APPENDIX H

GEOTECHNICAL ASSESSMENT

THURBER ENGINEERING LTD.

FUNCTIONAL PLANNING STUDY FOR HIGHWAY 15:06 TWINNING (FROM RANGE ROAD 220 TO HIGHWAY 830 NORTH) FORT SASKATCHEWAN, ALBERTA GEOTECHNICAL ASSESSMENT – REVISION 1

Report

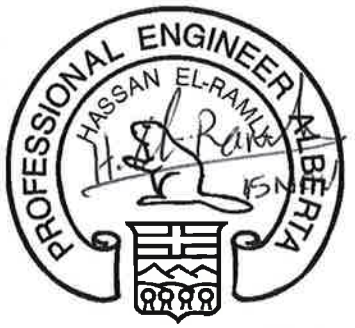
to

CIMA+

11/15/12

Stephen Coulter, P.Eng., P.E.
Project Engineer

PERMIT TO PRACTICE
THURBER ENGINEERING LTD.
Signature H-El Ramly
Date 15 NOV. 2012
PERMIT NUMBER: P 5186
The Association of Professional Engineers, Geologists and Geophysicists of Alberta



15 Nov 2012

Hassan El-Ramly, P.Eng., Ph.D.
Review Engineer

Date: November 15, 2012
File: 19-5819-6

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1. INTRODUCTION

This report presents the results of the geotechnical assessment carried out by Thurber Engineering Ltd. (Thurber) as part of the Functional Planning Study (FPS) for the proposed upgrading of a section of Highway 15:06 between Range Road 220 and Highway 830 North; some 7 km to the northeast of Fort Saskatchewan, Alberta. The objective of the proposed upgrades is to ease traffic congestion in that area and to accommodate projected future traffic volumes.

The scope of the assessment was outlined in our proposal to Mr. Dan Dmytryshyn, P.Eng., of CIMA+ dated December 5, 2011. Authorization to proceed with the investigation was received from CIMA+ in January, 2012.

The study presented herein is based on a desktop review of existing geological and geotechnical information and aerial photographs of the project area, supplemented by field observations from a site reconnaissance. The scope of work did not include any geotechnical test hole drilling along the proposed alignment or at the locations of the proposed interchange structures.

The objective of this desktop study is to provide a preliminary geotechnical assessment of the expected soil conditions along a corridor extending approximately 500 m on either side of the existing Highway 15:06. At the intersections with Range Road 220, Range Road 214, and Highway 830 North, the study area was expanded to a circle with a 1.5 km radius. As part of the study, visible geotechnical constraints that may affect the design and construction of the proposed upgrade works were also identified.

Use of this report is subject to the Statement of Limitations Conditions that is included at the end of the text of this report. The reader's attention is specifically drawn to these conditions as it is considered essential that they be followed for the proper use and interpretation of this report.

2. PROJECT BACKGROUND AND PROPOSED DEVELOPMENT

It is our understanding that Strathcona County plans to construct a major signalized intersection treatment at the intersection of Highway 15 and Range Road 220 to accommodate the increasing traffic volume to the Shell Canada Scotford facility. As part of the engineering assessments for the proposed intersection upgrades, Alberta Transportation and Strathcona County have partnered together to commission a FPS for a section of Highway 15 from Range Road 220 to Highway 830 North. The FPS will recommend a staged plan to

address Highway 15 medium and long term improvements needed to facilitate future transportation upgrades within the study area, the location of which is shown on Drawing 19-5819-6-1 in Appendix A.

Highway 15 is an arterial (level 2) roadway that connects the Edmonton region to the industrial developments in Fort Saskatchewan and to the Lamont County. It is also a frequently travelled route to Fort McMurray and the oil sands region by way of Highway 831 to Boyle.

Within the project limits, Highway 15:06 transitions from a four-lane divided highway to a two-lane undivided highway. The transition occurs roughly about 1.3 km east of the intersection of Highway 15 and Highway 830 South (Range Road 214). The undivided section of the highway consists of an approximately 3.7 m wide travel lane and a 3.0 m wide shoulder in each direction.

Based on the plan/profile drawings provided by CIMA+ (Appendix C), it is our understanding that the proposed Highway 15:06 upgrades will include the twining of the undivided section of the roadway between Range Roads 213 and 205 (approximately 7.3 km of roadway), limited improvements to the existing horizontal and vertical alignments, intersection improvements at Range Roads 210 and 212, and grade separation structures at the CP Rail crossing.

The proposed twinning will involve reconfiguring the existing highway to form the westbound lanes of the divided roadway, and the construction of two new eastbound lanes some 50 m to the south. Along a short segment at the intersection with Range Road 213, new westbound and eastbound lanes will be constructed to the south of the existing highway to accommodate a larger radius of curvature. The vertical alignment of the twined highway will match that of the existing roadway. As a result, the new eastbound lanes will be constructed entirely in fill with embankment heights up to a maximum of about 4.5 m in some areas. The approach embankment of the proposed CP Rail grade separation structures will be up to 10 m in height.

3. METHOD OF INVESTIGATION

The geotechnical assessment comprised a desktop review of available information and a site reconnaissance of the project area. Brief descriptions of each component are presented in the following subsections. The findings of the assessment are discussed in Sections 4 and 5.

3.1 Desktop Study

The desktop study consisted of the following tasks:

- Interpretation of aerial photography of the project area;
- Review of published geological, hydrogeological and topographic information; and
- Review of in-house geotechnical information from Thurber's files.

The air photo interpretation consisted of a detailed review of stereo aerial photography of the project area from 2006 (scale 1:40,000) and 2009 (scale 1:20,000). To assist with the interpretation, the following maps and reports were also reviewed:

- L. A. Bayrock. Surficial Geology Edmonton. NTS 83H. Alberta Research Council. 1972.
- L. D. Andriashek. Quaternary Stratigraphy of the Edmonton Map Area, NTS 83H. Open File Report # 198804. Terrain Sciences Department, Natural Resources Division, Alberta Research Council. 1988.
- S. R. Slattery, A. A. Barker, L. D. Andriashek, G. Jean, S. A. Stewart, H. Moktan and T. G. Lemay. Bedrock Topography and Sediment Thickness Mapping in the Edmonton-Calgary Corridor, Central Alberta: An overview of Protocols and Methodologies. ERCB/AGS Open File Report 2010-12. 2011.
- The Canadian Topographic Maps 83H10, 11, 14, and 15 (scale 1:50,000).

The findings of the desktop review were supplemented by field observations made during a site reconnaissance of the project area (Section 3.2).

3.2 Site Reconnaissance

A site reconnaissance of the study area was carried out by Messrs. Stephen Coulter, P.Eng., and Milan Butorac, P.Geol., of Thurber, on May 16, 2012. The purpose of the site reconnaissance was to identify potential geotechnical constraints along the proposed roadway alignment, and to confirm and supplement (where applicable) the findings of the desktop review. Selected photographs from the reconnaissance are included in Appendix B.

4. GEOLOGICAL SETTING

4.1 Surficial Geology

The surficial geologic deposits underlying the project area are of preglacial, glacial and postglacial origin. The preglacial deposits comprise stratified sand, gravel and clay (mostly of fluvial origin), and are located directly on top of bedrock. They are locally referred to as Saskatchewan Sand and Gravel (or as the Empress Formation). The glacial deposits consist of ground moraine (or glacial till). The postglacial deposits comprise glaciolacustrine sediments, aeolian sands, and organic deposits. The emphasis in this study is placed on the geological units exposed at surface within the project area. The aerial distribution of these deposits is presented on Drawing No. 19-5819-6-2 in Appendix A. More detailed descriptions of each unit are presented in Section 5.2.

According to recently published geologic maps (Slattery et al., 2011), the total thickness of surficial deposits (or the depth to top of bedrock) within the study area varies between 20 and 40 m. Drawing No. 19-5816-3, Appendix A, shows thickness contours of the surficial deposits.

4.2 Bedrock

The bedrock underlying the surficial deposits belongs to a formation named the Belly River Group. It comprises thick-bedded sequences of sandstone, siltstone, and clay shale. Frequent coal seams are also present within the bedrock.

Bedrock topography in the study area was shaped primarily prior to and during the last glaciation. One of the characteristics of the bedrock topography is the presence of preglacial buried channels. The study area is located on the southeastern slope of a buried channel named the Beverly Valley (Andriashek, 1988). As a result, the elevation of top of bedrock varies from about 590 m near the Thalweg of the Beverly Valley at the western limit of the study area to about 630 m near the uplands of the buried valley at the eastern limit of the project.

5. SITE DESCRIPTION

5.1 Surface Conditions

5.1.1 General

Within the project limits, agricultural land use (acreages and farms) predominates most of the area surrounding Highway 15, both to north and south, with the following few exceptions:

- The Dow Chemical Plant is situated northwest of the intersection of Highway 15 and Range Road 220;
- The Canadian National Railway (CNR) Scotford Yard is situated northwest of the intersection of Highway 15 and Range Road 214;
- The Elk Island rail freight handling yard on the Canadian Pacific Railway (CPR) is situated northwest of the intersection of Highway 15 and Highway 830.

Other major features along the study area include the following:

- Highway 15 is a four-lane divided roadway from the western limit of the study area to approximately 500 m west of Range Road 213. Highway 15 continues eastward as a two-lane undivided roadway.
- At the time of the site reconnaissance, grading activities were underway at the intersection of Highway 15 and Range Road 220. Grading and earthworks were being performed to reconfigure Range Road 220 and the associated service road south of Highway 15. Range Road 220 north of Highway 15 had been reconstructed and widened, but was not yet paved at the time of the site visit. Earthworks were also being performed in the median of Highway 15, apparently for the construction of separate left turning lanes.
- The CNR railway runs parallel to Highway 15 on its northern side from the western extent of the project area, over Range Road 220 and until Range Road 213 where Highway 15 turns east, and the railway continues travelling in a northeasterly direction.
- Immediately east of Range Road 214, Highway 15 crosses over Astotin Creek. There are two existing structures at this crossing. The southern lanes (eastbound traffic) cross over the creek via a 5.5 m diameter structural steel pipe culvert. The northern lanes (westbound traffic) cross over the creek via a dual-opening concrete box culvert,

with each opening measuring approximately 2.4 m in width and 3 m in height. The Alberta Transportation bridge designation number for these structures was noted to be BF73649 on a signage visible at the site. North of Highway 15, Astotin Creek runs parallel to Range Road 214. Additional details pertaining to these bridge structures are discussed in Section 5.1.3.

- Approximately 500 m east of Range Road 211, Highway 15 crosses a CPR railway track. The crossing number is 30700, as per a sign posted at the site.

5.1.2 Surface Topography and Site Drainage

Simplified ground surface topography is presented on Drawing 19-5819-6-4, Appendix A. The topographic contours were created from the Canadian Digital Elevation Data, Level 1 (CDED1) for maps 83H10, 11, 14, and 15.

The western and central portions of the study area (west of Range Road 212) are relatively flat with occasional small depressions and very gentle hills. This area is generally poorly drained and most of the precipitation collects in topographic depressions, forming shallow ponds or marshes. Part of the collected surface water infiltrates into the ground, and part of it evaporates. The Astotin Creek and the short ditches/channels in the area (some of which appeared to be man-made) drain slowly and do not have a significant impact on surface drainage.

Embankments constructed for both the CNR railway and Highway 15 further limits the flow of surface water. Several small ponds with marsh growth were observed between the railway and the roadway alignments. Small ponds and pools of standing water with marsh growth were also observed at several locations between 125 Street and Range Road 220 on the south side of Highway 15.

East of Range Road 212, the terrain climbs up at a gentle gradient of approximately 1 percent. This area is much better drained, and features shallow waterways (creeks), generally oriented towards the northwest.

5.1.3 Stream Crossings

As noted earlier, Highway 15 crosses Astotin Creek directly east of Range Road 214. The creek flows northward towards the North Saskatchewan River. At the crossing location, the creek channel is approximately 6 m wide, with 3 to 4 m high banks sloped at inclinations of about 2H:1V. The creek banks were armoured with rock riprap, approximately 0.3-0.5 m in

size. The banks appeared to be stable and in good condition. Some minor surface erosion was observed on the creek uplands, apparently caused by runoff water draining from the road surface towards the creek.

The stream is channeled beneath Highway 15 via a 5.5 m diameter, structural steel plate culvert (eastbound lanes), and a dual opening, concrete box culvert (westbound lanes). Both structures were approximately 30 m in length. The fill cover above the crown of the two culverts was approximately 1.5 m thick. Both structures appeared to be in good condition.

5.1.4 Condition of Existing Highway

The existing Highway 15 embankments were generally 1 to 3 m in height, with sideslopes inclined at 3H:1V to 6H:1V. The embankment slopes were generally in good condition, and no major erosion features or instabilities were observed. Towards the western limit of the study area, some ponding water was observed in the road side ditches. Along the divided section of the highway, several small diameter CSP culverts connecting the median ditch to the drainage ditch on the south side of the road were observed. Some of these culverts were partially blocked by sediments.

The existing asphalt pavement of Highway 15 within the study area appeared to be in good condition. No areas of excessive pavement distress were observed. Some longitudinal and transverse pavement cracks were noted in the vicinity of the CPR railway crossing east of Range Road 211.

5.2 Subsurface Conditions

Information regarding subsurface soil conditions was gathered mainly from a review of published geologic data, aerial photograph interpretation, field observations, and a limited number of test holes available in the general vicinity of the project site. As discussed in Section 4.1, the surficial geology in the project area is dominated by glacial and glaciolacustrine deposits, with some aeolian deposits north of Highway 15 (refer to Drawing No. 19-5819-6-2). Brief descriptions of these soil units are presented in the following subsections.

5.2.1 Ground Moraine

The ground moraine, or glacial till, deposit underlies the entire study area, but is present at or near the ground surface in the eastern portion of the project site (east of Range Road 214). It

comprises an unsorted mixture of clay, silt and sand with pebbles, boulders and slabs/blocks of rafted bedrock. The thickness of this unit is expected to vary between 10 and 30 m.

5.2.2 Glaciolacustrine Deposit

In the western part of the study area (west of Range Road 214), the glacial till is overlain by glaciolacustrine sediments deposited by Glacial Lake Edmonton. The deposit consists of stratified silt, and sand with lesser amounts of clay. It could be up to 5 m in thickness.

5.2.3 Aeolian Deposits

In the northwest part of the study area, the glaciolacustrine unit is overlain by an aeolian deposit composed of medium to fine grained sand. This unit was originally deposited as glaciolacustrine and glaciofluvial sediments, but was subsequently transported and re-deposited by wind. In the study area, the thickness of aeolian sand could be up to 5 m.

5.2.4 Organic Deposits

Indications of organic deposits have been identified on the air photos and were observed in the field in localized areas along the following sections of the roadway alignment (the stations below are based on the chainage of the proposed eastbound lanes).

- Station 205+500 to 205+700;
- Station 206+100 to 206+250;
- Station 208+000 to 208+500;
- Station 208+700 to 209+000; and
- Station 211+850 to 212+250

Organic deposits in the study area occur, typically, in topographic depressions, and are linked to the accumulation of surface water in these depressions and the subsequent development of marshes and swamps. It appears that these areas dry up seasonally, and hence the thickness of organic materials in these depressions is expected to small, probably less than 1 m.

5.3 Groundwater

The regional groundwater regime in the area is described by Stein (1974). According to this map, the major aquifer underlying the study area is known as the Saskatchewan Sand and

Gravel Aquifer, and is located at the bottom of the buried Beverly valley. The water level in the aquifer is hydraulically connected to the North Saskatchewan River. As such, the water table in the aquifer is regulated by river level. In the project area, the top of the Saskatchewan Sand and Gravel aquifer occurs at depths more than 20 m below the existing ground surface.

The groundwater table within the glacial deposits overlying the Saskatchewan sand and gravel is much higher. The records of several shallow monitoring wells in the general project area indicate that the water table is within a few meters below the ground surface.

6. PRELIMINARY GEOTECHNICAL ASSESSMENT

This section presents an overall assessment of the terrain and geotechnical conditions along the proposed road alignment based on the findings of the desk study and site reconnaissance. At the design stage, a detailed geotechnical investigation, including borehole drilling, must be conducted to confirm the subsurface conditions inferred in this report and to provide the geotechnical parameters required for design.

The subsurface conditions in the project area are anticipated to be generally favorable for the proposed upgrade works depicted on the plan and profile drawings provided by CIMA+ (Appendix C). Discussions of specific geotechnical considerations are presented in the following subsections.

6.1 Foundation Conditions

Subsurface soils in the project area are expected to consist of clay till overlying sand and gravel deposits, with bedrock being at approximately 30 m depth below existing grade. In some areas, the clay till may be overlain by glaciolacustrine silt, sand and clay deposits. The groundwater table may be within 5 m of the ground surface.

In general, ground support for the proposed road upgrades is anticipated to be adequate. Localized pockets of soft and weak glaciolacustrine sediments may be present, especially in the poorly drained areas in the central and western portions of the study zone. In such areas, the removal and replacement of near surface weak/soft horizons and/or enhanced foundation preparation procedures would be required. Peat and organic deposits are also anticipated in localized areas along the alignment (Section 5.2.4). Organic deposits are deemed unfavorable foundation material for road construction. As discussed earlier, the thickness of organic deposits is anticipated to be limited, probably less than 1 m. Hence, the removal and replacement of these materials with engineered fill will likely be feasible and cost effective.

Should thick organic deposits be encountered, the complete removal and replacement of these materials may be impractical. Although feasible, roads built on top of peat and organic deposits usually require special design considerations to improve foundation support and enhance the stability of the embankment slopes (e.g. flat sideslopes, use of geotextile fabric and/or geogrid reinforcements, enhanced drainage, etc.). They also require maintenance on a regular basis for a number of years after construction to correct irregularities in the road surface due to settlement.

Exposed mineral soils at the foundation level (following the stripping of topsoil and any unsuitable material) should be adequately prepared in accordance with Alberta Transportation Standard Specifications for Highway Construction.

6.2 Embankment Fills

The preliminary gradeline information provided by CIMA+ indicated that the alignment of the proposed eastbound lanes will be entirely in fill, and will involve the construction of 2 to 4 m high embankments, except at the proposed railway overpass east of Highway 830 where the bridge approach fills would up to 10 m in height.

Given the flat topography of the project area, it is anticipated that borrow fill materials will be obtained from local “dugouts” near the roadway alignment. Borrow fills may, thus, comprise clay or clay till of varying degrees of plasticity and moisture conditions. Given that surface drainage in portions of the study area was observed to be poor, it is anticipated that borrow fill materials extracted from local dugouts may be on the wet side of the optimum moisture content, and may require moisture conditioning.

Assuming adequate foundation condition, it is expected that conventional roadway cross-sections with sideslopes no steeper than 3H:1V will generally be appropriate for the proposed development. Site-specific geotechnical investigation and slope stability analyses should be undertaken for embankment fills over 4 m in height, and at the locations of the proposed overpass structure and any large culverts.

6.3 Frost Considerations

The near surface soils anticipated in the project (clay and clay till) are expected to have low to medium frost heave potential, depending on the presence, thickness, and continuity of silt/sand lenses. Where necessary, design and construction measures may be implemented to minimize frost effects. Such measures may include the removal and replacement of any frost susceptible soils near the finished subgrade level, the use of frost non-susceptible fill

materials for embankment and subgrade construction, maintaining an adequate separation depth between the subgrade level and the base of the drainage ditches (typically in the order of 1.5 m), and the installation of an adequate surface drainage system (Section 6.4).

As discussed in Section 5.1.4, the paved surface of the existing highway was generally in good condition, and no visible signs of frost heave problems were observed.

6.4 Surface Drainage and Erosion Protection

As discussed in Section 5.1.2, drainage conditions in the central and western portions of the study area were generally poor. Past experience has shown that poor road performances are attributed, in many cases, to poor drainage. Hence, the design of the proposed road must incorporate an adequate drainage system capable of collecting and directing surface runoff away from the roadway. This could include the use of proper crossfall slopes (at least 2%) on both the subgrade and pavement surfaces, the installation of drainage culverts to facilitate the flow of water and minimize ponding near roadway embankments, and the positive grading of drainage ditches towards relief points away from the roadway.

Embankment fill slopes and roadway ditches should be covered with topsoil and vegetated to reduce the potential for erosion by surface runoff. Water flows in roadway ditches should be evaluated to assess if additional erosion protection measures are needed.

6.5 Pavement Design

Based on field observations, the existing pavement of Highway 15 appears to have performed adequately. Assuming comparable traffic loads and frequencies, it would appear that a pavement structure comparable to the existing one would serve as a reasonable starting point for the design of the pavement structure of the proposed twined roadway.

7. FUTURE SITE INVESTIGATION

The preliminary evaluation presented herein is based on a desktop review and a site reconnaissance. No geotechnical test holes were drilled for this functional planning study.

During the design stage, it is recommended that a detailed geotechnical investigation (including test hole drilling) be conducted to provide site-specific information for the design of the various components of this project. The following elements should be part of the detailed geotechnical investigation:

- Drilling of deep test holes (25 to 30 m deep) for the design of the railway overpass structure and associated approach embankments;

- Drilling of shallow test holes (in the order of 3 m deep) at regular intervals (typical Alberta Transportation guidelines require one test hole at every 200 m) along the proposed roadway alignment to confirm the subsurface soil and groundwater conditions;

- Drilling of deeper test holes at the locations of embankment fills over 4 m in height for slope stability analyses;

- Drilling of shallow test holes to confirm the depth and extent of organic deposits located along or in the immediate vicinity of the proposed alignment; and

- Test hole drilling to investigate the suitability of potential borrow sources.

8. REFERENCES

Andriashek, L.D., 1988. Quaternary Stratigraphy of the Edmonton Map Area, NTS 83H. Open File Report # 198804. Terrain Sciences Department, Natural Resources Division, Alberta Research Council. 1988.

Bayrock, L.A.. 1972. Surficial Geology Edmonton. NTS 83H. Alberta Research Council. 1972.

Slattery, S.R., A. A. Barker, L. D. Andriashek, G. Jean, S. A. Stewart, H. Moktan and T. G. Lemay., 2011. Bedrock Topography and Sediment Thickness Mapping in the Edmonton-Calgary Corridor, Central Alberta: An overview of Protocols and Methodologies. ERCB/AGS Open File Report 2010-12.

Stein, R., 1974. Hydrogeological Map Edmonton Area (Northeast Segment) Alberta. NTS 83H-NE. Alberta Research Council.

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STATEMENT OF LIMITATIONS AND CONDITIONS

1. STANDARD OF CARE

This study and Report have been prepared in accordance with generally accepted engineering or environmental consulting practices in this area. No other warranty, expressed or implied, is made.

2. COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report which is of a summary nature and is not intended to stand alone without reference to the instructions given to us by the Client, communications between us and the Client, and to any other reports, writings, proposals or documents prepared by us for the Client relative to the specific site described herein, all of which constitute the Report.

IN ORDER TO PROPERLY UNDERSTAND THE SUGGESTIONS, RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. WE CANNOT BE RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT.

3. BASIS OF REPORT

The Report has been prepared for the specific site, development, design objectives and purposes that were described to us by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the document, subject to the limitations provided herein, are only valid to the extent that this Report expressly addresses proposed development, design objectives and purposes, and then only to the extent there has been no material alteration to or variation from any of the said descriptions provided to us unless we are specifically requested by the Client to review and revise the Report in light of such alteration or variation or to consider such representations, information and instructions.

4. USE OF THE REPORT

The information and opinions expressed in the Report, or any document forming part of the Report, are for the sole benefit of the Client. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION THEREOF WITHOUT OUR WRITTEN CONSENT AND SUCH USE SHALL BE ON SUCH TERMS AND CONDITIONS AS WE MAY EXPRESSLY APPROVE. The contents of the Report remain our copyright property. The Client may not give, lend or, sell the Report, or otherwise make the Report, or any portion thereof, available to any person without our prior written permission. Any use which a third party makes of the Report, are the sole responsibility of such third parties. Unless expressly permitted by us, no person other than the Client is entitled to rely on this Report. We accept no responsibility whatsoever for damages suffered by any third party resulting from use of the Report without our express written permission.

5. INTERPRETATION OF THE REPORT

a) Nature and Exactness of Soil and Contaminant Description: Classification and identification of soils, rocks, geological units, contaminant materials and quantities have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification of these factors are judgmental in nature. Comprehensive sampling and testing programs implemented with the appropriate equipment by experienced personnel, may fail to locate some conditions. All investigations utilizing the standards of Paragraph 1 will involve an inherent risk that some conditions will not be detected and all documents or records summarizing such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated and the Client and all other persons making use of such documents or records with our express written consent should be aware of this risk and this report is delivered on the express condition that such risk is accepted by the Client and such other persons. Some conditions are subject to change over time and those making use of the Report should be aware of this possibility and understand that the Report only presents the conditions at the sampled points at the time of sampling. Where special concerns exist, or the Client has special considerations or requirements, the Client should disclose them so that additional or special investigations may be undertaken which would not otherwise be within the scope of investigations made for the purposes of the Report.

b) Reliance on Provided Information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to us. We have relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, we cannot accept responsibility for any deficiency, misstatement or inaccuracy contained in the Report as a result of misstatements, omissions, misrepresentations, or fraudulent acts of the Client or other persons providing information relied on by us. We are entitled to rely on such representations, information and instructions and are not required to carry out investigations to determine the truth or accuracy of such representations, information and instructions.

(see over …)

INTERPRETATION OF THE REPORT *(continued. . .)*

c) Design Services: The Report may form part of the design and construction documents for information purposes even though it may have been issued prior to the final design being completed. We should be retained to review the final design, project plans and documents prior to construction to confirm that they are consistent with the intent of the Report. Any differences that may exist between the report recommendations and the final design detailed in the contract documents should be reported to us immediately so that we can address potential conflicts.

d) Construction Services: During construction we must be retained to provide field reviews. Field reviews consist of performing sufficient and timely observations of encountered conditions to confirm and document that the site conditions do not materially differ from those interpreted conditions considered in the preparation of the report. Adequate field reviews are necessary for Thurber to provide letters of assurance, in accordance with the requirements of many regulatory authorities.

6. RISK LIMITATION

Geotechnical engineering and environmental consulting projects often have the potential to encounter pollutants or hazardous substances and the potential to cause an accidental release of those substances. In consideration of the provision of the services by us, which are for the Client's benefit, the Client agrees to hold harmless and to indemnify and defend us and our directors, officers, servants, agents, employees, workmen and contractors (hereinafter referred to as the "Company") from and against any and all claims, losses, damages, demands, disputes, liability and legal investigative costs of defence, whether for personal injury including death, or any other loss whatsoever, regardless of any action or omission on the part of the Company, that result from an accidental release of pollutants or hazardous substances occurring as a result of carrying out this Project. This indemnification shall extend to all Claims brought or threatened against the Company under any federal or provincial statute as a result of conducting work on this Project. In addition to the above indemnification, the Client further agrees not to bring any claims against the Company in connection with any of the aforementioned causes.

7. SERVICES OF SUBCONSULTANTS AND CONTRACTORS

The conduct of engineering and environmental studies frequently requires hiring the services of individuals and companies with special expertise and/or services which we do not provide. We may arrange the hiring of these services as a convenience to our Clients. As these services are for the Client's benefit, the Client agrees to hold the Company harmless and to indemnify and defend us from and against all claims arising through such hirings to the extent that the Client would incur had he hired those services directly. This includes responsibility for payment for services rendered and pursuit of damages for errors, omissions or negligence by those parties in carrying out their work. In particular, these conditions apply to the use of drilling, excavation and laboratory testing services.

8. CONTROL OF WORK AND JOBSITE SAFETY

We are responsible only for the activities of our employees on the jobsite. The presence of our personnel on the site shall not be construed in any way to relieve the Client or any contractors on site from their responsibilities for site safety. The Client acknowledges that he, his representatives, contractors or others retain control of the site and that we never occupy a position of control of the site. The Client undertakes to inform us of all hazardous conditions, or other relevant conditions of which the Client is aware. The Client also recognizes that our activities may uncover previously unknown hazardous conditions or materials and that such a discovery may result in the necessity to undertake emergency procedures to protect our employees as well as the public at large and the environment in general. These procedures may well involve additional costs outside of any budgets previously agreed to. The Client agrees to pay us for any expenses incurred as the result of such discoveries and to compensate us through payment of additional fees and expenses for time spent by us to deal with the consequences of such discoveries. The Client also acknowledges that in some cases the discovery of hazardous conditions and materials will require that certain regulatory bodies be informed and the Client agrees that notification to such bodies by us will not be a cause of action or dispute.

9. INDEPENDENT JUDGEMENTS OF CLIENT

The information, interpretations and conclusions in the Report are based on our interpretation of conditions revealed through limited investigation conducted within a defined scope of services. We cannot accept responsibility for independent conclusions, interpretations, interpolations and/or decisions of the Client, or others who may come into possession of the Report, or any part thereof, which may be based on information contained in the Report. This restriction of liability includes but is not limited to decisions made to develop, purchase or sell land.

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APPENDIX A

Drawing No. 19-5819-6-1 – Location of Study Area
Drawing No. 19-5819-6-2 – Site Plan Showing Surficial Geology
Drawing No. 19-5819-6-3 – Thickness Contours of Surficial Deposits
Drawing No. 19-5819-6-4 – Ground Surface Topography

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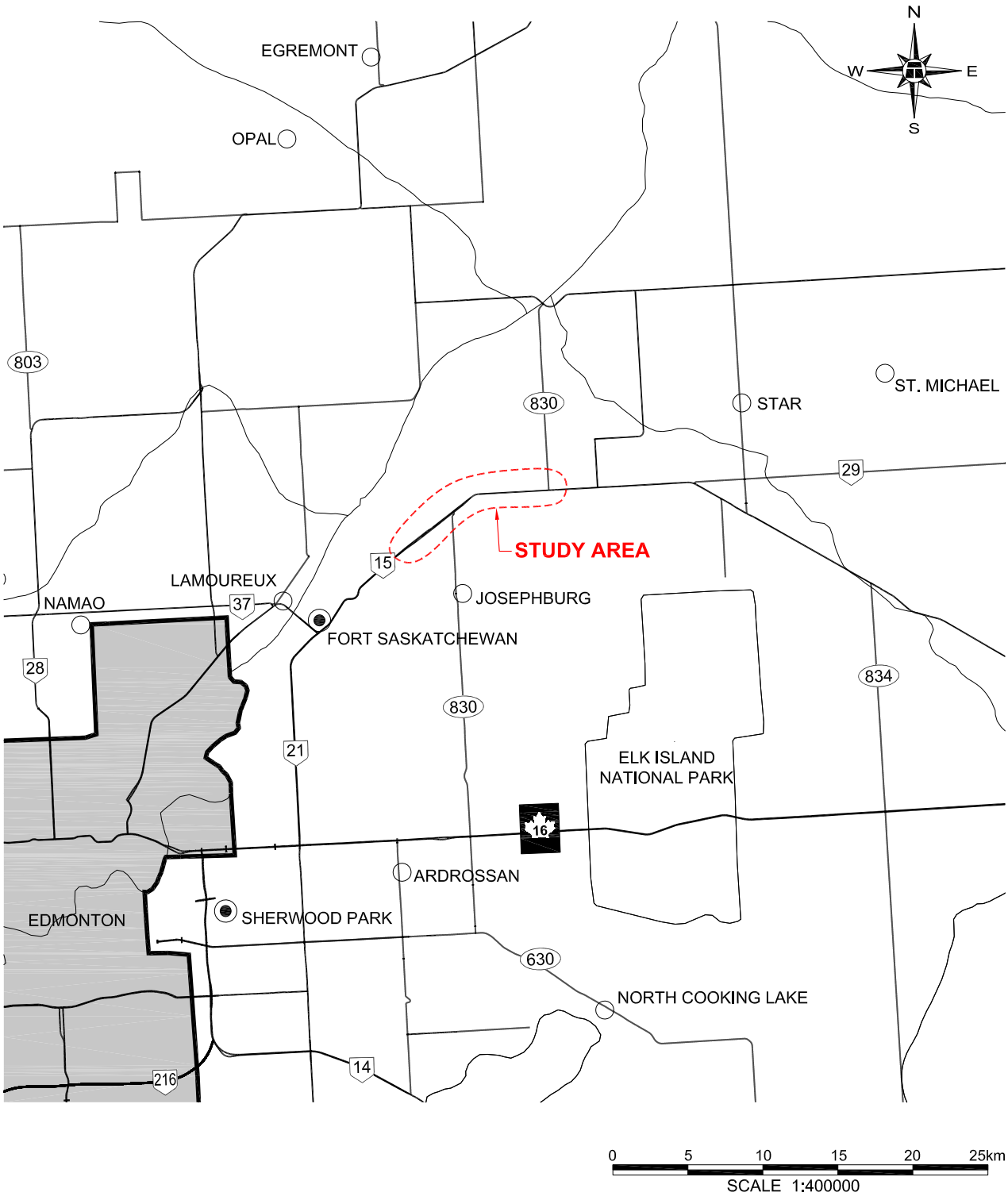

FUNCTIONAL PLANNING STUDY
HWY 15:06 TWINNING, NORTHEAST OF FORT SASKATCHEWAN
(FROM RR 220 TO HWY 830 NORTH)

LOCATION OF STUDY AREA

DWG No. 19-5819-6-1

CIMA+

DRAWN BY	KLW
DESIGNED BY	SEC
APPROVED BY	HER
SCALE	1:400000
DATE	NOVEMBER 2012
FILE No.	19-5819-6

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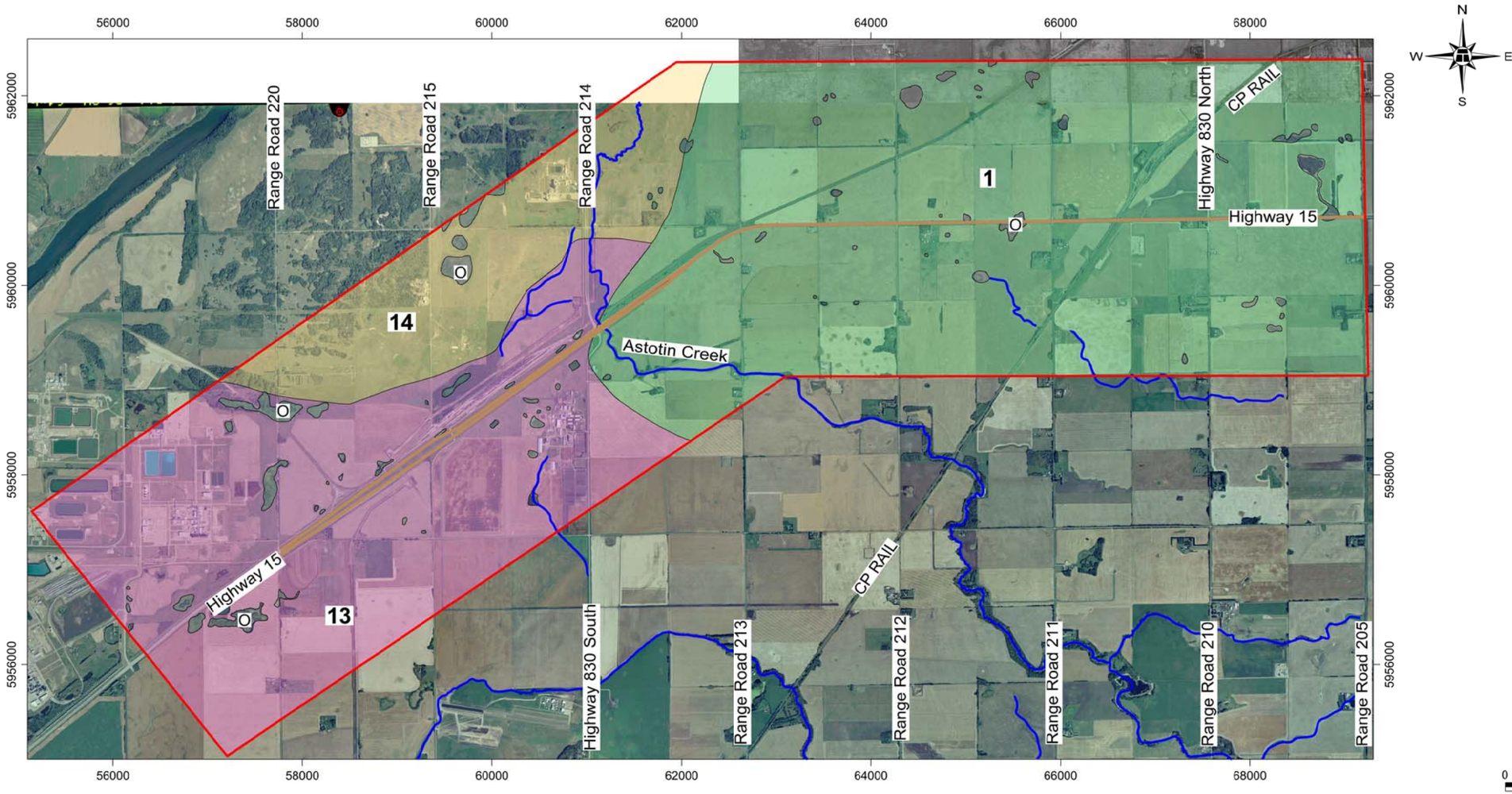

0 500 1000 1500 2000 2500 3000m

SCALE 1:50000

LEGEND

STUDY AREA

1 - GLACIAL DEPOSITS - GROUND MORAINE (TILL COMPOSED OF CLAY, SILT AND SAND WITH PEBBLES AND BOULDERS; VARIABLE IN THICKNESS ; TOPOGRAPHY LEVEL TO UNDULATING)

13 - GLACIOLACUSTRINE DEPOSITS. SILT AND CLAY; BEDDED SILT AND CLAY, WITH MINOR SAND; VARVED IN PLACES.

14 - AEOLIAN DEPOSITS; SAND, DUNES; MEDIUM TO FINE-GRAINED SAND IN SHEET AND DUNE FORM.

O - ORGANIC DEPOSITS

Reference; L.A.Bayrock. Surficial Geology Edmonton. NTS 83H. Alberta Research Council. 1972.

2006 Air Photo Provided by Air Photo Distribution, Government of Alberta.

CIMA+

FUNCTIONAL PLANNING STUDY
HWY 15:06 TWINNING, NORTHEAST OF FORT SASKATCHEWAN (FROM RR 220 TO HWY 830 NORTH)

SITE PLAN SHOWING SURFICIAL GEOLOGY

DWG No. 19-5819-6-2

DRAWN BY	KLW
DESIGNED BY	SEC
APPROVED BY	HER
SCALE	1:50000
DATE	NOVEMBER 2012
FILE No.	19-5819-6

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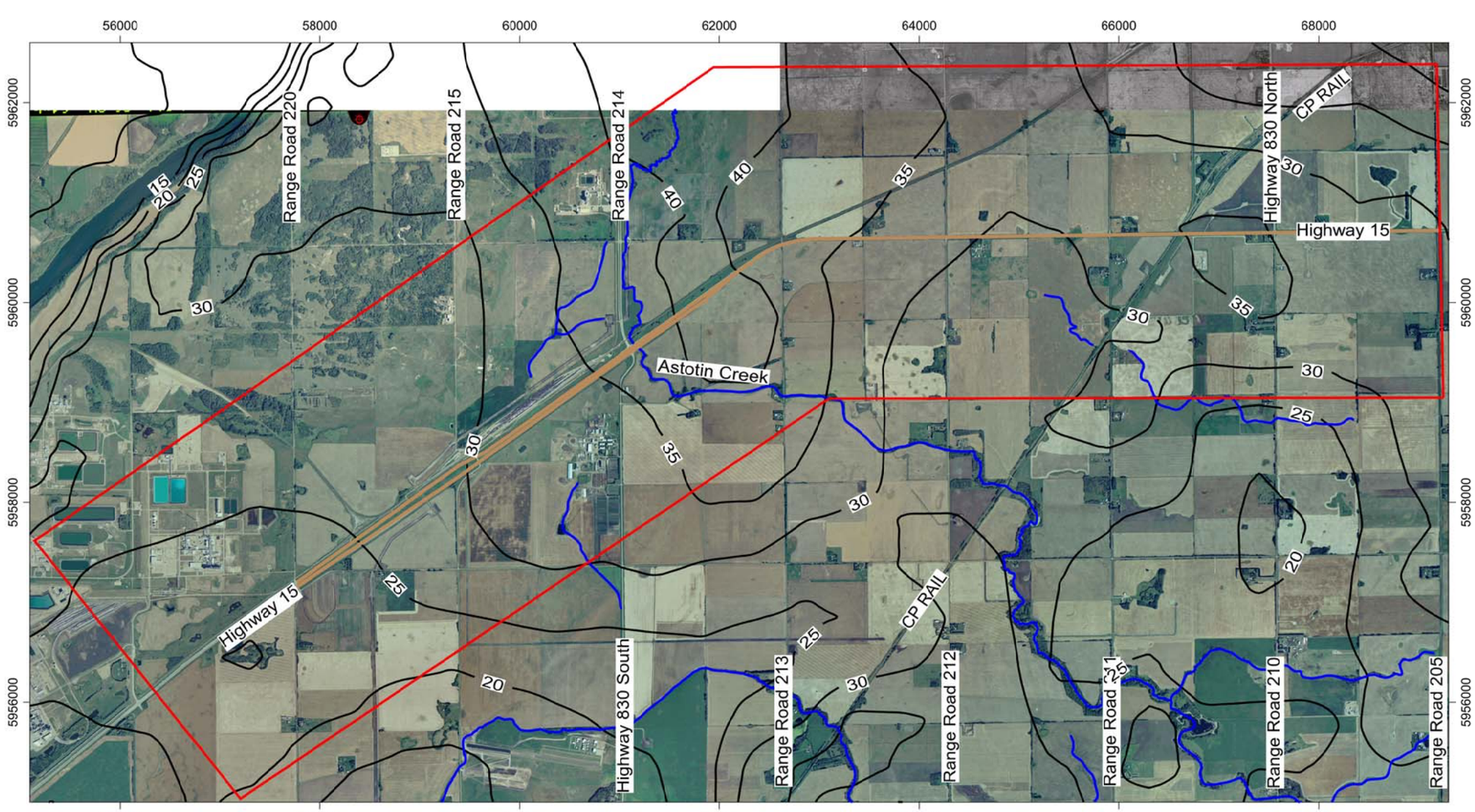

N
W E
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0 500 1000 1500 2000 2500 3000m
SCALE 1:50000

LEGEND

STUDY AREA

35 SURFICIAL DEPOSITS THICKNESS CONTOURS (5m INTERVALS)

Reference;
S. R. Slattery, A. A. Barker, L. D. Andriashek, G. Jean, S. A. Stewart, H. Moktan and T. G. Lemay. Bedrock Topography and Sediment Thickness Mapping in the Edmonton-Calgary Corridor, Central Alberta: An overview of Protocols and Methodologies. ERCB/AGS Open File Report 2010-12. February 2011.

CIMA+

FUNCTIONAL PLANNING STUDY
HWY 15:06 TWINNING, NORTHEAST OF FORT SASKATCHEWAN (FROM RR 220 TO HWY 830 NORTH)

THICKNESS CONTOURS OF SURFICIAL DEPOSITS

DWG No. 19-5819-6-3

DRAWN BY	KLW
DESIGNED BY	SEC
APPROVED BY	HER
SCALE	1:50000
DATE	NOVEMBER 2012
FILE No.	19-5819-6

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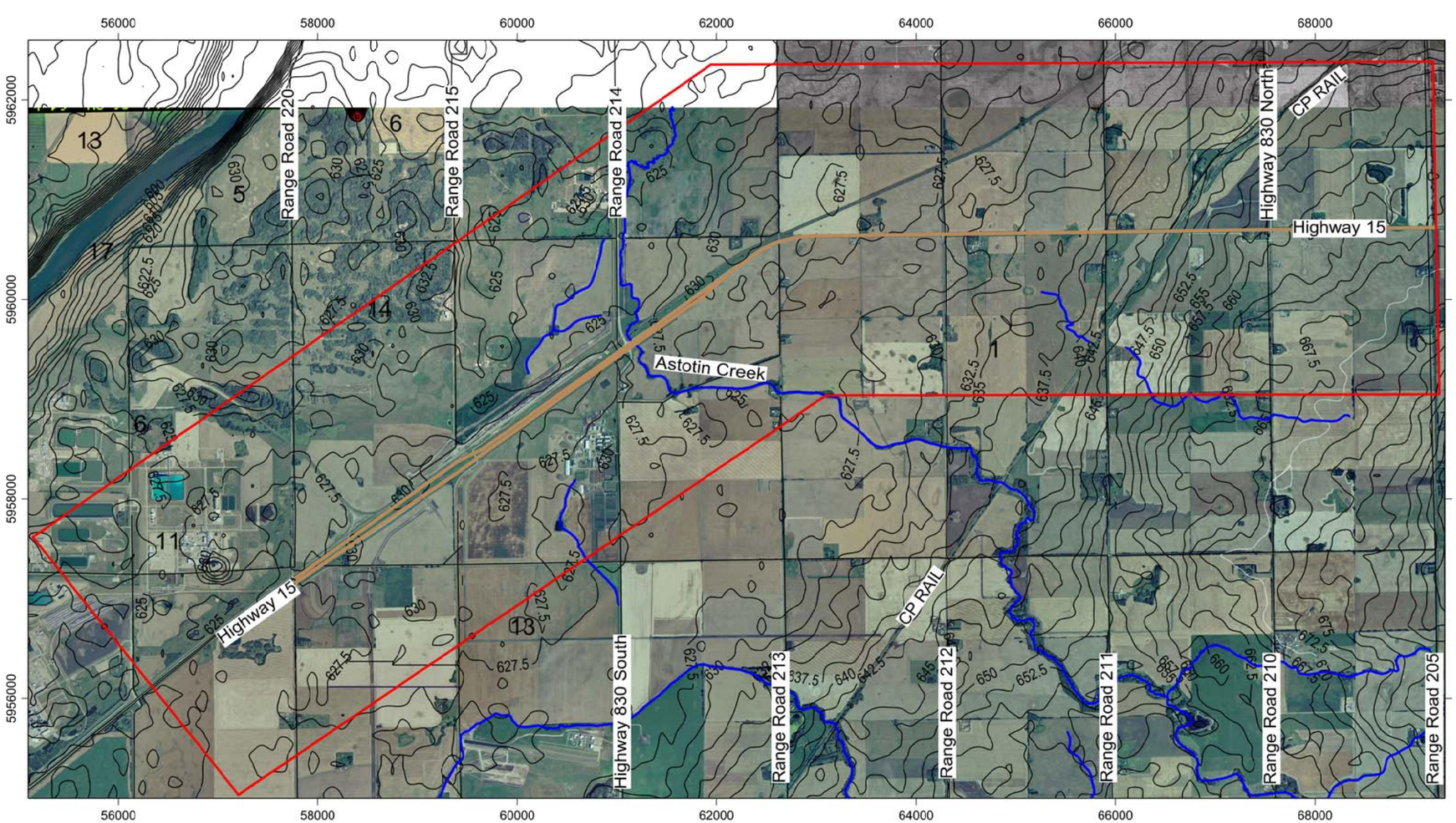

N
W E
S

0 500 1000 1500 2000 2500 3000m
SCALE 1:50000

REFERENCE:
NATIONAL RESOURCES CANADA (NRCAN)
CANADIAN DIGITAL ELEVATION DATA (CDED)

LEGEND

STUDY AREA

650 CONTOUR OF GROUND SURFACE TOPOGRAPHY (2.5m INTERVALS)

CIMA+

FUNCTIONAL PLANNING STUDY
HWY 15:06 TWINNING, NORTHEAST OF FORT SASKATCHEWAN
(FROM RR 220 TO HWY 830 NORTH)

GROUND SURFACE TOPOGRAPHY

DWG No. 19-5819-6-4

DRAWN BY	KLW
DESIGNED BY	SEC
APPROVED BY	HER
SCALE	1:50000
DATE	NOVEMBER 2012
FILE No.	19-5819-6

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APPENDIX B

Selected Photographs from Site Reconnaissance
(May 16, 2012)

Photo 1 – Vegetation in ditch, looking east along Highway 15 from 125 Street towards Range Road 220

Photo 2 – Standing water along east side of Range Road 220 looking north towards Highway 15

Photo 3 – Active construction at intersection of Highway 15 and Range Road 220.

Photo 4 – Looking west along embankment on south side of Highway 15 at Range Road 215

Photo 5 – Median sideslope conditions, looking west from intersection at Range Road 214

Photo 6 – Standing water and poor drainage between north embankment of Highway 15 and parallel CNR railway, looking west from the intersection with Range Road 220

Photo 7 – CSP culvert beneath eastbound lanes of Highway 15 at Astotin Creek – BF73649

Photo 8 – Double box culvert beneath westbound lanes of Highway 15 at Astotin Creek - BF73649

Photo 9 – Typical embankment conditions, looking east between Range Roads 214 and 213

Photo 10 – Typical median conditions, looking west between Range Roads 214 and 213

Photo 11 – Typical embankment conditions, looking west at Range Road 212

Photo 12 – CPR railway crossing 30700, east of Range Road 211

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APPENDIX C

Proposed Highway 15 Twinning Plan and Profile Drawings (by CIMA+)

CONSULTANT

JOB No. E00311A

CIMA

DESIGNER

CHECKER

DRAFT
FOR DISCUSSION PURPOSES ONLY
OCTOBER 16/2012

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DATE

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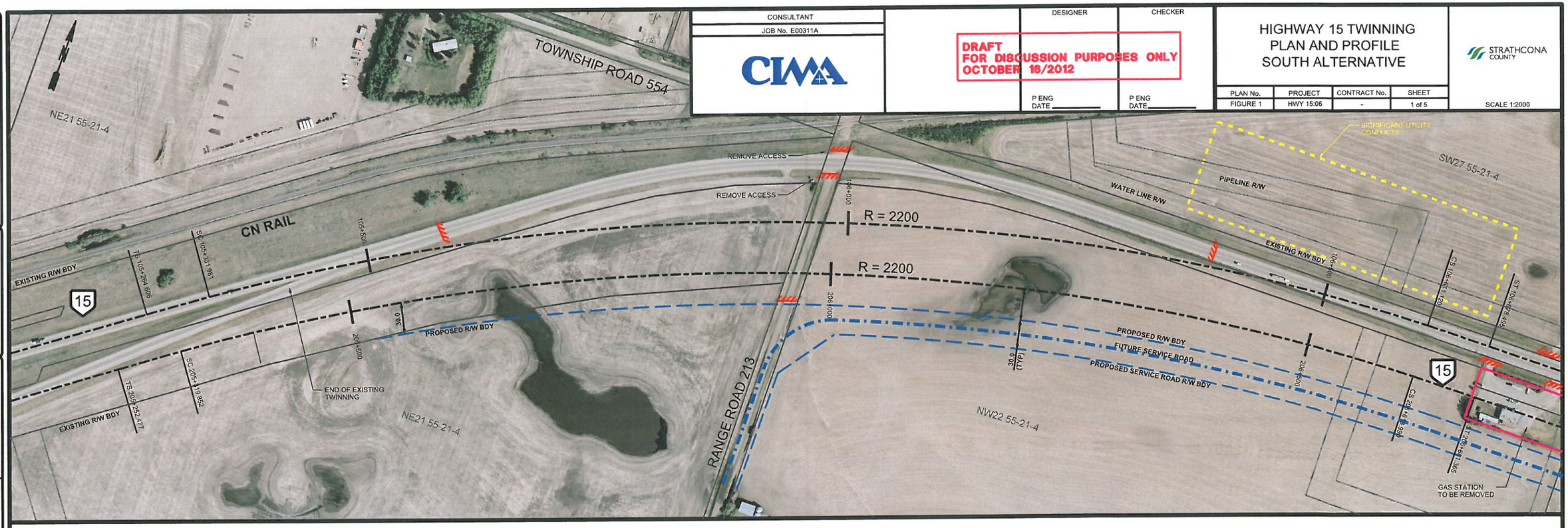
DATE

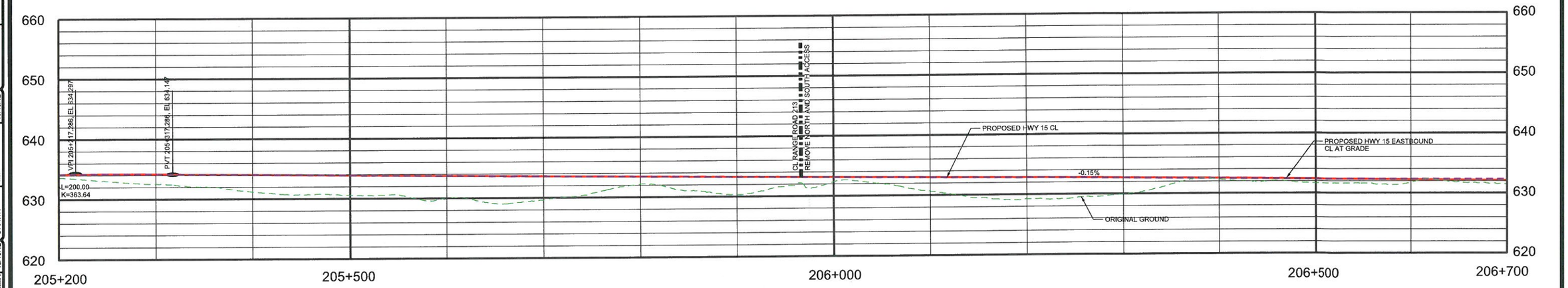
HIGHWAY 15 TWINNING PLAN AND PROFILE SOUTH ALTERNATIVE

PLAN No.	PROJECT	CONTRACT No.	SHEET
FIGURE 1	HWY 15:06	-	1 of 5

STRATHCONA COUNTY

SCALE 1:2000





PLAN DESCRIPTION
HIGHWAY 15 TWINNING
PLAN AND PROFILE
SOUTH ALTERNATIVE

BAR CODE

PLAN No.	FIGURE 1
CONTRACT No.	-
SITE No.	-

PHOTO No.	-
TITLE SEARCH	-
DATE GRAPHICS FILE	-

	BY	DATE
SURVEYED		
DESIGNED	DD	16/10/12
CHECKED	TW	16/10/12
DRAWN	MM	16/10/12

No.	REVISION	BY	DATE
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2			
1	ISSUED FOR INFORMATION	CIMA	16/10/12

CONSULTANT

JOB No. E00311A

CIMA

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HIGHWAY 15 TWINNING PLAN AND PROFILE SOUTH ALTERNATIVE

PLAN No.	PROJECT	CONTRACT No.	SHEET
FIGURE 2	HWY 15:06	-	2 of 5

STRATHCONA COUNTY

SCALE 1:2000

PLAN DESCRIPTION

HIGHWAY 15 TWINNING
PLAN AND PROFILE
SOUTH ALTERNATIVE

BAR CODE

PLAN No.	FIGURE 2
CONTRACT No.	-
SITE No.	-

PHOTO No.	-
TITLE SEARCH	-
DATE GRAPHICS FILE	-

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DESIGNED	DD	16/10/12
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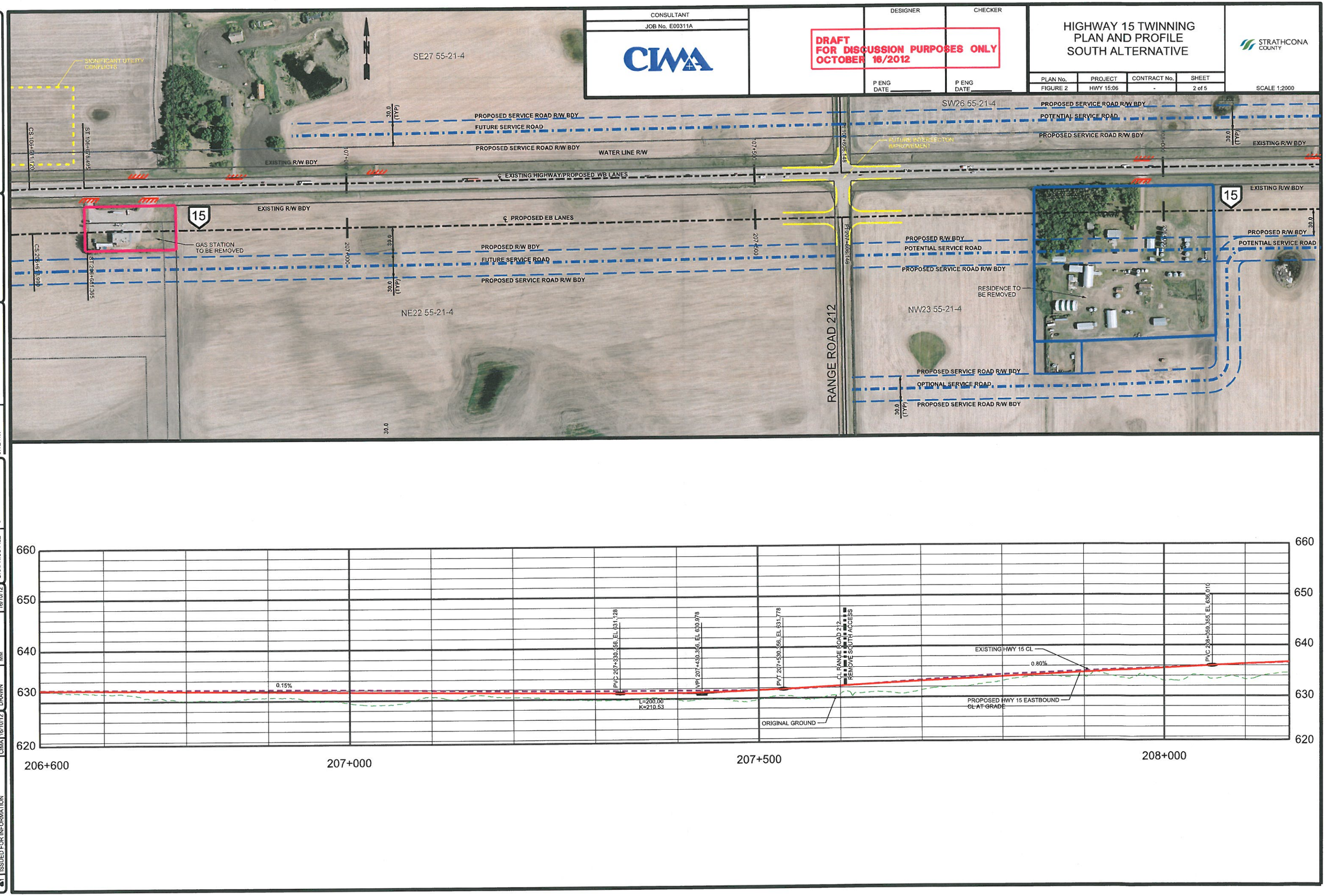

CONSULTANT

JOB No. E00311A

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P ENG DATE

HIGHWAY 15 TWINNING PLAN AND PROFILE SOUTH ALTERNATIVE

STRATHCONA COUNTY

PLAN No.	PROJECT	CONTRACT No.	SHEET
FIGURE 3	HWY 15:06		3 of 5

SCALE 1:2000

PLAN DESCRIPTION
HIGHWAY 15 TWINNING
PLAN AND PROFILE
SOUTH ALTERNATIVE

BAR CODE

PLAN No. - | FIGURE 3
CONTRACT No. - | SITE No. -

No.	REVISION	BY	DATE
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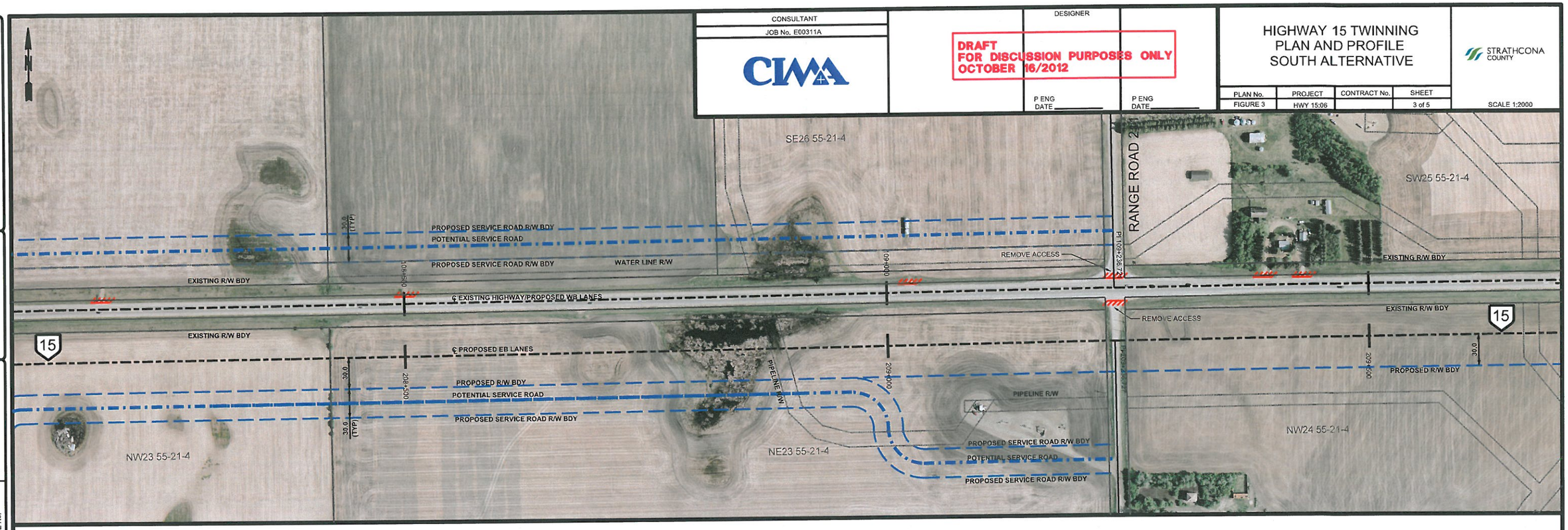
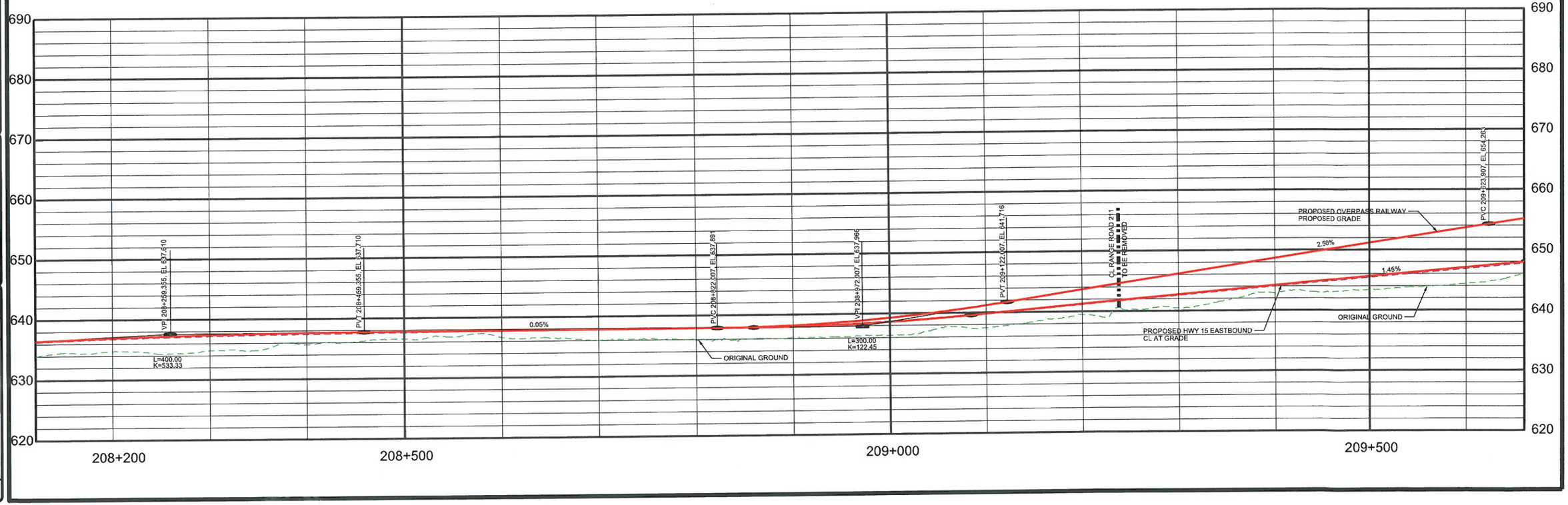
	BY	DATE
SURVEYED		
DESIGNED	DD	16/10/12
CHECKED	TW	16/10/12
DRAWN	MM	16/10/12

PHOTO No. -
TITLE SEARCH -
DATE
GRAPHICS FILE -





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HIGHWAY 15 TWINNING
PLAN AND PROFILE
SOUTH ALTERNATIVE

STRATHCONA COUNTY

PLAN No.	PROJECT	CONTRACT No.	SHEET
FIGURE 4	HWY 15:06		4 of 5

SCALE 1:2000

PLAN DESCRIPTION
HIGHWAY 15 TWINNING
PLAN AND PROFILE
SOUTH ALTERNATIVE

BAR CODE

PLAN No.	FIGURE 4
CONTRACT No.	-
SITE No.	-

No.	REVISION	BY	DATE
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2			
1	ISSUED FOR INFORMATION	CIMA	16/10/12

	BY	DATE
SURVEYED		
DESIGNED	DD	16/10/12
CHECKED	TW	16/10/12
DRAWN	MM	16/10/12

PHOTO No.	-
TITLE SEARCH	-
DATE	16/10/12
GRAPHICS FILE	-

SW25 55-21-4

SE25 55-21-4

SW30 55-20-4

NW24 55-21-4

NE24 55-21-4

NW19 55-20-4

CP RAIL

PIPELINE R/W

POTENTIAL RAILWAY OVERPASS LOCATION

PROPOSED R/W BDY

EXISTING R/W BDY

WATER LINE R/W

SIGNIFICANT UTILITY CONFLICTS

830

15

FUTURE INTERSECTION IMPROVEMENT

PROPOSED SERVICE ROAD R/W BDY

POTENTIAL SERVICE ROAD

RESIDENCE TO BE REMOVED

Range Road 210

30.0 (TYP.)

PI 209+873.907

PI 210+875.000

210+000

210+500

211+000

690
680
670
660
650
640
630
620

PVC 209+323.907, EL 654.263

VPI 209+473.907, EL 660.513

C.P. RAIL

PVT 210+123.907, EL 660.263

PROPOSED OVERPASS RAILWAY
PROPOSED GRADE

PVC 210+508.897, EL 659.878

VPI 210+633.897, EL 659.753

PVT 210+758.897, EL 660.878

CL RANGE ROAD 210

2.50%

-0.10%

0.90%

-1.45%

RAILWAY CROSSING

L=500.00
K=192.31

L=250.00
K=250.00

EXISTING HWY 15 CL

PROPOSED HWY 15 EASTBOUND
CL AT GRADE

ORIGINAL GROUND

209+700

210+000

210+500

211+000

CONSULTANT

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HIGHWAY 15 TWINNING
PLAN AND PROFILE
SOUTH ALTERNATIVE

STRATHCONA COUNTY

PLAN No.	PROJECT	CONTRACT No.	SHEET
FIGURE 5	HWY 15:06	-	5 of 5

SCALE 1:2000

PLAN DESCRIPTION
HIGHWAY 15 TWINNING
PLAN AND PROFILE
SOUTH ALTERNATIVE

BAR CODE

PLAN No.	CONTRACT No.	SITE No.
FIGURE 6	-	-

PHOTO No.	-
TITLE SEARCH	-
DATE GRAPHICS FILE	-

	SURVEYED	DESIGNED	CHECKED	DRAWN
BY		DD	TW	MM
DATE		16/10/12	16/10/12	16/10/12

No.	REVISION	BY	DATE
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3			
2			
1	ISSUED FOR INFORMATION	CIMA	16/10/12