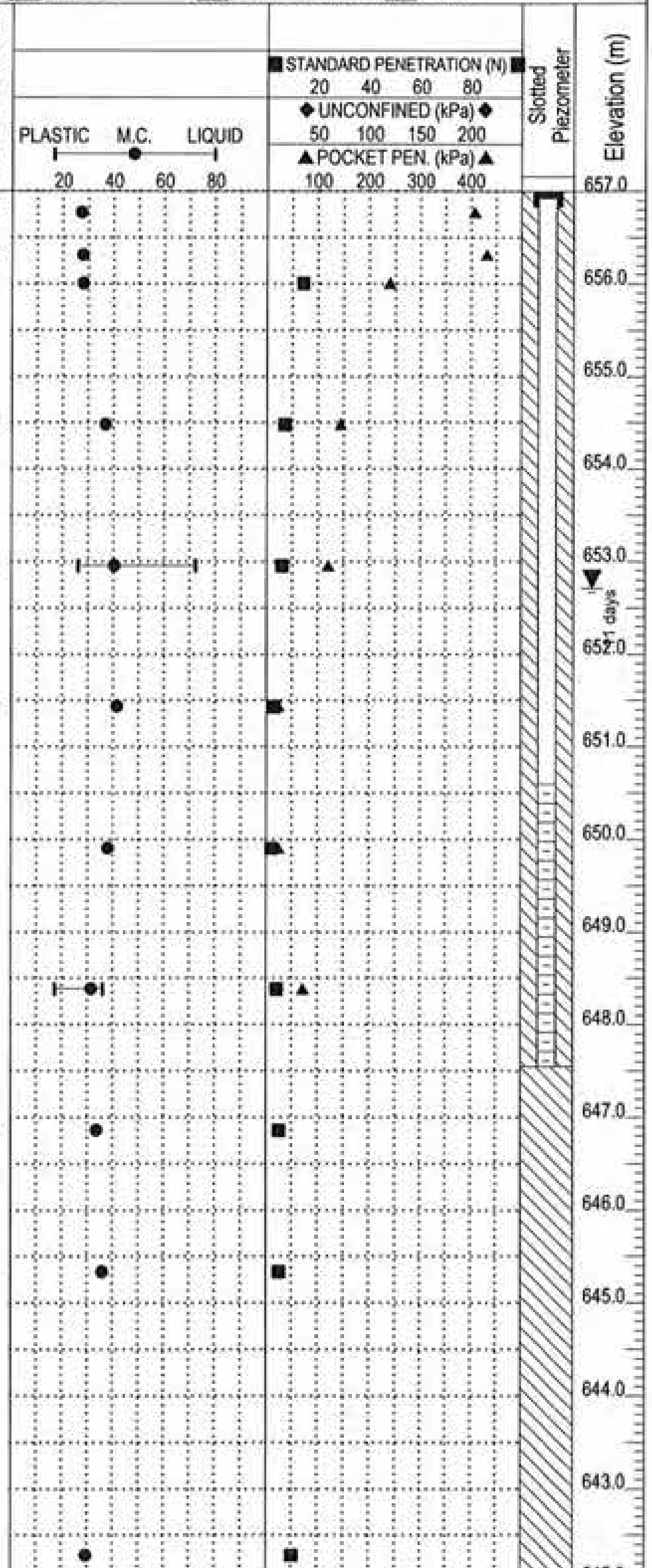
| EBA Engineering Consultants Ltd. | LOGGED BY: DJK | COMPLETION DEPTH: 30.1m |
|---|---|---|
| | REVIEWED BY: AFR | COMPLETE: 07/10/29 |
| | DRAWING NO: 12201227-02 | Page 3 of 3 |

| WRR BYPASS - PROPOSED INTERCHANGES | ISL ENGINEERING & LAND SERVICES LTD. | PROJECT NO. - BOREHOLE NO. |
|---|---|---|
| McKENNEY AVENUE | DRILL: HOLLOW STEM AUGER | E12201227-03 |
| ST. ALBERT, ALBERTA | 944037N; 21752E | ELEVATION: 657m |

SAMPLE TYPE: DISTURBED, NO RECOVERY, SPT, A-CASING, SHELBY TUBE, CORE

BACKFILL TYPE: BENTONITE, PEA GRAVEL, SLOUGH, GROUT, DRILL CUTTINGS, SAND

| Depth (m) | SOIL DESCRIPTION | SAMPLE TYPE | SPT (N) | MOISTURE CONTENT |
|---|---|---|---|---|
| 0 | ASPHALT - (60mm thick) | | | |
| | SAND AND GRAVEL (FILL) - trace of silt, well graded, moist, dark greyish brown, (165mm thick) | Disturbed | | 27.2 |
| | | Disturbed | | 27.8 |
| 1 | CLAY (FILL) - silty, moist, hard, high plastic, greyish brown | SPT | 14 | 28 |
| | CLAY - silty, organics, damp, hard, medium plastic, black | | | |
| | - trace of organics, stained very dark greyish brown | | | |
| 2 | - moist, very stiff, high plastic, greyish brown | | | |
| | - stiff, white deposits | SPT | 7 | 36.8 |
| 4 | - siltier layers, moist to wet, oxide staining | SPT | 6 | 40.3 |
| | - silt layers, rapid dilatancy, saturated, dark grey | SPT | 3 | 41.5 |
| 7 | SILT - clayey, saturated, very loose, medium plastic, dark grey | SPT | 2 | 38 |
| | - clay layers | | | |
| | - coal inclusions | SPT | 4 | 31.4 |
| 10 | | SPT | 5 | 33.6 |
| 11 | | SPT | 5 | 35.9 |
| 15 | - sandy, loose to compact | SPT | 10 | 29.4 |




**EBA Engineering Consultants Ltd.**

| LOGGED BY: DJK | COMPLETION DEPTH: 33.22m |
|---|---|
| REVIEWED BY: AFR | COMPLETE: 07/10/30 |
| DRAWING NO: 12201227-03 | Page 1 of 3 |

| WRR BYPASS - PROPOSED INTERCHANGES | ISL ENGINEERING & LAND SERVICES LTD. | PROJECT NO. - BOREHOLE NO. |
|---|---|---|
| McKENNEY AVENUE | DRILL: HOLLOW STEM AUGER | E12201227-03 |
| ST. ALBERT, ALBERTA | 944037N; 21752E | ELEVATION: 657m |

SAMPLE TYPE: DISTURBED, NO RECOVERY, SPT, A-CASING, SHELBY TUBE, CORE

BACKFILL TYPE: BENTONITE, PEA GRAVEL, SLOUGH, GROUT, DRILL CUTTINGS, SAND

Chart scales: PLASTIC — M.C. — LIQUID (20, 40, 60, 80); ■ STANDARD PENETRATION (N) ■ 20 40 60 80; ◆ UNCONFINED (kPa) ◆ 50 100 150 200; ▲ POCKET PEN. (kPa) ▲ 100 200 300 400; Slotted Piezometer

| Depth (m) | SOIL DESCRIPTION | SAMPLE TYPE | SPT (N) | MOISTURE CONTENT | Elevation (m) |
|---|---|---|---|---|---|
| 15 | | | | | 642.0 |
| 16 | | | | | 641.0 |
| 17 | | | | | 640.0 |
| 18 | | SPT | 10 | 29.1 | 639.0 |
| 19 | | | | | 638.0 |
| 20 | | | | | 637.0 |
| 21 | SAND - some silt, medium grained, saturated, compact, dark grey | SPT | 15 | 28.3 | 636.0 |
| 22 | | | | | 635.0 |
| 23 | | | | | 634.0 |
| 24 | SILT - clayey, trace of sand, saturated, compact, low plastic, dark grey | SPT | 14 | 28.8 | 633.0 |
| 25 | | | | | 632.0 |
| 26 | | | | | 631.0 |
| 27 | SAND - silty, fine grained, saturated, compact, dark grey | SPT | 21 | 28.1 | 630.0 |
| 28 | | | | | 629.0 |
| 29 | | | | | 628.0 |
| 30 | | SPT | | | 627.0 |

| EBA Engineering Consultants Ltd. | LOGGED BY: DJK | COMPLETION DEPTH: 33.22m |
|---|---|---|
| | REVIEWED BY: AFR | COMPLETE: 07/10/30 |
| | DRAWING NO: 12201227-03 | Page 2 of 3 |

| WRR BYPASS - PROPOSED INTERCHANGES | ISL ENGINEERING & LAND SERVICES LTD. | PROJECT NO. - BOREHOLE NO. |
|---|---|---|
| McKENNEY AVENUE | DRILL: HOLLOW STEM AUGER | E12201227-03 |
| ST. ALBERT, ALBERTA | 944037N; 21752E | ELEVATION: 657m |

SAMPLE TYPE: DISTURBED, NO RECOVERY, SPT, A-CASING, SHELBY TUBE, CORE

BACKFILL TYPE: BENTONITE, PEA GRAVEL, SLOUGH, GROUT, DRILL CUTTINGS, SAND

| Depth (m) | SOIL DESCRIPTION | SAMPLE TYPE | SPT (N) | MOISTURE CONTENT | PLASTIC / M.C. / LIQUID (20 40 60 80) | STANDARD PENETRATION (N) 20 40 60 80; UNCONFINED (kPa) 50 100 150 200; POCKET PEN. (kPa) 100 200 300 400 | Slotted Piezometer | Elevation (m) |
|---|---|---|---|---|---|---|---|---|
| 30 | | SPT | 22 | 23.7 | | | Drill cuttings | 627.0 |
| 31 | | | | | | | | 626.0 |
| 32 | | | | | | | | 625.0 |
| 33 | | SPT | 25 | 25.8 | ● | ■ | | 624.0 |
| 34 | END OF BOREHOLE (33.22 metres)<br>water - 4.29 metres at 11 days<br>Standpipe installed to 9.45 metres | | | | | | | 623.0 |
| 35 | | | | | | | | 622.0 |
| 36 | | | | | | | | 621.0 |
| 37 | | | | | | | | 620.0 |
| 38 | | | | | | | | 619.0 |
| 39 | | | | | | | | 618.0 |
| 40 | | | | | | | | 617.0 |
| 41 | | | | | | | | 616.0 |
| 42 | | | | | | | | 615.0 |
| 43 | | | | | | | | 614.0 |
| 44 | | | | | | | | 613.0 |
| 45 | | | | | | | | 612.0 |

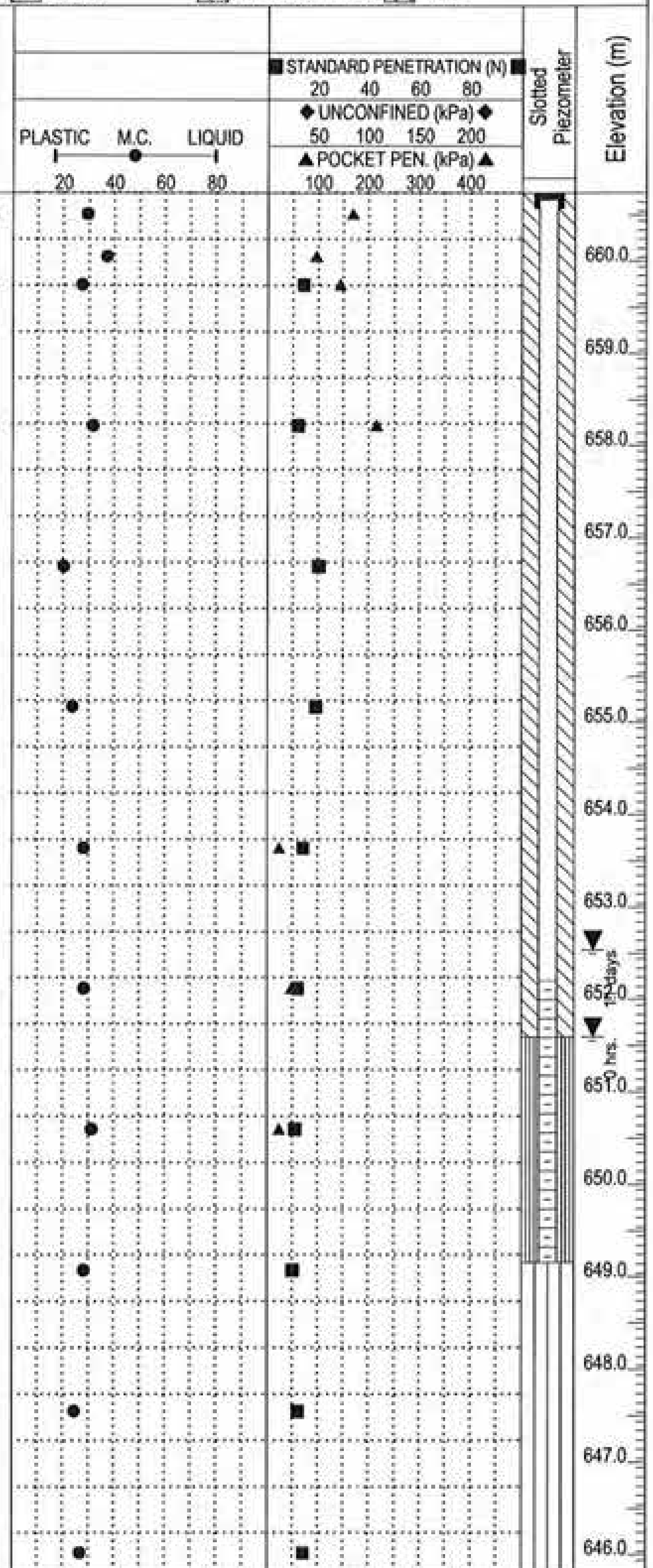
| EBA Engineering Consultants Ltd. | LOGGED BY: DJK | COMPLETION DEPTH: 33.22m |
|---|---|---|
| | REVIEWED BY: AFR | COMPLETE: 07/10/30 |
| | DRAWING NO: 12201227-03 | Page 3 of 3 |

| WRR BYPASS - PROPOSED INTERCHANGES | ISL ENGINEERING & LAND SERVICES LTD. | PROJECT NO. - BOREHOLE NO. |
|---|---|---|
| FUTURE 137 AVENUE CROSSING | DRILL: HOLLOW STEM AUGER | E12201227-04 |
| ST. ALBERT, ALBERTA | 941865N; 23150E | ELEVATION: 660.74m |

SAMPLE TYPE: DISTURBED, NO RECOVERY, SPT, A-CASING, SHELBY TUBE, CORE

BACKFILL TYPE: BENTONITE, PEA GRAVEL, SLOUGH, GROUT, DRILL CUTTINGS, SAND

| Depth (m) | SOIL DESCRIPTION | SAMPLE TYPE | SPT (N) | MOISTURE CONTENT |
|---|---|---|---|---|
| 0 | CLAY (FILL) - silty, trace of sand, moist,s tiff, medium plastic, dark greyish brown | DISTURBED | | 29.3 |
| | | DISTURBED | | 37 |
| 1 | | SPT | 14 | 27.3 |
| | CLAY - silty, moist, stiff, medium plastic, dark greyish brown | | | |
| 2 | | | | |
| | - siltier layers | SPT | 12 | 31.5 |
| 3 | | | | |
| 4 | SILT - clayey, sandy, damp, compact, low plastic, dark greyish brown | SPT | 20 | 20.1 |
| | - interbedded sand layers, fine grained | | | |
| 5 | - easier drilling | | | |
| | - moist | SPT | 19 | 23.6 |
| 6 | | | | |
| 7 | - rapid dilatancy, saturated | SPT | 14 | 28.1 |
| 8 | | | | |
| 9 | | SPT | 12 | 28.2 |
| 10 | | SPT | 11 | 31.2 |
| 11 | | | | |
| | SAND - trace of silt, fine to medium grained, saturated, loose to compact, grey | SPT | 10 | 28.1 |
| 12 | | | | |
| 13 | | SPT | 12 | 24.4 |
| 14 | | | | |
| 15 | - compact, coal deposits | SPT | 14 | 26.6 |




EBA Engineering Consultants Ltd.

| LOGGED BY: DJK | COMPLETION DEPTH: 33.22m |
|---|---|
| REVIEWED BY: AFR | COMPLETE: 07/10/31 |
| DRAWING NO: 12201227-04 | Page 1 of 3 |

GEOTECHNICAL E12201227.GPJ EBA.GDT 08/3/5

| WRR BYPASS - PROPOSED INTERCHANGES | ISL ENGINEERING & LAND SERVICES LTD. | PROJECT NO. - BOREHOLE NO. |
|---|---|---|
| FUTURE 137 AVENUE CROSSING | DRILL: HOLLOW STEM AUGER | E12201227-04 |
| ST. ALBERT, ALBERTA | 941865N; 23150E | ELEVATION: 660.74m |

SAMPLE TYPE: DISTURBED, NO RECOVERY, SPT, A-CASING, SHELBY TUBE, CORE

BACKFILL TYPE: BENTONITE, PEA GRAVEL, SLOUGH, GROUT, DRILL CUTTINGS, SAND

| Depth (m) | SOIL DESCRIPTION | SAMPLE TYPE | SPT (N) | MOISTURE CONTENT | Elevation (m) |
|---|---|---|---|---|---|
| 15 | | | | | |
| 16 | | | | | 645.0 |
| 17 | | | | | 644.0 |
| 18 | - fine grained, dense to compact | SPT | 27 | 25 | 643.0 |
| 19 | | | | | 642.0 |
| 20 | | | | | 641.0 |
| 21 | | SPT | 28 | 23.3 | 640.0 |
| 22 | - silty, coal deposits | | | | 639.0 |
| 23 | | | | | 638.0 |
| 24 | | SPT | 36 | 25.2 | 637.0 |
| 25 | | | | | 636.0 |
| 26 | | | | | 635.0 |
| 27 | - clean, trace of silt, very dense, (hollow stem not advanced for 0.5 hour, sand locked) | SPT | 90 | 20.8 | 634.0 |
| 28 | | | | | 633.0 |
| 29 | | | | | 632.0 |
| 30 | - dense to compact | NO RECOVERY | | | 631.0 |

Chart columns: PLASTIC — M.C. — LIQUID (20, 40, 60, 80); ■ STANDARD PENETRATION (N) ■ (20, 40, 60, 80); ◆ UNCONFINED (kPa) ◆ (50, 100, 150, 200); ▲ POCKET PEN. (kPa) ▲ (100, 200, 300, 400); Slotted Piezometer

| EBA Engineering Consultants Ltd. | LOGGED BY: DJK | COMPLETION DEPTH: 33.22m |
|---|---|---|
| | REVIEWED BY: AFR | COMPLETE: 07/10/31 |
| | DRAWING NO: 12201227-04 | Page 2 of 3 |

| WRR BYPASS - PROPOSED INTERCHANGES | ISL ENGINEERING & LAND SERVICES LTD. | PROJECT NO. - BOREHOLE NO. |
|---|---|---|
| FUTURE 137 AVENUE CROSSING | DRILL: HOLLOW STEM AUGER | E12201227-04 |
| ST. ALBERT, ALBERTA | 941865N; 23150E | ELEVATION: 660.74m |

SAMPLE TYPE: DISTURBED, NO RECOVERY, SPT, A-CASING, SHELBY TUBE, CORE

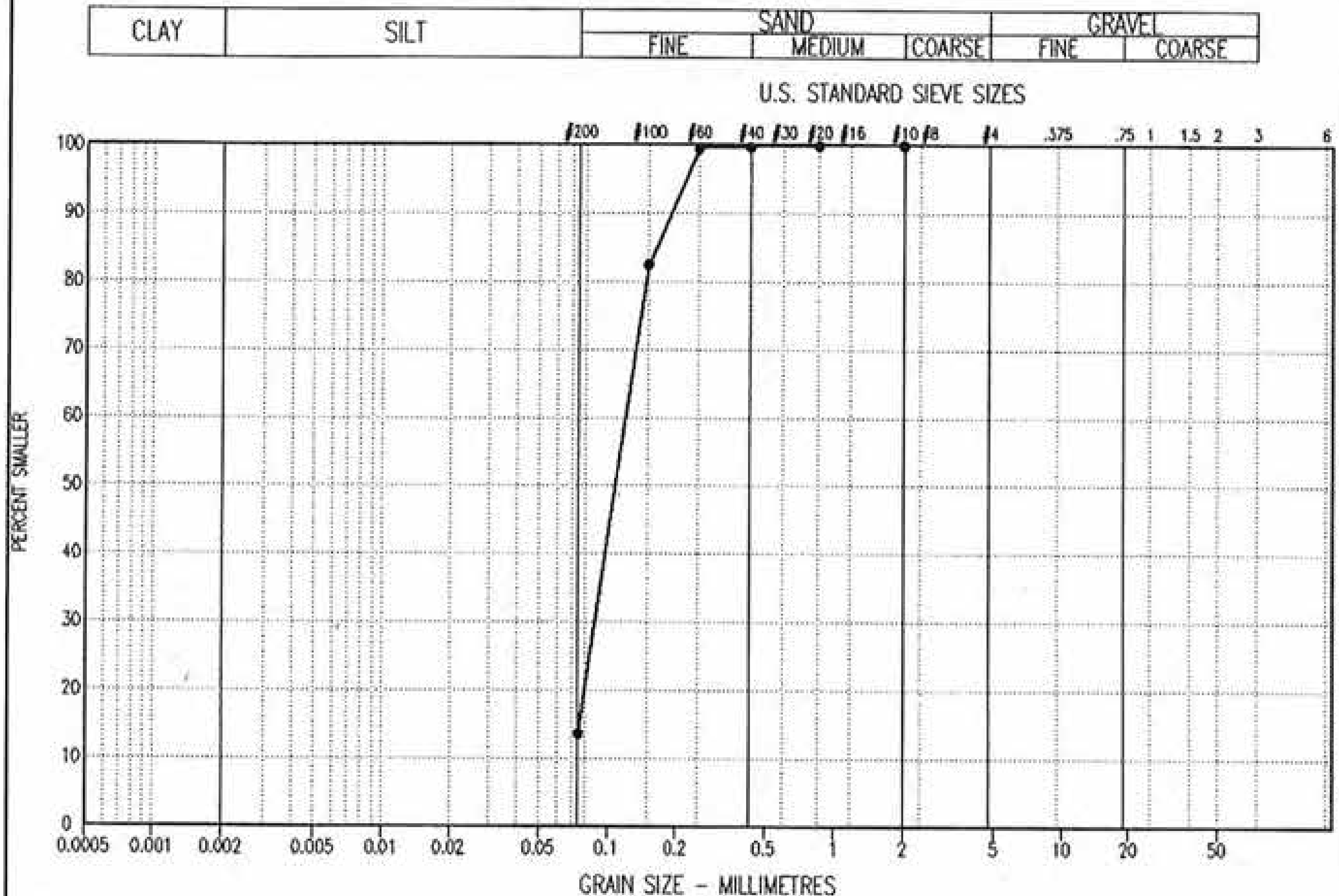
BACKFILL TYPE: BENTONITE, PEA GRAVEL, SLOUGH, GROUT, DRILL CUTTINGS, SAND

| Depth (m) | SOIL DESCRIPTION | SAMPLE TYPE | SPT (N) | MOISTURE CONTENT | PLASTIC / M.C. / LIQUID (20 40 60 80) | STANDARD PENETRATION (N) 20 40 60 80; UNCONFINED (kPa) 50 100 150 200; POCKET PEN. (kPa) 100 200 300 400 | Slotted Piezometer | Elevation (m) |
|---|---|---|---|---|---|---|---|---|
| 30 | | No recovery | 30 | | | | | |
| 31 | | | | | | | | 630.0 |
| 32 | | | | | | | | 629.0 |
| 33 | - medium grained, compact | SPT | 26 | 23.6 | ● | ■ | | 628.0 |
| | END OF BOREHOLE (33.22 metres)<br>slough - 9.14 metres at 0 hrs.<br>water - trace at 0 hrs.<br>- 8.20 metres at 11 days<br>Standpipe installed to 11.58 metres | | | | | | | 627.0 |
| 34 | | | | | | | | |
| 35 | | | | | | | | 626.0 |
| 36 | | | | | | | | 625.0 |
| 37 | | | | | | | | 624.0 |
| 38 | | | | | | | | 623.0 |
| 39 | | | | | | | | 622.0 |
| 40 | | | | | | | | 621.0 |
| 41 | | | | | | | | 620.0 |
| 42 | | | | | | | | 619.0 |
| 43 | | | | | | | | 618.0 |
| 44 | | | | | | | | 617.0 |
| 45 | | | | | | | | 616.0 |

| EBA Engineering Consultants Ltd. | LOGGED BY: DJK | COMPLETION DEPTH: 33.22m |
|---|---|---|
| | REVIEWED BY: AFR | COMPLETE: 07/10/31 |
| | DRAWING NO: 12201227-04 | Page 3 of 3 |

# EBA Engineering

## PARTICLE SIZE – ANALYSIS OF SOILS




| SYMBOL | BOREHOLE NUMBER | DEPTH (m) | CLAY % | SILT % | SAND % | GRAVEL % | Cu | Cc | U.S.C |
|---|---|---|---|---|---|---|---|---|---|
| •——• | 3 | 20.70 | --- 14 --- | | 86 | 0 | 1.8 | 1.0 | SM |

Project: E12201227

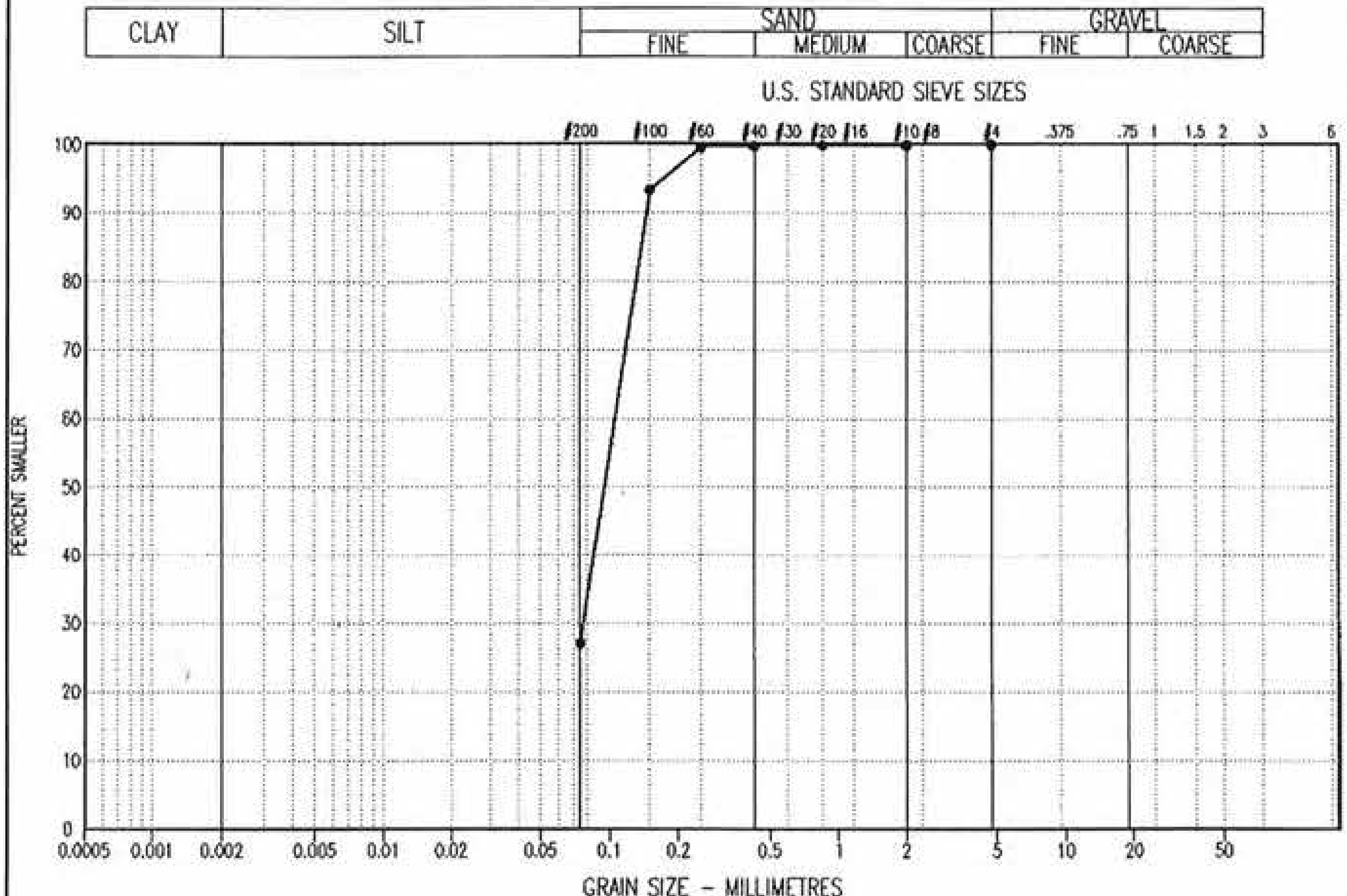
Date Tested: 07/11/06

BY: KTP

Tested in accordance with ASTM D422 unless otherwise noted.

# EBA Engineering

## PARTICLE SIZE – ANALYSIS OF SOILS




| SYMBOL | BOREHOLE NUMBER | DEPTH (m) | DESCRIPTION CLAY % | SILT % | SAND % | GRAVEL % | Cu | Cc | U.S.C |
|---|---|---|---|---|---|---|---|---|---|
| ●——● | 3 | 29.90 | ---- 27 | ---- | 73 | 0 | 2.0 | 1.0 | SM |

Project: E12201227

Date Tested: 07/11/06

BY: KTP

Tested in accordance with ASTM D422 unless otherwise noted.

# APPENDIX F

# Appendix F

## Environmental Report

# An Evaluation of the Environmental Assessment, Approval and Permitting Implications of Upgrading Ray Gibbon Drive to Provincial Roadway Status

**Final Report**

*Prepared for:*

**ISL Engineering and Land Services Ltd.**
Edmonton, Alberta

*Prepared by:*

**Spencer Environmental Management Services Ltd.**
Edmonton, Alberta

Project Number EP-369

JUNE 2008

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# 1.0 INTRODUCTION

## *1.1 Background*

In 2004, Spencer Environmental, under contract to ISL Engineering and Lands, completed an Environmental Impact Assessment (EIA) pursuant to the *Canadian Environmental Assessment Act* (*CEAAct*) for a segment of the proposed West Regional Roadway (WRR) (also now officially named Ray Gibbon Drive). That project was an initiative of the City of St. Albert. The entire WRR was planned to be constructed in three geographic phases. Phase 1, which contained the segment for which the *CEAAct EIA* was prepared, extended north from 137 Avenue to approximately McKenney Avenue. Phase 2 extends from McKenney Avenue to Giroux Road. Detailed engineering design, including environmental assessment activities in support of environmental permitting, have been completed but construction has not commenced. Phase 3 extends from Giroux Road north to Villeneuve Road. Some environmental assessment work in support of environmental permitting has been undertaken but that work is incomplete. Detailed engineering design for Phase 3 is incomplete.

Within the geographic phases of the project, work is scheduled to be undertaken in temporal stages with additional lanes and bridge decks over the Sturgeon River to be added according to increasing traffic volumes. Stage 1 of Phase 1 included construction of one bridge deck over the Sturgeon River. Vehicle travel lanes were limited to one in each direction for Stage 1 of Phase 1. Stage 2 will include the addition of another lane in each direction and placement of another bridge deck over piers placed in the Sturgeon River as part of Stage 1.

*The CEAAct* EIA focused on Stage 2 of a segment of Phase One between 137 Avenue and the existing CN Rail Line (Sangudo Subdivision), located 800 m north of Meadowview Drive. The *CEAAct* review examined the Sturgeon river crossing and the rail crossing. The ultimate roadway design for the project was a four lane expressway constructed within a corridor of sufficient width to eventually accommodate a six lane expressway. Stage 2 would involve 2 lanes in each direction and two bridges over the Sturgeon River. The speed limit for that expressway was proposed as and currently is 70 kph. A Right-of-Way (ROW) of 58 m was assessed, featuring a 1 to 1.5m high berm planned within the Sturgeon River Valley and parks areas. Those perimeter berms were for purposes of noise attenuation and visual screening.

At the Sturgeon River, bridge piers were installed to accommodate two separate bridge decks but only the downstream deck was installed as part of the initial WRR project. The upstream deck was to be installed when traffic volumes so justified. The Stage One bridge incorporated a 3 m wide pedestrian pathway. Stage Two would include a 4 m wide pedway. West and east of the bridge, a 3 m wide pathway was planned for either within the 58 m wide right of way or immediately outside of it and the perimeter berms.

Department of Fisheries and Oceans Canada (DFO) was the Responsible Authority (RA) for the project review under *CEAAct*. The City of St. Albert then completed an EIA for the project that addressed several environmental subject areas and issues of relevance to federal government legislated mandates. DFO issued Terms-of-Reference (TOR), identifying specific information to be supplied in support of DFO's *CEAAct* Environmental Screening Report. The City of St. Albert also determined to supply other environmental impact information in their EIA that addressed issues outside of the federal government's interest but that were of interest to public interest stakeholders. Some of those issues related to lands outside of the *CEAAct* EIA study area are specified in the TOR.

The province of Alberta participated in the EIA process in accordance with Appendix 3 of the Canada-Alberta Agreement for Environmental Assessment Cooperation (Appendix A-2). That past involvement with the project is an important aspect requiring consideration for any future environmental assessment activities that could occur.

City of St. Albert's EIA for the WRR project was accepted as satisfactory for the federal government's (DFO in this case) information requirements and the project proceeded to the environmental permitting stage. City of St. Albert applied for specific provincial and federal environmental permits to construct the project. All necessary permits and approvals were secured and construction of the project commenced in autumn of 2004.

In 2007, City of St. Albert officially renamed WRR as Ray Gibbon Drive and opened Phase 1 in October of that year. Also in autumn of 2007, the City of St. Albert and the provincial government [Alberta Infrastructure and Transportation (INFTRA)] reached an understanding whereby the Province of Alberta would investigate the viability of incorporating Ray Gibbon Drive with the provincial highway network - specifically as part of Highway 2. In order for Ray Gibbon Drive to become part of that provincial highway network, however, certain provincial design standards that Ray Gibbon Drive does not currently meet must be achieved.

In autumn of 2007, City of St. Albert retained ISL Engineering and Land Services to review the current Ray Gibbon Drive design and to recommend the facilities and a specific design needed for that roadway (referred to as "provincial road" in the remainder of this report) to achieve the provincial standard. In turn, ISL retained Spencer Environmental to undertake an analysis of the implications of the changed design for future environmental reviews and permitting. This document does not address the matter of decommissioned landfills and hydrocarbon well-sites in the vicinity of Villeneuve Road. That is because it is known to Spencer Environmental that ISL is already working on those subjects.

Spencer Environmental's mandate for the exercise was not to prepare a new EIA or update the existing EIA document.

### 1.2 Objectives

In December of 2007, Spencer Environmental submitted a proposal to ISL for an analysis of what is termed "a provincial road" with the following objectives:

- Review the revised project description to determine how it differs from the WRR project that was assessed in the 2004 EIA.
- On a broad level, undertake a spatial analysis of the revised project to determine any new areas of potential impacts and any new types of environmental features that could generate impacts not already covered in the original EIA. On the basis of the above, determine if any environmental permits (federal or provincial) are required or any environmental review processes triggered.
- Considering the project revisions, review the existing EIA document to determine which of the impact predictions of that EIA would no longer be valid. That review would extend to subject matter not covered by environmental permitting but pertaining to important issues in the original EIA.
- Review existing environmental permits for the project to determine which of those may require alteration in the context of a revised project description.
- Determine any new environmental information needs to support environmental permits applications or amendments to existing applications.
- Determine what options, other than by way of environmental permit applications, the federal government may have for initiating a reassessment of the project pursuant to *CEAAct*.
- Make recommendations concerning future environmental assessment and planning for the provincial road.

### 1.3 Report Organization

This report comprises 11 Chapters. Chapter 1 provides background to the assignment and lists the assignment objectives. Chapter 2 describes the methods used to meet each of the objectives. The remaining chapters are sequentially organized by assignment objective. Chapter 11 summarizes the findings and recommendations and represents, in effect, a plan for future action regarding environmental reviews and permitting. Chapter 12 is references.

Extensive use of tables is employed to facilitate presentation of information.

## 2.0 METHODS

In order to meet the exercise objectives, Spencer Environmental undertook the following tasks:

- We reviewed concept plans for the proposed provincial road. Those concept plans showed the proposed roadway alignment, locations of proposed interchanges, right-of-way width, locations of new stormwater management (SWM) facilities, locations of some pedestrian infrastructure, and locations of any supporting service roads, all at a conceptual level (Figure 2-1).
- We interviewed ISL engineering personnel to gain an understanding of the project components.
- We compared the provincial road design and specific features with the existing design and features.
- We contacted federal government Canadian Environmental Assessment Agency (CEAA) representatives for an opinion about whether the WRR environmental review could be reopened considering the upgraded design. We sought an opinion irrespective of anticipated applications for new federal environmental permits.
- We reviewed the proposed design for the provincial road in order to determine, on the basis of our experience, which provincial and federal environmental permits would be required. Based on the environmental permits required, we assessed the possibility that applying for them would trigger a *CEAAct* review.
- Based on the new environmental permits that would be required to construct the provincial road, we employed our knowledge of the permitting systems to identify the types of environmental information needed to support the permit applications.
- We reviewed the WRR EIA in order to identify all of the potential impacts predicted for that project, including those not covered by environmental permitting. Our review included the potential impact ratings. Based on our knowledge of the constructed project, the project area and the proposed provincial road design, we identified those impact predictions that may no longer be valid and that should be re-assessed. Based on our professional judgment, we identified potential impacts from the WRR EIA that were resolved in that previous review and no longer warranted assessment for the provincial road.
- We reviewed the WRR EIA to determine what environmental information had been obtained and generated for that exercise and to support the WRR permit applications. Based on probable permit requirements for the upgraded project and the types of impact predictions that we identified as requiring re-assessment, we determined if the existing environmental data were sufficient for those objectives or if new data would need to be generated.

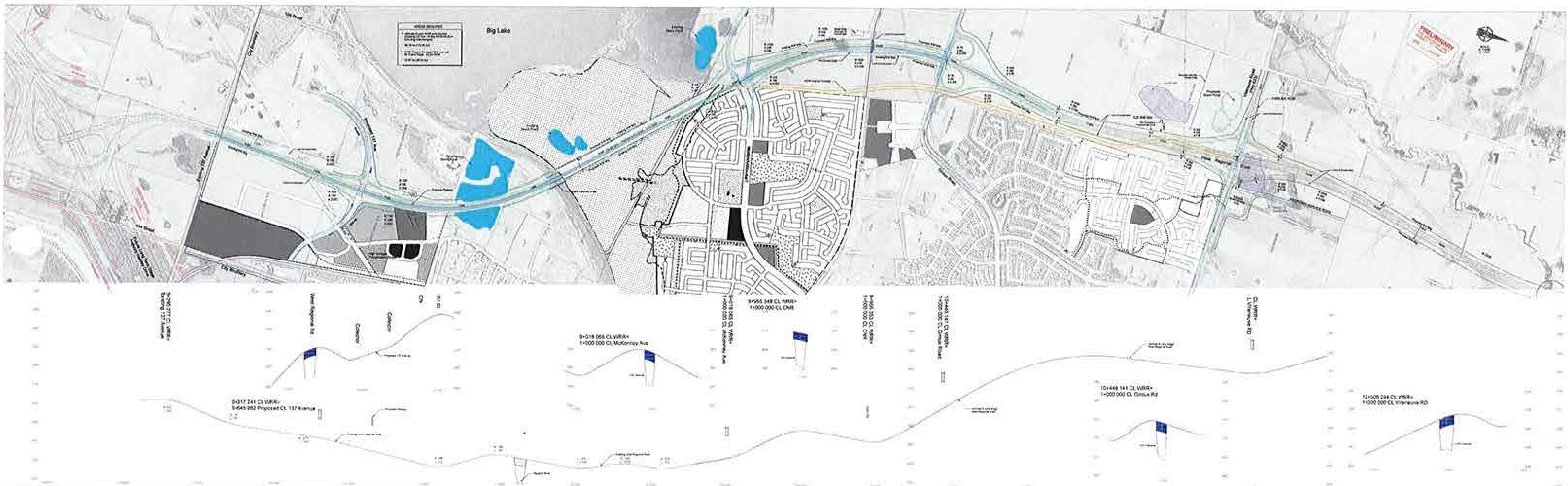


Figure 2-1. Conceptual Plan of Proposed Provincial Roac

# 3.0 REVISED PROJECT FACILITIES AND PHYSICAL FOOTPRINT

The following are the main characteristics of the proposed provincial road as shown in Figure 2-1:

- The right of-way (ROW) will accommodate up to eight lanes with a typical width of 78 m, extending in some areas up to 100 m. At locations of proposed interchanges, the ROW would be wider. No berms demarking the ROW limits are planned.
- Grade-separated roadway interchanges are proposed for the locations of:
  - 137 Avenue,
  - McKenney Avenue,
  - Giroux Road, and
  - Villeneuve Road.
- Piers that have been previously installed for a WRR bridge deck at the Sturgeon River Crossing would have a bridge deck installed for new lanes to accommodate south bound vehicle traffic. Three lanes in either direction would be accommodated on two bridge decks.
- Primary pedestrian accommodation along the proposed provincial upgrade would be by way of 3 m wide pedways located outside of the ROW. The exceptions to that would be at interchanges and over the Sturgeon River.
- Separate pedestrian ways (pedways), typically about 2.5 m width, would be constructed at the interchanges. Specifically, those pedways would be located on:
  - the north side of the 137 Avenue interchange,
  - the south side of the interchange at McKenney Avenue,
  - the south side of the Giroux Road interchange, and
  - the south side of the Villeneuve Road interchange.
- At the Sturgeon River, a bridge dedicated to pedestrian use would be constructed. A dedicated pedestrian bridge is required because the bridge decks on the WRR bridges are insufficiently wide to accommodate both vehicular and pedestrian traffic according to provincial standards.
- North of 137 Avenue and south of the Riel Wetland, an elevated pathway is being considered for over the roadway to link lands east of the road with Lois Hole Centennial Provincial Park.
- To accommodate anticipated increased stormwater from the larger roadway footprint, it is possible that Stormwater Management Facilities (SWMF) constructed as part of the WRR project would require expansion to provide

increased storage capacities. That would include the Riel Pond and Wetland (an SWMF) and the facility immediately north of the Sturgeon River and, potentially, the constructed wetland in the vicinity of the McKenney Avenue interchange.

- A new SWMF would be constructed in the southwest quadrant of the interchange proposed for Villeneuve Road. That SWMF would drain into Carrot Creek to the west by way of an armored ditch and outfall. The bottom of the Carrot Creek channel would be armored at the discharge location. The Villeneuve Road SWMF was required as a component of current Phase 3 of Ray Gibbon Drive. The capacity of that SWMF facility may have to be increased relative to the original need for Phase 3 to accommodate additional surface run-off from the larger roadway footprint.
- At the location of the already constructed at-grade CN Rail crossing north of McKenney Avenue, a new grade-separated interchange with the rail line is proposed. Further, the location of the crossing would be adjusted westward.
- A new service road would be constructed in the northeast quadrant of the Villeneuve Road interchange.
- The speed limit for the new roadway would be increased to 100 kph from the present Ray Gibbon Drive limit of 70 kph.
- Traffic volumes for the provincial road would be greater than those projected for the ultimate Ray Gibbon Drive.

Table 3.1 compares the existing Ray Gibbon Drive project with the proposed provincial Highway 2 Upgrade.

**Table 3-1 Comparison of Characteristics for Ultimate Ray Gibbon Drive (Constructed and Design only Phases) with the Proposed Provincial Road**

| | Ray Gibbon Drive | Provincial Road |
|---|---|---|
| **Characteristics** | | |
| Right-of-Way Width | • 58 m | • 78-100 m, wider at interchanges |
| Ultimate Number of Lanes | • 6 | • 8 |
| Acoustical/Landscape berms present or planned | • Yes, in Sturgeon River Valley/Parks areas | • From south of McKenny Ave to Villeneuve Rd |
| Roadway Interchange Types and Locations | • 137 Ave at-grade<br>• McKenney Ave at-grade<br>• Giroux Rd at-grade<br>• Villeneuve Rd at-grade | • 137 Avenue (grade-separated)<br>• McKenney Avenue (grade-separated)<br>• Giroux Road (grade-separated)<br>• Villeneuve Road (grade-separated) |
| Number of River Crossing Structures/Types | • Two bridges decks with 4 vehicle lanes over Sturgeon River with pedestrian accommodation on downstream deck | • Two vehicular bridge decks over Sturgeon River |
| Pedestrian Walkways/Characteristics/ Locations | • 3 m wide pedways within 58 m ROW<br>• Dedicated 3 m wide pedway on downstream bridge deck and 4 m wide on upstream deck | • 3 m wide pedways outside of ROW<br>• 2.5 m pedways at interchanges<br>• Dedicated pedestrian bridge at Sturgeon River |
| Pedestrian Road Crossing Structures | • None constructed | • One elevated pedway over road south of Riel Wetland |

| Characteristics | Ray Gibbon Drive | Provincial Road |
|---|---|---|
| SWMF | • Riel Pond and Wetland<br>• North Side of Sturgeon River<br>• South of McKenney Avenue<br>• Future facility near Villeneuve Road | • Riel Pond and Wetland possibly enlarged<br>• North side of Sturgeon River possibly enlarged<br>• South of McKenney Avenue possibly enlarged<br>• New facility at Villeneuve Road |
| Rail Crossings/Types | • One at-grade north of Meadowview Drive | • One grade- separated north of Meadowview Drive |
| Service Roads | • None | • One at Villeneuve Road |
| Speed Limits | • 70 kph | • 100 kph |

# 4.0 NEW FACILITIES AND TYPES OF ENVIRONMENTAL IMPACTS

Table 4-1 shows the provincial road characteristics and, for each of those characteristics, a very preliminary list of the types of potential impacts that might occur as a result of construction and operation. This preliminary list is important to identifying what types of existing and new environmental data may be required to assess those of impacts.

**Table 4-1 Provincial Road Characteristics and Preliminary List of Potential Impacts**

| Upgraded Roadway Characteristics | Types of Potential Impacts |
|---|---|
| | |
| Increased ROW Width (20m) | • Surface erosion of disturbed areas<br>• Infilling of Sturgeon River flood plain reducing flood storage<br>• Siltation in vicinity of already constructed compensatory wetlands (Riel Wetland and SWMF south of McKenney Avenue<br>• Increased load on abandoned landfill, resulting in increased leachate migration<br>• Disturbance to compensatory and natural wetlands<br>• Surface disturbance to areas of natural vegetation, wildlife habitat, and designated St. Albert Natural Areas<br>• Increased vehicle/wildlife collisions<br>• Additional erosion associated with increased surface disturbance and longer side slopes<br>• Adverse impacts to historical resources<br>• Adverse impacts to outdoor recreation playing fields |
| Increased Number of Lanes (2) (4 lanes were considered for WRR EIA) | • Increased traffic volumes, resulting in greater traffic noise<br>• Increased adverse impacts to wildlife movement<br>• Adverse impacts associated with re-suspending contaminated bottom materials in Riel Pond and Riel Wetland |
| Absence of Acoustical/Landscape Berms | • Increased adverse impacts on wildlife and land use associated with traffic noise |
| Change in the number, location and design of interchanges (now grade-separated) | • By way of the larger footprint, additional disturbance to:<br>o natural vegetation communities,<br>o wetlands,<br>o wildlife and wildlife habitat, and<br>o designated St. Albert Natural Areas<br>• Increase in severity of impacts associated with increased noise levels emanating from elevated facilities |

| **Upgraded Roadway Characteristics** | **Types of Potential Impacts** |
|---|---|
| | |
| Additional river crossing structure dedicated to pedestrian use | • Adverse impacts to water quality<br>• Adverse impacts to fish and fish habitat<br>• Adverse impacts to wildlife corridors<br>• Adverse impacts to watercourse navigation |
| No segregated pedestrian trail within ROW | • Safety risk to outdoor recreationists |
| Elevated pedestrian crossing over roadway at Riel Wetland vicinity | • Safer cross roadway access for outdoor recreationists than that provided by the one originally planned but not constructed |
| Potential enlargement of WRR SWMFs and construction of a new SWMF to accommodate additional stormwater volumes | • Adverse impacts to Riel Wetland and to Riel Marsh<br>• Loss of portions of WRR compensatory wetland habitat constructed at Riel Wetland south of McKenney Avenue<br>• Adverse impacts to natural vegetation communities, wildlife habitat and designated St. Albert Natural Areas |
| Planned at-grade rail line crossing moved westward and constructed as a grade-separated feature | • Safer roadway environment for motoring public<br>• Decreased hazardous materials spills<br>• Increased adverse impacts associated with increased traffic noise from elevated location |
| Service road at Villeneuve Road interchange location (Outside geographic scope of WRR EIA) | • Adverse impacts to natural vegetation, wildlife habitat and designated St. Albert Natural Areas, including wetlands |
| Speed limit increased from 70 kph to 110 kph | • Increased adverse impacts of all types associated with increased noise levels<br>• Increased adverse impacts to wildlife movement |
| Increased traffic volumes and changed vehicle composition | • Increased adverse impacts associated with increased noise levels<br>• Increased adverse impacts associated with reduced air quality<br>• Increased adverse impacts to wildlife movement<br>• Increased adverse impacts associated with hazardous materials spills during roadway operation |

# 5.0 WRR-IDENTIFIED IMPACTS THAT REQUIRE RE-EVALUATION

Our review of the WRR EIA for impact predictions that may no longer be valid for the provincial road led to the identification of some new potential impacts. This chapter of the report addresses both of those scenarios.

The WRR EIA generated acoustical information to support analyses of that project's potential impacts to wildlife and outdoor recreation pursuits. While none of the environmental permits issued for construction of the project referred specifically to roadway operational noise, an in-depth analysis of the effects of noise on those subjects was of vital concern to government and non-government stakeholders. The proposed provincial road project includes certain components that may make the acoustical impact-related information for WRR invalid. That is because the provincial road as currently presented:

- has no berming planned for it while portions of the WRR did,
- will include eight lanes at ultimate development as opposed to six lanes for WRR,
- will convey a larger volume of traffic than proposed for WRR,
- will include grade-separated interchanges that could alter acoustics, and
- will have a higher speed limit with potential to alter acoustics.

We recommend a re-evaluation of the impacts of operational roadway noise on wildlife and outdoor recreation. That re-evaluation should use the same methods and receptors as that used for the WRR. Other receptors may need to be added. This is especially the case if the potential noise impacts to residential areas are of interest to INFTRA. We recommend that a re-evaluation be undertaken, despite the possibility that RAs do not specifically ask for it, in support of a review process or environmental permit applications. The results will be critical for developing mitigation strategies. The potential impacts of noise were of important interest to stakeholders for the WRR *CEAAct* EIA and there are no obvious reasons why environmental stakeholders would not pursue this issue again with or without a formal *CEAAct* environmental review.

With respect to new impacts, the WRR EIA examined the potential for adverse impacts on wildlife movement corridors and recommended certain mitigation strategies. Considering the larger footprint of the proposed provincial road, the increased traffic volumes and the higher speed limits, the conclusions reached in the WRR EIA may no longer apply. Those wildlife movement impacts need to be reassessed and, if required, new mitigation strategies employed.

Since the WRR was completed, City of St. Albert has annexed new lands from Sturgeon County. Recently, the City of St. Albert's inventory of Natural Areas (Spencer Environmental 1999) was updated (Stantec, in preparation) to include any Natural Areas within those annexed lands. Portions of the provincial road would overlap the annexed lands. We recommend that any evaluation of the proposed roadway include examining potential impacts to Natural Areas in newly annexed lands. Some of the Natural Areas could be wetlands pursuant to the interim Alberta Wetland Policy.

Also with respect to new potential impacts, the larger footprint of the provincial road ROW and interchanges will have the potential to impact more natural vegetation and wildlife habitats than the WRR. Some of those areas will not have been included within the environmental inventories conducted for WRR or other recent environmental planning initiatives. We recommend that those areas of expanded footprint, where not covered by WRR investigations be assessed for impacts on vegetation communities and wildlife populations.

In addition to the above-described general impact types, several issue-specific or subject-specific impacts identified in the WRR EIA warrant re-evaluation. Table 5-1 shows individual impact predictions addressed in the WRR EIA that may require re-evaluation. The original descriptions of impact severity have been sourced from the WRR EIA. A rationale is provided for each of the impact predictions recommended for re-evaluation. In the case of new potential impacts, these are identified as such in Table 5-1.

**Table 5-1 Rationale for Re-evaluating Certain Impact Predictions**

| Predicted Impact Requiring Re-evaluation | Rationale |
|---|---|
| | |
| **Surface Water Quality** | |
| • Negligible to adverse, minor, short-term and predictable impacts to surface water quality in the unlikely event of a hazardous materials spill during roadway operation | • The increased traffic volumes and speeds may increase the potential for a hazardous materials spill |
| **Vegetation including Wetlands** | |
| • Adverse, minor, permanent and predictable impacts to upland plant communities **(new impact)** | • The increased footprint of the project increases the potential for directly disturbing upland native plant communities |
| • Negligible to adverse, minor, permanent and predictable impacts to wetlands **(new impact)** | • The increased footprint of the project increases the potential for directly disturbing wetland communities |

| Predicted Impact Requiring Re-evaluation | Rationale |
|---|---|
| | |
| • Negligible hydrogeological impacts to the spruce woodland | • Considering the public sensitivity concerning this feature and the increased footprint of the road, this potential impact warrants re-valuation |
| • Adverse, minor to major, permanent and predictable impacts to sensitive species of vascular plants and bryophytes **(new impact)** | • The increased footprint of the roadway may affect previously un-inventoried plant habitats |
| **Wildlife and Wildlife Habitat** | |
| • Adverse, minor, permanent and predictable impact to deciduous woodland habitat **(new impact)** | • The larger footprint of the project may impact more of this habitat type |
| • Negligible to adverse, minor, permanent and predictable impact to wetlands and riparian habitat **(new impact)** | • The larger footprint of the project may impact more of this habitat type |
| • Negligible to adverse, minor, permanent and uncertain impacts to ungulates from collisions with vehicles | • Considering the larger project footprint, greater traffic volumes and higher roadway speeds, this impact prediction warrants revisiting |
| • Adverse, minor to major long term and predictable impacts to amphibians, migratory songbirds from roadway noise | • Considering the potential for increased noise levels, this impact prediction warrants revisiting |
| • Adverse, minor to major, permanent, uncertain impact to wildlife movement corridor in north floodplain | • Considering the wider footprint of the roadway, greater traffic volumes, higher roadway speeds, and the fact that installed culverts intended to pass small animals would be longer, this impact prediction warrants revisiting |

| Predicted Impact Requiring Re-evaluation | Rationale |
|---|---|
| | |
| • Adverse, minor, permanent, predictable adverse impact to wildlife movement along south river edge | • Considering the addition of another bridge structure and the new landscaping in Riel Park that will provide some wildlife habitat, this impact prediction warrants revisiting |
| • Adverse, major, permanent, uncertain impact to bird use of the spruce woodland as a result of roadway noise | • Considering the increased traffic volumes associated with the provincial road, the predicted impacts warrant reconsidering |
| • Negligible to adverse, minor to major impact to avifauna using Big Lake from roadway noise | • Considering the increased traffic volumes, altered roadway configuration and increased speed limit, this predicted impact warrants reconsideration |
| • Negligible to adverse, minor, permanent uncertain impacts to some species at Riel Pond resulting from possible noise level increase | • Considering the increased traffic volumes and altered roadway configuration, this predicted impact warrants reconsideration |
| • Adverse, minor to major permanent uncertain impacts to avifauna using Riel Marsh as a result of increased noise levels | • Considering the increased traffic volumes and new roadway configuration, this predicted impact warrants reconsideration |
| **Fish and Aquatic Resources** | |
| • Potential loss of fish habitat resulting from the new pedestrian bridge (this impact assumes some instream work occurs) | • Pedestrian bridge may include some instream work |
| **Land Use** | |
| • Adverse, minor, short term predictable impact from loss of 22.4 ha of agricultural lands to roadway construction **(new impact)** | • Considering the expanded roadway footprint, this impact prediction should be re-evaluated |

| Predicted Impact Requiring Re-evaluation | Rationale |
|---|---|
| | |
| • Negligible impact from loss of a portion of soccer practice field to ROW footprint **(new impact)** | • Considering the increased footprint, the extent of impact on recreational playing field in this vicinity should be revisited |
| • Negligible impact to soccer and rugby players and referees from roadway noise | • With the increased traffic volumes and roadway configuration, this impact prediction warrants revisiting |
| • Negligible to adverse, minor, permanent and predictable impact to the quality of nature appreciation activities at picnic shelter at intermediate traffic levels | • Considering the increased traffic volumes and altered roadway design, this predicted impact warrants reconsidering |
| • Adverse, major, permanent, predictable impact to quality of nature appreciation activities at north shore of Big Lake at intermediate traffic levels | • Considering the increased traffic volumes and altered roadway design, this impact prediction should be re-evaluated |
| • Adverse, minor to major, permanent, predictable impact to quality of nature appreciation activities near viewing platform/Riel Marsh owing to vehicle noise, at ultimate development | • Considering the increased traffic volumes and altered roadway design, this predicted impact warrants re-evaluation |
| • Adverse, major, permanent, uncertain impact to nature appreciation activities near the Spruce Woodland owing to road noise at short-term traffic levels | • Considering the increased traffic volumes and altered roadway design, this predicted impact warrants re-evaluation |

# 6.0 INVENTORY OF WRR AND PROVINCIAL ROAD ENVIRONMENTAL PERMITS

Table 6-1 shows the facilities and features that were required to construct WRR and the facilities and WRR facilities and features that will need updating to construct the provincial road. New features for the provincial road are also shown in this table. For each of the facilities and features mentioned, a description of the relevant federal and provincial environmental permits is provided.

**Table 6-1 Environmental Permits for WRR and for Provincial Road**

| | | WRR | | Provincial Road | |
|---|---|---|---|---|---|
| Facility and Location | | Federal Approvals | Provincial Approvals | Federal Approvals | Provincial Approvals |
| | | | | | |
| WRR | Provincial Road | | | | |
| | | | | | |
| Construct Riel Wetland SWMF and outfall into Sturgeon River | Enlarge Riel Wetland | | • Registration pursuant to *Alberta Environmental Protection and Enhancement Act (AEPEA)*<br>• Notification under Code of Practice for Stormwater Outfalls under *Alberta Water Act* | | • Amend existing registration pursuant to *AEPEA* |
| Sturgeon River Bridge Crossing | Sturgeon River Bridge 2nd Deck | • Authorization to install bridge piers and abutments pursuant to *Fisheries Act*<br>• Approval pursuant to *Navigable Waters Protection Act (NWPA)* to construct bridge piers, abutments and deck | • Notification under Code of Practice for Watercourse Crossings pursuant to *Alberta Water Act*<br>• License of Occupation (LOC) for the bridge abutments and piers pursuant to the *Alberta Lands Act* | • Application under *NWPA* to add additional bridge deck | |

| Facility and Location | | WRR | | Provincial Road | |
|---|---|---|---|---|---|
| | | Federal Approvals | Provincial Approvals | Federal Approvals | Provincial Approvals |
| | New pedestrian-dedicated bridge at Sturgeon River | | | • Authorization to construct piers (if required) and abutments in Sturgeon River pursuant to federal *Fisheries Act*<br>• Approval to construct bridge pursuant to *NWPA* | • LOC for bridge abutments and piers (if required) under *Alberta Lands Act*<br>• Notification under Code of Practice for Water Course Crossings |
| Fish Habitat Compensation Area | | | • LOC pursuant to *Alberta Lands Act* | | |
| SWMF on north side of Sturgeon River including outfall into Sturgeon River | Enlarge SWMF on north side of river | • Letter of advice pursuant to the federal *Fisheries Act* | • Registration of the facility pursuant to *AEPEA*<br>• Notification under Code of Practice for Outfalls<br>• LOC pursuant to *Alberta Public Lands Act* | | • Amendment to registration under *AEPEA*<br>• Amendment to LOC |
| SWMF at McKenney Avenue | Enlarge SWMF at McKenney Avenue | | • Registration of the facility pursuant to *AEPEA* | | • Amendment to registration under *AEPEA* |

| Facility and Location | | WRR | | Provincial Road | |
|---|---|---|---|---|---|
| | | Federal Approvals | Provincial Approvals | Federal Approvals | Provincial Approvals |
| | | | | | |
| At-grade rail crossing north of McKenney Avenue | Grade-separated rail crossing at McKenney Avenue | • Canadian Transportation Authority (*CTA*) Approval | | • CTA approval may require a new EA | |
| | Construct SWMF with outfall to Carrot Creek and armour Carrot Creek channel | | | • Authorization or Letter of Advice pursuant to federal *Fisheries Act* for installing SWMF outfall and channel armouring in Carrot Creek<br>• Approval pursuant to *NWPA* for outfall and channel armouring | • LOC under *Alberta Lands Act* for outfall structure into Carrot Creek bank<br>• Registration of SWMF and drainage plan pursuant to *AEPEA* |
| | Potential Removal of wetlands | | | | • Approval pursuant to *Alberta Water Act* with reference to Interim Alberta Wetland Policy |
| | Potential removal of City of St. Albert designated Natural Areas | | | | • City of St. Albert environmental assessment may be required |
| | Overall drainage plan for interchanges and widened footprint | | | | • Notification and subsequent registration under *AEPEA* |

# 7.0 FEDERAL ENVIRONMENTAL PERMIT REQUIREMENTS THAT COULD TRIGGER CEAA

Table 7-1 shows each of the facilities for the provincial road that will or may require federal environmental permits. Such permit applications could trigger an environmental review of the provincial road project or certain components of it pursuant to *CEAAct.* Such a review's scope cannot be completely known now but the study area could be larger for the provincial road. That is because the provincial road project would require environmental permits for two watercourses while WRR only required federal approvals for Sturgeon River facilities.

**Table 7-1 *CEAAct* Environmental Review Permit Triggers for Proposed Provincial Road**

| Project Feature or Facility | Federal Environmental Permit Potentially Triggering Review |
|---|---|
| • Second bridge deck on already placed piers Sturgeon River Bridge | • Approval pursuant to *NWPA*. |
| • New stand alone pedestrian bridge over Sturgeon River | • Approval pursuant to *NWPA*<br>• Authorization pursuant to federal Fisheries Act |
| • Construction of a grade-separated railway crossing over the roadway on the north side of Sturgeon River | • Approval from CTA |
| • Construction of a stormwater outlet and placement of creek armouring in Carrot Creek on the west side of Villeneuve Road intersection | • Authorization pursuant to federal *Fisheries Act*<br>• Approval pursuant to *NWPA* |

# 8.0 OTHER AVENUES FOR ASSESSING THE UPGRADE PROJECT BY WAY OF *CEAACT*

The Edmonton office of the Canadian Environmental Assessment Agency (CEAA) was contacted for advice on this subject. Personnel in that Regional CEAA office are familiar with the original WRR Project. The contact was made in order to obtain an opinion concerning other triggers or factors outside of permitting requirements that might initiate a *CEAAct* environmental review of the provincial road.

In the case of the upgrading project, potential Responsible Authorities (RAs) (federal government departments that would lead any environmental assessment of the project) under *CEAAct* would be as follows:

- Fisheries and Oceans Canada who administer the federal *Fisheries Act*.
- Transport Canada who administers the *Canadian Transportation Act*, as well as the *Navigable Waters Protection Act*.

According to *CEAA*, normally in the case of a project already assessed, the RAs would assess the proposed project changes and make a determination as to whether the changes were significant enough to require reassessing the project. If the changes were deemed to be significant, then it is likely that the RAs would typically start a new assessment rather than open the existing one. They would be free to use any applicable information from the existing assessment in the new assessment. Often, little new information is required for a new assessment.

The *CEAA* representative that we consulted surmised that if there is to be no change in bridge pier configuration or navigability, then it is likely that neither RA would require an EA for adjusting an existing bridge deck. A larger road footprint and higher speeds would not likely be an issue because those factors are not within the two RAs' mandates. Transport Canada might look for reassurance that the additional lanes would not affect navigability.

The new pedestrian bridge, however, would be considered a separate project and that would be what could trigger a review of the upgrading project.

# 9.0 NEW ENVIRONMENTAL INFORMATION NEEDS TO SUPPORT FACILITY-SPECIFIC ENVIRONMENTAL PERMIT APPLICATIONS

Table 9-1 shows for each of the project facilities planned for specific locations, the environmental permits required to construct them and the types of environmental information that would need to be generated to support applications for those permits. Some of this same information would need to be generated for any exercise to re-evaluate WRR-identified impacts and to support any future *CEAA* environmental assessments of the provincial road.

**Table 9-1 Environmental Information Requirements for Obtaining Environmental Permits to construct the Provincial Upgrade Project**

| Facility and Location | Environmental Permit Required | Environmental Information Required |
|---|---|---|
| • Stand alone pedestrian bridge over Sturgeon River | **Provincial** | |
| | • LOC pursuant to *Alberta Public Lands Act* for bridge abutments and piers<br>• Depending on construction technique employed, approval to divert water pursuant to *Alberta Water Act* to install bridge piers | • Depending on exact location, the required environmental information may already be available from WRR EIA |
| | • Notification under the Code of Practice for Watercourse Crossings pursuant to the *Alberta Water Act* | • Depending on exact location, all environmental information may already available from WRR EIA |
| | **Federal** | |
| | • Authorization pursuant to the federal *Fisheries Act* to construct piers in Sturgeon River | • All environmental information may already available from WRR EIA |
| | • Approval pursuant to the *NWPA* to construct pedestrian bridge | • Depending on proximity of pedestrian bridge to WRR vehicle bridge, environmental information may be available from WRR EIA |

| Facility and Location | Environmental Permit Required | Environmental Information Required |
|---|---|---|
| • Enlarged existing SWMF assuming no changes to any already constructed outfall structures | **Provincial**<br><br>• Amendment to all registrations for SWM facilities entered under *AEPEA*.<br>• Amendment to LOCs for SWMF constructed immediately north of Sturgeon River | • All environmental information already available from WRR EIA |
| • New SWMF at Villeneuve Road and associated outfall channel connected to Carrot Creek (Assumes no temporary or permanent creek diversions). This is outside of the scope of study identified for the original EIA for WRR. | **Provincial**<br><br>• LOC pursuant to *Alberta Public Lands Act* for SWM outfall into bank of Carrot Creek.<br>• Registration of SWMF and drainage plan pursuant to *AEPEA*.<br><br>**Federal**<br><br>• Authorization or Letter of Advice pursuant to federal *Fisheries Act* for installation of SWMF outlet and channel armouring in Carrot Creek<br><br>• Approval pursuant to *NWPA* for SWM outfall and channel armouring in Carrot Creek | • Requires site specific information about hydrology, water quality, vegetation and wildlife for Carrot Creek<br><br>• Requires fish and fish habitat, vegetation and wildlife information for Carrot Creek<br><br>• Requires recreational land use information for Carrot Creek<br>• Requires fish and fish habitat, vegetation and wildlife information for Carrot Creek |
| • New grade-separated railway crossing located west of existing at grade intersection | **Federal**<br><br>• CTA approval may require environmental assessment before application can be approved | • Sufficient environmental information available from WRR EIA |

| Facility and Location | Environmental Permit Required | Environmental Information Required |
|---|---|---|
| **Other Situations**<br><br>• Removal of Wetlands | **Provincial**<br><br>• Approval pursuant to *Alberta Water Act* with reference to Draft Alberta Wetland Policy. Wetland compensation plans may be required when wetlands are disturbed | <br><br>• Proposed ROW needs to be examined for presence of wetlands. All wetlands potentially impacted require wetland assessment pursuant to interim Alberta Wetlands Policy |
| • Removal of City of St. Albert Natural Areas | • No city permits required | • Environmental Assessments may be required where natural areas are to be removed |
| • Provision of overall drainage Plan for project interchanges and widened footprint | **Provincial**<br><br>• Notification and subsequent registration pursuant to *AEPEA*. | <br><br>• Depending on design information, some biophysical information may need to be obtained within the footprint |

# 10.0 ENVIRONMENTAL INFORMATION NEEDS TO SUPPORT NEW ENVIRONMENTAL REVIEW PROCESSES

As mentioned in Chapters 9, new environmental information is required to:

- re-evaluate the validity of WRR-identified impact predictions,
- assess new impacts exclusive to the provincial roadway,
- support environmental permit applications, and
- support any future *CEAAct* environmental reviews of the upgrade project.

This chapter focuses on information needs for supporting a potential new *CEAAct* review for the provincial road. Included in the review is an assessment of how some new information generated from other land use initiatives in the project vicinity may contribute to the information needs of a potential *CEAAct* review.

The provincial road project would have a larger footprint than Ray Gibbon Drive. A major contributing factor is the land required for proposed grade-separated interchanges. A review of spatial environmental information contained in the WRR EIA confirms that some environmental information outside of the proposed WRR footprint was collected and that it can also be used for any new environmental review. Further, since the WRR EIA was completed and Ray Gibbon Drive constructed, there have been other land use developments in that vicinity of Ray Gibbon Drive. This is especially the case in the vicinity of the proposed 137 Avenue interchange where Area Structure Plans (ASPs) have been completed. Those ASPs included environmental components that have provided additional environmental information for the vicinity, focusing on locations of City of St. Albert-designated Natural Areas. Westworth Associates Environmental Ltd. (2007) undertook vegetation and wildlife investigations of St. Albert Natural Areas, previously identified by Spencer Environmental (1999), in the 137 Avenue vicinity. Included in Westworth's investigations were rare plant searches. We assume that those surveys were for vascular plants and that bryophytes were not included. An assessment of roadway project impacts on bryophytes was required for the WRR EIA. An update to the WRR EIA for *CEAAct* purposes should only need to obtain bryophyte information in the vicinity of the 137 Avenue interchange.

Some vegetation and wildlife data were obtained during the WRR EIA in the vicinity of the McKenney Drive interchange; however, only for lands within about a 100m corridor centered on the WRR centre line. Outside of that corridor, where the provincial road interchange extends, there would be insufficient information to support a *CEAAct* review, providing that natural habitats exist. Although some additional bryophyte information was collected in a few areas outside of the WRR corridor in 2004 (Spencer Environmental 2005), some new bryophyte information may need to be obtained.

The frequency of Natural Areas diminishes northward from McKenney Avenue as lands to the north are heavily cultivated. North of the CN rail crossing, no information for the WRR CEAA review was obtained because the CN rail line formed the north boundary for the WRR EIA. For Phases 2 and 3 of WRR, the same types of environmental information that were developed for the WRR EIA were not obtained. That was due, in part, to the paucity of natural habitats and the fact that no federal EIA for these road segments was required. If Giroux Road were to be included within the scope of any future *CEAAct* review of the project, the area would need to be examined for natural areas and more detailed inventories of then undertaken.

No detailed vegetation, wildlife and fish investigations have been conducted in the vicinity of Villeneuve Road interchange for Phase 3 of the WRR project. That is because detailed planning for this section is still in preparation. Stormwater management planning for Phase 3 has recently been completed and will be the same as for the provincial road. It will involve instream work in Carrot Creek, a tributary to Big Lake. A SWMF to be constructed in the southwest quadrant of the interchange will drain by way of an armoured ditch to a stormwater outlet in the bank of Carrot Creek. At that outlet location, the channel of Carrot Creek will also be armoured. There is strong potential that Carrot Creek will be considered a fish-bearing stream by DFO and may also be considered navigable pursuant to *NWPA*. Carrot Creek is located well north of the north boundary of the WRR EIA and has some potential to trigger an environmental review of greater geographic scope than the WRR EIA. Contributing to this possibility, a provincial road environmental review could include the stand-alone pedestrian bridge, the grade-separated rail crossing and the Carrot Creek SWMF. While there is generally adequate environmental information available for the bridge and rail crossing locations, there is currently insufficient information for Carrot Creek to support a *CEAAct* environmental review processes and subsequent permitting.

With reference to the proposed dedicated pedestrian bridge over the Sturgeon River, our assessment is that, depending on its exact location, most of the technical environmental information required to support any environmental review of the project pursuant to *CEAAct* is in place. Most of the information is available from environmental/technical investigations conducted in support of the WRR EIA. The most critical information is fish and fish habitat information. If the location of the new bridge falls outside of the boundaries of that information obtained for the WRR EIA, new fish and fish habitat information will need to be obtained.

The WRR EIA scope was limited to the vicinity of the Sturgeon River bridge crossing and the rail crossing. Those locations were contained within Phase 1 of WRR construction. Since then, Phase 2 has been constructed to McKenney Avenue and detailed design for Phase 3, north to Villeneuve Road, has been proceeding.

Matters relating to acoustics were covered in detail in the WRR EIA. Considering the provincial road characteristics, it is highly probable that *CEAAct* RAs would ask for that information to be presented for any new review. New noise projections would need to be generated for those same locations as used in the WRR EIA and, potentially, for others.

A program of public consultation accompanied both planning and environmental assessment stages of WRR. A small but engaged group of stakeholders will have strong expectations for continued involvement in any initiatives to construct a provincial road.

Some stakeholders are well informed about potential environmental impacts, environmental review and permitting processes and, if not appropriately consulted, and even if so, will use whatever means are available to them to secure a high degree of public involvement. It would be in the best interests of the update project to conduct a meaningful public consultation program.

# 11.0 SUMMARY

Chapters three through 10 of this report:

- described the proposed provincial road and compared it with planned and constructed sections of Ray Gibbon Drive,
- made a preliminary assessment of the types of impacts that might be associated with the provincial road and identified those impact predictions in the WRR EIA that might need to be reassessed,
- reviewed the environmental permits that were issued for WRR construction and identified the new permits that may be required to construct the provincial road,
- reviewed the potential for any applications for new federal permits to trigger a *CEAAct* review of the provincial road,
- assessed the potential for a new environmental review pursuant to *CEAAct* for any other reasons, and finally,
- identified the environmental information needs for either re-assessing WRR-identified impacts, securing environmental permits or assessing the types of environmental impacts that might occur with the provincial road.

This chapter of the report presents our findings, conclusions and recommendations with regard to the following:

- Our communication with CEAA concerning future *CEAAct* environmental reviews.
- The need for any new environmental information to support any future reviews and environmental permitting.
- Future public consultation
- The potential for a future *CEAAct* review of the provincial road on the basis of federal environmental permits required.
- The accuracy of environmental impact predictions made in the WRR EIA, now that a provincial road is being proposed.

## *11.1 Regulatory Agency Liaison*

On the basis of our review of the upgrade project components and on the basis of our conversations with Regional CEAA personnel, we are of the opinion that early consultation with provincial and federal regulators would be prudent for the following reasons:

- The environmental review for WRR was a cooperative initiative of the federal and provincial governments under a harmonization agreement pertaining to *CEAAct* projects. The provincial government has set a precedent for environmental reviews of this project.

- There are several potential triggers in the form of environmental permit applications for a new *CEAAct* review of the provincial road.
- The potential triggers for the provincial road project cover a broader geographic area than for the WRR.
- Personnel in the DFO regional office have changed since the WRR project was reviewed and personnel currently in that regional office may have a limited knowledge of the environmental permitting and review history for WRR. That could lead to DFO uncertainty in determining the scope of any *CEAAct* review of the provincial road. Further, personnel in Alberta's Environmental Assessment Branch will likely have changed and may also have limited knowledge of the project's review history. There is a good possibility of environmental stakeholders taking an active role in "educating" new federal and provincial personnel about the WRR project with the objective of influencing DFO's decisions.

## 11.2 Potential for a new CEAAct Environmental Review

There are several new components to the provincial road project that could trigger a *CEAAct* review. Those triggers are:

- an application for a Fisheries Authorization and *NWPA* approval for a newly proposed pedestrian-dedicated bridge crossing over the Sturgeon River,
- an application for *CTA* approval for a grade-separated interchange with the CN rail in the near vicinity of the one near Meadowview Drive that was constructed as part of WRR, and/or
- an application for a Fisheries Authorization and *NWPA* Approval for SWM facilities in Carrot Creek.

## 11.3 Accuracy of WRR Impact Predictions

Certain provincial road project characteristics make some environmental impact predictions presented in the WRR EIA suspect. The obvious ramification of that is that new or modified mitigation measures may need to be developed, however, that determination requires re-evaluation of impacts. The primary differences from the WRR causing uncertainty in impact severity prediction are:

- the increased width of the overall roadway footprint,
- the addition of grade-separated interchanges,
- the increased speed limit proposed for the project,
- the increased traffic volumes anticipated, and
- the addition of another bridge structure across the Sturgeon River.

Further, certain design features of the provincial road create potential for new impacts specific to that project.

### 11.4 New Information Needs

The potential for the provincial road to be subjected to a new federal *CEAAct* review, the need for new provincial and federal environmental permits and the fact that some of the WRR impact predictions will need to be re-assessed initiated an analysis of technical environmental information needs. There is generally good technical environmental information in the original WRR EIA study area for supporting any future environmental reviews and permit applications that are required for provincial road project elements situated within that study area. There are, however, potential concerns about the adequacy of information collected within the WRR EIA study area relating to the following:

- The distribution of rare bryophytes. The bryophyte inventories undertaken for the WRR EIA were limited to a narrower corridor than for other vegetation values. Additional infill investigations were conducted in 2004 (Spencer Environmental 2005), but this information may still be incomplete.
- Fish and fish habitat information, if the location for the new pedestrian-dedicated bridge over the Sturgeon River falls outside of the location of fish habitat information obtained for WRR. This assumes that the new bridge would require fish habitat assessment work.
- Vegetation data at the site of the new bridge if situated outside of the WRR vegetation study area. New information may be required in support of an application for a LOC.
- The accuracy of noise projections used to predict impacts to wildlife and outdoor recreation pursuits. Those predictions were based on specific WRR design elements and it is quite possible that impacts would actually be more severe than predicted in the WRR EIA.

To the north of the former WRR EIA north boundary (the CN Rail line), there is insufficient technical environmental information to support securing environmental permits or for supporting any *CEAAct* review that might include those lands. That is because stormwater management strategies proposed for the area require detailed environmental information for Carrot Creek. For Carrot Creek, information would need to be obtained about surface hydrology and water quality, vegetation (including rare plants and bryophytes), wildlife (including amphibians, mammals and avifauna) and fish and fish habitat.

Further the roadway footprint may impact lands recently annexed by City of St. Albert that contain City of St. Albert designed Natural Areas. The City would require information on those areas. In addition, any wetlands situated within the roadway footprint would need to be re-assessed in support of the required *Alberta Water Act* Approvals to alter wetlands.

### 11.5 Public Consultation

Public consultation is a standard activity for many of INFTRA's project planning and environmental assessment activities. It was a critical component of the WRR EIA exercise. The public will have definite expectations that there be a continuing dialogue for any new environmental assessment whether it is *CEAAct*-initiated, provincially initiated, or just carried out as matter of INFTRA policy.

### 11.6 Recommendations

The following are our recommendations:

- The proponent for this proposed provincial road project should submit a revised project description to CTA and DFO, both of whom were *CEAAct* RAs for the WRR EIA. The purpose of that formal submission would be to obtain a determination from them as to environmental review requirements. The project description should also be supplied to Alberta Environment as the provincial government participated in the review of WRR.
- In anticipation of the project proceeding, a more detailed assessment of the interaction of the roadway footprint and City of St. Albert designated Natural Areas and any type of wetland should be undertaken.
- A new investigation for bryophytes should be undertaken focusing on those areas within the revised project area that were not covered in the WRR EIA or the supplementary work in 2004 (Spencer Environmental 2005). That investigation should focus on any areas of natural habitat.
- The location of the proposed pedestrian bridge over the Sturgeon River should be reviewed by the fisheries biologists who assisted with the WRR EIA so that a determination may be made about the applicability of WRR generated fisheries information to the pedestrian bridge location. Further, the information would be required to support federal government environmental permits.
- At Carrot Creek, at the location of potential instream activity, detailed biophysical information suitable for environmental permitting and reviews should be obtained should be obtained. That information will be required in support of both provincial and federal government permit applications.
- Noise predictions for the same locations assessed in WRR EIA should be re-calculated using the new project description information. Some new locations may also need to be assessed. All potential environmental impact predictions reliant on that noise information should be re-evaluated.
- All other impact predictions identified for re-evaluation in this document should be re-assessed based on the new project description information.
- A strategy for public consultation to accompany any new environmental assessment activities associated with the provincial road project should be developed. That strategy should consider both regulatory and political demands considering the environmental assessment and public interest history of the project.

# 12.0 REFERENCES

## *12.1 Literature Cited*

Spencer Environmental. 1999. St. Albert Natural Areas Review and Inventory. Final Report. Prepared for City of St. Albert, Planning and Engineering Services. St. Albert, AB.

Spencer Environmental. 2003. West Regional Road Environmental Impact Assessment. St. Albert, AB.

Spencer Environmental. 2005. Rare Bryophyte Follow-up Surveys and Transplantations in the Vicinity of St. Albert West Regional Road Corridor.

Stantec Consulting Ltd. 2007. St. Albert Natural Areas Review and inventory Addendum. Draft Report.

Westworth Associates Environmental Ltd. 2007. Natural Areas Assessment for the South Riel Area Structure Plan. Prepared for Beaverbrook St. Albert Ltd. and IBI Group Ltd.

# APPENDIX G

# Appendix G

## Noise Report

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Environmental Noise Impact Assessment
For

# Ray Gibbon Drive, St. Albert

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April 24 2008

**aci Project #: 08-010**
**April 24, 2008**

## Executive Summary

aci Acoustical Consultants Inc., of Edmonton AB, was retained by ISL Engineering and Land Services Ltd. (ISL) to conduct an environmental noise impact assessment for the proposed Ray Gibbon Drive (RGD) in St. Albert, Alberta. The purpose of the work was to generate a computer noise model of the proposed road and determine the relative noise impact on current and future residential developments. In addition, the noise levels were to be compared to the highway noise guidelines set forth by Alberta Infrastructure and Transportation (AIT).

The results of the noise modeling for Future Conditions on the RGD indicated noise levels in excess of the AIT guidelines criteria of 65 dBA $L_{eq}24$[1] at many locations directly adjacent to the RGD, indicating that noise mitigation would be required. In particular, some locations were as high as 69 dBA $L_{eq}24$. As such, noise mitigation barriers were added to the model with the intent of meeting two design criteria: 1) a total noise level less than 65 dBA Leq24, and 2) a minimum reduction (relative to the baseline case) of 5 dBA with the installation of a noise wall.

The results of the noise mitigation measures indicated a noise barrier height of 3.5 m would be required for much of the study area (entirely on the east side of the RGD) spanning from just south of McKenney Avenue all the way north to approximately 260 m south of Villeneuve Road. From this point, further north until approximately 400 m east of Villeneuve Road, a 1.8 m barrier will suffice.

Finally, as an exercise, the three main traffic parameters which affect the noise levels (i.e. volume, % heavy trucks, and speed) were reviewed to determine the sensitivity of each on the noise levels. It was found that modification to each one (by ±10 %) had a small impact on the noise levels and differences would not be subjectively noticeable. The cumulative effect of increasing all three parameters by 10% resulted in increases ranging from 0.1 – 1.7 dBA which would still be barely subjectively noticeable. Further, the increased noise levels at all locations would still be below 65 dBA $L_{eq}24$ with the above mentioned noise mitigation. The only area which is of concern for this was the 1.8 m barrier section at the north end of North Ridge. The noise levels resulting from increases of 10% to the three parameters will be very close to 65 dBA $L_{eq}24$. It is, therefore, recommended to review the possibility of increasing the barrier height to 3.5 m (similar to the other areas to the south).

[1] The term $L_{eq}$ represents the energy equivalent sound level. This is a measure of the equivalent sound level for a specified period of time accounting for fluctuations.

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## 1.0 Introduction

aci Acoustical Consultants Inc., of Edmonton AB, was retained by ISL Engineering and Land Services Ltd. (ISL) to conduct an environmental noise impact assessment for the proposed Ray Gibbon Drive (RGD) in St. Albert, Alberta. The purpose of the work was to generate a computer noise model of the proposed road and determine the relative noise impact on current and future residential developments. In addition, the noise levels were to be compared to the highway noise guidelines set forth by Alberta Infrastructure and Transportation (AIT).

## 2.0 Location Description

RGD is proposed to be a 8-lane twinned freeway on the west side of St. Albert, Alberta. RGD will extend from the south end where it will intersect with Anthony Henday Drive (AHD) in Edmonton (currently under construction) up to the north end where it will intersect with Hwy. 2 north of St. Albert, as shown in Fig. 1. Starting from the grade separated interchange at AHD, RGD will head north until the proposed grade separated interchange at 137 Avenue (east of the proposed South Riel subdivision). RGD will then curve to the northwest and cross the Sturgeon River and continue until the proposed grade separated interchange with McKenney Avenue (east of the proposed Timberlea subdivision). RGD will then curve north, cross the CP Rail line (RGD will go underneath the Rail line) and then meet the proposed grade separated interchange at Giroux Road. RGD will then continue north until the proposed grade separated interchange with Villeneuve Road. Finally, RGD will turn northeast until the proposed grade separated interchange with Highway 2, north of St. Albert.

Current residential development east of the proposed RGD (near the road) includes the North Ridge subdivision. All other existing residential development on the east side of RGD is several hundred meters away and is not of concern because there is proposed development which will be much closer to RGD. To the west of RGD are some acreage style residences including two near the existing 137 Avenue, four along McKenney Avenue, one along Giroux Road, one between Giroux Road and Villeneuve Road and two just north of Villeneuve Road. Of these acreage style residences, the closest to RGD is approximately 200 m away.

Proposed residential development includes the South Riel subdivision to be located east of RGD, north of the existing 137 Avenue and south of Levasseur Road. The closest residential lots to RGD will be approximately 300 m away. The next proposed development is the Timberlea subdivision which will be located east of RGD, north of the Sturgeon River and south of the CN Rail line. The closest residential lots to RGD will be at the road right-of-way, 30 m from the road curb. The next development will be east of RGD, north of the CN Rail line and south of Giroux Road. As with the Timberlea subdivision, the closest residential lots will likely be at the 30 m road right-of-way. North of Giroux Road is the existing North Ridge subdivision. Although the current houses in the southwest portion of the subdivision are approximately 100 m from the nearest off-ramp, future development closer to the road is possible. As such, the closest residential lots may be at the 30 m right-of-way. This will continue along the east side of RGD, all the way north until Villeneuve Road. Finally, north of Villeneuve Road, there is an offset due to a service road with the closest potential residential lots at least 225 m from RGD. This continues north until beyond the limits of the study area.

Topographically, the land in the area is generally flat with gradual changes in elevation throughout. There are some existing sections with earth piled in preparation for the pending interchanges. At the proposed interchanges, the contours will have a combination of RGD reducing in elevation and the intersecting avenue/road increasing in elevation to allow room for the bridges. This will provide a level of acoustical shielding for surrounding receptors.

## 3.0 Modeling Methods

The computer noise modeling was conducted using the CADNA/A (version 3.7.123) software package. CADNA/A allows for the modeling of various noise sources such as road, rail, and various stationary sources. In addition, topographical features such as land contours, vegetation, and bodies of water can be included. Finally, meteorological conditions such as temperature, relative humidity, wind-speed and wind-direction can be included in the calculations.

The calculation method used for noise propagation follows the ISO standard 9613-2. All receiver locations were assumed as being downwind from the source(s). In particular, as stated in Section 5 of the ISO document:

> "Downwind propagation conditions for the method specified in this part of IS0 9613 are as specified in 5.4.3.3 of IS0 1996-2:1987, namely
>
> - wind direction within an angle of $\pm 45^0$ of the direction connecting the centre of the dominant sound source and the centre of the specified receiver region, with the wind blowing from source to receiver, and
> - wind speed between approximately 1 m/s and 5 m/s, measured at a height of 3 m to 11 m above the ground.
>
> The equations for calculating the average downwind sound pressure level LAT(DW) in this part of IS0 9613, including the equations for attenuation given in clause 7, are the average for meteorological conditions within these limits. The term average here means the average over a short time interval, as defined in 3.1.
>
> These equations also hold, equivalently, for average propagation under a well-developed moderate ground-based temperature inversion, such as commonly occurs on clear, calm nights".

Due to the small amount of vegetation and relatively short distances between the road and receptor locations, no vegetation was included in the model. Similarly, no snow cover was included since there can be variation in absorption/reflection caused by different snow conditions. As a result, all sound level propagation calculations are considered conservative.

The exact location of future residential lots are not known, but it is apparent that they will likely be directly adjacent to the road right-of-way. As such, a receptor location of 10 m from the right-of-way was used to represent a "typical" backyard outdoor amenity location. All receptors were modeled at a height of 1.5 m which is consistent with the applicable guidelines. Also, given that most locations would have no buildings in between RGD and the residential outdoor amenity spaces, and because none of the nearby residential lot layouts are currently known buildings were not included. Again, this will result in a conservative estimate of the noise levels.

The noise modeling was conducted with several scenarios. These included:

1) **Future Conditions**. With projected traffic volumes (approximately 20 years) maximum volumes on 8-lane twinned configuration on RGD and grade separated interchanges at:
   a. Anthony Henday Drive
   b. 137 Avenue
   c. McKenney Avenue
   d. Giroux Road
   e. Villeneuve Road

   Traffic data for all roads were provided by ISL, along with road layouts and topographical information.

2) **Future Mitigation Conditions**. As in Item #1 with noise mitigation required to reduce the noise levels a) below 65 dBA $L_{eq}24$ and b) at least 5 dBA relative to no mitigation.

3) **Future Sensitivity Analysis**. As in Item #2 with sensitivity analysis on RGD traffic parameters listed below. This involved modification of the various parameters to determine their effect on noise levels.
   a. Traffic counts
   b. Traffic composition (i.e. % heavy vehicles)
   c. Traffic speeds

The computer noise modeling results were calculated in two ways. First, sound levels were calculated at specific receiver locations (i.e. residents). Next, the sound levels were calculated using a 10 m x 10 m grid over the entire study area. This provided color noise contours for easier visualization of the results.

Refer to Appendix I for a list of the computer noise modeling parameters.

## 4.0 Permissible Sound Levels

Environmental noise levels from road traffic are commonly described in terms of equivalent sound levels or $L_{eq}$. This is the level of a steady sound having the same acoustic energy, over a given time period, as the fluctuating sound. In addition, this energy averaged level is A–weighted to account for the reduced sensitivity of average human hearing to low frequency sounds. These $L_{eq}$ in dBA, which are the most common environmental noise measure, are often given for day-time (07:00 to 22:00) $L_{eq}$Day and night-time (22:00 to 07:00) $L_{eq}$Night while other criteria use the entire 24-hour period as $L_{eq}$24. Refer to Appendix II for a description of the acoustical terminology, and Appendix III for a list of common noise sources.

The criteria used to evaluate the road noise in the study area are based on the draft document entitled *"Noise Attenuation Guidelines for Provincial Highways Under Provincial Jurisdiction Within Cities and Urban Areas"* by Alberta Infrastructure and Transportation. The document specifies:

> "For construction or improvement of highways through cities and other urban areas where noise in residential areas is expected to exceed 65 dBA $L_{eq}$24, Alberta Infrastructure and Transportation will consider noise mitigation..."

The noise levels are to be measured for the first row of dwellings adjacent to the highway at 1.5 m above ground level, 15 m from the dwelling's façade.

## 5.0 Results and Discussion

### 5.1. Future Conditions

The results of the Future Conditions noise modeling are shown in Table 1 and Fig. 2. It can be seen that the projected noise levels will be below the limit of 65 dBA $L_{eq}24$ for all locations south of the Sturgeon River and east of RGD. North of the river is a relatively large environmental reserve in which noise levels are not a concern. At the first area of residential development east of RGD (labelled as Timberlea 1 in Fig. 2), however, the noise levels will be above 65 dBA $L_{eq}24$. At the location labelled Timberlea 2, the noise level will be marginally below 65 dBA $L_{eq}24$, however, noise mitigation is still warranted. Further north and east of RGD, and still south of McKenney Avenue, there is enough shielding provided by the off-ramp to result in levels well below 65 dBA $L_{eq}24$. A similar scenario occurs north of McKenney Avenue and east of RGD with some shielding being provided by the on-ramp and then noise levels increasing at locations such as Timberlea 7 and Timberlea 8. The noise climate will be similar east of RGD, north of the CN Rail line and South of Giroux Road. Similarly, in North Ridge, many of the locations are projected to be higher than 65 dBA $L_{eq}24$. Finally, north of Villeneuve Road and east of RGD, the noise climate will be below 65 dBA $L_{eq}24$ in the area east of the service road.

On the west side of RGD, at all of the adjacent acreage style residences, the noise levels are projected to be well below 65 dBA Leq24. This is largely a function of distance from RGD. As mentioned previously, the closest residence is approximately 200 m from RGD. This is a substantial setback (relative to the closer subdivision locations east of RGD). It is important to note that noise from RGD will be distinctly audible, but still below the criteria for which mitigation will be required.

**Table 1. Future Conditions Noise Modeling Results**

| Receptor | $L_{eq}$24 (dBA) | $L_{eq}$Day (dBA) | $L_{eq}$Night (dBA) |
|---|---|---|---|
| South Riel 1 | 60.6 | 62.1 | 54.9 |
| South Riel 2 | 57.8 | 59.3 | 52.0 |
| Fieldhouse | 57.2 | 58.7 | 51.4 |
| Track | 52.7 | 54.3 | 47.0 |
| Timberlea 1 | 66.8 | 68.3 | 61.0 |
| Timberlea 2 | 64.7 | 66.3 | 59 |
| Timberlea 3 | 59.9 | 61.4 | 54.1 |
| Timberlea 4 | 60.9 | 62.5 | 55.2 |
| Timberlea 5 | 60.9 | 62.5 | 55.2 |
| Timberlea 6 | 61.0 | 62.6 | 55.3 |
| Timberlea 7 | 67.4 | 69.0 | 61.7 |
| Timberlea 8 | 67.9 | 69.5 | 62.2 |
| Timberlea 9 | 63.6 | 65.2 | 57.9 |
| Residential 1' | 64.7 | 66.3 | 58.9 |
| Residential 2 | 68.8 | 70.4 | 63.0 |
| Residential 3 | 66.7 | 68.3 | 61.0 |
| Residential 4 | 62.6 | 64.2 | 56.8 |
| North Ridge 1 | 62.1 | 63.7 | 56.3 |
| North Ridge 2 | 60.7 | 62.3 | 54.9 |
| North Ridge 3 | 65.7 | 67.2 | 59.9 |
| North Ridge 4 | 66.7 | 68.3 | 60.9 |
| North Ridge 5 | 66.1 | 67.7 | 60.3 |
| North Ridge 6 | 63.9 | 65.5 | 58.2 |
| North Ridge 7 | 63.6 | 65.2 | 57.9 |
| North Ridge 8 | 64.3 | 65.8 | 58.5 |
| North Resident | 57.7 | 59.3 | 52.0 |
| Acreage 1 | 58.1 | 59.7 | 52.5 |
| Acreage 2 | 60.9 | 62.5 | 55.2 |
| Acreage 3 | 58.2 | 59.7 | 52.4 |
| Acreage 4 | 59.6 | 61.2 | 53.9 |
| Acreage 5 | 58.0 | 59.6 | 52.3 |
| Acreage 6 | 55.1 | 56.7 | 49.3 |
| Acreage 7 | 55.4 | 56.9 | 49.5 |
| Acreage 8 | 50.3 | 51.9 | 44.5 |
| Acreage 9 | 55.2 | 56.8 | 49.4 |
| Acreage 10 | 52.0 | 53.6 | 46.3 |

### 5.2. Future Mitigation Conditions

As a result of the modeling under future conditions, noise mitigation will be required for many of the areas east of RGD from just south of McKenney Avenue up to Villeneuve Road. As a result, noise barriers were included into the model to determine the relative locations and heights required. The two assessment criteria used for evaluation of the barrier effectiveness were as follows:

1) The barrier had to result in a noise level below 65 dBA $L_{eq}24$.
2) The total noise reduction with the barrier (relative to no-barrier conditions) had to be at least 5 dBA. This is the typical minimum acceptable level of attenuation required to justify the cost associated with installation of a barrier since any less reduction is only marginally subjectively noticeable.

Using these two criteria, noise barriers were modeled adjacent to all of the locations for which the Future Conditions modeling resulted in noise levels in excess of 65 dBA $L_{eq}24$. The barriers were located at RGD right-of-way since this would be at the rear property line of the proposed future development. The barrier heights were started at 1.83 m (6-ft) and increased until both of the criteria were satisfied.

The modeling indicated that a height of 3.5 m relative to grade would be required for most locations. In particular:

- Starting from the southwest residential lot adjacent to RGD in Timberlea (south of McKenney Avenue) and wrapping around along the south edge for at least 2-lots and then continuing until approximately 120 m south of McKenney Avenue.
- Starting from approximately 100 m north of McKenney Avenue in Timberlea and continuing until the CN Rail right-of-way then wrapping around adjacent to the CN Rail right-of-way for at least 2-lots from RGD.
- Starting from north of the CN Rail right-of-way (and also wrapping around adjacent to the CN Rail right-of-way for at least 2-lots from RGD and continuing on until just south of Giroux Road and extending east to approximately 75 m east of RGD.
- Starting at approximately 250 m north of Giroux Road and continuing along until approximately 260 m south of Villeneuve Road.

North of this, a barrier height of 1.8 m can be used starting from 260 m south of Villeneuve Road and continuing north then turning east until approximately 400 m east of RGD.

The resulting noise levels with the barriers in place are shown in Table 2 and Fig. 3. It can be seen that all locations which were previously above 65 dBA $L_{eq}24$ are now well below and have a reduction of at least 5 dBA.

**Table 2. Future Mitigation Noise Modeling Results**

| Receptor | $L_{eq}24$ (dBA) | $L_{eq}24$ Change Relative to No Mitigation (dBA) | $L_{eq}$Day (dBA) | $L_{eq}$Night (dBA) |
|---|---|---|---|---|
| South Riel 1 | 60.6 | 0.0 | 62.1 | 54.9 |
| South Riel 2 | 57.8 | 0.0 | 59.3 | 52.0 |
| Fieldhouse | 57.2 | 0.0 | 58.7 | 51.4 |
| Track | 52.7 | 0.0 | 54.3 | 47.0 |
| Timberlea 1 | 60.5 | -6.3 | 62.1 | 54.8 |
| Timberlea 2 | 59.1 | -5.6 | 60.7 | 53.4 |
| Timberlea 3 | 59.4 | -0.5 | 61.0 | 53.7 |
| Timberlea 4 | 60.6 | -0.3 | 62.2 | 54.9 |
| Timberlea 5 | 60.8 | -0.1 | 62.4 | 55.1 |
| Timberlea 6 | 60.6 | -0.4 | 62.2 | 54.9 |
| Timberlea 7 | 61.7 | -5.7 | 63.2 | 55.9 |
| Timberlea 8 | 61.3 | -6.6 | 62.9 | 55.5 |
| Timberlea 9 | 59.6 | -4.0 | 61.1 | 53.8 |
| Residential 1 | 59.8 | -4.9 | 61.4 | 54.0 |
| Residential 2 | 62.0 | -6.8 | 63.6 | 56.2 |
| Residential 3 | 61.5 | -5.2 | 63.1 | 55.7 |
| Residential 4 | 62.2 | -0.4 | 63.8 | 56.4 |
| North Ridge 1 | 61.9 | -0.2 | 63.5 | 56.2 |
| North Ridge 2 | 60.6 | -0.1 | 62.2 | 54.8 |
| North Ridge 3 | 59.8 | -5.9 | 61.3 | 54.0 |
| North Ridge 4 | 60.3 | -6.4 | 61.9 | 54.5 |
| North Ridge 5 | 60.3 | -5.8 | 61.9 | 54.5 |
| North Ridge 6 | 63.2 | -0.7 | 64.8 | 57.4 |
| North Ridge 7 | 63.5 | -0.1 | 65.0 | 57.7 |
| North Ridge 8 | 62.3 | -2.0 | 63.9 | 56.6 |
| North Resident | 57.7 | 0.0 | 59.3 | 52.0 |
| Acreage 1 | 58.1 | 0.0 | 59.7 | 52.5 |
| Acreage 2 | 60.9 | 0.0 | 62.5 | 55.2 |
| Acreage 3 | 58.2 | 0.0 | 59.7 | 52.4 |
| Acreage 4 | 59.6 | 0.0 | 61.2 | 53.9 |
| Acreage 5 | 58.0 | 0.0 | 59.6 | 52.3 |
| Acreage 6 | 55.1 | 0.0 | 56.7 | 49.3 |
| Acreage 7 | 55.4 | 0.0 | 56.9 | 49.5 |
| Acreage 8 | 50.3 | 0.0 | 51.9 | 44.5 |
| Acreage 9 | 55.2 | 0.0 | 56.8 | 49.4 |
| Acreage 10 | 52.0 | 0.0 | 53.6 | 46.3 |

Barrier construction can generally be either solid screen wood fences or masonry noise walls. If using wood materials, the fences should be, at a minimum, double boarded with no visible gaps through the fence or at the bottom and have a surface density of at least 20 $kg/m^2$. A sample schematic of fence construction is provided in Fig. 4. For masonry noise walls, there should also be no visible gaps and the surface density must also be at least 20 $kg/m^2$.

If there are to be any walkways or roadways penetrating through the proposed barrier locations, then the barrier should either: a) wrap around on both sides of the opening on the inside for at least the distance from the rear property line to the structure or, b) wrap around past the opening for at least 3 equivalent opening dimensions. Both options are shown in Fig. 5.

For all barriers taller than 1.83 m, it is possible to exchange berm height for fence height and vice-versa, as long as the centerline of the fence does not change (i.e. it remains at the current proposed property line). The key is that the total height has to be that listed above.

Barriers abutting each other with varying elevations can either have an abrupt change or a gradual change as long as the appropriate heights are in place for their respective locations.

### 5.3. Future Sensitivity Analysis

As part of the study, a sensitivity analysis was completed to determine the relative impact of the three main traffic parameters which effect the noise levels (traffic volume, % heavy vehicles, speed). The Future Mitigation Conditions model was used as the base and then each of the three parameters was modified by a specific amount to determine the impact. In addition, the cumulative effect of modifying all three parameters was evaluated to determine the "worst case" impact.

#### 5.3.1. Traffic Volume

The analysis of varying traffic volume does not require modifications to the noise model. As with any noise source, the relative change in noise level with changing quantity is a simple logarithmic function as indicated below:

$$\Delta SPL = 10\log_{10}\left(\textit{relative change}\right)$$

This means that if the traffic volumes, for example, are doubled, there will be a 3.0 dBA increase. **If there is an increase in traffic volumes of 10% (likely maximum error in 20 year planning horizon), there will be a 0.4 dBA increase.** An increase of this magnitude would not be subjectively noticeable and would be insufficient to result in noise levels above 65 dBA $L_{eq}24$ at all locations once the previously discussed noise mitigation has been implemented. As an aside, typical traffic volumes on urban roads only vary a few % from day-to-day. This means that changes in noise levels from day-to-day are almost entirely dictated by environmental and meteorological conditions, and not by varying traffic volumes.

#### 5.3.2. % Heavy Vehicles

In order to determine the effect of varying % heavy trucks, two scenarios were modeled. The Future Mitigation Conditions case included day-time and night-time % heavy trucks of 10% south of 137 Avenue and 5% north of 137 Avenue on RGD. These values were increased by 5% and then decreased by 5% to determine a relative range of values. It is un-likely that in the future 15 % heavy trucks will fall outside of this range. The results are shown in Table 3. It can be seen that **the relative sound level increase with 15% heavy trucks south of 137 Avenue and 10% heavy trucks north of 137 Avenue is approximately 0.1 – 1.1 dBA. The relative sound level decrease with 5% heavy trucks south of**

**137 Avenue and 0% heavy trucks north of 137 Avenue is approximately 0.2 – 1.5 dBA.** Again, given that a minimum 2.0 – 3.0 dBA change is required before most people start to notice a change, it will take a significant change to the % heavy trucks before most people will notice the difference. Also, with an increase of heavy trucks as mentioned above, the noise levels will still be below the AIT limit of 65 dBA $L_{eq}24$ at all locations once the previously discussed noise mitigation has been implemented.

In general, the effect of changing the % heavy trucks is logarithmic. The difference between 0% and 1% is significant (approximately 0.7 dBA) while the difference between 10% and 11% is much less (approximately 0.2 dBA). Since the current and future modeled % heavy trucks are near 10%, small % changes will not have a significant impact.

## Table 3. Future Mitigation with Change in % Heavy Trucks Noise Modeling Results

| Receptor | Trucks on RGD + 5% $L_{eq}24$ (dBA) | Change in $L_{eq}24$ Relative to Future Mitigation Conditions (dBA) | | Trucks on RGD - 5% $L_{eq}24$ (dBA) | Change in $L_{eq}24$ Relative to Future Mitigation Conditions (dBA) |
|---|---|---|---|---|---|
| South Riel 1 | 60.9 | 0.3 | | 60.2 | -0.4 |
| South Riel 2 | 58.7 | 0.9 | | 56.5 | -1.3 |
| Fieldhouse | 58.2 | 1.0 | | 55.8 | -1.4 |
| Track | 53.7 | 1.0 | | 51.3 | -1.4 |
| Timberlea 1 | 61.5 | 1.0 | | 59.2 | -1.3 |
| Timberlea 2 | 60.0 | 0.9 | | 57.9 | -1.2 |
| Timberlea 3 | 59.9 | 0.5 | | 58.8 | -0.6 |
| Timberlea 4 | 61.0 | 0.4 | | 60.2 | -0.4 |
| Timberlea 5 | 61.2 | 0.4 | | 60.4 | -0.4 |
| Timberlea 6 | 61.3 | 0.7 | | 59.7 | -0.9 |
| Timberlea 7 | 62.7 | 1.0 | | 60.3 | -1.4 |
| Timberlea 8 | 62.4 | 1.1 | | 59.9 | -1.4 |
| Timberlea 9 | 60.6 | 1.0 | | 58.1 | -1.5 |
| Residential 1 | 60.8 | 1.0 | | 58.3 | -1.5 |
| Residential 2 | 63.1 | 1.1 | | 60.6 | -1.4 |
| Residential 3 | 62.5 | 1.0 | | 60.1 | -1.4 |
| Residential 4 | 62.7 | 0.5 | | 61.6 | -0.6 |
| North Ridge 1 | 62.4 | 0.5 | | 61.5 | -0.4 |
| North Ridge 2 | 61.6 | 1.0 | | 59.3 | -1.3 |
| North Ridge 3 | 60.8 | 1.0 | | 58.4 | -1.4 |
| North Ridge 4 | 61.4 | 1.1 | | 58.9 | -1.4 |
| North Ridge 5 | 61.3 | 1.0 | | 58.9 | -1.4 |
| North Ridge 6 | 64.1 | 0.9 | | 62.1 | -1.1 |
| North Ridge 7 | 63.7 | 0.2 | | 63.2 | -0.3 |
| North Ridge 8 | 62.5 | 0.2 | | 62.1 | -0.2 |
| North Resident | 58.5 | 0.8 | | 56.6 | -1.1 |
| Acreage 1 | 58.4 | 0.3 | | 57.8 | -0.3 |
| Acreage 2 | 61.4 | 0.5 | | 60.3 | -0.6 |
| Acreage 3 | 58.9 | 0.7 | | 57.3 | -0.9 |
| Acreage 4 | 60.0 | 0.4 | | 59.3 | -0.3 |
| Acreage 5 | 58.2 | 0.2 | | 57.7 | -0.3 |
| Acreage 6 | 55.9 | 0.8 | | 54.1 | -1.0 |
| Acreage 7 | 55.5 | 0.1 | | 55.2 | -0.2 |
| Acreage 8 | 51.2 | 0.9 | | 49.1 | -1.2 |
| Acreage 9 | 55.6 | 0.4 | | 54.7 | -0.5 |
| Acreage 10 | 52.9 | 0.9 | | 50.9 | -1.1 |

### 5.3.3. Speed

In order to determine the effect of different traffic speeds, two scenarios were modeled. The Future Mitigation Conditions case included a speed of 100 km/hr on RGD throughout the entire study area. This speed was increased to 110 km/hr and then decreased to 90 km/hr to determine the relative change compared to 100 km/hr. It is highly unlikely that the traffic speeds will fall outside of this range. Table 4 shows the $L_{eq}24$ results for both the 110 km/hr and 90 km/hr conditions as well as the relative change in noise levels at all modeled receptor locations. **When increasing the speed to 110 km/hr, the noise levels increased by 0.0 – 0.8 dBA. When reducing the speed to 90 km/hr, the noise levels decreased by 0.1 – 0.8 dBA.** As with the % heavy trucks assessment, given that a minimum 2.0 – 3.0 dBA change is required before most people start to notice a change, changing the traffic speeds will not significantly impact the perceived noise climate. Also, with an increase in speeds as mentioned above, the noise levels will still be below the AIT limit of 65 dBA $L_{eq}24$ at all locations once the previously discussed noise mitigation has been implemented.

## Table 4. Future Mitigation with Change in Speed Noise Modeling Results

| Receptor | Speed on RGD 110 km/hr $L_{eq}24$ (dBA) | Change in $L_{eq}24$ Relative to Future Mitigation Conditions (dBA) | | Speed on RGD 90 km/hr $L_{eq}24$ (dBA) | Change in $L_{eq}24$ Relative to Future Mitigation Conditions (dBA) |
|---|---|---|---|---|---|
| South Riel 1 | 60.8 | 0.2 | | 60.4 | -0.2 |
| South Riel 2 | 58.4 | 0.6 | | 57.1 | -0.7 |
| Fieldhouse | 57.9 | 0.7 | | 56.4 | -0.8 |
| Track | 53.4 | 0.7 | | 52.0 | -0.7 |
| Timberlea 1 | 61.2 | 0.7 | | 59.8 | -0.7 |
| Timberlea 2 | 59.8 | 0.7 | | 58.5 | -0.6 |
| Timberlea 3 | 59.8 | 0.4 | | 59.1 | -0.3 |
| Timberlea 4 | 60.9 | 0.3 | | 60.4 | -0.2 |
| Timberlea 5 | 61.1 | 0.3 | | 60.6 | -0.2 |
| Timberlea 6 | 61.1 | 0.5 | | 60.2 | -0.4 |
| Timberlea 7 | 62.4 | 0.7 | | 61.0 | -0.7 |
| Timberlea 8 | 62.1 | 0.8 | | 60.5 | -0.8 |
| Timberlea 9 | 60.3 | 0.7 | | 58.8 | -0.8 |
| Residential 1 | 60.5 | 0.7 | | 59.0 | -0.8 |
| Residential 2 | 62.8 | 0.8 | | 61.3 | -0.7 |
| Residential 3 | 62.2 | 0.7 | | 60.8 | -0.7 |
| Residential 4 | 62.5 | 0.3 | | 61.9 | -0.3 |
| North Ridge 1 | 62.2 | 0.3 | | 61.7 | -0.2 |
| North Ridge 2 | 61.3 | 0.7 | | 59.9 | -0.7 |
| North Ridge 3 | 60.5 | 0.7 | | 59.0 | -0.8 |
| North Ridge 4 | 61.1 | 0.8 | | 59.6 | -0.7 |
| North Ridge 5 | 61.0 | 0.7 | | 59.6 | -0.7 |
| North Ridge 6 | 63.8 | 0.6 | | 62.6 | -0.6 |
| North Ridge 7 | 63.7 | 0.2 | | 63.3 | -0.2 |
| North Ridge 8 | 62.5 | 0.2 | | 62.2 | -0.1 |
| North Resident | 58.3 | 0.6 | | 57.1 | -0.6 |
| Acreage 1 | 58.3 | 0.2 | | 57.9 | -0.2 |
| Acreage 2 | 61.2 | 0.3 | | 60.6 | -0.3 |
| Acreage 3 | 58.7 | 0.5 | | 57.7 | -0.5 |
| Acreage 4 | 59.9 | 0.3 | | 59.4 | -0.2 |
| Acreage 5 | 58.1 | 0.1 | | 57.8 | -0.2 |
| Acreage 6 | 55.6 | 0.5 | | 54.6 | -0.5 |
| Acreage 7 | 55.4 | 0.0 | | 55.3 | -0.1 |
| Acreage 8 | 50.9 | 0.6 | | 49.7 | -0.6 |
| Acreage 9 | 55.5 | 0.3 | | 54.9 | -0.3 |
| Acreage 10 | 52.7 | 0.7 | | 51.4 | -0.6 |

### 5.3.4. Cumulative Effect

With the information provided by the sensitivity analysis for each of the three main traffic parameters, it is possible to determine a cumulative effect if all three are taken into account simultaneously. As such, **increasing the traffic volume by 10%, increasing the traffic speed to 110 km/hr, and increasing the heavy trucks to 15% south of 137 Avenue and 10 % north of 137 Avenue will result in an overall maximum increase ranging from 0.1 – 1.7 dBA as shown in Table 5.** Even with this increase, the highest sound level at any residential receptor will still be below the limit of 65 dBA. However, the residential receptors at the north end of North Ridge will be very close. The noise mitigation recommendations, provided in Section 5.2 indicated that the height of the barrier would only need to be 1.8 m at this location. It is, therefore, recommended to review the possibility of increasing the barrier height to 3.5 m (similar to the other areas to the south).

## Table 5. Future Mitigation with Cumulative Impact of Higher Volumes, % Heavy Traffic and Speeds Noise Modeling Results

| Receptor | Cumulative Effect $L_{eq}24$ (dBA) | Change in $L_{eq}24$ Relative to Future Mitigation Conditions (dBA) |
|---|---|---|
| South Riel 1 | 61.1 | 0.5 |
| South Riel 2 | 59.3 | 1.5 |
| Fieldhouse | 58.8 | 1.6 |
| Track | 54.3 | 1.6 |
| Timberlea 1 | 62.1 | 1.6 |
| Timberlea 2 | 60.6 | 1.5 |
| Timberlea 3 | 60.2 | 0.8 |
| Timberlea 4 | 61.3 | 0.7 |
| Timberlea 5 | 61.4 | 0.6 |
| Timberlea 6 | 61.8 | 1.2 |
| Timberlea 7 | 63.2 | 1.5 |
| Timberlea 8 | 62.9 | 1.6 |
| Timberlea 9 | 61.2 | 1.6 |
| Residential 1 | 61.4 | 1.6 |
| Residential 2 | 63.6 | 1.6 |
| Residential 3 | 63.1 | 1.6 |
| Residential 4 | 62.9 | 0.7 |
| North Ridge 1 | 62.6 | 0.7 |
| North Ridge 2 | 62.1 | 1.5 |
| North Ridge 3 | 61.4 | 1.6 |
| North Ridge 4 | 62.0 | 1.7 |
| North Ridge 5 | 61.9 | 1.6 |
| North Ridge 6 | 64.6 | 1.4 |
| North Ridge 7 | 63.9 | 0.4 |
| North Ridge 8 | 62.6 | 0.3 |
| North Resident | 59.0 | 1.3 |
| Acreage 1 | 58.6 | 0.5 |
| Acreage 2 | 61.7 | 0.8 |
| Acreage 3 | 59.3 | 1.1 |
| Acreage 4 | 60.2 | 0.6 |
| Acreage 5 | 58.3 | 0.3 |
| Acreage 6 | 56.3 | 1.2 |
| Acreage 7 | 55.5 | 0.1 |
| Acreage 8 | 51.7 | 1.4 |
| Acreage 9 | 55.9 | 0.7 |
| Acreage 10 | 53.4 | 1.4 |

## 6.0 Conclusion

The results of the noise modeling for Future Conditions on RGD indicated noise levels in excess of the AIT guidelines criteria of 65 dBA $L_{eq}24$ at many locations directly adjacent to RGD, indicating that noise mitigation would be required. In particular, some locations were as high as 69 dBA $L_{eq}24$. As such, noise mitigation barriers were added to the model with the intent of meeting two design criteria: 1) a total noise level less than 65 dBA Leq24, and 2) a minimum reduction (relative to the baseline case) of 5 dBA with the installation of a noise wall.

The results of the noise mitigation measures indicated a noise barrier height of 3.5 m would be required for much of the study area (entirely on the east side of RGD) spanning from just south of McKenney Avenue all the way north to approximately 260 m south of Villeneuve Road. From this point, further north until approximately 400 m east of Villeneuve Road, a 1.8 m barrier will suffice.

Finally, as an exercise, the three main traffic parameters which affect the noise levels (i.e. volume, % heavy trucks, and speed) were reviewed to determine the sensitivity of each on the noise levels. It was found that modification to each one (by ±10 %) had a small impact on the noise levels and differences would not be subjectively noticeable. The cumulative effect of increasing all three parameters by 10% resulted in increases ranging from 0.1 – 1.7 dBA which would still be barely subjectively noticeable. Further, the increased noise levels at all locations would still be below 65 dBA $L_{eq}24$ with the above mentioned noise mitigation. The only area which is of concern for this was the 1.8 m barrier section at the north end of North Ridge. The noise levels resulting from increases of 10% to the three parameters will be very close to 65 dBA $L_{eq}24$. It is, therefore, recommended to review the possibility of increasing the barrier height to 3.5 m (similar to the other areas to the south).

## 7.0 References


- *"Noise Attenuation Guidelines for Provincial Highways Under Provincial Jurisdiction Within Cities and Urban Areas"* DRAFT version, by Alberta Infrastructure and Transportation. January 31, 2006.
- International Organization for Standardization (ISO), *Standard 1996-1, Acoustics – Description, measurement and assessment of environmental noise – Part 1: Basic quantities and assessment procedures, 2003*, Geneva Switzerland.
- International Organization for Standardization (ISO), *Standard 9613-1, Acoustics – Attenuation of sound during propagation outdoors – Part 1: Calculation of absorption of sound by the atmosphere, 1993*, Geneva Switzerland.
- International Organization for Standardization (ISO), *Standard 9613-2, Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation, 1996*, Geneva Switzerland.


**Figure 1a. Study Area (South)**

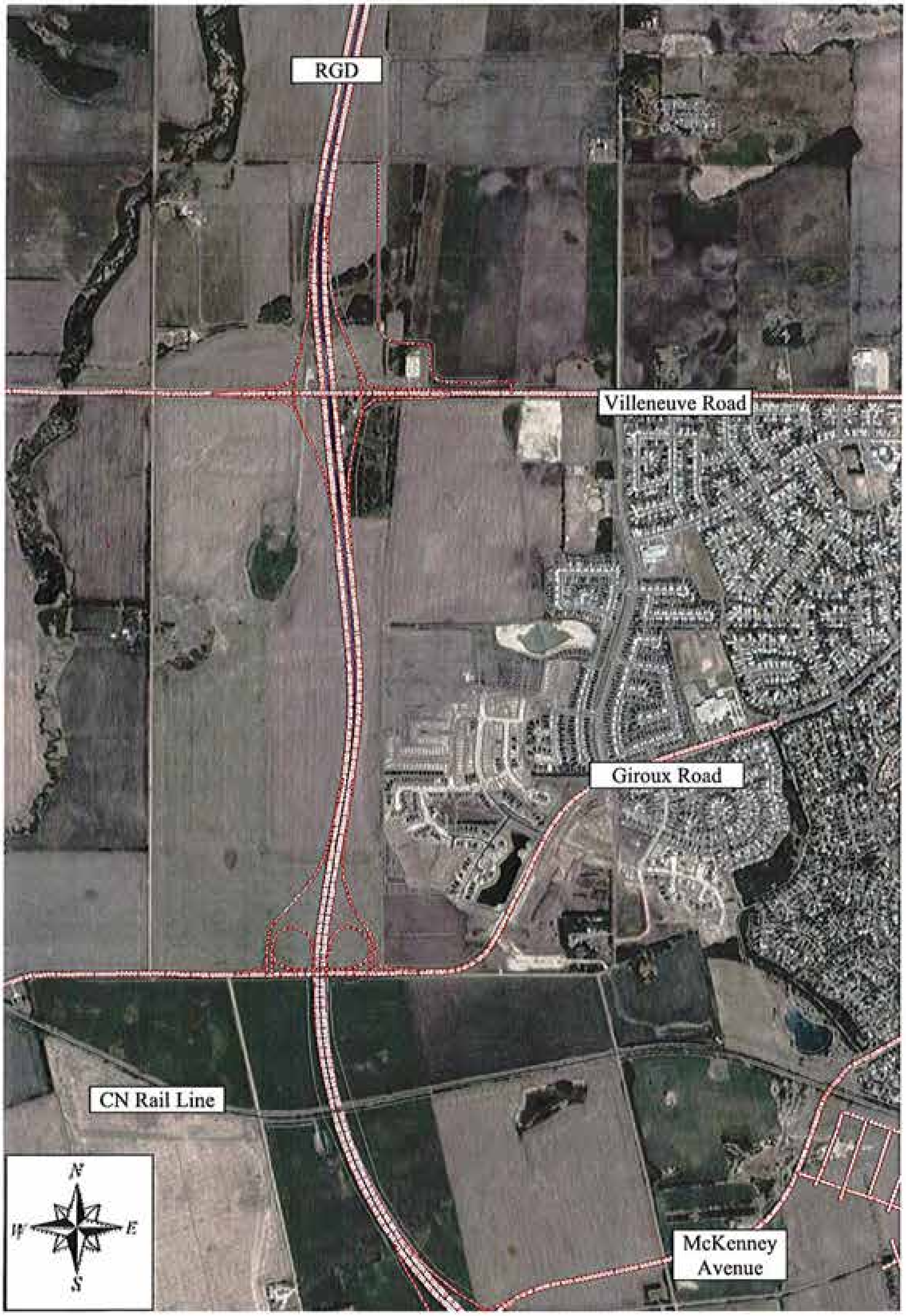



**Figure 1b. Study Area (North)**

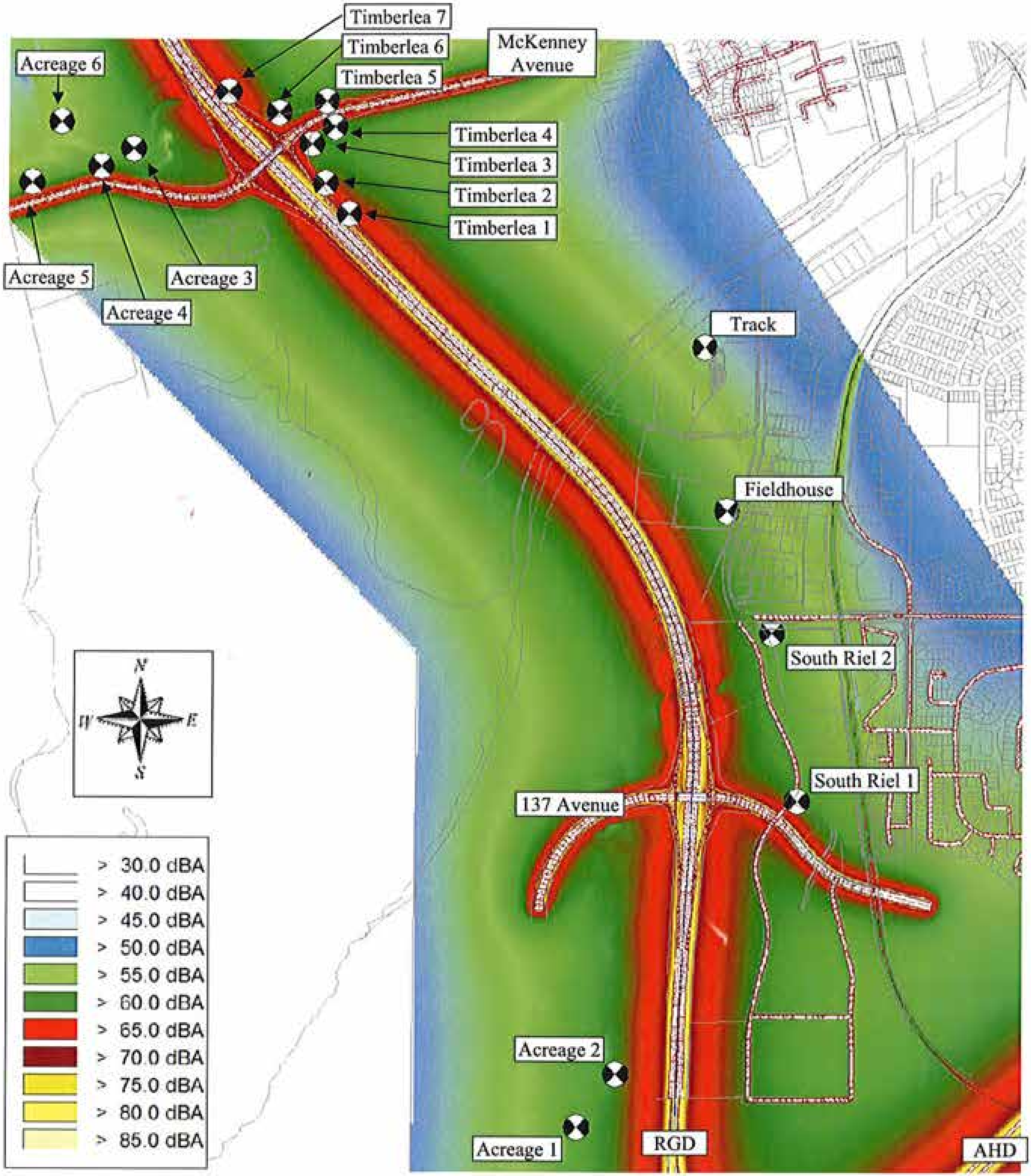



**Figure 2a. Future Conditions $L_{eq}$24 Noise Modeling Results (South Study Area)**

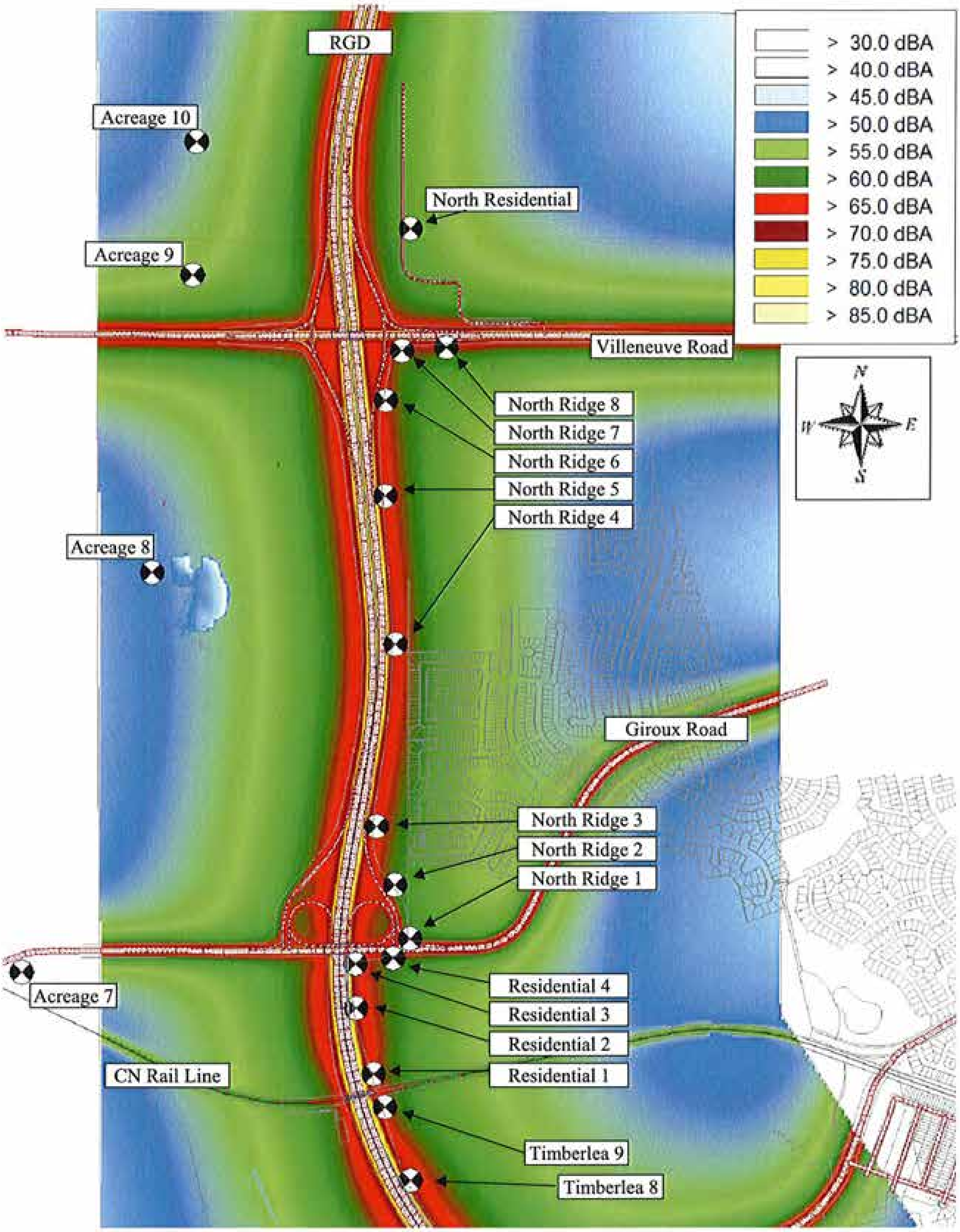



**Figure 2b. Future Conditions $L_{eq}$24 Noise Modeling Results (North Study Area)**

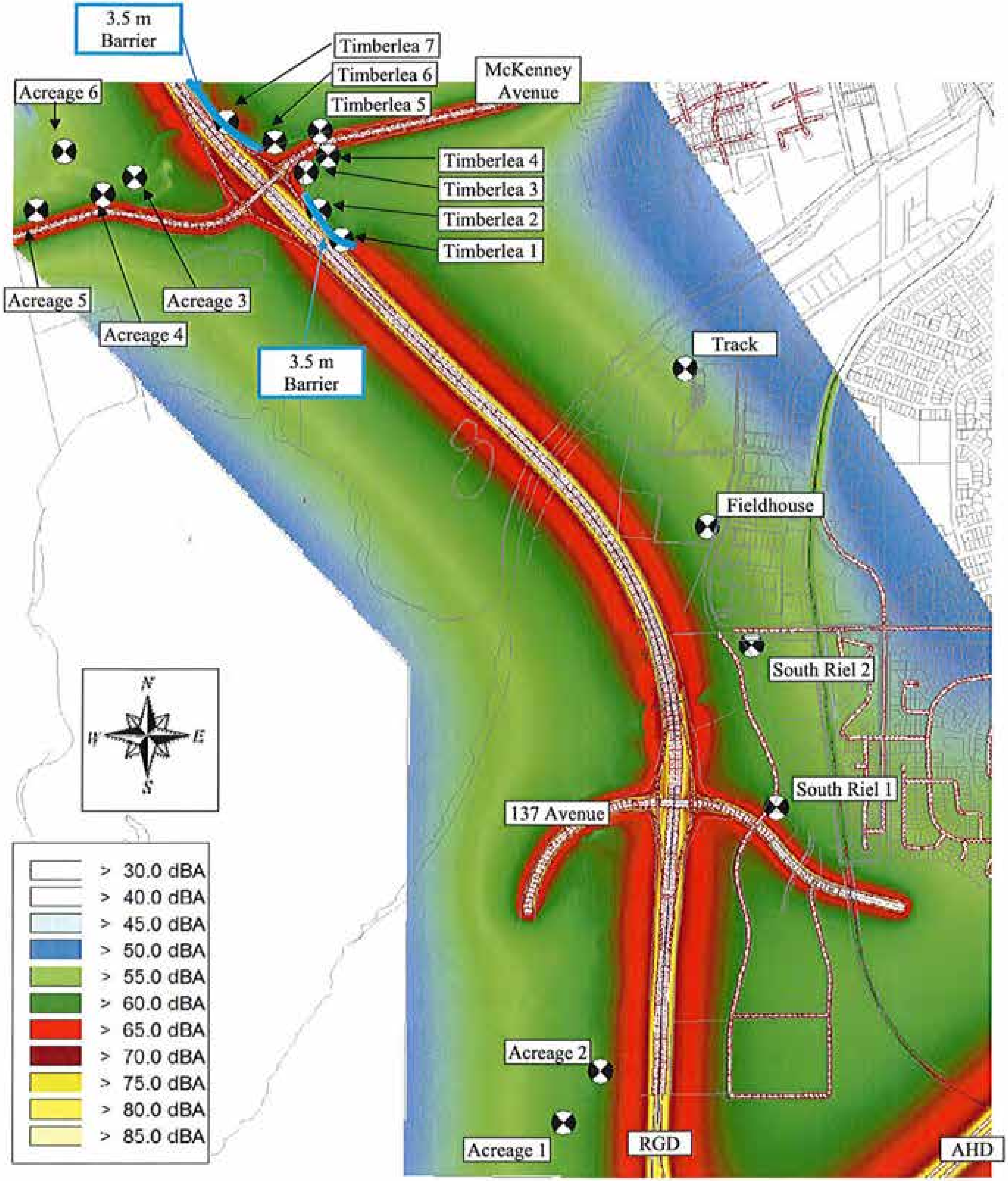



**Figure 3a. Future Mitigation Conditions $L_{eq}$24 Noise Modeling Results (South Study Area)**

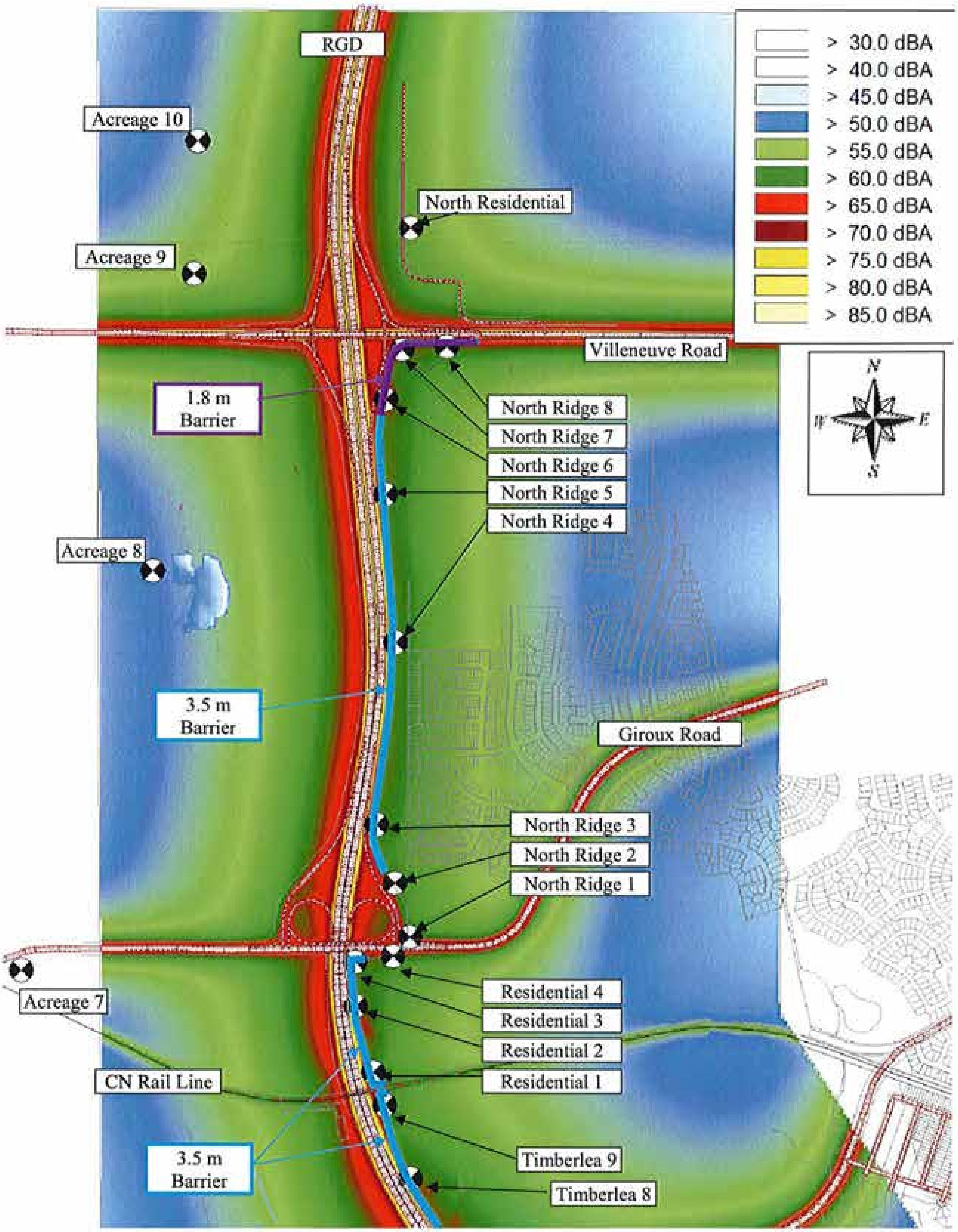



**Figure 3b. Future Mitigation Conditions $L_{eq}$24 Noise Modeling Results (North Study Area)**

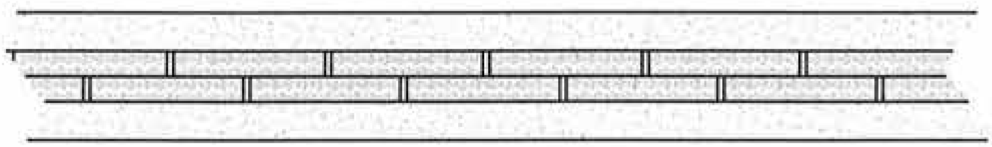


**Figure 4. Minimum Recommended Wooden Fence Construction Sectional View**

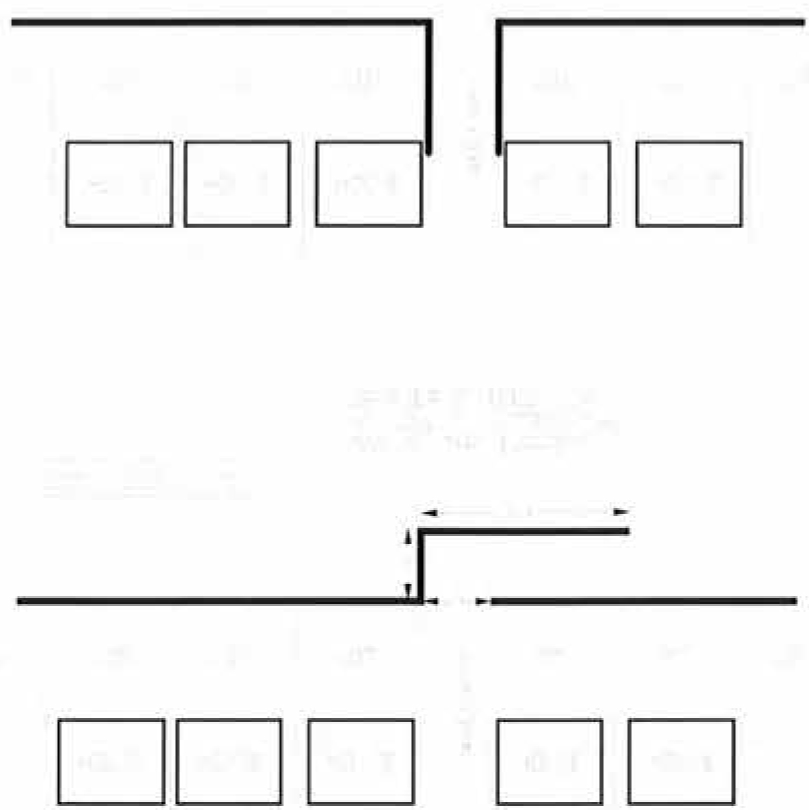


**Figure 5. Minimum Recommended Walkway/Roadway Penetration Barrier Construction**

# Appendix I

## NOISE MODELING PARAMETERS

| Road | Day (Vehicles Per Hour) | Day % Heavy Trucks | Night (Vehicles Per Hour) | Night % Heavy Trucks | Speed (km/hr) |
|---|---|---|---|---|---|
| RGD Between AHD and 137 Ave NB | 2145 | 10 | 400 | 10 | 100 |
| RGD Between AHD and 137 Ave SB | 2145 | 10 | 400 | 10 | 100 |
| RGD Between 137 Ave and McKenney Ave NB | 2430 | 5 | 450 | 5 | 100 |
| RGD Between 137 Ave and McKenney Ave SB | 2430 | 5 | 450 | 5 | 100 |
| RGD Between McKenney Ave and Giroux Road NB | 2120 | 5 | 390 | 5 | 100 |
| RGD Between McKenney Ave and Giroux Road SB | 2120 | 5 | 390 | 5 | 100 |
| RGD Between Giroux Road and Villeneuve Road NB | 1700 | 5 | 310 | 5 | 100 |
| RGD Between Giroux Road and Villeneuve Road SB | 1700 | 5 | 310 | 5 | 100 |
| RGD North of Villenueve Road NB | 1200 | 5 | 225 | 5 | 100 |
| RGD North of Villenueve Road SB | 1200 | 5 | 225 | 5 | 100 |
| | | | | | |
| Anthony Henday Drive Northbound | 2310 | 16 | 595 | 14 | 100 |
| Anthony Henday Drive Southhbound | 2310 | 16 | 595 | 14 | 100 |
| | | | | | |
| AHD NB to RGD NB | 715 | 10 | 133 | 10 | 100 |
| AHD SB to RGD NB | 715 | 10 | 133 | 10 | 100 |
| 184 Street NB to RGD NB | 715 | 10 | 133 | 10 | 100 |
| RGD SB to AHD SB | 715 | 10 | 133 | 10 | 100 |
| RGD SB to 184 Street SB | 715 | 10 | 133 | 10 | 100 |
| RGD SB to AHD NB | 715 | 10 | 133 | 10 | 100 |
| | | | | | |
| 137 Avenue | 1650 | 10 | 306 | 10 | 60 |
| 137 Avenue to RGD Ramps | 165 | 10 | 31 | 10 | 80 |
| Riel Drive South of Levasseur Road | 1320 | 3 | 242 | 3 | 60 |
| Riel Drive South of 137 Avenue | 960 | 3 | 176 | 3 | 60 |
| | | | | | |
| McKenney Avenue | 1200 | 5 | 225 | 5 | 60 |
| McKenney Avenue to RGD Ramps | 120 | 5 | 23 | 5 | 80 |
| | | | | | |
| Giroux Road | 540 | 5 | 100 | 5 | 60 |
| Giroux Road Ramps | 54 | 5 | 10 | 5 | 80 |
| | | | | | |
| Villeneuve Road | 1830 | 5 | 340 | 5 | 60 |
| Villeneuve Road Ramps | 183 | 5 | 34 | 5 | 80 |

# Appendix II

## THE ASSESSMENT OF ENVIRONMENTAL NOISE (GENERAL)

### Sound Pressure Level

Sound pressure is initially measured in Pascal's (Pa). Humans can hear several orders of magnitude in sound pressure levels, so a more convenient scale is used. This scale is known as the decibel (dB) scale, named after Alexander Graham Bell (telephone guy). It is a base 10 logarithmic scale. When we measure pressure we typically measure the RMS sound pressure.

$$SPL = 10\log_{10}\left[\frac{P_{RMS}^2}{P_{ref}^2}\right] = 20\log_{10}\left[\frac{P_{RMS}}{P_{ref}}\right]$$

Where: $SPL$ = Sound Pressure Level in dB
$P_{RMS}$ = Root Mean Square measured pressure (Pa)
$P_{ref}$ = Reference sound pressure level ($P_{ref} = 2\text{x}10^{-5}$ Pa = 20 μPa)

This reference sound pressure level is an internationally agreed upon value. It represents the threshold of human hearing for "typical" people based on numerous testing. It is possible to have a threshold which is lower than 20 μPa which will result in negative dB levels. As such, zero dB does not mean there is no sound!

In general, a difference of 1 – 2 dB is the threshold for humans to notice that there has been a change in sound level. A difference of 3 dB (factor of 2 in acoustical energy) is perceptible and a change of 5 dB is strongly perceptible. A change of 10 dB is typically considered a factor of 2. This is quite remarkable when considering that 10 dB is 10-times the acoustical energy!

| Sound pressure in decibels (dB) | Sound pressure in pounds per square inch (PSI) | Common Sounds |
|---|---|---|
| 160 | 3X10$^{-1}$ | Medium jet engine |
| 140 | 3X10$^{-2}$ | Large propeller aircraft<br>Air raid siren<br>Riveting and chipping |
| 120 | 3X10$^{-3}$ | Discotheque |
| | | Punch press |
| 100 | 3X10$^{-4}$ | Canning plant<br>Heavy city traffic; subway |
| 80 | 3X10$^{-5}$ | Busy office |
| 60 | 3X10$^{-6}$ | Normal speech |
| | | Private office |
| 40 | 3X10$^{-7}$ | Quiet residential neighborhood |
| 20 | 3X10$^{-8}$ | Whisper |
| 0 | 3X10$^{-9}$ | Threshold of hearing |

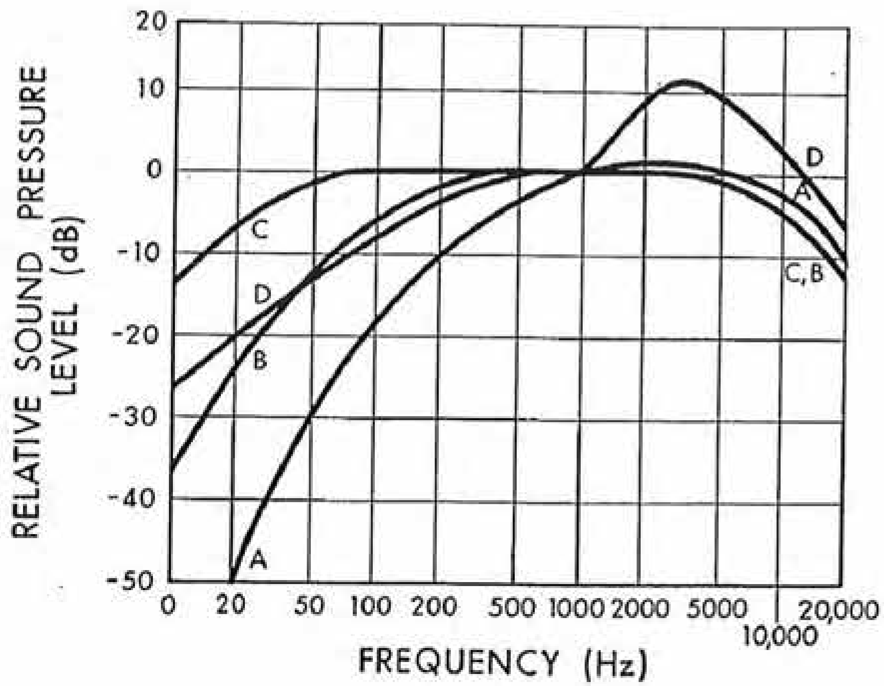
## Frequency

The range of frequencies audible to the human ear ranges from approximately 20 Hz to 20 kHz. Within this range, the human ear does not hear equally at all frequencies. It is not very sensitive to low frequency sounds, is very sensitive to mid frequency sounds and is slightly less sensitive to high frequency sounds. Due to the large frequency range of human hearing, the entire spectrum is often divided into 31 bands, each known as a 1/3 octave band.

The internationally agreed upon center frequencies and upper and lower band limits for the 1/1 (whole octave) and 1/3 octave bands are as follows:

| | Whole Octave | | | 1/3 Octave | |
|---|---|---|---|---|---|
| Lower Band Limit | Center Frequency | Upper Band Limit | Lower Band Limit | Center Frequency | Upper Band Limit |
| 11 | **16** | 22 | 14.1 | **16** | 17.8 |
| | | | 17.8 | **20** | 22.4 |
| | | | 22.4 | **25** | 28.2 |
| 22 | **31.5** | 44 | 28.2 | **31.5** | 35.5 |
| | | | 35.5 | **40** | 44.7 |
| | | | 44.7 | **50** | 56.2 |
| 44 | **63** | 88 | 56.2 | **63** | 70.8 |
| | | | 70.8 | **80** | 89.1 |
| | | | 89.1 | **100** | 112 |
| 88 | **125** | 177 | 112 | **125** | 141 |
| | | | 141 | **160** | 178 |
| | | | 178 | **200** | 224 |
| 177 | **250** | 355 | 224 | **250** | 282 |
| | | | 282 | **315** | 355 |
| | | | 355 | **400** | 447 |
| 355 | **500** | 710 | 447 | **500** | 562 |
| | | | 562 | **630** | 708 |
| | | | 708 | **800** | 891 |
| 710 | **1000** | 1420 | 891 | **1000** | 1122 |
| | | | 1122 | **1250** | 1413 |
| | | | 1413 | **1600** | 1778 |
| 1420 | **2000** | 2840 | 1778 | **2000** | 2239 |
| | | | 2239 | **2500** | 2818 |
| | | | 2818 | **3150** | 3548 |
| 2840 | **4000** | 5680 | 3548 | **4000** | 4467 |
| | | | 4467 | **5000** | 5623 |
| | | | 5623 | **6300** | 7079 |
| 5680 | **8000** | 11360 | 7079 | **8000** | 8913 |
| | | | 8913 | **10000** | 11220 |
| | | | 11220 | **12500** | 14130 |
| 11360 | **16000** | 22720 | 14130 | **16000** | 17780 |
| | | | 17780 | **20000** | 22390 |

Human hearing is most sensitive at approximately 3500 Hz which corresponds to the ¼ wavelength of the ear canal (approximately 2.5 cm). Because of this range of sensitivity to various frequencies, we typically apply various weighting networks to the broadband measured sound to more appropriately account for the way humans hear. By default, the most common weighting network used is the so-called "A-weighting". It can be seen in the figure that the low frequency sounds are reduced significantly with the A-weighting.




## Combination of Sounds

When combining multiple sound sources the general equation is:

$$\Sigma SPL_n = 10\log_{10}\left[\sum_{i=1}^{n} 10^{\frac{SPL_i}{10}}\right]$$

Examples:

- Two sources of 50 dB each add together to result in 53 dB.
- Three sources of 50 dB each add together to result in 55 dB.
- Ten sources of 50 dB each add together to result in 60 dB.
- One source of 50 dB added to another source of 40 dB results in 50.4 dB

It can be seen that, if multiple similar sources exist, removing or reducing only one source will have little effect.

## Sound Level Measurements

Over the years a number of methods for measuring and describing environmental noise have been developed. The most widely used and accepted is the concept of the Energy Equivalent Sound Level ($L_{eq}$) which was developed in the US (1970's) to characterize noise levels near US Air-force bases. This is the level of a steady state sound which, for a given period of time, would contain the same energy as the time varying sound. The concept is that the same amount of annoyance occurs from a sound having a high level for a short period of time as from a sound at a lower level for a longer period of time.
The $L_{eq}$ is defined as:

$$L_{eq} = 10\log_{10}\left[\frac{1}{T}\int_0^T 10^{\frac{dB}{10}}\, dT\right] = 10\log_{10}\left[\frac{1}{T}\int_0^T \frac{P^2}{P_{ref}^2}\, dT\right]$$

We must specify the time period over which to measure the sound. i.e. 1-second, 10-seconds, 15-seconds, 1-minute, 1-day, etc. **An $L_{eq}$ is meaningless if there is no time period associated.**

In general there a few very common $L_{eq}$ sample durations which are used in describing environmental noise measurements. These include:

- $L_{eq}$24 - Measured over a 24-hour period
- $L_{eq}$Night - Measured over the night-time (typically 22:00 – 07:00)
- $L_{eq}$Day - Measured over the day-time (typically 07:00 – 22:00)
- $L_{DN}$ - Same as $L_{eq}$24 with a 10 dB penalty added to the night-time

**Statistical Descriptor**

Another method of conveying long term noise levels utilizes statistical descriptors. These are calculated from a cumulative distribution of the sound levels over the entire measurement duration and then determining the sound level at xx % of the time.

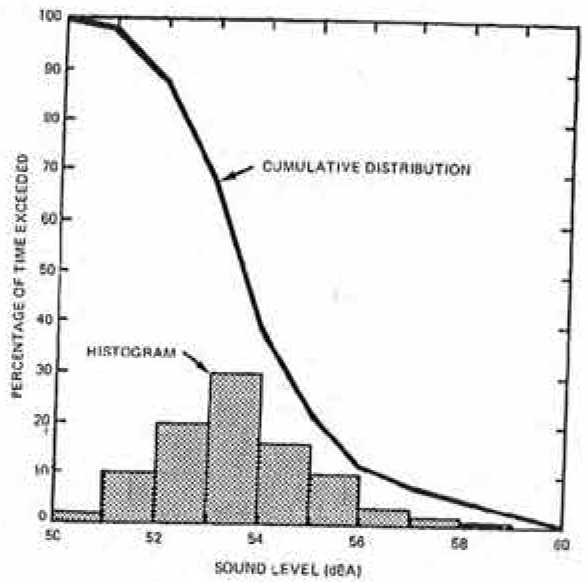



Figure 16.6 Statistically processed community noise showing histogram and cumulative distribution of A weighted sound levels.

*Industrial Noise Control, Lewis Bell, Marcel Dekker, Inc. 1994*

The most common statistical descriptors are:

- $L_{min}$ - minimum sound level measured
- $L_{01}$ - sound level that was exceeded only 1% of the time
- $L_{10}$ - sound level that was exceeded only 10% of the time.
  - Good measure of intermittent or intrusive noise
  - Good measure of Traffic Noise
- $L_{50}$ - sound level that was exceeded 50% of the time (arithmetic average)
  - Good to compare to $L_{eq}$ to determine steadiness of noise
- $L_{90}$ - sound level that was exceeded 90% of the time
  - Good indicator of typical "ambient" noise levels
- $L_{99}$ - sound level that was exceeded 99% of the time
- $L_{max}$ - maximum sound level measured

These descriptors can be used to provide a more detailed analysis of the varying noise climate:

- If there is a large difference between the $L_{eq}$ and the $L_{50}$ ($L_{eq}$ can never be any lower than the $L_{50}$) then it can be surmised that one or more short duration, high level sound(s) occurred during the time period.
- If the gap between the $L_{10}$ and $L_{90}$ is relatively small (less than 15 – 20 dBA) then it can be surmised that the noise climate was relatively steady.

## Sound Propagation

In order to understand sound propagation, the nature of the source must first be discussed. In general, there are three types of sources. These are known as 'point', 'line', and 'area'. This discussion will concentrate on point and line sources since area sources are much more complex and can usually be approximated by point sources at large distances.

### Point Source

As sound radiates from a point source, it dissipates through geometric spreading. The basic relationship between the sound levels at two distances from a point source is:

$$\therefore\ SPL_1 - SPL_2 = 20\log_{10}\left(\frac{r_2}{r_1}\right)$$

Where: $SPL_1$ = sound pressure level at location 1, $SPL_2$ = sound pressure level at location 2
$r_1$ = distance from source to location 1, $r_2$ = distance from source to location 2

Thus, the reduction in sound pressure level for a point source radiating in a free field is **6 dB per doubling of distance**. This relationship is independent of reflectivity factors provided they are always present. Note that this only considers geometric spreading and does not take into account atmospheric effects. Point sources still have some physical dimension associated with them, and typically do not radiate sound equally in all directions in all frequencies. The directionality of a source is also highly dependent on frequency. As frequency increases, directionality increases.

Examples (note no atmospheric absorption):

- A point source measuring 50 dB at 100m will be 44 dB at 200m.
- A point source measuring 50 dB at 100m will be 40.5 dB at 300m.
- A point source measuring 50 dB at 100m will be 38 dB at 400m.
- A point source measuring 50 dB at 100m will be 30 dB at 1000m.

### Line Source

A line source is similar to a point source in that it dissipates through geometric spreading. The difference is that a line source is equivalent to a long line of many point sources. The basic relationship between the sound levels at two distances from a line source is:

$$SPL_1 - SPL_2 = 10\log_{10}\left(\frac{r_2}{r_1}\right)$$

The difference from the point source is that the '20' term in front of the 'log' is now only 10. Thus, the reduction in sound pressure level for a line source radiating in a free field is **3 dB per doubling of distance**.

Examples (note no atmospheric absorption):

- A line source measuring 50 dB at 100m will be 47 dB at 200m.
- A line source measuring 50 dB at 100m will be 45 dB at 300m.
- A line source measuring 50 dB at 100m will be 34 dB at 400m.
- A line source measuring 50 dB at 100m will be 40 dB at 1000m.

## Atmospheric Absorption

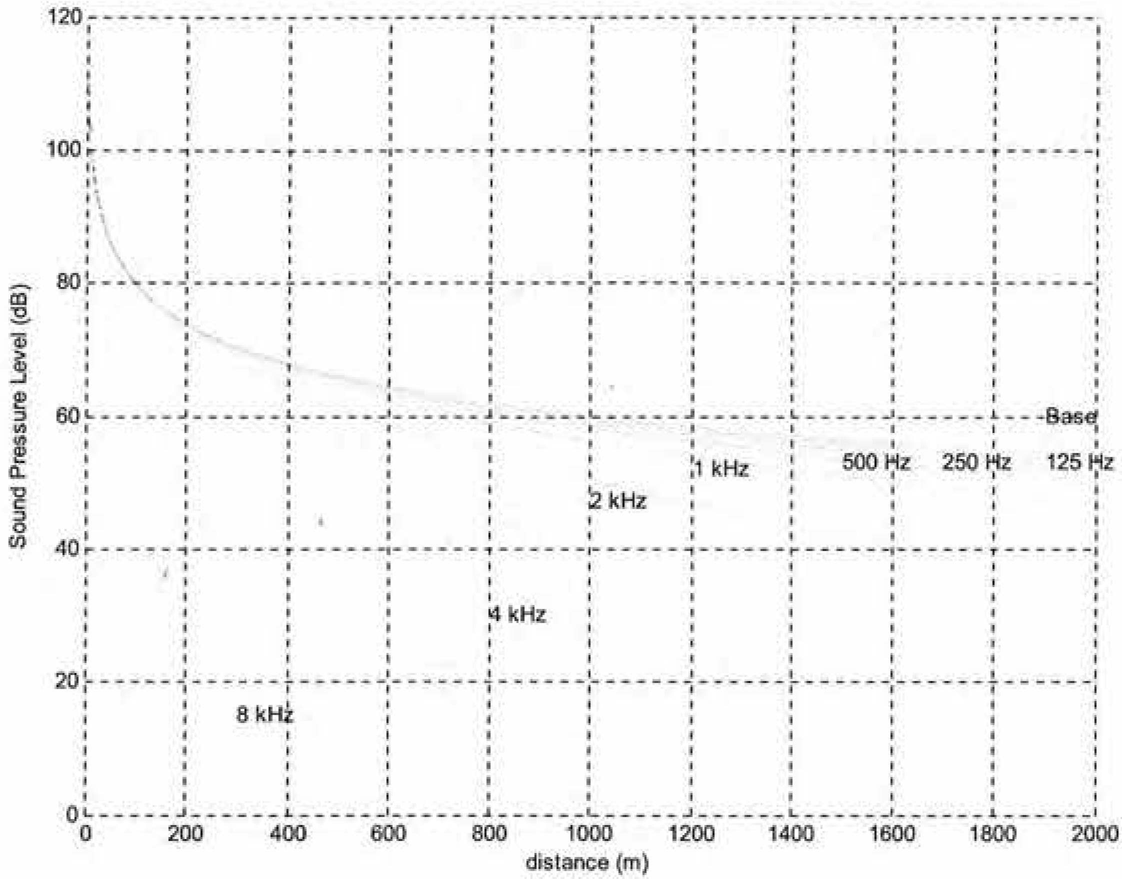
As sound transmits through a medium, there is an attenuation (or dissipation of acoustic energy) which can be attributed to three mechanisms:

1) **Viscous Effects** - Dissipation of acoustic energy due to fluid friction which results in thermodynamically irreversible propagation of sound.
2) **Heat Conduction Effects** - Heat transfer between high and low temperature regions in the wave which result in non-adiabatic propagation of the sound.
3) **Inter Molecular Energy Interchanges** - Molecular energy relaxation effects which result in a time lag between changes in translational kinetic energy and the energy associated with rotation and vibration of the molecules.

The following table illustrates the attenuation coefficient of sound at standard pressure (101.325 kPa) in units of dB/100m.

| Temperature °C | Relative Humidity (%) | Frequency (Hz) 125 | 250 | 500 | 1000 | 2000 | 4000 |
|---|---|---|---|---|---|---|---|
| 30 | 20 | 0.06 | 0.18 | 0.37 | 0.64 | 1.40 | 4.40 |
| | 50 | 0.03 | 0.10 | 0.33 | 0.75 | 1.30 | 2.50 |
| | 90 | 0.02 | 0.06 | 0.24 | 0.70 | 1.50 | 2.60 |
| 20 | 20 | 0.07 | 0.15 | 0.27 | 0.62 | 1.90 | 6.70 |
| | 50 | 0.04 | 0.12 | 0.28 | 0.50 | 1.00 | 2.80 |
| | 90 | 0.02 | 0.08 | 0.26 | 0.56 | 0.99 | 2.10 |
| 10 | 20 | 0.06 | 0.11 | 0.29 | 0.94 | 3.20 | 9.00 |
| | 50 | 0.04 | 0.11 | 0.20 | 0.41 | 1.20 | 4.20 |
| | 90 | 0.03 | 0.10 | 0.21 | 0.38 | 0.81 | 2.50 |
| 0 | 20 | 0.05 | 0.15 | 0.50 | 1.60 | 3.70 | 5.70 |
| | 50 | 0.04 | 0.08 | 0.19 | 0.60 | 2.10 | 6.70 |
| | 90 | 0.03 | 0.08 | 0.15 | 0.36 | 1.10 | 4.10 |

- As frequency increases, absorption increases
- As Relative Humidity increases, absorption decreases
- There is no direct relationship between absorption and temperature
- **The net result of atmospheric absorption is to modify the sound propagation of a point source from 6 dB/doubling-of-distance to approximately 7 – 8 dB/doubling-of-distance (based on anecdotal experience)**




**Atmospheric Absorption at 10°C and 70% RH**

## Meteorological Effects

There are many meteorological factors which can affect how sound propagates over large distances. These various phenomena must be considered when trying to determine the relative impact of a noise source either after installation or during the design stage.

Wind

- Can greatly alter the noise climate away from a source depending on direction
- Sound levels downwind from a source can be increased due to refraction of sound back down towards the surface. This is due to the generally higher velocities as altitude increases.
- Sound levels upwind from a source can be decreased due to a "bending" of the sound away from the earth's surface.
- Sound level differences of ±10dB are possible depending on severity of wind and distance from source.
- Sound levels crosswind are generally not disturbed by an appreciable amount
- Wind tends to generate its own noise, however, and can provide a high degree of masking relative to a noise source of particular interest.

Temperature

- Temperature effects can be similar to wind effects
- Typically, the temperature is warmer at ground level than it is at higher elevations.
- If there is a very large difference between the ground temperature (very warm) and the air aloft (only a few hundred meters) then the transmitted sound refracts upward due to the changing speed of sound.
- If the air aloft is warmer than the ground temperature (known as an *inversion*) the resulting higher speed of sound aloft tends to refract the transmitted sound back down towards the ground. This essentially works on Snell's law of reflection and refraction.
- Temperature inversions typically happen early in the morning and are most common over large bodies of water or across river valleys.
- Sound level differences of ±10dB are possible depending on gradient of temperature and distance from source.

Rain

- Rain does not affect sound propagation by an appreciable amount unless it is very heavy
- The larger concern is the noise generated by the rain itself. A heavy rain striking the ground can cause a significant amount of highly broadband noise. The amount of noise generated is difficult to predict.
- Rain can also affect the output of various noise sources such as vehicle traffic.

Summary

- In general, these wind and temperature effects are difficult to predict
- Empirical models (based on measured data) have been generated to attempt to account for these effects.
- Environmental noise measurements must be conducted with these effects in mind. Sometimes it is desired to have completely calm conditions, other times a "worst case" of downwind noise levels are desired.

## Topographical Effects

Similar to the various atmospheric effects outlined in the previous section, the effect of various geographical and vegetative factors must also be considered when examining the propagation of noise over large distances.

Topography

- One of the most important factors in sound propagation.
- Can provide a natural barrier between source and receiver (i.e. if berm or hill in between).
- Can provide a natural amplifier between source and receiver (i.e. large valley in between or hard reflective surface in between).
- Must look at location of topographical features relative to source and receiver to determine importance (i.e. small berm 1km away from source and 1km away from receiver will make negligible impact).

Grass

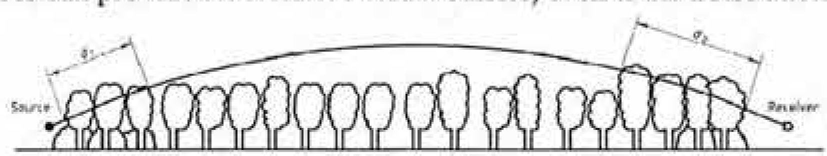
- Can be an effective absorber due to large area covered
- Only effective at low height above ground. Does not affect sound transmitted direct from source to receiver if there is line of sight.
- Typically less absorption than atmospheric absorption when there is line of sight.
- Approximate rule of thumb based on empirical data is:

$$A_g = 18\log_{10}(f) - 31 \qquad (dB/100m)$$

Where: $A_g$ is the absorption amount

Trees

- Provide absorption due to foliage
- Deciduous trees are essentially ineffective in the winter
- Absorption depends heavily on density and height of trees
- No data found on absorption of various kinds of trees
- Large spans of trees are required to obtain even minor amounts of sound reduction
- In many cases, trees can provide an effective visual barrier, even if the noise attenuation is negligible.




NOTE — $d_f = d_1 + d_2$

For calculating $d_1$ and $d_2$, the curved path radius may be assumed to be 5 km.

**Figure A.1 — Attenuation due to propagation through foliage increases linearly with propagation distance $d_f$ through the foliage**

**Table A.1 — Attenuation of an octave band of noise due to propagation a distance $d_f$ through dense foliage**

| Propagation distance $d_f$ | Nominal midband frequency Hz | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| m | 63 | 125 | 250 | 500 | 1 000 | 2 000 | 4 000 | 8 000 |
| | Attenuation, dB | | | | | | | |
| $10 \leq d_f \leq 20$ | 0 | 0 | 1 | 1 | 1 | 1 | 2 | 3 |
| | Attenuation, dB/m | | | | | | | |
| $20 \leq d_f \leq 200$ | 0,02 | 0,03 | 0,04 | 0,05 | 0,06 | 0,08 | 0,09 | 0,12 |

*Tree/Foliage attenuation from ISO 9613-2:1996*

Bodies of Water

- Large bodies of water can provide the opposite effect to grass and trees.
- Reflections caused by small incidence angles (grazing) can result in larger sound levels at great distances (increased reflectivity, Q).
- Typically air temperatures are warmer high aloft since air temperatures near water surface tend to be more constant. Result is a high probability of temperature inversion.
- Sound levels can "carry" much further.

Snow

- Covers the ground for approximately 1/2 of the year in northern climates.
- Can act as an absorber or reflector (and varying degrees in between).
- Freshly fallen snow can be quite absorptive.
- Snow which has been sitting for a while and hard packed due to wind can be quite reflective.
- Falling snow can be more absorptive than rain, but does not tend to produce its own noise.
- Snow can cover grass which might have provided some means of absorption.
- Typically sound propagates with less impedance in winter due to hard snow on ground and no foliage on trees/shrubs.

## Appendix III

## SOUND LEVELS OF FAMILIAR NOISE SOURCES

Used with Permission Obtained from EUB Guide 38: Noise Control Directive User Guide (November 1999)

| **Source**[1] | **Sound Level ( dBA)** |
|---|---|
| Bedroom of a country home | 30 |
| Soft whisper at 1.5 m | 30 |
| Quiet office or living room | 40 |
| Moderate rainfall | 50 |
| Inside average urban home | 50 |
| Quiet street | 50 |
| Normal conversation at 1 m | 60 |
| Noisy office | 60 |
| Noisy restaurant | 70 |
| Highway traffic at 15 m | 75 |
| Loud singing at 1 m | 75 |
| Tractor at 15 m | 78-95 |
| Busy traffic intersection | 80 |
| Electric typewriter | 80 |
| Bus or heavy truck at 15 m | 88-94 |
| Jackhammer | 88-98 |
| Loud shout | 90 |
| Freight train at 15 m | 95 |
| Modified motorcycle | 95 |
| Jet taking off at 600 m | 100 |
| Amplified rock music | 110 |
| Jet taking off at 60 m | 120 |
| Air-raid siren | 130 |

[1] Cottrell, Tom, 1980, *Noise in Alberta*, Table 1, p.8, ECA80 - 16/1B4 (Edmonton: Environment Council of Alberta).

## SOUND LEVELS GENERATED BY COMMON APPLIANCES

Used with Permission Obtained from EUB Guide 38: Noise Control Directive User Guide (November 1999)

| Source[1] | Sound level at 3 feet (dBA) |
|---|---|
| Freezer | 38-45 |
| Refrigerator | 34-53 |
| Electric heater | 47 |
| Hair clipper | 50 |
| Electric toothbrush | 48-57 |
| Humidifier | 41-54 |
| Clothes dryer | 51-65 |
| Air conditioner | 50-67 |
| Electric shaver | 47-68 |
| Water faucet | 62 |
| Hair dryer | 58-64 |
| Clothes washer | 48-73 |
| Dishwasher | 59-71 |
| Electric can opener | 60-70 |
| Food mixer | 59-75 |
| Electric knife | 65-75 |
| Electric knife sharpener | 72 |
| Sewing machine | 70-74 |
| Vacuum cleaner | 65-80 |
| Food blender | 65-85 |
| Coffee mill | 75-79 |
| Food waste disposer | 69-90 |
| Edger and trimmer | 81 |
| Home shop tools | 64-95 |
| Hedge clippers | 85 |
| Electric lawn mower | 80-90 |

[1] Reif, Z. F., and Vermeulen, P. J., 1979, "Noise from domestic appliances, construction, and industry," Table 1, p.166, in Jones, H. W., ed., *Noise in the Human Environment*, vol. 2, ECA79-SP/1 (Edmonton: Environment Council of Alberta).

# APPENDIX H

# Appendix H

## Cost Estimates

## Cost Estimates

The following section discusses the costs related to constructing the various types of roadway proposed for Ray Gibbon Drive.

### 1. Arterial Roadway Costs

Originally Ray Gibbon Drive was planned as a 2-lane arterial. The costs shown in the following tables represent the cost to build this facility, without modifications to accommodate the future freeway. The assumptions for each stage are listed below.

**Stage 1 (Existing 137 Avenue to 8+800)**

- 45m ROW and 2 lane construction, on existing alignment
- Based on actual contract costs
- Add Riel Pond
- Sewer for 4 lanes
- Bridge costs for only NB lanes (Subtract additional pier and piling costs from tendered cost)
- North Pond cost as constructed
- Pavement Structure RG Drive.

**Stage 2 (8+800 to 10+400)**

- 45m ROW and 2 lane construction, on arterial alignment (see Exhibit 3)
- Based on actual contract costs
- Simple intersection at McKenney
- Stage 2 Pond will be assumed to be 40% of final costs (good for stage 3 base)
- Assume urban x-section full length
- Pavement Structure RG Drive
- Storm Sewer for 4 lanes no grade separation with accommodate run off from portion of stage 3
- Rail Crossing at grade.

**Stage 3 (10+400 to 12+500)**

- 22.5m ROW and 2 lane construction, on arterial alignment (see Exhibit 3)
- 2008 construction prices
- Storm Sewer will be for 2 lanes and 22.5m ROW will tie into Stage 2 system and pond (will drain everything from Villeneuve south to stage 2 pond)
- Assume Urban x-section full length
- Pavement Structure RG Drive.

# Preliminary Roadway Cost Estimate for Ray Gibbon Drive

## Scenario I Stage I (137 Avenue to Station 8+800)

**2 Lanes - Actual Contract Prices**

| | | | 22.5m ROW | | | 45.0m ROW | | | 78.0m ROW | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Item No. | Description | Unit Price | Approx. Quantity | Unit | Amount | Approx. Quantity | Unit | Amount | Approx. Quantity | Unit | Amount |
| **1: Storm Sewer And Drainage** | | | | | | | | | | | |
| 1.01 | Trench Excavation and Native Backfill 300mm Stm (2.0-3.0m depth) | $115.00 | 58 | m | $6,670 | 0 | m | $0 | 0 | m | $0 |
| 1.02 | Trench Excavation and Native Backfill 375mm Stm (2.0-3.0m depth) | $117.00 | 120 | m | $14,040 | 0 | m | $0 | 0 | m | $0 |
| 1.03 | Trench Excavation and Native Backfill 450mm Stm (2.0-3.0m depth) | $120.79 | 230 | m | $27,782 | 0 | m | $0 | 0 | m | $0 |
| 1.04 | Trench Excavation and Native Backfill 525mm Stm (2.0-3.0m depth) | $123.06 | 896 | m | $110,262 | 0 | m | $0 | 0 | m | $0 |
| 1.05 | Trench Excavation and Native Backfill 600mm Stm (2.0-3.0m depth) | $124.52 | 190 | m | $23,659 | 0 | m | $0 | 0 | m | $0 |
| 1.06 | Trench Excavation and Native Backfill 675mm Stm (2.0-3.0m depth) | $127.60 | 590 | m | $75,284 | 0 | m | $0 | 0 | m | $0 |
| 1.07 | Trench Excavation and Native Backfill 750mm Stm (2.0-3.0m depth) | $129.67 | 840 | m | $108,923 | 0 | m | $0 | 0 | m | $0 |
| 1.08 | Trench Excavation and Native Backfill 900mm Stm (2.0-3.0m depth) | $137.64 | 424.5 | m | $58,428 | 0 | m | $0 | 0 | m | $0 |
| 1.09 | Trench Excavation and Native Backfill 1050mm Stm (2.0-3.0m depth) | $157.00 | 22 | m | $3,454 | 0 | m | $0 | 0 | m | $0 |
| 1.10 | 300mm Class IV Concrete Storm Sewer | $36.27 | 58 | m | $2,104 | 0 | m | $0 | 0 | m | $0 |
| 1.11 | 375mm Class IV Concrete Storm Sewer | $150.00 | 120 | m | $18,000 | 0 | m | $0 | 0 | m | $0 |
| 1.12 | 450mm Class IV Concrete Storm Sewer | $67.00 | 230 | m | $15,410 | 0 | m | $0 | 0 | m | $0 |
| 1.13 | 525mm Class IV Concrete Storm Sewer | $84.30 | 896 | m | $75,533 | 0 | m | $0 | 0 | m | $0 |
| 1.14 | 600mm Class IV Concrete Storm Sewer | $105.86 | 190 | m | $20,113 | 0 | m | $0 | 0 | m | $0 |
| 1.15 | 675mm Class IV Concrete Storm Sewer | $114.68 | 590 | m | $67,661 | 0 | m | $0 | 0 | m | $0 |
| 1.16 | 750mm Class IV Concrete Storm Sewer | $188.55 | 840 | m | $158,382 | 0 | m | $0 | 0 | m | $0 |
| 1.17 | 900mm Class IV Concrete Storm Sewer | $266.77 | 424.5 | m | $113,244 | 0 | m | $0 | 0 | m | $0 |
| 1.18 | 1050mm Class IV Concrete Storm Sewer | $431.23 | 22 | m | $9,487 | 0 | m | $0 | 0 | m | $0 |
| 1.19 | 300mm Class V Concrete Catchbasin Lead | $36.27 | 479 | m | $17,373 | 0 | m | $0 | 0 | m | $0 |
| 1.20 | 1200mm Manhole | $1,297.94 | 128 | v.m. | $166,136 | 0 | v.m. | $0 | 0 | v.m. | $0 |
| 1.21 | 900mm Catchbasin | $1,994.66 | 29 | No | $57,845 | 0 | No | $0 | 0 | No | $0 |
| 1.22 | 1200mm CB/MH | $1,228.64 | 103.5 | v.m. | $127,164 | 0 | v.m. | $0 | 0 | v.m. | $0 |
| 1.23 | 300mm Flared End c/w Galvanized Bar Screen | $3,282.48 | 3 | No | $9,847 | 0 | No | $0 | 0 | No | $0 |
| 1.24 | 450mm Flared End c/w Galvanized Bar Screen | $3,446.12 | 3 | No | $10,338 | 0 | No | $0 | 0 | No | $0 |
| 1.25 | 525mm Flared End c/w Galvanized Bar Screen | $3,738.82 | 2 | No | $7,478 | 0 | No | $0 | 0 | No | $0 |
| 1.26 | 900mm Flared End c/w Galvanized Bar Screen | $5,204.34 | 2 | No | $10,409 | 0 | No | $0 | 0 | No | $0 |
| 1.27 | 1050mm Flared End c/w Galvanized Bar Screen | $6,066.00 | 1 | No | $6,066 | 0 | No | $0 | 0 | No | $0 |
| 1.28 | NF-80 Frame and Cover | $486.86 | 32 | No | $15,580 | 0 | No | $0 | 0 | No | $0 |

# Preliminary Roadway Cost Estimate for Ray Gibbon Drive

## Scenario I Stage I (137 Avenue to Station 8+800)

**2 Lanes - Actual Contract Prices**

| | | | 22.5m ROW | | | 45.0m ROW | | | 78.0m ROW | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Item No. | Description | Unit Price | Approx. Quantity | Unit | Amount | Approx. Quantity | Unit | Amount | Approx. Quantity | Unit | Amount |
| 1.29 | F-51 Frame and Cover | $806.54 | 74 | No | $59,684 | 0 | No | $0 | 0 | No | $0 |
| 1.30 | Gabion Matting (0.3m thick) North Pond | $95.36 | 626 | m2 | $59,695 | 0 | m2 | $0 | 0 | m2 | $0 |
| 1.31 | Riel Pond Intercell Weir Structure | $7,295.00 | 25 | No. | $182,375 | 0 | No. | $0 | 0 | No. | $0 |
| 1.32 | North Pond Outlet Control Structure | $43,124.44 | 1 | No. | $43,124 | 0 | No. | $0 | 0 | No. | $0 |
| 1.33 | North Pond Isolation Structure | $15,005.99 | 1 | No. | $15,006 | 0 | No. | $0 | 0 | No. | $0 |
| 1.34 | 600mm CSP Culvert | $162.10 | 150 | m | $24,315 | 0 | m | $0 | 0 | m | $0 |
| 1.35 | 600mm CSP Wildlife Culvert | $151.54 | 122 | m | $18,488 | 0 | m | $0 | 0 | m | $0 |
| 1.36 | 500mm CSP Wildlife Culvert | $136.14 | 118 | m | $16,065 | 0 | m | $0 | 0 | m | $0 |
| 1.37 | 900mm CSP Wildlife Culvert | $221.76 | 134 | m | $29,716 | 0 | m | $0 | 0 | m | $0 |
| 1.38 | STC300 Stormceptor | $18,500.00 | 1 | No. | $18,500 | 0 | No. | $0 | 0 | No. | $0 |
| 1.39 | STC750 Stormceptor | $20,454.97 | 1 | No. | $20,455 | 0 | No. | $0 | 0 | No. | $0 |
| 1.40 | STC4000 Stormceptor | $65,108.98 | 2 | No. | $130,218 | 0 | No. | $0 | 0 | No. | $0 |
| | | **Total Part 1:** | | | **$1,954,313** | | | **$0** | | | **$0** |

**2: Earthworks**

| Item No. | Description | Unit Price | Approx. Quantity | Unit | Amount | Approx. Quantity | Unit | Amount | Approx. Quantity | Unit | Amount |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.01 | Common Excavation of Roadway - South Side | $4.56 | 96000 | m3 | $437,760 | 64000 | m3 | $291,840 | 0 | m3 | $0 |
| 2.02 | Common Excavation - North Storm Pond | $4.83 | 30363 | m3 | $146,653 | 0 | m3 | $0 | 0 | m3 | $0 |
| 2.03 | Common Excavation from Stockpile at Hogan Road - North Side | $5.22 | 10300 | m3 | $53,766 | 0 | m3 | $0 | 0 | m3 | $0 |
| 2.04 | Contractor Supplied Borrow Excavation - North Side | $11.57 | 54000 | m3 | $624,780 | 36000 | m3 | $416,520 | 0 | m3 | $0 |
| 2.05 | Topsoil Strip and Stockpile -North Side | $2.68 | 8437.5 | m3 | $22,613 | 8437.5 | m3 | $22,613 | 0 | m3 | $0 |
| 2.06 | Topsoil Strip and Stockpile - South Side | $2.56 | 5850 | m3 | $14,976 | 5850 | m3 | $14,976 | 0 | m3 | $0 |
| 2.06 | Place Seeding and 150mm Topsoil | $1.44 | 53031.5 | $m^2$ | $76,365 | 53031.5 | $m^2$ | $76,365 | 0 | $m^2$ | $0 |
| 2.07 | Rock Rip Rap | $69.66 | 2201 | m2 | $153,322 | 0 | m2 | $0 | 0 | m2 | $0 |
| 2.07 | Woven Filter Fabric | $5.43 | 2201 | m2 | $11,951 | 0 | m2 | $0 | 0 | m2 | $0 |
| 2.08 | Load, Haul and Place Concrete Rubble to Riel Pond | $9.47 | 525 | m3 | $4,972 | 0 | m3 | $0 | 0 | m3 | $0 |
| 2.08 | Bi- Axle Geogrid | $5.43 | 10020 | m3 | $54,409 | 0 | m3 | $0 | 0 | m3 | $0 |
| 2.09 | Silt Curtain | $72.61 | 330 | m | $23,961 | 0 | m | $0 | 0 | m | $0 |
| 2.09 | Silt Fence | $5.97 | 567 | m | $3,385 | 0 | m | $0 | 0 | m | $0 |
| | | **Total Part 2:** | | | **$1,628,913** | | | **$822,314** | | | **$0** |

**3: Roadways and Concrete - New Construction**

| Item No. | Description | Unit Price | Approx. Quantity | Unit | Amount | Approx. Quantity | Unit | Amount | Approx. Quantity | Unit | Amount |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3.01 | 200mm Curb and 500mm Gutter | $65.92 | 6180 | m | $407,386 | 0 | m | $0 | 0 | m | $0 |
| 3.02 | 300mm Cement Stabilized Subgrade (22kg/m2) | $11.33 | 25721 | sq m | $291,419 | 0 | sq m | $0 | 0 | sq m | $0 |
| 3.03 | 400mm of 20mm Granular Base Course | $23.43 | 28255 | sq m | $662,015 | 0 | sq m | $0 | 0 | sq m | $0 |
| 3.04 | 130mm of 25mm Asphalt Base | $25.18 | 20230 | sq m | $509,391 | 0 | sq m | $0 | 0 | sq m | $0 |
| 3.05 | 50mm of 12.5mm Asphalt Base | $11.56 | 20230 | sq m | $233,859 | 0 | sq m | $0 | 0 | sq m | $0 |
| 3.06 | 50mm of 12.5mm Asphalt Surface | $21.25 | 20230 | sq m | $429,888 | 0 | sq m | $0 | 0 | sq m | $0 |
| 3.07 | 3.0m Asphalt Walkway | $40,010.85 | 1 | No. | $40,011 | 0 | No. | $0 | 0 | No. | $0 |
| 3.08 | Increase Gutter Depth | $46,746.81 | 1 | No. | $46,747 | 0 | No. | $0 | 0 | No. | $0 |
| | | **Total Part 3:** | | | **$2,620,715** | | | **$0** | | | **$0** |

# Preliminary Roadway Cost Estimate for Ray Gibbon Drive

## Scenario I Stage I (137 Avenue to Station 8+800)

**2 Lanes - Actual Contract Prices**

| | | | 22.5m ROW | | | 45.0m ROW | | | 78.0m ROW | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Item No. | Description | Unit Price | Approx. Quantity | Unit | Amount | Approx. Quantity | Unit | Amount | Approx. Quantity | Unit | Amount |
| **4: Sturgeon River Bridge** | | | | | | | | | | | |
| 4.01 | Sturgeon River Bridge | $4,570,206.33 | 1 | No. | $4,570,206 | 0 | No. | $0 | 0 | No. | $0 |
| | | **Total Part 4:** | | | **$4,570,206** | | | **$0** | | | **$0** |
| **5: Landscaping** | | | | | | | | | | | |
| 5.01 | Wet Meadow Mix Seeding on 150mm Topsoil | $1.89 | 2957 | m2 | $5,589 | 0 | m2 | $0 | 0 | m2 | $0 |
| 5.02 | Planting Bed Construction | $4.32 | 7364 | sq.m | $31,812 | 0 | sq.m | $0 | 0 | sq.m | $0 |
| 5.03 | Shredded Wood Mulch | $4.32 | 7364 | sq.m | $31,812 | 0 | sq.m | $0 | 0 | sq.m | $0 |
| 5.04 | Caliper Trees - Supply & Install | $232.20 | 256 | each | $59,443 | 0 | each | $0 | 0 | each | $0 |
| 5.05 | Containerized Trees - Supply & Install | $28.62 | 2565 | each | $73,410 | 0 | each | $0 | 0 | each | $0 |
| 5.06 | Containerized Shrubs - Supply & Install | $12.42 | 2100 | each | $26,082 | 0 | each | $0 | 0 | each | $0 |
| 5.07 | Emergent Plants - Supply & Install | $10.80 | 40 | each | $432 | 0 | each | $0 | 0 | each | $0 |
| 5.08 | Live Willow Stakes - Supply & Install | $10.80 | 300 | each | $3,240 | 0 | each | $0 | 0 | each | $0 |
| 5.09 | Landscape Maintenance | $82,080.00 | 1 | No. | $82,080 | 0 | No. | $0 | 0 | No. | $0 |
| 5.10 | North Pond Landscape | $40,717.35 | 1 | No. | $40,717 | 0 | No. | $0 | 0 | No. | $0 |
| | | **Total Part 5:** | | | **$354,619** | | | **$0** | | | **$0** |
| **6: Pavement Markings and Signing - Supply and Install** | | | | | | | | | | | |
| 6.01 | Misc. Charges for Signing and Marking | $274,800.00 | 1 | No. | $274,800 | 0 | No. | $0 | 0 | No. | $0 |
| | | **Total Part 6:** | | | **$274,800** | | | **$0** | | | **$0** |
| **7: Street Lighting** | | | | | | | | | | | |
| 7.01 | Supply and Install Street Lighting | $300,000.00 | 1 | No. | $300,000 | 0 | No. | $0 | 0 | No. | $0 |
| | | **Total Part 7:** | | | **$300,000** | | | **$0** | | | **$0** |
| **8: Land Cost** | | | | | | | | | | | |
| 8.01 | Land Pruchases | $1,717,000.00 | 0.29 | No. | $496,000 | 0.29 | No. | $496,000 | 0.42 | No. | $725,000 |
| | | **Total Part 8:** | | | **$496,000** | | | **$496,000** | | | **$725,000** |
| **9: Riel Pond Wetland Construction** | | | | | | | | | | | |
| 9.01 | Riel Pond Wetland Construction Cost | $1,372,400.00 | 1 | No. | $1,372,400 | 0 | No. | $0 | 0 | No. | $0 |
| 9.02 | Second Outfall | $180,000.00 | 1 | No. | $180,000 | 0 | No. | $0 | 0 | No. | $0 |
| 9.03 | Landfill Charges | $320,000.00 | 1 | No. | $320,000 | 0 | No. | $0 | 0 | No. | $0 |
| | | **Total Part 9:** | | | **$1,872,400** | | | **$0** | | | **$0** |

# Preliminary Roadway Cost Estimate for Ray Gibbon Drive

## Scenario I Stage I (137 Avenue to Station 8+800)

**2 Lanes - Actual Contract Prices**

| | | | 22.5m ROW | | | 45.0m ROW | | | 78.0m ROW | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Item No. | Description | Unit Price | Approx. Quantity | Unit | Amount | Approx. Quantity | Unit | Amount | Approx. Quantity | Unit | Amount |
| **10: Utility Relocation** | | | | | | | | | | | |
| 10.01 | Alta Link Power line Relocation | $53,100.00 | 1 | No. | $53,100 | 0 | No. | $0 | 0 | No. | $0 |
| | | **Total Part 10:** | | | **$53,100** | | | **$0** | | | **$0** |
| **11: Engineering Cost** | | | | | | | | | | | |
| 11.01 | EIA Process | $540,000.00 | 1 | No. | $540,000 | 0 | No. | $0 | 0 | No. | $0 |
| 11.02 | Spencer Environmental | $265,100.00 | 0.8 | No. | $212,080 | 0.2 | No. | $53,020 | 0 | No. | $0 |
| 11.03 | ISL Engineering | $2,400,000.00 | 0.8 | No. | $1,920,000 | 0.2 | No. | $480,000 | 0 | No. | $0 |
| 11.04 | Spencer Monitoring | $240,000.00 | 0.8 | No. | $192,000 | 0.2 | No. | $48,000 | 0 | No. | $0 |
| | | **Total Part 11:** | | | **$2,864,080** | | | **$581,020** | | | **$0** |

| Cost Summary | 22.5m ROW | 45m ROW | 78m ROW |
|---|---|---|---|
| 1: Storm Sewer And Drainage | $1,954,313 | $0 | $0 |
| 2: Earthworks | $1,628,913 | $822,314 | $0 |
| 3: Roadways and Concrete - New Construction | $2,620,715 | $0 | $0 |
| 4: Sturgeon River Bridge | $4,570,206 | $0 | $0 |
| 5: Landscaping | $354,619 | $0 | $0 |
| 6: Pavement Markings and Signing - Supply and Install | $274,800 | $0 | $0 |
| 7: Street Lighting | $300,000 | $0 | $0 |
| 8: Land Cost | $496,000 | $496,000 | $725,000 |
| 9: Riel Pond Wetland Construction | $1,872,400 | $0 | $0 |
| 10: Utility Relocation | $53,100 | $0 | $0 |
| 11: Engineering Cost | $2,864,080 | $581,020 | $0 |
| **Total Roadway Estimate:** | **$16,989,145** | **$1,899,334** | **$725,000** |

# Preliminary Roadway Cost Estimate for Ray Gibbon Drive

**Scenario I Stage II (Sta . 8+800 to Giroux)**
**2 Lanes - Actual Contract Prices**

| | | | 22.5m ROW | | | 45.0m ROW | | |
|---|---|---|---|---|---|---|---|---|
| Item No | Description | Unit Price | Approx. Quantity | Unit | Amount | Approx. Quantity | Unit | Amount |
| **1: Storm Sewer And Drainage** | | | | | | | | |
| 1.01 | Trench Excavation and Native Backfill 450mm Stm (2.0-3.0m depth) | $450.00 | 308.4 | m | $138,780.00 | 205.6 | m | $92,520 |
| 1.02 | Trench Excavation and Native Backfill 525mm Stm (2.0-3.0m depth) | $450.00 | 403.8 | m | $181,710.00 | 269.2 | m | $121,140 |
| 1.03 | Trench Excavation and Native Backfill 750mm Stm (2.0-3.0m depth) | $500.00 | 648 | m | $324,000.00 | 432 | m | $216,000 |
| 1.04 | Trench Excavation and Native Backfill 450mm Stm (0-3.0m depth) | $450.00 | 20.4 | m | $9,180.00 | 13.6 | m | $6,120 |
| 1.05 | Trench Excavation and Native Backfill 525mm Stm (0-3.0m depth) | $450.00 | 43.8 | m | $19,710.00 | 29.2 | m | $13,140 |
| 1.06 | Trench Excavation and Native Backfill 750mm Stm (0-3.0m depth) | $500.00 | 37.2 | m | $18,600.00 | 24.8 | m | $12,400 |
| 1.07 | Trench Excavation and Native Backfill 750mm Stm (3.0-4.0m depth) | $550.00 | 70.8 | m | $38,940.00 | 47.2 | m | $25,960 |
| 1.08 | Trench Excavation and Native Backfill 750mm Stm (4.0-5.0m depth) | $600.00 | 12 | m | $7,200.00 | 8 | m | $4,800 |
| 1.09 | Trench Excavation and Native Backfill 750mm Stm (5.0-6.0m depth) | $650.00 | 12 | m | $7,800.00 | 8 | m | $5,200 |
| 1.10 | Trench Excavation and Native Backfill 900mm Stm (0.0 - 0.3m depth) | $450.00 | 9.6 | m | $4,320.00 | 6.4 | m | $2,880 |
| 1.10 | 450mm Class IV Concrete Storm Sewer | $110.00 | 308.4 | m | $33,924.00 | 205.6 | m | $22,616 |
| 1.11 | 525mm Class IV Concrete Storm Sewer | $170.00 | 403.8 | m | $68,646.00 | 269.2 | m | $45,764 |
| 1.12 | 750mm Class IV Concrete Storm Sewer | $350.00 | 648 | m | $226,800.00 | 432 | m | $151,200 |
| 1.13 | 900mm Class IV Concrete Storm Sewer | $170.00 | 9.6 | m | $1,632.00 | 6.4 | m | $1,088 |
| 1.13 | 300mm Class V Concrete Catchbasin Lead | $80.00 | 100.8 | m | $8,064.00 | 67.2 | m | $5,376 |
| 1.14 | 1200mm Manhole | $2,000.00 | 44.7 | v.m. | $89,400.00 | 29.8 | v.m. | $59,600 |
| 1.15 | 900mm Catchbasin | $5,250.00 | 13.8 | No | $72,450.00 | 9.2 | No | $48,300 |
| 1.16 | 1200mm CB/MH | $3,900.00 | 38.64 | v.m. | $150,696.00 | 25.76 | v.m. | $100,464 |
| 1.17 | NF-80 Frame and Cover | $1,500.00 | 10.2 | No | $15,300.00 | 6.8 | No | $10,200 |
| 1.18 | F-51 Frame and Cover | $1,500.00 | 30.6 | No | $45,900.00 | 20.4 | No | $30,600 |
| 1.19 | 450mm Flared End | $4,000.00 | 0.6 | No | $2,400.00 | 0.4 | No | $1,600 |
| 1.20 | 525mm Flared End | $5,000.00 | 0.6 | No | $3,000.00 | 0.4 | No | $2,000 |
| 1.21 | 750mm Flared End | $8,000.00 | 0.6 | No | $4,800.00 | 0.4 | No | $3,200 |
| 1.22 | 900mm Flared End c/w Galvanized Bar Screen | $8,000.00 | 0.6 | No | $4,800.00 | 0.4 | No | $3,200 |
| 1.23 | Storm Pond Outlet Control Structure | $75,000.00 | 0.6 | No | $45,000.00 | 0.4 | No | $30,000 |
| 1.24 | Storm Pond Isolation Structure | $40,000.00 | 0.6 | No | $24,000.00 | 0.4 | No | $16,000 |
| 1.25 | Gabion Matting | $105,000.00 | 0.6 | No | $63,000.00 | 0.4 | No | $42,000 |
| 1.26 | Storm Crossing High Pressure Atco Pipeline | $30,000.00 | 0.6 | No | $18,000.00 | 0.4 | No | $12,000 |
| 1.27 | Rock Rip Rap | $26,250.00 | 0.6 | No | $15,750.00 | 0.4 | No | $10,500 |
| 1.28 | Woven Filter Fabric | $1,050.00 | 0.6 | No | $630.00 | 0.4 | No | $420 |
| | | **Total Part 1:** | | | **$1,644,432.00** | | | **$1,096,288.00** |

## Preliminary Roadway Cost Estimate for Ray Gibbon Drive

**Scenario I Stage II (Sta . 8+800 to Giroux)**

**2 Lanes - Actual Contract Prices**

| | | | 22.5m ROW | | | 45.0m ROW | | |
|---|---|---|---|---|---|---|---|---|
| Item No | Description | Unit Price | Approx. Quantity | Unit | Amount | Approx. Quantity | Unit | Amount |
| **2: Earthworks** | | | | | | | | |
| 2.01 | Common Excavation | $8.00 | 2783.4 | m3 | $22,267.20 | 1855.6 | m3 | $14,845 |
| 2.02 | Borrow Excavation Contractor Supply | $18.00 | 23244 | m3 | $418,392.00 | 15496 | m3 | $278,928 |
| 2.03 | Topsoil Strip and Stockpile | $6.00 | 7114.5 | m3 | $42,687.00 | 7114.5 | m3 | $42,687 |
| 2.04 | Place 150mm Topsoil | $1.00 | 31195 | $m^2$ | $31,195.00 | 31195 | m2 | $31,195 |
| 2.05 | Seeding | $0.50 | 31195 | $m^2$ | $15,597.50 | 31195 | m2 | $15,598 |
| 2.06 | Common Excavation South CNR to Pond | $99,225.60 | 0.6 | No | $59,535.36 | 0.4 | No | $39,690 |
| 2.07 | Common Excavation on Storm Pond | $126,048.00 | 0.6 | No | $75,628.80 | 0.4 | No | $50,419 |
| 2.08 | Topsoil Strip and Stockpile Storm Pond | $43,644.00 | 0.6 | No | $26,186.40 | 0.4 | No | $17,458 |
| 2.09 | Topsoil Haul and Place Storm Pond | $14,198.00 | 0.6 | No | $8,518.80 | 0.4 | No | $5,679 |
| 2.10 | Seeding - Storm Pond | $7,099.00 | 0.5 | $m^2$ | $3,549.50 | 0.5 | m2 | $3,550 |
| 2.11 | Landscape Storm Pond | $90,000.00 | 0.5 | No | $45,000.00 | 0.5 | No | $45,000 |
| | | **Total Part 2:** | | | **$748,557.56** | | | **$545,048.04** |
| **3: Roadways and Concrete - New Construction** | | | | | | | | |
| 3.01 | 230mm Curb and 500mm Gutter | $200.00 | 4160 | m | $832,000.00 | 0 | m | $0 |
| 3.02 | 300mm Cement Stabilized Subgrade (22kg/m2) | $17.00 | 21750 | $m^2$ | $369,750.00 | 0 | m2 | $0 |
| 3.03 | 400mm of 20mm Granular Base Course | $55.00 | 21750 | $m^2$ | $1,196,250.00 | 0 | m2 | $0 |
| 3.04 | 130mm of 25mm Asphalt Base | $55.00 | 18520 | $m^2$ | $1,018,600.00 | 0 | m2 | $0 |
| 3.05 | 50mm of 12.5mm Asphalt Base | $25.00 | 18520 | $m^2$ | $463,000.00 | 0 | m2 | $0 |
| 3.06 | 50mm of 12.5mm Asphalt Surface | $25.00 | 18520 | $m^2$ | $463,000.00 | 0 | m2 | $0 |
| 3.07 | 200mm Slab-on Median | $250.00 | 280 | $m^2$ | $70,000.00 | 0 | m2 | $0 |
| | | **Total Part 3:** | | | **$4,412,600.00** | | | **$0.00** |
| **4: Landscaping** | | | | | | | | |
| 4.01 | Landscaping Storm Pond | $104,000.00 | 1 | No. | $104,000.00 | 0 | No. | $0 |
| | | **Total Part 4:** | | | **$104,000.00** | | | **$0.00** |
| **5: Pavement Markings and Signing - Supply and Install** | | | | | | | | |
| 5.01 | Supply and Install Pavement Markings and Signing | $9,300.00 | 1 | No | $9,300.00 | 0 | No | $0 |
| 5.01 | Supply and Install Traffic Signals at McKenny | $199,700.00 | 1 | No | $199,700.00 | 0 | No | $0 |
| | | **Total Part 5:** | | | **$209,000.00** | | | **$0.00** |

# Preliminary Roadway Cost Estimate for Ray Gibbon Drive

**Scenario I Stage II (Sta . 8+800 to Giroux)**
**2 Lanes - Actual Contract Prices**

| | | | 22.5m ROW | | | 45.0m ROW | | |
|---|---|---|---|---|---|---|---|---|
| Item No | Description | Unit Price | Approx. Quantity | Unit | Amount | Approx. Quantity | Unit | Amount |
| **6: Street Lighting** | | | | | | | | |
| 6.01 | Supply and Install Street Lighting | $273,315.00 | 1 | No. | 273,315.00 | 0 | No. | $0 |
| 6.02 | Fortis | $38,600.00 | 1 | No. | 38,600.00 | 0 | No. | $0 |
| | | **Total Part 6:** | | | **$311,915.00** | | | **$0.00** |
| **7: CN Rail Cost** | | | | | | | | |
| 7.01 | Railway Cost | $196,600.00 | 1 | No. | $196,600.00 | 0 | No. | $0 |
| | | **Total Part 7:** | | | **$196,600.00** | | | **$0.00** |
| **8: Engineering Costs** | | | | | | | | |
| 8.01 | Spencer Environment EIA | $96,000.00 | 1 | No. | $96,000.00 | 0 | No. | $0 |
| 8.02 | ISL Engineering | $937,926.59 | 0.8 | No. | $750,341.27 | 0.2 | No. | $187,585 |
| | | **Total Part 8:** | | | **$846,341.27** | | | **$187,585.32** |
| **9: Land Costs** | | | | | | | | |
| 9.01 | Stage 2 Land Costs (St. 8+900 to 10+420) | $100,000.00 | 8.35 | ac | $835,000.00 | 8.35 | ac | $835,000 |
| | | **Total Part 9:** | | | **$835,000.00** | | | **$835,000.00** |

| Cost Summary | 22.5m ROW | 45m ROW |
|---|---|---|
| 1: Storm Sewer And Drainage | $1,644,432 | $1,096,288 |
| 2: Earthworks | $748,558 | $545,048 |
| 3: Roadways and Concrete - New Construction | $4,412,600 | $0 |
| 4: Landscaping | $104,000 | $0 |
| 5: Pavement Markings and Signing - Supply and Install | $209,000 | $0 |
| 6: Street Lighting | $311,915 | $0 |
| 7: CN Rail Cost | $196,600 | $0 |
| 8: Engineering Costs | $846,341 | $187,585 |
| 9: Land Costs | $835,000 | $835,000 |
| **Total Roadway Estimate:** | **$9,308,446** | **$2,663,921** |

# Preliminary Roadway Cost Estimate for Ray Gibbon Drive
## Scenario I Stage III (Giroux Road to Villeneue Road)
### Base Alignment

| Item No. | Description | Unit Price | Approx. Quantity | Unit | Amount |
|---|---|---|---|---|---|
| | | | 22.5m ROW | | |
| **1: Storm Sewer And Drainage** | | | | | |
| 1.01 | Trench Excavation and Native Backfill 300mm Stm (2.0-3.0m depth) | $275.00 | 480 | m | $132,000 |
| 1.02 | Trench Excavation and Native Backfill 375mm Stm (2.0-3.0m depth) | $375.00 | 720 | m | $270,000 |
| 1.03 | Trench Excavation and Native Backfill 450mm Stm (2.0-3.0m depth) | $500.00 | 240 | m | $120,000 |
| 1.04 | 300mm Pipe Class IV Concrete Storm Sewer | $125.00 | 480 | m | $60,000 |
| 1.05 | 375mm Pipe Class IV Concrete Storm Sewer | $150.00 | 720 | m | $108,000 |
| 1.06 | 450mm Pipe Class IV Concrete Storm Sewer | $200.00 | 240 | m | $48,000 |
| 1.07 | 300mm Class V Concrete Catchbasin Lead | $105.00 | 129.5 | m | $13,598 |
| 1.08 | 1200mm Manhole | $8,500.00 | 52 | v.m. | $442,000 |
| 1.09 | 900mm Catchbasin | $3,700.00 | 15 | No | $55,500 |
| 1.10 | 1200mm CB/MH | $3,700.00 | 44 | v.m. | $162,800 |
| 1.11 | NF-80 Frame and Cover | $900.00 | 13 | No | $11,700 |
| 1.12 | F-51 Frame and Cover | $1,500.00 | 34 | No | $51,000 |
| | | **Total Part 1:** | | | **$1,474,598** |
| **2: Earthworks** | | | | | |
| 2.01 | Common Excavation | $11.00 | 4,866 | m3 | $53,526 |
| 2.02 | Contractor Supplied Borrow Excavation | $40.00 | 34,372 | m3 | $1,374,880 |
| 2.03 | Topsoil Strip and Stockpile | $8.00 | 13,557 | m3 | $108,456 |
| 2.04 | Place 150mm Topsoil | $3.00 | 30,300 | $m^2$ | $90,900 |
| 2.05 | Seeding | $1.50 | 30,300 | $m^2$ | $45,450 |
| | | **Total Part 2:** | | | **$1,673,212** |
| **3: Roadways and Concrete - New Construction** | | | | | |
| 3.01 | 230mm Curb and 500mm Gutter | $160.00 | 5560 | m | $889,600 |
| 3.02 | 300mm Cement Stabilized Subgrade (22kg/m2) | $27.00 | 28742 | $m^2$ | $776,034 |
| 3.03 | 400mm of 20mm Granular Base Course | $66.00 | 28320 | $m^2$ | $1,869,120 |
| 3.04 | 190mm of 25mm Asphalt Base | $83.00 | 10520 | $m^2$ | $873,160 |
| 3.05 | 180mm of 25mm Asphalt Base | $80.00 | 21042 | $m^2$ | $1,683,360 |
| 3.06 | 50mm of 12.5mm Asphalt Surface | $27.50 | 24942 | $m^2$ | $685,905 |
| 3.07 | 200mm Slab-on Median | $250.00 | 290 | $m^2$ | $72,500 |
| | | **Total Part 3:** | | | **$6,849,679** |

# Preliminary Roadway Cost Estimate for Ray Gibbon Drive
## Scenario I Stage III (Giroux Road to Villeneue Road)
### Base Alignment

| Item No. | Description | Unit Price | Approx. Quantity (22.5m ROW) | Unit | Amount |
|---|---|---|---|---|---|
| **4: Pavement Markings and Signing - Supply and Install** | | | | | |
| 4.01 | Roadway Lines Supply and painting | $9,300.00 | 1 | No. | $9,300 |
| 4.02 | Supply and Install Intersection Signing | $5,000.00 | 2 | No. | $10,000 |
| | | **Total Part 4:** | | | **$19,300** |
| **5: Street Lighting** | | | | | |
| 5.01 | Supply and Install Street Lighting | $15,000.00 | 40 | No. | $600,000 |
| | | **Total Part 5:** | | | **$600,000** |
| **6: Intersection Signilization** | | | | | |
| 6.01 | Signilization for Intersection at Giroux | $225,000.00 | 1 | No. | $225,000 |
| 6.02 | Signilization for Intersection at Villeneuve | $225,000.00 | 1 | No. | $225,000 |
| | | **Total Part 6:** | | | **$450,000** |
| **7: Land Costs** | | | | | |
| 7.01 | Stage 3 Land Costs (St. 10+400 to 12+510) | $82,000.00 | 22.9 | Ac | $1,877,800 |
| | | **Total Part 7:** | | | **$1,877,800** |

| **Cost Summary** | | **22.5m ROW** |
|---|---|---|
| **1: Storm Sewer And Drainage** | | **$1,474,598** |
| **2: Earthworks** | | **$1,673,212** |
| **3: Roadways and Concrete - New Construction** | | **$6,849,679** |
| **4: Pavement Markings and Signing - Supply and Install** | | **$19,300** |
| **5: Street Lighting** | | **$600,000** |
| **6: Intersection Signilization** | | **$450,000** |
| **7: Land Costs** | | **$1,877,800** |
| **Subtotal:** | | **$12,944,589** |
| **Mob and Demob** | ***5%*** | **$553,339** |
| **Engineering** | ***10%*** | **$1,106,679** |
| **Contingency** | ***15%*** | **$1,660,018** |
| **Total Preliminary Roadway Estimate:** | | **$16,264,625** |

## 2. Costs to Date

Modifications were made to the original plan to assist with the future conversion of Ray Gibbon Drive to a freeway. The costs shown in the following represent the costs for a 2-lane modified arterial roadway. Stages 1 and 2 are based on actual construction costs, completed in 2006 and 2007 dollars, respectively. Assumptions for Stage 3 are listed below

**Stage 3**

- 2008 unit rates
- Full Ultimate ROW, 2 lanes constructed (proposed 2009 construction)
- Ultimate alignment, at Villeneuve SW ramp alignment will be used
- Ultimate vertical alignment where possible
- Urban/rural drainage
- Ultimate wet pond to be constructed, with outfall to Carrot Creek
- Pavement Structure – As per RGD
- Semi-mountable curb
- Includes storm pipe extension to connect to Stage 2
- Includes roadway and drainage costs to 14+000
- Includes Sifton Pipeline Relocation
- Includes required and remnant land costs from Giroux Road to Villeneuve Road, and right-of-way for the storm pond and Carrot Creek outfall

Refer to Appendix I for the Mass haul diagram.

# Preliminary Roadway Cost Estimate for Ray Gibbon Drive

**Scenario II Stage I (137 Ave to St. 8+800)**
**Costs as Constructed**

| | | | 22.5m ROW | | | 45m ROW | | | 78m ROW | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Item No. | Description | Unit Price | Approx. Quantity | Unit | Amount | Approx. Quantity | Unit | Amount | Approx. Quantity | Unit | Amount |
| **1: Completed Contract Work** | | | | | | | | | | | |
| 1.01 | Bridge Contract | $6,723,300.00 | 0.68 | No | $4,570,200 | 0.32 | No | $2,153,100 | 0 | No | $0 |
| 1.02 | Street Lighting Contract | $400,000.00 | 1 | No | $400,000 | 0 | No | $0 | 0 | No | $0 |
| 1.03 | Sureway Road Contract | $11,028,700.00 | 0.80 | No | $8,874,400 | 0.16 | No | $1,754,300 | 0.04 | No | $400,000 |
| 1.04 | Wilco- Riel Wetland Contract | $2,366,200.00 | 0.58 | No | $1,372,200 | 0 | No | $0 | 0.42 | No | $994,000 |
| 1.05 | Landscaping | $180,000.00 | 1 | No | $180,000 | 0 | No | $0 | 0 | No | $0 |
| | | **Total Part 1:** | | | **$15,396,800** | | | **$3,907,400** | | | **$1,394,000** |
| **2: Utility Relocation** | | | | | | | | | | | |
| 2.01 | Alta Link | $53,100.00 | 1 | No. | $53,100 | 0 | No. | $0 | 0 | No. | $0 |
| | | **Total Part 2:** | | | **$53,100** | | | **$0** | | | **$0** |
| **3: Land Costs** | | | | | | | | | | | |
| 3.01 | Land Acquired | $1,717,000.00 | 0.29 | No. | $496,000 | 0.29 | No. | $496,000 | 0.42 | No. | $725,000 |
| | | **Total Part 3:** | | | **$496,000** | | | **$496,000** | | | **$725,000** |
| **4: Pavement Markings and Signing - Actual Cost** | | | | | | | | | | | |
| 4.01 | Misc. Charges for Signage and Marking | $274,800.00 | 1 | No. | $274,800 | 0 | No. | $0 | 0 | No. | $0 |
| | | **Total Part 4:** | | | **$274,800** | | | **$0** | | | **$0** |
| **5: Work To Complete** | | | | | | | | | | | |
| 5.01 | Landscape Maintenance | $138,500.00 | 0 | No. | $0 | 1 | No. | $138,500 | 0 | No. | $0 |
| | | **Total Part 5:** | | | **$0** | | | **$138,500** | | | **$0** |

## Preliminary Roadway Cost Estimate for Ray Gibbon Drive

**Scenario II Stage I (137 Ave to St. 8+800)**
**Costs as Constructed**

| | | | 22.5m ROW | | | 45m ROW | | | 78m ROW | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Item No. | Description | Unit Price | Approx. Quantity | Unit | Amount | Approx. Quantity | Unit | Amount | Approx. Quantity | Unit | Amount |
| **6: Engineering Costs** | | | | | | | | | | | |
| 6.01 | EIA Process | $900,000.00 | 0.6606 | No. | $594,540 | 0.208 | No. | $187,200 | 0.131 | No. | $118,260 |
| 6.02 | Spencer Environmental | $457,000.00 | 0.6606 | No. | $301,894 | 0.208 | No. | $95,056 | 0.131 | No. | $60,050 |
| 6.03 | ISL Engineering | $2,448,387.00 | 0.6606 | No. | $1,617,404 | 0.208 | No. | $509,264 | 0.131 | No. | $321,718 |
| 6.04 | Spencer Monitoring | $400,000.00 | 0.6606 | No. | $264,240 | 0.208 | No. | $83,200 | 0.131 | No. | $52,560 |
| | | **Total Part 6:** | | | **$2,778,079** | | | **$874,720** | | | **$552,588** |

| Cost Summary | 22.5m ROW | 45m ROW | 78m ROW |
|---|---|---|---|
| **1: Completed Contract Work** | **$15,396,800** | **$3,907,400** | **$1,394,000** |
| **2: Utility Relocation** | **$53,100** | **$0** | **$0** |
| **3: Land Costs** | **$496,000** | **$496,000** | **$725,000** |
| **4: Pavement Markings and Signing - Actual Cost** | **$274,800** | **$0** | **$0** |
| **5: Work To Complete** | **$0** | **$138,500** | **$0** |
| **6: Engineering Costs** | **$2,778,079** | **$874,720** | **$552,588** |
| **Total Roadway Cost:** | **$18,998,779** | **$5,416,620** | **$2,671,588** |

# Preliminary Roadway Cost Estimate for Ray Gibbon Drive

## Scenario II Stage II (Station 8+800 to Giroux Road)

### Costs as Constructed

| | | | 22.5m ROW | | | 45m ROW | | | 78m ROW | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Item No. | Description | Unit Price | Approx. Quantity | Unit | Amount | Approx. Quantity | Unit | Amount | Approx. Quantity | Unit | Amount |
| **1: Completed Contract Work** | | | | | | | | | | | |
| 1.01 | In- Line- Road Contract | $10,765,900.00 | 0.52 | No | $5,586,900 | 0.117 | No | $1,261,000 | 0.364 | No | $3,918,000 |
| 1.02 | Signilization | $199,700.00 | 1 | No | $199,700 | 0 | No | $0 | 0 | No | $0 |
| 1.03 | Fortis- Street Lighting | $38,600.00 | 1 | No | $38,600 | 0 | No | $0 | 0 | No | $0 |
| 1.04 | Landscaping Pond | $260,000.00 | 1 | No. | $260,000 | 0 | No. | $0 | 0 | No. | $0 |
| | | **Total Part 1:** | | | **$6,085,200** | | | **$1,261,000** | | | **$3,918,000** |
| **2: CNR Costs** | | | | | | | | | | | |
| 2.01 | CNR | $196,600.00 | 1 | No. | $196,600 | 0 | No. | $0 | 0 | No. | $0 |
| | | **Total Part 2:** | | | **$196,600** | | | **$0** | | | **$0** |
| **3: Land Costs** | | | | | | | | | | | |
| 3.01 | McKenney Avenue Land Costs | $581,000.00 | 0 | No. | $0 | 0 | No. | $0 | 1 | No. | $581,000 |
| | | **Total Part 3:** | | | **$0** | | | **$0** | | | **$581,000** |
| **4: Pavement Markings and Signing - Actual Cost** | | | | | | | | | | | |
| 4.01 | Misc. Charges for Signage and Marking | $9,300.00 | 1 | No. | $9,300 | 0 | No. | $0 | 0 | No. | $0 |
| | | **Total Part 4:** | | | **$9,300** | | | **$0** | | | **$0** |
| **5: Engineering Costs** | | | | | | | | | | | |
| 5.01 | ISL Engineering | $1,490,700.00 | 0.68 | No. | $1,008,000 | 0.20 | No. | $300,000 | 0.12 | No. | $182,700 |
| | | **Total Part 5:** | | | **$1,008,000** | | | **$300,000** | | | **$182,700** |

## Preliminary Roadway Cost Estimate for Ray Gibbon Drive

### Scenario II Stage II (Station 8+800 to Giroux Road)

**Costs as Constructed**

| | | | 22.5m ROW | | | 45m ROW | | | 78m ROW | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Item No | Description | Unit Price | Approx. Quantity | Unit | Amount | Approx. Quantity | Unit | Amount | Approx. Quantity | Unit | Amount |

| Cost Summary | 22.5m ROW | 45m ROW | 78m ROW |
|---|---|---|---|
| 1: Completed Contract Work | $6,085,200 | $1,261,000 | $3,918,000 |
| 2: CNR Costs | $196,600 | $0 | $0 |
| 3: Land Costs | $0 | $0 | $581,000 |
| 4: Pavement Markings and Signing - Actual Cost | $9,300 | $0 | $0 |
| 5: Engineering Costs | $1,008,000 | $300,000 | $182,700 |
| **Total Roadway Cost:** | $7,299,100 | $1,561,000 | $4,681,700 |

# Preliminary Roadway Cost Estimate for Ray Gibbon Drive

## Scenario II Stage III (Giroux to Villeneuve)

### Proposed Construction

| Item No. | Description | Unit Price | Ultimate ROW<br>Approx. Quantity | Unit | Amount |
|---|---|---|---|---|---|
| **1A: Storm Sewer And Drainage- Stage 2** | | | | | |
| 1.01 | Trench Excavation and Native Backfill 900mm Stm (8.0-9.0m depth) | $825.00 | 98 | m | $80,850.00 |
| 1.02 | Trench Excavation and Native Backfill 900mm Stm (9.0-10.0m depth) | $850.00 | 132 | m | $112,200.00 |
| 1.03 | Trench Excavation and Native Backfill 900mm Stm (10.0-11.0m depth) | $875.00 | 120 | m | $105,000.00 |
| 1.04 | Trench Excavation and Native Backfill 900mm Stm (11.0-12.0m depth) | $900.00 | 95 | m | $85,500.00 |
| 1.05 | Trench Excavation and Native Backfill 1500mm Stm (7.0-8.0m depth) | $1,650.00 | 65 | m | $107,250.00 |
| 1.06 | Trench Excavation and Native Backfill 1500mm Stm (8.0-9.0m depth) | $1,700.00 | 28 | m | $47,600.00 |
| 1.07 | Trench Excavation and Native Backfill 1500mm Stm (9.0-10.0m depth) | $1,750.00 | 23 | m | $40,250.00 |
| 1.08 | Trench Excavation and Native Backfill 1500mm Stm (10.0-11.0m depth) | $1,800.00 | 19 | m | $34,200.00 |
| 1.09 | Trench Excavation and Native Backfill 1500mm Stm (11.0-12.0m depth) | $1,850.00 | 22 | m | $40,700.00 |
| 1.10 | Trench Excavation and Native Backfill 1500mm Stm (12.0-13.0m depth) | $1,900.00 | 10 | m | $19,000.00 |
| 1.11 | Trenchless Excavation 1500mm | $2,000.00 | 75 | m | $150,000.00 |
| 1.12 | 900mm Class IV Concrete Storm Sewer | $900.00 | 445 | m | $400,500.00 |
| 1.13 | 1500mm Class IV Concrete Storm Sewer | $1,400.00 | 242 | m | $338,800.00 |
| 1.14 | 2400mm Manhole | $9,000.00 | 35 | v.m. | $315,000.00 |
| 1.15 | 1200mm Manhole | $8,500.00 | 31 | v.m. | $263,500.00 |
| 1.16 | 1200mm CB/MH | $3,700.00 | 16.1 | v.m. | $59,570.00 |
| 1.17 | 1800mm Manhole | $5,000.00 | 24 | v.m. | $120,000.00 |
| 1.18 | 900mm Catchbasin | $5,800.00 | 7 | No | $40,600.00 |
| 1.19 | NF-80 Frame and Cover | $900.00 | 7 | No. | $6,300.00 |
| 1.20 | DK-7 Frame and Cover | $1,500.00 | 14 | No. | $21,000.00 |
| | | **Total Part 1A:** | | | **$2,387,820.00** |
| **1B: Storm Sewer And Drainage- Stage 3** | | | | | |
| 1.01 | Trench Excavation and Native Backfill 375mm Stm (2.0-3.0m depth) | $375.00 | 120 | m | $45,000.00 |
| 1.02 | Trench Excavation and Native Backfill 375mm Stm (4.0-5.0m depth) | $400.00 | 90 | m | $36,000.00 |
| 1.03 | Trench Excavation and Native Backfill 525mm Stm (2.0-3.0m depth) | $550.00 | 120 | m | $66,000.00 |
| 1.04 | Trench Excavation and Native Backfill 600mm Stm (3.0-4.0m depth) | $650.00 | 240 | m | $156,000.00 |
| 1.05 | Trench Excavation and Native Backfill 600mm Stm (4.0-5.0m depth) | $700.00 | 75 | m | $52,500.00 |
| 1.06 | Trench Excavation and Native Backfill 675mm Stm (3.0-4.0m depth) | $700.00 | 120 | m | $84,000.00 |
| 1.07 | Trench Excavation and Native Backfill 675mm Stm (4.0-5.0m depth) | $725.00 | 120 | m | $87,000.00 |
| 1.08 | Trench Excavation and Native Backfill 750mm Stm (3.0-4.0m depth) | $725.00 | 40 | m | $29,000.00 |

# Preliminary Roadway Cost Estimate for Ray Gibbon Drive
## Scenario II Stage III (Giroux to Villeneuve)
### Proposed Construction

| | | | Ultimate ROW | | |
|---|---|---|---|---|---|
| Item No. | Description | Unit Price | Approx. Quantity | Unit | Amount |
| 1.09 | Trench Excavation and Native Backfill 750mm Stm (5.0-6.0m depth) | $750.00 | 60 | m | $45,000.00 |
| 1.10 | Trench Excavation and Native Backfill 750mm Stm (6.0-7.0m depth) | $775.00 | 60 | m | $46,500.00 |
| 1.11 | Trench Excavation and Native Backfill 1350mm Stm (7.0-8.0m depth) | $1,550.00 | 250 | m | $387,500.00 |
| 1.12 | Trench Excavation and Native Backfill 900mm Stm (7.0-8.0m depth) | $800.00 | 120 | m | $96,000.00 |
| 1.13 | 375mm Class IV Concrete Storm Sewer | $150.00 | 210 | m | $31,500.00 |
| 1.14 | 525mm Class IV Concrete Storm Sewer | $220.00 | 120 | m | $26,400.00 |
| 1.15 | 600mm Class IV Concrete Storm Sewer | $310.00 | 315 | m | $97,650.00 |
| 1.16 | 675mm Class IV Concrete Storm Sewer | $500.00 | 240 | m | $120,000.00 |
| 1.17 | 750mm Class IV Concrete Storm Sewer | $750.00 | 40 | m | $30,000.00 |
| 1.18 | 900mm Class IV Concrete Storm Sewer | $900.00 | 120 | m | $108,000.00 |
| 1.19 | 1350mm Class IV Concrete Storm Sewer | $1,250.00 | 250 | m | $312,500.00 |
| 1.20 | 2400mm Manhole | $9,000.00 | 0 | v.m. | $0.00 |
| 1.21 | 1200mm Manhole | $8,500.00 | 46 | v.m. | $391,000.00 |
| 1.22 | 1200mm CB/MH | $3,700.00 | 19 | v.m. | $70,300.00 |
| 1.23 | 1800mm Manhole | $5,000.00 | 24 | v.m. | $120,000.00 |
| 1.24 | 900mm Catchbasin | $5,800.00 | 27 | No | $156,600.00 |
| 1.25 | NF-80 Frame and Cover | $900.00 | 13 | No. | $11,700.00 |
| 1.26 | DK-7 Frame and Cover | $1,500.00 | 16 | No. | $24,000.00 |
| 1.27 | 600mm Flared End c/w Galvanized Bar Screen | $8,300.00 | 2 | No | $16,600.00 |
| 1.28 | 750mm Flared End c/w Galvanized Bar Screen | $10,000.00 | 1 | No | $10,000.00 |
| 1.29 | 1350mm Flared End c/w Galvanized Bar Screen | $15,000.00 | 1 | No | $15,000.00 |
| 1.30 | STC6000 Stormceptor | $90,000.00 | 1 | No. | $90,000.00 |
| 1.31 | Gabion Matting | $550.00 | 170 | m2 | $93,500.00 |
| 1.32 | Rock Rip Rap | $200.00 | 500 | m2 | $100,000.00 |
| 1.33 | 600 mm Culverts | $750.00 | 40 | m | $30,000.00 |
| 1.34 | North Pond Outlet Control Structure | $80,000.00 | 1 | No. | $80,000.00 |
| 1.35 | Forebay Isolation Structure | $45,000.00 | 1 | No. | $45,000.00 |
| | | **Total Part 1B:** | | | **$3,110,250.00** |

| **2: Earthworks** | | | | | |
|---|---|---|---|---|---|
| 2.01 | Common Excavation | $11.00 | 25,317 | m3 | $278,487.00 |
| 2.02 | Borrow Excavation Contractor Supply | $40.00 | 113,639 | m3 | $4,545,560.00 |
| 2.03 | Topsoil Strip and Stockpile | $8.00 | 117,139 | m3 | $937,112.00 |
| 2.04 | Haul and Place 150mm depth Topsoil from Stockpile | $3.00 | 28,746 | $m^2$ | $86,238.00 |
| 2.05 | Seeding | $1.50 | 28,746 | $m^2$ | $43,119.00 |
| 2.06 | Common Excavation of North Pond | $11.00 | 150,000 | $m^3$ | $1,650,000.00 |
| | | **Total Part 2:** | | | **$7,262,029.00** |

| **3: Roadways and Concrete - New Construction** | | | | | |
|---|---|---|---|---|---|
| 3.01 | 300mm Cement Stabilized Subgrade (22kg/m2) | 27.00 | 24024 | sq m | $648,637.20 |
| 3.02 | 400mm of 20mm Granular Base Course | 66.00 | 30696 | sq m | $2,025,909.60 |
| 3.03 | 1000mm Bottom Ash (Includes Geotextile) | $70.00 | 8,184 | $m^2$ | $572,880.00 |

# Preliminary Roadway Cost Estimate for Ray Gibbon Drive

## Scenario II Stage III (Giroux to Villeneuve)

### Proposed Construction

| | | | Ultimate ROW | | |
|---|---|---|---|---|---|
| Item No. | Description | Unit Price | Approx. Quantity | Unit | Amount |
| 3.04 | 180mm of 25mm Asphalt Base | 80.00 | 20922 | sq m | $1,673,760.00 |
| 3.05 | 190mm of 25mm Asphalt Base | 83.00 | 6560 | sq m | $544,480.00 |
| 3.05 | 50mm of 12.5mm Asphalt Surface | 27.50 | 29068 | sq m | $799,370.00 |
| 3.06 | Semi Mountable Roll Face Curb and Gutter | 175.00 | 3540 | m2 | $619,500.00 |
| | | **Total Part 3:** | | | **$6,265,036.80** |

| 4: Landscaping | | | | | |
|---|---|---|---|---|---|
| 4.01 | Landscaping Villeneuve Pond | $260,000.00 | 1 | No. | $260,000.00 |
| | | **Total Part 4:** | | | **$260,000.00** |

| 5: Pavement Markings and Signing - Supply and Install | | | | | |
|---|---|---|---|---|---|
| 5.01 | Roadway Lines Supply and Paint and painting (directional dividing and 2 edge lines) | $4,600.00 | 2.2 | km | $10,120.00 |
| 5.02 | Supply and Install Signing | $20,000.00 | 1.0 | No. | $20,000.00 |
| | | **Total Part 5:** | | | **$30,120.00** |

| 6: Street Lighting | | | | | |
|---|---|---|---|---|---|
| 6.01 | Supply and Install Lighting | $15,000.00 | 45 | No. | 678,000.00 |
| | | **Total Part 6:** | | | **$678,000.00** |

| 7: Signilization | | | | | |
|---|---|---|---|---|---|
| 7.01 | Signilization for Intersection at Giroux Ave | $225,000.00 | 1 | No. | $225,000.00 |
| 7.02 | Signilization for Intersection at Villeneuve Ave | $225,000.00 | 1 | No. | $225,000.00 |
| | | **Total Part 7:** | | | **$450,000.00** |

| 8: Miscellaneous | | | | | |
|---|---|---|---|---|---|
| 8.01 | Coconut ECB - NAG 125 | $12.00 | 14,120 | m2 | $169,440.00 |
| 8.02 | Georidge | $50.00 | 209 | m | $10,434.78 |
| | | **Total Part 8:** | | | **$179,874.78** |

| 9: Land Cost | | | | | |
|---|---|---|---|---|---|
| 9.01 | Initial 22.5m ROW | $5,540,000.00 | 1 | No | $5,540,000.00 |
| | | **Total Part 9:** | | | **$5,540,000.00** |

| 10: Environmental Costs | | | | | |
|---|---|---|---|---|---|
| 10.01 | Environmental Costs | $100,000.00 | 1 | No | $100,000.00 |
| | | **Total Part 10:** | | | **$100,000.00** |

## Preliminary Roadway Cost Estimate for Ray Gibbon Drive

### Scenario II Stage III (Giroux to Villeneuve)

**Proposed Construction**

| | | | Ultimate ROW | | |
|---|---|---|---|---|---|
| Item No. | Description | Unit Price | Approx. Quantity | Unit | Amount |
| **11: Gasline Relocation Costs** | | | | | |
| 11.01 | Villeneuve Gas Line Relocation | $250,000.00 | 1 | No | $250,000.00 |
| | | **Total Part 11:** | | | **$250,000.00** |

| Cost Summary | | Ultimate ROW |
|---|---|---|
| **1A: Storm Sewer And Drainage- Stage 2** | | **$2,387,820.00** |
| **1B: Storm Sewer And Drainage- Stage 3** | | **$3,110,250.00** |
| **2: Earthworks** | | **$7,262,029.00** |
| **3: Roadways and Concrete - New Construction** | | **$6,265,036.80** |
| **4: Landscaping** | | **$260,000.00** |
| **5: Pavement Markings and Signing - Supply and Install** | | **$30,120.00** |
| **6: Street Lighting** | | **$678,000.00** |
| **7: Signilization** | | **$450,000.00** |
| **8: Miscellaneous** | | **$179,874.78** |
| **9: Land Cost** | | **$5,540,000.00** |
| **10: Environmental Costs** | | **$100,000.00** |
| **11: Gasline Relocation Costs** | | **$250,000.00** |
| **Subtotal:** | | **$26,513,130.58** |
| **Contingency** | *15%* | **$3,145,969.59** |
| **Engineering** | *10%* | **$2,097,313.06** |
| **Total Roadway Estimate:** | | **$31,756,413.23** |

## 3. Freeway Improvement Costs

Using the two existing lanes of Ray Gibbon Drive, cost estimates were prepared to determine the cost of improving the modified arterial roadway to an ultimate 8-lane cross-section. Costs are provided to widen to a 4, 6 and 8-lane cross-section.

### 3.1 Four Lanes Grade Separated, from 5+280 to 14+600

The following table identifies costs to go from the existing infrastructure to a 4-lane cross-section with interchanges and a grade-separation at the CN crossing, plus Stage 3 (proposed 2009 construction). The assumptions for this stage are listed below:

- 2008 Prices
- Detour roads at 137 Ave, CN (road), Giroux and Villeneuve
- CN Detour (rail) included in bridge estimate
- Structures – 137 Ave, CN, McKenney, Giroux, Villeneuve
- Signals at all ramp terminals
- Ultimate Grading
- Landfill excavation (Holden)
- Noise Attenuation
- Overhead Sign Structures
- North Pond Renovation
- Stage 2 and 3 ponds no work required
- Box Culvert Expansion
- Curb and Gutter removal on existing stage 1 and 2 replace with semi mountable
- Widen road for extra shoulder width – AT standard
- Removals – (throw away) detours
- Road removal and construction NB lanes approx 9+000 to 11+000
- Additional street lighting (modifications)
- Pedestrian Bridge
- Remaining right-of-way requirements, including parcels north of Villeneuve Road to 14+600.

# Preliminary Roadway Cost Estimate for Ray Gibbon Drive

Scenario III, 4 Lanes With Interchanges (137 Ave to St. 14+600)

| | | | Stage I | | | Stage II | | | Stage III Expanded | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Item No | Description | Unit Price | Approx. Quantity | Unit | Amount | Approx. Quantity | Unit | Amount | Approx. Quantity | Unit | Amount |
| 1: Storm Sewer And Drainage | | | | | | | | | | | |
| 1.01 | Trench Excavation and Native Backfill 300mm Stm (3.0-4.0m depth) | $300.00 | 22.8 | m | $6,840 | 10.8 | m | $3,240 | 26.4 | m | $7,920 |
| 1.02 | Trench Excavation and Native Backfill 375mm Stm (3.0-4.0m depth) | $375.00 | 79.8 | m | $29,925 | 37.8 | -m | $14,175 | 92.4 | m | $34,650 |
| 1.03 | Trench Excavation and Native Backfill 450mm Stm (3.0-4.0m depth) | $500.00 | 91.2 | m | $45,600 | 43.2 | m | $21,600 | 105.6 | m | $52,800 |
| 1.04 | Trench Excavation and Native Backfill 525mm Stm (3.0-4.0m depth) | $600.00 | 222.68 | m | $133,608 | 105.48 | m | $63,288 | 257.84 | m | $154,704 |
| 1.05 | Trench Excavation and Native Backfill 600mm Stm (3.0-4.0m depth) | $650.00 | 84.36 | m | $54,834 | 39.96 | m | $25,974 | 97.68 | m | $63,492 |
| 1.06 | Trench Excavation and Native Backfill 600mm Stm (4.0-5.0m depth) | $700.00 | 28.5 | m | $19,950 | 13.5 | m | $9,450 | 33 | m | $23,100 |
| 1.07 | Trench Excavation and Native Backfill 675mm Stm (3.0-4.0m depth) | $700.00 | 45.6 | m | $31,920 | 21.6 | m | $15,120 | 52.8 | m | $36,960 |
| 1.08 | Trench Excavation and Native Backfill 750mm Stm (3.0-4.0m depth) | $725.00 | 178.6 | m | $129,485 | 84.6 | m | $61,335 | 206.8 | m | $149,930 |
| 1.09 | Trench Excavation and Native Backfill 900mm Stm (3.0-4.0m depth) | $775.00 | 178.6 | m | $138,415 | 84.6 | m | $65,565 | 206.8 | m | $160,270 |
| 1.10 | Trench Excavation and Native Backfill 1050mm Stm (3.0-4.0m depth) | $800.00 | 168.34 | m | $134,672 | 79.74 | m | $63,792 | 194.92 | m | $155,936 |
| 1.11 | Trench Excavation and Native Backfill 1200mm Stm (3.0-4.0m depth) | $850.00 | 224.96 | m | $191,216 | 106.56 | m | $90,576 | 260.48 | m | $221,408 |
| 1.12 | Trench Excavation and Native Backfill 1350mm Stm (7.0-8.0m depth) | $1,550.00 | 95 | m | $147,250 | 45 | m | $69,750 | 110 | m | $170,500 |
| 1.13 | 300mm Class IV Concrete Storm Sewer | $125.00 | 22.8 | m | $2,850 | 10.8 | m | $1,350 | 26.4 | m | $3,300 |
| 1.14 | 375mm Class IV Concrete Storm Sewer | $150.00 | 79.8 | m | $11,970 | 37.8 | m | $5,670 | 92.4 | m | $13,860 |
| 1.15 | 450mm Class IV Concrete Storm Sewer | $200.00 | 91.2 | m | $18,240 | 43.2 | m | $8,640 | 105.6 | m | $21,120 |
| 1.16 | 525mm Class IV Concrete Storm Sewer | $220.00 | 222.68 | m | $48,990 | 105.48 | m | $23,206 | 257.84 | m | $56,725 |
| 1.17 | 600mm Class IV Concrete Storm Sewer | $310.00 | 112.86 | m | $34,987 | 53.46 | m | $16,573 | 130.68 | m | $40,511 |
| 1.18 | 675mm Class IV Concrete Storm Sewer | $500.00 | 45.6 | m | $22,800 | 21.6 | m | $10,800 | 52.8 | m | $26,400 |
| 1.19 | 750mm Class IV Concrete Storm Sewer | $750.00 | 178.6 | m | $133,950 | 84.6 | m | $63,450 | 206.8 | m | $155,100 |
| 1.20 | 900mm Class IV Concrete Storm Sewer | $900.00 | 178.6 | m | $160,740 | 84.6 | m | $76,140 | 206.8 | m | $186,120 |
| 1.21 | 1050mm Class IV Concrete Storm Sewer | $1,000.00 | 168.34 | m | $168,340 | 79.74 | m | $79,740 | 194.92 | m | $194,920 |
| 1.22 | 1200mm Class IV Concrete Storm Sewer | $1,200.00 | 224.96 | m | $269,952 | 106.56 | m | $127,872 | 260.48 | m | $312,576 |
| 1.23 | 1350mm Class IV Concrete Storm Sewer | $1,250.00 | 95 | m | $118,750 | 45 | m | $56,250 | 110 | m | $137,500 |
| 1.24 | 300mm Class V Concrete Catchbasin Lead | $105.00 | 622.44 | m | $65,356 | 294.84 | m | $30,958 | 720.72 | m | $75,676 |
| 1.25 | 1200mm Manhole | $4,000.00 | 68.4 | v.m. | $273,600 | 32.4 | v.m. | $129,600 | 79.2 | v.m. | $316,800 |
| 1.26 | 900mm Catchbasin | $5,800.00 | 41.8 | No. | $242,440 | 19.8 | No. | $114,840 | 48.4 | No. | $280,720 |
| 1.27 | 1200mm CB/MH | $3,700.00 | 54.34 | v.m. | $201,058 | 25.74 | v.m. | $95,238 | 62.92 | v.m. | $232,804 |
| 1.28 | 1800mm MH | $5,000.00 | 6.84 | v.m. | $34,200 | 3.24 | v.m. | $16,200 | 7.92 | v.m. | $39,600 |
| 1.29 | Adjust MH/CB | $5,000.00 | 6.08 | v.m. | $30,400 | 2.88 | v.m. | $14,400 | 7.04 | v.m. | $35,200 |
| 1.30 | NF-80 Frame and Cover | $900.00 | 23.94 | No | $21,546 | 11.34 | No | $10,206 | 27.72 | No | $24,948 |
| 1.31 | DK-7 Frame and Cover | $1,500.00 | 69.92 | No | $104,880 | 33.12 | No | $49,680 | 80.96 | No | $121,440 |
| 1.32 | 300mm Flared End c/w Galvanized Bar Screen | $3,000.00 | 1.14 | No | $3,420 | 0.54 | No | $1,620 | 1.32 | No | $3,960 |
| 1.33 | 375mm Flared End c/w Galvanized Bar Screen | $4,000.00 | 0.38 | No | $1,520 | 0.18 | No | $720 | 0.44 | No | $1,760 |
| 1.34 | 1050mm Flared End c/w Galvanized Bar Screen | $12,000.00 | 0.38 | No | $4,560 | 0.18 | No | $2,160 | 0.44 | No | $5,280 |
| 1.35 | 1350mm Flared End c/w Galvanized Bar Screen | $15,000.00 | 0.38 | No | $5,700 | 0.18 | No | $2,700 | 0.44 | No | $6,600 |
| 1.36 | Remove CBMH and Leads | $5,000.00 | 4.94 | No. | $24,700 | 2.34 | No. | $11,700 | 5.72 | No. | $28,600 |

# Preliminary Roadway Cost Estimate for Ray Gibbon Drive

**Scenario III, 4 Lanes With Interchanges (137 Ave to St. 14+600)**

| | | | Stage I | | | Stage II | | | Stage III Expanded | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Item No | Description | Unit Price | Approx. Quantity | Unit | Amount | Approx. Quantity | Unit | Amount | Approx. Quantity | Unit | Amount |
| 1.37 | Remove CB and Leads | $4,500.00 | 13.68 | No. | $61,560 | 6.48 | No. | $29,160 | 15.84 | No. | $71,280 |
| 1.38 | Drop Structure | $50,000.00 | 0.38 | No. | $19,000 | 0.18 | No. | $9,000 | 0.44 | No. | $22,000 |
| 1.39 | 600mm CSP Culverts | $750.00 | 30.4 | m | $22,800 | 14.4 | m | $10,800 | 35.2 | m | $26,400 |
| 1.40 | 1000mm CSP Culverts | $950.00 | 45.6 | m | $43,320 | 21.6 | m | $20,520 | 52.8 | m | $50,160 |
| 1.41 | STC750 Stormceptor | $60,000.00 | 0.76 | No. | $45,600 | 0.36 | No. | $21,600 | 0.88 | No. | $52,800 |
| 1.42 | STC6000 Stormceptor | $90,000.00 | 0.38 | No. | $34,200 | 0.18 | No. | $16,200 | 0.44 | No. | $39,600 |
| 1.43 | Modification to North Pond | $150,000.00 | 0.38 | No. | $57,000 | 0.18 | .No. | $27,000 | 0.44 | No. | $66,000 |
| 1.44 | CB Remove and Replace at McKenny | $20,000.00 | 0.38 | No. | $7,600 | 0.18 | No. | $3,600 | 0.44 | No. | $8,800 |
| | | **Total Part 1:** | | | **$3,359,743** | | | **$1,591,457** | | | **$3,890,229** |
| **2: Removals** | | | | | | | | | | | |
| 2.01 | Remove Curb and Gutter | $35.00 | 4955.2 | m | $173,432 | 2,347 | m | $82,152 | 5,738 | m | $200,816 |
| 2.02 | Remove Asphalt | $3.00 | 47880 | m2cm | $143,640 | 22,680 | m2cm | $68,040 | 55,440 | m2cm | $166,320 |
| 2.03 | Remove Misc. Concrete | $67.00 | 285.76 | $m^2$ | $19,146 | 135 | $m^2$ | $9,069 | 331 | $m^2$ | $22,169 |
| 2.04 | Remove Walking Trail | $3.00 | 3249 | m2cm | $9,747 | 1,539 | m2cm | $4,617 | 3,762 | m2cm | $11,286 |
| | | **Total Part 2:** | | | **$345,965** | | | **$163,878** | | | **$400,591** |
| **3: Earthworks** | | | | | | | | | | | |
| 3.01 | Common Excavation South of Sturgeon River | $12.00 | 12571.16 | m3 | $150,854 | 5,955 | m3 | $71,457 | 14,556 | m3 | $174,673 |
| 3.02 | Borrow Excavation Contractor Supply - South of Sturgeon River | $40.00 | 42493.88 | m3 | $1,699,755 | 20,129 | m3 | $805,147 | 49,203 | m3 | $1,968,138 |
| 3.03 | Strip & Stockpile Topsoil Station - South of Sturgeon River | $8.00 | 13758.28 | m3 | $110,066 | 6,517 | m3 | $52,137 | 15,931 | m3 | $127,445 |
| 3.04 | Common Excavation - North of Sturgeon River | $14.00 | 331277.92 | m3 | $4,637,891 | 156,921 | m3 | $2,196,896 | 383,585 | m3 | $5,370,189 |
| 3.05 | Borrow Excavation Contractor Supply - North of Sturgeon River | $40.00 | 131989.58 | m3 | $5,279,583 | 62,521 | m3 | $2,500,855 | 152,830 | m3 | $6,113,202 |
| 3.06 | Strip & Stockpile Topsoil Station - North of Sturgeon River | $8.00 | 50788.9 | m3 | $406,311 | 24,058 | m3 | $192,463 | 58,808 | m3 | $470,466 |
| 3.07 | Common Excavation- Holden Landfill Offsite | $50.00 | 19186.2 | m3 | $959,310 | 9,088 | m3 | $454,410 | 22,216 | m3 | $1,110,780 |
| 3.08 | Haul and Place 150mm Topsoil From Stockpile | $3.00 | 230968.56 | $m^2$ | $692,906 | 109,406 | $m^2$ | $328,218 | 267,437 | $m^2$ | $802,312 |
| 3.09 | Seeding | $1.50 | 230968.56 | $m^2$ | $346,453 | 109,406 | $m^2$ | $164,109 | 267,437 | $m^2$ | $401,156 |
| 3.10 | Clearing & Grubbing | $1,000.00 | 0.38 | Ha | $380 | 0.18 | Ha | $180 | 0.44 | Ha | $440 |
| | | **Total Part 3:** | | | **$14,283,509** | | | **$6,765,873** | | | **$16,538,800** |
| **4: Concrete And Pavement Structure** | | | | | | | | | | | |
| 4.01 | Semi Mountable Roll Face Curb and Gutter | $175.00 | 13892.8 | m | $2,431,240 | 6,581 | m | $1,151,640 | 16,086 | m | $2,815,120 |
| 4.02 | 230mm Curb 500mm Gutter | $160.00 | 3192 | m | $510,720 | 1,512 | m | $241,920 | 3,696 | m | $591,360 |
| 4.03 | 200mm Slab-on Median | $250.00 | 197.6 | $m^2$ | $49,400 | 94 | $m^2$ | $23,400 | 229 | $m^2$ | $57,200 |
| 4.04 | 130mm Concrete Island Filler | $150.00 | 570 | $m^2$ | $85,500 | 270 | $m^2$ | $40,500 | 660 | $m^2$ | $99,000 |
| 4.05 | 300mm Cement Stabilized Subgrade | $27.00 | 120202.36 | $m^2$ | $3,245,464 | 56,938 | $m^2$ | $1,537,325 | 139,182 | $m^2$ | $3,757,905 |
| 4.06 | Asphalt Trail | $175.00 | 152 | $m^2$ | $26,600 | 72 | $m^2$ | $12,600 | 176 | $m^2$ | $30,800 |

# Preliminary Roadway Cost Estimate for Ray Gibbon Drive

**Scenario III, 4 Lanes With Interchanges (137 Ave to St. 14+600)**

| | | | Stage I | | | Stage II | | | Stage III Expanded | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Item No | Description | Unit Price | Approx. Quantity | Unit | Amount | Approx. Quantity | Unit | Amount | Approx. Quantity | Unit | Amount |
| 4.07 | 1000mm Bottom Ash (Includes Geotextile) | $70.00 | 14200.6 | $m^2$ | $994,042 | 6,727 | $m^2$ | $470,862 | 16,443 | $m^2$ | $1,150,996 |
| 4.08 | 400mm of 20mm Granular Base Course | $66.00 | 103261.2 | $m^2$ | $6,815,239 | 48,913 | $m^2$ | $3,228,271 | 119,566 | $m^2$ | $7,891,330 |
| 4.09 | 180mm of 25mm Asphalt Base | $80.00 | 107834.88 | $m^2$ | $8,626,790 | 51,080 | $m^2$ | $4,086,374 | 124,861 | $m^2$ | $9,988,915 |
| 4.10 | 50mm of 12.5mm Asphalt Surface | $27.50 | 139754.88 | $m^2$ | $3,843,259 | 66,200 | $m^2$ | $1,820,491 | 161,821 | $m^2$ | $4,450,090 |
| 4.11 | 190mm of 25mm Asphalt Base | $83.00 | 33516 | $m^2$ | $2,781,828 | 15,876 | $m^2$ | $1,317,708 | 38,808 | $m^2$ | $3,221,064 |
| 4.12 | 75mm of 12.5mm Asphalt Surface | $32.00 | 1520 | $m^2$ | $48,640 | 720 | $m^2$ | $23,040 | 1,760 | $m^2$ | $56,320 |
| 4.13 | 140mm of 25mm Asphalt Base | $75.00 | 33440 | $m^2$ | $2,508,000 | 15,840 | $m^2$ | $1,188,000 | 38,720 | $m^2$ | $2,904,000 |
| 4.14 | Install and Remove Giroux Interchange Detour | $1,066,151.00 | 0.38 | No. | $405,137 | 0.18 | No. | $191,907 | 0.44 | No. | $469,106 |
| 4.15 | Install and Remove Villeneuve Interchange Detour | $1,066,151.00 | 0.38 | No. | $405,137 | 0.18 | No. | $191,907 | 0.44 | No. | $469,106 |
| 4.16 | Install and Remove McKenny Interchange Detour | $1,325,000.00 | 0.38 | No. | $503,500 | 0.18 | No. | $238,500 | 0.44 | No. | $583,000 |
| | | **Total Part 4:** | | | **$33,280,497** | | | **$15,764,446** | | | **$38,535,313** |

**5: Bridge Structures**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5.01 | Pre-Cast New Mini Barriers | $400.00 | | No. | $0 | 18 | No. | $7,200 | | No. | $0 |
| 5.02 | CNR Subway bridge | $2,600,000.00 | 0 | No. | $0 | 1 | No. | $2,600,000 | 0 | No. | $0 |
| 5.03 | Install and Remove Sheetpiling (CNR Detour Road) | $500,000.00 | 0 | No. | $0 | 1.0 | No. | $500,000 | 0 | No. | $0 |
| 5.04 | Giroux overpass | $13,900,000.00 | 0 | No. | $0 | 0.5 | No. | $6,950,000 | 0.5 | No. | $6,950,000 |
| 5.05 | McKenney Overpass | $11,500,000.00 | 0.5 | No. | $5,750,000 | 0.5 | No. | $5,750,000 | 0 | No. | $0 |
| 5.06 | Villeneuve Overpass | $11,800,000.00 | 0 | No. | $0 | 0.0 | No. | $0 | 1.0 | No. | $11,800,000 |
| 5.07 | 137 Ave Overpass | $9,300,000.00 | 1 | No. | $9,300,000 | 0.0 | No. | $0 | 0 | No. | $0 |
| 5.08 | Retaining Walls at 137 Aveneue | $1,200,000.00 | 1 | No. | $1,200,000 | 0.0 | No. | $0 | 0 | No. | $0 |
| 5.09 | Sturgeon River Bridge | $4,400,000.00 | 1 | No. | $4,400,000 | 0.0 | No. | $0 | 0 | No. | $0 |
| 5.10 | Sturgeon River Pedestrian Bridge | $1,900,000.00 | 1 | No. | $1,900,000 | 0.0 | No. | $0 | 0 | No. | $0 |
| | | **Total Part 5:** | | | **$22,550,000** | | | **$15,807,200** | | | **$18,750,000** |

**6: Pavement Markings and Signing - Supply and Install**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 6.01 | Roadway Lines Supply and Paint and painting (directional dividing and 2 edge lines) | $2,000.00 | 3.8 | km | $7,600 | 1.8 | km | $3,600 | 4.4 | km | $8,800 |
| 6.02 | Install Signs (Overhead) | $2,000,000.00 | 1.52 | No. | $3,040,000 | 0.7 | No. | $1,440,000 | 1.8 | No. | $3,520,000 |
| | | **Total Part 6:** | | | **$3,047,600** | | | **$1,443,600** | | | **$3,528,800** |

**7: Noise Attenuation**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 7.01 | Noise Attenuation | $500.00 | 0 | m2 | $0 | 3183.6 | m2 | $1,591,800 | 7428.4 | m2 | $3,714,200 |
| | | **Total Part 7:** | | | **$0** | | | **$1,591,800** | | | **$3,714,200** |

## Preliminary Roadway Cost Estimate for Ray Gibbon Drive

**Scenario III, 4 Lanes With Interchanges (137 Ave to St. 14+600)**

| | | | Stage I | | | Stage II | | | Stage III Expanded | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Item No | Description | Unit Price | Approx. Quantity | Unit | Amount | Approx. Quantity | Unit | Amount | Approx. Quantity | Unit | Amount |
| **8: Street Lighting** | | | | | | | | | | | |
| 8.01 | Supply &Install Street Lighting | $15,000.00 | 201.78 | No. | $3,026,700 | 95.58 | No. | $1,433,700 | 233.64 | No. | $3,504,600 |
| 8.02 | Signilization | $180,000.00 | 2 | No. | $360,000 | 3 | No. | $540,000 | 3 | No. | $540,000 |
| 8.03 | Relocate McKenny Signilization | $100,000.00 | 0 | No. | $0 | 0.5 | No. | $50,000 | 0.5 | No. | $50,000 |
| | | **Total Part 8:** | | | **$3,386,700** | | | **$2,023,700** | | | **$4,094,600** |
| **9: Miscellaneous** | | | | | | | | | | | |
| 9.01 | Coconut ECB - NAG C125 | 12.00 | 13680 | $m^2$ | $164,160 | 6480 | $m^2$ | $77,760 | 15840 | $m^2$ | $190,080 |
| 9.02 | Georidge | 50.00 | 380 | m | $19,000 | 180 | m | $9,000 | 440 | m | $22,000 |
| | | **Total Part 9:** | | | **$183,160** | | | **$86,760** | | | **$212,080** |
| **10: Land Costs** | | | | | | | | | | | |
| 10.01 | Land North of Villeneuve | $3,610,000.00 | 0 | No. | $0 | 0 | No. | $0 | 1 | No. | $3,610,000 |
| | | **Total Part 10:** | | | **$0** | | | **$0** | | | **$3,610,000** |
| **11: Alta Link Relocates** | | | | | | | | | | | |
| 11.01 | Relocation Cost at Giroux | $100,000.00 | 0 | No. | $0 | 0.5 | No. | $50,000 | 0.5 | No. | $50,000 |
| 11.02 | Relocation Cost at Riel Pond | $40,000.00 | 1 | No. | $40,000 | 0 | No. | $0 | 0 | No. | $0 |
| | | **Total Part 11:** | | | **$40,000** | | | **$50,000** | | | **$50,000** |

| Cost Summary | | Stage I | Stage II | Stage III Expanded |
|---|---|---|---|---|
| **1: Storm Sewar & Drainage** | | $3,359,743 | $1,591,457 | $3,890,229 |
| **2: Removals** | | $345,965 | $163,878 | $400,591 |
| **3: Earthworks** | | $14,283,509 | $6,765,873 | $16,538,800 |
| **4: Concrete And Pavement Structure** | | $33,280,497 | $15,764,446 | $38,535,313 |
| **5: Bridge Structures** | | $22,550,000 | $15,807,200 | $18,750,000 |
| **6: Pavement Markings and Signing - Supply and Install** | | $3,047,600 | $1,443,600 | $3,528,800 |
| **7: Noise Attenuation** | | $0 | $1,591,800 | $3,714,200 |
| **8: Street Lighting** | | $3,386,700 | $2,023,700 | $4,094,600 |
| **9: Miscellaneous** | | $183,160 | $86,760 | $212,080 |
| **10: Land Costs** | | $0 | $0 | $3,610,000 |
| **11: Alta Link Relocates** | | $40,000 | $50,000 | $50,000 |
| **Subtotal:** | | $80,477,175 | $45,288,714 | $93,324,613 |
| **Mob & Demob** | *5%* | $4,023,859 | $2,264,436 | $4,485,731 |
| **Contingency** | *15%* | $12,071,576 | $6,793,307 | $13,998,692 |
| **Engineering** | *10%* | $8,047,717 | $4,528,871 | $8,971,461 |
| **Total Preliminary Roadway Estimate:** | | **$104,620,327** | **$58,875,329** | **$120,780,497** |

### 3.2 Widen from Four to Six Lanes

An additional lane is added to the outside in both directions in this stage. Additional work includes:

- SB lanes shift across Sturgeon River (road removal and construction)
- Curb and gutter removal and construction
- Drainage CB lead extension and CB removal and replacement
- Widen road pavement structure
- Riel Pond modifications (Rip Rap removal, outfall extensions, etc.)
- Existing street light wire remove and replace (east side)
- Sturgeon bridge widening
- Grading for widening and fill through pond.

The following table identifies additional costs to expand to a 6-lane cross-section.

# Preliminary Roadway Cost Estimate for Ray Gibbon Drive
## Scenario IV 6 Lane Stage (Adding North Bound and South Bound Outer Lanes)
### From 137 Avenue to Station 14+600

| | | | Stage I | | | Stage II | | | Stage III Expanded | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Item No | Description | Unit Price | Approx. Quantity | Unit | Amount | Approx. Quantity | Unit | Amount | Approx. Quantity | Unit | Amount |
| **1: Storm Sewar & Drainage** | | | | | | | | | | | |
| 1.01 | 900mm Catch Basin | $5,800.00 | 36.1 | No. | $209,380 | 17.1 | No. | $99,180 | 41.8 | No. | $242,440 |
| 1.02 | 300mm Class IV Concrete Catchbasin Lead | $105.00 | 114 | m | $11,970 | 54 | m | $5,670 | 132 | m | $13,860 |
| 1.03 | 1500mm x 3000mm Precast Box Culvert Section | $15,000.00 | 2.28 | No. | $34,200 | 1.08 | No. | $16,200 | 2.64 | No. | $39,600 |
| 1.04 | Extend 300mm Pipe & Outfalls | $6,000.00 | 1.14 | No. | $6,840 | 0.54 | No. | $3,240 | 1.32 | No. | $7,920 |
| 1.05 | Extend 600mm Pipe & Outfall | $7,500.00 | 0.38 | No. | $2,850 | 0.18 | No. | $1,350 | 0.44 | No. | $3,300 |
| 1.06 | Remove CB and Leads | $4,500.00 | 36.1 | No. | $162,450 | 17.1 | No. | $76,950 | 41.8 | No. | $188,100 |
| | | **Total Part 1:** | | | **$427,690** | | | **$202,590** | | | **$495,220** |
| **2: Earthworks** | | | | | | | | | | | |
| 2.01 | Common Excavation (5+300 to 7+600) | $30.00 | 10450 | m3 | $313,500 | 4950 | m3 | $148,500 | 12100 | m3 | $363,000 |
| 2.02 | Strip & Stockpile Topsoil Station (5+300 to 7+600) | $30.00 | 3541.6 | m3 | $106,248 | 1677.6 | m3 | $50,328 | 4100.8 | m3 | $123,024 |
| 2.03 | Common Excavation (7+600 to 10+000) | $30.00 | 9310 | m3 | $279,300 | 4410 | m3 | $132,300 | 10780 | m3 | $323,400 |
| 2.04 | Common Excavation from (7+600 to 10+000) to (7+000 to 5+000) | $30.00 | 5130 | m3 | $153,900 | 2430 | m3 | $72,900 | 5940 | m3 | $178,200 |
| 2.05 | Common Excavation Offsite (7+600 to 10+000) | $45.00 | 3040 | m3 | $136,800 | 1440 | m3 | $64,800 | 3520 | m3 | $158,400 |
| 2.06 | Strip & Stockpile Topsoil Station (7+600 to 10+000) | $30.00 | 3860.8 | m3 | $115,824 | 1828.8 | m3 | $54,864 | 4470.4 | m3 | $134,112 |
| 2.07 | Common Excavation Offsite (10+000 to 13+300) | $45.00 | 31160 | m3 | $1,402,200 | 14760 | m3 | $664,200 | 36080 | m3 | $1,623,600 |
| 2.08 | Strip & Stockpile Topsoil Station (10+000 to 13+300) | $30.00 | 6916 | m3 | $207,480 | 3276 | m3 | $98,280 | 8008 | m3 | $240,240 |
| 2.09 | Place 150mm Topsoil | $3.00 | 7919.2 | $m^2$ | $23,758 | 3751.2 | $m^2$ | $11,254 | 9169.6 | $m^2$ | $27,509 |
| 2.10 | Seeding | $1.50 | 7919.2 | $m^2$ | $11,879 | 3751.2 | $m^2$ | $5,627 | 9169.6 | $m^2$ | $13,754 |
| | | **Total Part 2:** | | | **$2,750,888** | | | **$1,303,052** | | | **$3,185,239** |
| **3: Removals** | | | | | | | | | | | |
| 3.01 | Remove Curb and Gutter (Includes Sawcut) | $35.00 | 4,848.8 | m | $169,708 | 2296.8 | m | $80,388 | 5,614.4 | m | $196,504 |
| 3.02 | Remove and Replace Rock Rip Rap | $110,000.00 | 0.38 | No | $41,800 | 0.18 | No | $19,800 | 0.4 | No | $48,400 |
| | | **Total Part 3:** | | | **$211,508** | | | **$100,188** | | | **$244,904** |

# Preliminary Roadway Cost Estimate for Ray Gibbon Drive

## Scenario IV 6 Lane Stage (Adding North Bound and South Bound Outer Lanes)

### From 137 Avenue to Station 14+600

| | | | Stage I | | | Stage II | | | Stage III Expanded | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Item No | Description | Unit Price | Approx. Quantity | Unit | Amount | Approx. Quantity | Unit | Amount | Approx. Quantity | Unit | Amount |
| **4: Roadways and Concrete - New Construction** | | | | | | | | | | | |
| 4.01 | Install Semi Mountable Curb | $175.00 | 5,304.8 | m | $928,340 | 2512.8 | m | $439,740 | 6,142.4 | m | $1,074,920 |
| 4.02 | 300mm Cement Stabilized Subgrade | $27.00 | 42,134.4 | $m^2$ | $1,137,629 | 19958.4 | $m^2$ | $538,877 | 48,787.2 | $m^2$ | $1,317,254 |
| 4.03 | 1000mm Bottom Ash (Includes Geotextile) | $70.00 | 7,866.0 | $m^3$ | $550,620 | 3726.0 | $m^3$ | $260,820 | 9,108.0 | $m^3$ | $637,560 |
| 4.04 | 400mm of 20mm Granular Base Course | $66.00 | 32,216.4 | $m^2$ | $2,126,282 | 15260.4 | $m^2$ | $1,007,186 | 37,303.2 | $m^2$ | $2,462,011 |
| 4.05 | 180mm of 25mm Asphalt Base | $83.00 | 32,216.4 | $m^2$ | $2,673,961 | 15260.4 | $m^2$ | $1,266,613 | 37,303.2 | $m^2$ | $3,096,166 |
| 4.06 | 50mm of 12.5mm Asphalt Surface | $28.00 | 32,216.4 | $m^2$ | $902,059 | 15260.4 | $m^2$ | $427,291 | 37,303.2 | $m^2$ | $1,044,490 |
| | | **Total Part 4:** | | | **$8,318,892** | | | **$3,940,528** | | | **$9,632,401** |
| **5: Sturgeon River Bridge** | | | | | | | | | | | |
| 5.01 | Sturgeon River Bridge Widening | $7,600,000.00 | 1 | No. | $7,600,000 | 0 | No. | $0 | 0 | No. | $0 |
| | | **Total Part 5:** | | | **$7,600,000** | | | **$0** | | | **$0** |
| **6: Pavement Markings and Signing - Supply and Install** | | | | | | | | | | | |
| 6.01 | Roadway Lines Supply and Paint and painting (directional dividing and 2 edge lines) | $2,000.00 | 3.8 | km | $7,600 | 1.8 | km | $3,600 | 4.4 | km | $8,800 |
| | | **Total Part 6:** | | | **$7,600** | | | **$3,600** | | | **$8,800** |
| **7: Street Lighting** | | | | | | | | | | | |
| 7.01 | Remove and Relocate Streetlight Standards | $8,000.00 | 140.6 | No. | $1,124,800 | 66.6 | No. | $532,800 | 162.8 | No. | $1,302,400 |
| | | **Total Part 7:** | | | **$1,124,800** | | | **$532,800** | | | **$1,302,400** |

## Preliminary Roadway Cost Estimate for Ray Gibbon Drive

**Scenario IV 6 Lane Stage (Adding North Bound and South Bound Outer Lanes)**

**From 137 Avenue to Station 14+600**

| | | | Stage I | | | Stage II | | | Stage III Expanded | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Item No | Description | Unit Price | Approx. Quantity | Unit | Amount | Approx. Quantity | Unit | Amount | Approx. Quantity | Unit | Amount |
| **Cost Summary** | | | **Stage I** | | | **Stage II** | | | **Stage III Expanded** | | |
| | **1: Storm Sewar & Drainage** | | | | **$427,690** | | | **$202,590** | | | **$495,220** |
| | **2: Earthworks** | | | | **$2,750,888** | | | **$1,303,052** | | | **$3,185,239** |
| | **3: Removals** | | | | **$211,508** | | | **$100,188** | | | **$244,904** |
| | **4: Roadways and Concrete - New Construction** | | | | **$8,318,892** | | | **$3,940,528** | | | **$9,632,401** |
| | **5: Sturgeon River Bridge** | | | | **$7,600,000** | | | **$0** | | | **$0** |
| | **6: Pavement Markings and Signing - Supply and Install** | | | | **$7,600** | | | **$3,600** | | | **$8,800** |
| | **7: Street Lighting** | | | | **$1,124,800** | | | **$532,800** | | | **$1,302,400** |
| | | **Subtotal:** | | | **$20,441,378** | | | **$6,082,758** | | | **$14,868,964** |
| | **Mob & Demob** | | *5%* | | **$1,022,069** | | | **$304,138** | | | **$743,448** |
| | **Contingency** | | *15%* | | **$3,066,207** | | | **$912,414** | | | **$2,230,345** |
| | **Engineering** | | *10%* | | **$2,044,138** | | | **$608,276** | | | **$1,486,896** |
| | **Total Preliminary Roadway Estimate:** | | | | **$26,573,791** | | | **$7,907,585** | | | **$19,329,653** |

### 3.3 Widening from Six to Eight-Lanes

An additional lane is added to the inside in both directions in this stage. Additional work includes:

- Curb and gutter removal
- New Jersey Barrier and asphalt swale
- Drainage CB lead extension and CB removal and replacement
- Widen road pavement structure
- Adding double davits in centre barrier
- Sturgeon bridge widening
- Grading for widening.

The following table identifies additional costs to expand to an 8-lane cross-section.

# Preliminary Roadway Cost Estimate for Ray Gibbon Drive

## Scenario V 8 Lane Stage (Add Northbound and Southbound Median Lanes)

From 137 Avenue to Station 14+600

| | | | Stage I | | | Stage II | | | Stage III Expanded | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Item No | Description | Unit Price | Approx. Quantity | Unit | Amount | Approx. Quantity | Unit | Amount | Approx. Quantity | Unit | Amount |
| **1: Storm Sewar & Drainage** | | | | | | | | | | | |
| 1.01 | 1200mm Catch Basin Manhole | $3,700.00 | 34.96 | No. | $129,352 | 16.56 | No. | $61,272 | 40.48 | No. | $149,776 |
| 1.02 | Remove CB/MH and Leads | $5,000.00 | 34.96 | No. | $174,800 | 16.56 | No. | $82,800 | 40.48 | No. | $202,400 |
| 1.03 | 300mm Class IV Concrete Catchbasin Lead | $105.00 | 114 | m | $11,970 | 54 | m | $5,670 | 132 | m | $13,860 |
| | | **Total Part 1:** | | | **$316,122** | | | **$149,742** | | | **$366,036** |
| **2: Removals** | | | | | | | | | | | |
| 2.01 | Remove Curb and Gutter | $35.00 | 4,955 | m | $173,432 | 2,347 | m | $82,152 | 5,738 | m | $200,816 |
| | | **Total Part 2:** | | | **$173,432** | | | **$82,152** | | | **$200,816** |
| **3: Earthworks** | | | | | | | | | | | |
| 3.01 | Common Excavation Offsite (5+300 to 7+600) | $45.00 | 13351 | m3 | $600,791 | 0 | m3 | $0 | 0 | m3 | $0 |
| 3.02 | Strip & Stockpile Topsoil Station (5+300 to 7+600) | $30.00 | 3,262 | m3 | $97,860 | 0 | m3 | $0 | 0 | m3 | $0 |
| 3.03 | Common Excavation Offsite (7+600 to 10+000) | $45.00 | 0 | m3 | $0 | 23171 | m3 | $1,042,682 | 0 | m3 | $0 |
| 3.04 | Strip & Stockpile Topsoil Station (7+600 to 10+000) | $30.00 | 0 | m3 | $0 | 3,556 | m3 | $106,680 | 0 | m3 | $0 |
| 3.05 | Common Excavation Offsite (10+000 to 13+300) | $45.00 | 0 | m3 | $0 | 6396 | m3 | $287,820 | 42804 | m3 | $1,926,180 |
| 3.06 | Strip & Stockpile Topsoil Station (10+000 to 13+300) | $30.00 | 0 | m3 | $0 | 828 | m3 | $24,843 | 5,542 | m3 | $166,257 |
| 3.07 | Place 150mm topsoil | $3.00 | 4,408 | $m^2$ | $13,224 | 2,088 | $m^2$ | $6,264 | 5,104 | $m^2$ | $15,312 |
| 3.08 | Seeding | $1.50 | 4,408 | $m^2$ | $6,612 | 2,088 | $m^2$ | $3,132 | 5,104 | $m^2$ | $7,656 |
| | | **Total Part 3:** | | | **$718,487** | | | **$1,471,421** | | | **$2,115,405** |
| **4: Roadways and Concrete - New Construction** | | | | | | | | | | | |
| 4.01 | 300mm Cement Stabilized Subgrade | $27.00 | 31,114 | $m^2$ | $840,089 | 14,738 | $m^2$ | $397,937 | 36,027 | $m^2$ | $972,734 |
| 4.02 | 1000mm Bottom Ash | $70.00 | 10,051 | $m^2$ | $703,570 | 4,761 | $m^2$ | $333,270 | 11,638 | $m^2$ | $814,660 |
| 4.03 | 400mm of 20mm Granular Base Course | $66.00 | 41,165 | $m^2$ | $2,716,916 | 19,499 | $m^2$ | $1,286,960 | 47,665 | $m^2$ | $3,145,903 |
| 4.04 | 180mm of 25mm Asphalt Base | $83.00 | 39,376 | $m^2$ | $3,268,175 | 18,652 | $m^2$ | $1,548,083 | 45,593 | $m^2$ | $3,784,202 |
| 4.05 | 50mm of 12.5mm Asphalt Surface | $28.00 | 39,376 | $m^2$ | $1,102,517 | 18,652 | $m^2$ | $522,245 | 45,593 | $m^2$ | $1,276,598 |
| 4.06 | Install Jersey barrier in median | $350.00 | 2,424 | m | $848,540 | 1,148 | m | $401,940 | 2,807 | m | $982,520 |
| | | **Total Part 4:** | | | **$9,479,807** | | | **$4,490,435** | | | **$10,976,618** |

## Preliminary Roadway Cost Estimate for Ray Gibbon Drive
### Scenario V 8 Lane Stage (Add Northbound and Southbound Median Lanes)
From 137 Avenue to Station 14+600

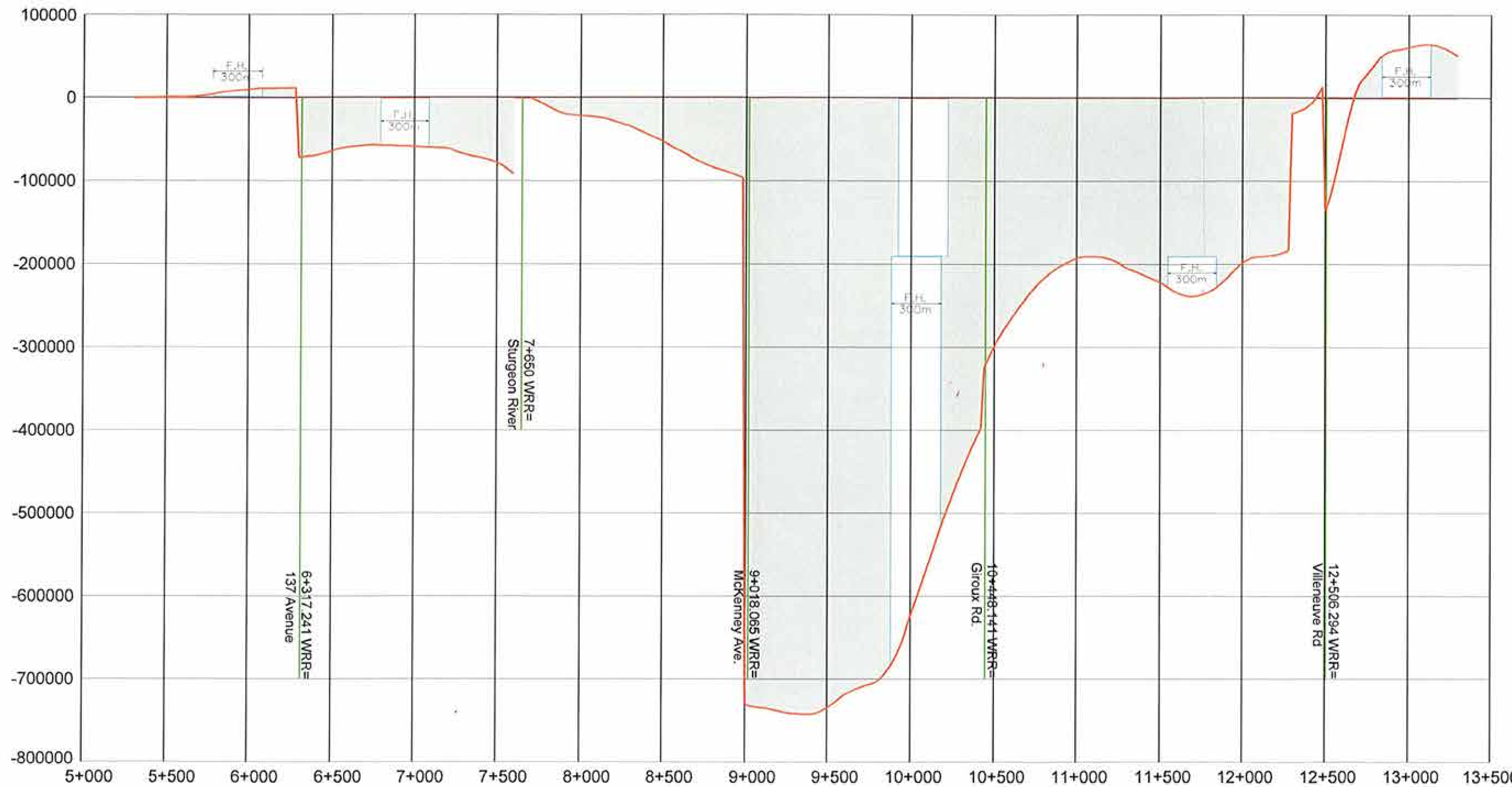
| | | | Stage I | | | Stage II | | | Stage III Expanded | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Item No | Description | Unit Price | Approx. Quantity | Unit | Amount | Approx. Quantity | Unit | Amount | Approx. Quantity | Unit | Amount |
| **5: Sturgeon River Bridge** | | | | | | | | | | | |
| 5.01 | Sturgeon River Bridge Modification | $3,600,000.00 | 1 | No. | $3,600,000 | 0 | No. | $0 | 0 | No. | $0 |
| | | **Total Part 5:** | | | **$3,600,000** | | | **$0** | | | **$0** |
| **6: Pavement Markings and Signing - Supply and Install** | | | | | | | | | | | |
| 6.01 | Roadway Lines Supply and Paint and painting (directional dividing and 2 edge lines) | $2,000.00 | 3.8 | km | $7,600 | 1.8 | km | $3,600 | 4.4 | km | $8,800 |
| | | **Total Part 6:** | | | **$7,600** | | | **$3,600** | | | **$8,800** |
| **7: Street Lighting** | | | | | | | | | | | |
| 7.01 | Supply & Install Double Davit Lighting in Center Median | $20,000.00 | 71.44 | No. | $1,428,800 | 33.84 | No. | $676,800 | 82.72 | No. | $1,654,400 |
| | | **Total Part 7:** | | | **$1,428,800** | | | **$676,800** | | | **$1,654,400** |

| Cost Summary | | Stage I | Stage II | Stage III Expanded |
|---|---|---|---|---|
| 1: Storm Sewar & Drainage | | $316,122 | $149,742 | $366,036 |
| 2: Removals | | $173,432 | $82,152 | $200,816 |
| 3: Earthworks | | $718,487 | $1,471,421 | $2,115,405 |
| 4: Roadways and Concrete - New Construction | | $9,479,807 | $4,490,435 | $10,976,618 |
| 5: Sturgeon River Bridge | | $3,600,000 | $0 | $0 |
| 6: Pavement Markings and Signing - Supply and Install | | $7,600 | $3,600 | $8,800 |
| 7: Street Lighting | | $1,428,800 | $676,800 | $1,654,400 |
| Subtotal: | | $15,724,247 | $6,874,149 | $15,322,075 |
| Mob & Demob | *5%* | $786,212 | $343,707 | $766,104 |
| Contingency | *15%* | $2,358,637 | $1,031,122 | $2,298,311 |
| Engineering | *10%* | $1,572,425 | $687,415 | $1,532,208 |
| **Total Preliminary Roadway Estimate:** | | **$20,441,521** | **$8,936,394** | **$19,918,698** |

# APPENDIX I

# Appendix I

## Mass Haul Diagram




ISL Engineering and Land Services

Free Haul F.H.

Over Haul

SCALE 1:25 000

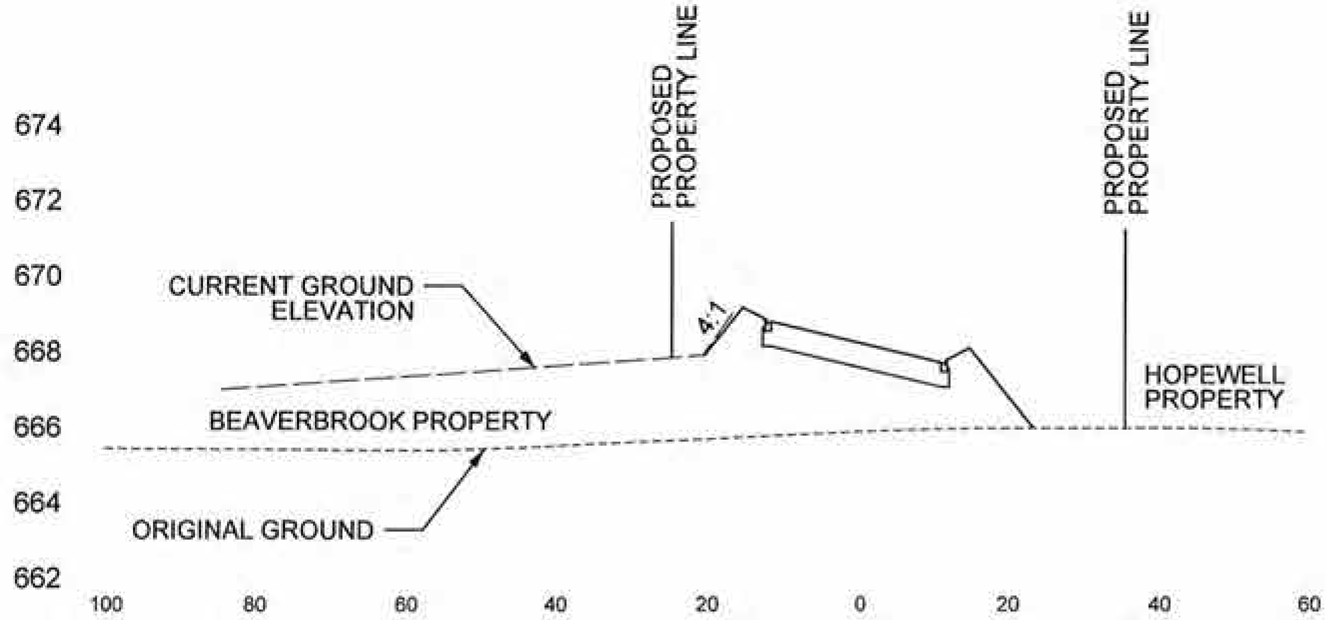
The City of St. Albert

| | |
|---|---|
| Project | Ray Gibbon Drive |
| Title | Masshaul Diagram<br>Functional Planning Study |
| Figure No. | 12436 MH 01 |

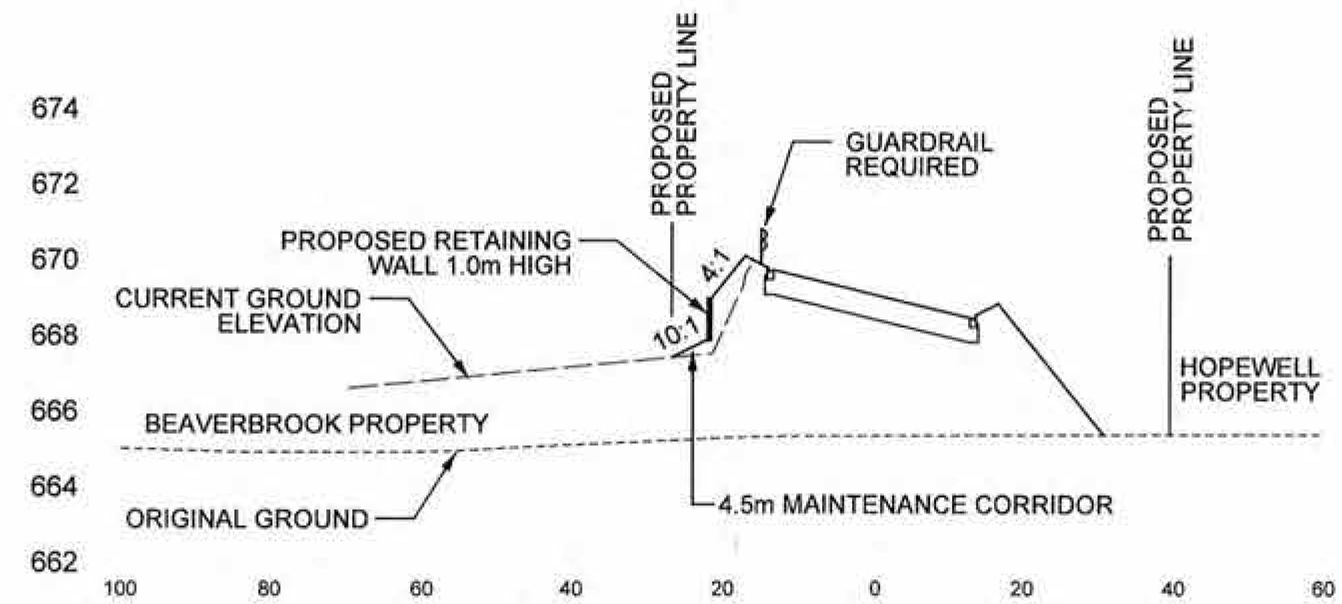
APPENDIX J

# Appendix J

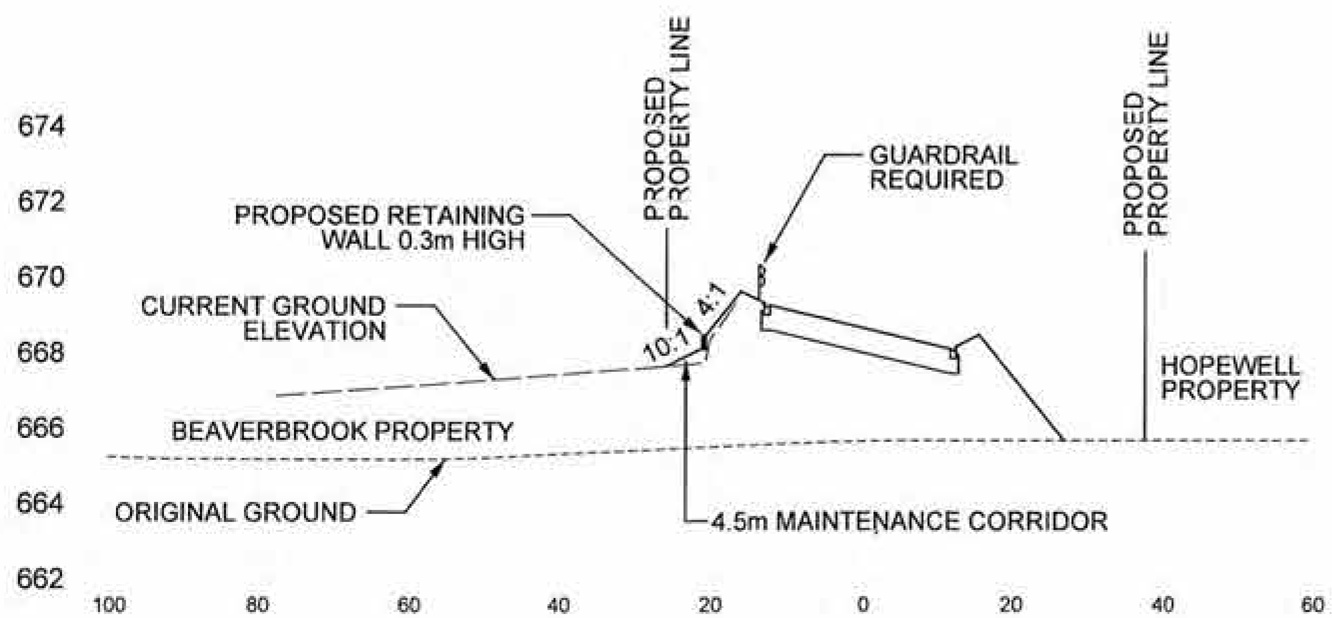
## Cross Sections



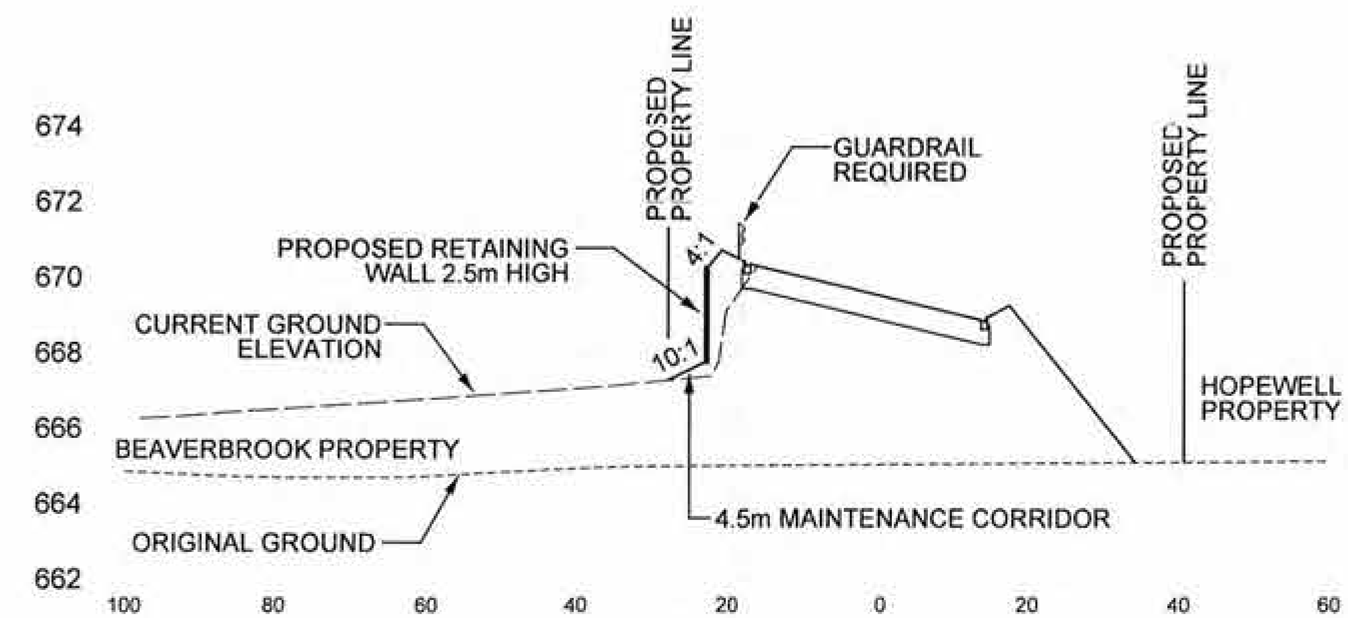

5+860.000 (NEAR RIEL DRIVE)
LOOKING EAST




5+820.000
LOOKING EAST




5+840.000
LOOKING EAST




5+800.000
LOOKING EAST

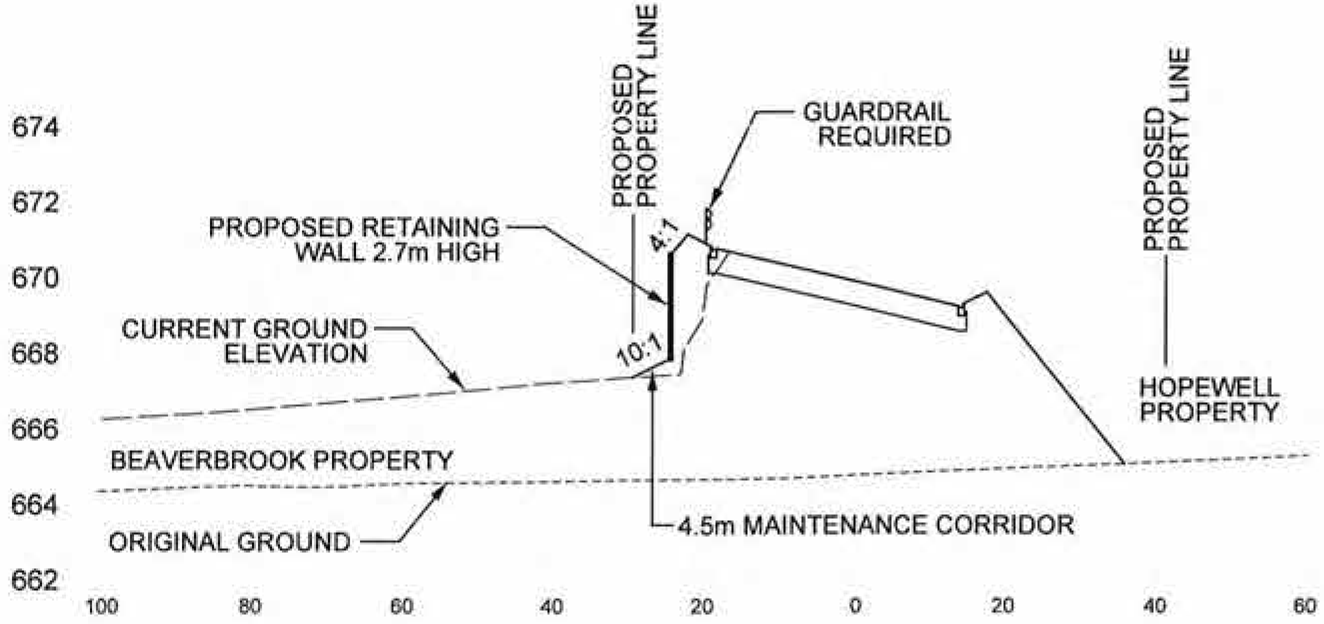
ISL Engineering and Land Services

NOTE:
THE PROPOSED WALL HEIGHT IS BASED ON THE GROUND ELEVATIONS PROVIDED TO ISL ON SEPTEMBER 4, 2008.

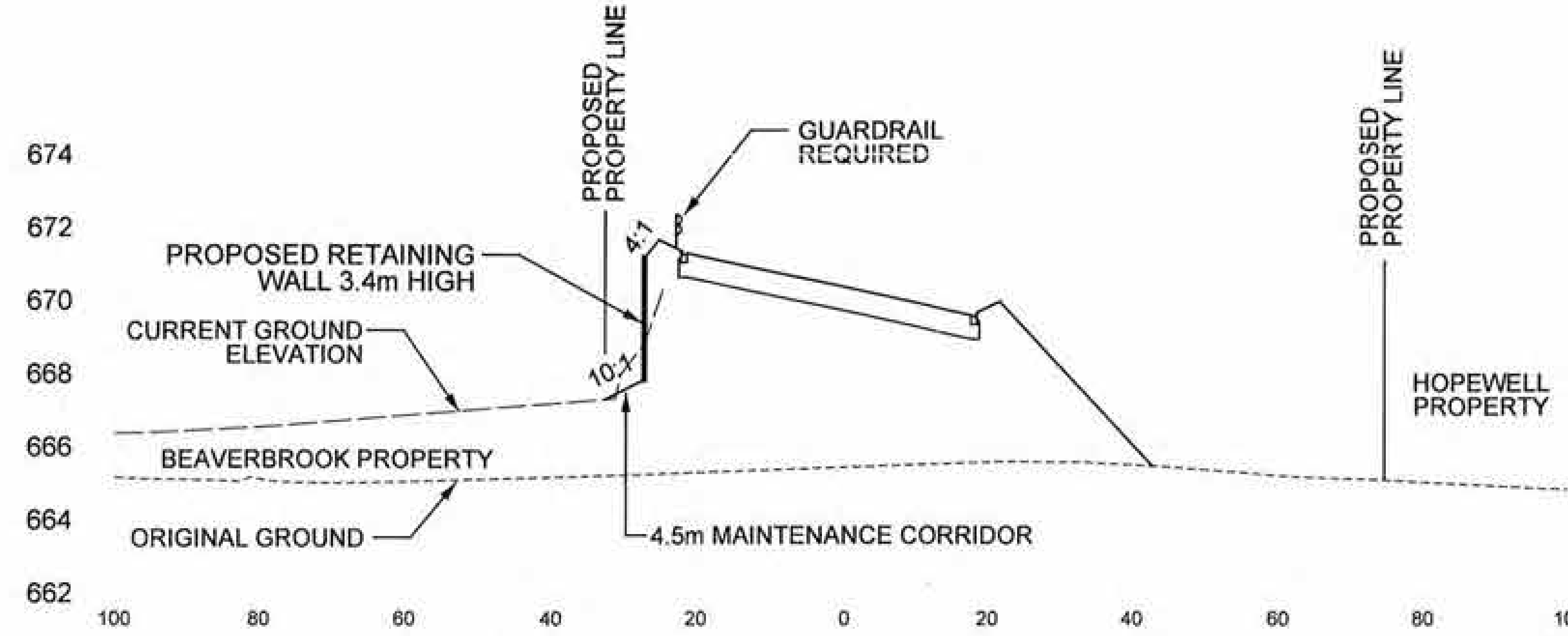
SCALE 1:125
1.0m 0 1.25m 2.5m

THE CITY OF St. Albert

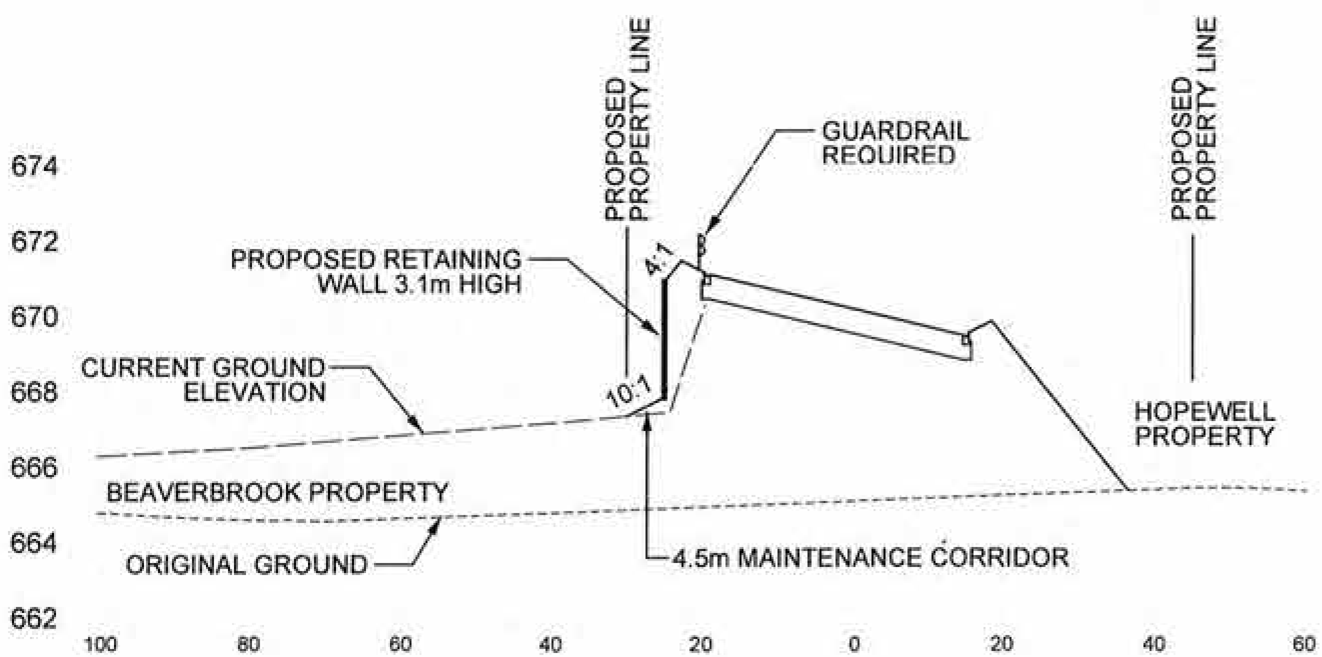
| | |
|---|---|
| Project | Ray Gibbon Drive FPS |
| Title | 137 Avenue Detailed Cross Sections |
| Figure No. | Exhibit DX01 |



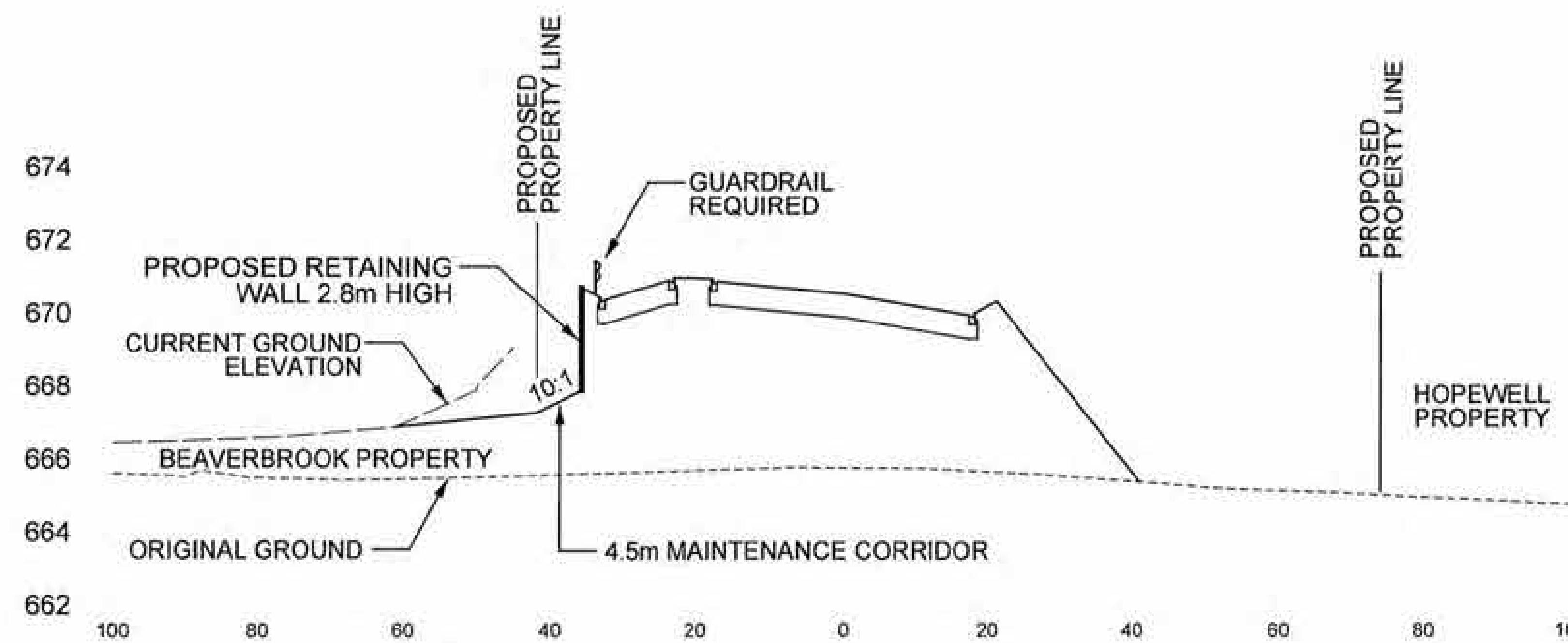

5+780.000
LOOKING EAST




5+740.000 (NEAR RAY GIBBON DRIVE)
LOOKING EAST




5+760.000
LOOKING EAST




5+720.000 (RIGHT-TURN CUT-OFF)
LOOKING EAST

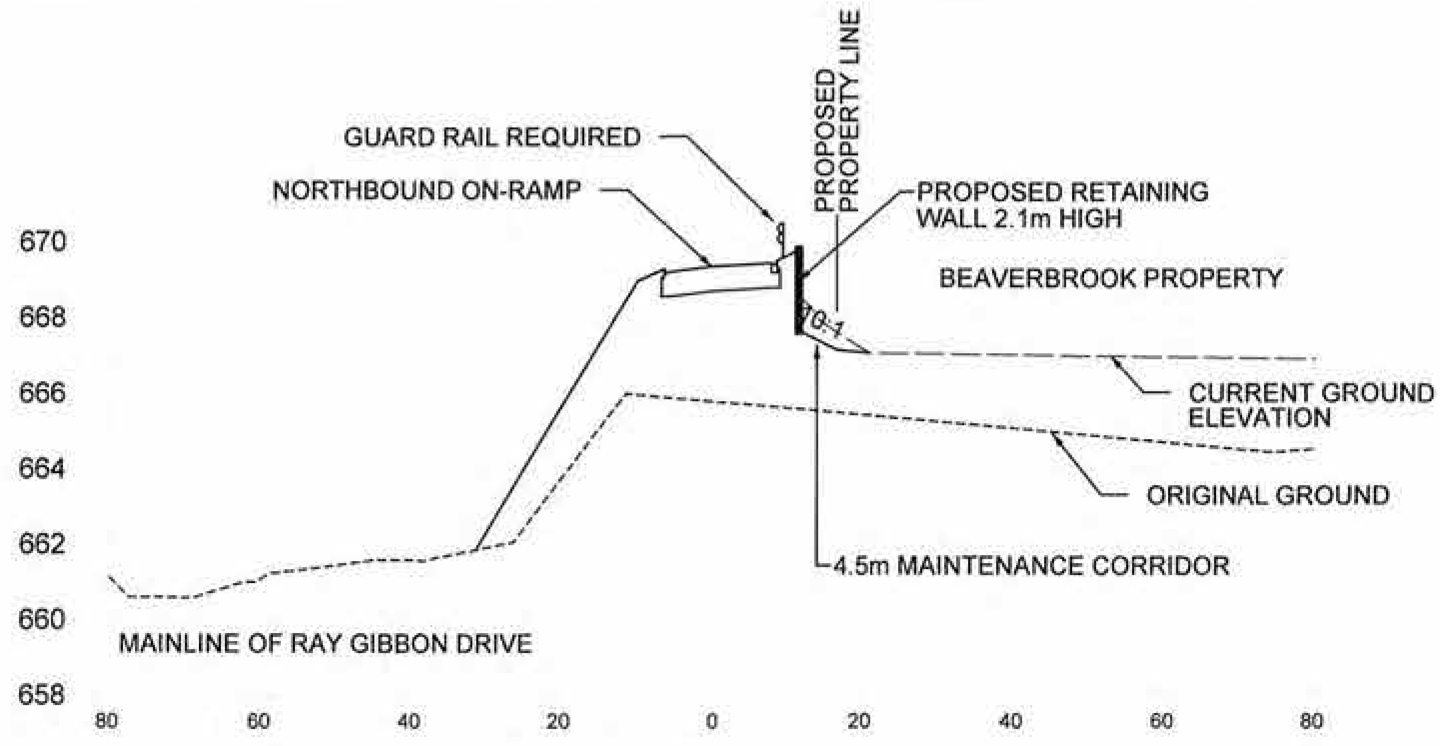
ISL Engineering and Land Services

NOTE:
THE PROPOSED WALL HEIGHT IS BASED ON THE GROUND ELEVATIONS PROVIDED TO ISL ON SEPTEMBER 4, 2008.

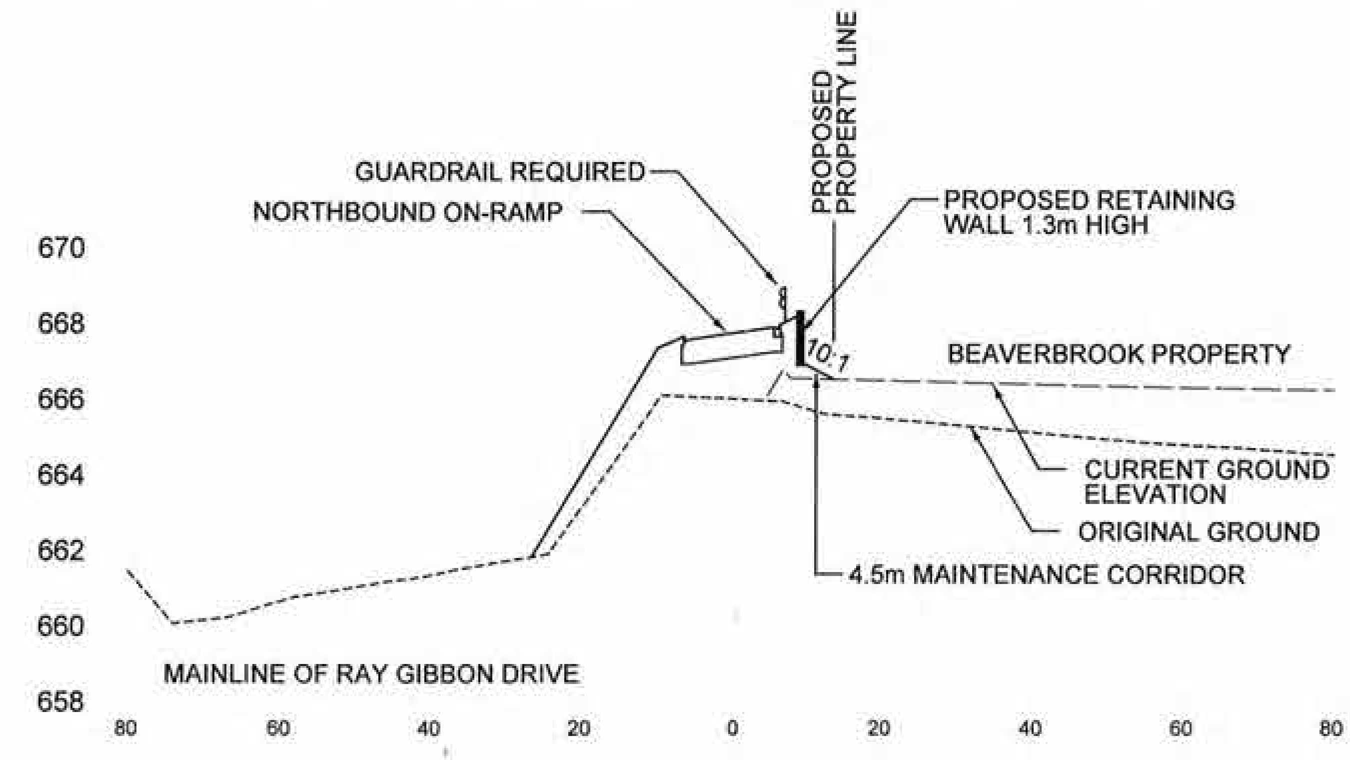
SCALE 1:125
1.0m 0 1.25m 2.5m

THE CITY OF St. Albert

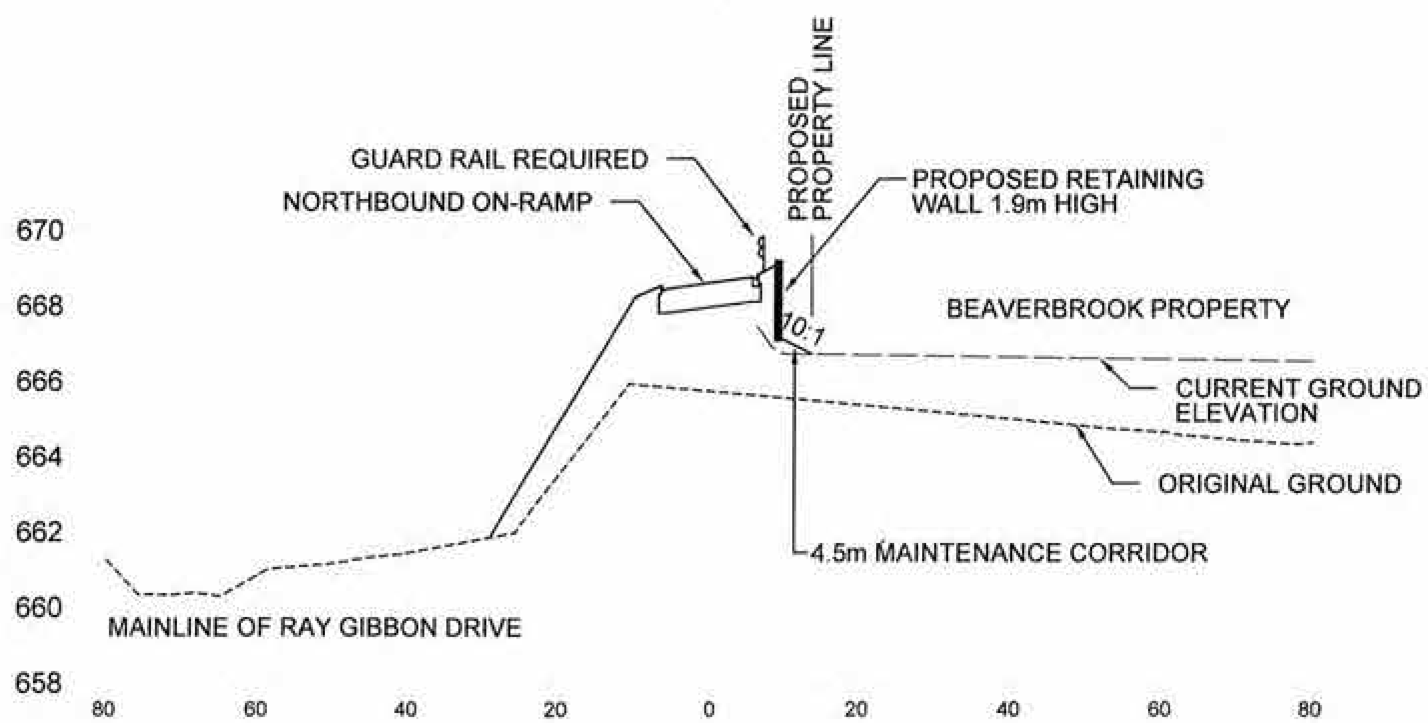
| | |
|---|---|
| Project | Ray Gibbon Drive FPS |
| Title | 137 Avenue Detailed Cross Sections |
| Figure No. | Exhibit DX02 |



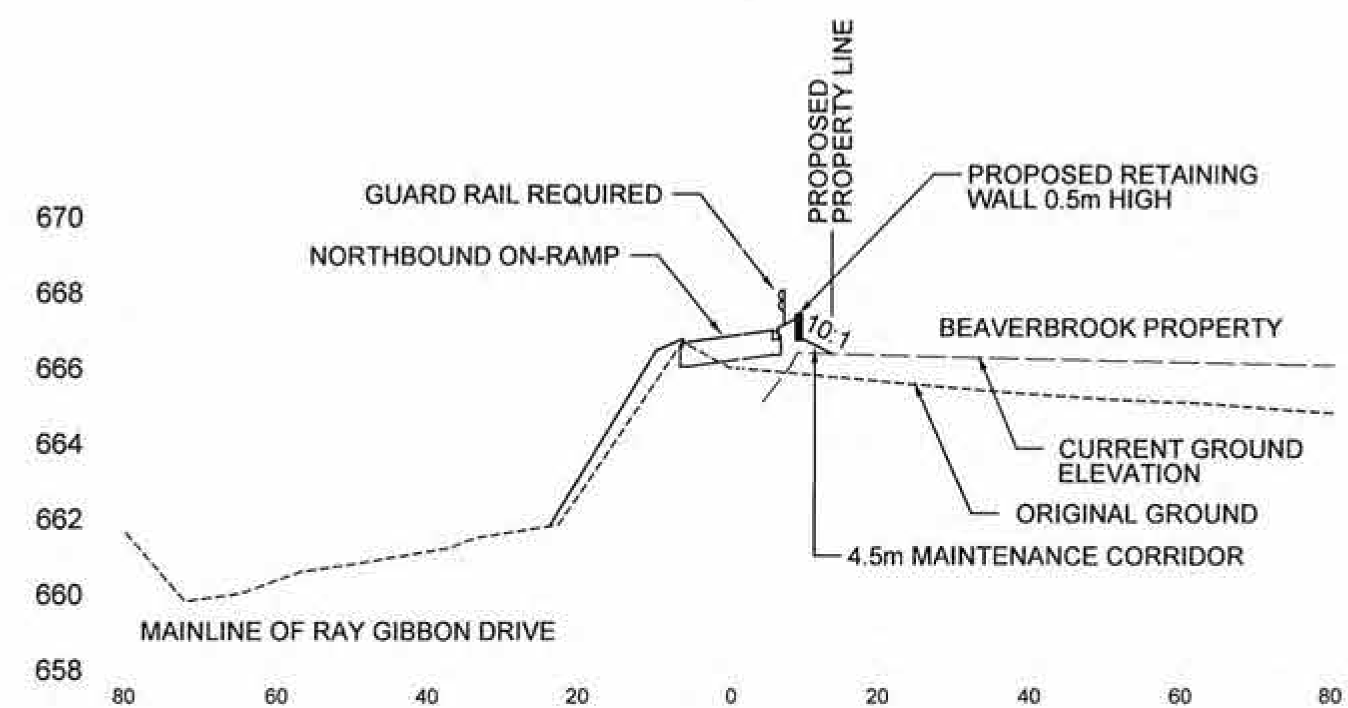

16+360.000 (NEAR 137 AVENUE)
LOOKING NORTH




16+400.000
LOOKING NORTH




16+380.000
LOOKING NORTH




16+420.000
LOOKING NORTH

ISL Engineering and Land Services

NOTE:
THE PROPOSED WALL HEIGHT IS BASED ON THE GROUND ELEVATIONS PROVIDED TO ISL ON SEPTEMBER 4, 2008.

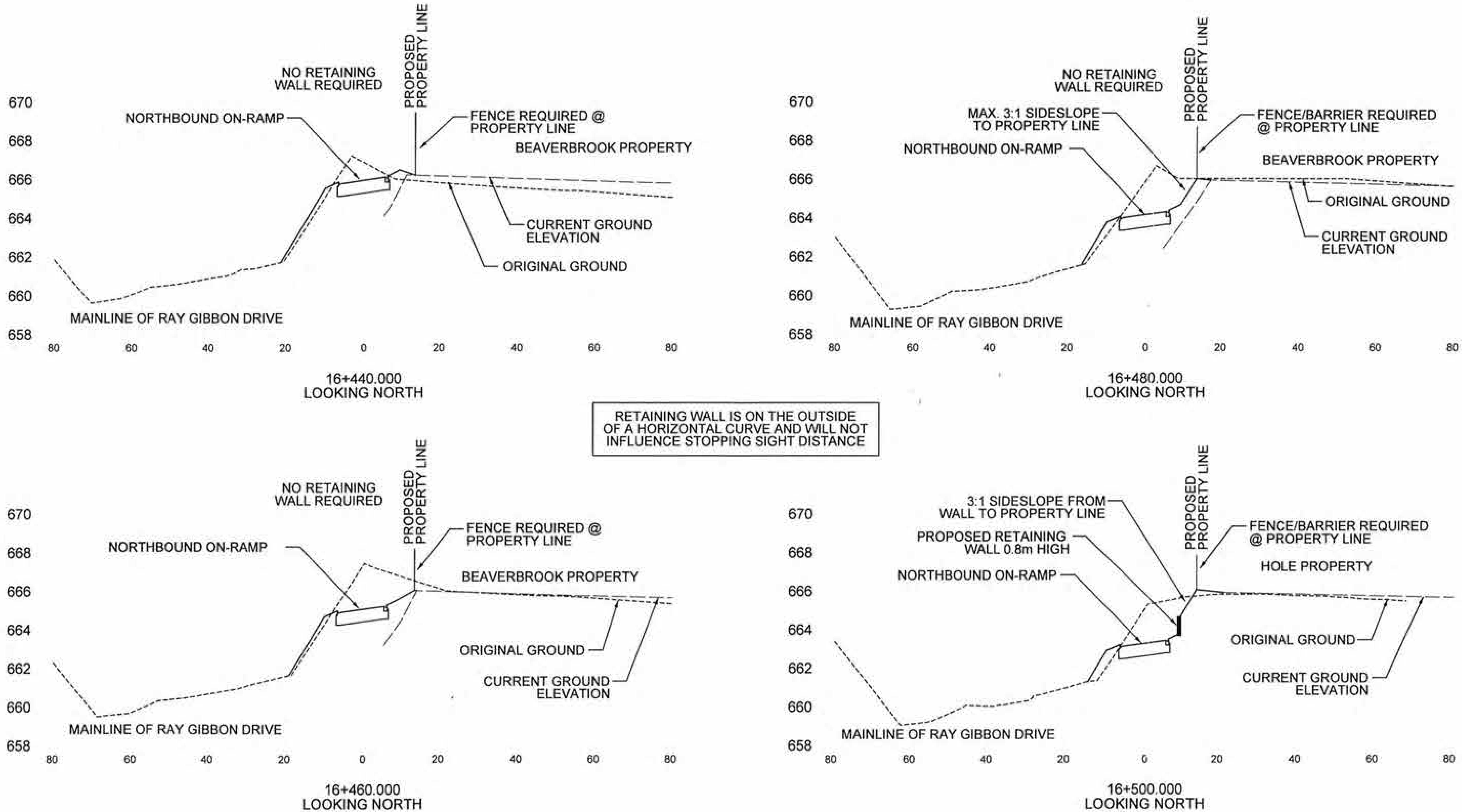
SCALE 1:250
1.0m 0 2.5m 5m

THE CITY OF St. Albert

Project: Ray Gibbon Drive FPS

Title: Northbound Ramp Detailed Cross Sections

Figure No.: Exhibit DX03



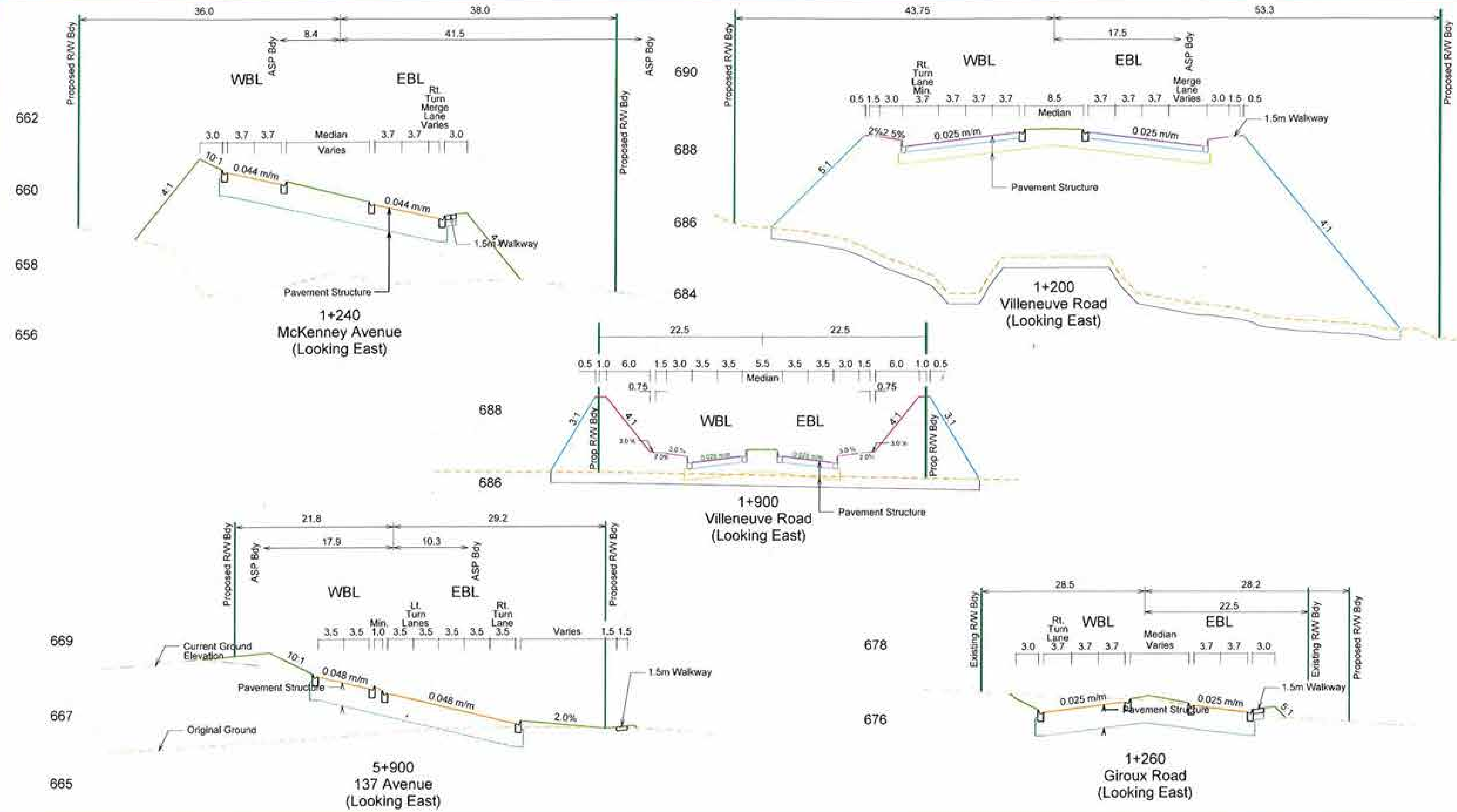

ISL Engineering and Land Services

NOTE:
THE PROPOSED WALL HEIGHT IS BASED ON THE GROUND ELEVATIONS PROVIDED TO ISL ON SEPTEMBER 4, 2008.

SCALE 1:125
1.0m 0 1.25m 2.5m

THE CITY OF St. Albert

| | |
|---|---|
| Project | Ray Gibbon Drive FPS |
| Title | Northbound Ramp Detailed Cross Sections |
| Figure No. | Exhibit DX04 |

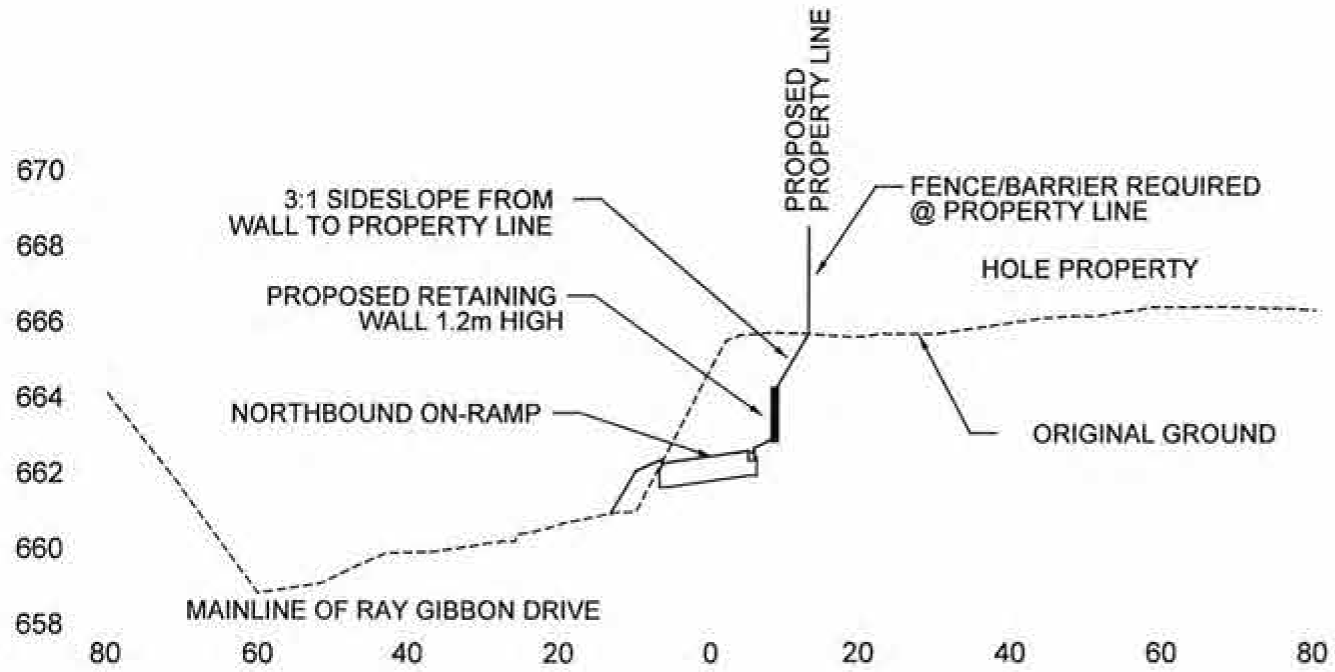



NOTE:
CITY ARTERIAL LANE WIDTHS TRANSITION FROM 3.7m TO 3.5m
BEYOND THE BRIDGE STRUCTURES

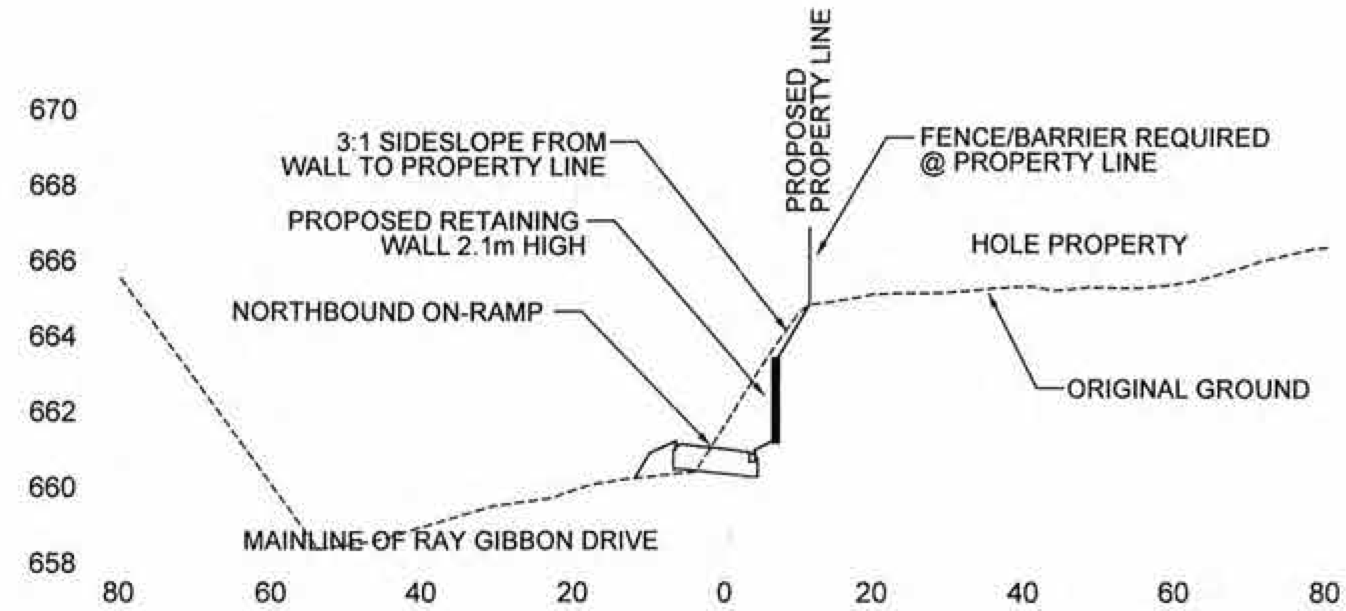
ISL Engineering and Land Services

City of St. Albert Engineering Services

| | |
|---|---|
| Project | Ray Gibbon Drive |
| Title | Functional Planning Study<br>Cross-sections |
| Figure No. | Exhibit X05 |

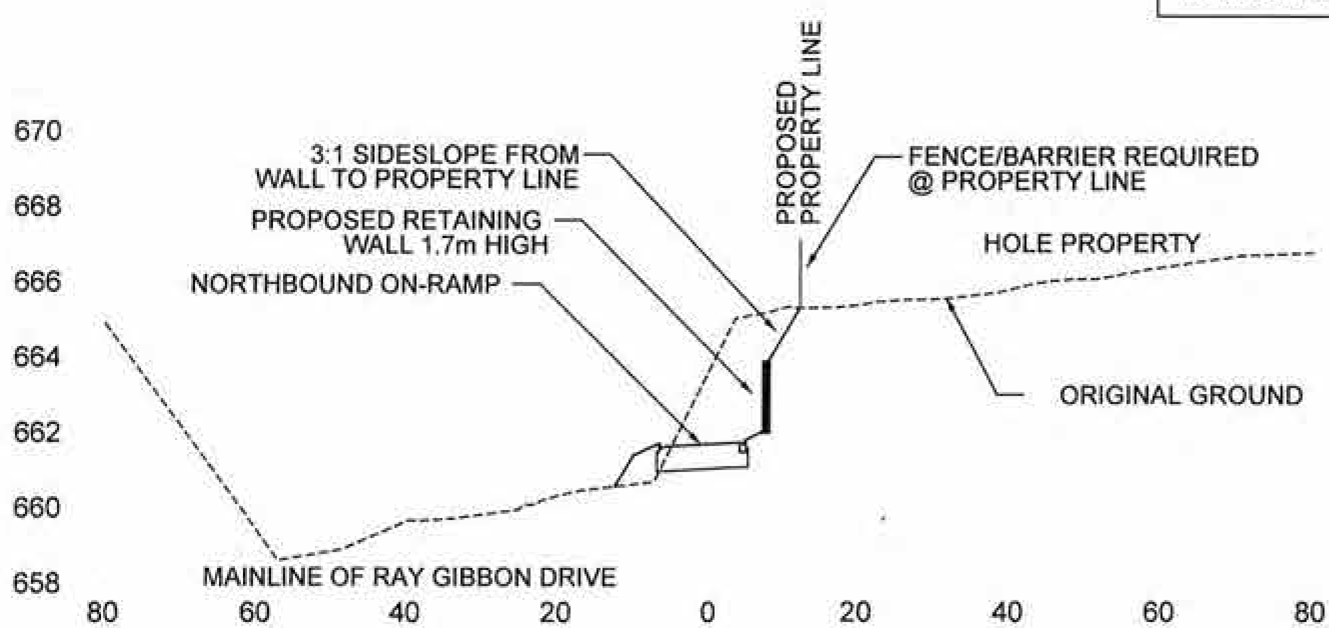



16+520.000
LOOKING NORTH

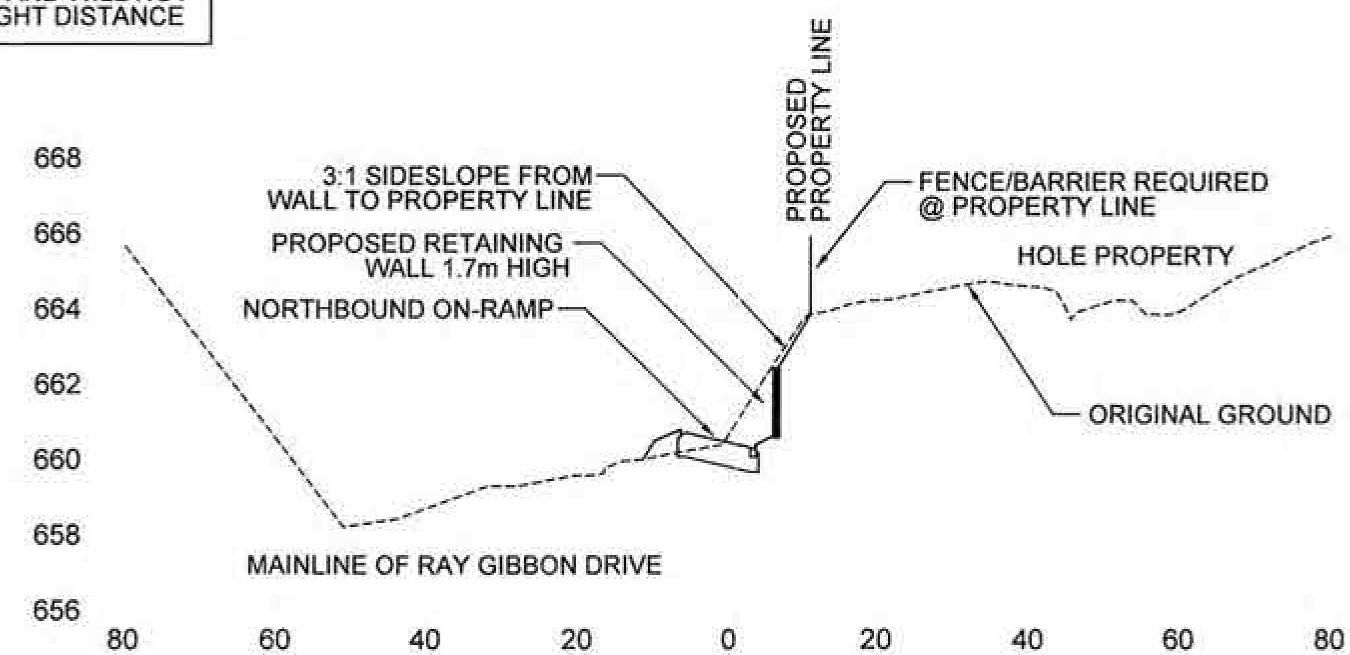



16+560.000
LOOKING NORTH

RETAINING WALL IS ON THE OUTSIDE OF A HORIZONTAL CURVE AND WILL NOT INFLUENCE STOPPING SIGHT DISTANCE




16+540.000
LOOKING NORTH




16+580.000
LOOKING NORTH

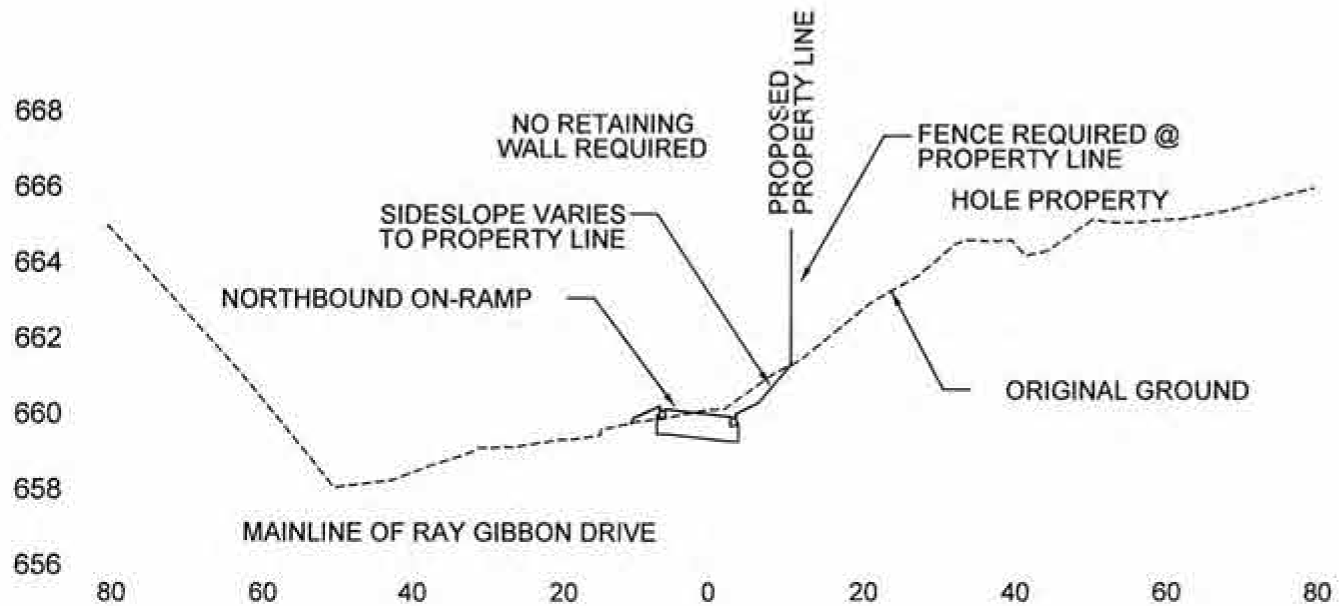
ISL Engineering and Land Services

NOTE:
THE PROPOSED WALL HEIGHT IS BASED ON THE GROUND ELEVATIONS PROVIDED TO ISL ON SEPTEMBER 4, 2008.

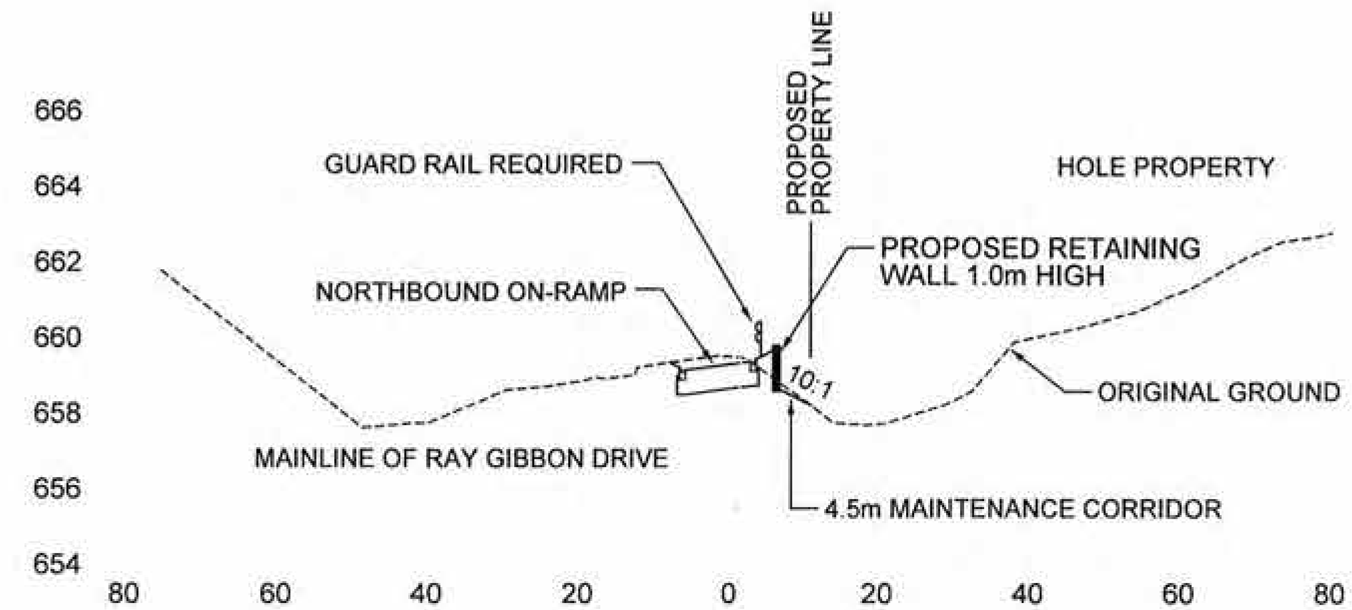
SCALE 1:125
1.0m 0 1.25m 2.5m

THE CITY OF St. Albert

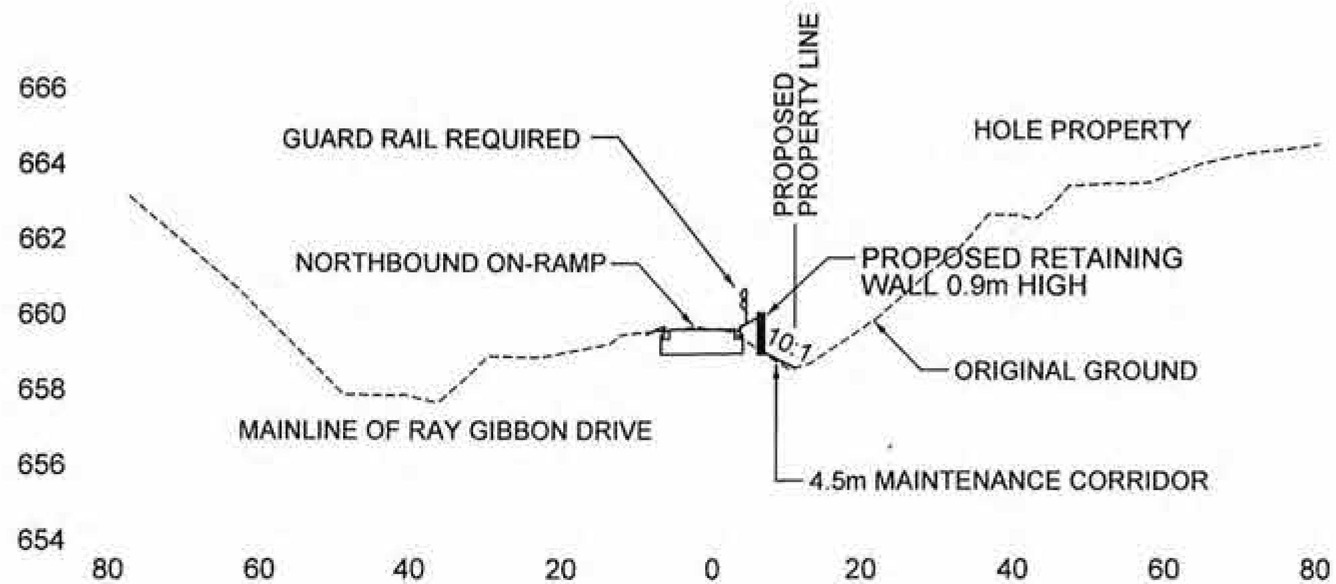
| | |
|---|---|
| Project | Ray Gibbon Drive FPS |
| Title | Northbound Ramp Detailed Cross Sections |
| Figure No. | Exhibit DX05 |



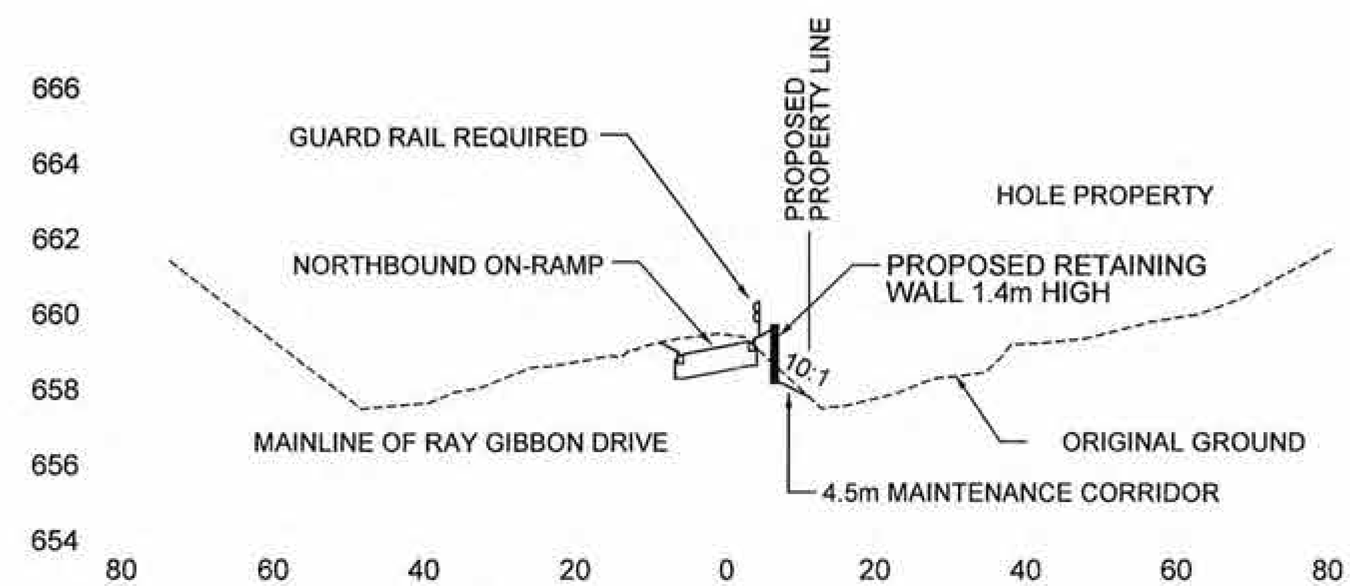

16+600.000
LOOKING NORTH




16+640.000
LOOKING NORTH




16+620.000
LOOKING NORTH




16+651.027 (ON-RAMP GORE)
LOOKING NORTH

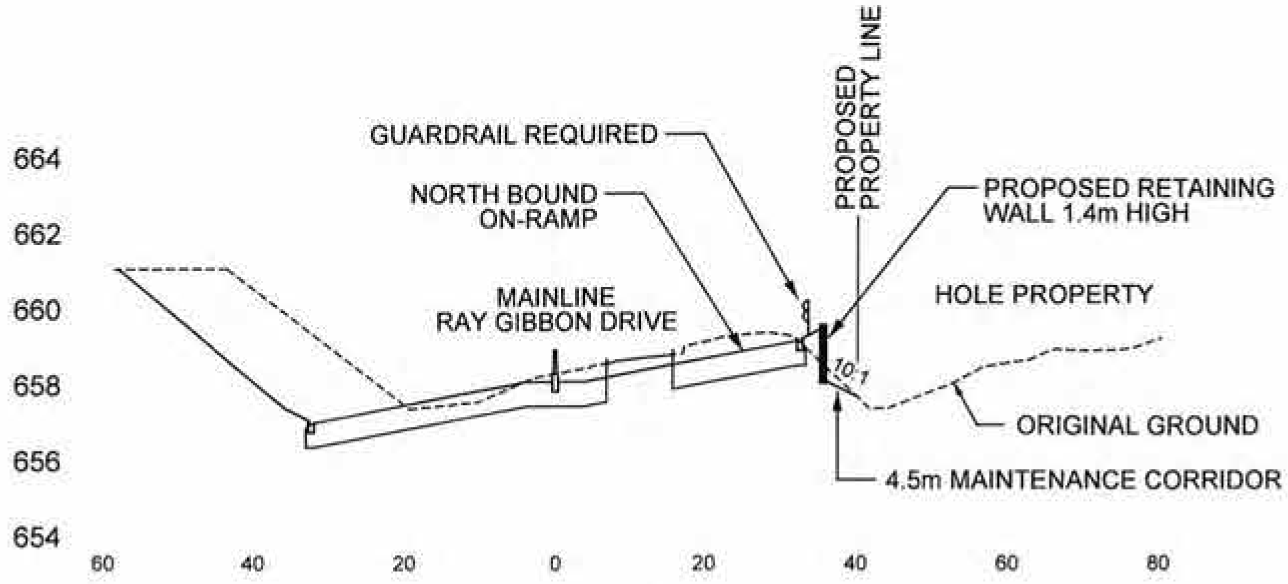
ISL Engineering and Land Services

NOTE:
THE PROPOSED WALL HEIGHT IS BASED ON THE GROUND ELEVATIONS PROVIDED TO ISL ON SEPTEMBER 4, 2008.

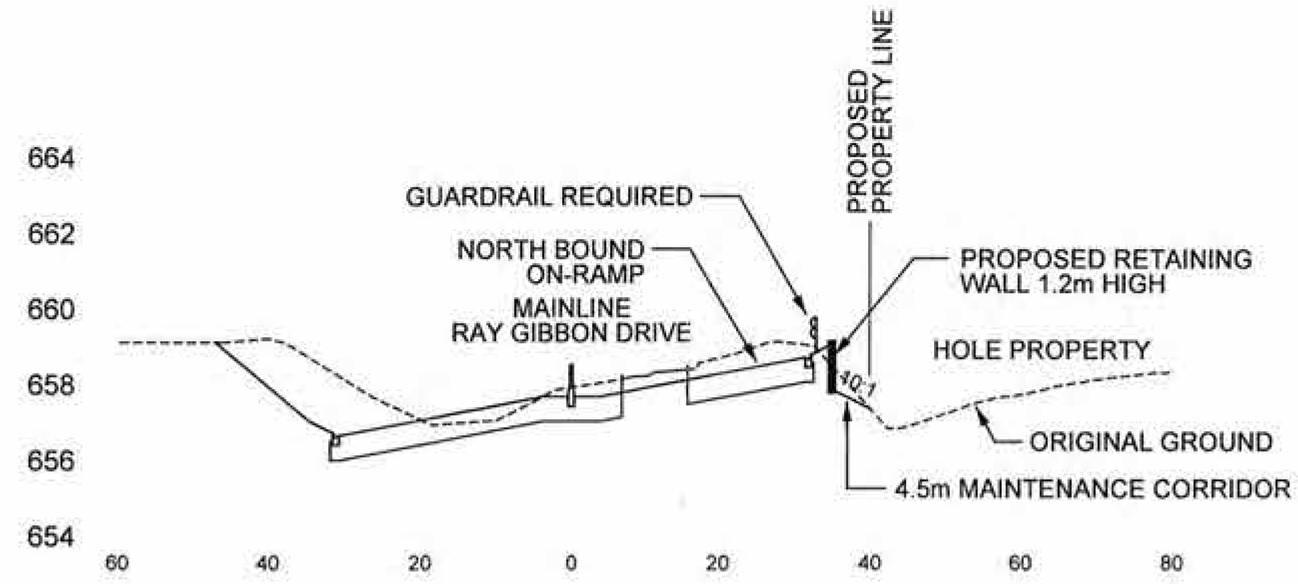
SCALE 1:125
1.0m 0 1.25m 2.5m

THE CITY OF St. Albert

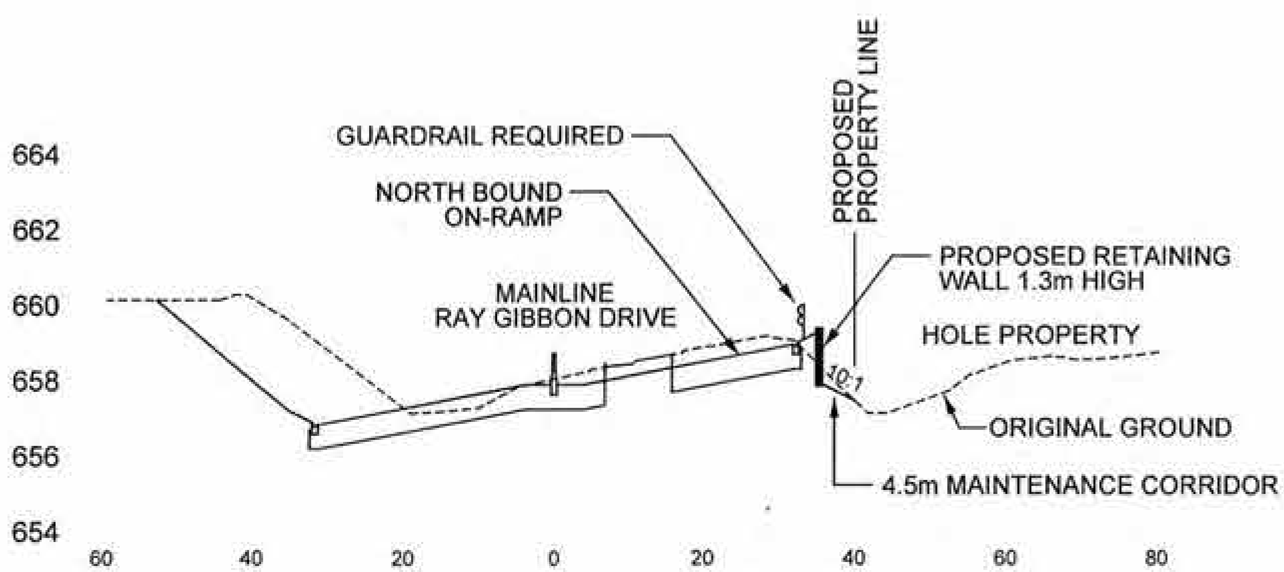
| | |
|---|---|
| Project | Ray Gibbon Drive FPS |
| Title | Northbound Ramp Detailed Cross Sections |
| Figure No. | Exhibit DX06 |



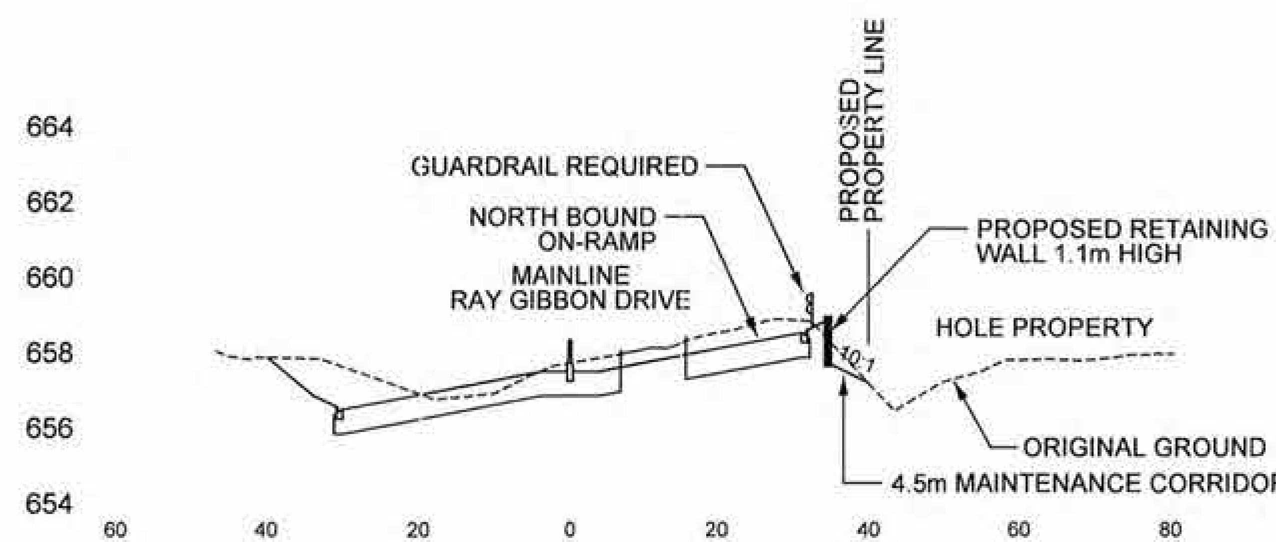

6+660.000 (NEAR ON-RAMP GORE)
LOOKING NORTH




6+700.000
LOOKING NORTH




6+680.000
LOOKING NORTH




6+720.000
LOOKING NORTH

ISL Engineering and Land Services

NOTE:
THE PROPOSED WALL HEIGHT IS BASED ON THE GROUND ELEVATIONS PROVIDED TO ISL ON SEPTEMBER 4, 2008.

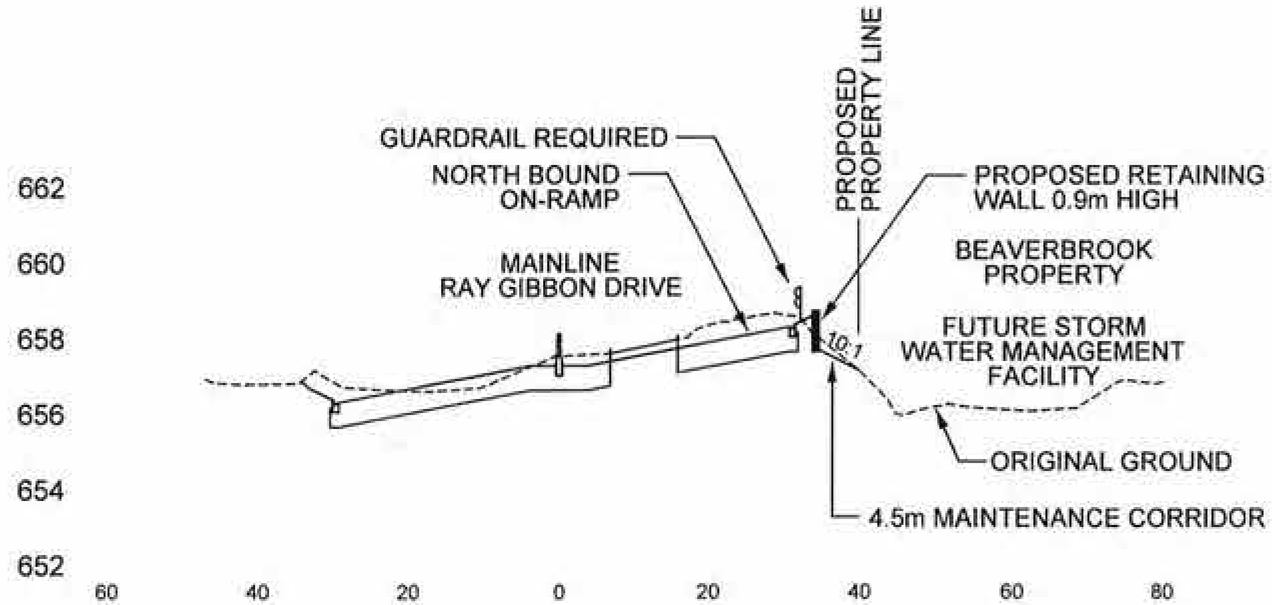
SCALE 1:125
1.0m 0 1.25m 2.5m

THE CITY OF St. Albert

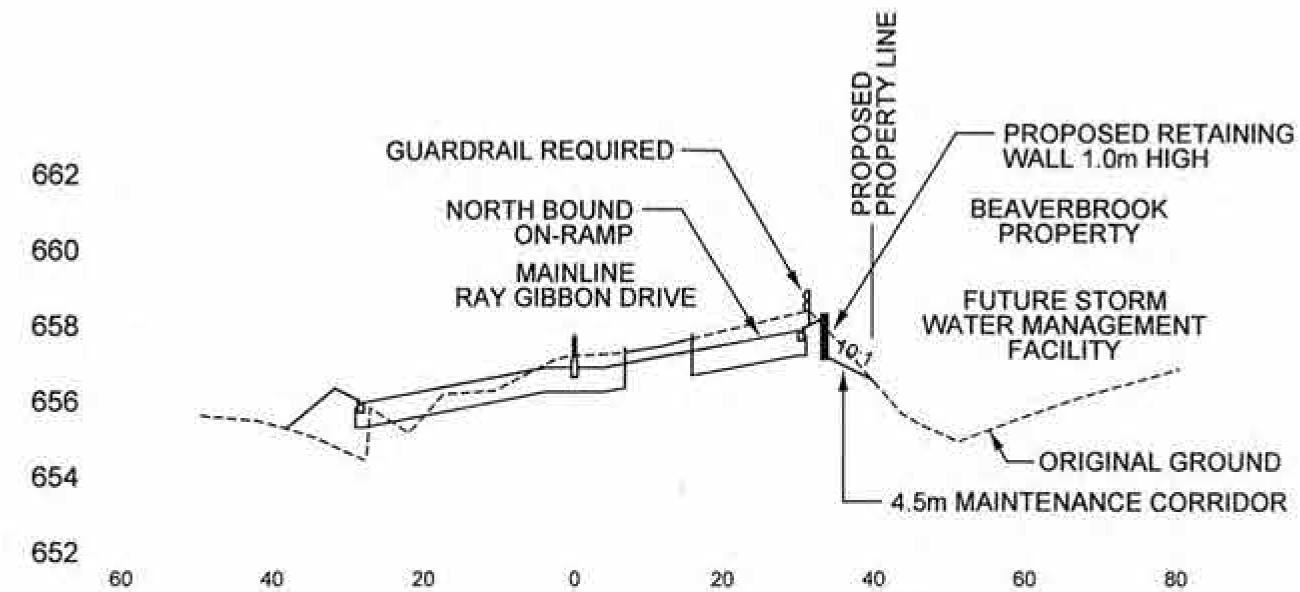
Project: Ray Gibbon Drive FPS

Title: Ray Gibbon Drive Detailed Cross Sections

Figure No.: Exhibit DX07

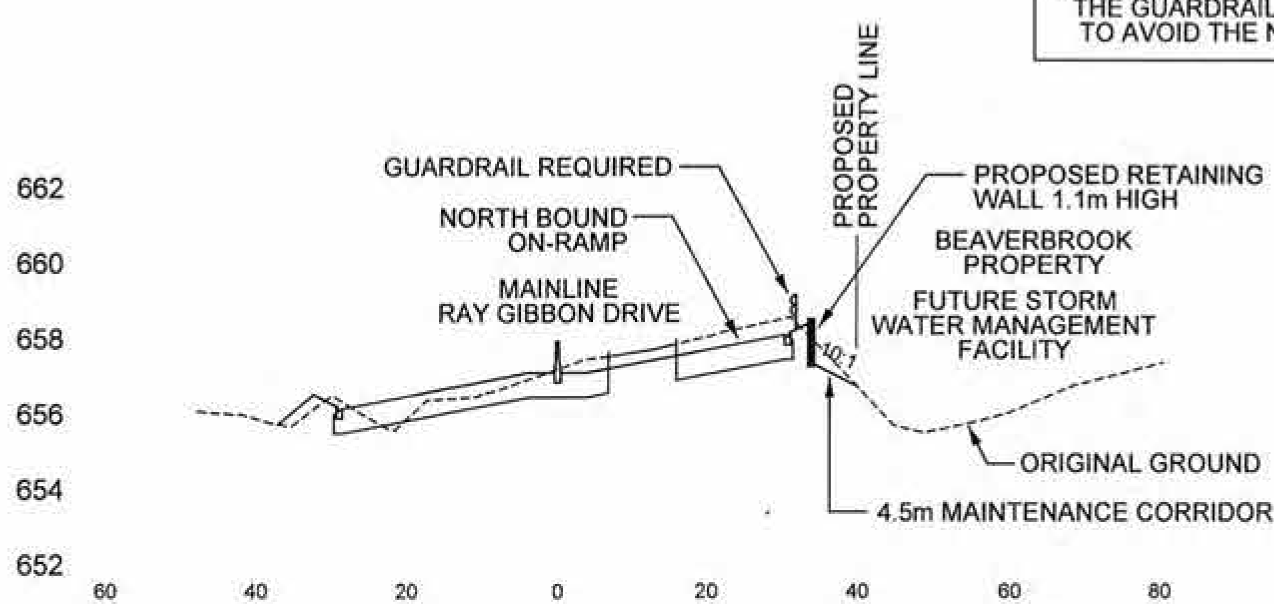



6+740.000
LOOKING NORTH

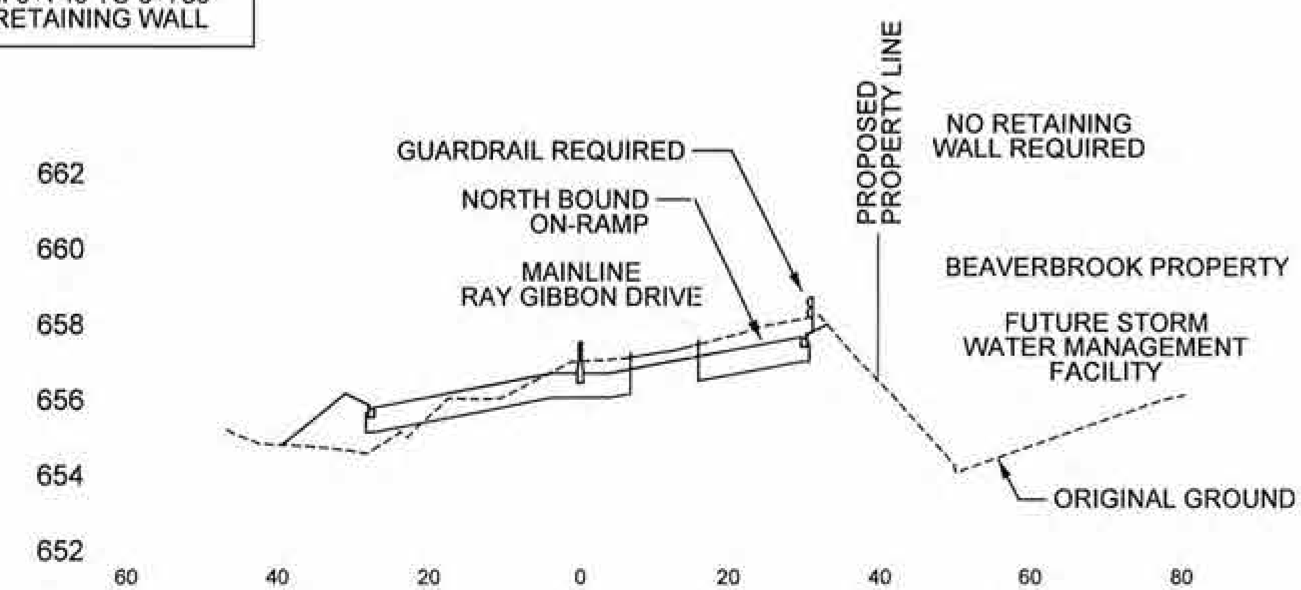



6+780.000
LOOKING NORTH

PROPOSE REGRADING THE SIDESLOPE BEHIND THE GUARDRAIL TO 4:1 FROM 6+740 TO 6+780 TO AVOID THE NEED FOR A RETAINING WALL




6+760.000
LOOKING NORTH




6+800.000
LOOKING NORTH

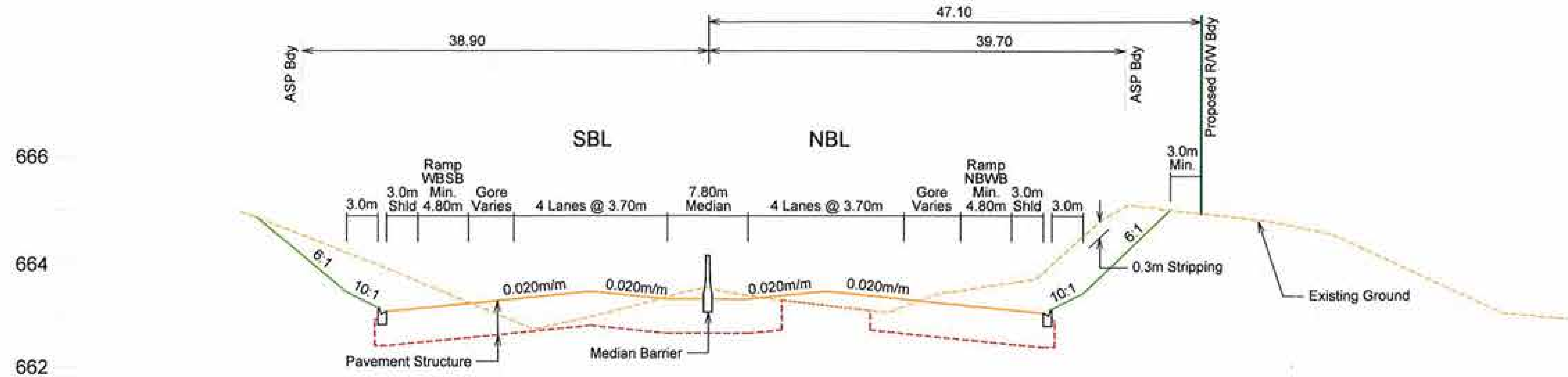
ISL Engineering and Land Services

NOTE:
THE PROPOSED WALL HEIGHT IS BASED ON THE GROUND ELEVATIONS PROVIDED TO ISL ON SEPTEMBER 4, 2008.

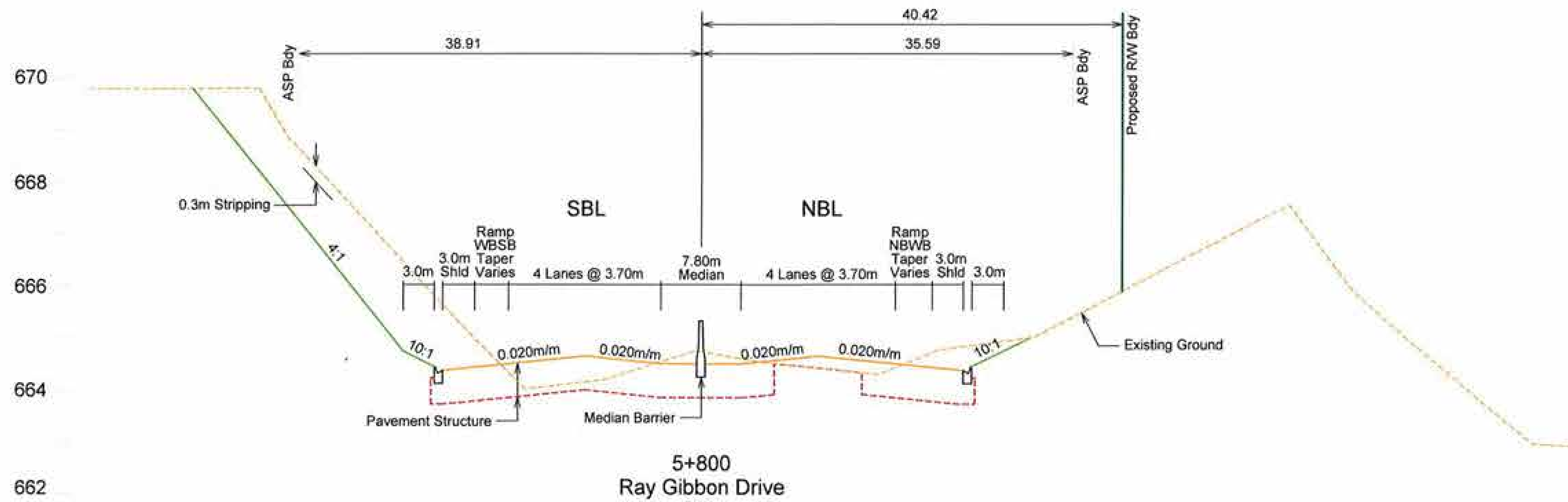
SCALE 1:125
1.0m 0 1.25m 2.5m

THE CITY OF St. Albert

| | |
|---|---|
| Project | Ray Gibbon Drive FPS |
| Title | Ray Gibbon Drive Detailed Cross Sections |
| Figure No. | Exhibit DX08 |




6+000
Ray Gibbon Drive




5+800
Ray Gibbon Drive

ISL Engineering and Land Services

SCALE 1:250 — HORIZONTAL

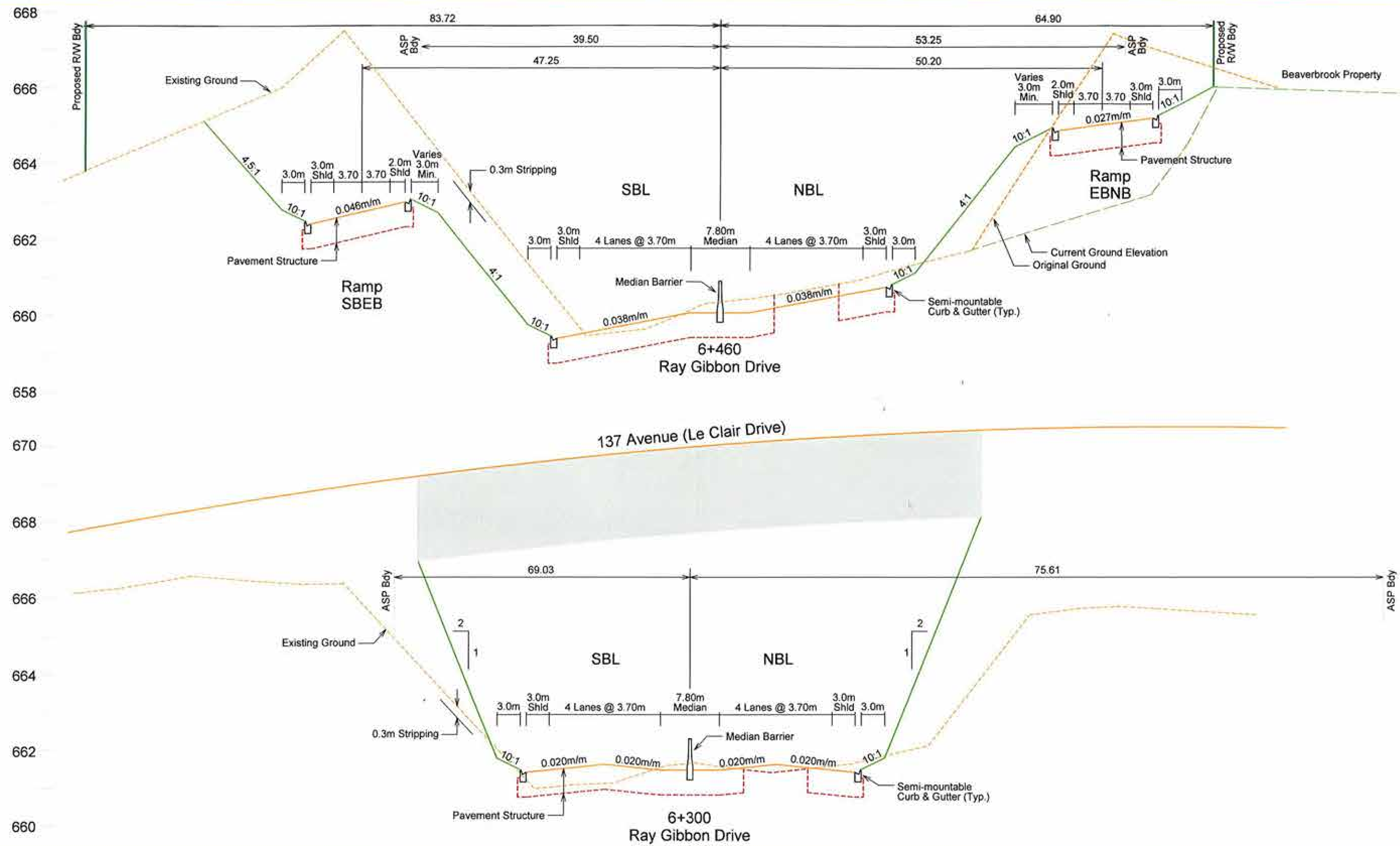
SCALE 1:50 — VERTICAL

THE CITY OF St. Albert

Project: Ray Gibbon Drive

Title: Functional Planning Study
Cross-sections

Figure No. Exhibit X01




ISL Engineering and Land Services

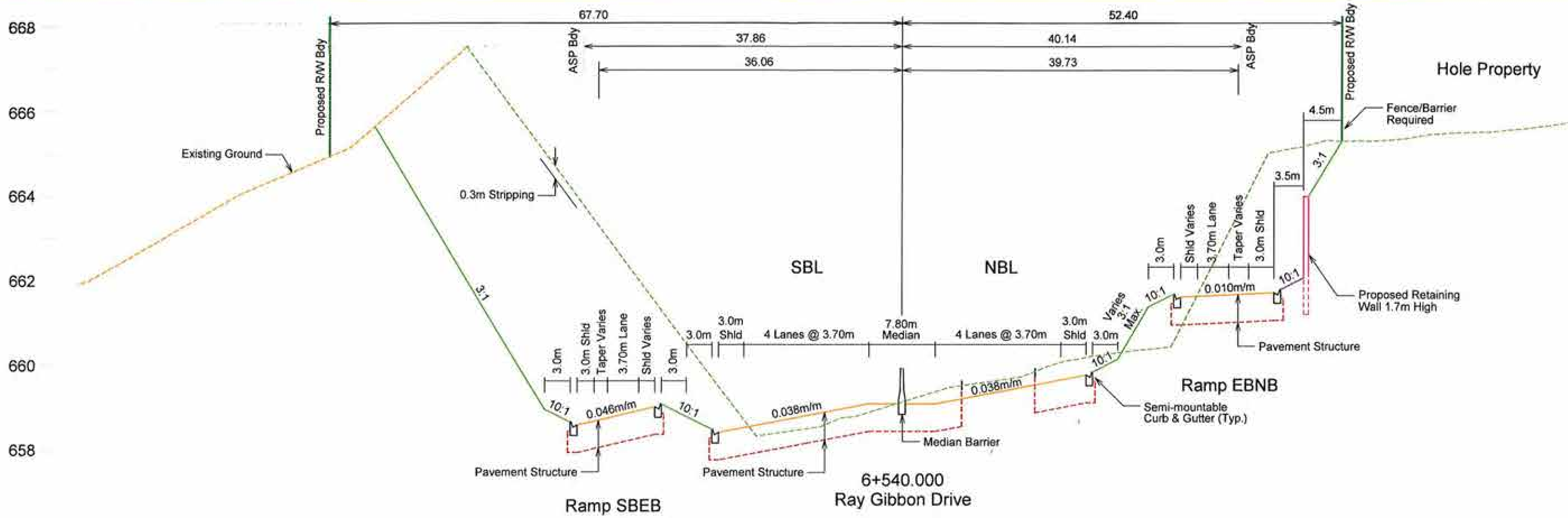
SCALE 1:250 HORIZONTAL
SCALE 1:50 VERTICAL

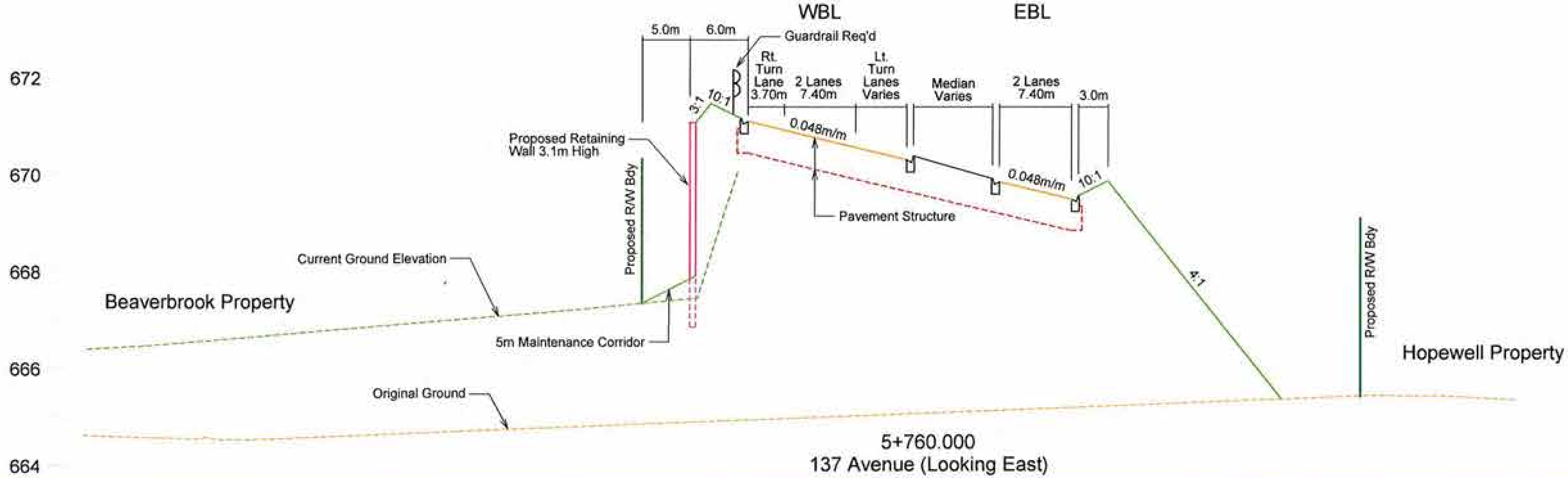
THE CITY OF St. Albert

Project: Ray Gibbon Drive

Title: Functional Planning Study Cross-sections

Figure No.: Exhibit X02




ISL Engineering and Land Services

NOTE:
THE PROPOSED WALL HEIGHT IS BASED ON THE GROUND ELEVATIONS PROVIDED TO ISL ON SEPTEMBER 4, 2008

RETAINING WALLS HAVE BEEN SHOWN FOR ILLUSTRATION PURPOSES ONLY AND WILL NEED TO BE DESIGNED PRIOR TO CONSTRUCTION

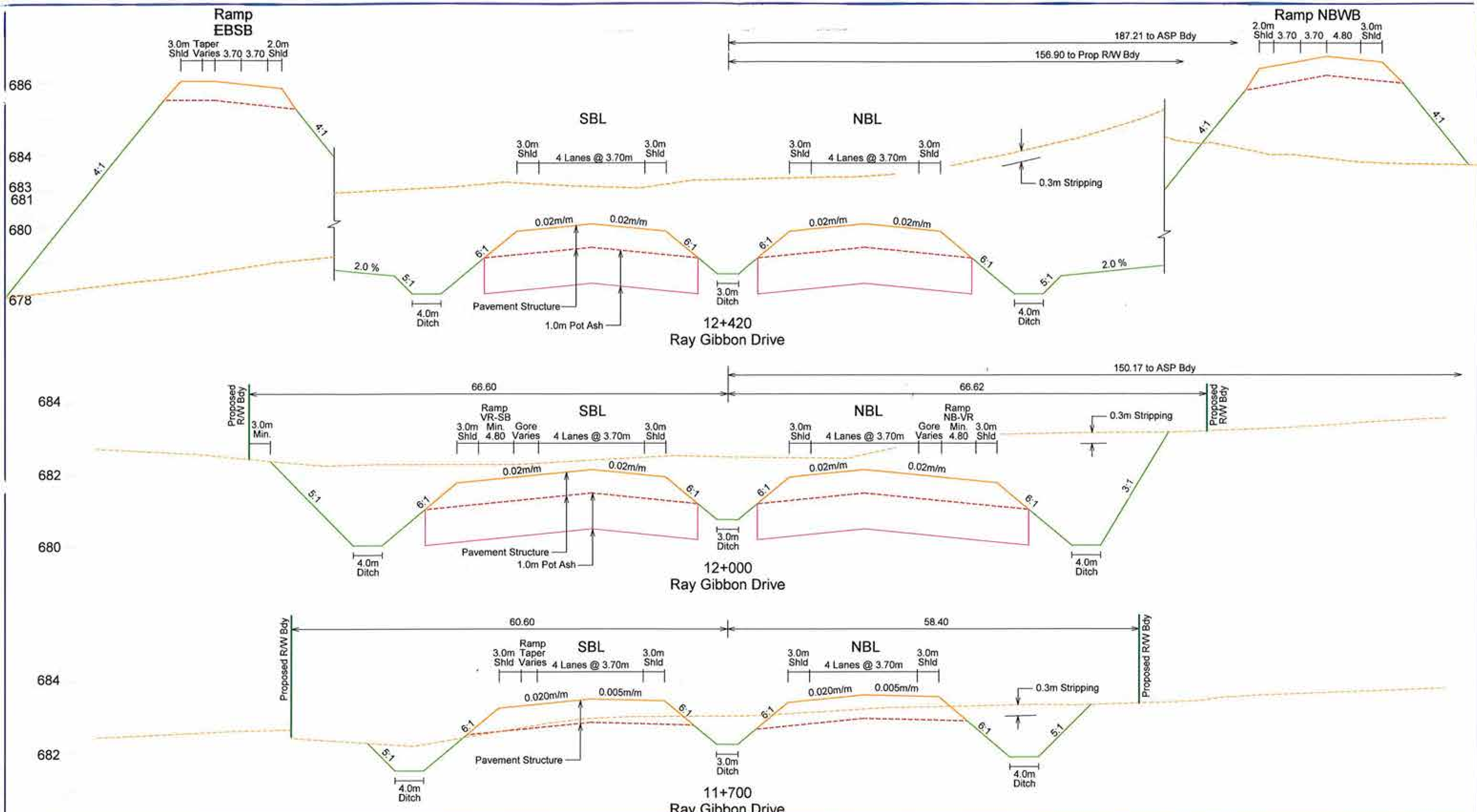
137 AVENUE LANE WIDTHS TRANSITION FROM 3.7m TO 3.5m BEYOND THE BRIDGE STRUCTURE

SCALE 1:250 — HORIZONTAL (5m, 0, 5m, 10m)

SCALE 1:50 — VERTICAL (1m, 0.5m, 0, 1m, 2m)

THE CITY OF St. Albert

| | |
|---|---|
| Project | Ray Gibbon Drive |
| Title | Functional Planning Study<br>Cross-sections |
| Figure No. | Exhibit X03 |



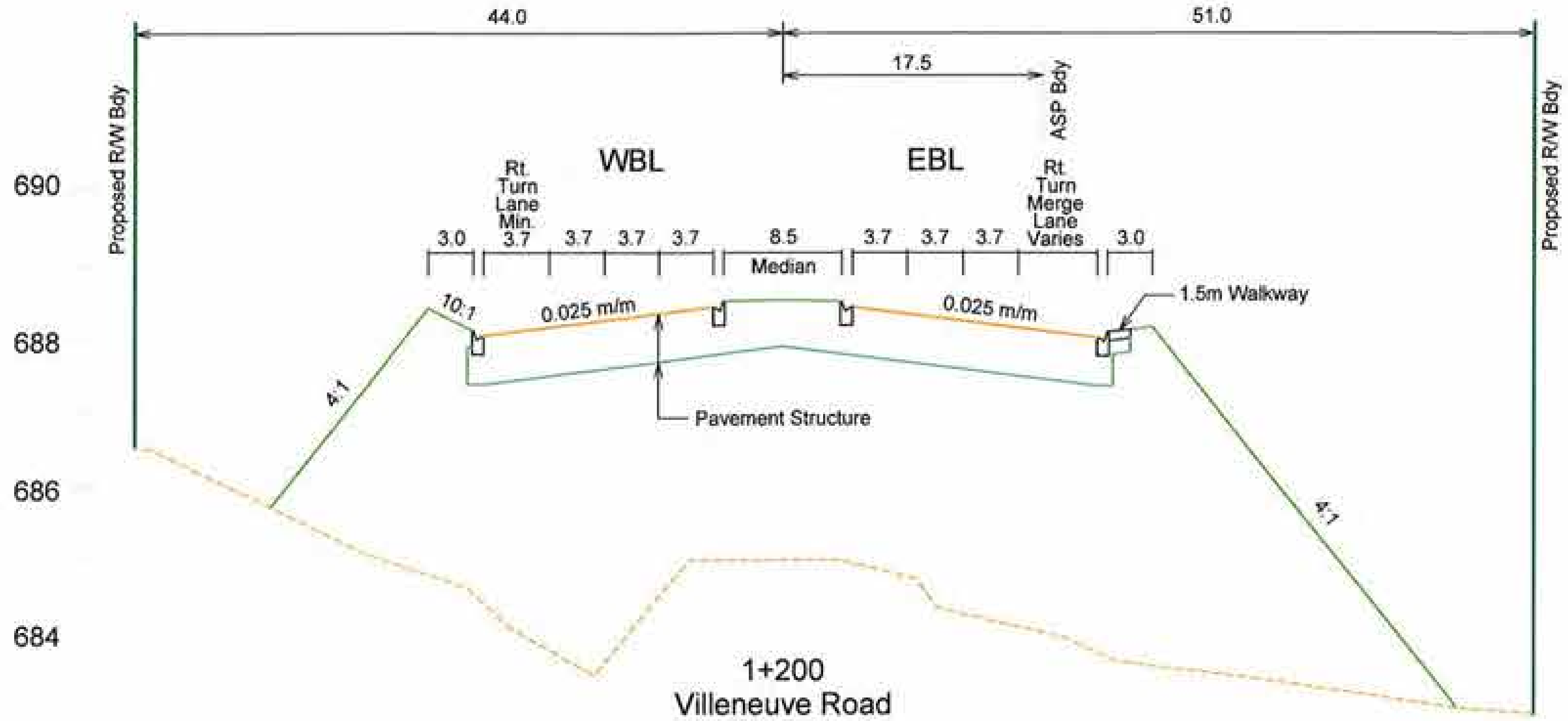

**ISL** Engineering and Land Services

SCALE 1:250
5m 0 5m 10m
HORIZONTAL

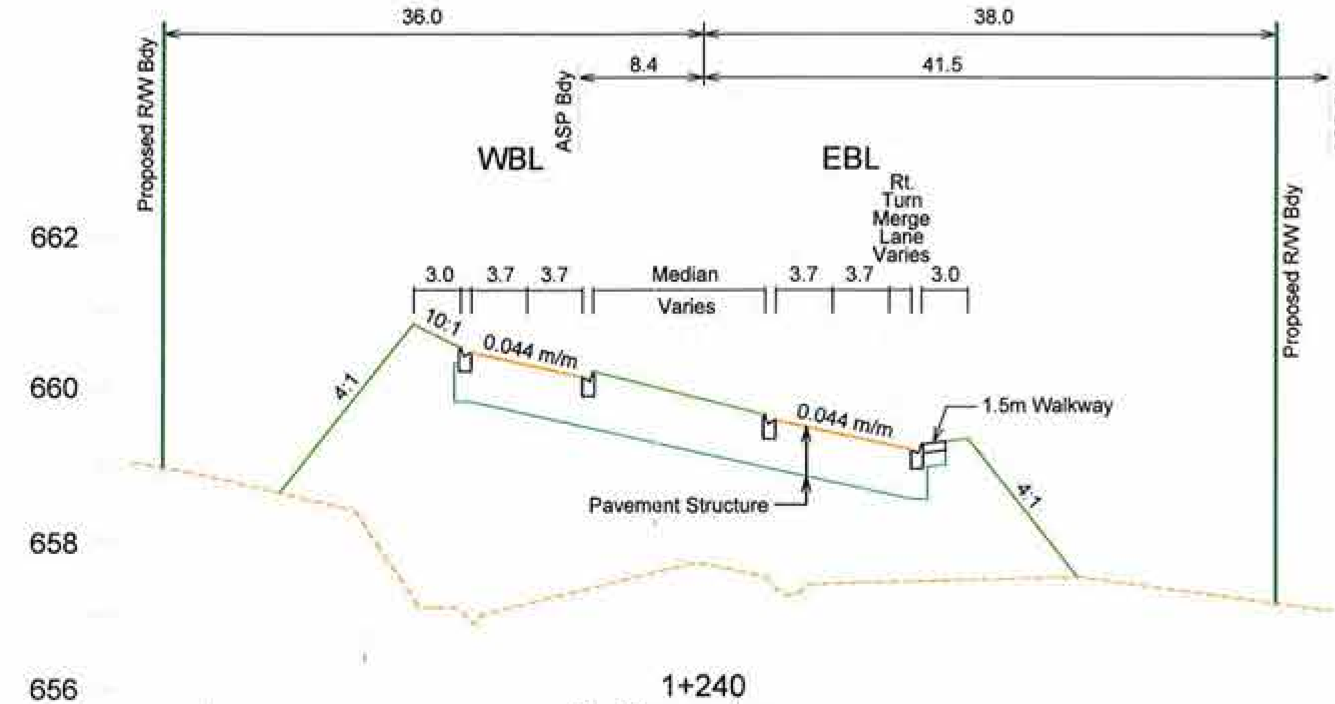
SCALE 1:50
1m 0.5m 0 1m 2m
VERTICAL

THE CITY OF St. Albert

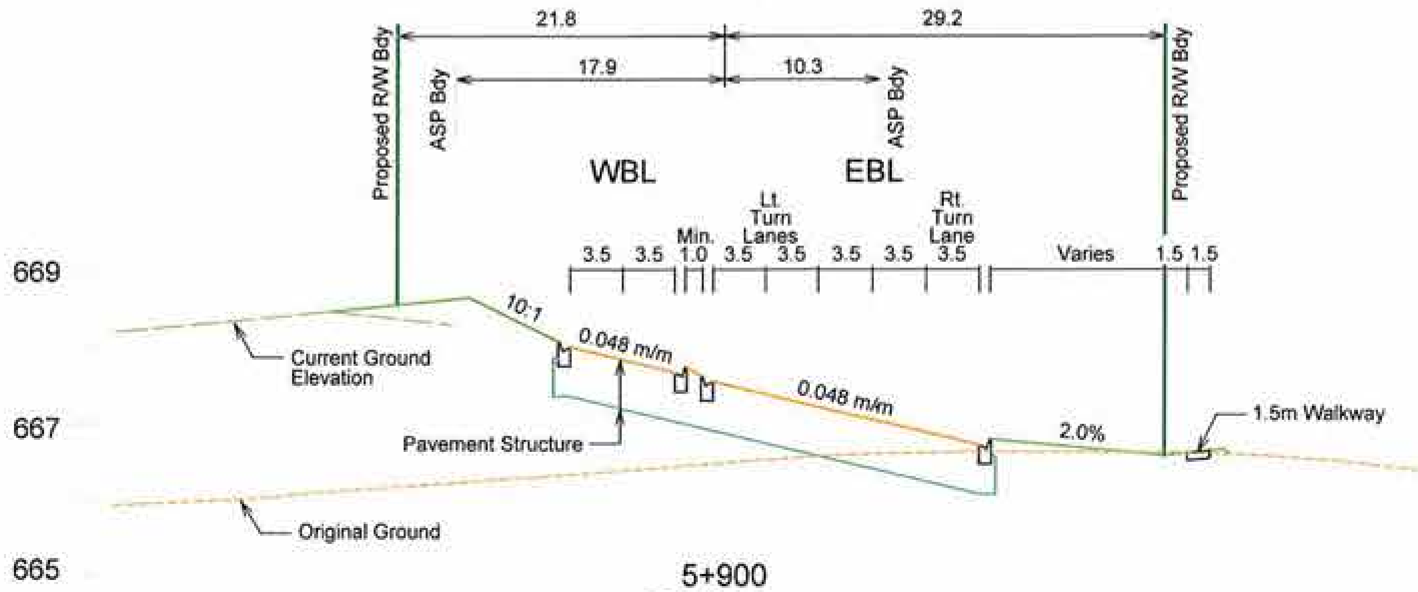
| | |
|---|---|
| Project | Ray Gibbon Drive |
| Title | Functional Planning Study<br>Cross-sections |
| Figure No. | Exhibit X04 |



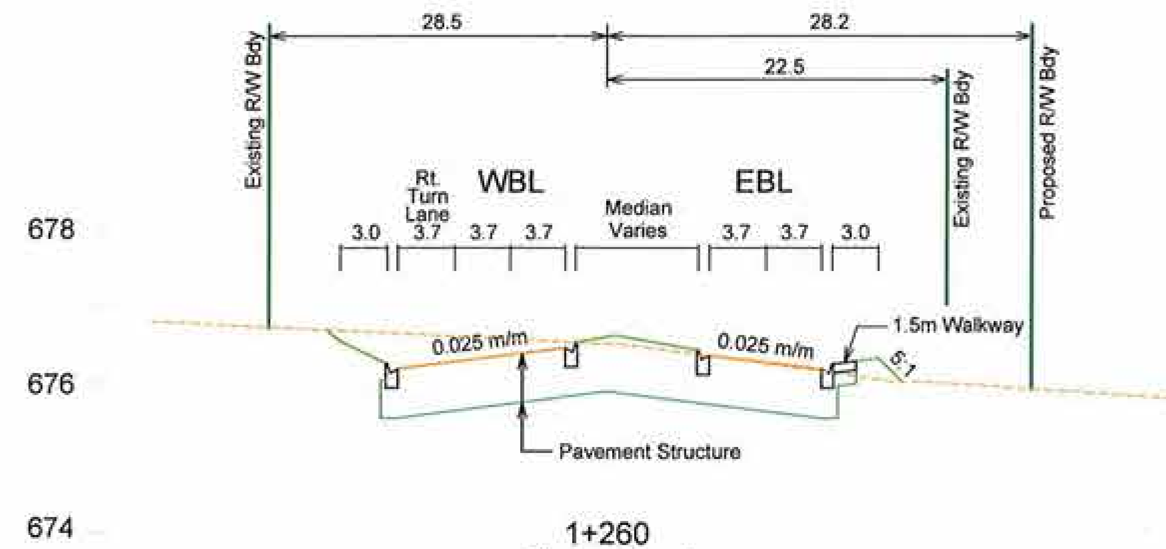

1+200
Villeneuve Road
(Looking East)




1+240
McKenney Avenue
(Looking East)




5+900
137 Avenue
(Looking East)




1+260
Giroux Road
(Looking East)

**ISL Engineering and Land Services**

NOTE:
CITY ARTERIAL LANE WIDTHS TRANSITION FROM 3.7m TO 3.5m BEYOND THE BRIDGE STRUCTURES

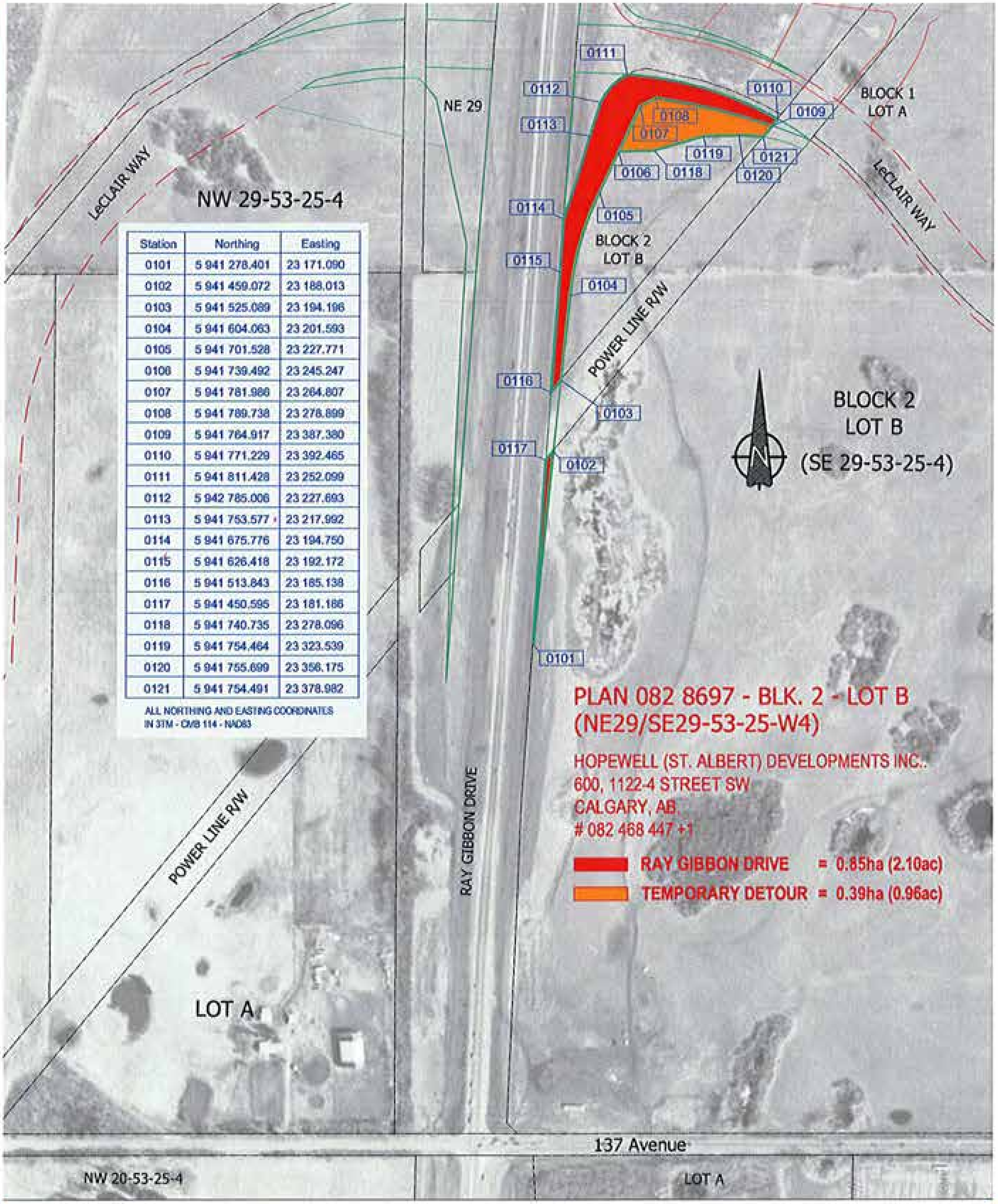
SCALE 1:250 — HORIZONTAL
SCALE 1:50 — VERTICAL

| | |
|---|---|
| Project | Ray Gibbon Drive |
| Title | Functional Planning Study<br>Cross-sections |
| Figure No. | Exhibit X05 |

# APPENDIX K

# Appendix K

## Detailed Right-of-Way Requests




| Station | Northing | Easting |
|---|---|---|
| 0101 | 5 941 278.401 | 23 171.090 |
| 0102 | 5 941 459.072 | 23 188.013 |
| 0103 | 5 941 525.089 | 23 194.196 |
| 0104 | 5 941 604.063 | 23 201.593 |
| 0105 | 5 941 701.528 | 23 227.771 |
| 0106 | 5 941 739.492 | 23 245.247 |
| 0107 | 5 941 781.986 | 23 264.807 |
| 0108 | 5 941 789.738 | 23 278.899 |
| 0109 | 5 941 764.917 | 23 387.380 |
| 0110 | 5 941 771.229 | 23 392.465 |
| 0111 | 5 941 811.428 | 23 252.099 |
| 0112 | 5 942 785.006 | 23 227.693 |
| 0113 | 5 941 753.577 | 23 217.992 |
| 0114 | 5 941 675.776 | 23 194.750 |
| 0115 | 5 941 626.418 | 23 192.172 |
| 0116 | 5 941 513.843 | 23 185.138 |
| 0117 | 5 941 450.595 | 23 181.186 |
| 0118 | 5 941 740.735 | 23 278.096 |
| 0119 | 5 941 754.464 | 23 323.539 |
| 0120 | 5 941 755.699 | 23 358.175 |
| 0121 | 5 941 754.491 | 23 378.982 |

ALL NORTHING AND EASTING COORDINATES IN 3TM - CM8 114 - NAD83

Feb 04, 2009 - 7:40pm User: ch

ISL Engineering and Land Services

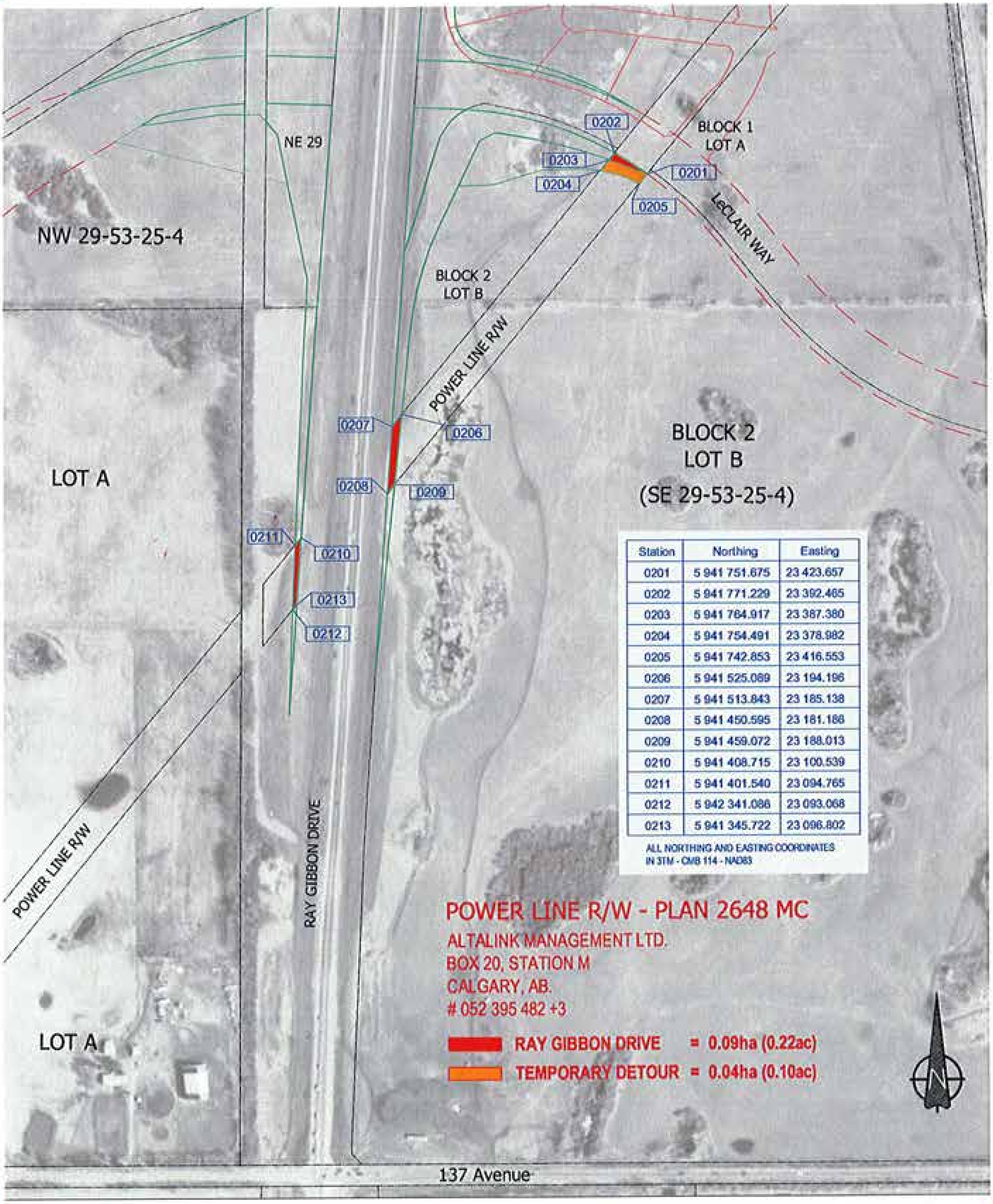
# PLAN SHOWING ADDITIONAL RIGHT-OF-WAY REQUIREMENTS FOR PROVINCIAL FREEWAY STANDARD FOR RAY GIBBON DRIVE

PLAN 082 8697 - BLK. 2 - LOT B

(NE29/SE29 - TWP 53-25-W4)

THE CITY OF St. Albert

SCALE: 1:5000 February 2009




| Station | Northing | Easting |
|---|---|---|
| 0201 | 5 941 751.675 | 23 423.657 |
| 0202 | 5 941 771.229 | 23 392.465 |
| 0203 | 5 941 764.917 | 23 387.380 |
| 0204 | 5 941 754.491 | 23 378.982 |
| 0205 | 5 941 742.853 | 23 416.553 |
| 0206 | 5 941 525.089 | 23 194.196 |
| 0207 | 5 941 513.843 | 23 185.138 |
| 0208 | 5 941 450.595 | 23 181.186 |
| 0209 | 5 941 459.072 | 23 188.013 |
| 0210 | 5 941 408.715 | 23 100.539 |
| 0211 | 5 941 401.540 | 23 094.765 |
| 0212 | 5 942 341.086 | 23 093.068 |
| 0213 | 5 941 345.722 | 23 096.802 |

ALL NORTHING AND EASTING COORDINATES IN 3TM - CMB 114 - NAD83

POWER LINE R/W - PLAN 2648 MC
ALTALINK MANAGEMENT LTD.
BOX 20, STATION M
CALGARY, AB.
# 052 395 482 +3

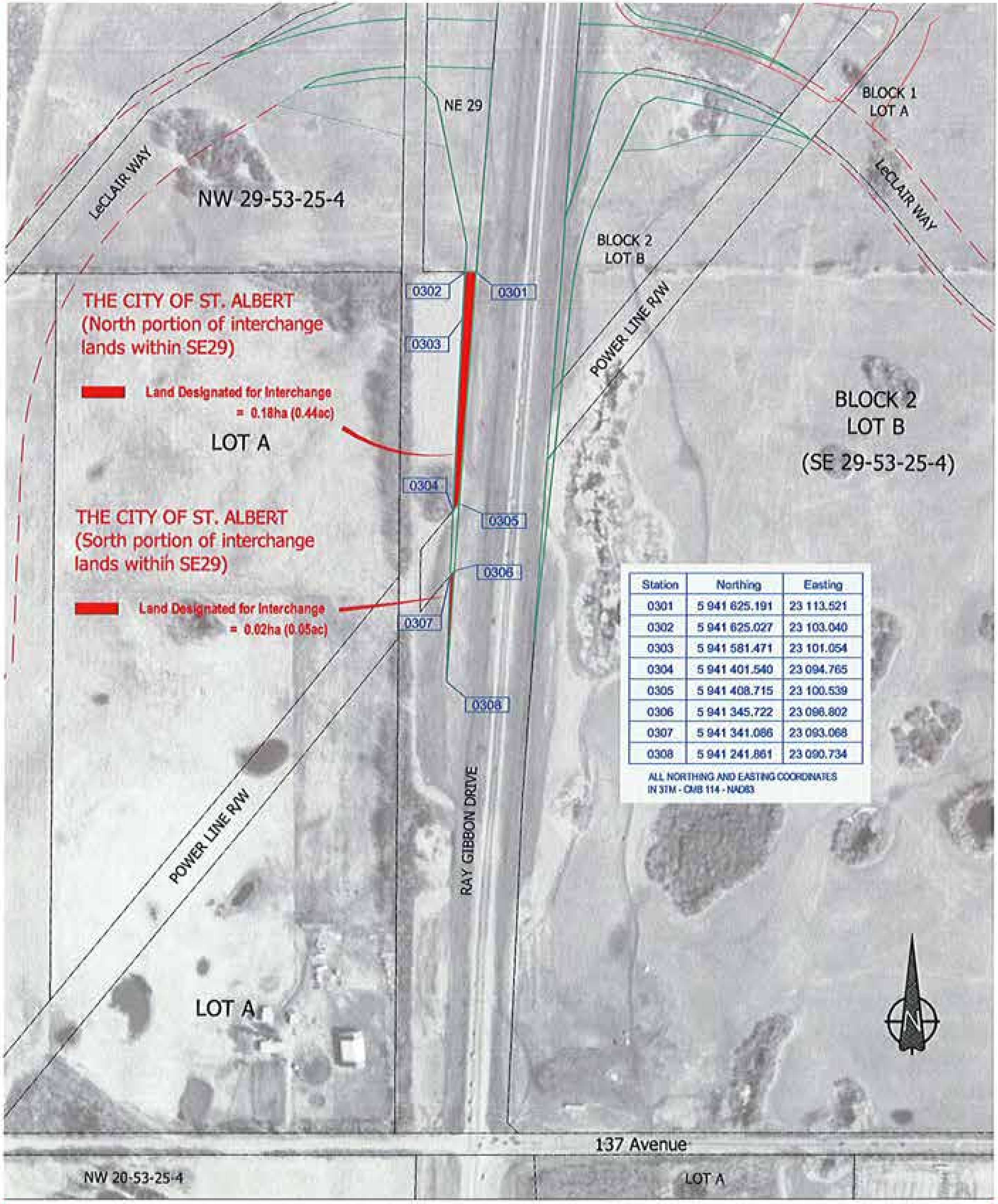
RAY GIBBON DRIVE = 0.09ha (0.22ac)
TEMPORARY DETOUR = 0.04ha (0.10ac)

ISL Engineering and Land Services

PLAN SHOWING ADDITIONAL
RIGHT-OF-WAY REQUIREMENTS FOR
PROVINCIAL FREEWAY STANDARD FOR
RAY GIBBON DRIVE
POWER LINE R/W - PLAN 2648 MC
Within E29 - TWP 53-25-W4

THE CITY OF St. Albert

SCALE: 1:5000 February 2009




| Station | Northing | Easting |
|---|---|---|
| 0301 | 5 941 625.191 | 23 113.521 |
| 0302 | 5 941 625.027 | 23 103.040 |
| 0303 | 5 941 581.471 | 23 101.054 |
| 0304 | 5 941 401.540 | 23 094.765 |
| 0305 | 5 941 408.715 | 23 100.539 |
| 0306 | 5 941 345.722 | 23 098.802 |
| 0307 | 5 941 341.086 | 23 093.068 |
| 0308 | 5 941 241.861 | 23 090.734 |

ALL NORTHING AND EASTING COORDINATES IN 3TM - CMB 114 - NAD83

ISL Engineering and Land Services

PLAN SHOWING ADDITIONAL
RIGHT-OF-WAY REQUIREMENTS FOR
PROVINCIAL FREEWAY STANDARD FOR
RAY GIBBON DRIVE
SE29 - TWP 53-25-W4
(Land Required from the City of St. Albert)

The City of St. Albert

SCALE: 1:5000 February 2009

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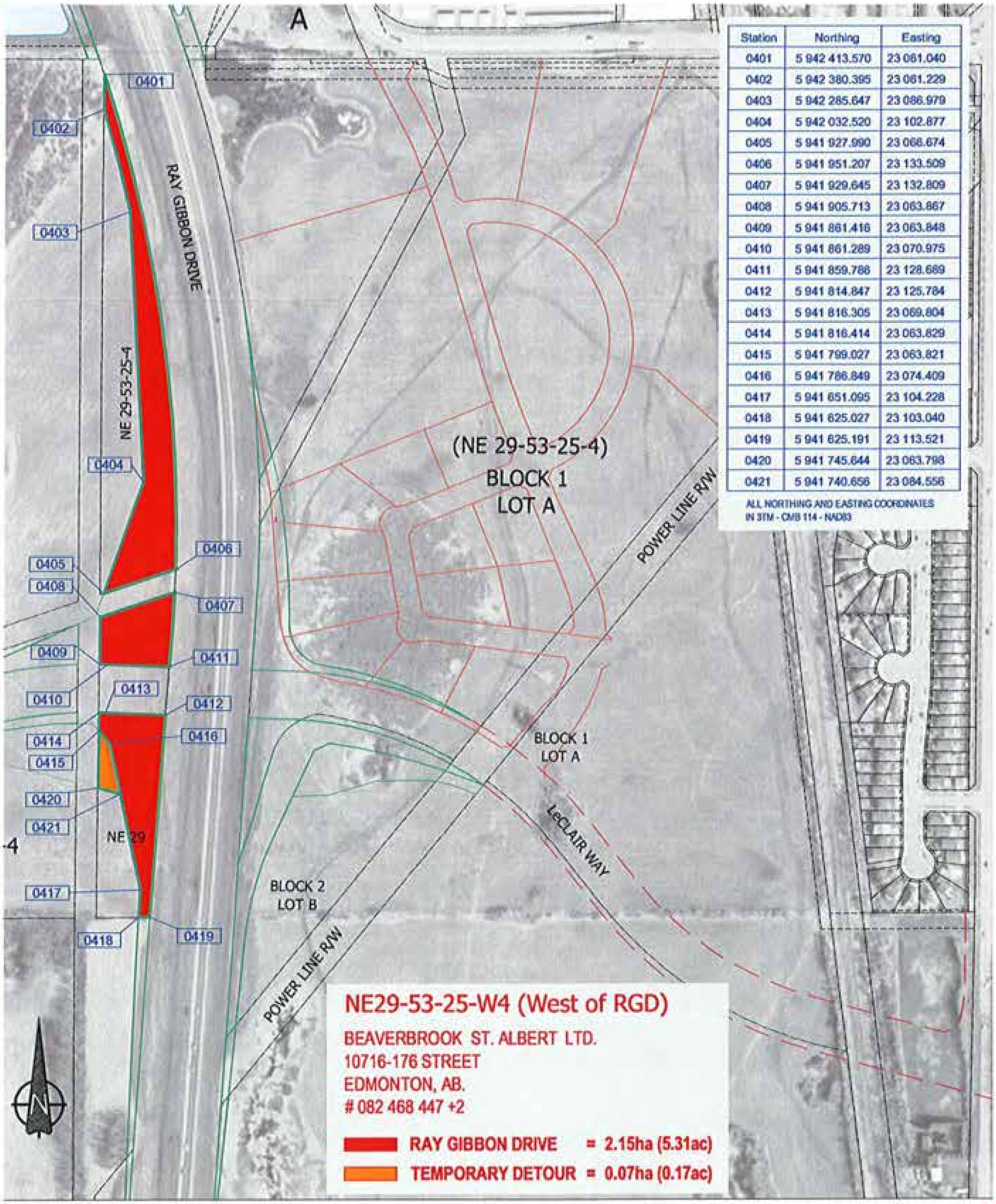



| Station | Northing | Easting |
|---|---|---|
| 0401 | 5 942 413.570 | 23 061.040 |
| 0402 | 5 942 380.395 | 23 061.229 |
| 0403 | 5 942 285.647 | 23 086.979 |
| 0404 | 5 942 032.520 | 23 102.877 |
| 0405 | 5 941 927.990 | 23 066.674 |
| 0406 | 5 941 951.207 | 23 133.509 |
| 0407 | 5 941 929.645 | 23 132.809 |
| 0408 | 5 941 905.713 | 23 063.867 |
| 0409 | 5 941 861.416 | 23 063.848 |
| 0410 | 5 941 861.289 | 23 070.975 |
| 0411 | 5 941 859.786 | 23 128.689 |
| 0412 | 5 941 814.847 | 23 125.784 |
| 0413 | 5 941 816.305 | 23 069.804 |
| 0414 | 5 941 816.414 | 23 063.829 |
| 0415 | 5 941 799.027 | 23 063.821 |
| 0416 | 5 941 786.849 | 23 074.409 |
| 0417 | 5 941 651.095 | 23 104.228 |
| 0418 | 5 941 625.027 | 23 103.040 |
| 0419 | 5 941 625.191 | 23 113.521 |
| 0420 | 5 941 745.644 | 23 063.798 |
| 0421 | 5 941 740.656 | 23 084.556 |

ALL NORTHING AND EASTING COORDINATES IN 3TM - CMB 114 - NAD83

## NE29-53-25-W4 (West of RGD)

BEAVERBROOK ST. ALBERT LTD.
10716-176 STREET
EDMONTON, AB.
# 082 468 447 +2

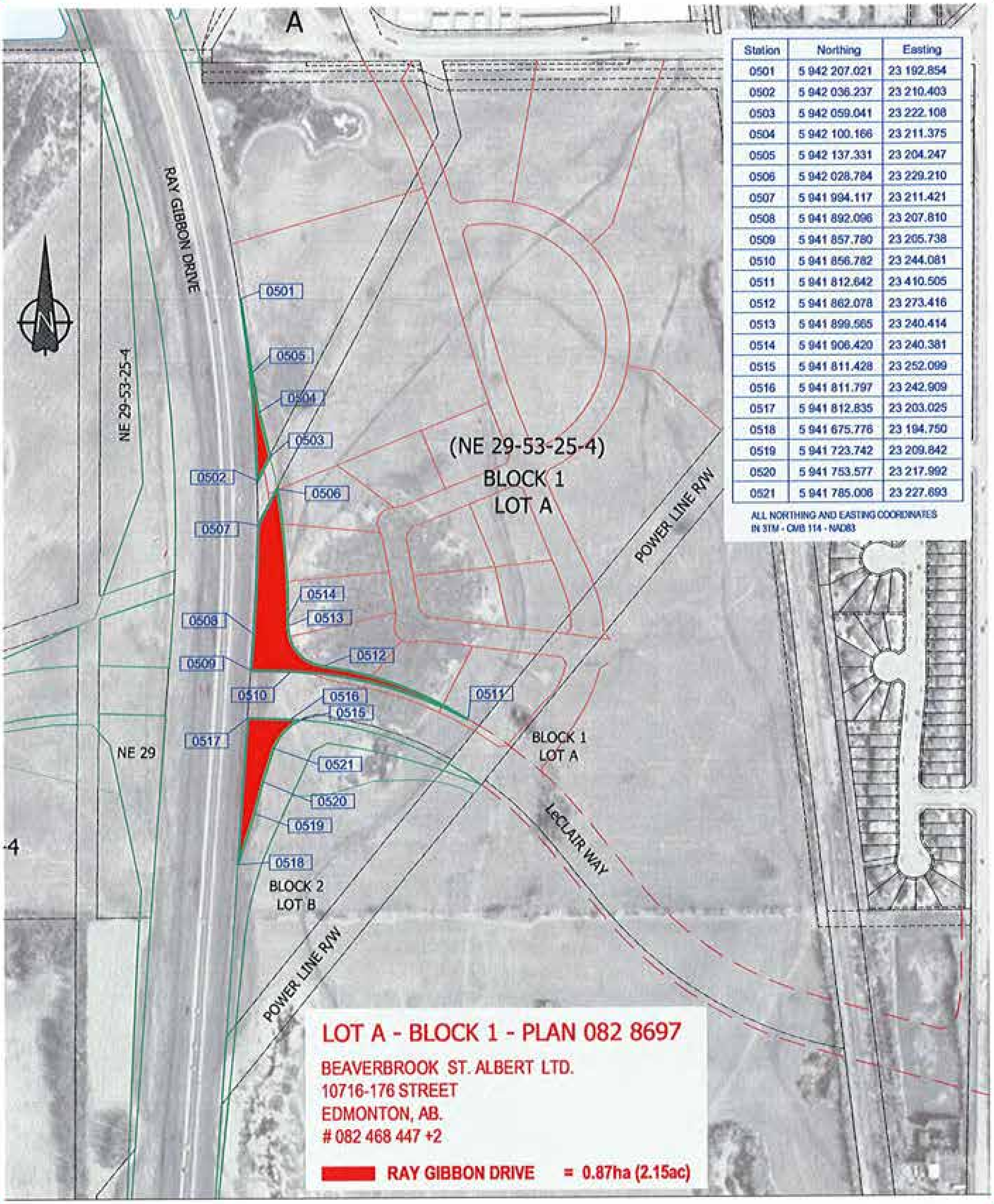
RAY GIBBON DRIVE = 2.15ha (5.31ac)
TEMPORARY DETOUR = 0.07ha (0.17ac)

ISL Engineering and Land Services

PLAN SHOWING ADDITIONAL
RIGHT-OF-WAY REQUIREMENTS FOR
PROVINCIAL FREEWAY STANDARD FOR
RAY GIBBON DRIVE
NE29 - TWP 53-25-W4

THE CITY OF St. Albert

SCALE: 1:5000 February 2009




| Station | Northing | Easting |
|---|---|---|
| 0501 | 5 942 207.021 | 23 192.854 |
| 0502 | 5 942 036.237 | 23 210.403 |
| 0503 | 5 942 059.041 | 23 222.108 |
| 0504 | 5 942 100.166 | 23 211.375 |
| 0505 | 5 942 137.331 | 23 204.247 |
| 0506 | 5 942 028.784 | 23 229.210 |
| 0507 | 5 941 994.117 | 23 211.421 |
| 0508 | 5 941 892.096 | 23 207.810 |
| 0509 | 5 941 857.780 | 23 205.738 |
| 0510 | 5 941 856.782 | 23 244.081 |
| 0511 | 5 941 812.642 | 23 410.505 |
| 0512 | 5 941 862.078 | 23 273.416 |
| 0513 | 5 941 899.565 | 23 240.414 |
| 0514 | 5 941 906.420 | 23 240.381 |
| 0515 | 5 941 811.428 | 23 252.099 |
| 0516 | 5 941 811.797 | 23 242.909 |
| 0517 | 5 941 812.835 | 23 203.025 |
| 0518 | 5 941 675.776 | 23 194.750 |
| 0519 | 5 941 723.742 | 23 209.842 |
| 0520 | 5 941 753.577 | 23 217.992 |
| 0521 | 5 941 785.006 | 23 227.693 |

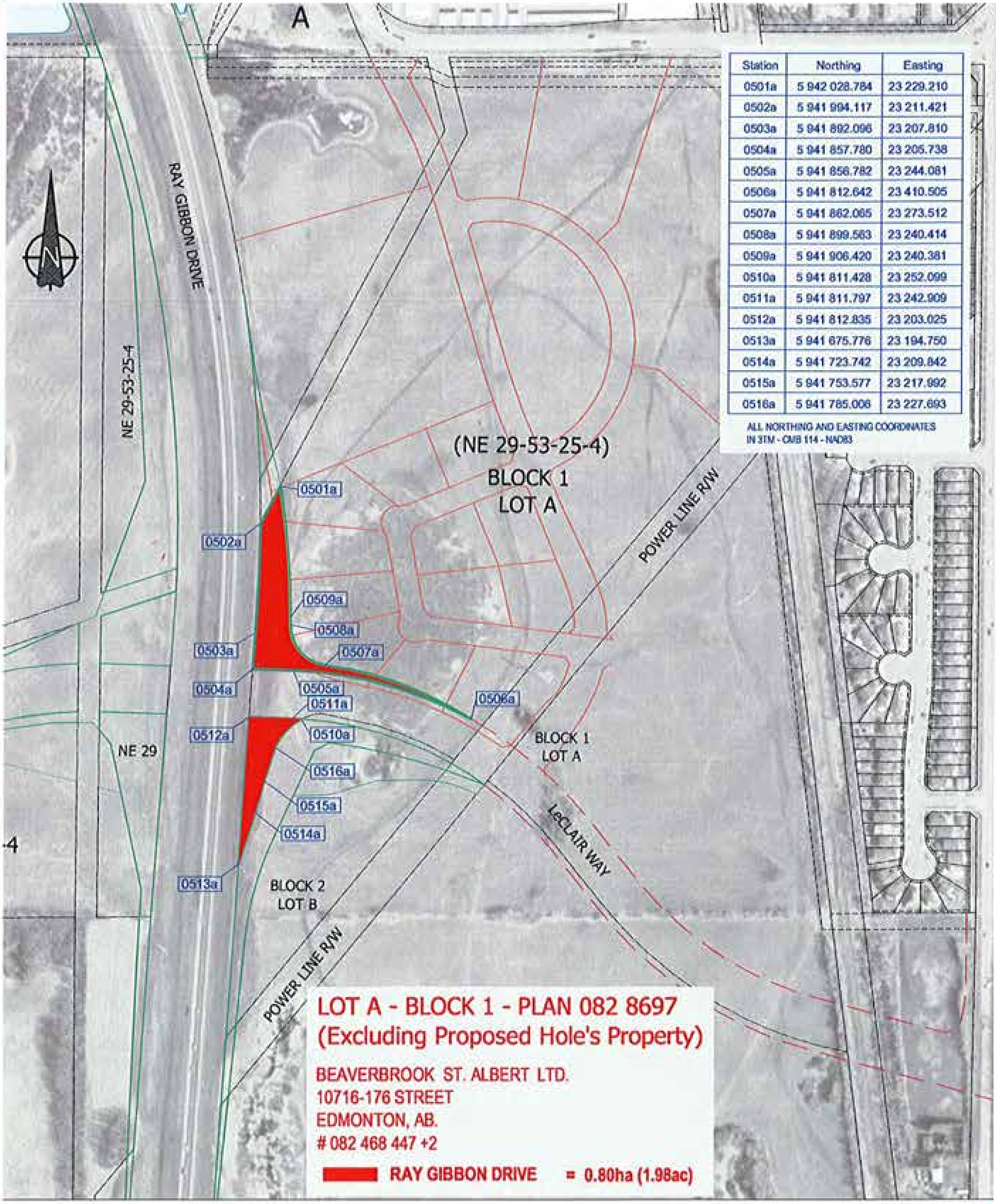
ALL NORTHING AND EASTING COORDINATES
IN 3TM - CMB 114 - NAD83

ISL Engineering and Land Services

PLAN SHOWING ADDITIONAL
RIGHT-OF-WAY REQUIREMENTS FOR
PROVINCIAL FREEWAY STANDARD FOR
RAY GIBBON DRIVE
LOT A - BLOCK 1 - PLAN 082 8697

THE CITY OF St. Albert

SCALE: 1:5000 February 2009




| Station | Northing | Easting |
|---|---|---|
| 0501a | 5 942 028.784 | 23 229.210 |
| 0502a | 5 941 994.117 | 23 211.421 |
| 0503a | 5 941 892.096 | 23 207.810 |
| 0504a | 5 941 857.780 | 23 205.738 |
| 0505a | 5 941 856.782 | 23 244.081 |
| 0506a | 5 941 812.642 | 23 410.505 |
| 0507a | 5 941 862.065 | 23 273.512 |
| 0508a | 5 941 899.563 | 23 240.414 |
| 0509a | 5 941 906.420 | 23 240.381 |
| 0510a | 5 941 811.428 | 23 252.099 |
| 0511a | 5 941 811.797 | 23 242.909 |
| 0512a | 5 941 812.835 | 23 203.025 |
| 0513a | 5 941 675.776 | 23 194.750 |
| 0514a | 5 941 723.742 | 23 209.842 |
| 0515a | 5 941 753.577 | 23 217.992 |
| 0516a | 5 941 785.006 | 23 227.693 |

ALL NORTHING AND EASTING COORDINATES IN 3TM - CM 114 - NAD83

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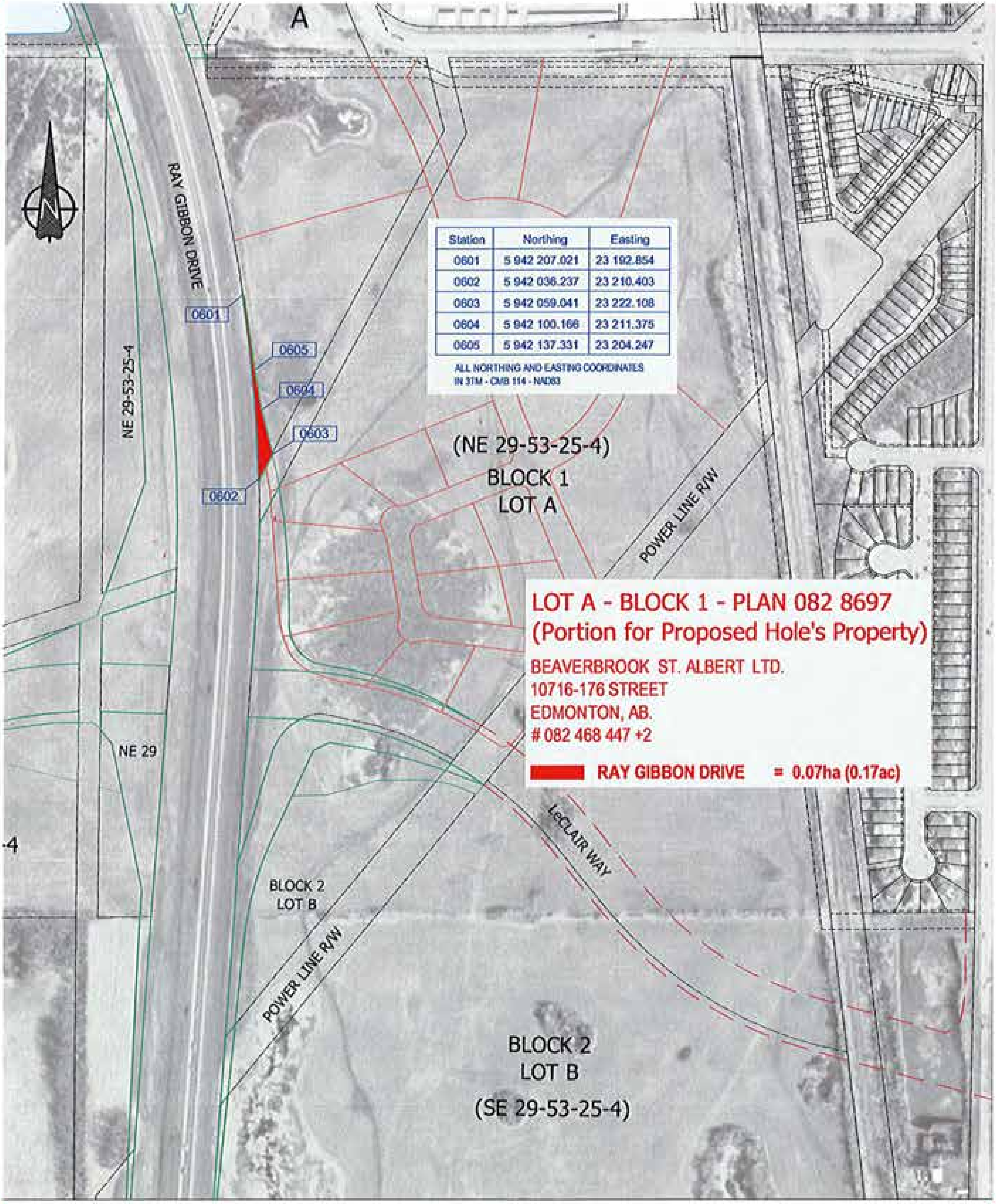
ISL Engineering and Land Services

PLAN SHOWING ADDITIONAL
RIGHT-OF-WAY REQUIREMENTS FOR
PROVINCIAL FREEWAY STANDARD FOR
RAY GIBBON DRIVE
LOT A - BLOCK 1 - PLAN 082 8697
(Excluding Proposed Hole's Property)

THE CITY OF St. Albert

SCALE: 1:5000 February 2009

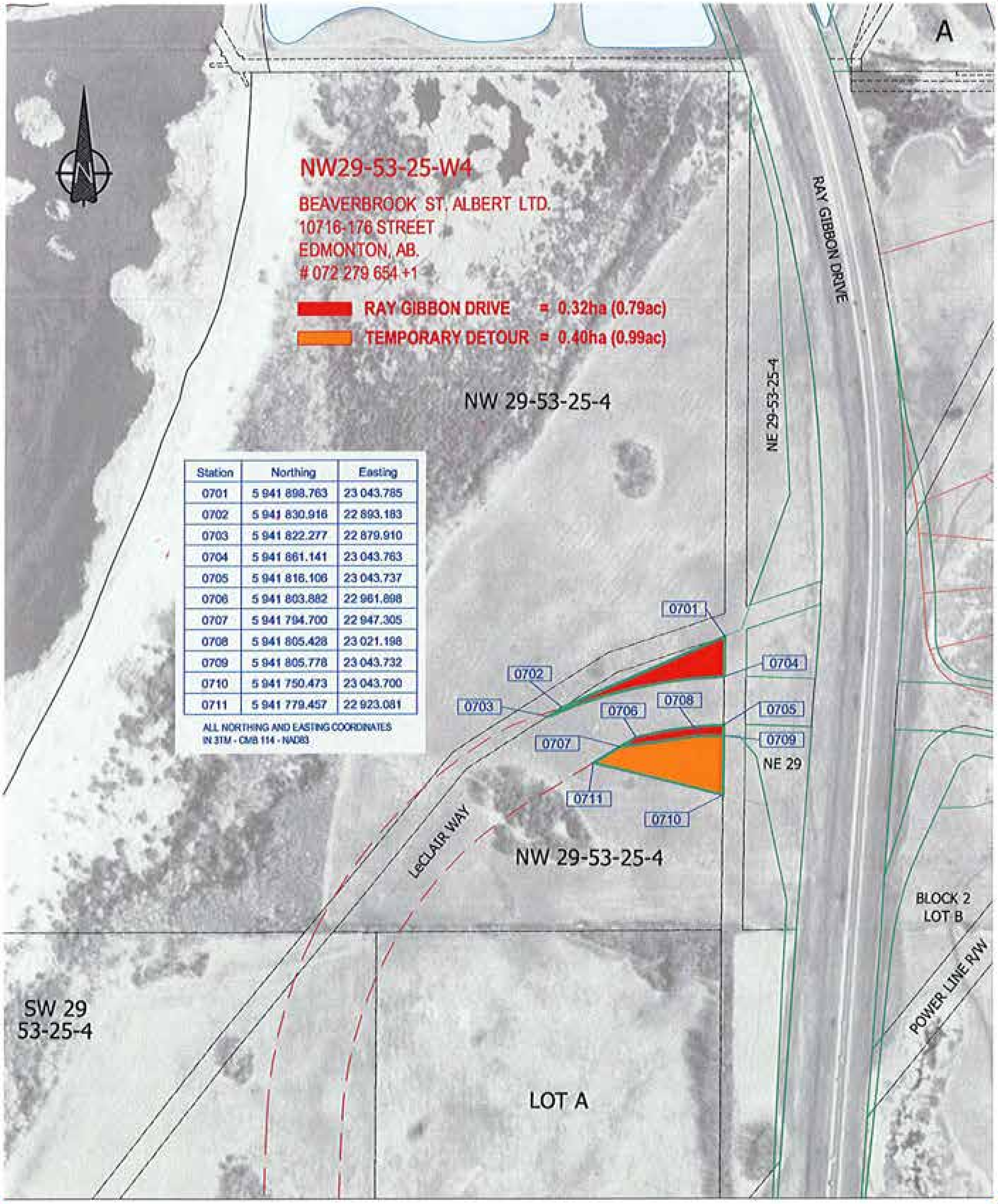



PLAN SHOWING ADDITIONAL
RIGHT-OF-WAY REQUIREMENTS FOR
PROVINCIAL FREEWAY STANDARD FOR
RAY GIBBON DRIVE
LOT A - BLOCK 1 - PLAN 082 8697
(Portion for Proposed Hole's Property)

ISL Engineering and Land Services

THE CITY OF St. Albert

SCALE: 1:5000 February 2009




| Station | Northing | Easting |
|---|---|---|
| 0701 | 5 941 898.763 | 23 043.785 |
| 0702 | 5 941 830.916 | 22 893.183 |
| 0703 | 5 941 822.277 | 22 879.910 |
| 0704 | 5 941 861.141 | 23 043.763 |
| 0705 | 5 941 816.106 | 23 043.737 |
| 0706 | 5 941 803.882 | 22 961.898 |
| 0707 | 5 941 794.700 | 22 947.305 |
| 0708 | 5 941 805.428 | 23 021.198 |
| 0709 | 5 941 805.778 | 23 043.732 |
| 0710 | 5 941 750.473 | 23 043.700 |
| 0711 | 5 941 779.457 | 22 923.081 |

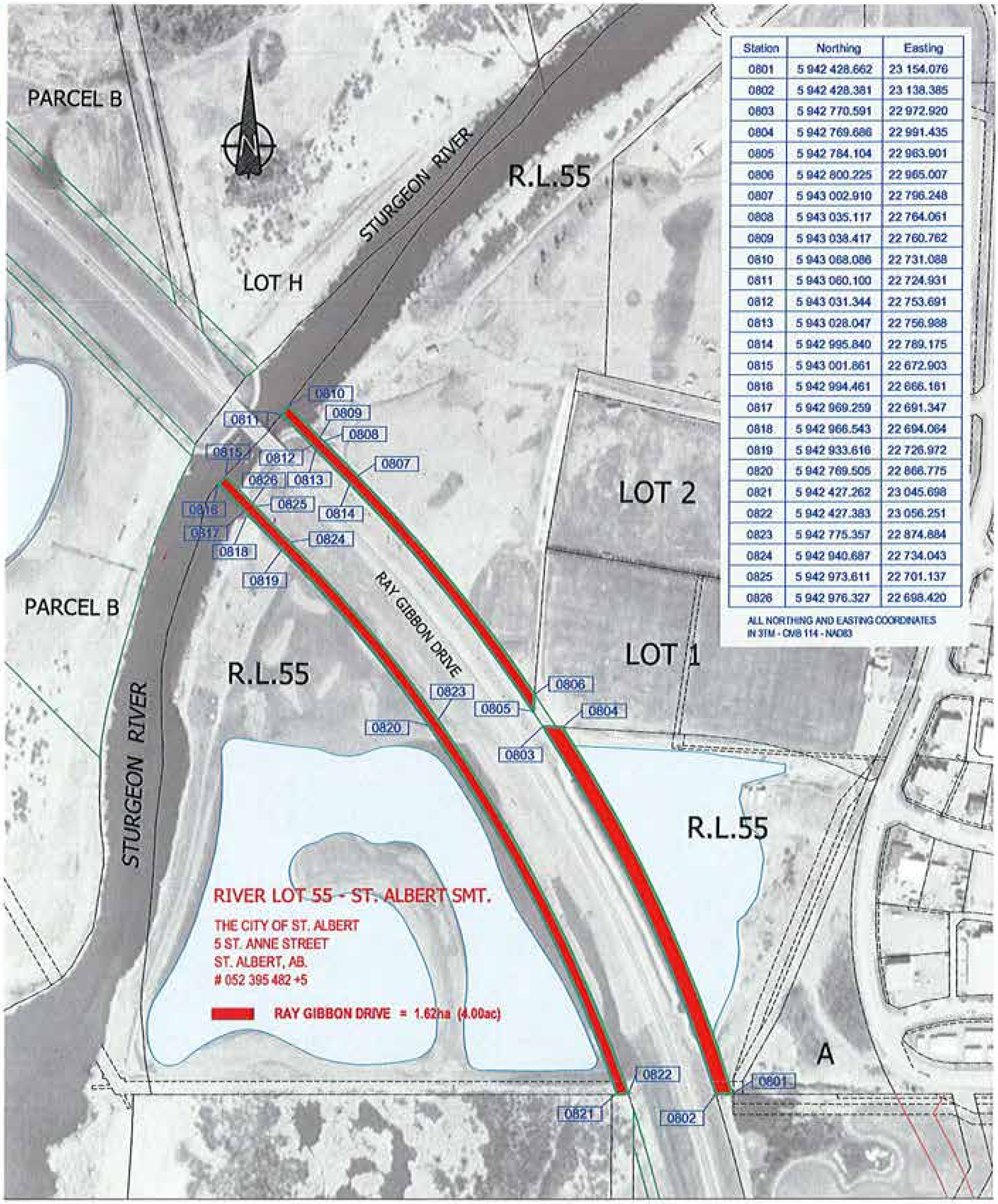
ALL NORTHING AND EASTING COORDINATES IN 3TM - CM8 114 - NAD83

ISL Engineering and Land Services

PLAN SHOWING ADDITIONAL
RIGHT-OF-WAY REQUIREMENTS FOR
PROVINCIAL FREEWAY STANDARD FOR
RAY GIBBON DRIVE
NW29 - TWP 53-25-W4

THE CITY OF St. Albert

SCALE: 1:5000 February 2009




| Station | Northing | Easting |
|---|---|---|
| 0801 | 5 942 428.662 | 23 154.076 |
| 0802 | 5 942 428.381 | 23 138.385 |
| 0803 | 5 942 770.591 | 22 972.920 |
| 0804 | 5 942 769.686 | 22 991.435 |
| 0805 | 5 942 784.104 | 22 963.901 |
| 0806 | 5 942 800.225 | 22 965.007 |
| 0807 | 5 943 002.910 | 22 796.248 |
| 0808 | 5 943 035.117 | 22 764.061 |
| 0809 | 5 943 038.417 | 22 760.762 |
| 0810 | 5 943 068.086 | 22 731.088 |
| 0811 | 5 943 060.100 | 22 724.931 |
| 0812 | 5 943 031.344 | 22 753.691 |
| 0813 | 5 943 028.047 | 22 756.988 |
| 0814 | 5 942 995.840 | 22 789.175 |
| 0815 | 5 943 001.861 | 22 672.903 |
| 0816 | 5 942 994.461 | 22 666.161 |
| 0817 | 5 942 969.259 | 22 691.347 |
| 0818 | 5 942 966.543 | 22 694.064 |
| 0819 | 5 942 933.616 | 22 726.972 |
| 0820 | 5 942 769.505 | 22 866.775 |
| 0821 | 5 942 427.262 | 23 045.698 |
| 0822 | 5 942 427.383 | 23 056.251 |
| 0823 | 5 942 775.357 | 22 874.884 |
| 0824 | 5 942 940.687 | 22 734.043 |
| 0825 | 5 942 973.611 | 22 701.137 |
| 0826 | 5 942 976.327 | 22 698.420 |

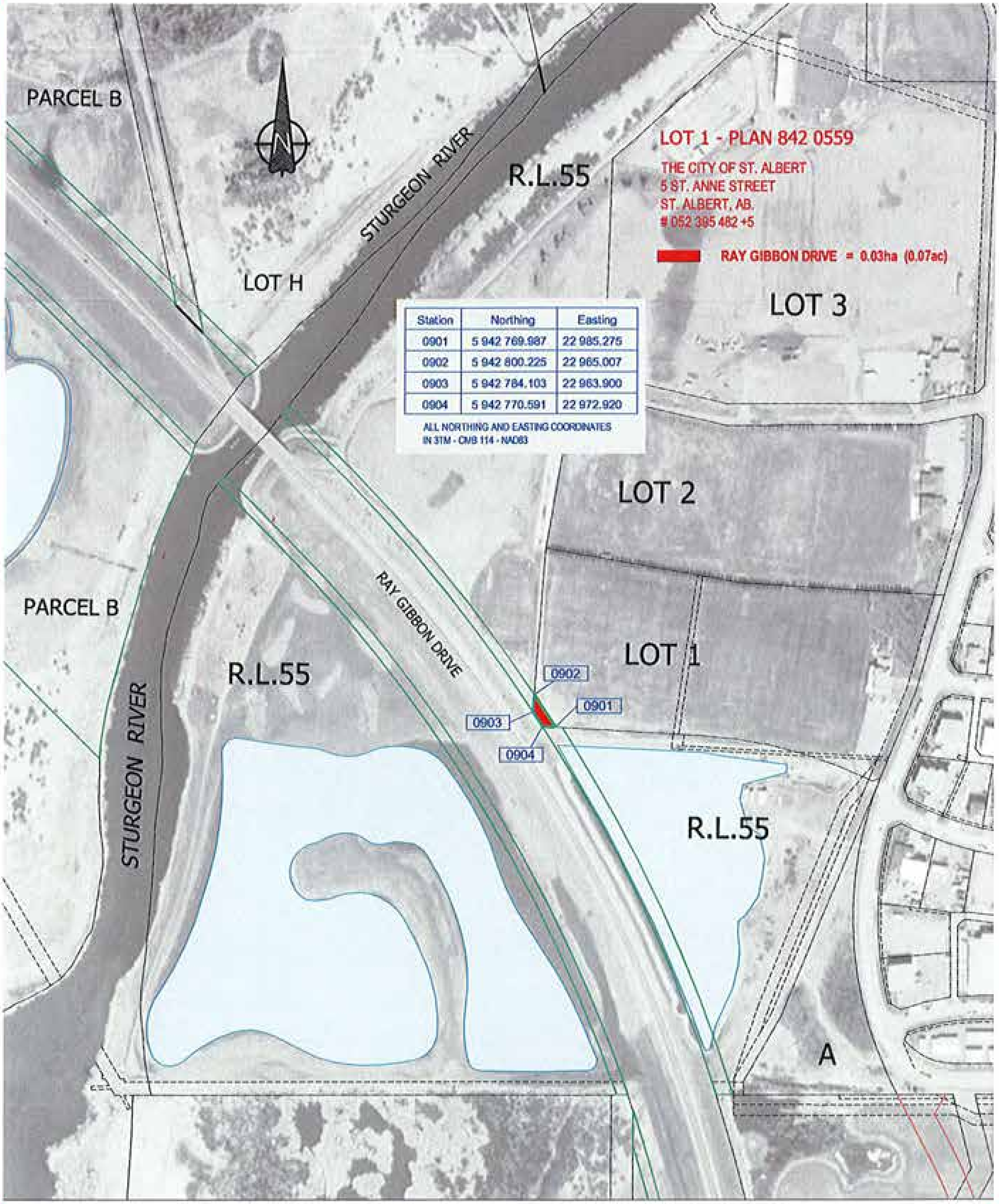
ALL NORTHING AND EASTING COORDINATES IN 3TM - CM8 114 - NAD83

ISL Engineering and Land Services

PLAN SHOWING ADDITIONAL
RIGHT-OF-WAY REQUIREMENTS FOR
PROVINCIAL FREEWAY STANDARD FOR
RAY GIBBON DRIVE
RIVER LOT 55 - ST. ALBERT SETTLEMENT

THE CITY OF St. Albert

SCALE: 1:5000 February 2009




| Station | Northing | Easting |
|---|---|---|
| 0901 | 5 942 769.987 | 22 985.275 |
| 0902 | 5 942 800.225 | 22 965.007 |
| 0903 | 5 942 784.103 | 22 963.900 |
| 0904 | 5 942 770.591 | 22 972.920 |

ALL NORTHING AND EASTING COORDINATES IN 3TM - CM3 114 - NAD83

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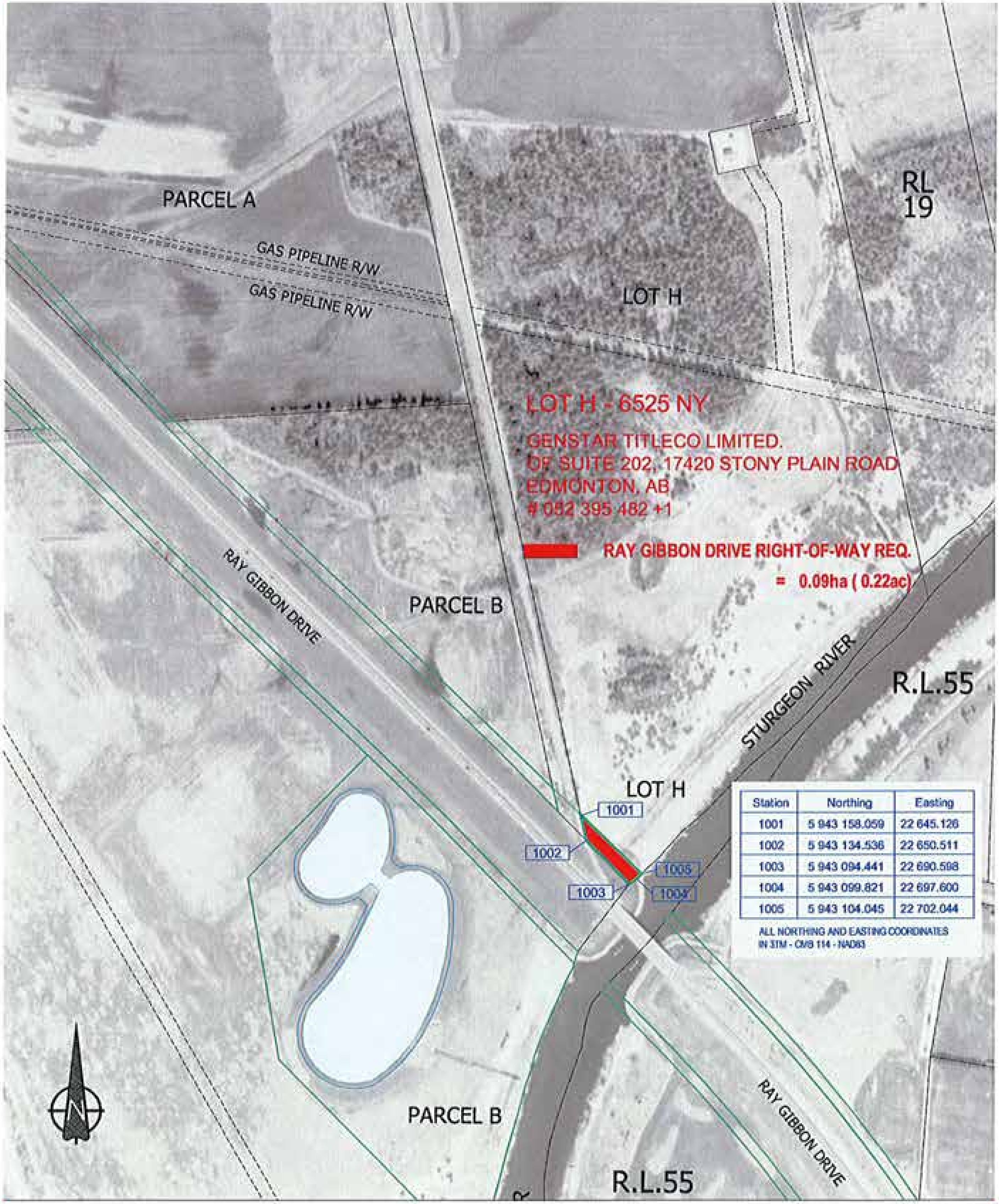
ISL Engineering and Land Services

PLAN SHOWING ADDITIONAL
RIGHT-OF-WAY REQUIREMENTS FOR
PROVINCIAL FREEWAY STANDARD FOR
RAY GIBBON DRIVE
LOT 1 - PLAN 842 0559

THE CITY OF St. Albert

SCALE: 1:5000 February 2009




| Station | Northing | Easting |
|---|---|---|
| 1001 | 5 943 158.059 | 22 645.126 |
| 1002 | 5 943 134.536 | 22 650.511 |
| 1003 | 5 943 094.441 | 22 690.598 |
| 1004 | 5 943 099.821 | 22 697.600 |
| 1005 | 5 943 104.045 | 22 702.044 |

ALL NORTHING AND EASTING COORDINATES IN 3TM - CM 114 - NAD83

ISL Engineering and Land Services

PLAN SHOWING ADDITIONAL
RIGHT-OF-WAY REQUIREMENTS FOR
PROVINCIAL FREEWAY STANDARD FOR
RAY GIBBON DRIVE
LOT H - PLAN 6525 NY

The City of St. Albert

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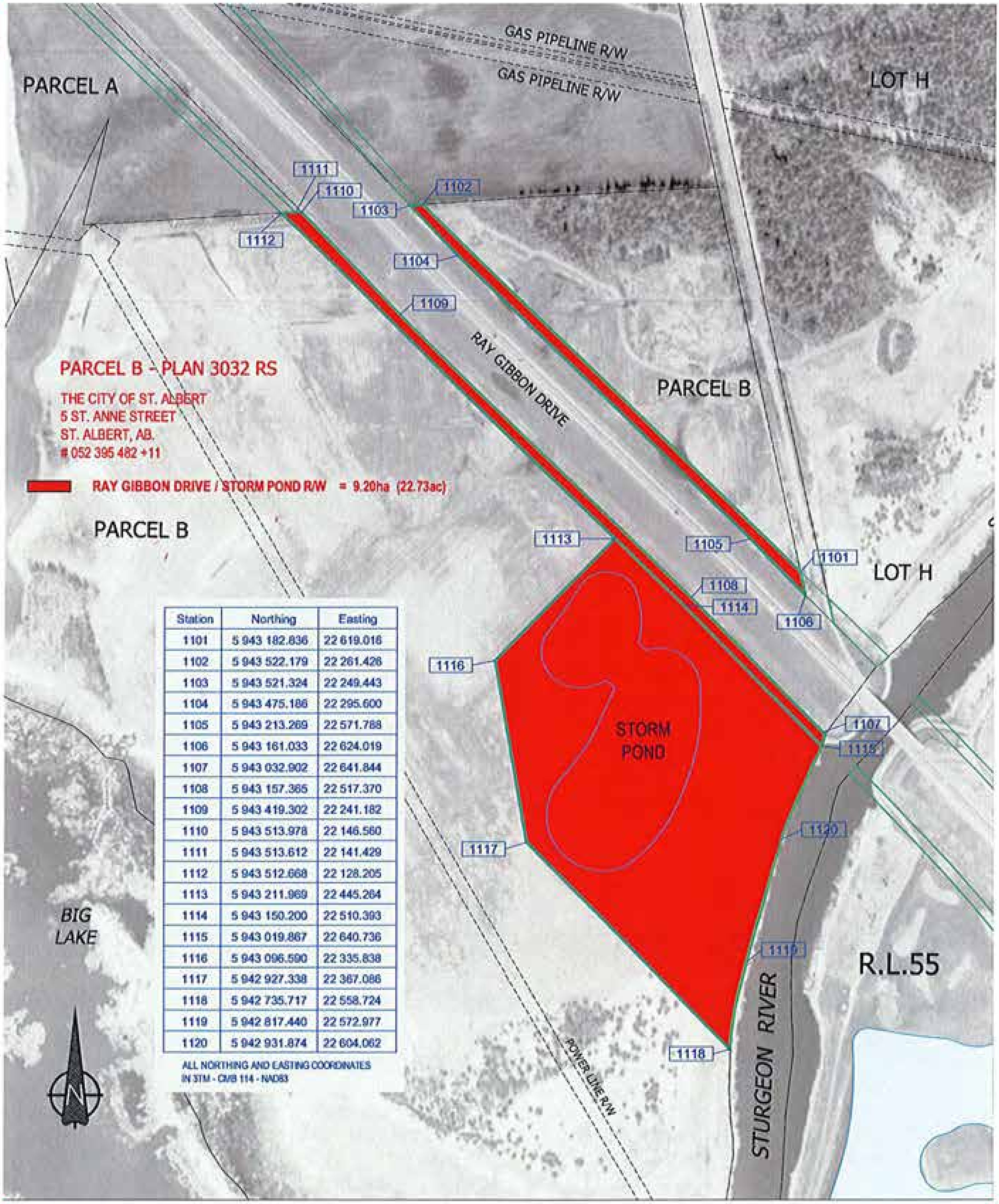


| Station | Northing | Easting |
|---|---|---|
| 1101 | 5 943 182.836 | 22 619.016 |
| 1102 | 5 943 522.179 | 22 261.428 |
| 1103 | 5 943 521.324 | 22 249.443 |
| 1104 | 5 943 475.186 | 22 295.600 |
| 1105 | 5 943 213.269 | 22 571.788 |
| 1106 | 5 943 161.033 | 22 624.019 |
| 1107 | 5 943 032.902 | 22 641.844 |
| 1108 | 5 943 157.365 | 22 517.370 |
| 1109 | 5 943 419.302 | 22 241.182 |
| 1110 | 5 943 513.978 | 22 146.560 |
| 1111 | 5 943 513.612 | 22 141.429 |
| 1112 | 5 943 512.668 | 22 128.205 |
| 1113 | 5 943 211.969 | 22 445.264 |
| 1114 | 5 943 150.200 | 22 510.393 |
| 1115 | 5 943 019.867 | 22 640.736 |
| 1116 | 5 943 096.590 | 22 335.838 |
| 1117 | 5 942 927.338 | 22 367.086 |
| 1118 | 5 942 735.717 | 22 558.724 |
| 1119 | 5 942 817.440 | 22 572.977 |
| 1120 | 5 942 931.874 | 22 604.062 |

ALL NORTHING AND EASTING COORDINATES IN 3TM - CM 114 - NAD83

ISL Engineering and Land Services

PLAN SHOWING ADDITIONAL
RIGHT-OF-WAY REQUIREMENTS FOR
PROVINCIAL FREEWAY STANDARD FOR
RAY GIBBON DRIVE
PARCEL B - PLAN 3032 RS

THE CITY OF St. Albert

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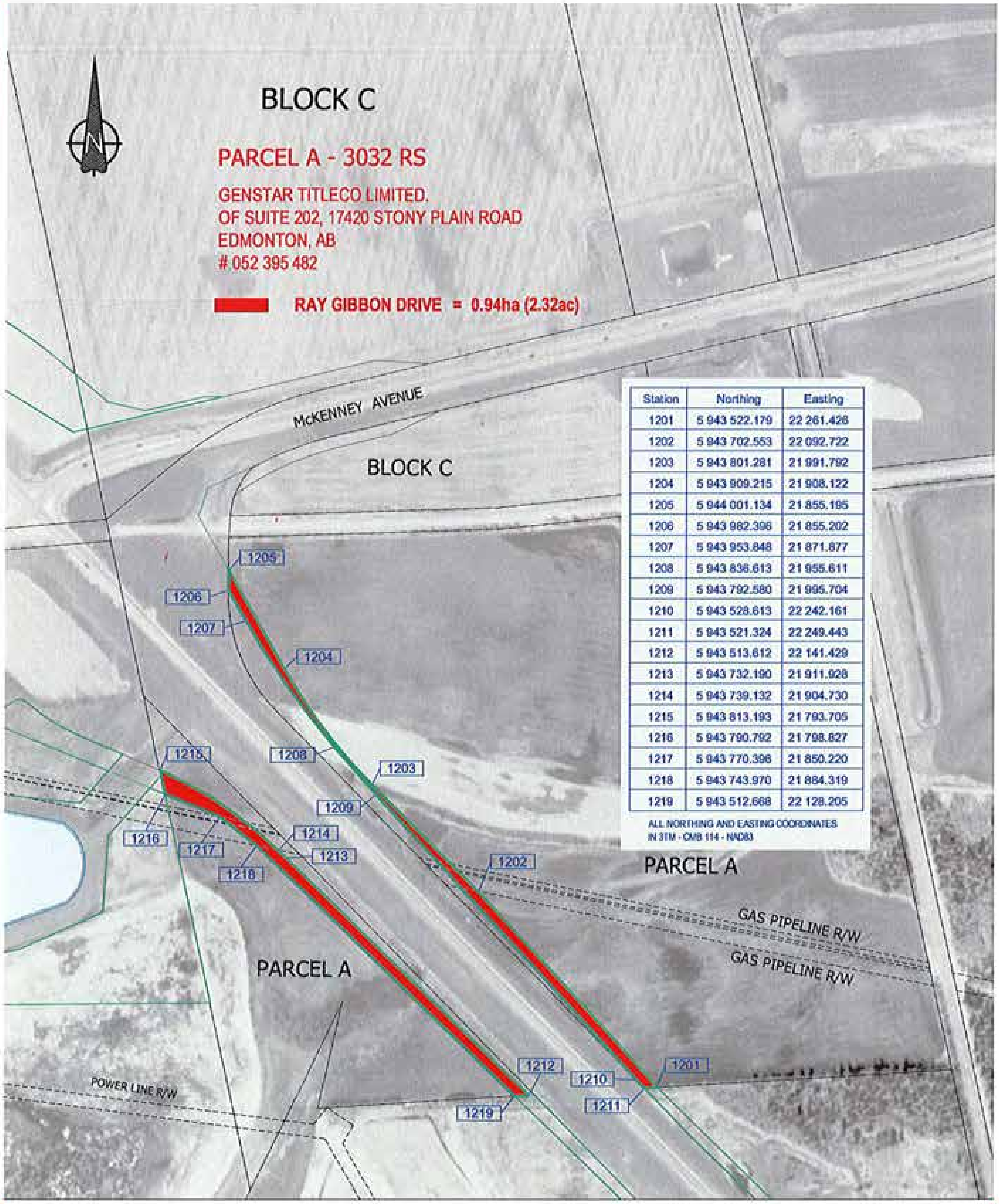



| Station | Northing | Easting |
|---|---|---|
| 1201 | 5 943 522.179 | 22 261.426 |
| 1202 | 5 943 702.553 | 22 092.722 |
| 1203 | 5 943 801.281 | 21 991.792 |
| 1204 | 5 943 909.215 | 21 908.122 |
| 1205 | 5 944 001.134 | 21 855.195 |
| 1206 | 5 943 982.396 | 21 855.202 |
| 1207 | 5 943 953.848 | 21 871.877 |
| 1208 | 5 943 836.613 | 21 955.611 |
| 1209 | 5 943 792.580 | 21 995.704 |
| 1210 | 5 943 528.613 | 22 242.161 |
| 1211 | 5 943 521.324 | 22 249.443 |
| 1212 | 5 943 513.612 | 22 141.429 |
| 1213 | 5 943 732.190 | 21 911.928 |
| 1214 | 5 943 739.132 | 21 904.730 |
| 1215 | 5 943 813.193 | 21 793.705 |
| 1216 | 5 943 790.792 | 21 798.827 |
| 1217 | 5 943 770.396 | 21 850.220 |
| 1218 | 5 943 743.970 | 21 884.319 |
| 1219 | 5 943 512.668 | 22 128.205 |

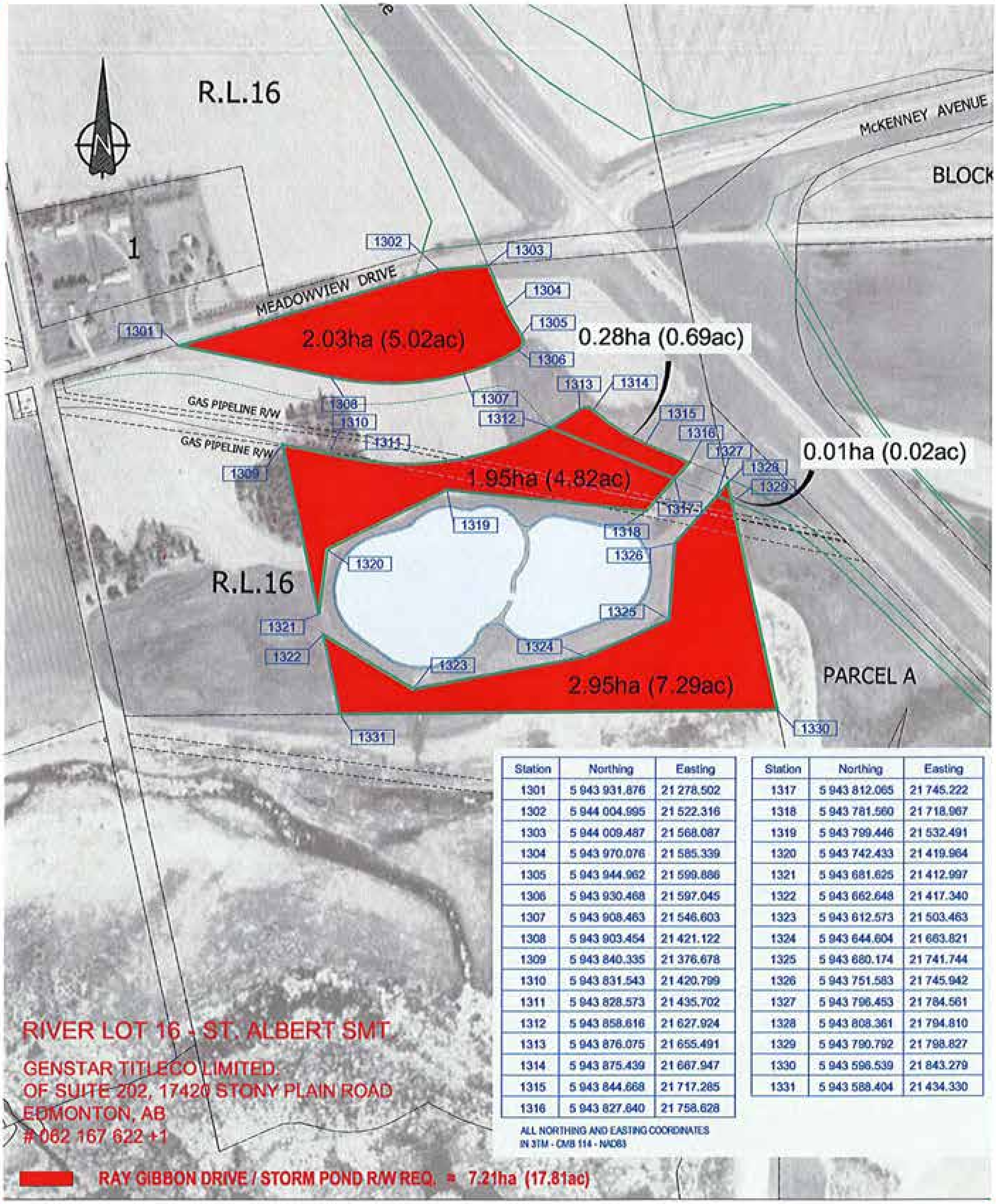
ALL NORTHING AND EASTING COORDINATES IN 3TM - CMB 114 - NAD83

ISL Engineering and Land Services

PLAN SHOWING ADDITIONAL
RIGHT-OF-WAY REQUIREMENTS FOR
PROVINCIAL FREEWAY STANDARD FOR
RAY GIBBON DRIVE
PARCEL A - PLAN 3032 RS

THE CITY OF St. Albert

SCALE: 1:5000 February 2009




| Station | Northing | Easting |
|---|---|---|
| 1301 | 5 943 931.876 | 21 278.502 |
| 1302 | 5 944 004.995 | 21 522.316 |
| 1303 | 5 944 009.487 | 21 568.087 |
| 1304 | 5 943 970.076 | 21 585.339 |
| 1305 | 5 943 944.962 | 21 599.886 |
| 1306 | 5 943 930.468 | 21 597.045 |
| 1307 | 5 943 908.463 | 21 546.603 |
| 1308 | 5 943 903.454 | 21 421.122 |
| 1309 | 5 943 840.335 | 21 376.678 |
| 1310 | 5 943 831.543 | 21 420.799 |
| 1311 | 5 943 828.573 | 21 435.702 |
| 1312 | 5 943 858.616 | 21 627.924 |
| 1313 | 5 943 876.075 | 21 655.491 |
| 1314 | 5 943 875.439 | 21 667.947 |
| 1315 | 5 943 844.668 | 21 717.285 |
| 1316 | 5 943 827.640 | 21 758.628 |

| Station | Northing | Easting |
|---|---|---|
| 1317 | 5 943 812.065 | 21 745.222 |
| 1318 | 5 943 781.560 | 21 718.967 |
| 1319 | 5 943 799.446 | 21 532.491 |
| 1320 | 5 943 742.433 | 21 419.964 |
| 1321 | 5 943 681.625 | 21 412.997 |
| 1322 | 5 943 662.648 | 21 417.340 |
| 1323 | 5 943 612.573 | 21 503.463 |
| 1324 | 5 943 644.604 | 21 663.821 |
| 1325 | 5 943 680.174 | 21 741.744 |
| 1326 | 5 943 751.583 | 21 745.942 |
| 1327 | 5 943 796.453 | 21 784.561 |
| 1328 | 5 943 808.361 | 21 794.810 |
| 1329 | 5 943 790.792 | 21 798.827 |
| 1330 | 5 943 596.539 | 21 843.279 |
| 1331 | 5 943 588.404 | 21 434.330 |

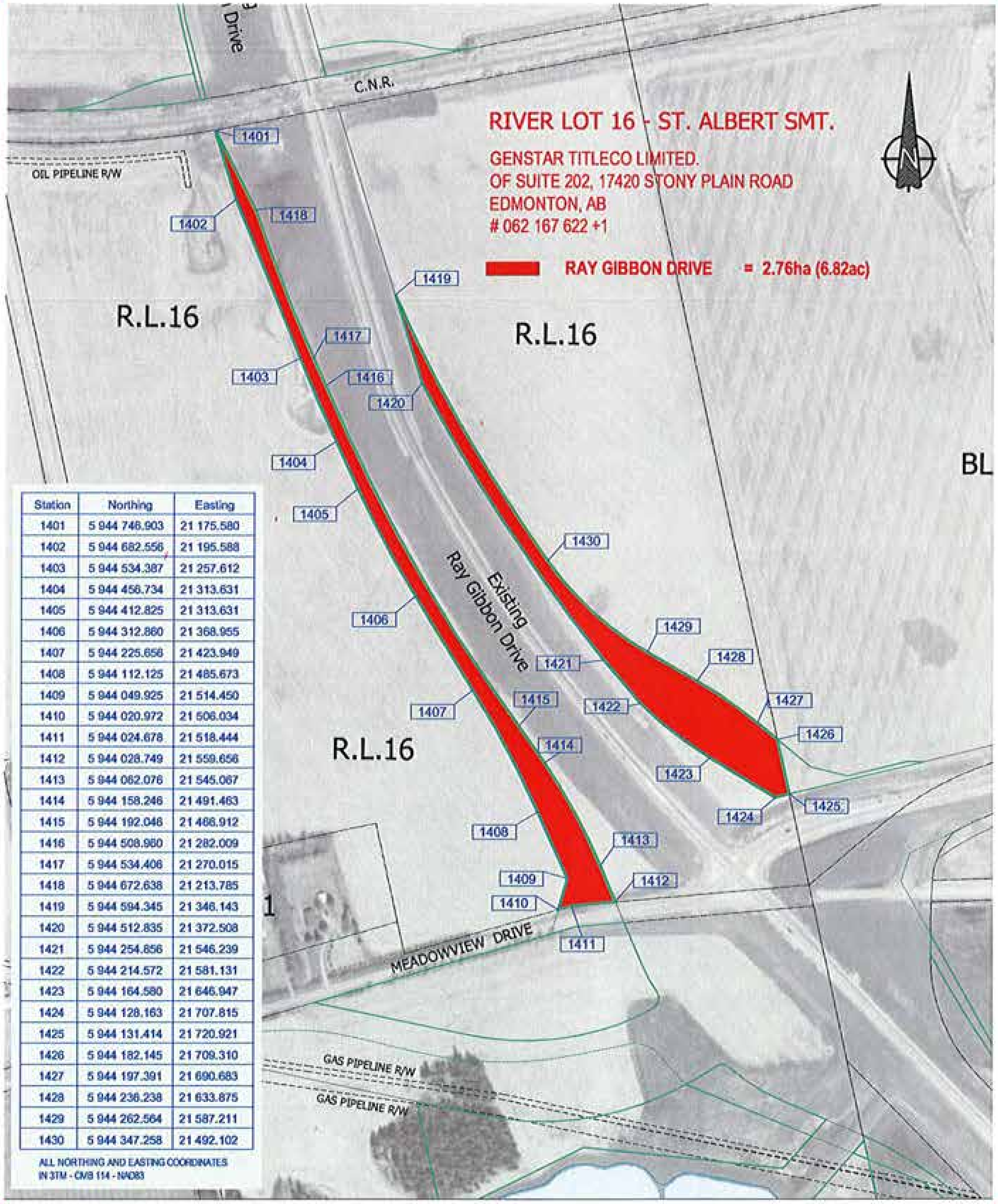
ALL NORTHING AND EASTING COORDINATES IN 3TM - CM8 114 - NAD83

ISL Engineering and Land Services

PLAN SHOWING ADDITIONAL
RIGHT-OF-WAY REQUIREMENTS FOR
PROVINCIAL FREEWAY STANDARD FOR
RAY GIBBON DRIVE
RIVER LOT 16 - ST. ALBERT SETTLEMENT
(Portion S. of Meadowview Road)

THE CITY OF St. Albert

SCALE: 1:5000 February 2009




| Station | Northing | Easting |
|---|---|---|
| 1401 | 5 944 746.903 | 21 175.580 |
| 1402 | 5 944 682.556 | 21 195.588 |
| 1403 | 5 944 534.387 | 21 257.612 |
| 1404 | 5 944 456.734 | 21 313.631 |
| 1405 | 5 944 412.825 | 21 313.631 |
| 1406 | 5 944 312.860 | 21 368.955 |
| 1407 | 5 944 225.656 | 21 423.949 |
| 1408 | 5 944 112.125 | 21 485.673 |
| 1409 | 5 944 049.925 | 21 514.450 |
| 1410 | 5 944 020.972 | 21 506.034 |
| 1411 | 5 944 024.678 | 21 518.444 |
| 1412 | 5 944 028.749 | 21 559.656 |
| 1413 | 5 944 062.076 | 21 545.067 |
| 1414 | 5 944 158.246 | 21 491.463 |
| 1415 | 5 944 192.046 | 21 466.912 |
| 1416 | 5 944 508.980 | 21 282.009 |
| 1417 | 5 944 534.406 | 21 270.015 |
| 1418 | 5 944 672.638 | 21 213.785 |
| 1419 | 5 944 594.345 | 21 346.143 |
| 1420 | 5 944 512.835 | 21 372.508 |
| 1421 | 5 944 254.856 | 21 546.239 |
| 1422 | 5 944 214.572 | 21 581.131 |
| 1423 | 5 944 164.580 | 21 646.947 |
| 1424 | 5 944 128.163 | 21 707.815 |
| 1425 | 5 944 131.414 | 21 720.921 |
| 1426 | 5 944 182.145 | 21 709.310 |
| 1427 | 5 944 197.391 | 21 690.683 |
| 1428 | 5 944 236.238 | 21 633.875 |
| 1429 | 5 944 262.564 | 21 587.211 |
| 1430 | 5 944 347.258 | 21 492.102 |

ALL NORTHING AND EASTING COORDINATES
IN 3TM - CM3 114 - NAD83

PLAN SHOWING ADDITIONAL RIGHT-OF-WAY
REQUIREMENTS FOR PROVINCIAL FREEWAY STANDARD
FOR
RAY GIBBON DRIVE
RIVER LOT 16 - ST. ALBERT SETTLEMENT
(Portion Between Meadowview Road and CNR Right-of-Way)

ISL Engineering and Land Services

THE CITY OF St. Albert

SCALE: 1:5000 February 2009

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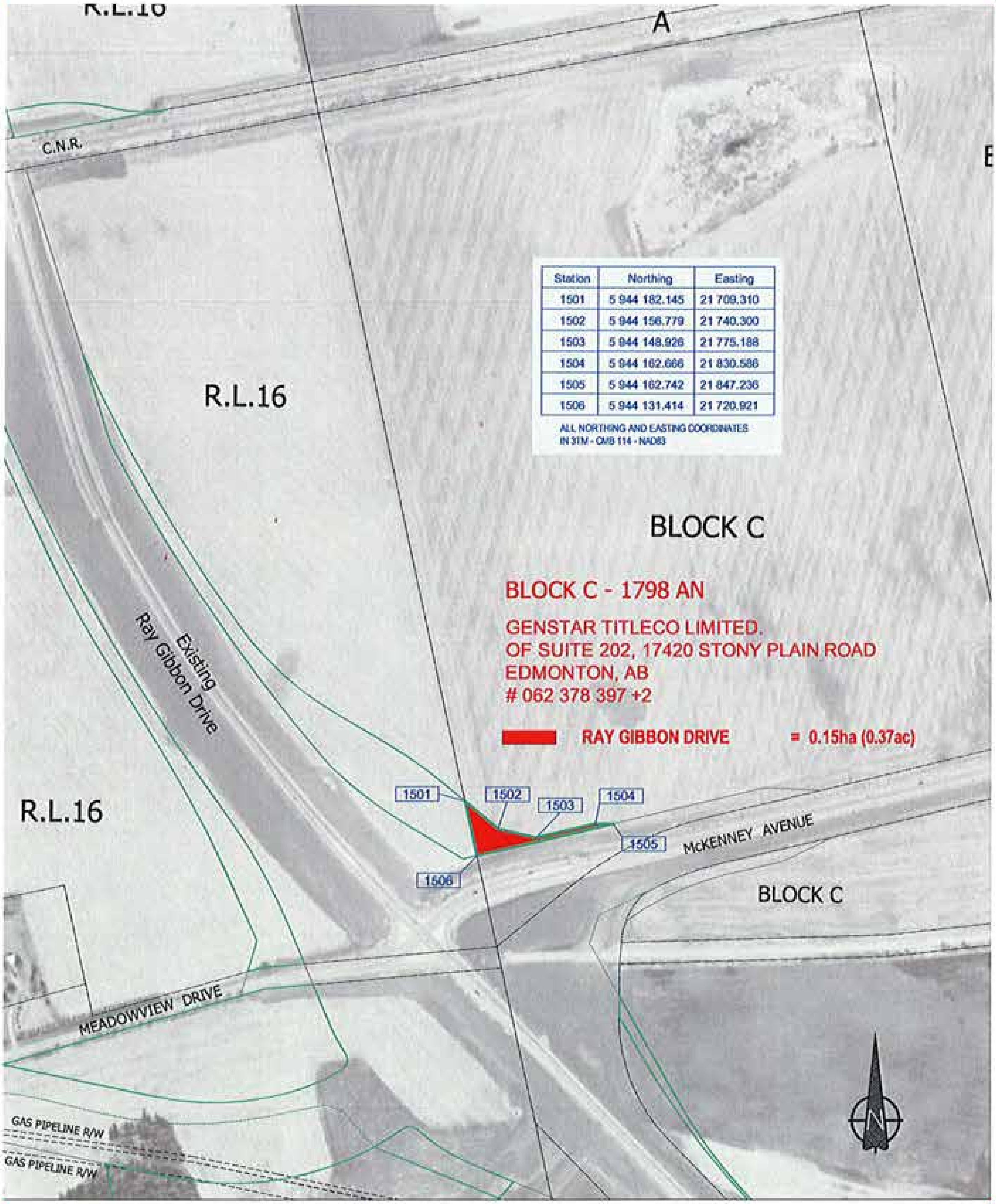



| Station | Northing | Easting |
|---|---|---|
| 1501 | 5 944 182.145 | 21 709.310 |
| 1502 | 5 944 156.779 | 21 740.300 |
| 1503 | 5 944 148.926 | 21 775.188 |
| 1504 | 5 944 162.666 | 21 830.586 |
| 1505 | 5 944 162.742 | 21 847.236 |
| 1506 | 5 944 131.414 | 21 720.921 |

ALL NORTHING AND EASTING COORDINATES IN 3TM - CMB 114 - NAD83

ISL Engineering and Land Services

PLAN SHOWING ADDITIONAL
RIGHT-OF-WAY REQUIREMENTS FOR
PROVINCIAL FREEWAY STANDARD FOR
RAY GIBBON DRIVE
BLOCK C - PLAN 1798 AN

THE CITY OF St. Albert

SCALE: 1:5000 February 2009


| Station | Northing | Easting |
|---|---|---|
| 1601 | 5 94 5233.686 | 20 854.727 |
| 1602 | 5 945 235.523 | 21 117.631 |
| 1603 | 5 945 171.471 | 21 118.255 |
| 1604 | 5 945 107.365 | 21 120.022 |
| 1605 | 5 945 004.499 | 21 124.634 |
| 1606 | 5 944 953.043 | 21 129.071 |
| 1607 | 5 944 851.021 | 21 145.592 |
| 1608 | 5 944 775.937 | 21 166.446 |
| 1609 | 5 944 775.124 | 21 161.788 |
| 1610 | 5 945 053.800 | 21 112.731 |
| 1611 | 5 945 198.197 | 21 104.626 |
| 1612 | 5 945 208.979 | 21 094.097 |
| 1613 | 5 945 228.029 | 20 856.024 |
| 1614 | 5 945 220.123 | 20 954.831 |
| 1615 | 5 945 105.810 | 21 025.921 |
| 1616 | 5 945 030.891 | 21 114.237 |
| 1617 | 5 944 931.123 | 21 238.716 |
| 1618 | 5 945 003.584 | 21 217.350 |
| 1619 | 5 945 011.745 | 21 215.690 |
| 1620 | 5 945 060.805 | 21 205.692 |
| 1621 | 5 945 207.998 | 21 197.574 |
| 1622 | 5 945 216.893 | 21 207.084 |
| 1623 | 5 945 225.916 | 21 292.750 |
| 1624 | 5 945 236.692 | 21 313.620 |
| 1625 | 5 945 237.969 | 21 467.637 |
| 1626 | 5 945 235.795 | 21 468.135 |
| 1627 | 5 945 216.673 | 21 223.688 |
| 1628 | 5 945 205.903 | 21 214.194 |
| 1629 | 5 945 099.950 | 21 219.234 |
| 1630 | 5 944 968.438 | 21 232.780 |

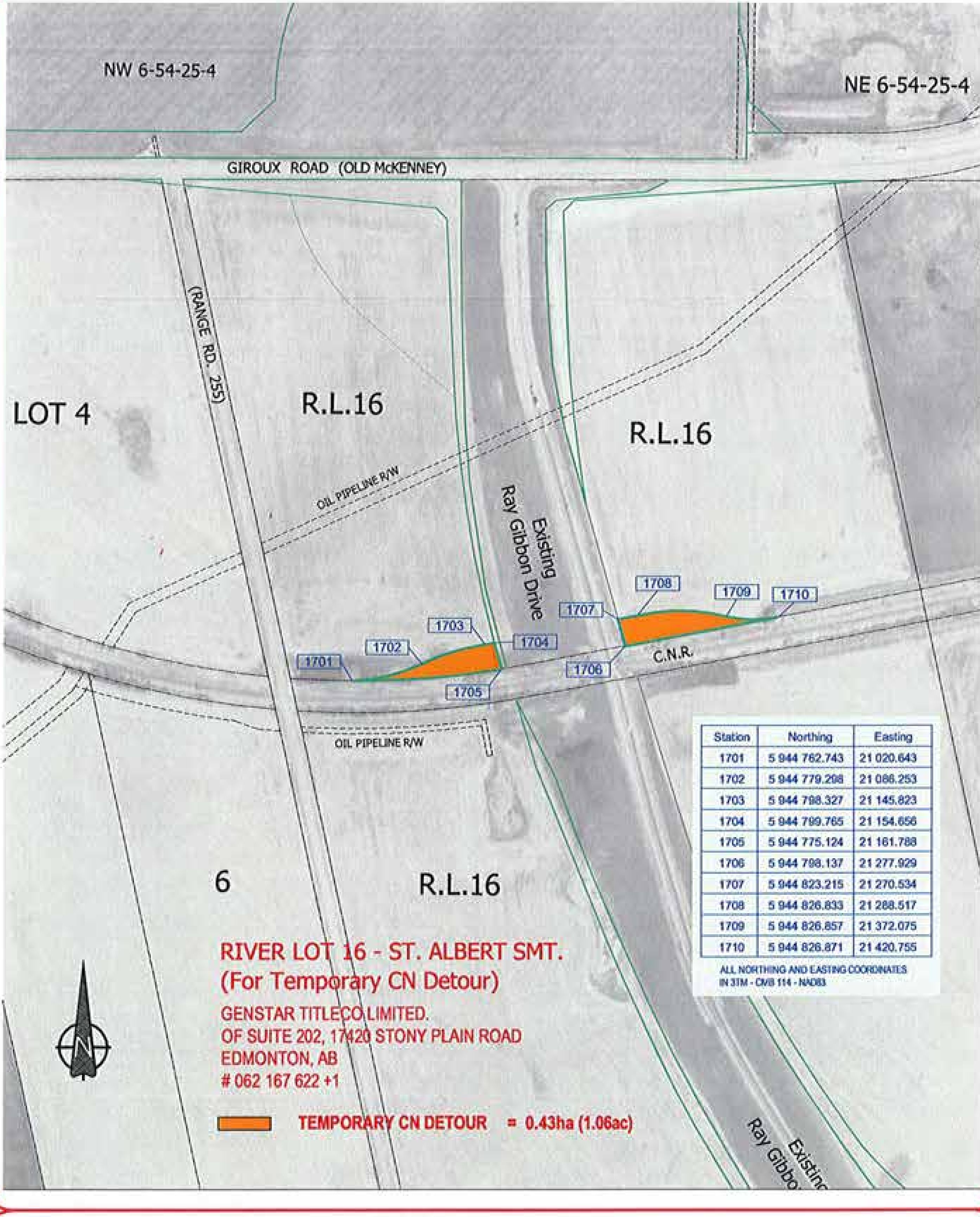
ALL NORTHING AND EASTING COORDINATES IN 3TM - CMB 114 - NAD83

ISL Engineering and Land Services

PLAN SHOWING ADDITIONAL
RIGHT-OF-WAY REQUIREMENTS FOR
PROVINCIAL FREEWAY STANDARD FOR
RAY GIBBON DRIVE
RIVER LOT 16 - ST. ALBERT SETTLEMENT
(Portion N. of CNR Right-of-Way)

THE CITY OF St. Albert

SCALE: 1:5000 February 2009




| Station | Northing | Easting |
|---|---|---|
| 1701 | 5 944 762.743 | 21 020.643 |
| 1702 | 5 944 779.208 | 21 086.253 |
| 1703 | 5 944 798.327 | 21 145.823 |
| 1704 | 5 944 799.765 | 21 154.656 |
| 1705 | 5 944 775.124 | 21 161.788 |
| 1706 | 5 944 798.137 | 21 277.929 |
| 1707 | 5 944 823.215 | 21 270.534 |
| 1708 | 5 944 826.833 | 21 288.517 |
| 1709 | 5 944 826.857 | 21 372.075 |
| 1710 | 5 944 826.871 | 21 420.755 |

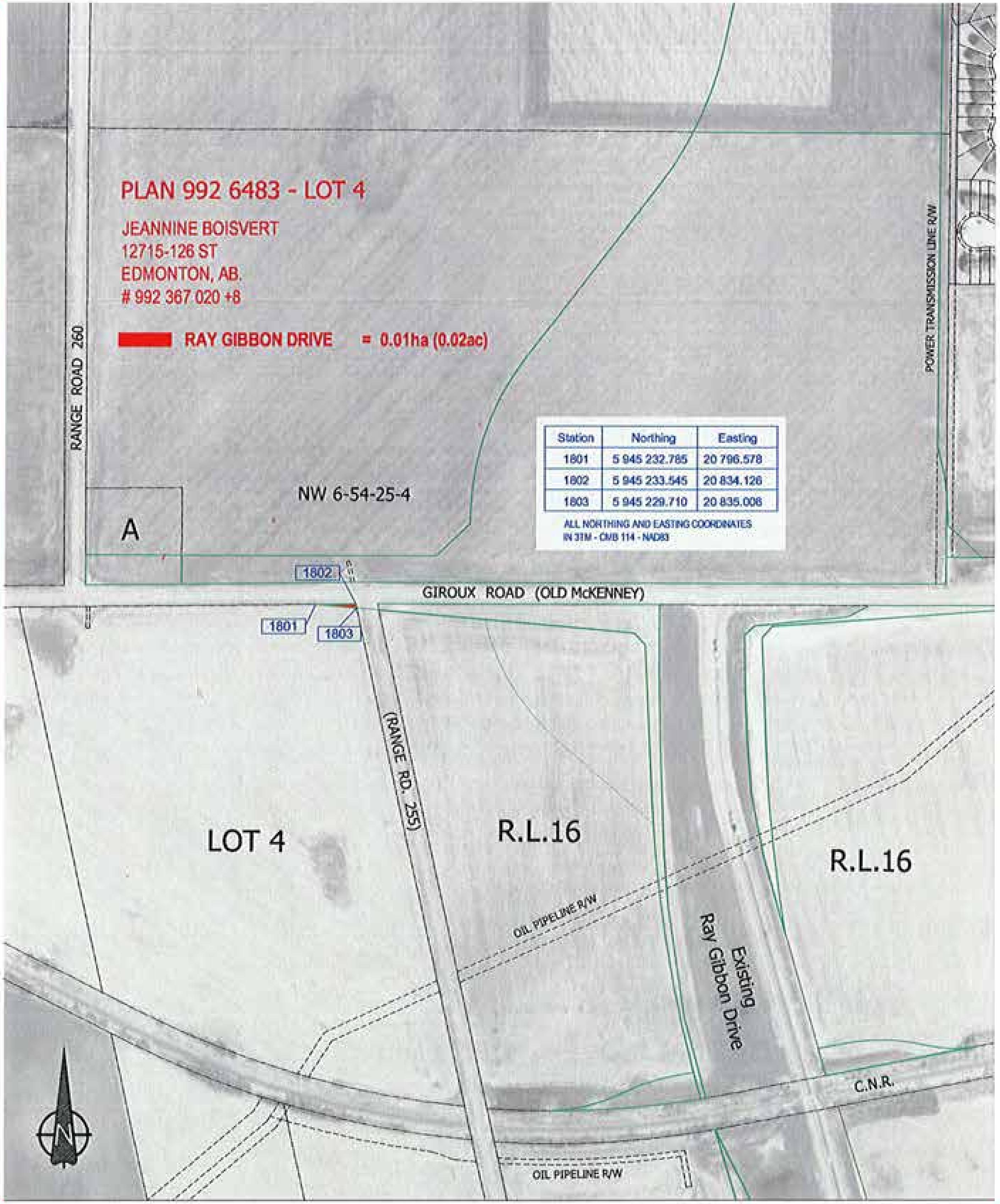
ALL NORTHING AND EASTING COORDINATES IN 3TM - CMB 114 - NAD83

ISL Engineering and Land Services

PLAN SHOWING ADDITIONAL
RIGHT-OF-WAY REQUIREMENTS FOR
PROVINCIAL FREEWAY STANDARD FOR
RAY GIBBON DRIVE
RIVER LOT 16 - ST. ALBERT SETTLEMENT
(FOR TEMPORARY CN DETOUR)

THE CITY OF St. Albert

SCALE: 1:5000 February 2009




| Station | Northing | Easting |
|---|---|---|
| 1801 | 5 945 232.785 | 20 796.578 |
| 1802 | 5 945 233.545 | 20 834.126 |
| 1803 | 5 945 229.710 | 20 835.006 |

ALL NORTHING AND EASTING COORDINATES IN 3TM - CM 114 - NAD83

ISL Engineering and Land Services

PLAN SHOWING ADDITIONAL
RIGHT-OF-WAY REQUIREMENTS FOR
PROVINCIAL FREEWAY STANDARD FOR
RAY GIBBON DRIVE
LOT 4 - PLAN 992 6483

THE CITY OF St. Albert

SCALE: 1:5000 February 2009


| Station | Northing | Easting |
|---|---|---|
| 1901 | 5 945 235.795 | 21 468.135 |
| 1902 | 5 945 237.969 | 21 467.637 |
| 1903 | 5 945 238.197 | 21 498.839 |

ALL NORTHING AND EASTING COORDINATES IN 3TM - CM8 114 - NAD83

ISL Engineering and Land Services

PLAN SHOWING ADDITIONAL
RIGHT-OF-WAY REQUIREMENTS FOR
PROVINCIAL FREEWAY STANDARD FOR
RAY GIBBON DRIVE
BLOCK 1B - PLAN 922 2031

THE CITY OF St. Albert

SCALE: 1:5000 February 2009


| Station | Northing | Easting |
|---|---|---|
| 2001 | 5 945 277.393 | 20 671.357 |
| 2002 | 5 945 279.070 | 20 908.902 |
| 2003 | 5 945 309.265 | 20 939.889 |
| 2004 | 5 945 323.765 | 20 940.366 |
| 2005 | 5 945 466.378 | 20 990.865 |
| 2006 | 5 945 628.347 | 21 113.412 |
| 2007 | 5 945 676.987 | 21 143.680 |
| 2008 | 5 945 677.773 | 21 375.116 |
| 2009 | 5 945 384.897 | 21 375.930 |
| 2010 | 5 945 331.972 | 21 385.669 |
| 2011 | 5 945 282.416 | 21 385.196 |
| 2012 | 5 945 257.569 | 21 385.282 |
| 2013 | 5 945 257.507 | 21 376.283 |
| 2014 | 5 945 253.747 | 20 833.797 |
| 2015 | 5 945 253.659 | 20 829.470 |
| 2016 | 5 945 250.433 | 20 671.558 |

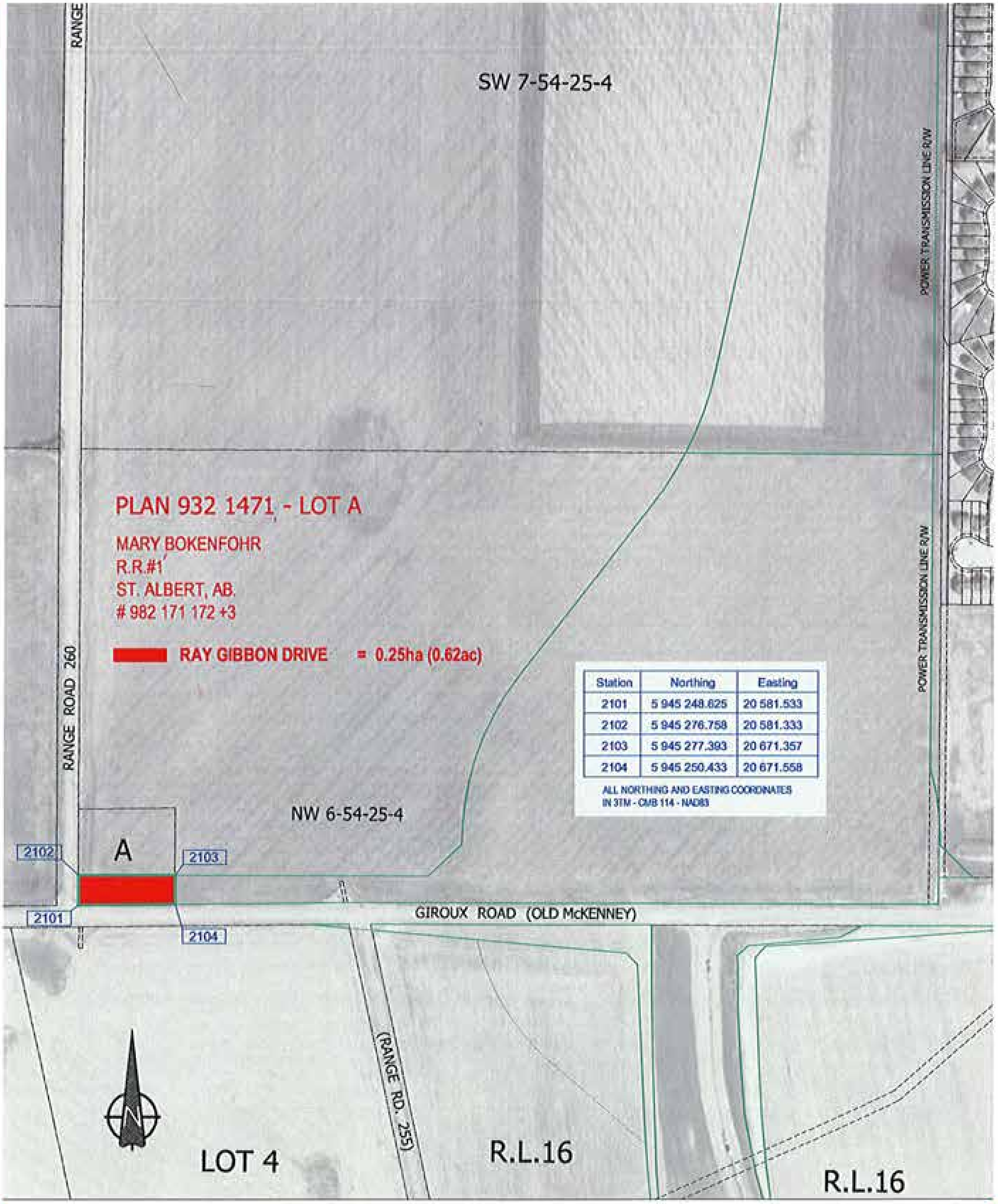
ALL NORTHING AND EASTING COORDINATES IN 3TM - CMB 114 - NAD83

ISL Engineering and Land Services

PLAN SHOWING ADDITIONAL
RIGHT-OF-WAY REQUIREMENTS FOR
PROVINCIAL FREEWAY STANDARD FOR
RAY GIBBON DRIVE
NW6 - TWP 54-25-W4

THE CITY OF St. Albert

SCALE: 1:5000 February 2009




| Station | Northing | Easting |
|---|---|---|
| 2101 | 5 945 248.625 | 20 581.533 |
| 2102 | 5 945 276.758 | 20 581.333 |
| 2103 | 5 945 277.393 | 20 671.357 |
| 2104 | 5 945 250.433 | 20 671.558 |

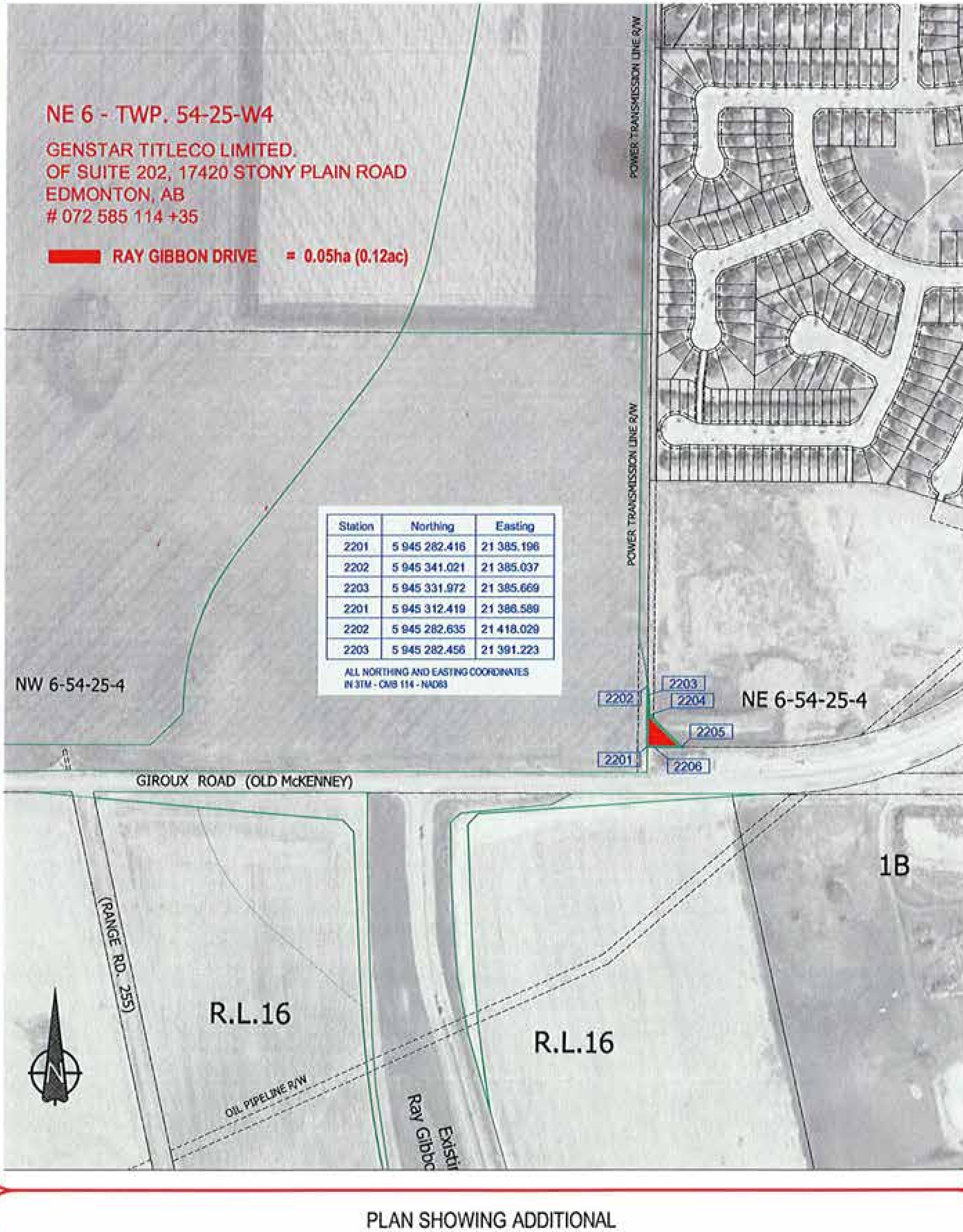
ALL NORTHING AND EASTING COORDINATES IN 3TM - CM 114 - NAD83

ISL Engineering and Land Services

PLAN SHOWING ADDITIONAL
RIGHT-OF-WAY REQUIREMENTS FOR
PROVINCIAL FREEWAY STANDARD FOR
RAY GIBBON DRIVE
LOT A - PLAN 932 1471

THE CITY OF St. Albert

SCALE: 1:5000 February 2009




| Station | Northing | Easting |
|---|---|---|
| 2201 | 5 945 282.416 | 21 385.196 |
| 2202 | 5 945 341.021 | 21 385.037 |
| 2203 | 5 945 331.972 | 21 385.669 |
| 2201 | 5 945 312.419 | 21 386.589 |
| 2202 | 5 945 282.635 | 21 418.029 |
| 2203 | 5 945 282.456 | 21 391.223 |

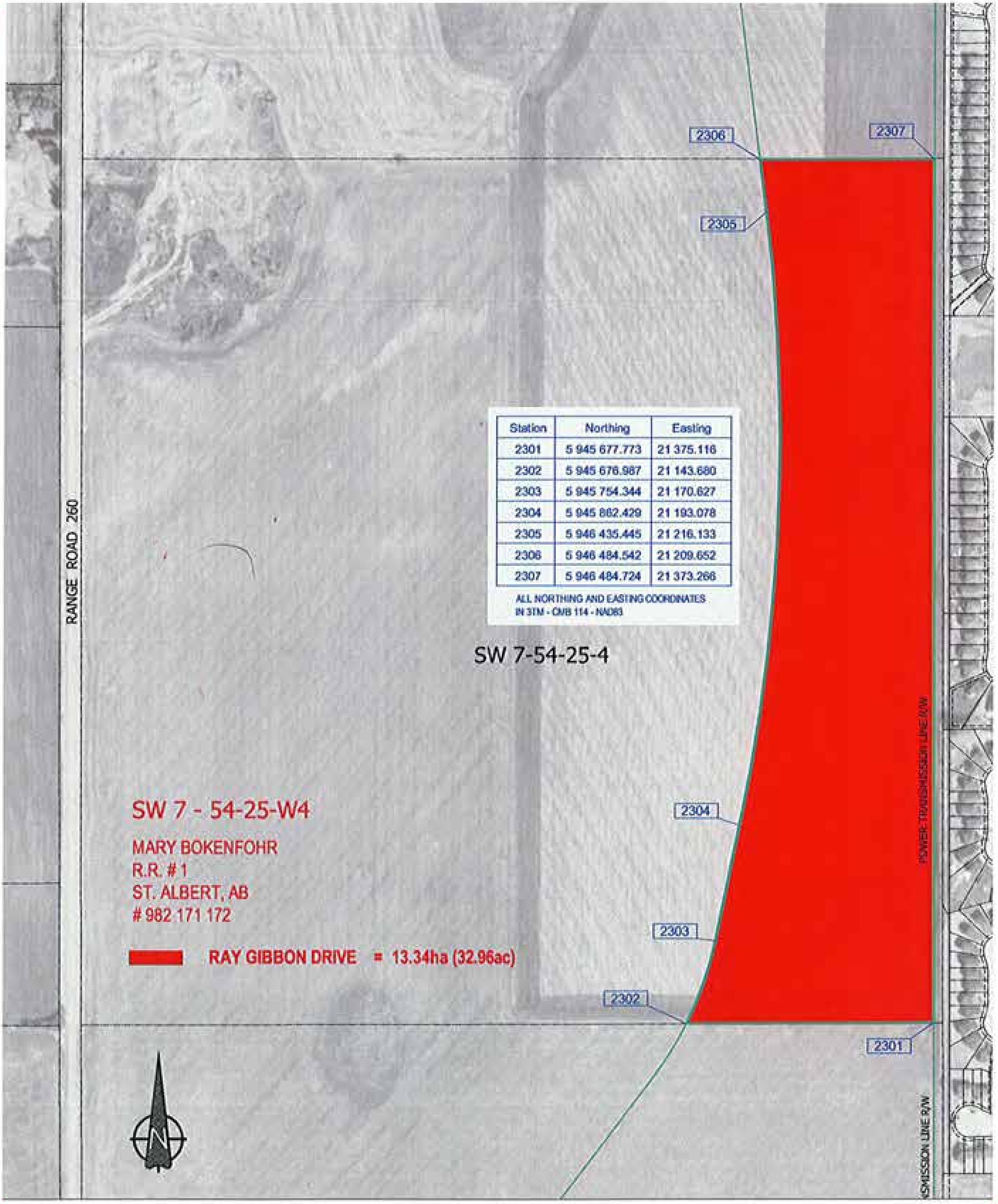
ALL NORTHING AND EASTING COORDINATES
IN 3TM - CMB 114 - NAD83

ISL Engineering and Land Services

PLAN SHOWING ADDITIONAL
RIGHT-OF-WAY REQUIREMENTS FOR
PROVINCIAL FREEWAY STANDARD FOR
RAY GIBBON DRIVE
NE6 - TWP 54-25-W4

THE CITY OF St. Albert

SCALE: 1:5000 February 2009




| Station | Northing | Easting |
|---|---|---|
| 2301 | 5 945 677.773 | 21 375.116 |
| 2302 | 5 945 676.987 | 21 143.680 |
| 2303 | 5 945 754.344 | 21 170.627 |
| 2304 | 5 945 862.429 | 21 193.078 |
| 2305 | 5 946 435.445 | 21 216.133 |
| 2306 | 5 946 484.542 | 21 209.652 |
| 2307 | 5 946 484.724 | 21 373.266 |

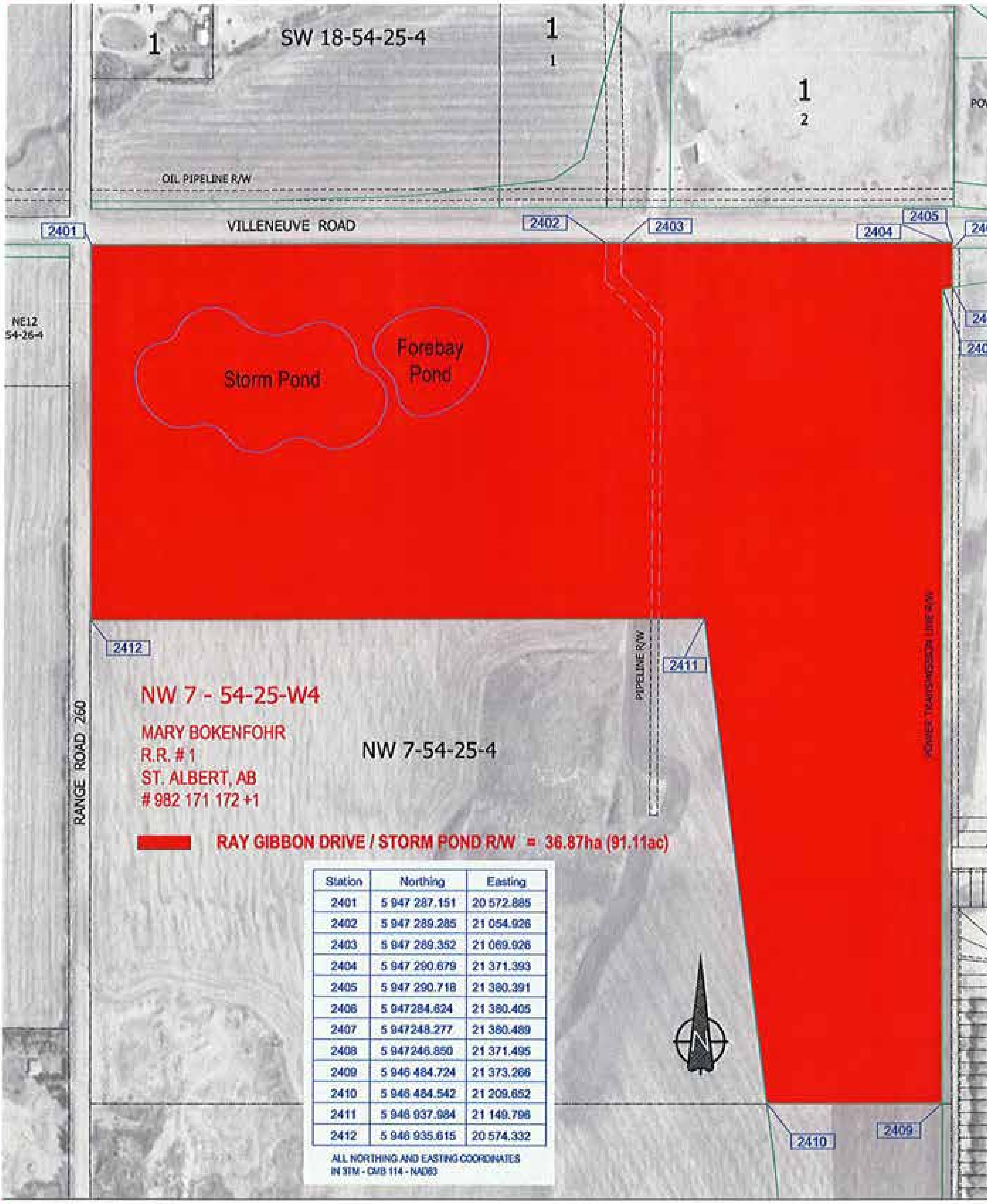
ALL NORTHING AND EASTING COORDINATES IN 3TM - CMB 114 - NAD83

ISL Engineering and Land Services

PLAN SHOWING ADDITIONAL
RIGHT-OF-WAY REQUIREMENTS FOR
PROVINCIAL FREEWAY STANDARD FOR
RAY GIBBON DRIVE
SW7 - TWP 54-25-W4

THE CITY OF St. Albert

SCALE: 1:5000 February 2009




| Station | Northing | Easting |
|---|---|---|
| 2401 | 5 947 287.151 | 20 572.885 |
| 2402 | 5 947 289.285 | 21 054.926 |
| 2403 | 5 947 289.352 | 21 069.926 |
| 2404 | 5 947 290.679 | 21 371.393 |
| 2405 | 5 947 290.718 | 21 380.391 |
| 2406 | 5 947284.624 | 21 380.405 |
| 2407 | 5 947248.277 | 21 380.489 |
| 2408 | 5 947246.850 | 21 371.495 |
| 2409 | 5 946 484.724 | 21 373.266 |
| 2410 | 5 946 484.542 | 21 209.652 |
| 2411 | 5 946 937.984 | 21 149.796 |
| 2412 | 5 946 935.615 | 20 574.332 |

ALL NORTHING AND EASTING COORDINATES
IN 3TM - CM8 114 - NAD83

ISL Engineering and Land Services

PLAN SHOWING ADDITIONAL
RIGHT-OF-WAY REQUIREMENTS FOR
PROVINCIAL FREEWAY STANDARD FOR
RAY GIBBON DRIVE
NW7 - TWP 54-25-W4

THE CITY OF St. Albert

SCALE: 1:5000 February 2009

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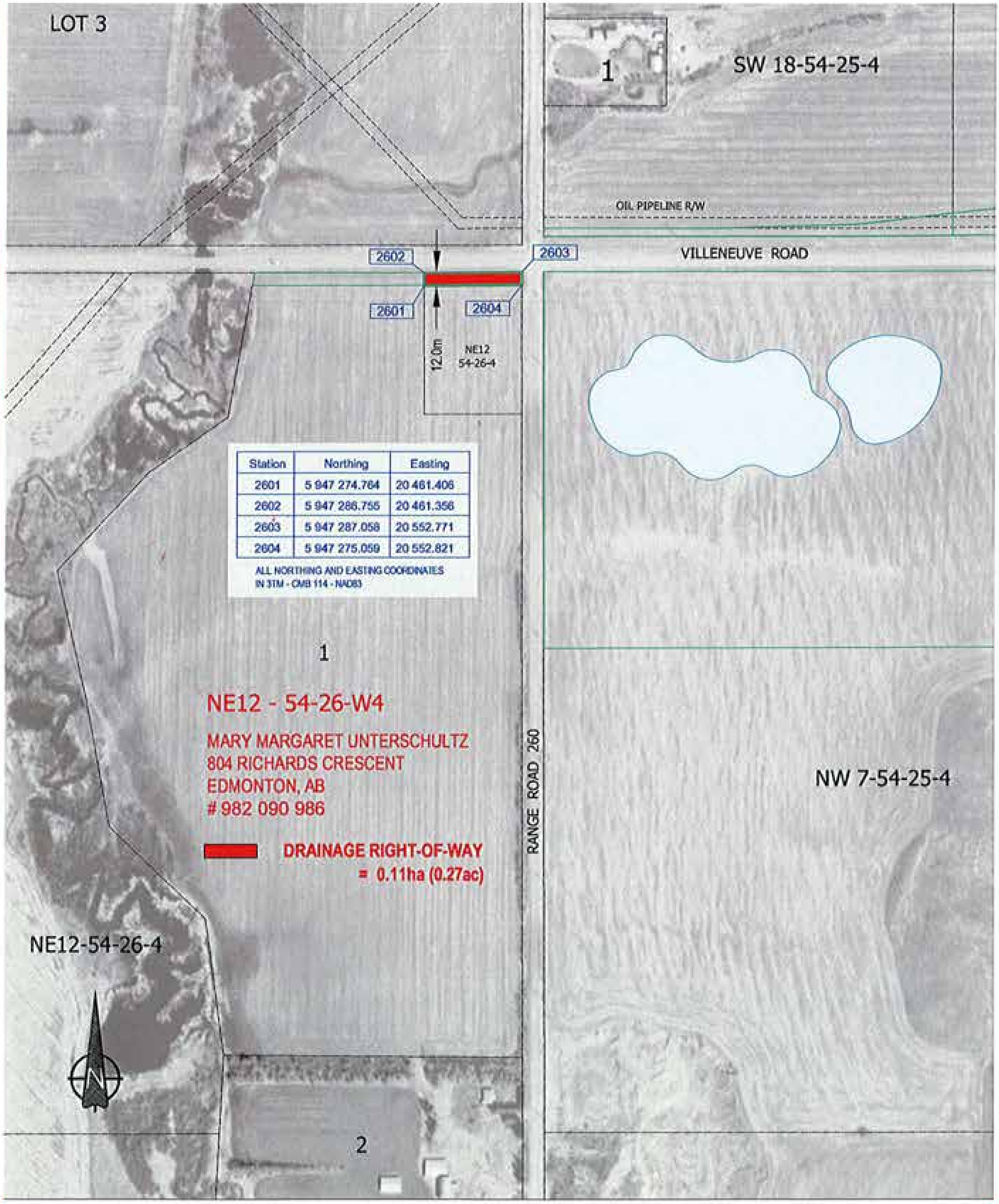



| Station | Northing | Easting |
|---|---|---|
| 2601 | 5 947 274.764 | 20 461.406 |
| 2602 | 5 947 286.755 | 20 461.356 |
| 2603 | 5 947 287.058 | 20 552.771 |
| 2604 | 5 947 275.059 | 20 552.821 |

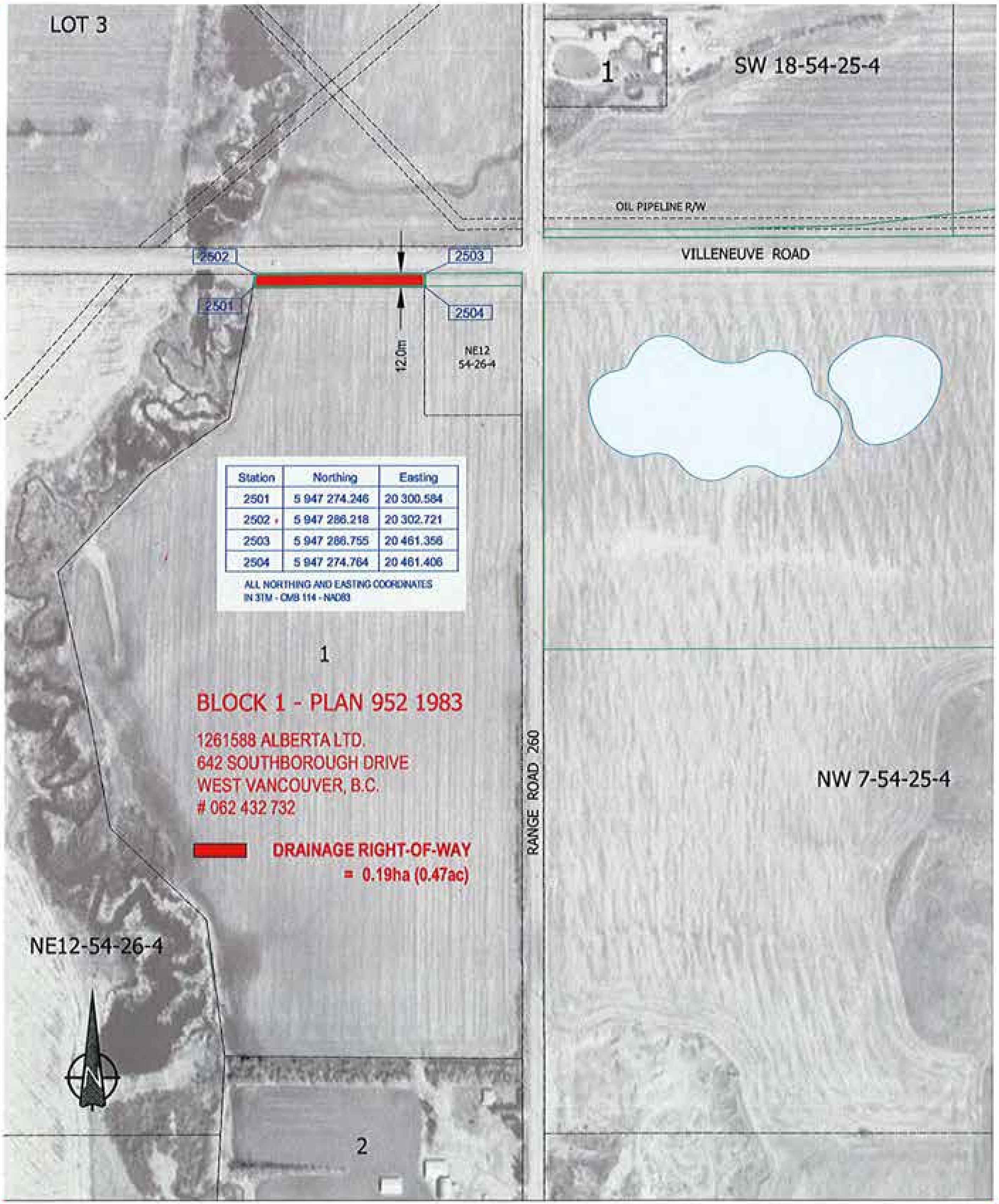
ALL NORTHING AND EASTING COORDINATES IN 3TM - CMB 114 - NAD83

ISL Engineering and Land Services

PLAN SHOWING ADDITIONAL
RIGHT-OF-WAY REQUIREMENTS FOR
PROVINCIAL FREEWAY STANDARD FOR
RAY GIBBON DRIVE
NE12 - TWP 54-26-W4

THE CITY OF St. Albert

SCALE: 1:5000 February 2009




| Station | Northing | Easting |
|---|---|---|
| 2501 | 5 947 274.246 | 20 300.584 |
| 2502 | 5 947 286.218 | 20 302.721 |
| 2503 | 5 947 286.755 | 20 461.356 |
| 2504 | 5 947 274.764 | 20 461.406 |

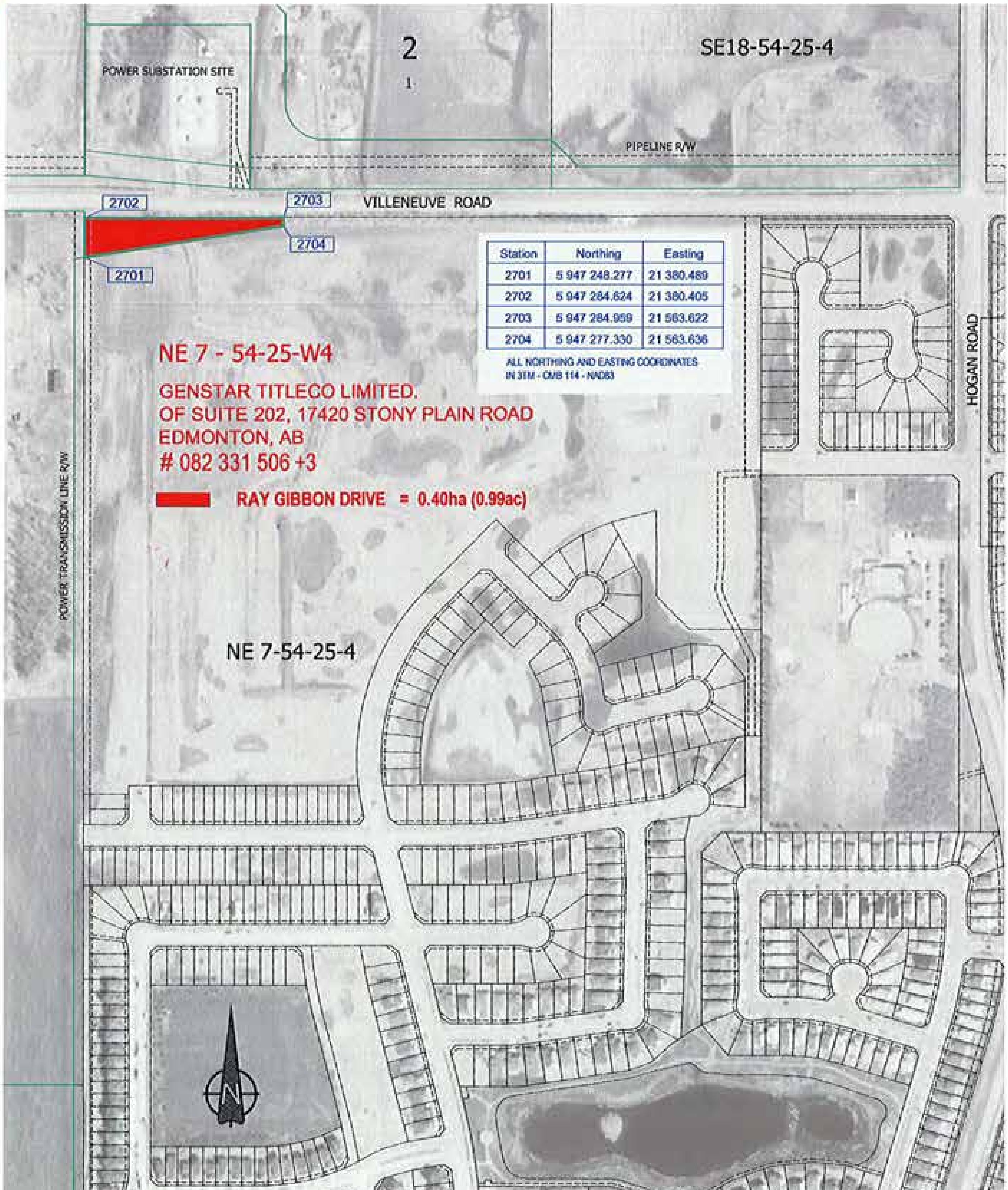
ALL NORTHING AND EASTING COORDINATES IN 3TM - CMB 114 - NAD83

ISL Engineering and Land Services

PLAN SHOWING ADDITIONAL
RIGHT-OF-WAY REQUIREMENTS FOR
PROVINCIAL FREEWAY STANDARD FOR
RAY GIBBON DRIVE
BLOCK 1 - PLAN 952 1983

THE CITY OF St. Albert

SCALE: 1:5000 February 2009




| Station | Northing | Easting |
|---|---|---|
| 2701 | 5 947 248.277 | 21 380.489 |
| 2702 | 5 947 284.624 | 21 380.405 |
| 2703 | 5 947 284.959 | 21 563.622 |
| 2704 | 5 947 277.330 | 21 563.636 |

ALL NORTHING AND EASTING COORDINATES IN 3TM - CM 114 - NAD83

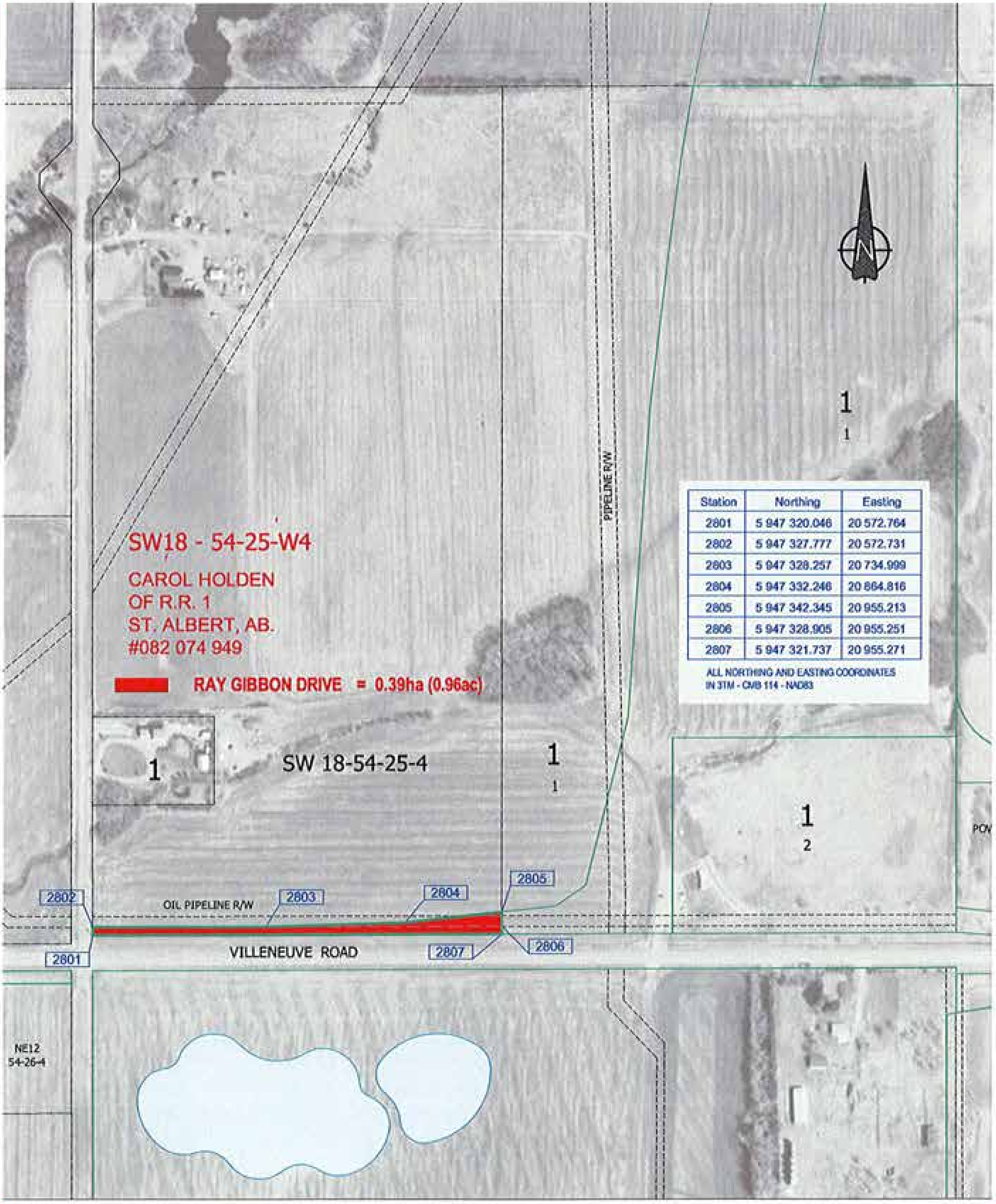
ISL Engineering and Land Services

PLAN SHOWING ADDITIONAL
RIGHT-OF-WAY REQUIREMENTS FOR
PROVINCIAL FREEWAY STANDARD FOR
RAY GIBBON DRIVE
NE7 - TWP 54-25-W4

THE CITY OF St. Albert

SCALE: 1:5000 February 2009

Feb 05, 2009 - 9:29am User: dh




| Station | Northing | Easting |
|---|---|---|
| 2801 | 5 947 320.046 | 20 572.764 |
| 2802 | 5 947 327.777 | 20 572.731 |
| 2803 | 5 947 328.257 | 20 734.999 |
| 2804 | 5 947 332.246 | 20 864.816 |
| 2805 | 5 947 342.345 | 20 955.213 |
| 2806 | 5 947 328.905 | 20 955.251 |
| 2807 | 5 947 321.737 | 20 955.271 |

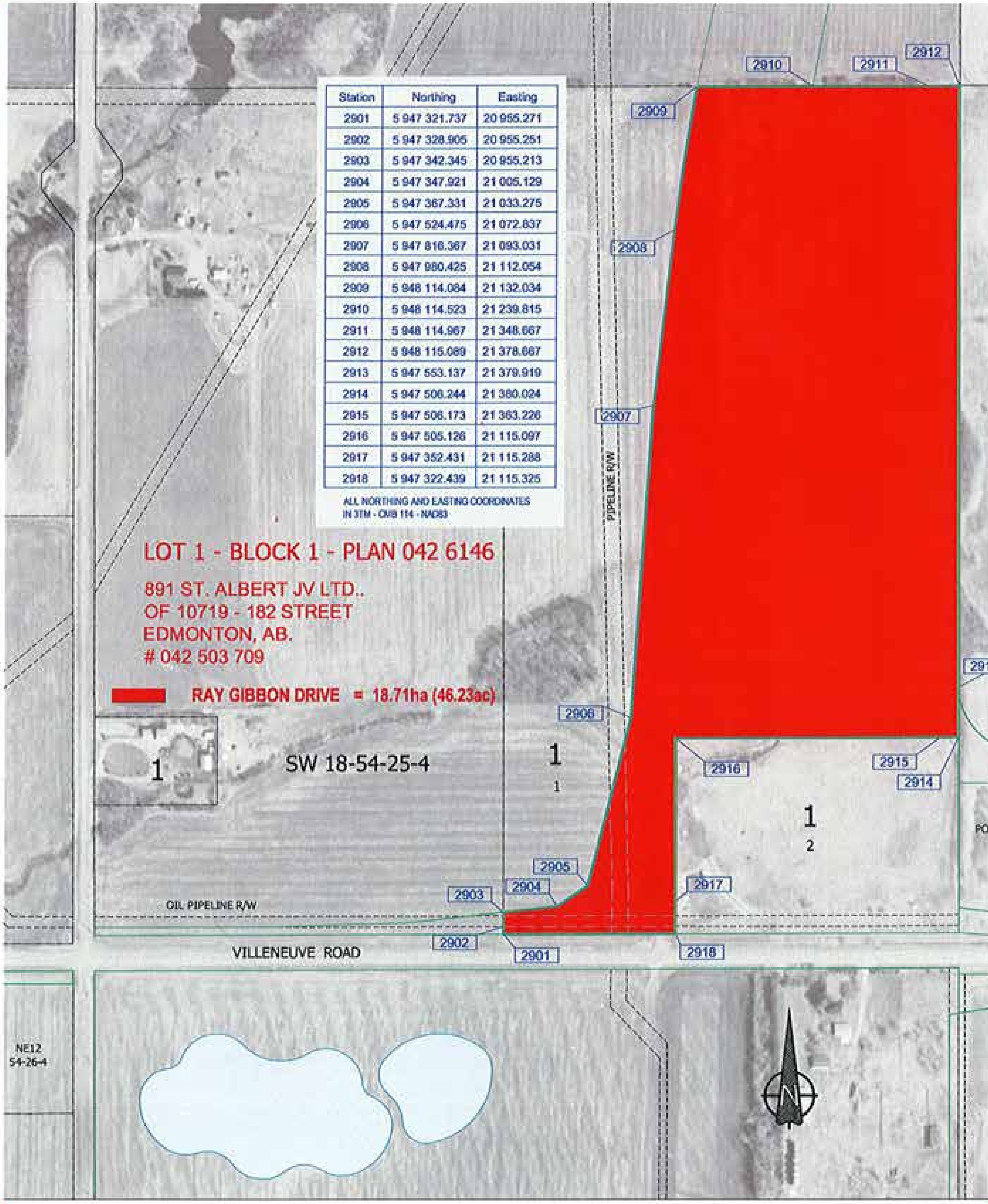
ISL Engineering and Land Services

PLAN SHOWING ADDITIONAL
RIGHT-OF-WAY REQUIREMENTS FOR
PROVINCIAL FREEWAY STANDARD FOR
RAY GIBBON DRIVE
SW18 - TWP 54-25-W4

THE CITY OF St. Albert

SCALE: 1:5000 February 2009

Feb 05, 2009 - 9:29am User: ch




| Station | Northing | Easting |
|---|---|---|
| 2901 | 5 947 321.737 | 20 955.271 |
| 2902 | 5 947 328.905 | 20 955.251 |
| 2903 | 5 947 342.345 | 20 955.213 |
| 2904 | 5 947 347.921 | 21 005.129 |
| 2905 | 5 947 367.331 | 21 033.275 |
| 2906 | 5 947 524.475 | 21 072.837 |
| 2907 | 5 947 816.367 | 21 093.031 |
| 2908 | 5 947 980.425 | 21 112.054 |
| 2909 | 5 948 114.084 | 21 132.034 |
| 2910 | 5 948 114.523 | 21 239.815 |
| 2911 | 5 948 114.967 | 21 348.667 |
| 2912 | 5 948 115.089 | 21 378.667 |
| 2913 | 5 947 553.137 | 21 379.919 |
| 2914 | 5 947 506.244 | 21 380.024 |
| 2915 | 5 947 506.173 | 21 363.226 |
| 2916 | 5 947 505.126 | 21 115.097 |
| 2917 | 5 947 352.431 | 21 115.288 |
| 2918 | 5 947 322.439 | 21 115.325 |

ALL NORTHING AND EASTING COORDINATES IN 3TM - CM 114 - NAD83

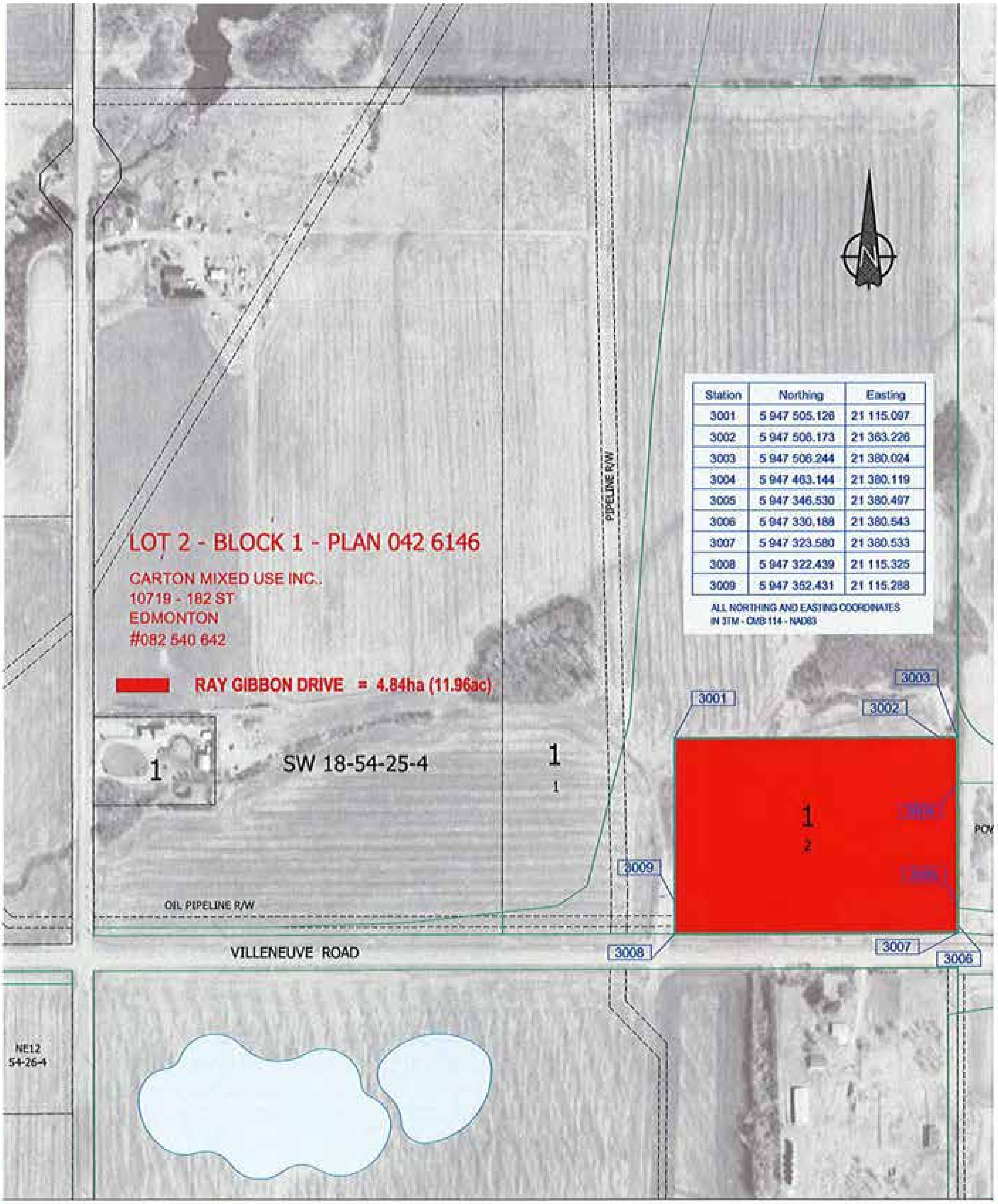
ISL Engineering and Land Services

# PLAN SHOWING ADDITIONAL RIGHT-OF-WAY REQUIREMENTS FOR PROVINCIAL FREEWAY STANDARD FOR RAY GIBBON DRIVE LOT 1 - BLOCK 1 - PLAN 042 6146

The City of St. Albert

SCALE: 1:5000 February 2009

Feb 05, 2009 - 9:29am User: dh




| Station | Northing | Easting |
|---|---|---|
| 3001 | 5 947 505.126 | 21 115.097 |
| 3002 | 5 947 506.173 | 21 363.226 |
| 3003 | 5 947 506.244 | 21 380.024 |
| 3004 | 5 947 463.144 | 21 380.119 |
| 3005 | 5 947 346.530 | 21 380.497 |
| 3006 | 5 947 330.188 | 21 380.543 |
| 3007 | 5 947 323.580 | 21 380.533 |
| 3008 | 5 947 322.439 | 21 115.325 |
| 3009 | 5 947 352.431 | 21 115.288 |

ALL NORTHING AND EASTING COORDINATES IN 3TM - CM8 114 - NAD83

ISL Engineering and Land Services

PLAN SHOWING ADDITIONAL
RIGHT-OF-WAY REQUIREMENTS FOR
PROVINCIAL FREEWAY STANDARD FOR
RAY GIBBON DRIVE
LOT 2 - BLOCK 1 - PLAN 042 6146

THE CITY OF St. Albert

SCALE: 1:5000 February 2009

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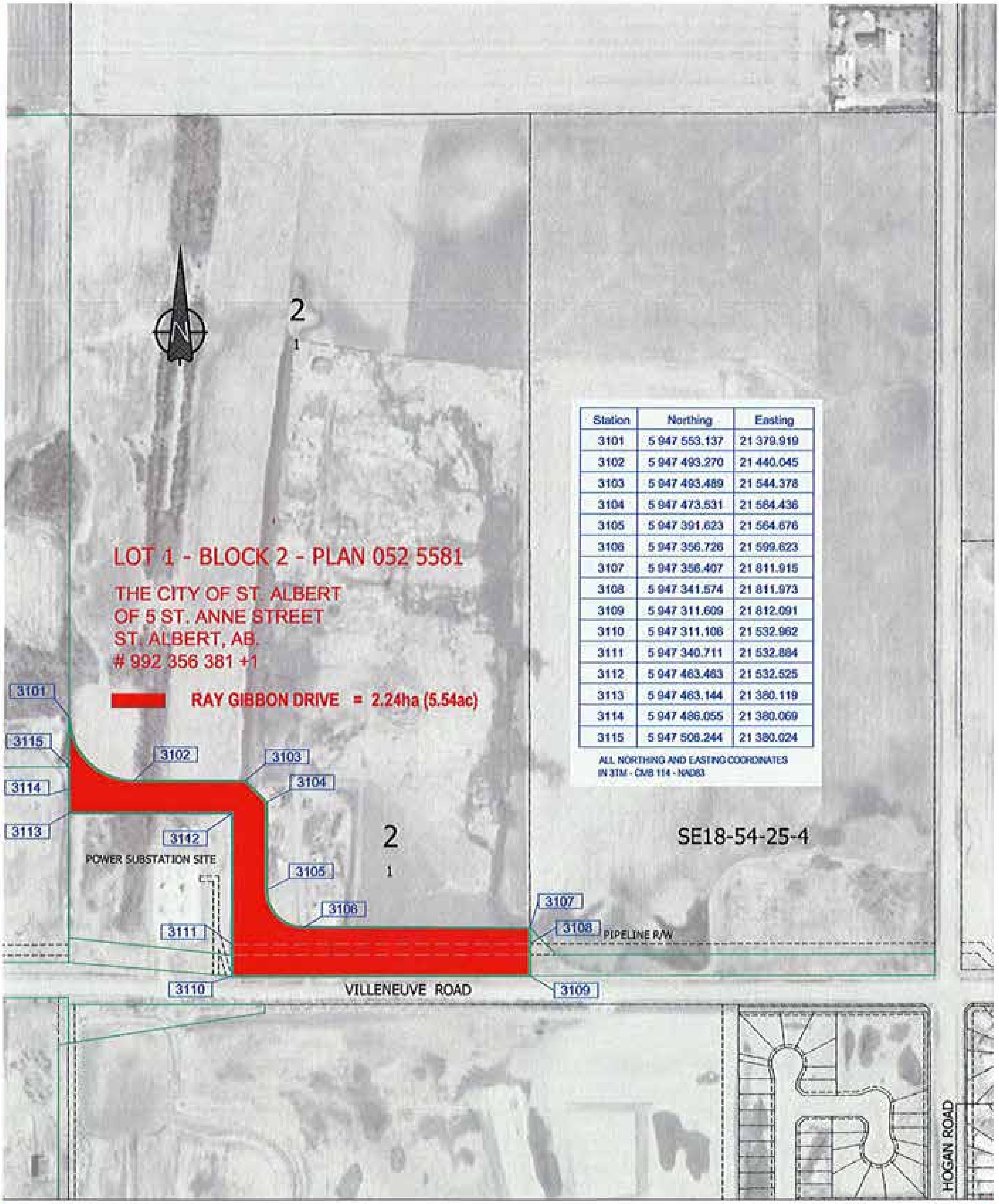



| Station | Northing | Easting |
|---|---|---|
| 3101 | 5 947 553.137 | 21 379.919 |
| 3102 | 5 947 493.270 | 21 440.045 |
| 3103 | 5 947 493.489 | 21 544.378 |
| 3104 | 5 947 473.531 | 21 564.436 |
| 3105 | 5 947 391.623 | 21 564.676 |
| 3106 | 5 947 356.726 | 21 599.623 |
| 3107 | 5 947 356.407 | 21 811.915 |
| 3108 | 5 947 341.574 | 21 811.973 |
| 3109 | 5 947 311.609 | 21 812.091 |
| 3110 | 5 947 311.106 | 21 532.962 |
| 3111 | 5 947 340.711 | 21 532.884 |
| 3112 | 5 947 463.463 | 21 532.525 |
| 3113 | 5 947 463.144 | 21 380.119 |
| 3114 | 5 947 486.055 | 21 380.069 |
| 3115 | 5 947 506.244 | 21 380.024 |

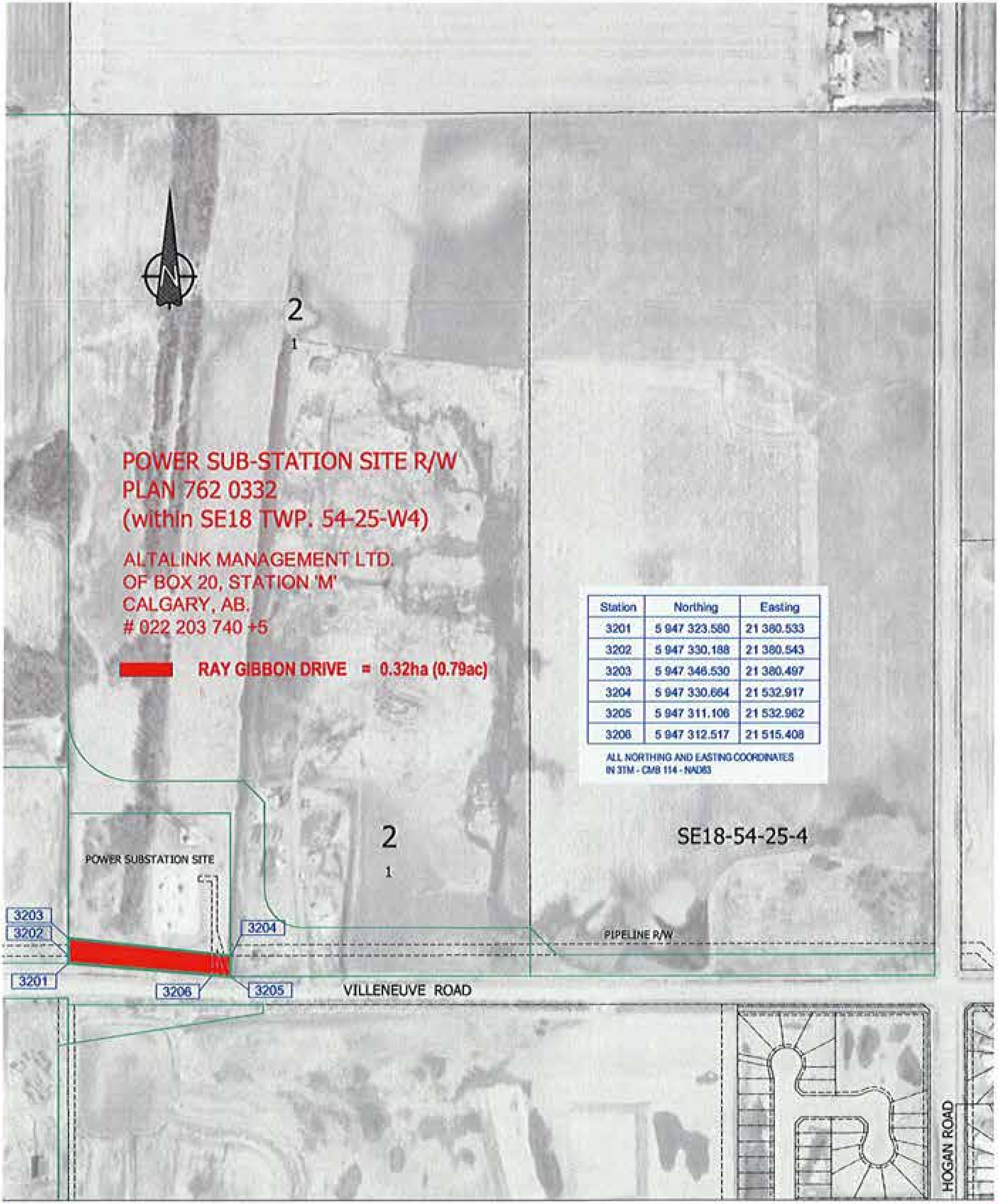
ALL NORTHING AND EASTING COORDINATES
IN 3TM - CM 114 - NAD83

ISL Engineering and Land Services

PLAN SHOWING ADDITIONAL
RIGHT-OF-WAY REQUIREMENTS FOR
PROVINCIAL FREEWAY STANDARD FOR
RAY GIBBON DRIVE
LOT 1 - BLOCK 2 - PLAN 052 5581

THE CITY OF St. Albert

SCALE: 1:5000 February 2009




| Station | Northing | Easting |
|---|---|---|
| 3201 | 5 947 323.580 | 21 380.533 |
| 3202 | 5 947 330.188 | 21 380.543 |
| 3203 | 5 947 346.530 | 21 380.497 |
| 3204 | 5 947 330.664 | 21 532.917 |
| 3205 | 5 947 311.106 | 21 532.962 |
| 3206 | 5 947 312.517 | 21 515.408 |

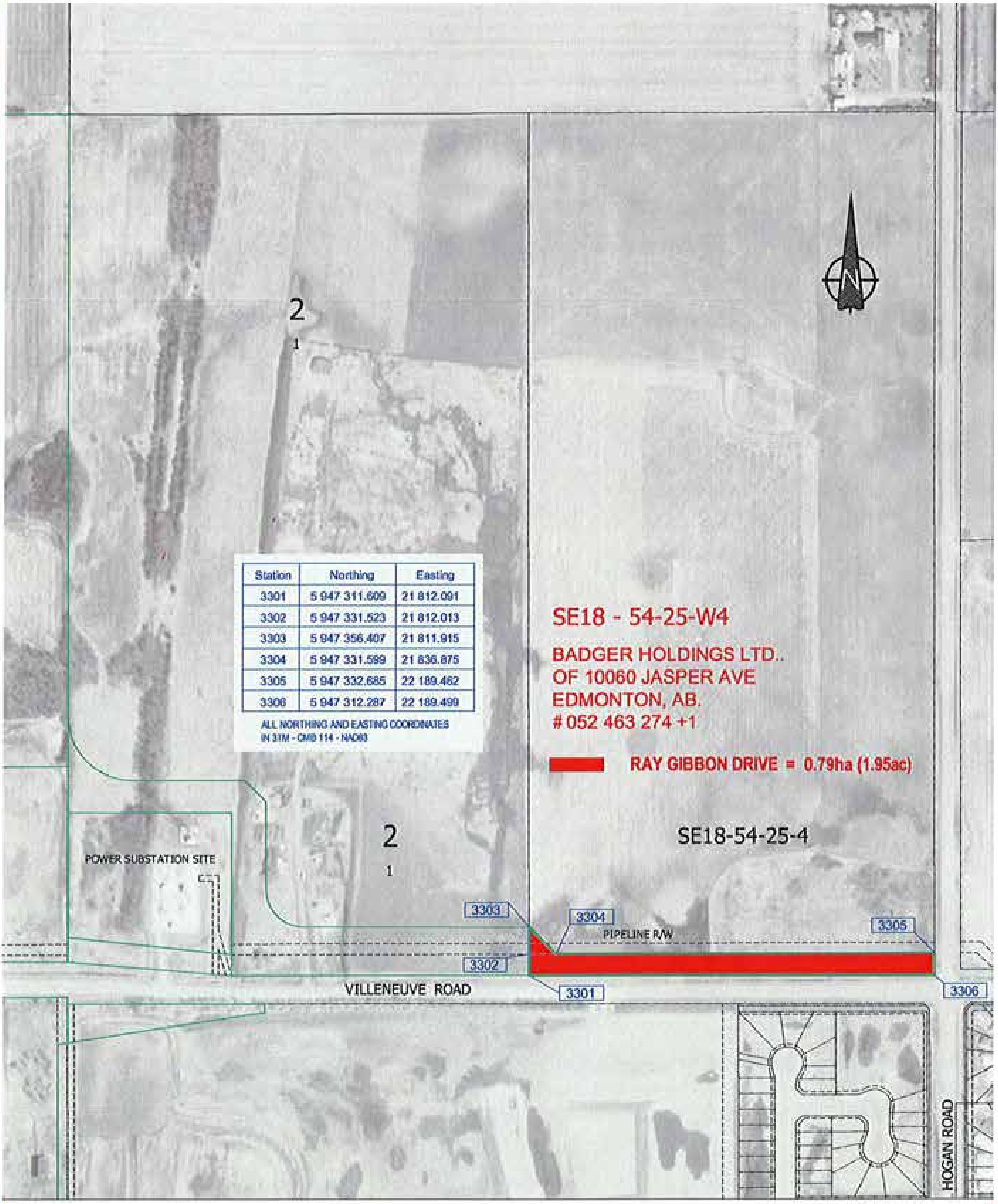
ALL NORTHING AND EASTING COORDINATES IN 3TM - CMB 114 - NAD83

ISL Engineering and Land Services

PLAN SHOWING ADDITIONAL
RIGHT-OF-WAY REQUIREMENTS FOR
PROVINCIAL FREEWAY STANDARD FOR
RAY GIBBON DRIVE
POWER SUB-STATION R/W
(SE18 - TWP 54-25-W4)

THE CITY OF St. Albert

SCALE: 1:5000 February 2009




| Station | Northing | Easting |
|---|---|---|
| 3301 | 5 947 311.609 | 21 812.091 |
| 3302 | 5 947 331.523 | 21 812.013 |
| 3303 | 5 947 356.407 | 21 811.915 |
| 3304 | 5 947 331.599 | 21 836.875 |
| 3305 | 5 947 332.685 | 22 189.462 |
| 3306 | 5 947 312.287 | 22 189.499 |

ALL NORTHING AND EASTING COORDINATES IN 3TM - CM8 114 - NAD83

ISL Engineering and Land Services

PLAN SHOWING ADDITIONAL
RIGHT-OF-WAY REQUIREMENTS FOR
PROVINCIAL FREEWAY STANDARD FOR
RAY GIBBON DRIVE
SE18 - TWP 54-25-W4

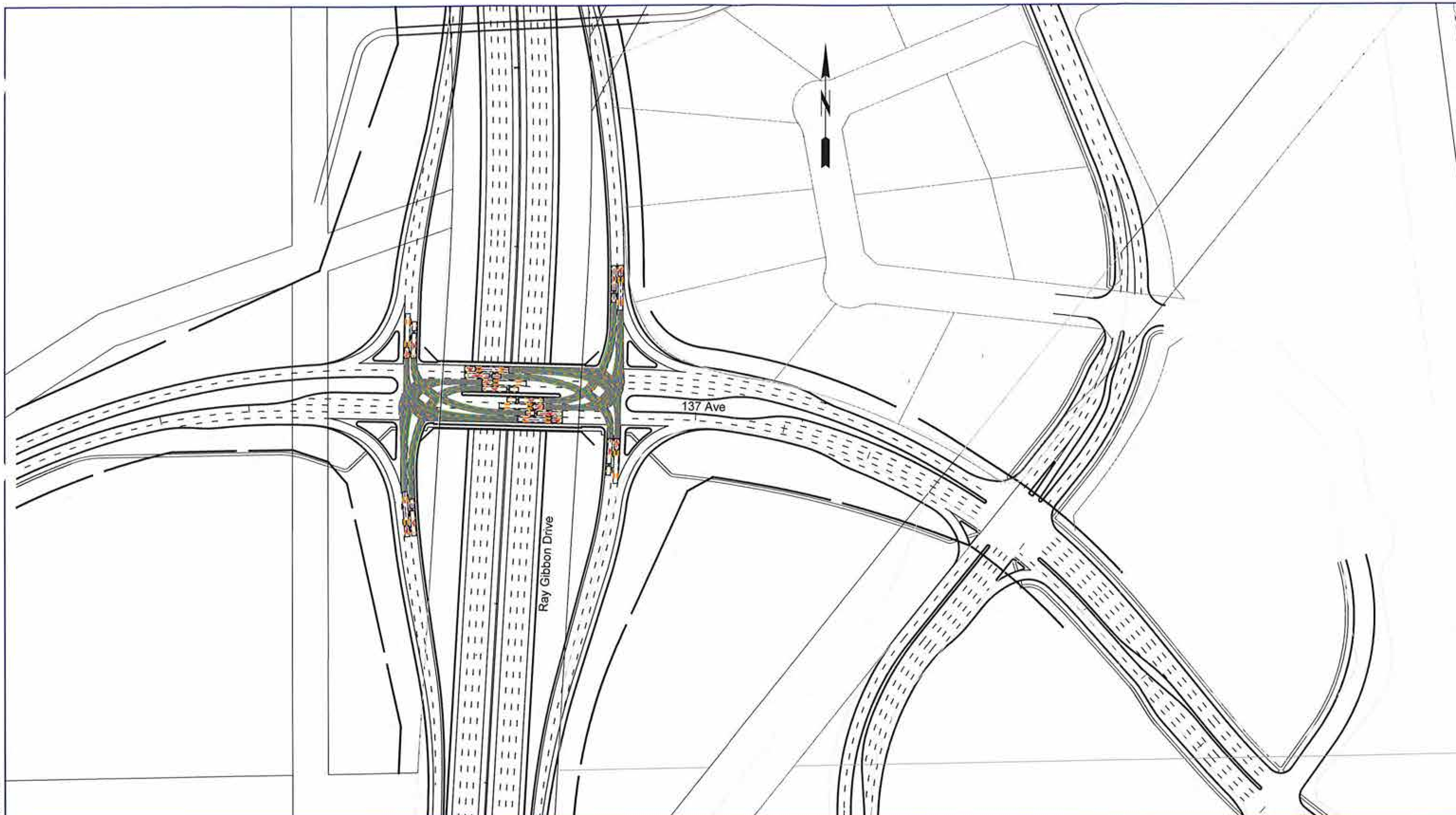
THE CITY OF St. Albert

SCALE: 1:5000 February 2009

APPENDIX L

# Appendix L

## Auto Turn Templates




Legend

ISL Engineering and Land Services

SCALE 1:2000
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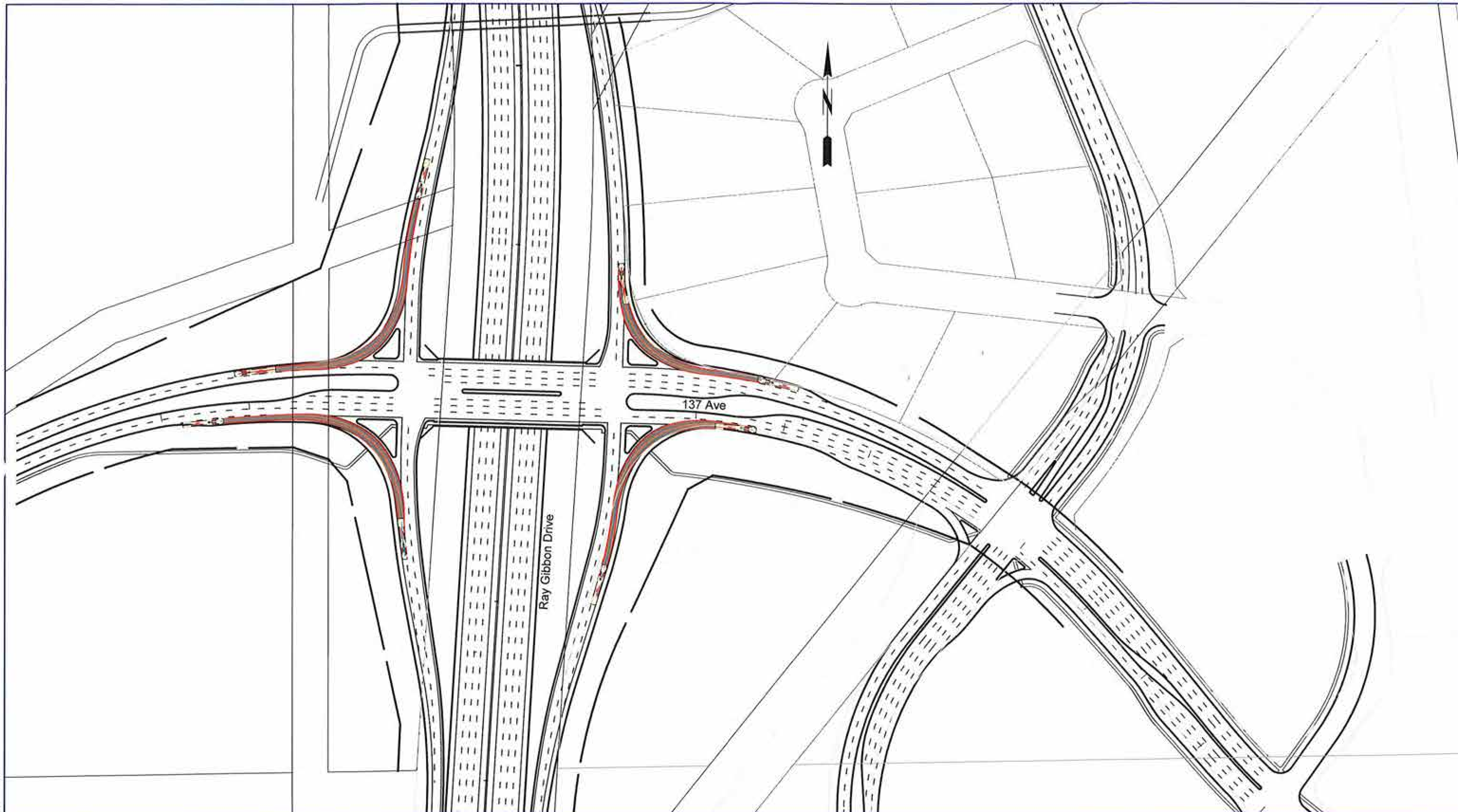
HORIZONTAL

THE CITY OF St. Albert

| | |
|---|---|
| Project | Ray Gibbon Drive |
| Title | 137 Avenue Interchange<br>Functional Planning Study<br>WB-21 and Bus/Trailer<br>Double-Left Turn Movements |
| Figure No. | |




ISL Engineering and Land Services

Legend

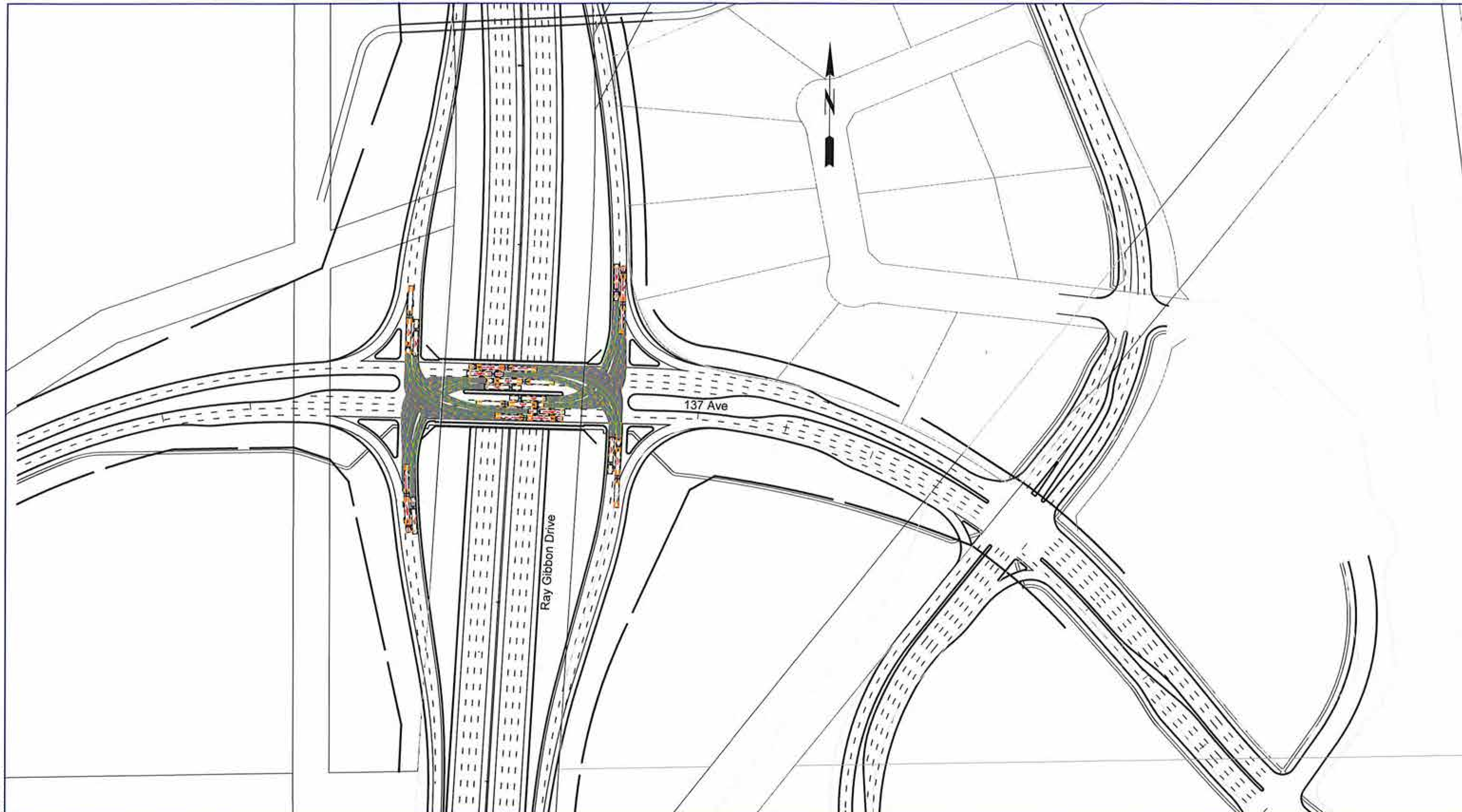
SCALE 1:2000
20m 0 20m 40m
HORIZONTAL

THE CITY OF St. Albert

Project: Ray Gibbon Drive

Title: 137 Avenue Interchange
Functional Planning Study
WB-21 Right-Turn Movements

Figure No.




ISL Engineering and Land Services

Legend

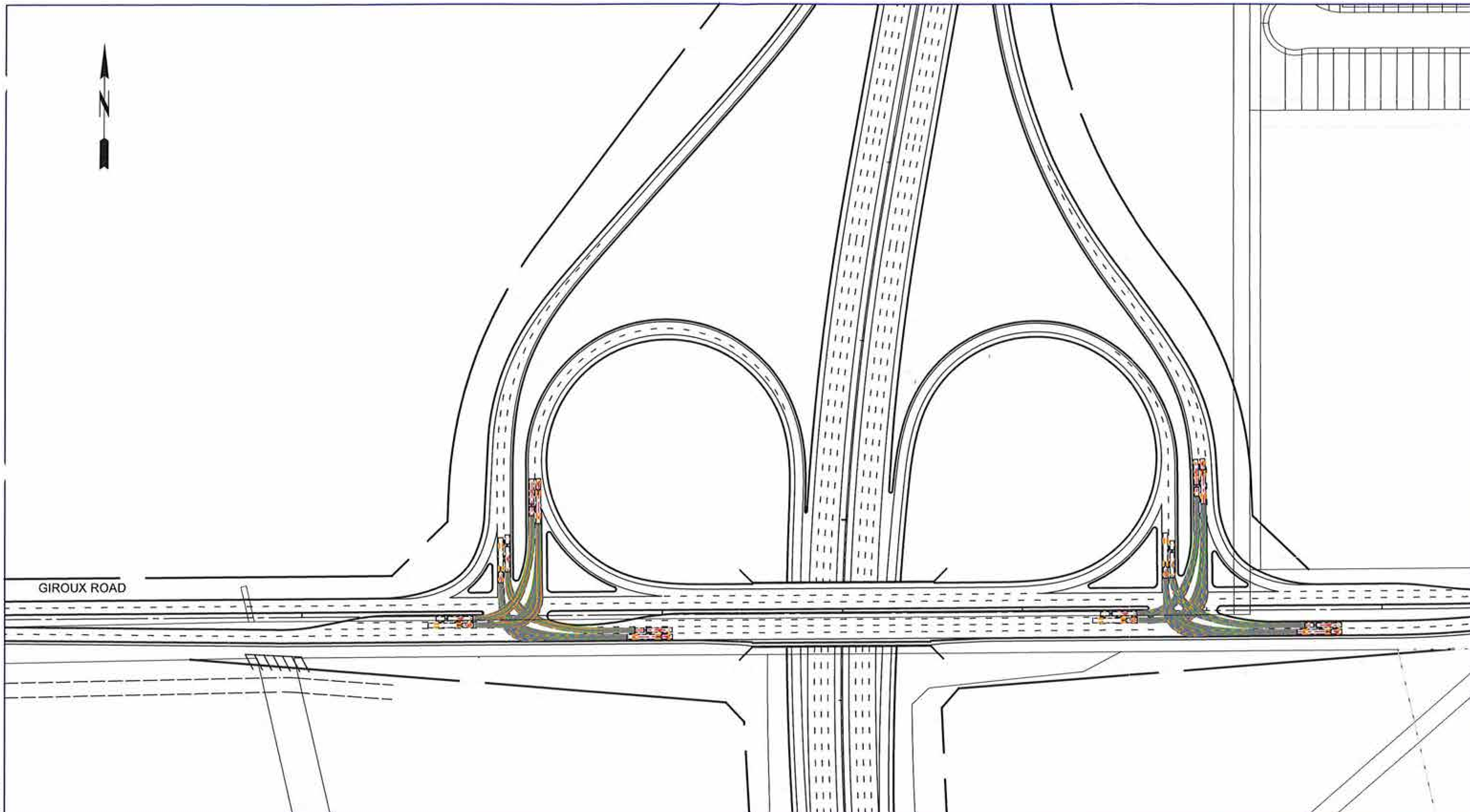
SCALE 1:2000
20m 0 20m 40m
HORIZONTAL

THE CITY OF St. Albert

Project: Ray Gibbon Drive

Title: 137 Avenue Interchange
Functional Planning Study
WB-36 and Bus/Trailer
Double-Left Turn Movements

Figure No.




Legend

SCALE 1:2000

20m 0 20m 40m

HORIZONTAL

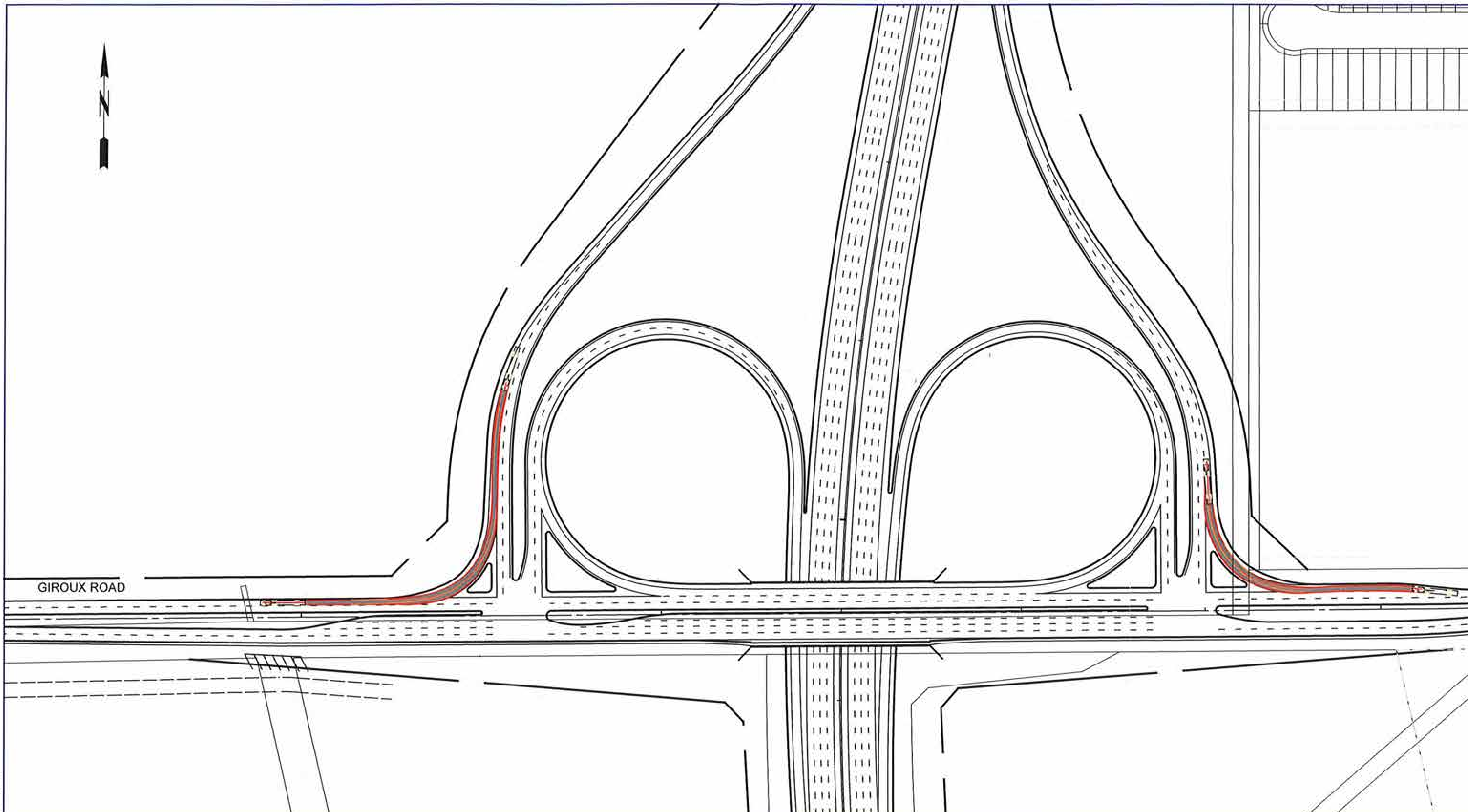
THE CITY OF St. Albert

ISL Engineering and Land Services

Project: Ray Gibbon Drive

Title: Giroux Road Interchange
Functional Planning Study
WB-21 and Bus/Trailer
Double-Left Turn Movements

Figure No.




Legend

ISL Engineering and Land Services

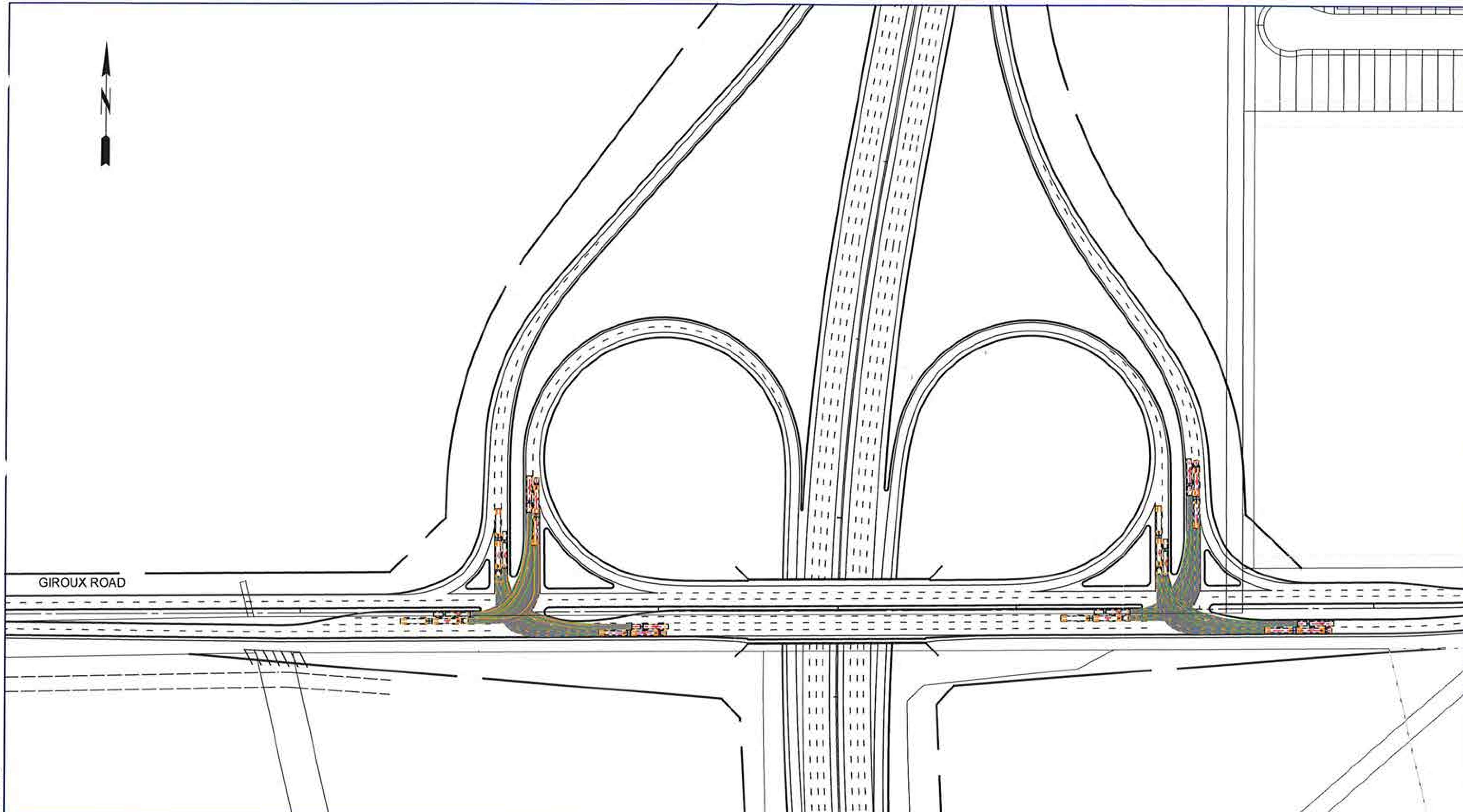
SCALE 1:2000
20m 0 20m 40m
HORIZONTAL

THE CITY OF St. Albert

Project: Ray Gibbon Drive

Title: Giroux Road Interchange
Functional Planning Study
WB-21 Right-Turn Movements

Figure No.




Legend

ISL Engineering and Land Services

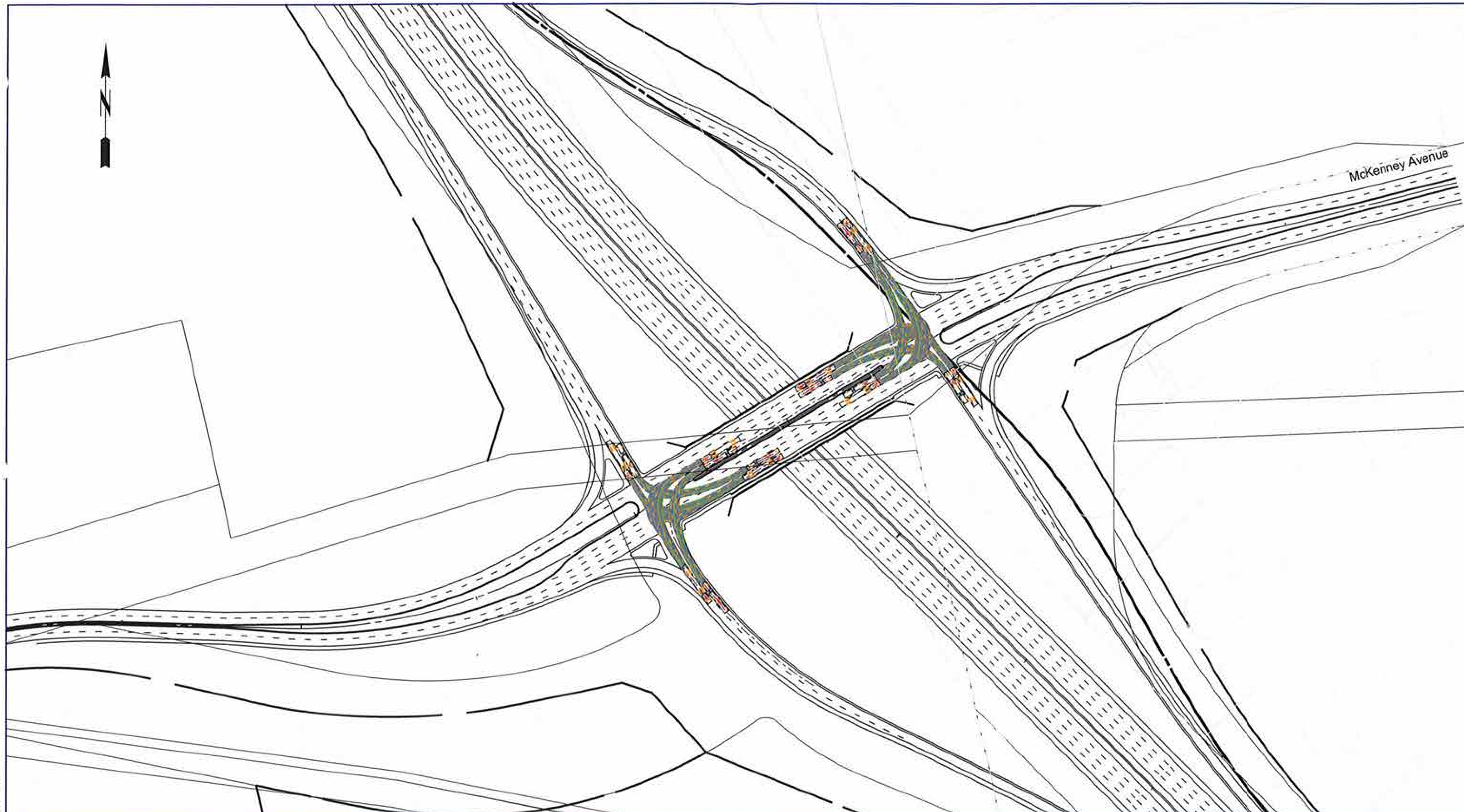
SCALE 1:2000
20m 0 20m 40m
HORIZONTAL

THE CITY OF St. Albert

Project: Ray Gibbon Drive

Title: Giroux Road Interchange
Functional Planning Study
WB-36 and Bus/Trailer
Double-Left Turn Movements

Figure No.




| | | | | |
|---|---|---|---|---|
| ISL Engineering and Land Services | Legend | SCALE 1:2000 HORIZONTAL | THE CITY OF St. Albert | Project: Ray Gibbon Drive |
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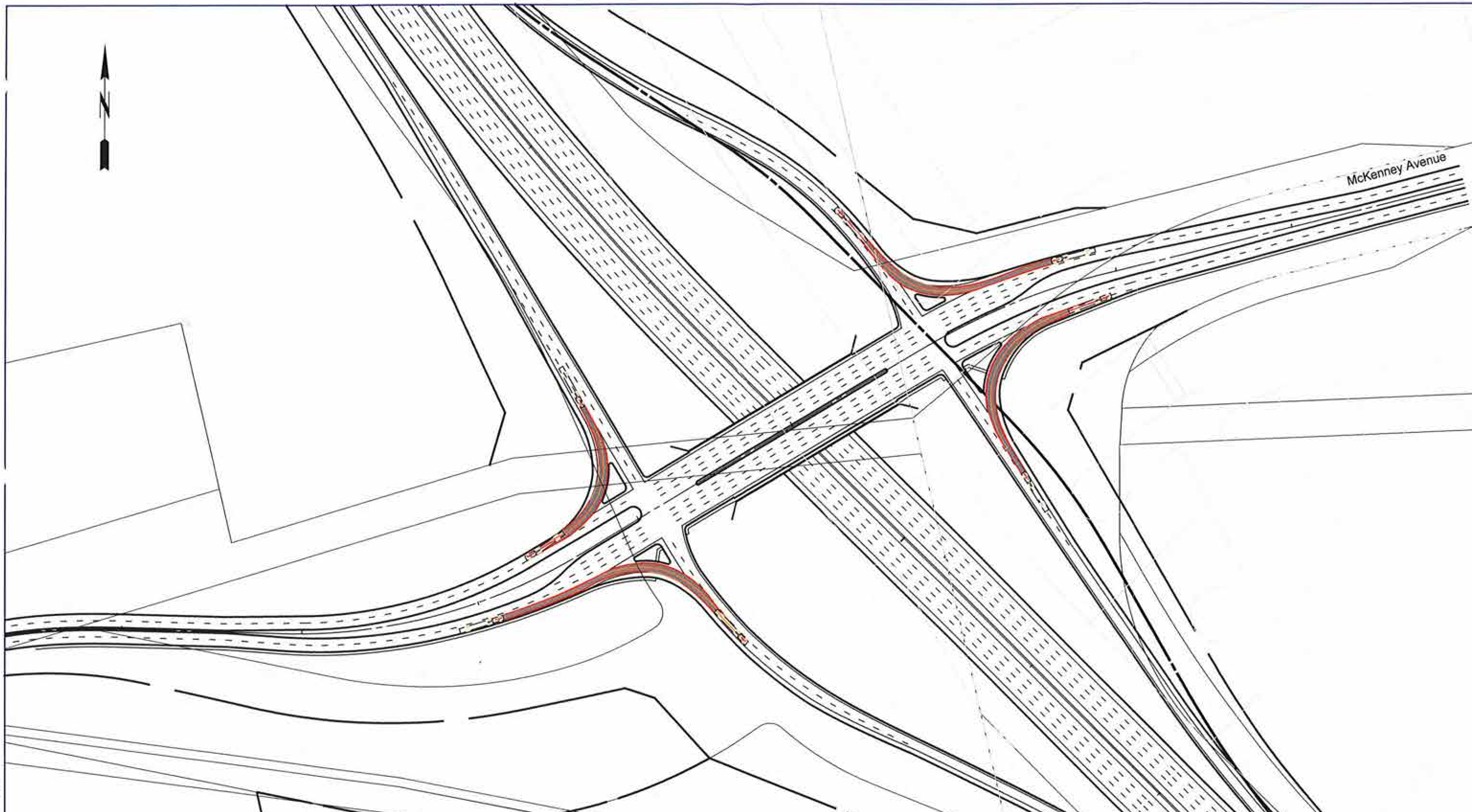
| | | | | Figure No. |




ISL Engineering and Land Services

Legend

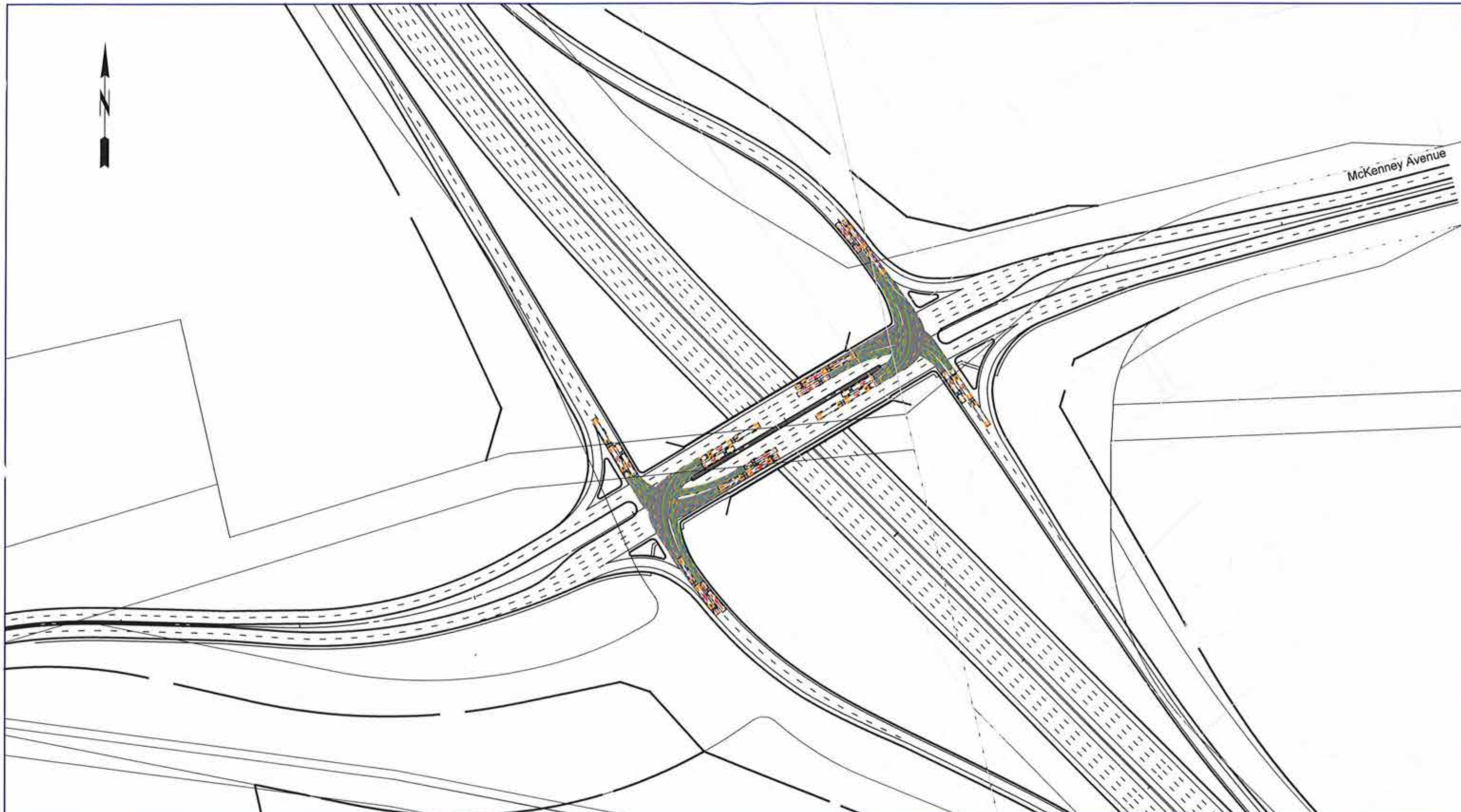
SCALE 1:2000
20m 0 20m 40m
HORIZONTAL

THE CITY OF St. Albert

Project: Ray Gibbon Drive

Title: McKenney Interchange
Functional Planning Study
WB-21 Right-Turn Movements

Figure No.




ISL Engineering and Land Services

Legend

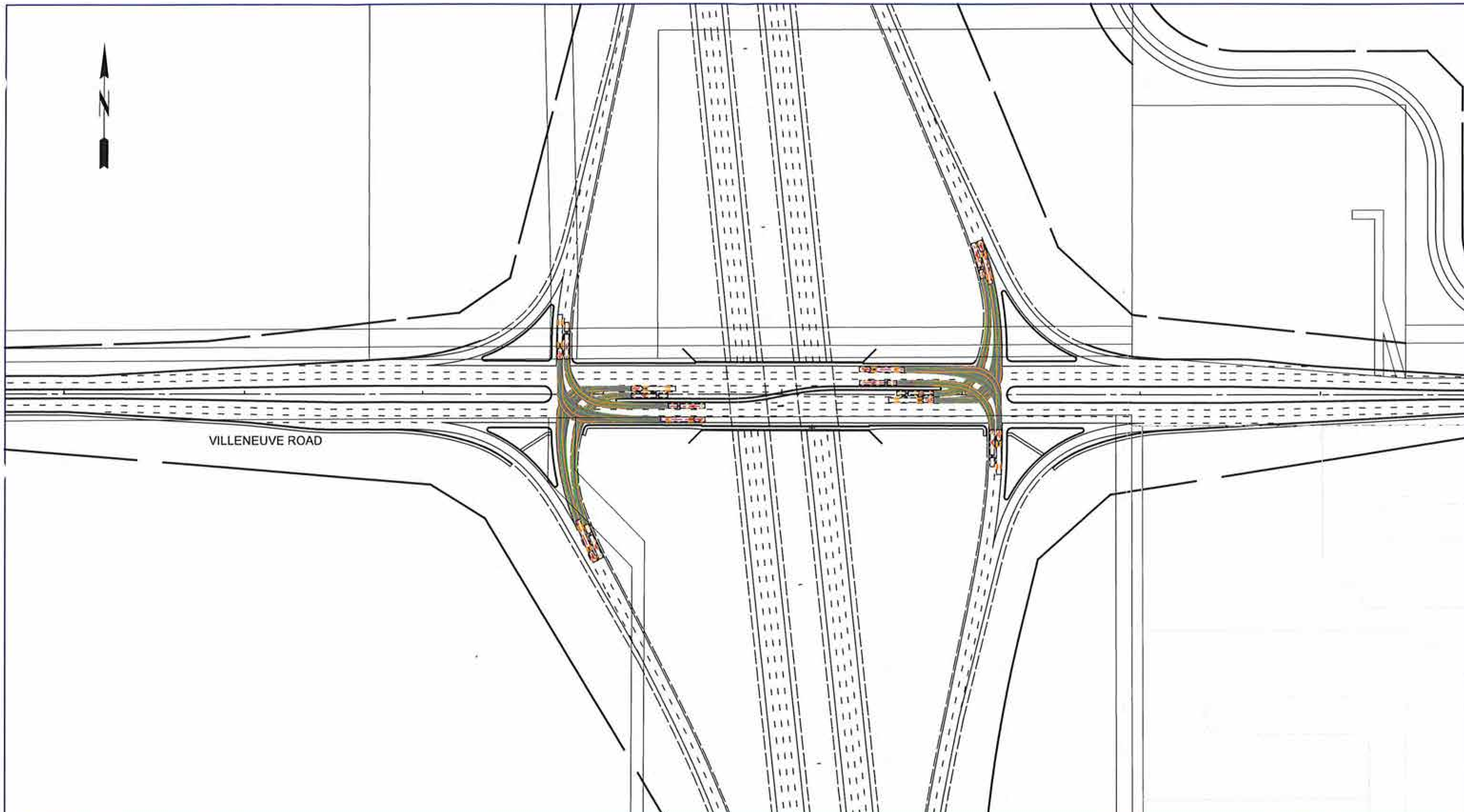
SCALE 1:2000
20m 0 20m 40m
HORIZONTAL

THE CITY OF St. Albert

Project: Ray Gibbon Drive

Title: McKenney Interchange
Functional Planning Study
WB-36 and Bus/Trailer
Double-Left Turn Movements

Figure No.



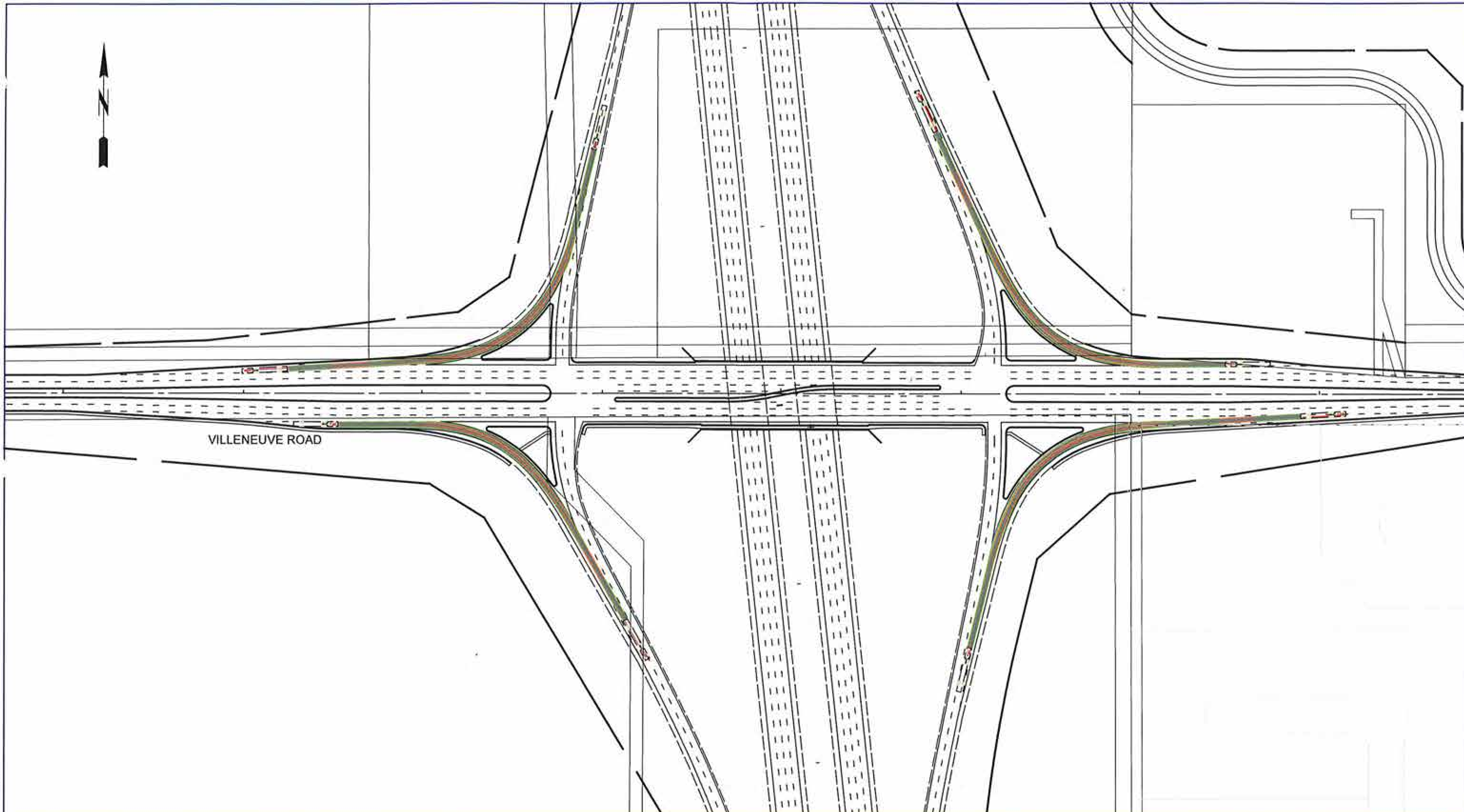

ISL Engineering and Land Services

Legend

SCALE 1:2000
20m 0 20m 40m
HORIZONTAL

THE CITY OF St. Albert

| | |
|---|---|
| Project | Ray Gibbon Drive |
| Title | Villeneuve Interchange<br>Functional Planning Study<br>WB-21 and Bus/Trailer<br>Double-Left Turn Movements |
| Figure No. | |



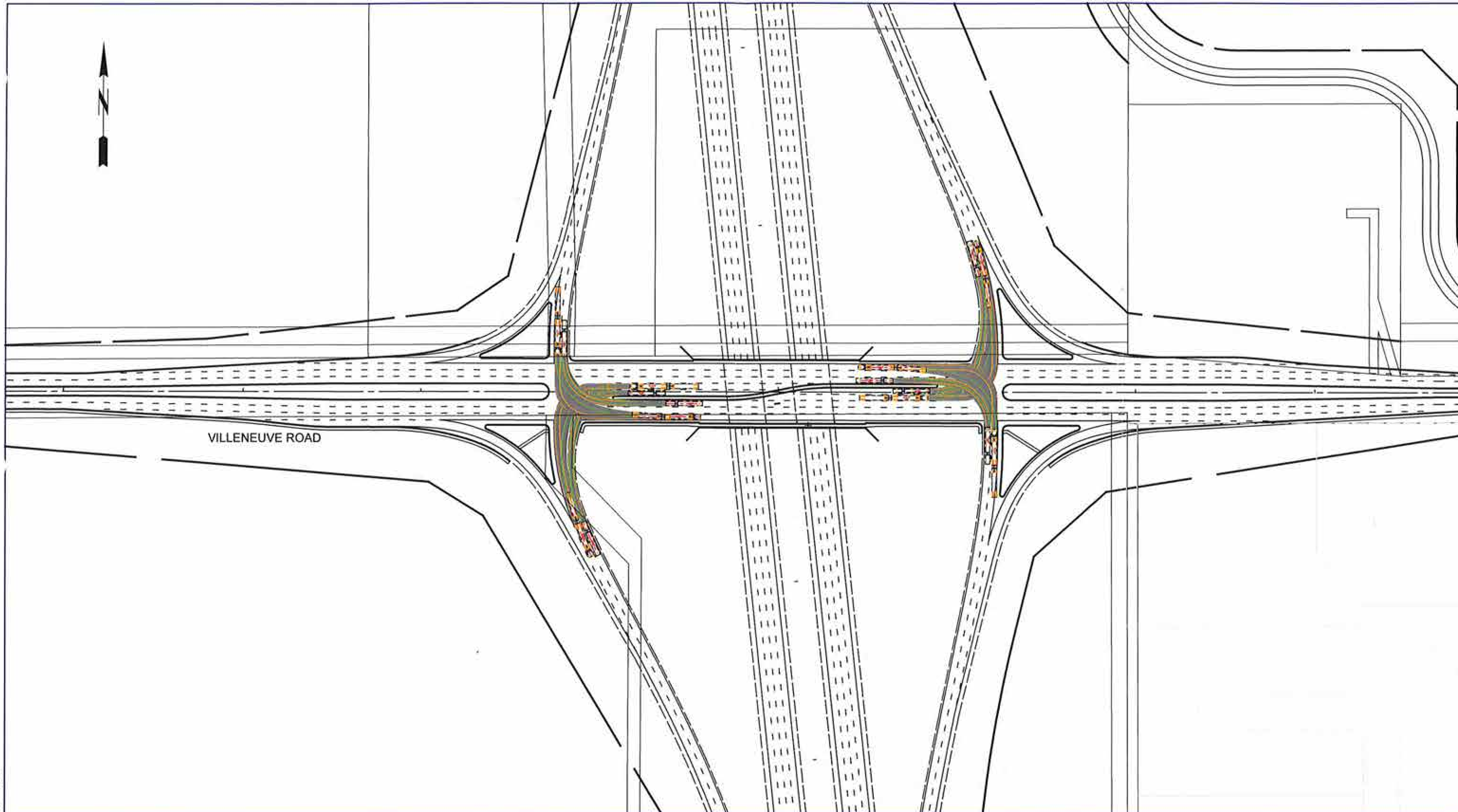

ISL Engineering and Land Services

Legend

SCALE 1:2000
20m 0 20m 40m
HORIZONTAL

THE CITY OF St. Albert

| | |
|---|---|
| Project | Ray Gibbon Drive |
| Title | Villeneuve Interchange<br>Functional Planning Study<br>WB-21 Right-Turn Movements |
| Figure No. | |




Legend

SCALE 1:2000
20m 0 20m 40m
HORIZONTAL

ISL Engineering and Land Services

THE CITY OF St. Albert

Project Ray Gibbon Drive

Title Villeneuve Interchange
Functional Planning Study
WB-36 and Bus/Trailer
Double-Left Turn Movements

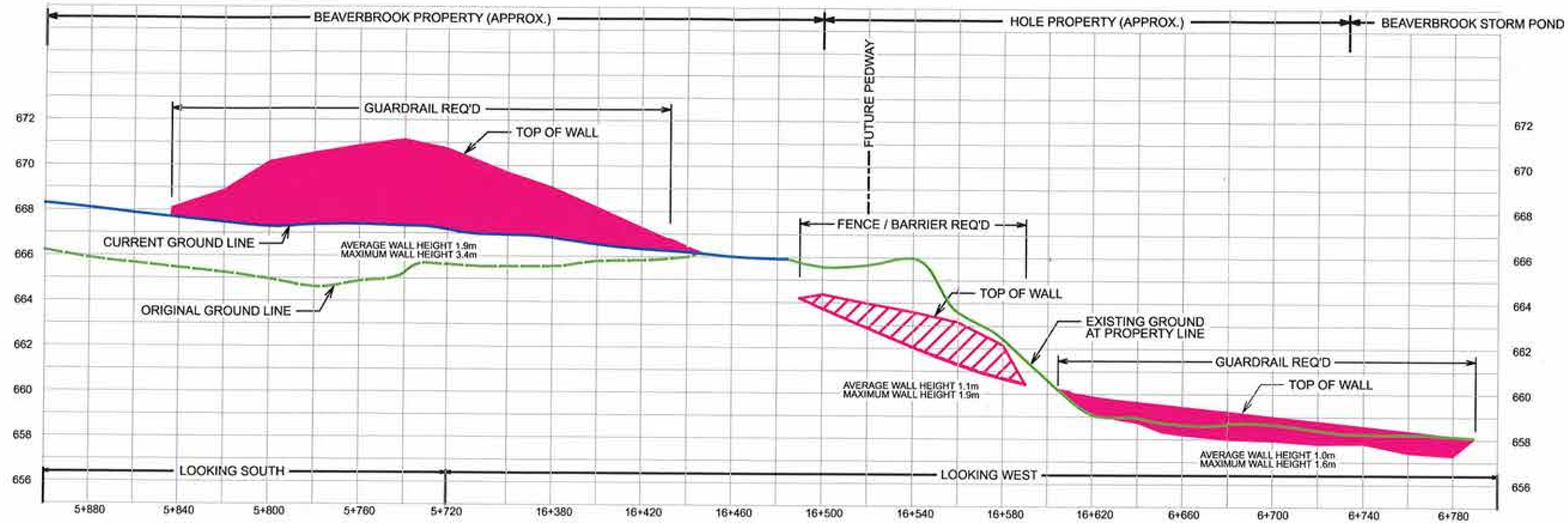
Figure No.

# APPENDIX M

# Appendix M

## Retaining Wall Profile near 137 Avenue

Exhibit 01




RAY GIBBON DRIVE FPS

# RETAINING WALL PROFILE N.E. QUADRANT 137 AVENUE

LOOKING SOUTHWEST FROM SOUTH RIEL ASP

THE CITY OF St. Albert

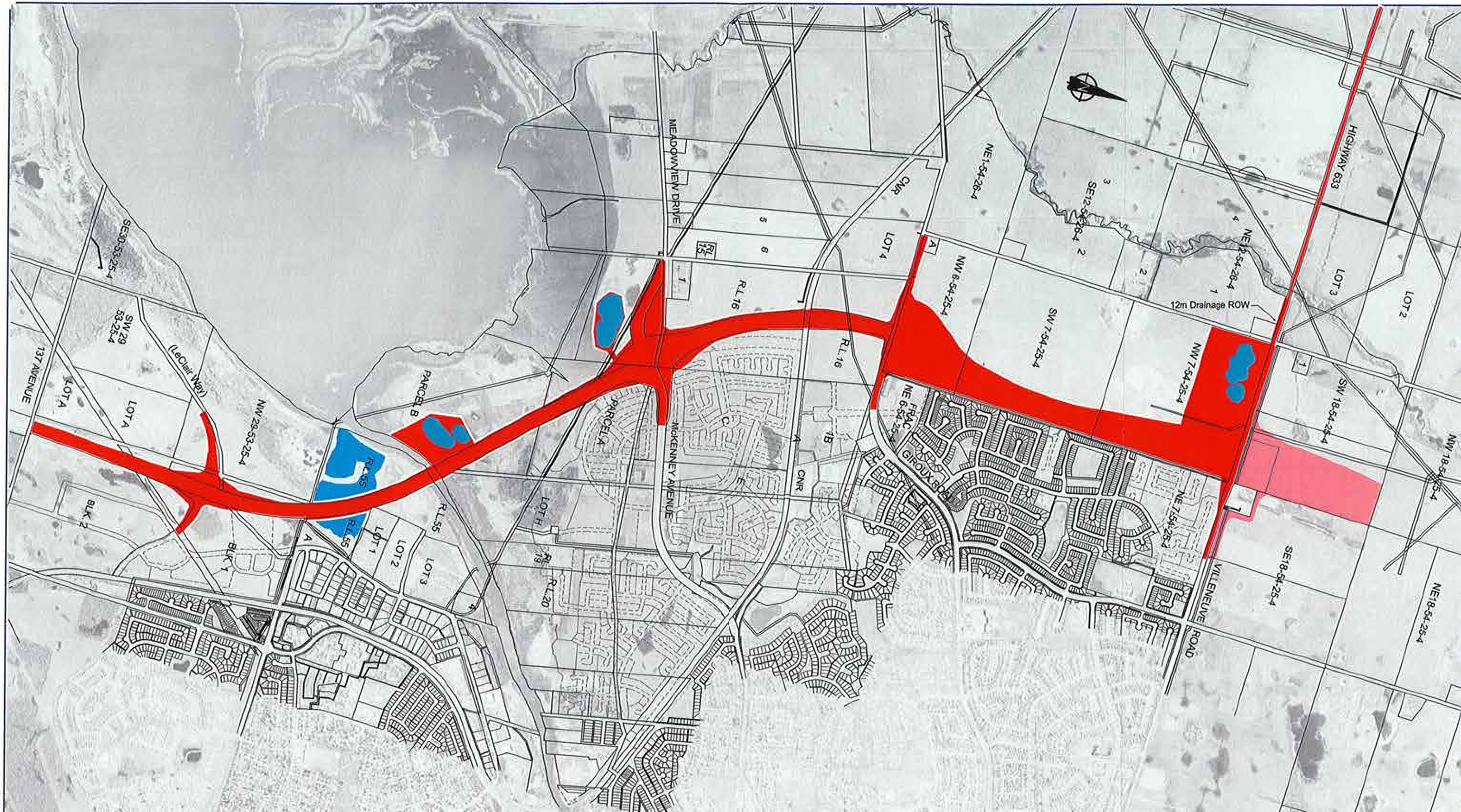
ISL Engineering and Land Services

J:/12400/12436_StAlbert_WRR_Freeway/_drafting/a_project/Exhibits/Exhibit_01_Profile.dgn

# APPENDIX N

# Appendix N

## Provincial Operations and Development Control Plan




ISL Engineering and Land Services

LEGEND

Ultimate Right-of-Way

Future Right-of-Way

SCALE 1:20,000

200m 0 200m 400m

HORIZONTAL

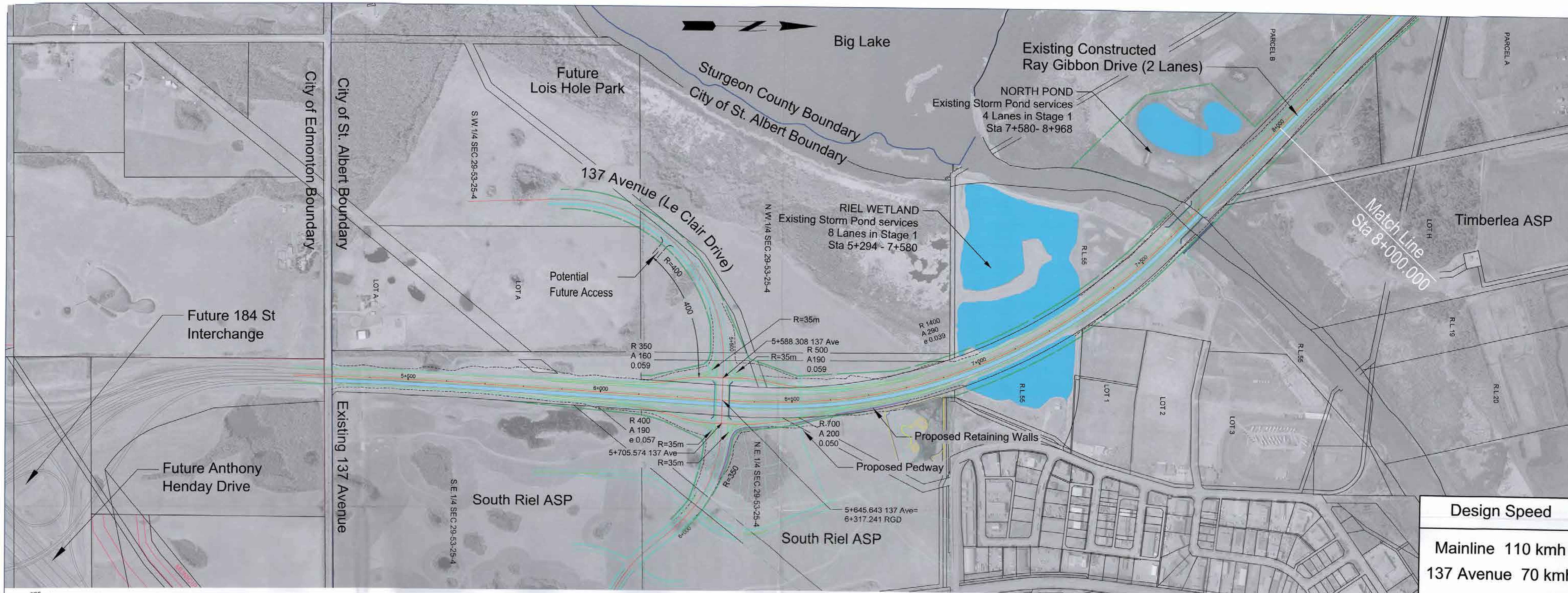
THE CITY OF St. Albert

Project: Ray Gibbon Drive

Title: Functional Planning Study

Provincial Operations and Development Control Plan

Figure No. Exhibit





ISL Engineering and Land Services

Legend

- PROPOSED Ray Gibbon Drive
- PROPOSED R/W BDY
- CITY OF ST ALBERT ASP
- EXISTING STORM POND
- CONSTRUCTED 2-LANE Ray Gibbon Drive
- LIMIT OF CUT
- LIMIT OF FILL
- PROPOSED NOISE WALL
- EXISTING LANDFILL SITE

Key Plan

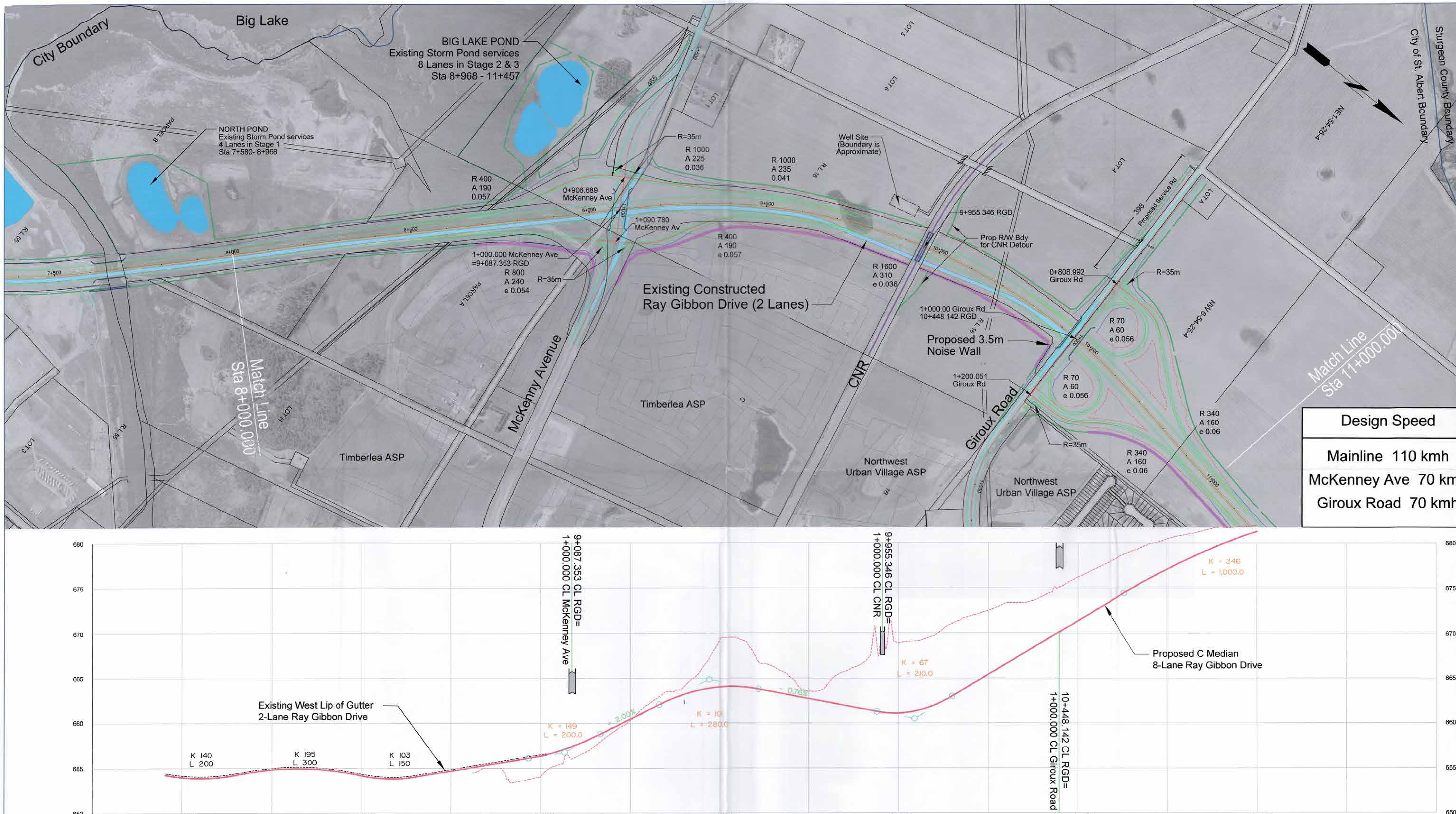
SCALE 1:10,000 — HORIZONTAL
SCALE 1:400 — VERTICAL

THE CITY OF St. Albert

Project: Ray Gibbon Drive

Title: Centreline Plan & Profile
Functional Planning Study
8-Lane Stage

Figure No. PP 01




## Legend

| | | | |
|---|---|---|---|
| PROPOSED Ray Gibbon Drive | | LIMIT OF CUT | |
| PROPOSED R/W BDY | | LIMIT OF FILL | |
| CITY OF ST ALBERT ASP | | PROPOSED NOISE WALL | |
| EXISTING STORM POND | | EXISTING LANDFILL SITE | |
| CONSTRUCTED 2-LANE Ray Gibbon Drive | | | |

Key Plan

SCALE 1:10,000 — HORIZONTAL (100m 0 100m 200m)

SCALE 1:400 — VERTICAL (4m 0 4m 8m)

ISL Engineering and Land Services

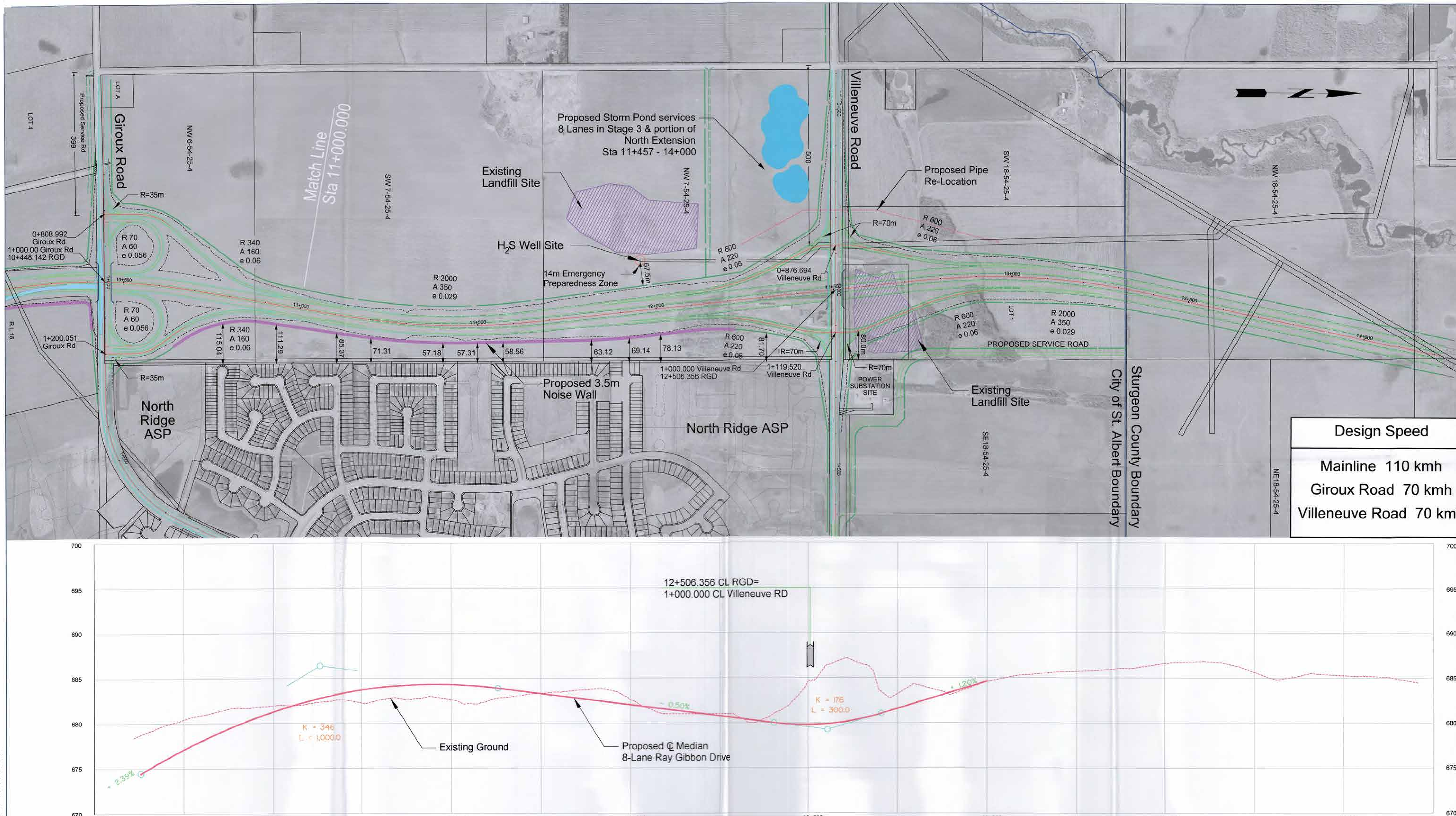
THE CITY OF St. Albert

Project: Ray Gibbon Drive

Title: Centreline Plan & Profile
Functional Planning Study
8-Lane Stage

Figure No. PP 02

11:35:56 AM Plan Profile Exhibit.tbl




ISL Engineering and Land Services

**Legend**

- PROPOSED Ray Gibbon Drive
- PROPOSED R/W BDY
- CITY OF ST ALBERT ASP
- EXISTING STORM POND
- CONSTRUCTED 2-LANE Ray Gibbon Drive
- LIMIT OF CUT
- LIMIT OF FILL
- PROPOSED NOISE WALL
- EXISTING LANDFILL SITE

Key Plan

SCALE 1:10,000 — HORIZONTAL

SCALE 1:400 — VERTICAL

THE CITY OF St. Albert

| | |
|---|---|
| Project | Ray Gibbon Drive |
| Title | Centreline Plan & Profile<br>Functional Planning Study<br>8-Lane Stage |
| Figure No. | PP 03 |