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December 12, 2013

Gerald Beaton
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Major Projects Branch
Ministry of Highways and Infrastructure
1630 Park Street
Regina, SK S4N 2G1

Dear Gerald,

RE: Southeast Regina Bypass Functional Design Study

MMM Group Limited (MMM) is pleased to submit five (5) hard copies and one (1) electronic copy of the final report for the Southeast Regina Bypass Functional Design Study.

If you have any questions regarding this submission, please do not hesitate to contact the undersigned at (306) 522-7158.

Sincerely,

MMM Group Limited

A handwritten signature in blue ink, appearing to read "Bruce Belmore".

Bruce Belmore, P. Eng., PTOE, AVS
Regional Manager, Transportation

BB/cb

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REVISION LOG

Revision #	Revised By	Date	Issue / Revision Description
-	C. Billings	October 18, 2013	Draft Report
1	C. Billings	December 12, 2013	Final Report

MMM GROUP LIMITED SIGNATURES

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Association of Professional Engineers & Geoscientists
of Saskatchewan

CERTIFICATE OF AUTHORIZATION

MMM Group Limited
Number C0860

Permission to Consult held by:

Discipline	Sk. Reg. No.	Signature
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EXECUTIVE SUMMARY

Background

In 2004, the Saskatchewan Ministry of Highways and Infrastructure (MHI) approved a plan for the Southeast Regina Bypass that would connect Ring Road to Highway No.1 East. The west terminal of the approved alignment was located on Ring Road just east of the existing interchange at Albert Street, and the east terminal was located at Tower Road.

A recent study completed in 2012 re-evaluated this alignment in light of regional changes that have occurred since 2004, including the establishment of the Global Transportation Hub west of Regina and the associated increase in truck traffic attempting to bypass the city. A new South Regina Bypass alignment was recommended through this study: one that maintained the east terminal at Tower Road, but moved the west terminal out to connect with the West Regina Bypass.

The general alignment of the South Regina Bypass between Highway No. 1 West and Highway No. 33 was determined through a study undertaken in the spring of 2013. The functional design of this segment is currently underway. The Southeast portion of the Regina Bypass will remain in the vicinity of Tower Road, with interchanges planned for the intersections at Highway No. 33 and Highway No. 1 East.

The *Southeast Regina Bypass Functional Design Study* was commissioned in April 2013, with the goal of determining a functional design for this southeast segment of the South Regina Bypass. This study includes a review of the previous design for the segment of the bypass between Highway No. 33 and Highway No. 1 East (hereafter referred to as the Base Case), and the development of a preferred functional design that includes the alignment of the highway and the interchange configurations.

Concept Development

The goal of the development phase of this study was to generate alternative design concepts for the Southeast Regina Bypass for comparison to the Base Case. After the concepts were refined, they could then be compared in a systematic manner to determine which design can meet the current and future needs of the road network in the most efficient and cost effective way.

The first step in the process was to quickly develop viable alternatives. This involved a concentrated effort up front using a Value Engineering (VE) Workshop to develop a number of potential solutions to some of the design issues that were recognized in the Base Case.

Value Engineering is a creative, organized effort which analyzes the requirements of a project for the purpose of achieving the essential functions at the most efficient cost. The VE Workshop brought together technical experts from MHI, MMM Group Limited, the City of Regina, and the RM of Sherwood, along with major developers/landowners in the study area, to form a VE Team. This team collaborated to develop design alternatives for the portion of the South Regina Bypass between Highway No. 1 East and Highway No. 33.

After the workshop, the proposed design concepts were refined using input from stakeholders and technical experts. Three final concepts were then brought forward for evaluation against the Base Case.

Consultation

The proposed Southeast Regina Bypass will have a significant impact on area transportation, as it will serve local, regional, provincial, national, and even international transportation needs. As such, there are many groups and individuals who hold a stake in the determination of the bypass alignment. The goal of the consultation program for this study was to try and understand the needs, issues, and preferences of various stakeholders, and to use this information to help make decisions regarding the design of the southeast segment of the bypass.

The Ministry of Highways and Infrastructure is responsible for the provincial road network. The Ministry has undertaken this planning study to ensure that the Southeast Regina Bypass will serve the provincial transportation needs in the most efficient way possible. The RM of Sherwood and the City of Regina were also invited to participate in the planning process, and were represented on the project Steering and Technical Committees. Other key stakeholders include the residents, landowners, and business owners within the RM and the City that will be directly impacted by the Southeast Regina Bypass alignment.

The consultation program for this study involved various methods of communication and information sharing, including Steering Committee meetings, Technical Review Committee meetings, two public open house sessions, and meetings with impacted landowners and residents.

Concept Selection

In order to select a preferred alignment, each alignment option must be objectively compared to the other. To facilitate this comparison, a set of route evaluation criteria was developed. These criteria were based on typical evaluation criteria used for route location studies, but were tailored for this specific case.

The final set of route evaluation criteria, presented in Table A, was developed through discussions with the Steering and Technical Committees, each of which had representation from MHI, the City of Regina, and the RM of Sherwood.

Table A – Route Evaluation Criteria

Evaluation Criteria	Description
1. TransCanada Highway Functionality	Maintains high speed, free-flow conditions for the westbound to southbound movement, and the northbound to eastbound movement – the future TransCanada Highway movements
2. Safety & Traffic Operations	Provides a safe and consistent design that will be familiar and easy to negotiate
3. Potential Phasing Opportunities	Provides a stage-able solution at Victoria Ave & Tower Rd intersection if an interchange is needed in the future. Consideration for whether or not the design can be integrated into a future Northeast Bypass.
4. Access to Adjacent Development	Limits the amount of development or land parcels that are isolated or will have poor access.
5. Property Impacts	Consideration for the amount of land that will have to be purchased and the impact on existing homes and businesses
6. Constructability	Minimizes disruption to existing traffic flows, and allows for existing Highway 1 infrastructure to be used during construction
7. Noise Impacts	Minimizes traffic noise for existing residents
8. Environmental Impacts	Avoids any environmentally sensitive areas, including areas with a high water table
9. Utility / Railway Impacts	Minimizes impacts to railways and utilities
10. Economic Development Potential	Increases the development potential for adjacent lands
11. Right-of-Way	Minimizes the total land required for the design
12. Construction Cost	Total construction cost estimate

After determining the appropriate evaluation criteria, an overall score for each concept was determined through a process of weighting and ranking each category for each alignment alternative. The ranking involved an investigation into each criterion, and its potential impact on the concepts.

The route alignment concept that received the highest overall score in the consultant’s ranking was selected as the recommended concept to be taken forward into functional design. The recommended concept was presented to the public at Open House 2 on August 15, 2013, and consultation with impacted landowners and residents continued during the functional design process.

Functional Design

The geometric design of the bypass was undertaken with consideration of Canadian and Saskatchewan design standards, impacts of the design on bridge structures, existing and forecast traffic volumes, geotechnical conditions, utilities, and the accommodation of an overall drainage scheme.

The proposed functional design of the Southeast Regina Bypass is illustrated in Figure A. The planning level cost estimate for this functional design is \$166.3 Million.

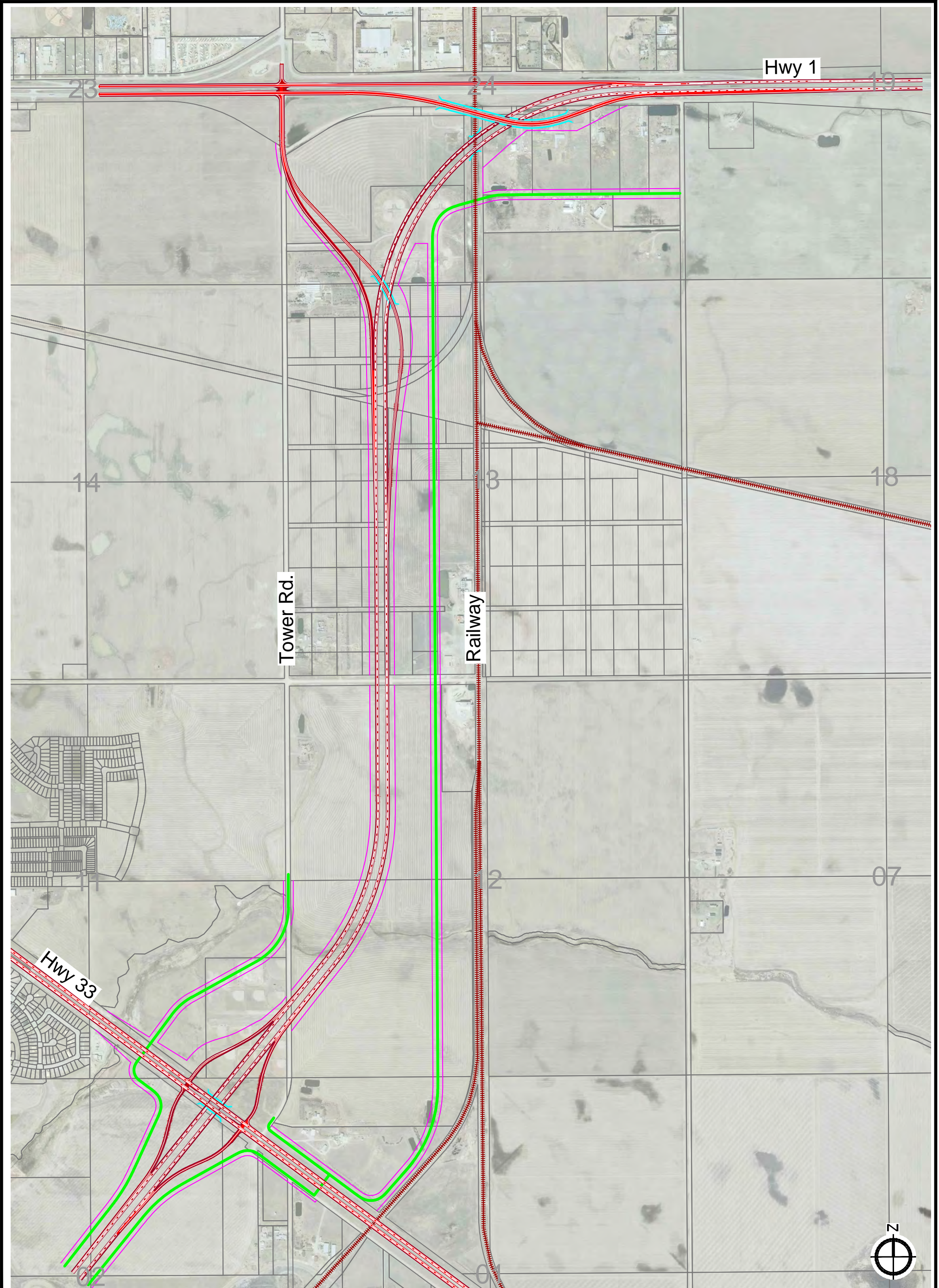
Conclusions

The *Southeast Regina Bypass Functional Design Study* has allowed the selection of a location for the bypass between Highway 1 and Highway 33, as well as identifies a layout for both the system interchange at Highway 1 and the service interchange at Highway 33.

The location of a bypass is typically controversial as it impacts the surrounding landowners. With the general location being set in the vicinity of Tower Road, the true test was to develop a design that would address Highway 1 traffic, but also daily commuter traffic from surrounding communities, as well as localized Regina traffic.

The recommended functional design provides the following attributes:

- ▶ Maintains high speed free-flow operation for traffic on Highway 1
- ▶ Provides a high level of service for traffic destined to Victoria Avenue
- ▶ Provides a buffer between the Southeast Regina Bypass and existing urban development
- ▶ Provides flexibility should it be decided to continue the Regina Bypass north on Tower Road
- ▶ A tight diamond moves Highway 33 interchange away from Chuka Creek and meets long term traffic volumes
- ▶ Provides flexibility for a future infrastructure at the Tower Road and Victoria Avenue intersection, should it be required
- ▶ Ability to keep all lanes on existing Highway 1 open during construction



LEGEND:

- RIGHT-OF-WAY
- DESIGN BRIDGES
- DESIGN ROADS
- DESIGN SERVICE ROADS



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Issued Date - 2013-10-23

**Figure A
Recommended Design**

Southeast Regina Bypass - Detailed Functional Design

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1.0 INTRODUCTION

MMM Group Limited (MMM) was commissioned by the Saskatchewan Ministry of Highways and Infrastructure (MHI) to complete the Southeast Regina Bypass Functional Design Study. The purpose of this study is to develop a functional design for the segment of the South Regina Bypass that will connect Highway No. 1 east of Regina to Highway No. 33 southeast of Regina, in the vicinity of Tower Road.

In 2004, MHI approved a plan for the Southeast Regina Bypass that would connect Ring Road to Highway No.1 East. The west terminal of the approved alignment was located on Ring Road just east of the existing interchange at Albert Street, and the east terminal was located at Tower Road. A recent study completed in 2012 re-evaluated this alignment in light of regional changes that have occurred since 2004, including the establishment of the Global Transportation Hub west of Regina and the associated increase in truck traffic attempting to bypass the city. A new South Regina Bypass alignment was recommended through this study: one that maintained the east terminal at Tower Road, but moved the west terminal out to connect with the West Regina Bypass.

The general alignment of the South Regina Bypass between Highway No. 1 West and Highway No. 33 was determined through a study undertaken by MMM in the spring of 2013. The functional design of this segment is currently underway. The Southeast portion of the bypass will remain in the vicinity of Tower Road, with interchanges planned for the intersections at Highway No. 33 and Highway No. 1 East.

The Southeast Regina Bypass Functional Design Study was commissioned in April 2013, with the goal of determining a functional design for this southeast segment of the South Regina Bypass. This study includes a review of the previous design for the segment of the bypass between Highway No. 33 and Highway No. 1 East, and the development of a preferred functional design that includes the alignment of the highway and the interchange configurations.

Steering and technical committees comprised of representatives from MMM, MHI, the City of Regina, and the RM of Sherwood No. 159 were formed to guide the study process and provide input into the decisions made. Additional stakeholder consultation was undertaken throughout the study in the form of stakeholder meetings and public open house events.

The Southeast Regina Bypass Functional Design Study involved the following key steps:

- ▶ Review of the existing functional design
- ▶ Development of design alternatives
- ▶ Determination of a preferred concept
- ▶ Development of a new functional design
- ▶ Establish a construction estimate for the new design

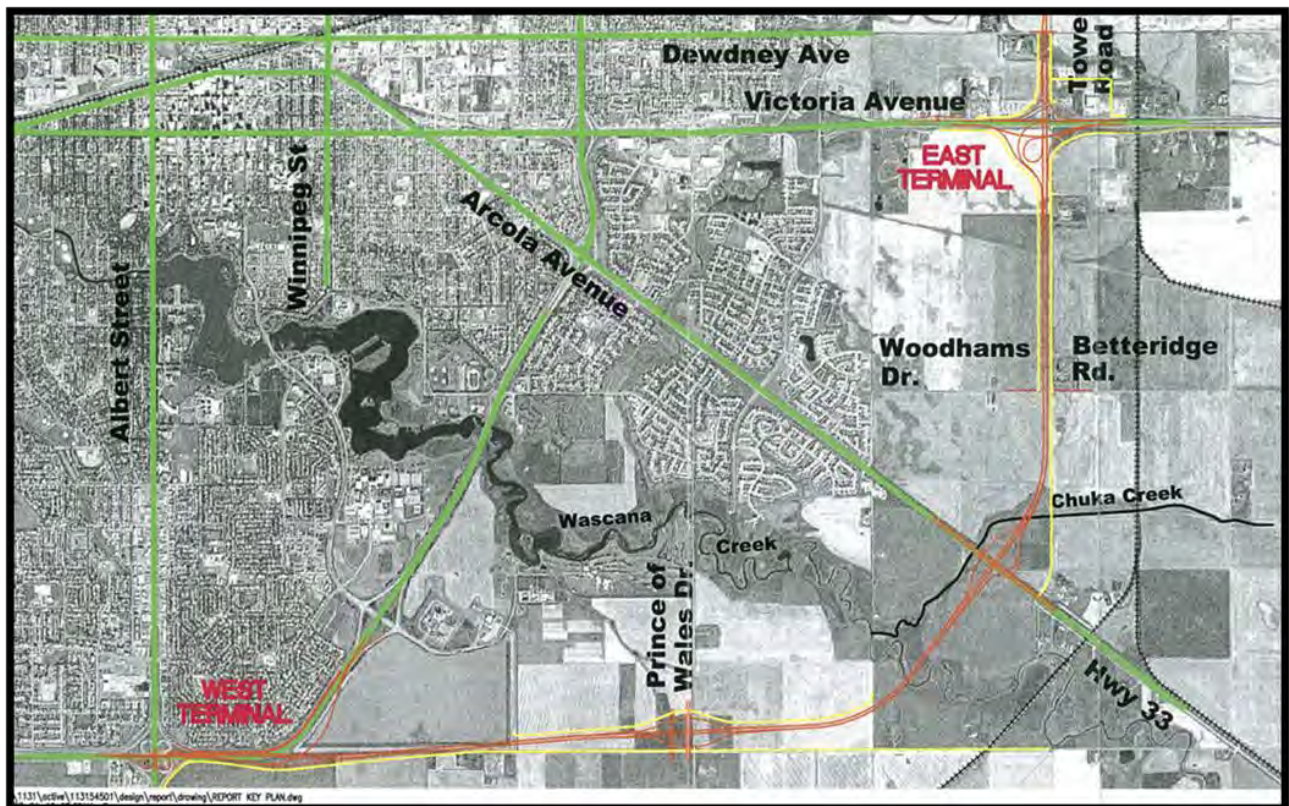
2.0 BACKGROUND

2.1 Existing Functional Design

Planning for a highway bypass around the south side of Regina began in 1996 with the *Regina Regional Highway Planning Study* undertaken by Reid Crowther & Partners Limited. This study included options for the development of a link between Highway No. 1 west of Regina and Highway No. 1 east of Regina, with the primary purpose of separating highway traffic from City traffic.

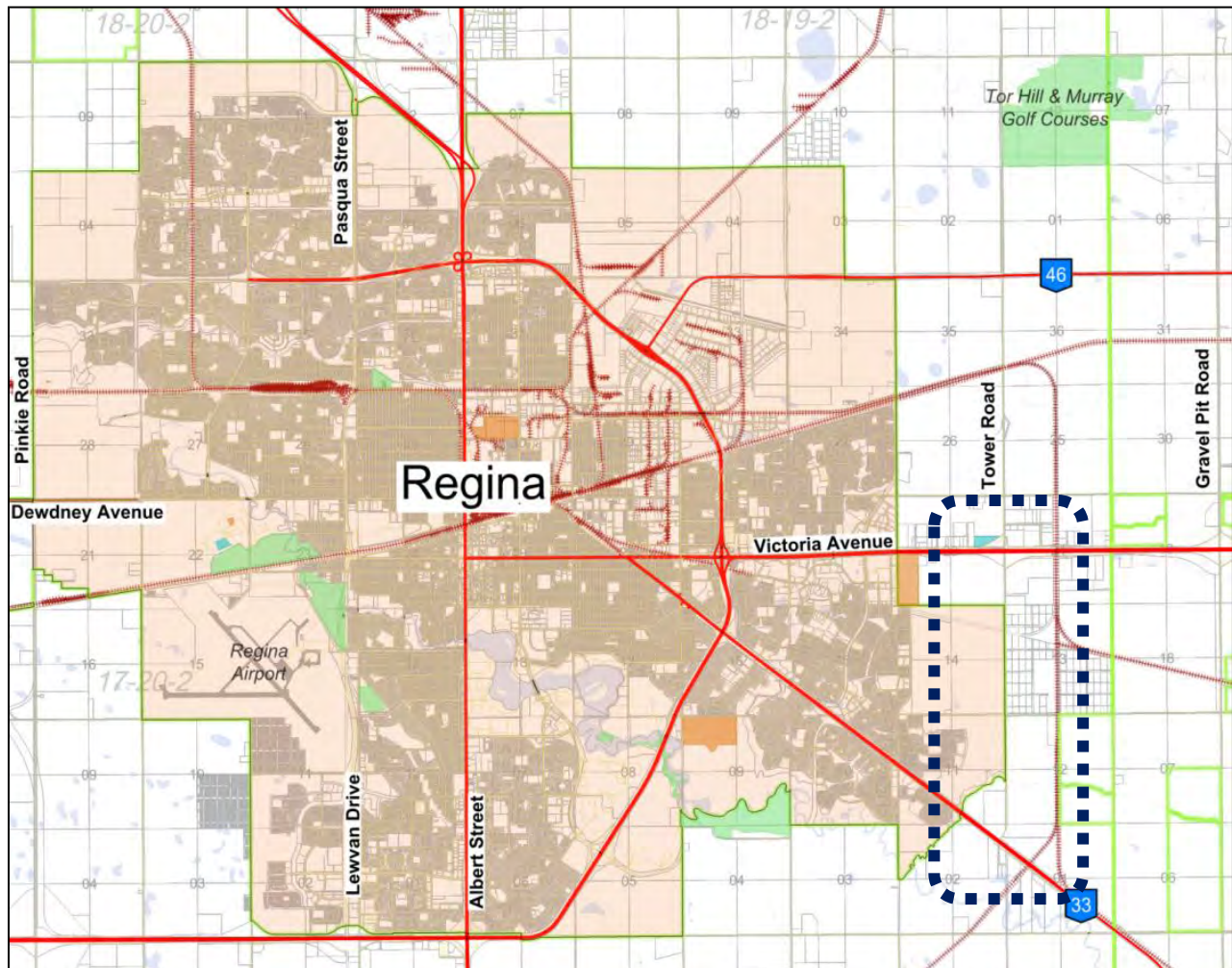
Since that time, many planning studies and functional design studies have been undertaken. A detailed functional design of the bypass was completed by Stantec Consulting Limited in 2007. This design, illustrated in Figure 1 consists of a west terminal on Highway No. 1 just east of the existing cloverleaf interchange at Highway No. 6, and an east terminal on Highway No. 1 at Tower Road. A review of this functional design undertaken by MMM in 2012 recommended moving the west terminal further west to provide a direct connection to the West Regina Bypass, which is currently under construction. The east portion of the bypass from Highway No. 1 East to Highway No. 33 was recommended to remain in the vicinity of Tower Road.

Figure 1 – Previous Alignment for the South Regina Bypass



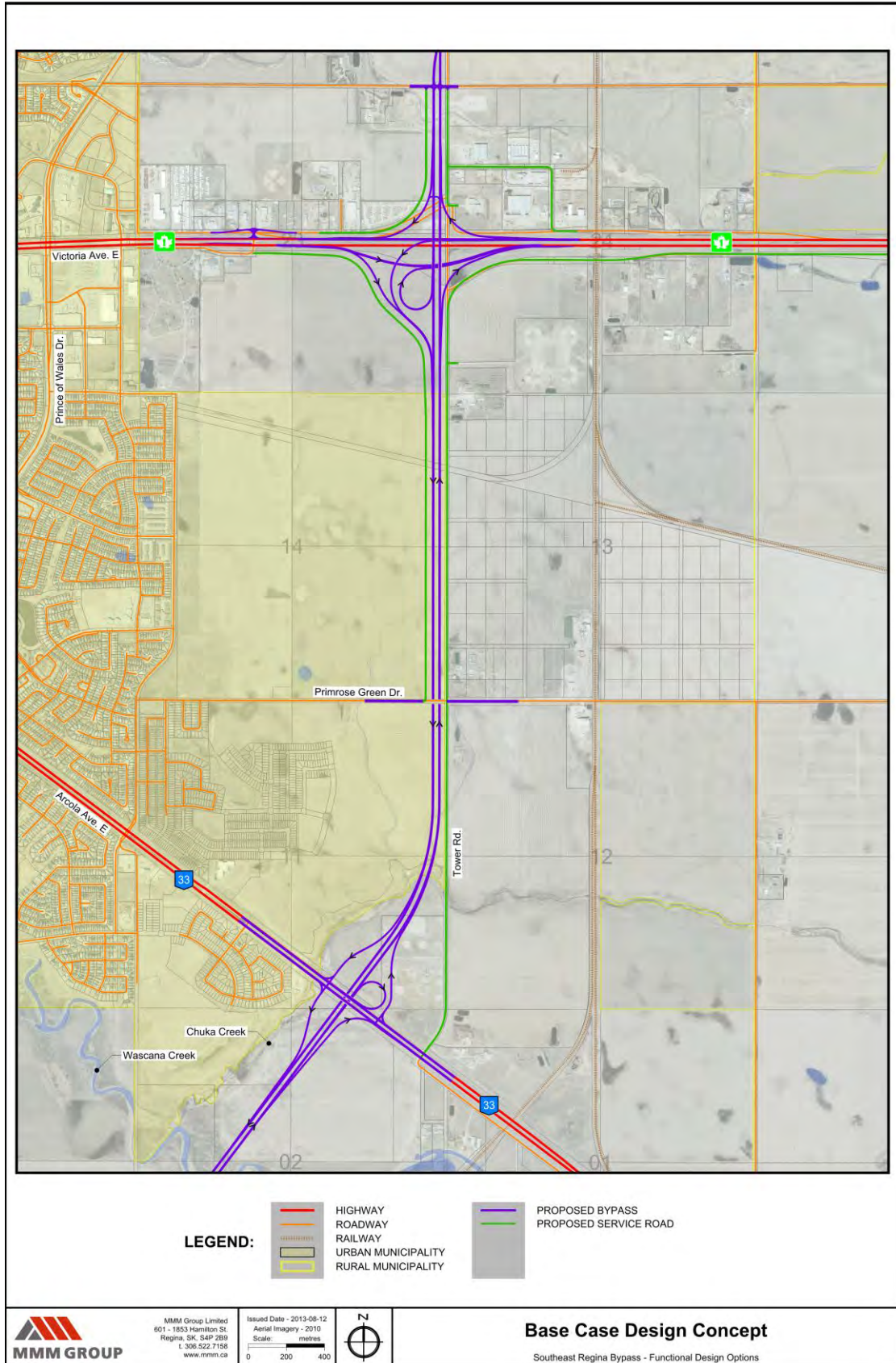
In the spring of 2013, the general location for the portion of the bypass that will link the West Regina Bypass to Highway No. 33 was established. The purpose of the current work is to complete the functional design of the east portion of the bypass that will link Highway No. 33 to Highway No. 1 East in the vicinity of Tower Road. The alignment of this southeast segment will fall between the Regina City Limits and the existing Canadian Pacific Rail (CPR) tracks. Figure 2 illustrates the general location of the study area east of Regina.

Figure 2 – Study Area



The existing functional design of the South Regina Bypass within this study area, referred to herein as the Base Case, is presented in Figure 3. The ultimate configuration of the Base Case is a four lane divided highway facility that follows an alignment west of Tower Road, connecting Highway No. 1 East to Highway No. 33. In this plan, the existing Tower Road becomes the east service road to the bypass.

Figure 3 – Base Case Design



The key feature of the interchange at Highway No. 1 is the directional ramp provided for the bypass traffic. This ramp serves the westbound to southbound movement, the key highway to highway connection. The interchange at Highway No. 33 has been designed as a single loop partial cloverleaf, with the loop serving the northbound to westbound movement back into Regina.

Some issues have been identified with the Base Case design. These issues are noted below.

Highway No. 1 Interchange

- ▶ Tight radius for directional ramp makes it impossible to maintain highway speeds for the key highway to highway movement (westbound to southbound)
- ▶ No provision for an eastbound to northbound movement
- ▶ Substandard northbound to westbound movement
- ▶ Unconventional left hand entry/exit from interchange ramps for TransCanada Highway traffic
- ▶ Large footprint impacts existing development and service roads

Highway No. 33 Interchange

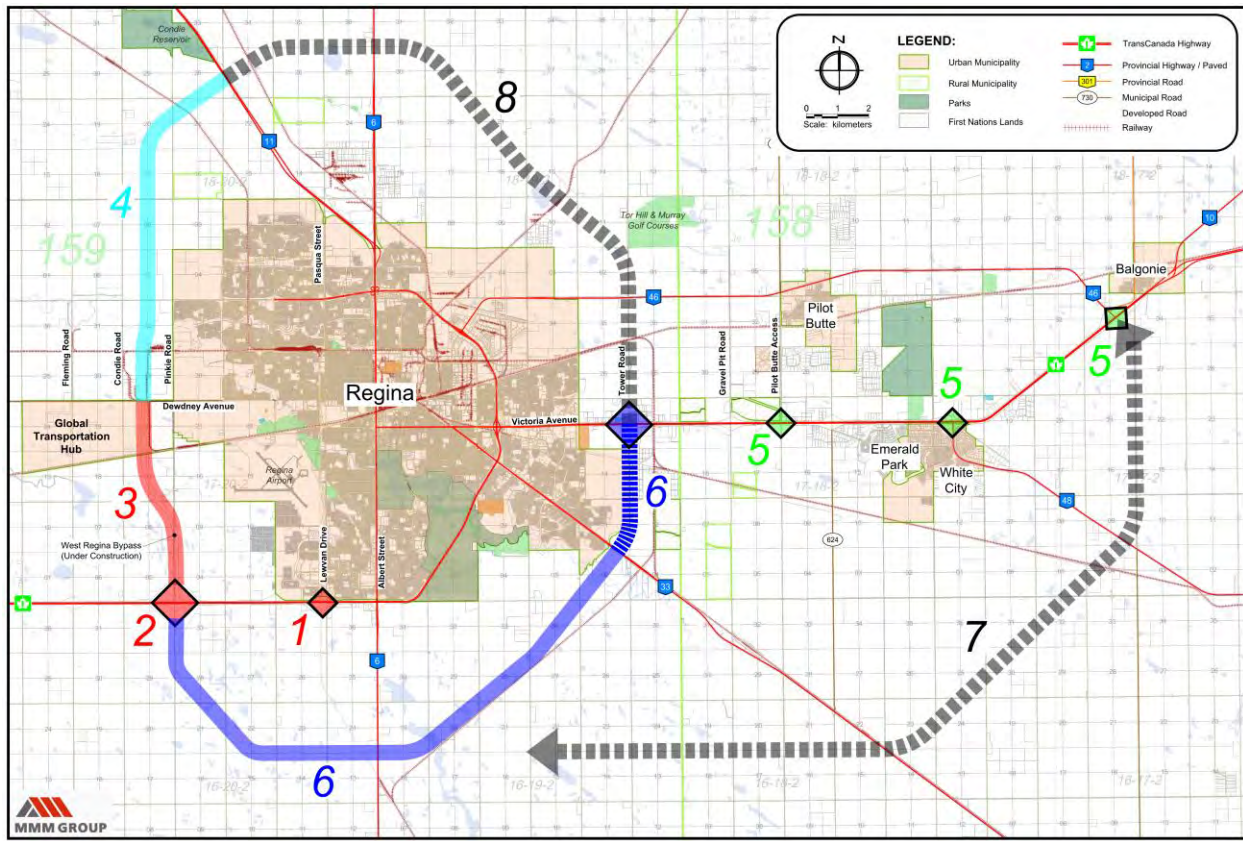
- ▶ Close to Chuka Creek
- ▶ Close to existing residential development

The purpose of this study is to re-examine the design of the Tower Road segment of the South Regina Bypass. This study will determine if the existing design is appropriate, and will provide alternatives that may be better suited to the existing and future road network requirements.

2.2 Regional Context

Figure 4 provides an illustration of the transportation network planning initiatives being undertaken in the Regina region. Each road segment shown in the figure represents a segment of the network that is in a different phase of development, from long term planning through to construction and operation. Note that the roadway alignments shown on this map are conceptual in nature, and are not meant to represent the exact alignment of any of these links.

Figure 4 – Regional Planning Initiatives



Interchanges are being planned to provide grade separated highway access for Pilot Butte, White City and Balgonie (Items 5). When considered in conjunction with the bypass alignment around Regina, this infrastructure is crucial to achieving the desired free-flow operation for the TransCanada Highway.

The bypass system could also extend around other urban centers along Highway 1 to the east in the very long-term horizon (Item 7). However, substantial development east of Regina would be necessary to justify a bypass facility located at such a distance from the city.

1. Highway 1 & Lewvan Drive Interchange (Item 1): This interchange was opened to traffic in 2011.
2. Highway 1 & West Regina Bypass Interchange (Item 2): This interchange was opened to traffic in October 2013 to serve vehicles on the West Regina Bypass.
3. West Regina Bypass – South Leg (Item 3): This segment of the West Regina Bypass between Highway 1 and Dewdney Avenue is currently under construction.
4. West Regina Bypass – North Leg (Item 4): A functional planning study was recently completed for this segment of the West Regina Bypass between Dewdney Avenue and Highway No. 11. The functional plan provides details regarding the alignment, including interchange layouts and access locations.

5. Highway 1 East (Item 5): A functional planning study completed in 2010 recommended interchanges at the Pilot Butte Access, Highway 48, and Highway 46. These interchanges are required to help resolve existing safety and capacity issues at these locations. The interchanges were spaced to provide separation from each other (and from the east terminal of the South Regina Bypass at Tower Road) while still providing access for the communities in the area. Because of the amount of commuter traffic generated by these communities, these interchanges will be required regardless of where the South Regina Bypass is located.
6. South Regina Bypass (Item 6): The solid portion of the South Regina Bypass (Highway 1 West to Highway 33) represents the general route location study undertaken in the spring of 2013. The dashed segment (i.e. also referred to as the SE Regina Bypass) between Highway No. 33 and Highway No. 1 East represents the work being undertaken in this study to develop a functional plan for this segment, including interchange layouts and service roads.
7. Long Term Bypass Route (Item 7): The idea for a long-term south bypass route was introduced in the Highway 1 East Functional Planning Study. This route would connect somewhere in the vicinity of Highway No. 46 and would bypass most of the communities east of Regina. This alignment hasn't been contemplated beyond a general idea. It was recognized that the cost of such a roadway would be so high, and the traffic volumes would be so low, that it would not be practical to build it for many years.
8. Future North East Regina Bypass (Item 8): Although no studies have been conducted regarding a possible alignment for the future Northeast Regina Bypass, it has been considered throughout the regional planning process. A northeast connection would form a new ring around Regina, providing options for bypass traffic in all directions, and providing use for City traffic as well. Decisions made regarding the location of the west and south legs of the bypass were influenced in part by the potential for this future northeast connection.

Although being examined as individual segments, there is an overall regional plan that unifies the links. The individual segments are anticipated to eventually form an overall perimeter route and/or a ring road facility bypassing Regina. Once constructed, the bypass network will provide a high speed, access-controlled facility serving as an alternate route for traffic traveling around Regina, but will be situated close enough to be useful for some city-based traffic. The proximity is important as the external highway system can be used to alleviate congestion on Regina roadways (i.e. Victoria Avenue East and Ring Road).

3.0 STAKEHOLDER CONSULTATION

The proposed Southeast Regina Bypass will have a significant impact on area transportation, as it will serve local, regional, provincial, national, and even international transportation needs. As such, there are many groups and individuals who hold a stake in the determination of the bypass alignment. The goal of the consultation program for this study was to try and understand the needs, issues, and preferences of various stakeholders, and to use this information to help make decisions regarding the design of the southeast segment of the bypass.

The Ministry of Highways and Infrastructure is responsible for the provincial road network. The Ministry has undertaken this planning study to ensure that the Southeast Regina Bypass will serve the provincial transportation needs in the most efficient way possible. The RM of Sherwood and the City of Regina were also invited to participate in the planning process. Both the RM and City road networks will be directly impacted by the bypass. Other key stakeholders include the residents, landowners, and business owners within the RM and the City that will be directly impacted by the Southeast Regina Bypass alignment.

The consultation program for this study involved various methods of communication and information sharing, including Steering Committee meetings, Technical Review Committee meetings, two public open house sessions, and meetings with impacted landowners.

3.1 Steering Committee

The Steering Committee for this study was comprised of representatives from the Ministry of Highway and Infrastructure, the RM of Sherwood, the City of Regina, and the study consultant. Key meetings were held at various points throughout the study to discuss study progress and review work that was underway.

As the study consultant, MMM Group was responsible for completing the engineering analysis and developing a functional design for the preferred alignment. The primary purpose of the Steering Committee was to review this work and ensure that the study was moving in the right direction. The meetings provided the Steering Committee members with the chance to make their needs known to the consultant and the other committee members.

3.2 Technical Review Committee

A Technical Review Committee was also formed for this study. Similar to the Steering Committee, the Technical Review Committee had representation from the Ministry of Highway and Infrastructure, the RM of Sherwood, the City of Regina, and the study consultant.

The Technical Review Committee was comprised of representatives from the member agencies with the technical background to comment on the engineering and analysis tasks undertaken throughout the study. They were tasked with reviewing the consultant's work and commenting on the assumptions and analysis methods used to develop the functional design.

The Technical Review Committee also provided insight into the future function of the roadway, and helped to determine potential impacts related to various design options. Technical Review Committee meetings were held in advance of or in conjunction with the Steering Committee meetings.

3.3 Public Open House No. 1

The first public open house for the study was held on Thursday, June 20, 2013 from 6:30 p.m. to 8:30 p.m. The event was held at F.W. Johnson Collegiate in the east end of Regina. The purpose of the Open House was to present several design options for the Southeast Regina Bypass, and to gather input from the public to assist in the selection of the preferred option. A general invitation was published in the Leader Post on June 8th and June 15th. In addition to the newspaper ads, a notice was posted on the Ministry of Highways and Infrastructure website.

Open House #1 was held as a come-and-go event at which attendees were invited to view a number of display boards and pose questions to representatives from MMM Group and the Ministry of Highways and Infrastructure. Following the open house, electronic copies of the display boards were made available to the public via the MHI website (Appendix A).

There were 84 people who signed in at the open house, and the total attendance was estimated at approximately 100 people. A number of participants provided their input on formal comment sheets that were supplied to them at the event. In addition, comments were received by phone, mail and e-mail following the open house. A summary of the comments received following the open house can be found in Appendix A.

Many of the individuals who provided comment sheets after Open House No. 1 indicated a preference for a specific alignment concept. A summary of the preferences is provided in Table 1. The majority of respondents preferred alignment Concept 2 or 2a, which represents the furthest east alignment. Of the 8 respondents that preferred alignments not shown at the Open House (i.e. Other), the majority indicated that they would prefer the bypass to be constructed further east.

Table 1 – Open House No. 1 – Preferred Concepts

Concept	No. of Respondents
Base Case	2
Concept 1	8
Concept 2/2a	19
Other	8
Unknown	3
Total	40

3.4 Public Open House No. 2

The second public open house for the study was held on Thursday, August 15, 2013 at the Glencairn Neighbourhood Recreation Centre from 6:00 p.m. to 9:00 p.m. The purpose of this open house was to present the preferred option for the Southeast Regina Bypass and to gather feedback from the public.

A general invitation was published in the Leader Post on August 3, 2013 and August 10, 2013, and a notice was posted on the Ministry of Highways and Infrastructure website. A letter of invitation was provided to the RM of Sherwood for a mail-out to landowners in the study area, and invitations were extended to individuals whose land is directly impacted by the preferred alignment.

Open House No. 2 was held as a come-and-go event with a formal presentation at 7:00 p.m. The attendees were invited to view a number of display boards and pose questions to representatives from MMM Group and the Ministry of Highways and Infrastructure. The presentation provided some background information about the Southeast Regina Bypass, and gave an account of the work done to date, including a description of the preferred alignment. Following the open house, electronic copies of the display boards were made available to the public via the MHI website (Appendix A)

This open house generated a considerable interest, with 109 people signing in, and an estimated total attendance of over 115 people. A number of participants provided their input on formal comment sheets that were supplied at the event. In addition, comments were received by phone, mail and e-mail following the open house. A summary of the comments received can be found in Appendix A.

3.5 Stakeholder Meetings

Stakeholder engagement was an important part of this study, particularly given the short timeframe for completion. Meetings were scheduled with impacted stakeholders at various points throughout the study in order to inform the stakeholders about the proposed designs, and to gather input about the stakeholder needs and desires.

The following list documents some of the stakeholder engagement activities that took place during the course of this study:

- ▶ Prior to Open House No. 1
 - ▶ Group meeting with stakeholders along the south side of Highway No. 1 East whose land would be directly impacted by Concept 2a
- ▶ After Open House No. 1
 - ▶ Group meeting with stakeholders in the study area whose land would be impacted by any of the concepts presented at the first open house
 - ▶ Group meeting with representatives from the Creeks development
- ▶ After Open House No. 2
 - ▶ Individual meetings with stakeholders whose land will be impacted by the preferred alignment

4.0 CONCEPT DEVELOPMENT

The goal of the development phase of this study was to generate alternative design concepts for the Southeast Regina Bypass for comparison to the Base Case. After the concepts were refined, they could then be compared in a systematic manner to determine which design can meet the current and future needs of the road network in the most efficient and cost effective way.

The first step in the process was to quickly develop viable alternatives. This involved a concentrated effort up front using a Value Engineering (VE) Workshop to develop a number of potential solutions to some of the design issues that were recognized in the Base Case. After the workshop, the proposed design concepts were refined using input from stakeholders and technical experts. The final concepts were then brought forward for evaluation.

This section of the report documents the concept development process from the VE Workshop through to the final presentation of options for evaluation.

4.1 Value Engineering Workshop

Value Engineering (VE) is a creative, organized effort which analyzes the requirements of a project for the purpose of achieving the essential functions at the most efficient cost. MMM Group Limited organized a four day VE Workshop to bring together key stakeholders to review the existing design of the Southeast Regina Bypass, and develop viable alternatives in a systematic and organized manner.

The VE Workshop brought together technical experts from MHI, MMM Group Limited, the City of Regina, and the RM of Sherwood, along with major developers/landowners in the study area, to form a VE Team. This team collaborated to develop design alternatives for the portion of the South Regina Bypass between Highway No. 1 East and Highway No. 33.

A full description of the VE Workshop activities has been documented in a separate report (*South Regina Bypass: Hwy 1 East to Hwy 33 – Value Engineering Report*). An overview of the activities and a description of the results are provided below.

4.1.1 Workshop Details

The VE Workshop was a four day session that took place in Regina, Saskatchewan between May 6 and May 9, 2013. A copy of the VE Workshop agenda is provided in Appendix B. Table 2 provides a list of the VE Workshop participants.

Table 2 – Value Engineering Workshop Participants

Name	Representing	Name	Representing
Chris Gauer	MMM Group Ltd.	Penny Semczyshyn	MHI
Bruce Belmore	MMM Group Ltd.	Howard Yea	MHI
Andrew Hachborn	MMM Group Ltd.	Scott Thomas	City of Regina
Robert Kleine	MMM Group Ltd.	Jeremy Fenton	City of Regina
Aaron Polley	MMM Group Ltd.	Rod Benroth	RM of Sherwood
Nathan Gray	MMM Group Ltd.	Blair Forster	Harvard Developments Inc.
Charlie Billings	MMM Group Ltd.	Murad Al-Katib	Saskcan Pulse Trading Inc.
Gerald Beaton	MHI	Gaetan Bourassa	Saskcan Pulse Trading Inc.
Zev Lazic	MHI	Brian Morsky	Landowner
Harold Retzlaff	MHI	Lorne Yagelniski	Yagar Developments
Sukhy Kent	MHI	Ryan Paus	All-Rite Group of Companies
Brent Miller	MHI	Fred Mehl	All-Rite Group of Companies

The VE participants went through the following steps to develop design alternatives for the Southeast Regina Bypass:

1. **Information Phase** – introduction to the project and a discussion of workshop objectives
2. **Function Analysis Phase** – brainstorming of primary project functions to guide the development of solutions
3. **Creative Phase** – generation of 93 design options in four value target areas: Highway No. 1 Interchange, Highway Alignment, Service Roads, and Highway No. 33 Interchange
4. **Evaluation Phase** – determination of performance criteria and initial ranking of creative ideas
5. **Development Phase** – development of preferred ideas into proposals for each value target area
6. **Scenario Development Phase** – development of four complete design options for comparison to the Base Case
7. **Presentation Phase** – presentation of the VE Workshop results to senior MHI staff

4.1.2 Value Engineering Scenarios

Four VE Scenarios were developed for comparison to the Base Case. It should be noted that VE Scenarios 3 and 4 are actually variations of VE Scenarios 1 and 2 respectively. There are several key features that are common to all four of the scenarios, particularly the configuration of the interchange at Highway No. 1 East.

VE Scenario 1

The basic alignment of VE Scenario 1 is illustrated in Figures 5 and 6. The key characteristics of VE Scenario 1 are as follows:

- ▶ Alignment – This scenario maintains the Base Case alignment west of Tower Road.
- ▶ Hwy 1 Interchange – Directional interchange with large radius curve (1,000 meters) for the westbound to southbound and northbound to eastbound movements. This maintains highway speed for the key highway to highway connection. An at-grade intersection is maintained at Tower Road and Victoria Avenue East to serve municipal traffic.
- ▶ Highway No. 33 Interchange – This interchange is maintained at the Base Case location, but a tight diamond configuration is used to pull the interchange slightly to the east to avoid Chuka Creek.
- ▶ Service Roads – Tower Road becomes the east service road for the bypass. No service roads are provided on the west side of the bypass, as this will be dealt with internally in the City network. The service road network north of Highway No. 1 East could remain as it is.

Figure 5 – VE Scenario 1 – North Half

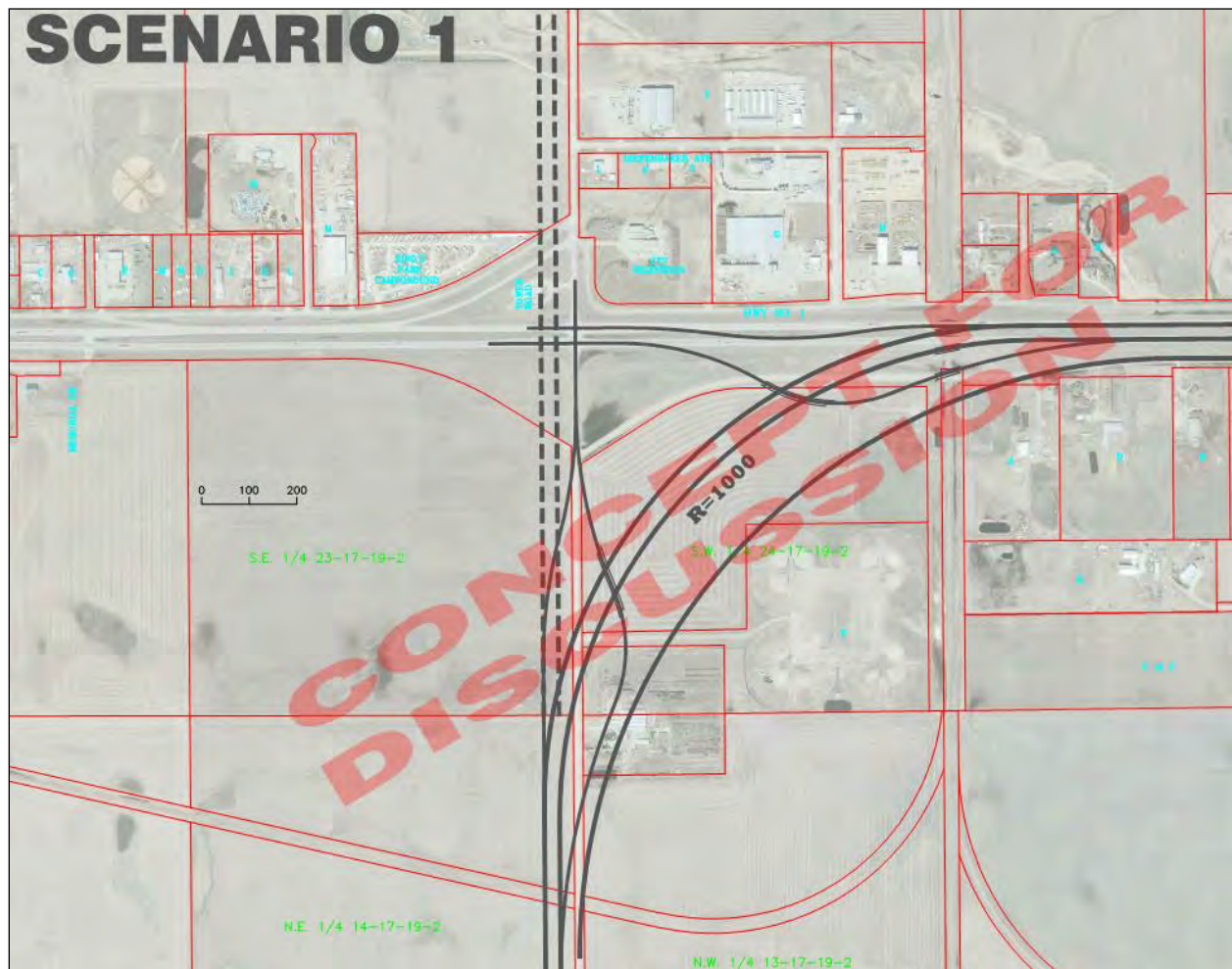
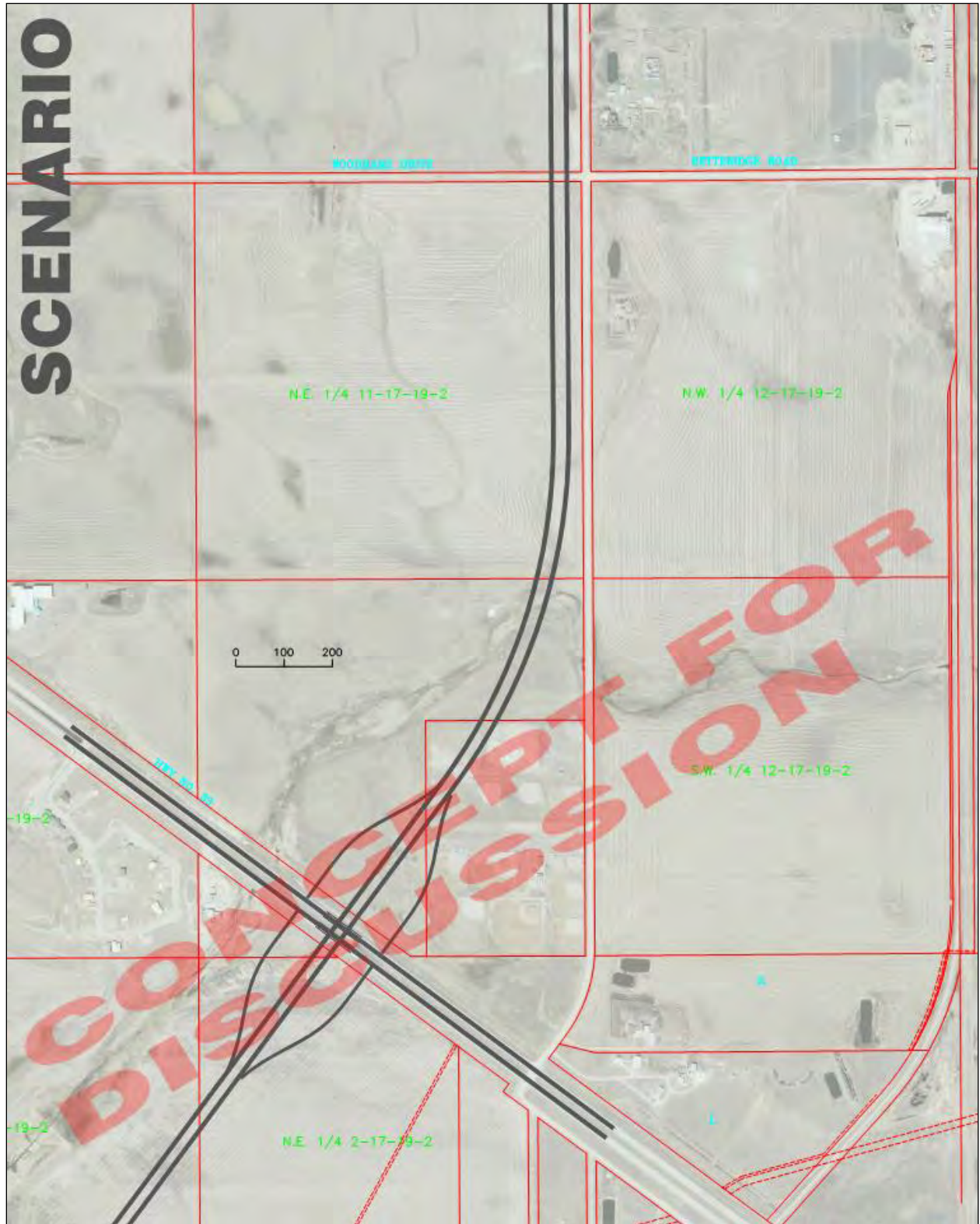


Figure 6 – VE Scenario 1 – South Half



VE Scenario 2

The basic alignment of VE Scenario 2 is illustrated in Figures 7 and 8. The key characteristics of VE Scenario 2 are as follows:

- ▶ Alignment – The bypass alignment is moved as far east as practical within the study area (approximately 400 m). This may support growth between the City of Regina and the bypass alignment.
- ▶ Highway No. 1 Interchange – Similar to VE Scenario 1, but is shown with a tighter radius (shown at 600 m) for the curve in Highway No. 1. The curve radius was reduced in this alternative in order to illustrate how the impact on the properties east of the interchange could be minimized. This can be compared to a curve radius of 1,000 m that maintains the consistent highway speed but also has more impact on the properties east of the interchange. Further information regarding the curve radius can be found later in this section. An at-grade intersection is maintained at Tower Road and Victoria Avenue East to serve municipal traffic.
- ▶ Highway No. 33 Interchange – A tight diamond interchange configuration is employed. The interchange is moved further east than both the Base Case and VE Scenario 1 interchanges.
- ▶ Service Roads – A new east service road is developed midway between the bypass and the railroad tracks. Tower Road can provide access to potential future development on the west side of the bypass. The service road network north of Highway No. 1 East could remain as it is.

Discussion occurred related to the potential impact of moving the alignment east and the associated impact to properties in the southwest quadrant of the Highway No. 1 interchange east of the railway. The VE team discussed the potential mitigation measure of reducing the curve radius of the main lanes to lessen the property impacts while maintaining safe highway operations.

The design speed of a curve is based on the radius and the super-elevation. Typically a rural highway utilizes a maximum super-elevation of 8%, however this can cause concerns for slower moving vehicles during icy road conditions, which typically occur near interchanges or in urban areas. In these locations, a maximum super-elevation of 6% is a more common maximum allowable super-elevation.

For comparison purposes, a radius of 600m was shown to reflect the minimum end of the spectrum that the Ministry would consider, and there was recognition that a curve with this radius may require a posted speed reduction of 10-20 km/h. The intent of a Value Engineering Session is to develop options for consideration, and this option was shown to reflect the trade-off of having a minimal acceptable curve in the alignment to minimize impacts to property. On the other end of the spectrum is a radius of 1,000 m which provides for the posted speed of 110 km/h but has a greater impact on the existing properties. The final radius would be designed in discussion with the Ministry, and further engineering would have to be completed to examine the safety implications of the reduction in design speed.

Figure 7 – VE Scenario 2 – North Half

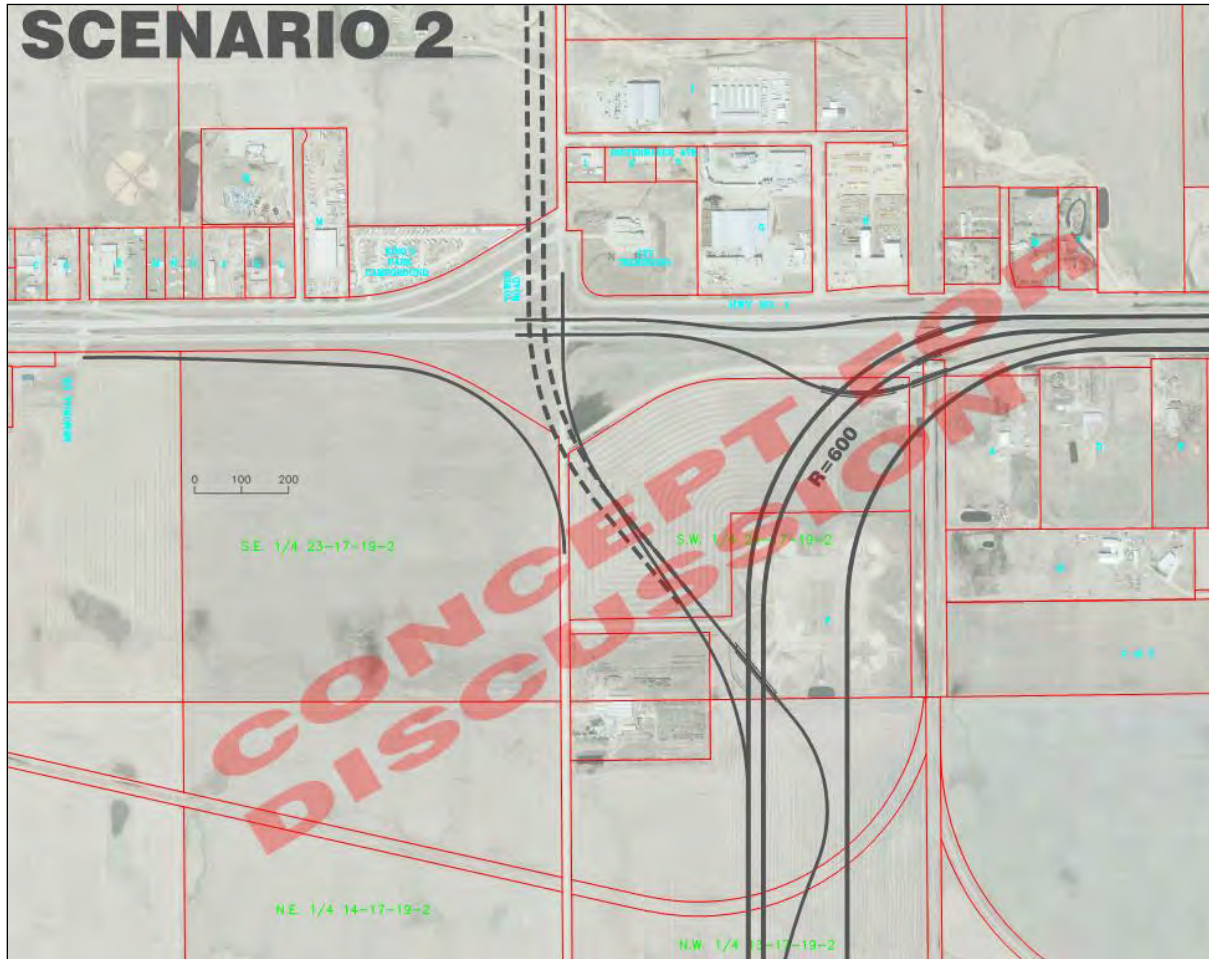
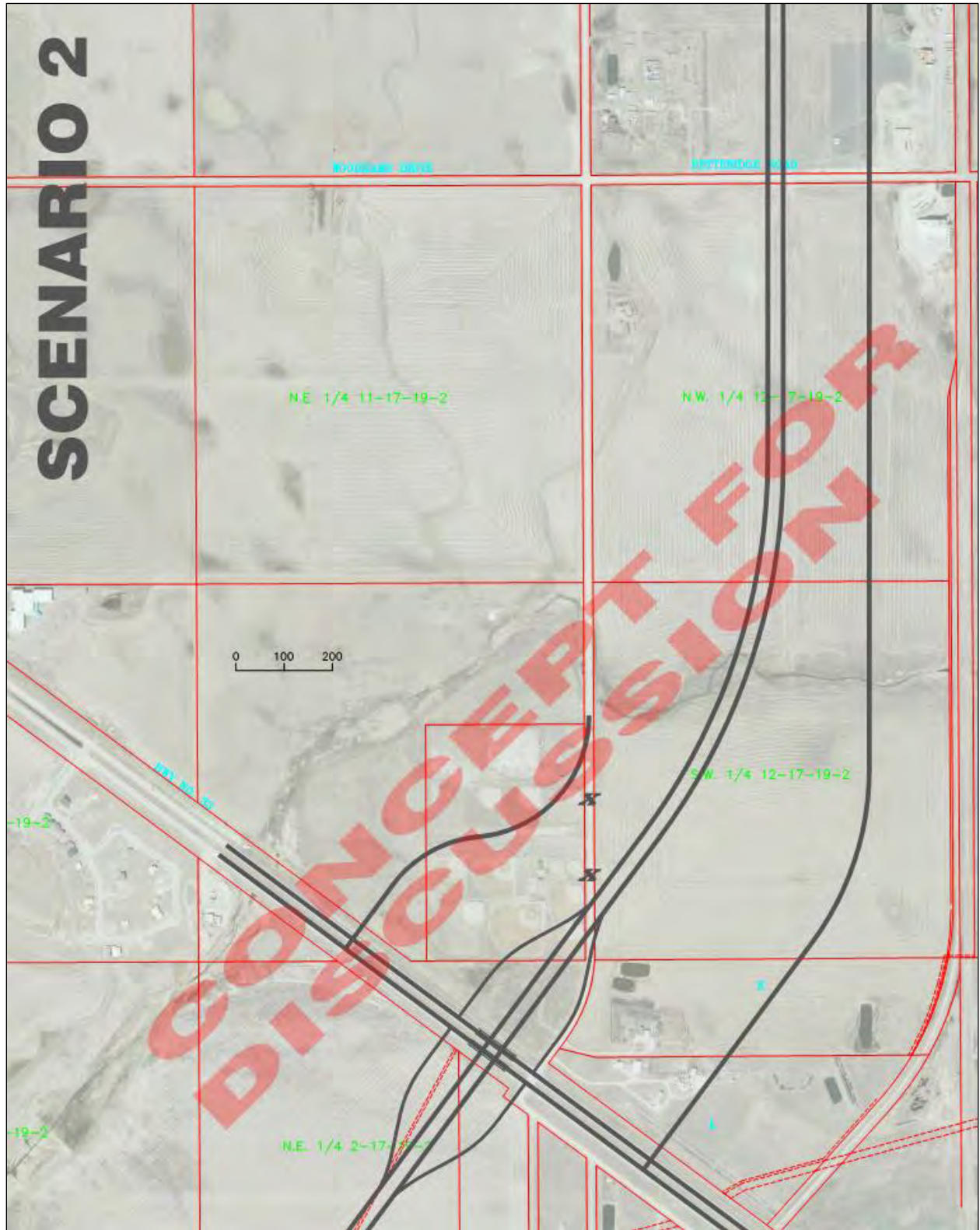


Figure 8 – VE Scenario 2 – South Half



VE Scenario 3

VE Scenario 3 is similar to VE Scenario 1, with the at-grade intersection at Tower Road and Victoria Avenue East upgraded to an interchange. The interchange configuration for VE Scenario 3 is illustrated in Figure 9.

Figure 9 – VE Scenario 3 – North Half



VE Scenario 4

VE Scenario 4 is similar to VE Scenario 2, with the at-grade intersection at Tower Road and Victoria Avenue East upgraded to an interchange. The interchange configuration for VE Scenario 4 is illustrated in Figure 10. The final curve radius for this interchange remains to be determined and is in the range of 600 m and 1,200 m.

Figure 10 – VE Scenario 4 – North Half



4.1.3 Value Engineering Evaluation

The Base Case and the four VE Scenarios were compared using an evaluation matrix, which used weighted performance criteria that were developed by the VE Team. The performance criteria consisted of the following categories:

1. Freeway Operations
2. Access
3. Safety
4. Property
5. Phasing
6. Constructability
7. Municipal Operations
8. Environment

The VE Team came to a consensus on the criteria scores for each VE Scenario by comparing their performance against the Base Case. A performance rating (P) was determined for each option by adding the criteria scores. Details regarding the criteria scores can be found in Appendix B.

The capital cost (C) of each option was calculated using a cost model. These costs were developed for comparative purposes only, and they should not be construed as official project cost estimates. The value of each VE Scenario was determined by dividing the performance rating by the capital cost (Value = Performance/Cost). The results of the evaluation are provided in Table 3.

Table 3 – Comparative Estimated Total Capital Cost

Scenario	Total Performance (P)	Comparative Estimated Total Capital Cost - \$M (C)	Value (P/C)
Base Case	428	128	3.3
VE Scenario 1	710	121	5.9
VE Scenario 2	645	127	5.1
VE Scenario 3	714	150	4.8
VE Scenario 4	635	156	4.1

As indicated in Table C, all of the VE Scenarios have a higher performance score than the Base Case. VE Scenarios 1 and 2 also have a cost that is comparable to the Base Case. As a result, VE Scenarios 1 and 2 have the highest value scores.

VE Scenarios 3 and 4 have the highest cost due to the addition of a diamond interchange at the Tower Road and Victoria Avenue East intersection, but their value scores are still higher than the Base Case due to their higher performance. The evaluation indicates that it might be best to treat the interchange at Tower Road and Victoria Avenue East as a future phasing option. The interchange could be provided in the future based on operational requirements at this location.

4.1.4 Value Engineering Conclusions

Through a collaborative process, the VE Team was able to develop several viable alternatives to the Base Case to be brought forward for further review. All of the VE Scenarios that were developed in the VE Workshop provided an increase in value over the Base Case design.

The following list highlights some of the key characteristics of the VE Scenarios:

- ▶ A high level of service is provided for the primary highway to highway movements. A long, large radius curve is provided for the westbound to southbound movement, allowing highway traffic to maintain free flow at highway speeds.
- ▶ Municipal traffic movements are separated from highway traffic movements. Maintaining Tower Road and Victoria Avenue East as a separate intersection helps to preserve land and service roads in the vicinity, while also providing all movements into and out of the City.
- ▶ The interchange ramps are designed to provide right hand entry and exit in keeping with driver expectation, which is an important safety consideration.

- ▶ There is the potential to move the bypass between 50 – 400 meters to the east. This would provide a buffer from Chuka Creek and existing residential development to the west, but would move the bypass closer to acreages currently east of Tower Road. This could also help to support growth between the City of Regina and the bypass alignment.
- ▶ These designs retain the option to develop a northern connection at Tower Road in the future if required.

There was general consensus among the VE Team members that the options developed during this VE Workshop should be brought forward for consideration as the alignment for this segment of the South Regina Bypass. A number of design suggestions were also noted during the VE process.

Further work was required in order to determine the feasibility of the proposed designs and identify the issues that may be encountered. Key among the design issues is the radius and super-elevation of the directional ramp on the Highway No. 1 East interchange. Other issues noted for further investigated included the design criteria for the future northeast bypass and the details of the extended service road network in the study area.

4.2 Design Concepts

Scenarios 1 and 2 from the VE session were brought forward for consideration as the main alternative concepts to the Base Case design, hereafter referred to as Concept 1 and Concept 2 respectively. It was recognized that the addition of an interchange at the Victoria Avenue East and Tower Road intersection could be introduced in the future if required. As a result, Scenarios 3 and 4 were treated as phasing options.

Further review of these concepts led to the introduction of an additional design concept, which is a variation of Concept 2. This new concept, labeled Concept 2a, is essentially Concept 2 with a higher radius curve for the key highway-to-highway movements at the Highway No. 1 East interchange. The radius of this curve was reduced in Concept 2 in order to minimize property impacts. Concept 2a was developed to provide an option that incorporated an eastern alignment, without compromising the level of service provided to highway traffic.

The design concepts brought forward for comparison to the Base Case, Concepts 1, 2, and 2a, are illustrated in Figures 11, 12, and 13 respectively.

Figure 11 – Southeast Regina Bypass Design Concept 1

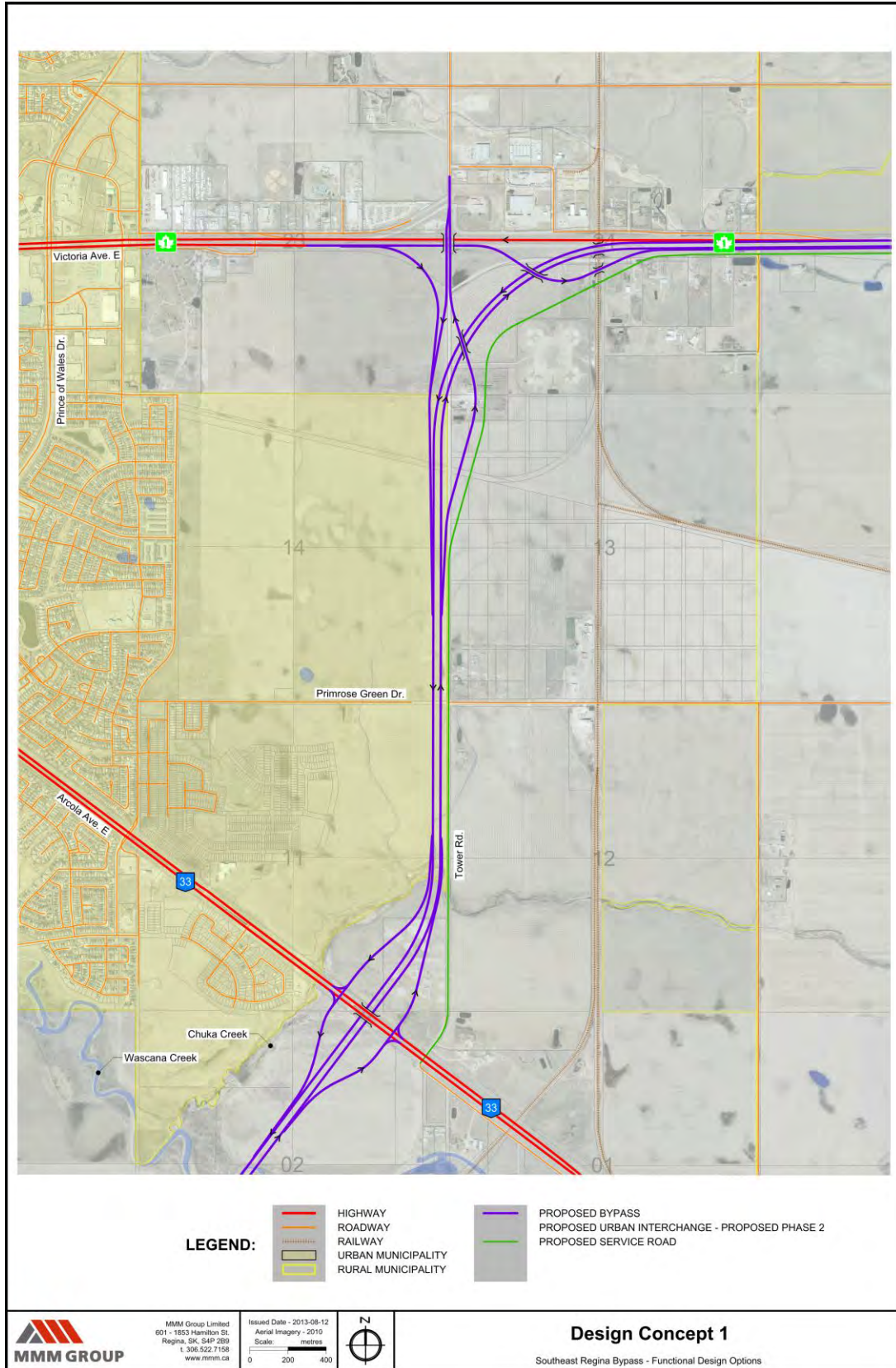


Figure 12 – Southeast Regina Bypass Design Concept 2

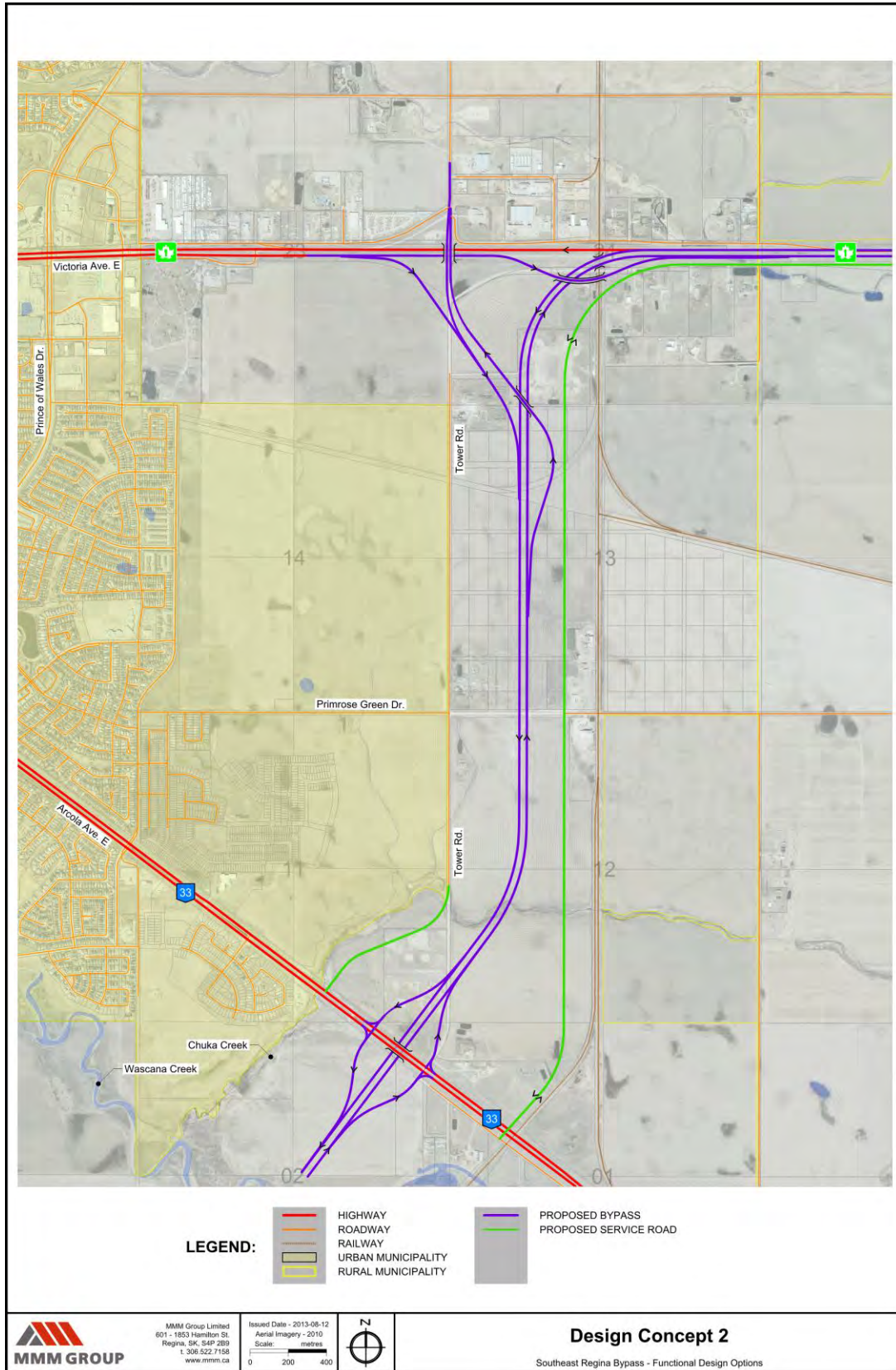
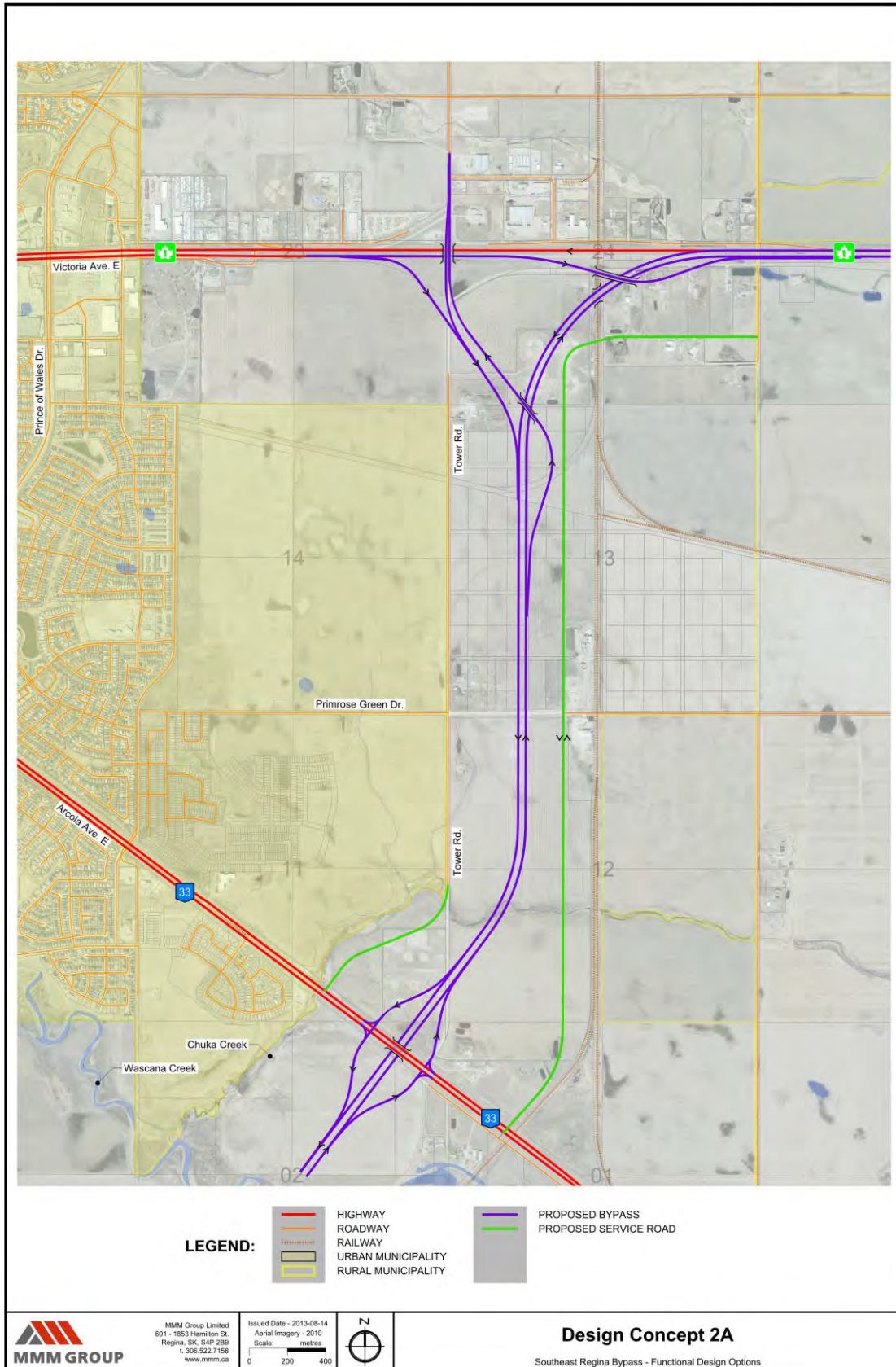


Figure 13 – Southeast Regina Bypass Design Concept 2a



5.0 CONCEPT SELECTION

In order to select a preferred alignment, each alignment option must be objectively compared to the other. To facilitate this comparison, a set of route evaluation criteria was developed. These criteria were based on typical evaluation criteria used for route location studies, but were tailored for this specific case. The evaluation criteria were selected specifically to help differentiate between the proposed Southeast Regina Bypass alignment options.

This section of the report presents the development of the route evaluation criteria, the determination of the weighting for each criterion, the application of the evaluation matrix to each alignment option, and the selection of the preferred alignment.

5.1 Evaluation Criteria

The following list presents typical evaluation criteria used for highway route location studies. This list is not exhaustive, but presents the general starting point for the development of evaluation criteria that are specific to the analysis:

- ▶ Network Compatibility
- ▶ Route Continuity
- ▶ Highway Design Standards
- ▶ Traffic Safety
- ▶ Traffic Operations
- ▶ Access Control
- ▶ Interchange Spacing
- ▶ Emergency Access
- ▶ Dangerous Goods/Over-Dimension Routes
- ▶ Socio-Economic Impacts
- ▶ Cost
- ▶ Impacts to Residences and Businesses
- ▶ Impacts to Agricultural Land
- ▶ Environmental and Heritage Impacts
- ▶ Geotechnical and Topographic Features
- ▶ Drainage Considerations
- ▶ Compatibility with Planned Development
- ▶ Impact to Goods Movement
- ▶ Construction Staging Opportunities
- ▶ Phasing Opportunities
- ▶ Utility Impacts
- ▶ Noise / Visual Impacts

After discussion with the Technical and Steering Committees, the criteria noted above were combined together under the twelve headings listed below in Table 4, with an emphasis on the criteria that could discriminate between the potential bypass alignments. Criteria were deemed to be nearly identical for each alignment were left out of the analysis.

Table 4 – Evaluation Criteria

Evaluation Criteria	Description
1. TransCanada Highway Functionality	Maintains high speed, free-flow conditions for the westbound to southbound movement, and the northbound to eastbound movement – the future TransCanada Highway movements
2. Safety & Traffic Operations	Provides a safe and consistent design that will be familiar and easy to negotiate
3. Potential Phasing Opportunities	Provides a stage-able solution at Victoria Ave & Tower Rd intersection if an interchange is needed in the future. Consideration for whether or not the design can be integrated into a future Northeast Bypass.
4. Access to Adjacent Development	Limits the amount of development or land parcels that are isolated or will have poor access.
5. Property Impacts	Consideration for the amount of land that will have to be purchased and the impact on existing homes and businesses
6. Constructability	Minimizes disruption to existing traffic flows, and allows for existing Highway 1 infrastructure to be used during construction
7. Noise Impacts	Minimizes traffic noise for existing residents
8. Environmental Impacts	Avoids any environmentally sensitive areas, including areas with a high water table
9. Utility / Railway Impacts	Minimizes impacts to railways and utilities
10. Economic Development Potential	Increases the development potential for adjacent lands
11. Right-of-Way	Minimizes the total land required for the design
12. Construction Cost	Total construction cost estimate

5.2 Criteria Weighting

After determining the appropriate evaluation criteria, a relative weighting was developed for each category. The purpose of the weighting is to define the relative importance of each category in the context of trying to differentiate between the proposed alignment options. Each of the design concepts will have an impact on the study area. The evaluation criteria should be weighted to ensure that the selected alignment will meet the intended purpose of the bypass, while striking a balance with the negative impacts.

The weighting of the evaluation criteria was determined through a paired comparison process at a combined Technical & Steering Committee Meeting, with input from all members present. The paired comparison method involves comparing each criterion to each other criterion individually to determine which should get higher priority in the analysis. After the comparison process is complete, the scores are tallied to determine the relative weighting. The results of the paired comparison are presented in Table 5.

Table 5 – Criteria Weighting

		B	C	D	E	F	G	H	I	J	K	L	Total	Weighting
		Safety & Traffic Operations	Potential Phasing Opportunities	Access to Adjacent Development	Property Impacts	Constructability	Noise Impacts	Environmental Impacts	Utility / Railway Impacts	Economic Development Potential	Right-of-Way	Construction Costs		
A	TransCanada Highway Functionality	1B	2A	2A	2A	2A	2A	2A	2A	2A	2A	2A	20	25
B	Safety & Traffic Operations		2B	2B	2B	2B	2B	2B	2B	2B	2B	2B	21	25
C	Potential Phasing Opportunities			0	1E	0	1C	1C	2C	0	1C	0	5	5
D	Access to Adjacent Development				1E	1D	1D	1D	1D	1D	1D	1D	7	10
E	Property Impacts					1E	0	1E	1E	1E	1E	1E	8	10
F	Constructability						1G	0	1F	0	1K	0	1	2.5
G	Noise Impacts							1G	1G	0	1G	1G	5	5
H	Environmental Impacts								1I	2J	1H	1H	2	2.5
I	Utility / Railway Impacts									2J	1I	1L	2	2.5
J	Economic Development Potential										1K	1L	4	5
K	Right-of-Way											1L	2	2.5
L	Construction Cost												3	5

The TransCanada Highway Functionality and Safety categories are weighted the highest. This is to ensure that the bypass fulfills its required function in a safe and efficient manner. An alignment that minimizes all negative impacts but does not provide the functionality of a highway bypass should not rank highest in the evaluation. Access and property impacts are also major considerations, as they are with all roadway projects.

5.3 Evaluation of Concepts

Each of the design concepts was given a rating between 1 and 4 in every category (1 = Poor, 2 = Average, 3 = Good, 4 = Excellent). The rating for each category was then multiplied by the category weighting to provide a category score. The overall score for each concept was then determined by adding the all of the category scores.

The following sections give an overview of the consultant's route evaluation for each category. Several iterations were performed before arriving at the final result.

5.3.1 Evaluation of TransCanada Highway Functionality

The South Regina Bypass will eventually become the part of the TransCanada Highway network, diverting vehicles around Regina and providing key regional, provincial, national, and international connections. The interchanges at the east and west terminals will be pivotal to the success of the bypass, as these are the locations at which the highway and municipal traffic streams diverge and converge.

At the Highway No. 1 East interchange, the westbound highway traffic will be diverted south through a 90 degree turn in order to continue around the City. In a similar fashion, eastbound traffic will approach from the south, and will be diverted through a 90 degree turn to head east. These represent the TransCanada Highway movements, and the desire is to keep them as high-speed, free flow movements, placing priority on the bypass traffic.

In the Base Case design, the westbound to southbound traffic is served by a relatively tight curve that requires a reduction in speed from 110 km/h down to 60 km/h. In this design, the highway traffic is not the priority movement, as traffic must exit the main lanes to stay on the highway. In the Base Case, priority is given to the municipal traffic heading into and out of Regina.

Concepts 1 and 2a received a high rating in this category because these designs can accommodate high speeds on Highway No. 1 through the use of a high radius curve for the westbound to southbound and northbound to eastbound movements. It may be possible to maintain the 110 km/h speed limit on Highway No. 1 using these concepts.

Concept 2 was rated higher than the Base Case, but some speed reduction is required with this option. The radius of the curve that serves the key highway to highway movements is somewhat reduced in this option compared to Concepts 1 and 2a, in order to minimize the impact to residences south of Highway No. 1. Speed reductions would be required, but not to the same degree as the reduction required for the Base Case. It is likely that speeds of 90 km/h could be maintained for the bypass traffic.

Table 6 – Ratings for TransCanada Highway Functionality

Concept	Base Case	Concept 1	Concept 2	Concept 2a
Rating (1-4)	1	4	3	4

5.3.2 Evaluation of Safety and Traffic Operations

Safety and traffic operations are a key consideration for any roadway project. It is important to ensure that the road is designed within acceptable parameters for safety while providing for the efficient movement of goods and people. As with functionality, the key will be the interchanges at Highway No. 1, as they are the most complex and specialized part of the bypass. The evaluation in this category focussed on the Highway No. 1 East interchange.

The Base Case received an average rating in this category. It is understood that the bypass will be designed to operate with an acceptable degree of safety, but there are some areas of this design that could be improved. The Base Case incorporates a left hand exit for westbound to southbound highway traffic, which is a non-standard configuration for highway exits. The Base Case design also involves some compromised movements: it does not provide for an eastbound to northbound movement, which will be important in the future as the northeast area of the City develops, and it provides the northbound to westbound movement through a non-standard U-turn maneuver. There was also consideration for the fact that westbound traffic on Highway No. 1 will have to slow from 110 km/h to 60 km/h, before accelerating back to 110 km/h.

All of the new concepts (Concepts 1, 2, and 2a) remove the need for a left hand exit. Bypass traffic will not have to exit: instead the highway traffic will stay on the main lanes, while municipal traffic is directed on/off the highway and is dealt with at the Tower Road intersection. All movements can be provided at the Tower Road intersection, whether at an at-grade intersection, or at a grade separated structure in the future if required.

In order to reduce land impacts, Concept 2 has tighter radius curve for the highway movements than Concepts 1 and 2a. This design would require a speed reduction on Highway No. 1 from 110 km/h to 90 km/h. This is not as desirable as Concepts 1 and 2a, which can still safely accommodate a highway speed of 110 km/h through the interchange.

Concepts 2 and 2a have an advantage over Concept 1 in that they provide more separation between Highway No. 1 and the intersection at Tower Road. This separation provides more room to develop a transition zone between high speed highway traffic and lower speed urban traffic, and provides more options for the future layout of the Tower Road intersection.

Table 7 – Ratings for Safety and Traffic Operations

Concept	Base Case	Concept 1	Concept 2	Concept 2a
Rating (1-4)	2	3	3	4

5.3.3 Evaluation of Potential Phasing Opportunities

Phasing refers to the ability to construct the roadway in stages: working toward an ultimate design, but only building what is needed now, while preserving the ability to upgrade at a later date. Also under consideration in this category is the ability for the design to accommodate a future northeast bypass link at Tower Road. A northeast bypass would complete the ring bypass system around Regina, linking the southeast bypass with the west bypass.

With the Base Case design, it is not easy to incorporate additional movements at the Highway No. 1 East interchange without acquiring additional land in the future and impacting existing structures. The Base Case could work as a link to the north bypass, but it does not provide some of the key traffic movements that are critical to the integration of the bypass network into the City road network.

All of the new concepts (Concepts 1, 2, and 2a) make it easier to provide all movements at Tower Road. The further east the alignment moves, the less constricted the Tower Road intersection becomes, and the more options are available at this location for future infrastructure requirements. Concept 2a provides the most separation between Tower Road and the Highway No. 1 East interchange, which provides more room for future upgrades at the Tower Road intersection that may be required to accommodate future municipal traffic, or a future northeast bypass connection.

Table 8 – Ratings for Potential Phasing Opportunities

Concept	Base Case	Concept 1	Concept 2	Concept 2a
Rating (1-4)	1	3	3	4

5.3.4 Evaluation of Access to Adjacent Development

The Southeast Regina Bypass will be a high-speed, access controlled facility. Access to adjacent development will be through interchanges: there will be no at-grade intersections on this segment of the bypass system. As such, the bypass can act as a barrier in this area.

All bypass design options will result in access issues for the southeast quadrant of the Highway No. 1 East interchange. The large systems interchange will limit access to this area and as a result the access points to the south (at Highway No. 33) and to the east (at Pilot Butte Access) will be key.

The Base Case introduces a large systems interchange right at Tower Road, which will limit access north of Highway No. 1 East. The existing access to businesses will have to be pushed north toward Dewdney Avenue. South of Highway No. 1, Tower Road will become the east service road for the bypass, which will become the key access point for residents and business owners east of the bypass (between the bypass and the railroad tracks). In the Base Case design, this key access point will be very close to the Southeast Regina Bypass interchange at Highway No. 33, which could cause some operational issues.

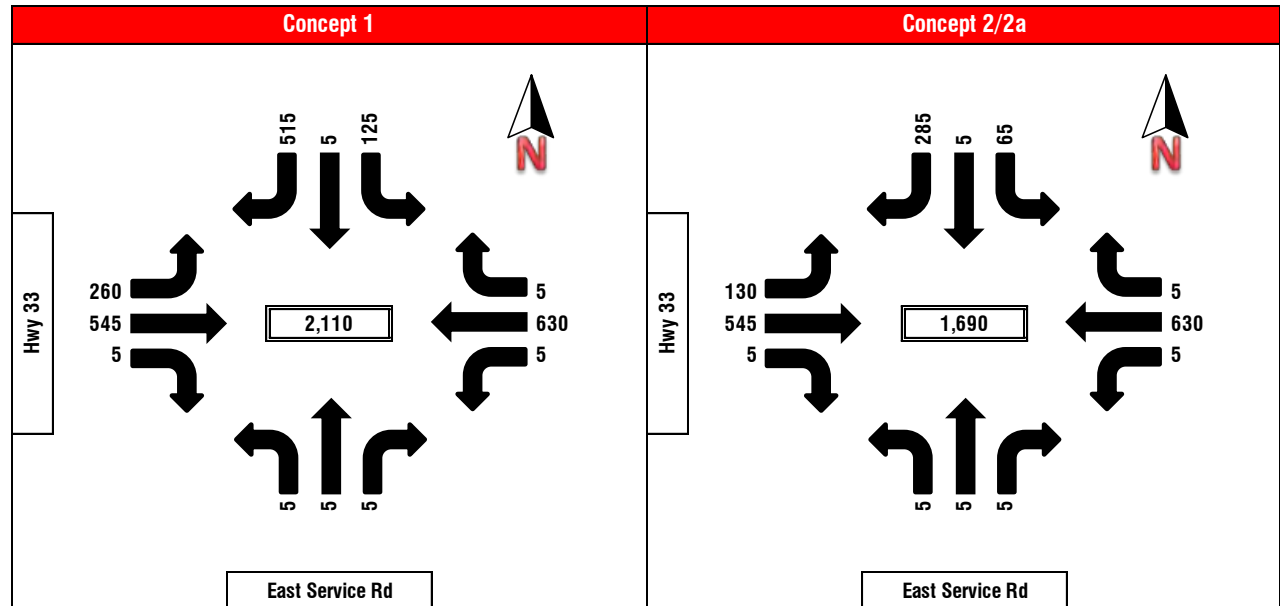
Concept 1 resolves the issues with access north of Highway No. 1, and was therefore ranked higher than the Base Case. The access points to the north can remain as-is, with the flexibility to increase the level of traffic control over time if required. The situation for the land east of the bypass is similar to the Base Case: Tower Road becomes the east service road, providing the main access to the land between the bypass and the railroad tracks via an intersection on Highway No. 33.

Concepts 2 and 2a are similar to Concept 1 north of Highway No. 1: the existing level of access can be maintained until such time as traffic conditions warrant a change in the level of access control. Access to the land between the bypass and the railroad tracks will be provided from Highway No. 33 via a new service road that will be constructed further east.

Under all scenarios, there will be limited access for the land between the Southeast Regina Bypass and the railroad tracks. The key will be the access provided from Highway No. 33. The more land that is isolated between the bypass and tracks, the more traffic will have to use that access in the future when the area develops.

Figure 14 illustrates a 2040 traffic forecast at the Highway No. 33 and East Service Road intersection. This forecast was developed using inputs from the Regina Regional EMME Model, along with some development assumptions for the study area. The forecast indicates that there could be an additional 420 vehicles turning at this intersection in the peak afternoon hour of the 2040 forecast year with design Concept 1 as compared to Concept 2 or 2a. This is due to the additional land east of the bypass that is available for development under Concept 1. The traffic forecast assumed primarily industrial development: the forecast numbers could be higher if more residential development was incorporated. These additional turning movements will negatively impact traffic operations at this intersection.

Figure 14 – 2040 Traffic Forecast: Hwy No. 33 and East Service Rd Intersection



Moving the bypass alignment east reduces the amount of land that is isolated between the bypass and the railway, easing pressure on the access to Highway No. 33. It also increases the amount of land within the bypass ring, which has a higher level of access by virtue of the fact that this land can be directly connected to the City road network. For these reasons Concepts 2 and 2a, the easternmost alignments, were ranked highest in the access category.

Table 9 – Ratings for Access to Adjacent Development

Concept	Base Case	Concept 1	Concept 2	Concept 2a
Rating (1-4)	2	3	4	4

5.3.5 Evaluation of Property Impacts

All of the functional designs under consideration will have impacts to land and existing development. This category applies more weight to direct impacts on existing businesses and residences.

All of the concepts impact the Pacers baseball facilities which are located in the northwest quadrant of the Highway No. 33 and Tower Road intersection. These facilities are operated by Baseball Regina, a volunteer non-profit organization which organizes baseball for Regina youth. A significant amount of time, effort, and money have been invested in these diamonds, and they will likely have to be relocated. The cost of moving the facilities is significant, and it requires several years of lead time to find a suitable space and construct the necessary infrastructure.

The Base Case also impacts land on north side of Highway No. 1, including the King’s Acres campground, and some land belonging to CKCK. The interchange at Highway No. 1 has limited utility for some City movements without major impacts to CKCK land. The Base Case has a significant impact to land in the Southwest quadrant of the Highway No. 1 East interchange. There are also significant impacts to agricultural land at the site of the Highway No. 33 interchange.

Concept 1 has fewer impacts to the land north of Highway No. 1. It does encroach on several residences located south of Highway No. 1 and east of the railroad tracks. There is a significant impact to an existing greenhouse on Tower Road. Most of southwest quadrant of the Highway No. 1 East interchange is salvaged with this option, but these impacts are moved over to the southeast quadrant. The impacts at the south end of the Concept 1 alignment are similar to the Base Case.

Concept 2 has similar impacts to Concept 1, except that land in the southeast quadrant of the Highway No. 1 East interchange is impacted to a greater degree, the greenhouse property is impacted to a lesser degree, and there are some impacts to the service road access for properties north and south of Highway No. 33.

Concept 2a has similar impacts to Concept 2, but with more impact to the residences located south of Highway No. 1 and east of the railroad tracks. Because of these relative impacts to existing businesses and residences, Concept 2a was ranked the lowest (2), Concepts 1 and 2 were given equal rank in the middle (3), and the Base Case was ranked the highest (4).

Table 10 – Ratings for Property Impacts

Concept	Base Case	Concept 1	Concept 2	Concept 2a
Rating (1-4)	4	3	3	2

5.3.6 Evaluation of Constructability

The constructability category focused on the impacts related to the construction of the bypass, specifically the impacts to the existing road network. Highway No. 1 East is a key entrance to the City of Regina, and experiences a high volume of traffic on a daily basis. The design concepts were primarily evaluated based on the impact they would have on Highway No. 1 East.

The construction of the Base Case would have major impacts to Tower Road, but it is possible that all lanes on Highway No. 1 East could remain open for the majority of the construction period. Concepts 1 and 2 would likely require the closure of the eastbound lanes of Highway No. 1 East during construction. It is possible that Concept 2a could be constructed off-line, with minimal impact to Highway No. 1 East.

Table 11 – Ratings for Constructability

Concept	Base Case	Concept 1	Concept 2	Concept 2a
Rating (1-4)	3	2	2	4

5.3.7 Evaluation of Noise Impacts

The development of the Southeast Regina Bypass, a high-speed freeway facility, will introduce additional noise to the study area. The focus of the noise impact evaluation was the southern end of the Southeast Regina Bypass, at Highway No. 33. The businesses and residences at the north end are in proximity to Highway No. 1 East, which already has a significant volume of traffic. The residences at the south end do experience some noise impacts from the traffic on Highway No. 33 at the present time, but the introduction of the bypass will likely have a more noticeable noise impact in this area.

The Base Case design brings the bypass close to the Creeks development in the City, but is further from existing RM residences. The alignment of Concept 1 is slightly further from the Creeks, and correspondingly closer to the RM side. This separation from the City continues with Concept 2 and 2a, as the bypass alignment is moved further east.

A preliminary noise model was developed using the STAMSON noise evaluation software package in order to test the impacts to property near Highway No. 33. Figure 15 indicates the three noise receptor locations that were tested: two receptors near the Creeks development and one receptor near Tower Road. Existing noise levels were measured at these locations for the purpose of calibrating the model results.

The Base Case, Concept 1, and Concept 2 were tested against a “do nothing” scenario using 2040 forecast traffic volumes (note: Concept 2a is identical to Concept 2 at the south end of the alignment). The forecast traffic volumes were taken from a regional traffic model developed for the MHI Systems Planning Branch. Note that this was a high-level analysis used for planning purposes: the intent was to determine the relative differences between each concept. More accurate noise models can be developed in the detailed design stage.

In the “do nothing” scenario, Receptors 1 and 3 both experience higher noise levels than Receptor 2, and they don’t change significantly with the introduction of a bypass at any of the proposed locations. The model indicates that the majority of the noise at these two locations is due to traffic on Highway No. 33 rather than traffic on the bypass, so moving the bypass does not have a significant impact. Receptor 2 is further from Highway No. 33, and it appears to experience more of a relative increase in noise due to the bypass. As the bypass is moved further east, the noise levels at Receptor 2 decrease.

Figure 15 – Noise Model Receptor Locations



In terms of noise generated by vehicles on the bypass, the impact of moving the bypass further east appears to be minimal for residences close to Highway No. 33. For residences close to the bypass alignment but further from Highway No. 33, the bypass location becomes more important from a noise perspective. The preliminary model shows marginal improvement for the Creeks residents as the bypass moves further east, particularly for those residences that are set back from Highway No. 33. For this reason, the eastern alignment options (2 and 2a) ranked highest.

Table 12 – Ratings for Noise Impacts

Concept	Base Case	Concept 1	Concept 2	Concept 2a
Rating (1-4)	2	2	3	3

5.3.8 Evaluation of Environmental Impacts

It was assumed that all legislative requirements with regards to environmental impacts would be met, regardless of the option chosen. The water table is high in the study area, and all options will impact Chuka Creek and Wascana Creek. None of the concepts affect the Mckell marsh protected area. There were no known environmental impacts that would distinguish one route from another. As a result, all concepts were ranked the same (2).

Table 13 – Ratings for Environmental Impacts

Concept	Base Case	Concept 1	Concept 2	Concept 2a
Rating (1-4)	2	2	2	2

5.3.9 Evaluation of Utility/Railway Impacts

The number of oil and gas transmission pipelines to the west and south of Regina made the utility impacts a key consideration for the west and south portions of the Regina Bypass. The utility constraints in the southeast study area are less of an issue, and play a limited role in the selection of a preferred alignment option. Regardless of the alignment selected, oil, gas, power, water, sewer and other distribution lines will have to be accounted for in the detailed design.

Concepts 2 and 2a may result in a service road in proximity to a rail line. This portion of the rail line is currently not in use, but future plans for this line are unknown. The Canadian National Railway Company (CN) was contacted with regards to their future plans for the line, but they were unable to provide a definite answer at this time.

The Base Case rated somewhat higher because it had the least amount of utility line crossings and avoids crossing the 230 kV SaskPower line crossing Highway No. 1. The other three concepts have overpasses over the railway which would require relocating the overhead power line at that location. The Base Case also avoided two major pipelines, one high pressure gas and one oil, running along Tower Road which would be high cost crossings.

Table 14 – Ratings for Utility/Railway Impacts

Concept	Base Case	Concept 1	Concept 2	Concept 2a
Rating (1-4)	3	2	2	2

5.3.10 Evaluation of Economic Development Potential

For the purposes of this evaluation, the question of economic development potential focusses on whether or not the location of the bypass will increase the development potential of the surrounding land. The Southeast Regina Bypass will form a barrier on the east end of the City. The barrier can be crossed, but at a limited number of locations, which will limit access in the area.

Any land inside the bypass will be easier to access from the City, while the land east of the bypass will be somewhat isolated between the bypass and the railroad tracks. Moving the bypass further east increases the amount of land inside the bypass, and limits the amount of isolated property. Also, land that is inside the bypass has a greater potential to be serviced from the City side.

Land that is inside the bypass will have the potential to be developed as low to high density residential, which could provide a better value to the landowners. Land that is isolated between the bypass and the railroad tracks would likely be used for light industrial and warehouse purposes.

It is difficult to determine exactly how the land surrounding the bypass will develop, but considering the issues noted above, Concepts 2 and 2a were ranked higher because they provide more land inside the bypass, which is potentially more valuable from a development perspective.

Table 15 – Ratings for Economic Development Potential

Concept	Base Case	Concept 1	Concept 2	Concept 2a
Rating (1-4)	2	2	3	3

5.3.11 Evaluation of Right-of-Way Requirements

The Right-of-Way (ROW) Requirements category was evaluated based on the acres of land impacted by each concept. This category does not account for the land use, which is covered in other categories (property impacts, economic development potential, etc.). A review of the preliminary concepts showed the following land impacts:

- ▶ Base Case - 250 acres
- ▶ Concept 1 - 255 acres
- ▶ Concept 2 - 266 acres
- ▶ Concept 2a - 297 acres

The Base Case and Concept 1 were found to have similar ROW requirement, and were assigned the same rank (4). Concept 2 was found to have slightly greater land requirements, and Concept 2a was found to require the most land for ROW. These concepts were ranked accordingly.

Table 16 – Ratings for Right-of-Way Requirements

Concept	Base Case	Concept 1	Concept 2	Concept 2a
Rating (1-4)	4	4	3	2

5.3.12 Evaluation of Construction Cost

The evaluation of construction cost was based on high level construction cost estimates. These planning level estimates do not reflect the final costs: they are preliminary estimates based on limited information, and are intended to establish relative costs for the purpose of distinguishing between the options. Detailed design information is required to establish more accurate construction costs.

The preliminary cost estimates are as follows:

- ▶ Base Case - \$129M
- ▶ Concept 1 - \$138M
- ▶ Concept 2 - \$153M
- ▶ Concept 2a - \$155M

The design concepts were ranked accordingly, with the assumption that the costs for Concepts 2 and 2a were essentially equal.

Table 17 – Ratings for Construction Cost

Concept	Base Case	Concept 1	Concept 2	Concept 2a
Rating (1-4)	4	3	2	2

5.4 Evaluation Results

The results of the consultant's evaluation are provided in Table 18. The ratings for each category are combined with the category weighting to produce a category score. The scores for each category are added to produce an overall score for each concept.

Concept 2a received the highest score (345). Concept 1 had the second highest score (310), followed closely by Concept 2 (297.5). The Base Case ranked lowest (210). The final ratings reflect the fact that the new design concepts (concepts 1, 2, and 2a) were introduced to improve on the functionality and safety of the Base Case. Sometimes this comes at the expense of other features, like property impacts or construction costs. According to the category weighting that was used in the analysis, the improved functionality, safety, and flexibility of Concept 2a was deemed to be worth the additional costs.

Table 18 – Consultant Evaluation Results

Evaluation Criteria	Weighting	Ratings			
		Base Case	Concept 1	Concept 2	Concept 2a
TransCanada Highway Functionality	25	1	4	3	4
Safety & Traffic Operations	25	2	3	3	4
Potential Phasing Opportunities	5	1	3	3	4
Access to Adjacent Development	10	2	3	4	4
Property Impacts	10	4	3	3	2
Constructability	2.5	3	2	2	4
Noise Impacts	5	2	2	3	3
Environmental Impacts	2.5	2	2	2	2
Utility / Railway Impacts	2.5	3	2	2	2
Economic Development Potential	5	2	2	3	3
Right-of-Way	2.5	4	4	3	2
Construction Cost	5	4	3	2	2
Weighted Total		210	310	297.5	345

In addition to the consultant’s analysis, the Steering Committee members were invited to submit their own rankings. The City of Regina, RM and MHI undertook individual evaluations, using the Evaluation Criteria as a basis but provided the latitude to revise the criteria if they deemed appropriate. The results of this exercise are provided in Table 19. The Ministry evaluation resulted in the same rankings as the consultant evaluation. The City of Regina also ranked Concept 2a the highest, though Concepts 1 and 2 were ranked in a different order. The RM of Sherwood ranked Concept 1 first, and Concept 2a was ranked last (in a tie with the Base Case).

Table 19 – Summary of Evaluation Results from Different Agencies

Evaluator	Evaluation Results – By Rank			
	Base Case	Concept 1	Concept 2	Concept 2a
MMM Group	4th	2nd	3rd	1st
MHI	4th	2nd	3rd	1st
City of Regina	4th	3rd	2nd	1st
RM of Sherwood	3rd	1st	2nd	3rd

5.5 Preferred Concept

Based on the evaluation undertaken during the study, Concept 2a was chosen as the preferred concept to be taken forward into functional design.

5.6 Stakeholder Engagement on the Preferred Concept

An opportunity was given to affected landowners to comment on the preferred concept, as presented at Open House #2. Not all stakeholders felt the need to meet and discuss the preferred concept. Some simply wanted a status update and others wanted more information on the preferred plan or to provide feedback directly to the consultant. Of particular importance during many of the meetings was gaining some resolution around the location of the service roads. This was deemed important to many people along the corridor as it directly affected their access and travel routes in the area.

Meetings on the preferred concept took place over a one and a half month period between August 27th and October 10th, 2013 and included 9 in-person meetings, as well as various telephone conversations with major landowners/developers in the area. The following is a summary of the key findings of these meetings and phone conversations aggregated under common themes:

Location of curve at Highway 1

- ▶ Concern over loss of land for the size of the interchange
- ▶ Land has artesian well on it
- ▶ Potential for development would be removed for landowner
- ▶ Impact on several residents on south service road adjacent to Highway 1. These comments are included below under the Service Roads heading

Bypass Alignment being 350 m east of Tower Road

- ▶ General agreement that the option of 350m east of Tower Road was better than the bypass directly on Tower Road
- ▶ Several comments that alignment should be moved further east of the railway as it would eliminate impacts to landowners

Interchange at Highway 33

- ▶ General agreement that the interchange as shown during Open House #2 provides a balance between residents on either side of the interchange
- ▶ Following a discussion by a key landowner immediately south of Highway 33, it was decided that splitting their property into two equal portions was acceptable. Both properties would be accessible and viable for development

- ▶ Preference would be to lower the grade of the bypass near Highway 33 interchange to lessen noise impacts on surrounding residents. It was mentioned that the excavated fill could be used for bridge abutments and ramps. This is a detailed design consideration
- ▶ Creeks residents are concerned about noise mitigation or visual screening. It was assumed that there would be development blocking the view of the interchange in the long term but, until that time, they have requested a plan for noise mitigation/visual screening. Concern for who will be responsible (i.e. MHI, City, RM, developer) and timing of this mitigation
- ▶ Desire to see posted speeds lowered along this section. Two items work in this favour - development is growing east and will likely dictate a lower speed as people enter the urban area, and the lower speed will result in a more compact footprint for the interchange

Service Roads – South Service Road Adjacent to Highway 1

- ▶ Concern by one resident on the timing of construction and impact on when they would need to move from their house. Sooner rather than later was of preference
- ▶ Concern for loss of direct access to Highway 1. Preference by landowner along Highway 1 south service road would be to move the bypass much further east or at minimum provide access back to Tower Road (somewhere in the vicinity of the current service road access. It was indicated that this would require a crossing under the bypass. Plan shows closest accesses to the south service road at Highway 33 and a right in/right out at Gravel Pit Road
- ▶ Plan is to move service road from the front of the properties adjacent to Highway 1 to the south side of the properties. Associated issues include whether or not the land for the service road would be shared by land owners on either side of the service road or just one side, driveway accesses in some instances being too long and others the buildings being very close and the driveways inadequate for trucks proposed on-site. As well, there is a low-lying area on at least one of the properties that will require driveways to be built up

Service Roads – East Service Road at Highway 33

- ▶ Landowners were informed there would be only one east service road intersection accessing both sides of Highway 33. The preferred location for the intersection on Highway 33 was somewhere at the midpoint between the interchange and the railway (this preference was received by residents from both sides of Highway 33)
- ▶ Note that there is potential for a mosque to be developed on the south side of Highway 33. The volumes of traffic this development will generate are large (i.e. potentially 2,000 patrons during prayers). Should this development go ahead, additional review is needed to determine how it will be accommodated in the context of the service roads
- ▶ One of the key issues is connecting the service road was the alignment leaving Highway 33 to the north. There are two properties to the north of Highway 33, one of which is a horse stable and pasture

operation. There are three options available: realign the service road west of these properties (MHI would construct and maintain a longer service road), go directly through the properties (logical in the long term but does not suit current use as horse stable), or go east of their properties adjacent to the rail (as was shown at the open house). Concern for the east option by one of the residents was maintaining a long driveway in winter

- ▶ The east service road leaving Highway 33 to the south was discussed. There was general consensus that the service road should address those that front Highway 33 but also hug the interchange before travelling south. This alignment affects one land owner that has land on both sides of Wascana Creek

Service Roads – West Service Road at Highway 33

- ▶ People were informed there would be only one service road intersection serving both sides of Highway 33 west of the interchange.
- ▶ Creeks residents expressed concern over having a high speed, dusty north-south service road developed behind their properties. Preference would be to see residential development and a slower speed, paved, urban cross-section type road accessing development. Also, concern was raised that the road should not simply be a service road but instead be constructed to a higher standard, particularly as it relates to any development west of the interchange
- ▶ It was indicated that the road may be used to access future development south of Wascana Creek over time. This raised further concern over the function and location of this road
- ▶ It was indicated that the access to Highway 33 would be dictated by the design of the interchange. Highway 33 goes over the bypass and will impact the location of the intersection
- ▶ This same intersection would be used for access to the north. It is shown as tying into existing Tower Road. Over time it is believed that Tower Road may not exist in its current location or at all. These elements will be dictated by the surround land use and whether or not this roadway gets absorbed into urban fabric

6.0 GEOMETRIC DESIGN

The geometric design must take into consideration the inputs previously mentioned, in addition to traffic volumes, Canadian and Saskatchewan design standards, geotechnical conditions, accommodating the overall drainage scheme, and impacts of the design of the bridge structures. This section provides additional details on the main considerations.

6.1 Traffic Volumes

The forecast traffic volumes used for the analysis and design were developed using the Regina Region Traffic Forecasting Model (RRTFM) as a base with vehicles added to the network to account for traffic generated from additional development in lands immediately adjacent to the bypass. Knowledge of the RM Wascana Village development proposal came late within the study. As such, the traffic volume projections do not include this potential future development located south of Regina.

This model, which was developed using the EMME travel demand modeling platform, was designed to help integrate the existing City of Regina traffic model with regional traffic patterns in order to help make decisions about the regional traffic network. The RRTFM uses available information about existing traffic volumes as a baseline, and incorporates known development plans, population and employment data to produce traffic forecasts for the Regina region.

The RRTFM was developed in parallel with the functional design of the Southeast Regina Bypass. Model updates were provided throughout the design process: the most recent traffic forecast information is provided in Appendix C. The traffic forecast updates were used to test and refine some of the functional design details, including interchange and intersection configurations. In some cases adjustments were made to the forecast to provide further details about potential traffic patterns in the study area (e.g. forecasting traffic on the east service road by incorporating additional development in the study area).

6.2 Digital Elevation Model

A digital elevation model (DEM) was the source of existing ground elevations used for vertical elevation information for the project, as topographic survey data was not available. This model is based on a triangulated surface created from points and contours, and accuracy due to averaging of elevations between points can vary. This is particularly true in areas of higher change in elevations such as the overpass on Highway 1. Variances of 1-2 metres could be present in this data, and greater immediately near overpass embankments.

6.3 Design Criteria

Table 20 presents the geometric design criteria established for the development of the functional design for the roadways and interchanges within the limits of this project.

Table 20 – Geometric Design Criteria

Design Parameter	Highway No. 1 (Including Bypass)		Highway 33		Ramps		Service Road
Roadway Type	Four Lane Divided		Four Lane Divided				
<u>Design Speed</u>							
Vertical Curves	130 km/h Desirable 120km/h Min		100 km/h (within interchange area)		Condition Dependant (50 km/h Min)		90 km/h Rural 60 km/h Urban
Horizontal Curves	130 km/h Desirable 120km/h Min		N/A (On Tangent)		Condition Dependant (50 km/h Min)		90 km/h Rural 60 km/h Urban
Lane Widths	3.7 m		3.7 m		Single Lane - 4.4 m Double Lane – 3.7 m		3.7 m
Shoulder Widths	Inside	Outside	Inside	Outside	Inside	Outside	0.8 m
	1.0 m	3.0 m	1.0 m	3.0 m	1.0 m	2.5 m	
<u>Typical Cross Slope</u>							
Mainline	2% lanes & inner shoulder 5% outer shoulder		2% lanes & inner shoulder 5% outer shoulder		2% lanes & inner shoulder 5% outer shoulder		2%
Maximum Allowable Superelevation	6%		6%		6%		6%
Maximum Vertical Gradient	3% Upgrade 5% Downgrade		3%		4% Upgrade 5% Downgrade		6%
Ditch Depth “D”	D≥1.1 m D≥1.2 m (Desirable)		D≥1.1 m D≥1.2 m (Desirable)		D≥1.1 m D≥1.2 m (Desirable)		D≥0.8
Sideslopes	6:1 Desirable (Assume 5:1 for Maximum Slope in Interchange Embankment for Stability)		6:1 Desirable (Assume 5:1 for Maximum Slope in Interchange Embankment for Stability)		6:1 Desirable (Assume 5:1 for Maximum Slope in Interchange Embankment for Stability)		4:1
Ditch Width	8.0 m Desirable		8.0 m Desirable		8.0 m Desirable		5.0 m Minimum
Backslopes	4:1 Desirable (Minimum 3:1)		4:1 Desirable (Minimum 3:1)		4:1 Desirable (Minimum 3:1)		4:1 Desirable (Minimum 3:1)
Median Width	32 m		32 m		N/A		N/A
Right of Way Width	101.4 m		101.4 m		Varies		40 m
Design Vehicle	Turnpike Triple (Custom)		WB-20		WB-20		WB-20
<u>Vertical Clearances</u>							
Railway (from top of rail)	7.31 m		7.31 m		7.31 m		7.31 m
Roadway	5.3 m (allows for 100mm future overlay)		5.3 m (allows for 100mm future overlay)		5.3 m (allows for 100mm future overlay)		5.3 m (allows for 100mm future overlay)
<u>Lateral Clearances (Underpass)</u>							
Railway	Rail Specific						
Roadway	9.0 to Centre Pier & Abutment, 6.0 m to 3:1 spill-thru slope						

6.4 Horizontal and Vertical Geometry

6.4.1 Highway Bypass Main Lanes

Figure 16 illustrates the recommended proposed functional design of the corridor. Figure 17.1 through Figure 17.19 illustrate the proposed horizontal and vertical alignments in detail. Throughout the concept development, it was established that the main bypass lanes should provide a high level of functionality for traffic remaining on the highway lanes. Right hand exits and entrances are standard, and reduction in operating speed through curves is not desirable. The alignment of the north-south tangent was established earlier in the study through the consultation and evaluation process and the decision was made to proceed with this design.

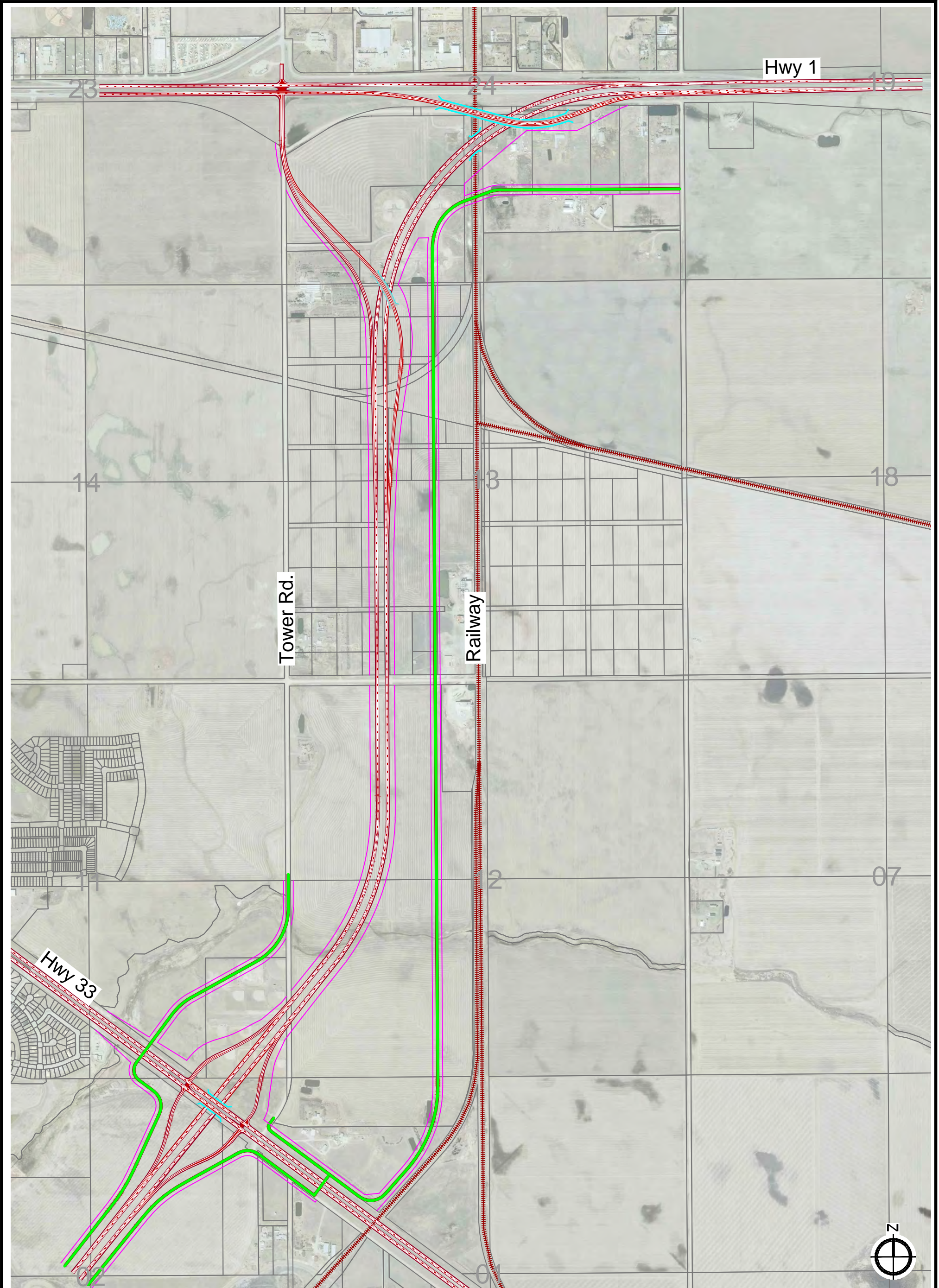
Based on these decisions, the main bypass lanes were designed to maintain a design speed of 130 km/h, with a maximum superelevation of 6%, which utilizing TAC standards results in a design radius of 950 to 1000 metres. TAC standards were used, as MHI design tables for Emax of 6% do not go up to a design speed of 130 km/h, and moving to the radius shown in the MHI design table for Emax of 8% seems excessively large, and some other jurisdictions utilize the 6% maximum as the design standard for new construction of highways, even in rural locations. Utilizing the 6% maximum is further supported due to the fact that this corridor has interchanges at either terminal, and is near an urban development.

Should there be any deviations in the alignment during detailed design, care should be taken with the curves in the main lanes north of Highway 33, as increasing the radius of the curve would be desirable but may extend the length of the curve, and the merge points of the connecting ramps to Highway 33 will overlap into the curves. This is more of an issue with the northbound acceleration lane as it must merge on to a curve superelevated against the final ramp curve, and the acceleration lane may need to be extended to the end of the curve to avoid a merging issue on the curve.

The alignment has been set south of Highway 33 to cross Wascana Creek at a location identified in the previous study, which appears to allow for the shortest crossing. Further investigation should be done to establish the geotechnical and hydraulic benefits of modifying this alignment further.

Both sets of bypass lanes cross over the existing railway at the north end of the alignment, which will require two bridges on the 1000m radius curve, superelevated to 6% in order to provide required clearance over the top of the tracks.

It should be noted that a reduction in median width for the main lanes, particularly in the areas where the bypass lanes are underneath bridge structures, at two ramp locations and at Highway 33 would also reduce structure lengths and costs. The safety implications of this would have to be reviewed, and a decision made to support this as a cost savings measure. Median widths in the 24 m range have been suggested as a good compromise to provide separation for headlight glare and snow storage, with some increase in the risk of cross-median collisions.

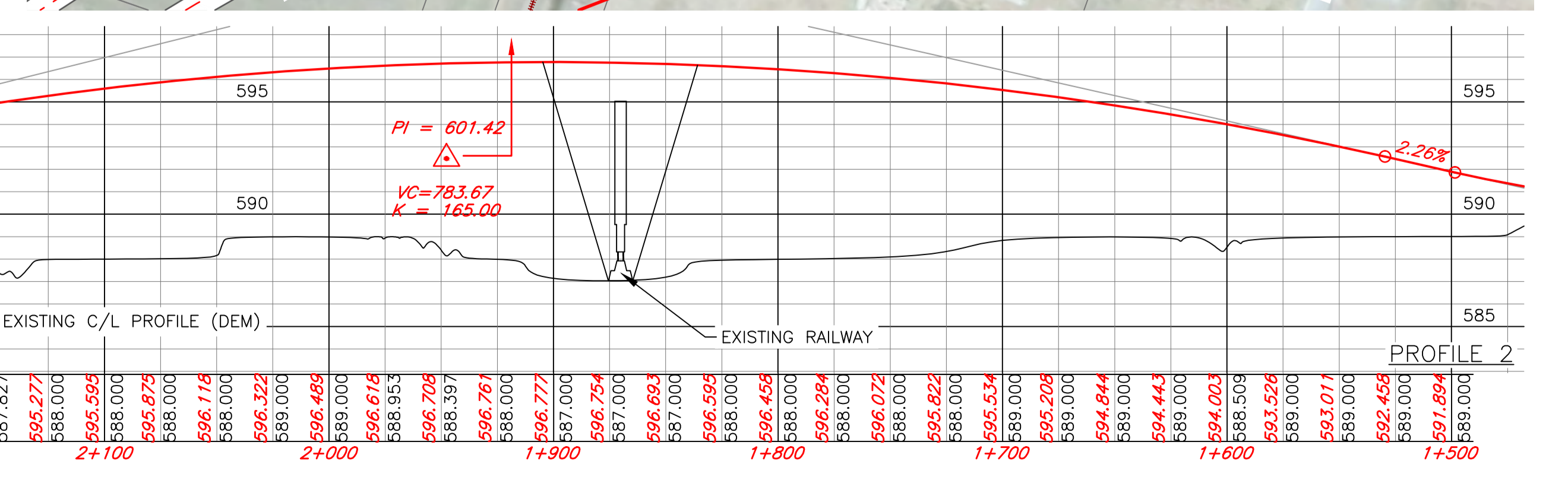
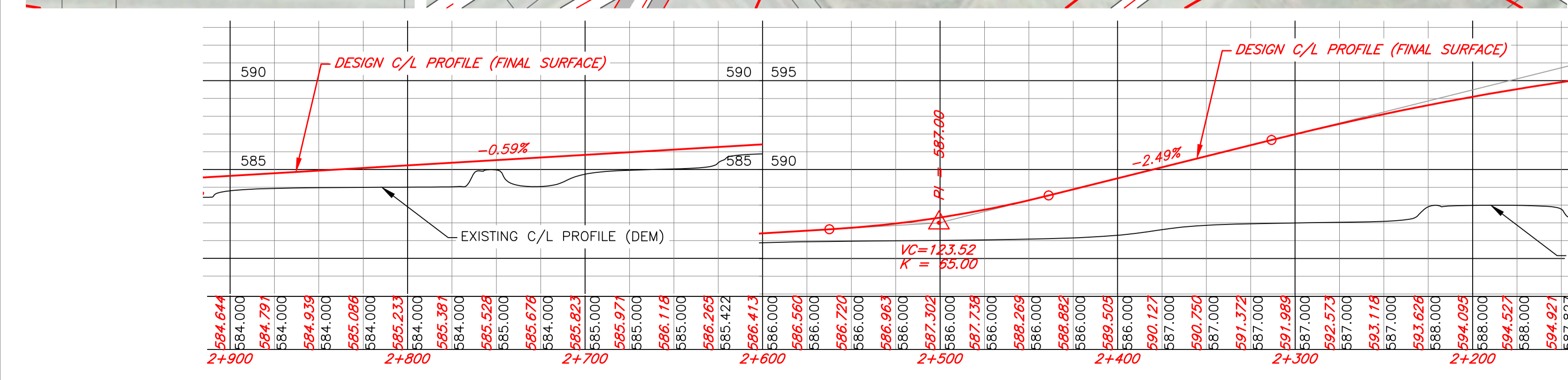
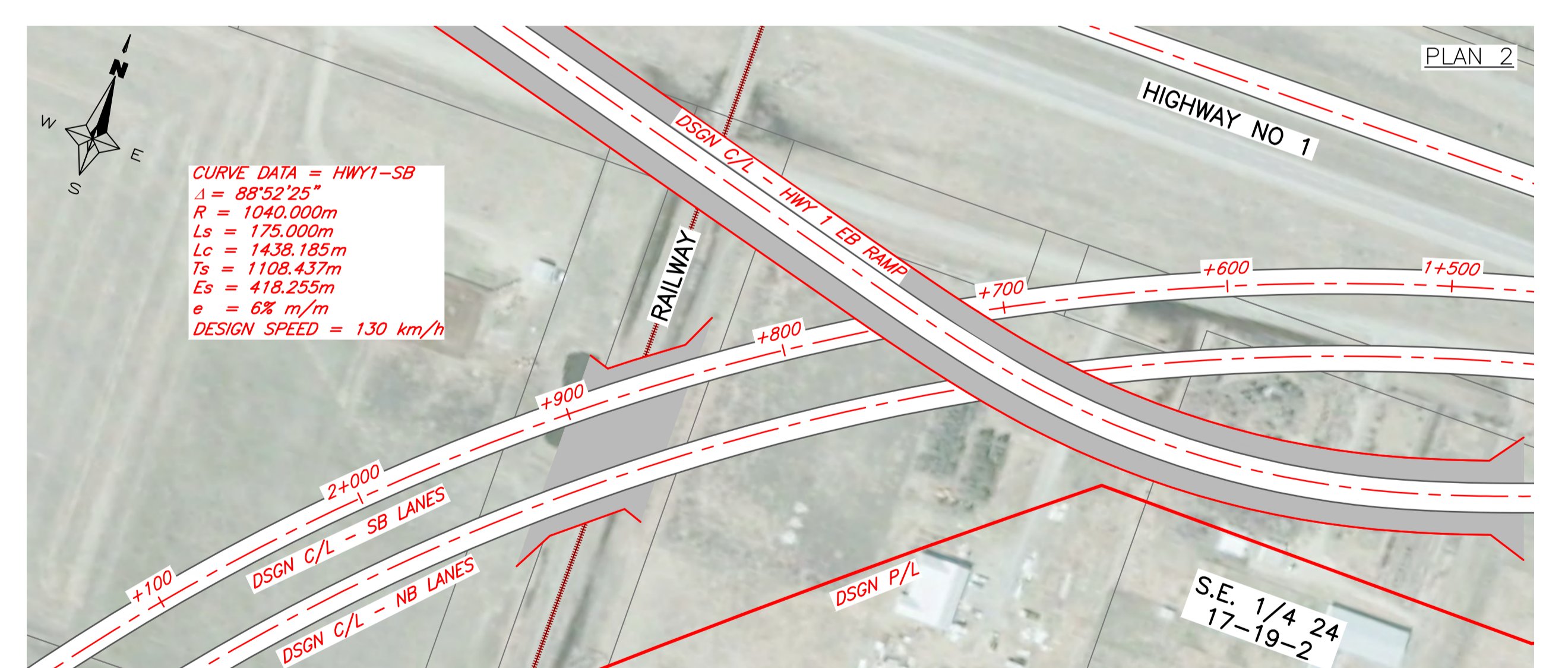
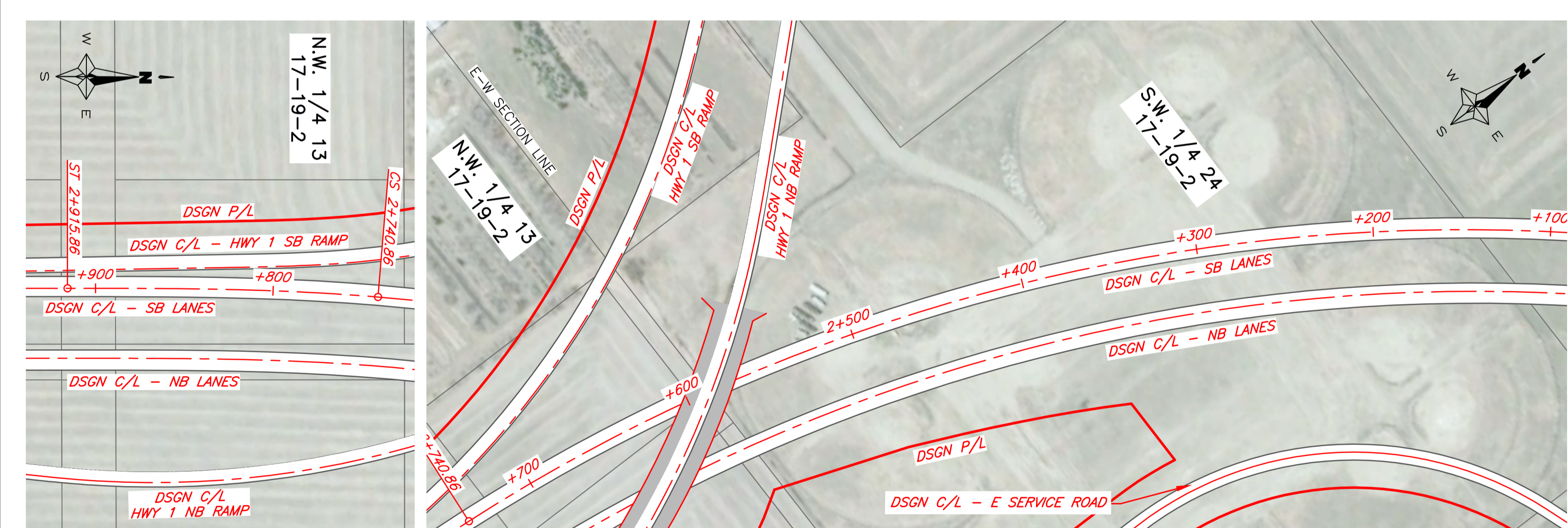
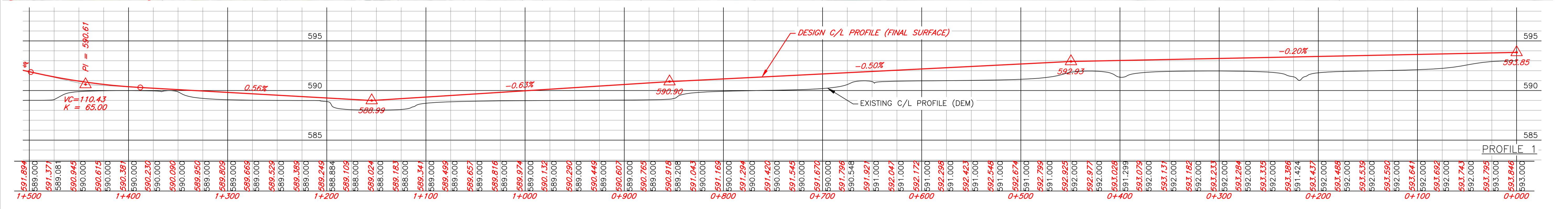
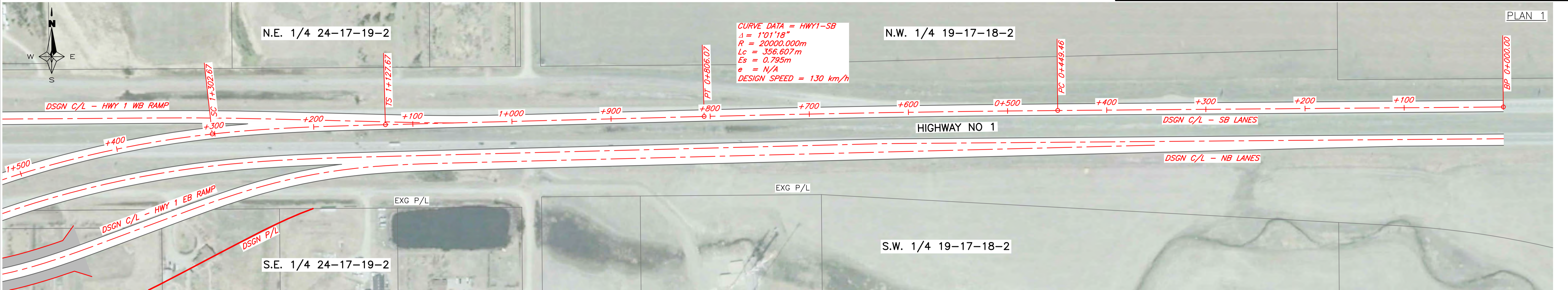


LEGEND:

- RIGHT-OF-WAY
- DESIGN BRIDGES
- DESIGN ROADS
- DESIGN SERVICE ROADS

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			DRAWN BY	K. MORROW	DATE	13/10/18
			DESIGNED BY	A. POLLEY	DATE	13/10/18

PLAN AND PROFILE
SOUTHEAST REGINA BYPASS
(FUNCTIONAL DESIGN)
HWY 1 - SB LANES
FIGURE 17.1

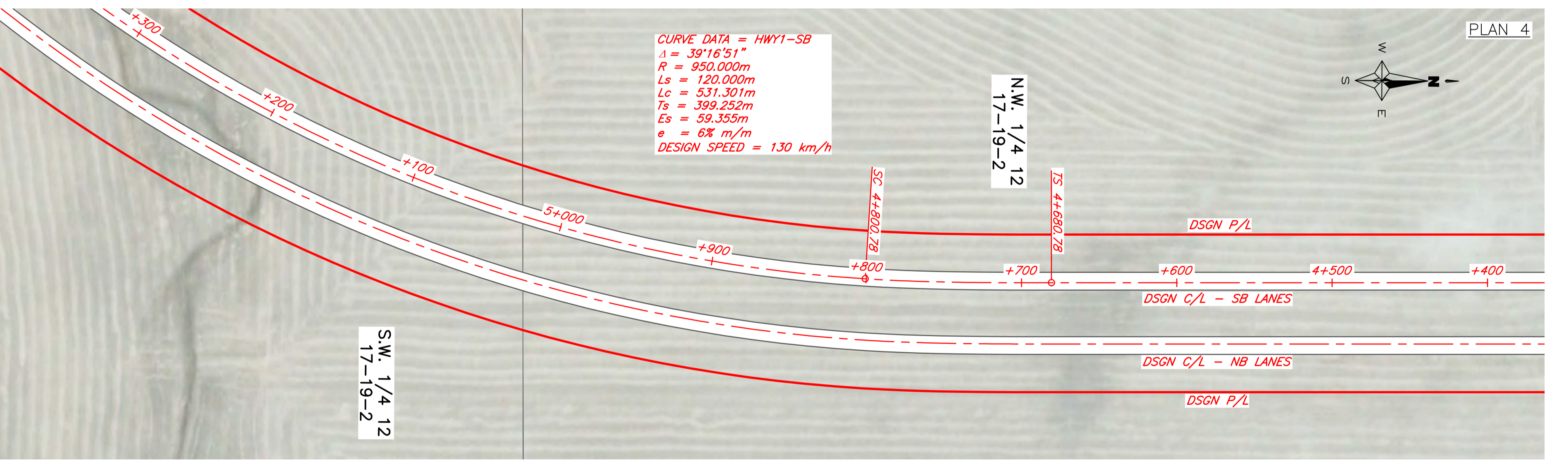
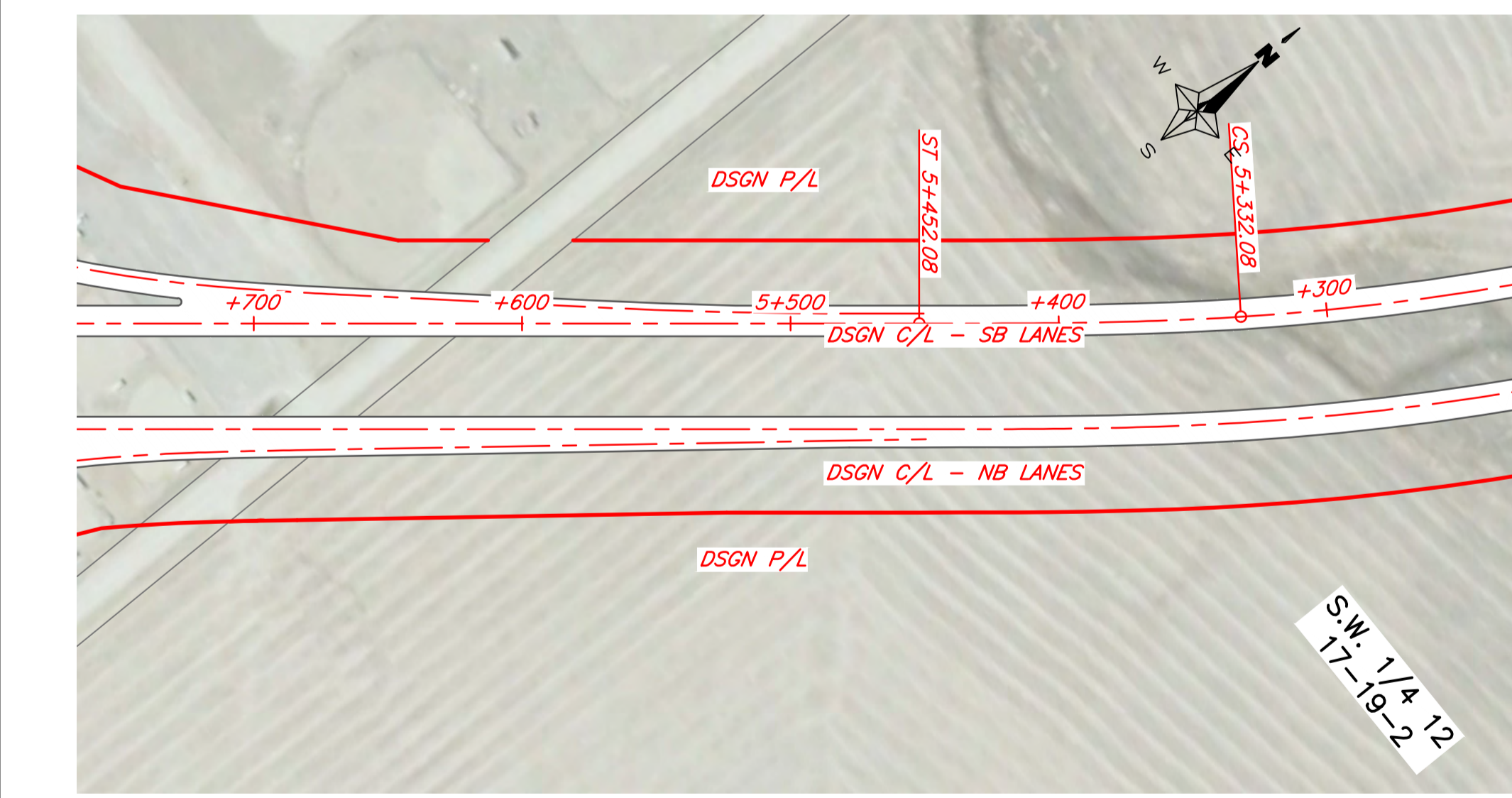
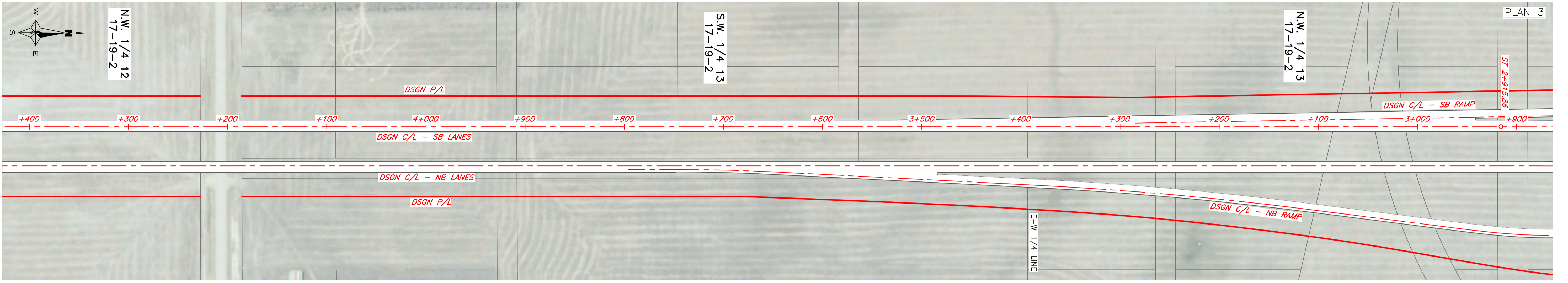


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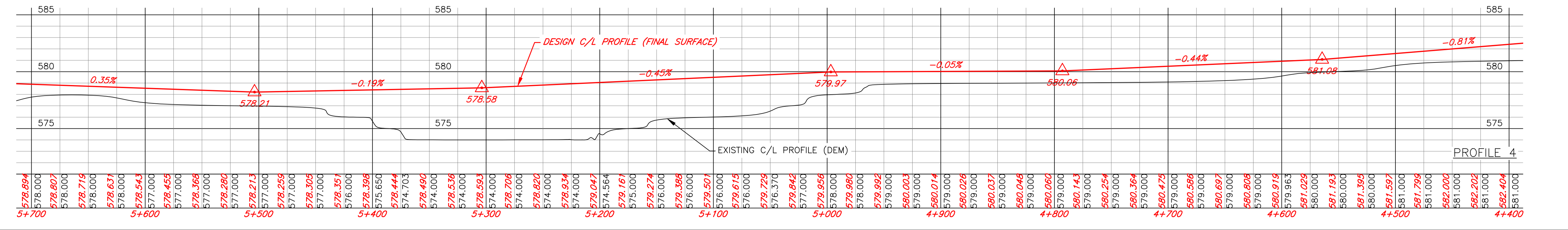
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PHOTO DATE	2010	SHEET	2
DRAWN BY	K. MORROW	DATE	13/10/18
DESIGNED BY	A. POLLEY	DATE	13/10/18

FULL SIZE SCALE (m)
PLAN 1:2000
PROFILE (H) 1:2000
PROFILE (V) 1:200

PLAN AND PROFILE
SOUTHEAST REGINA BYPASS
(FUNCTIONAL DESIGN)
HWY 1 - SB LANES
FIGURE 17.2



CURVE DATA = HWY1-SB
 $\Delta = 39^{\circ}15'51''$
 $R = 950.000m$
 $Ls = 120.000m$
 $Lc = 531.301m$
 $Ts = 399.252m$
 $Es = 59.355m$
 $e = 6\% m/m$
 DESIGN SPEED = 130 km/h

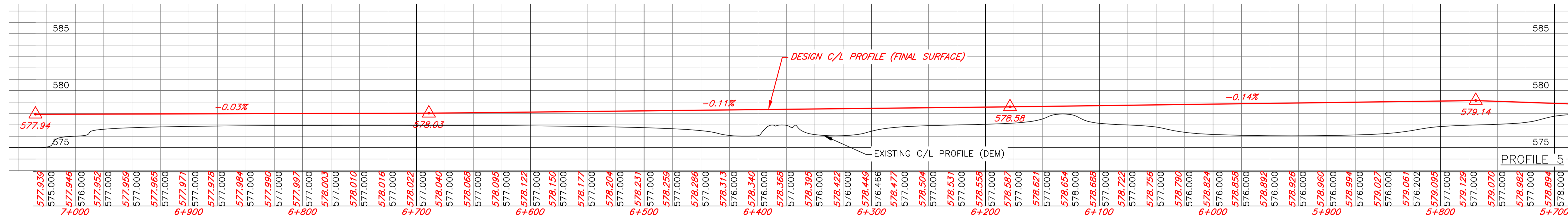
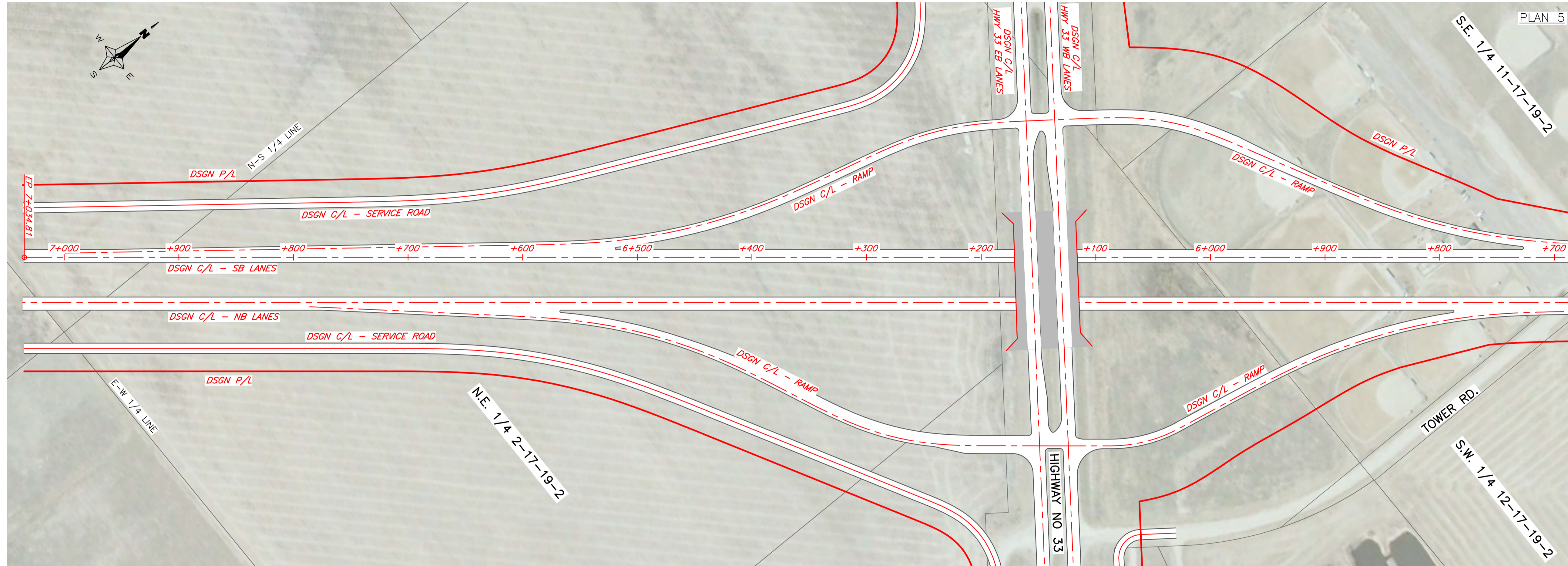


REVISIONS		
NO	DATE	SIGNATURE

CS	N/A	TAB NO	3A-3
PHOTO DATE	2010	SHEET	3
DRAWN BY	K. MORROW	DATE	13/10/18
DESIGNED BY	A. POLLEY	DATE	13/10/18

FULL SIZE SCALE (m)
 PLAN 1:2000 0 25 50
 PROFILE (H) 1:2000 0 25 50
 PROFILE (V) 1:200 0 1 2 3 4 5

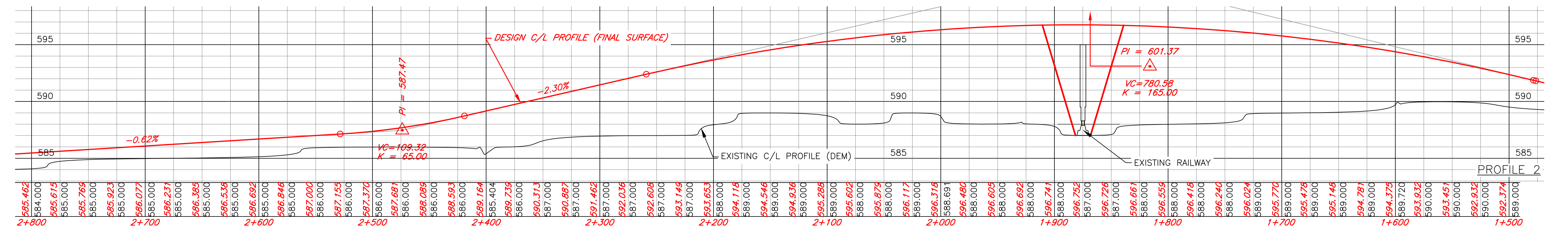
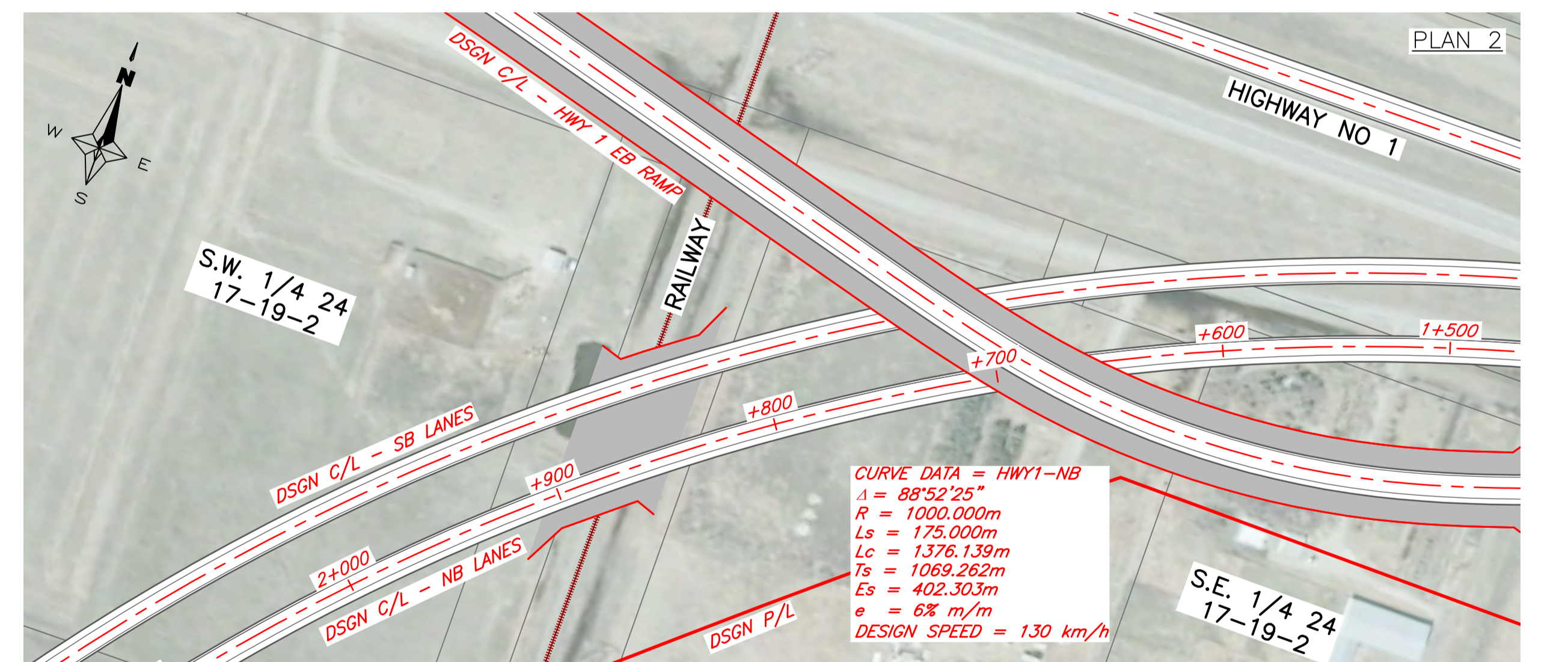
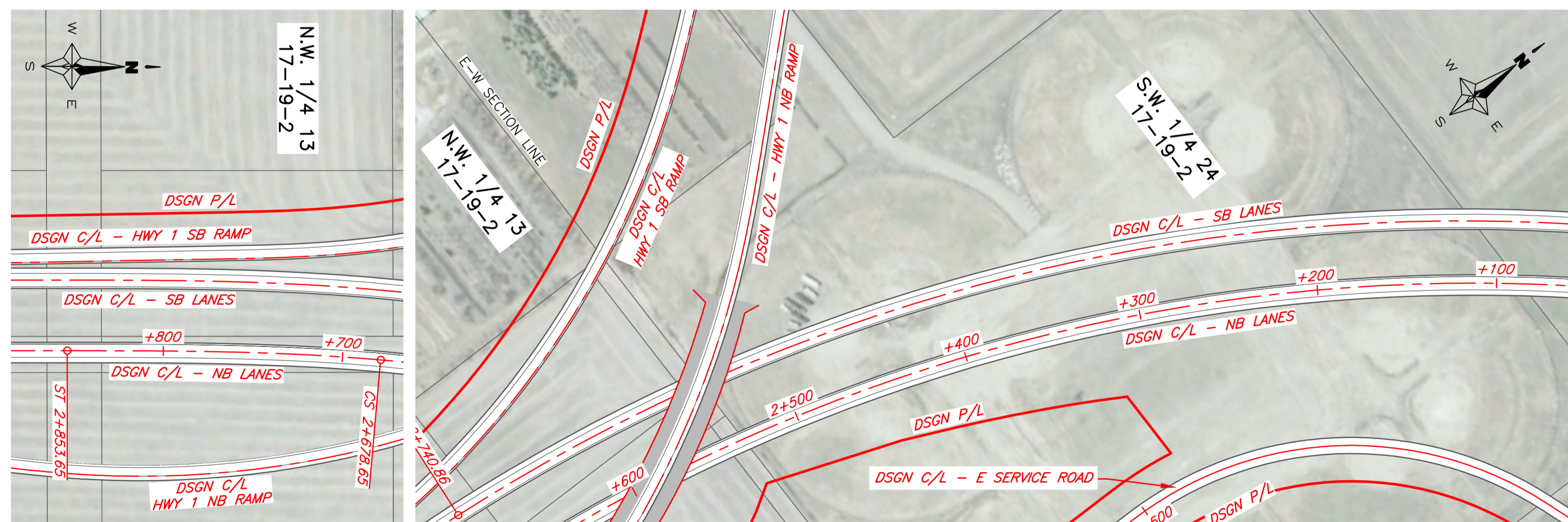
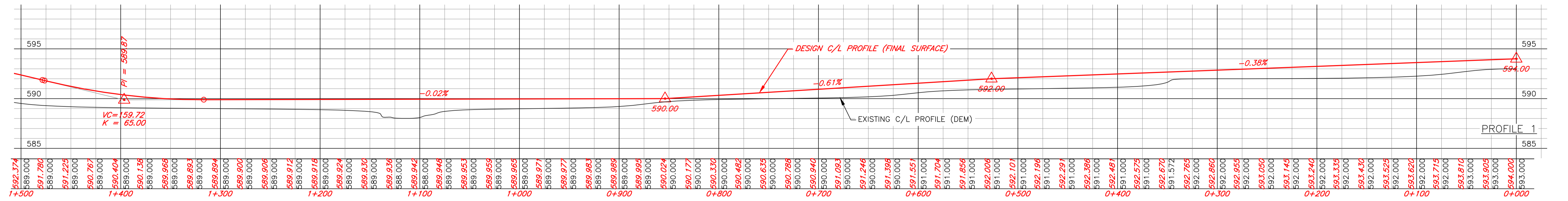
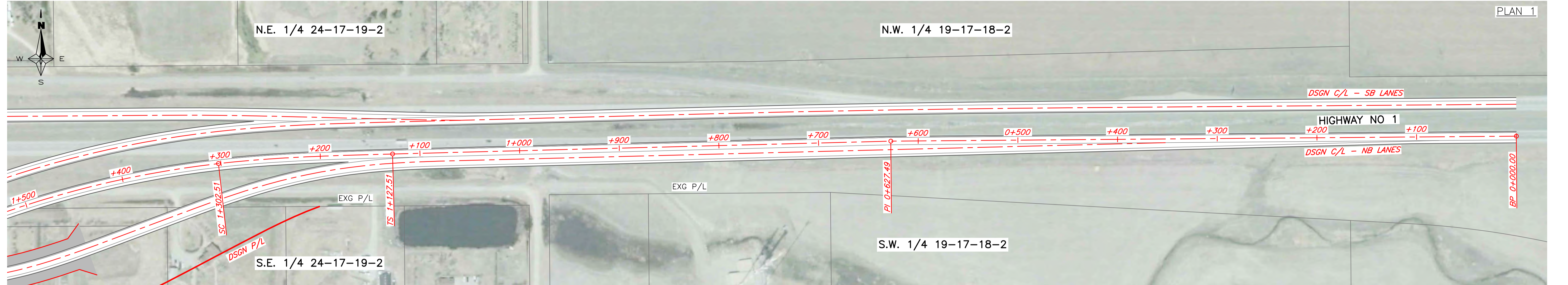
PLAN AND PROFILE
 SOUTHEAST REGINA BYPASS
 (FUNCTIONAL DESIGN)
 HWY 1 - SB LANES
 FIGURE 17.3



REVISIONS		
NO	DATE	SIGNATURE

CS	10-06	TAB NO	3B-1
PHOTO DATE	2010	SHEET	4
DRAWN BY	K. MORROW	DATE	13/10/18
DESIGNED BY	A. POLLEY	DATE	13/10/18

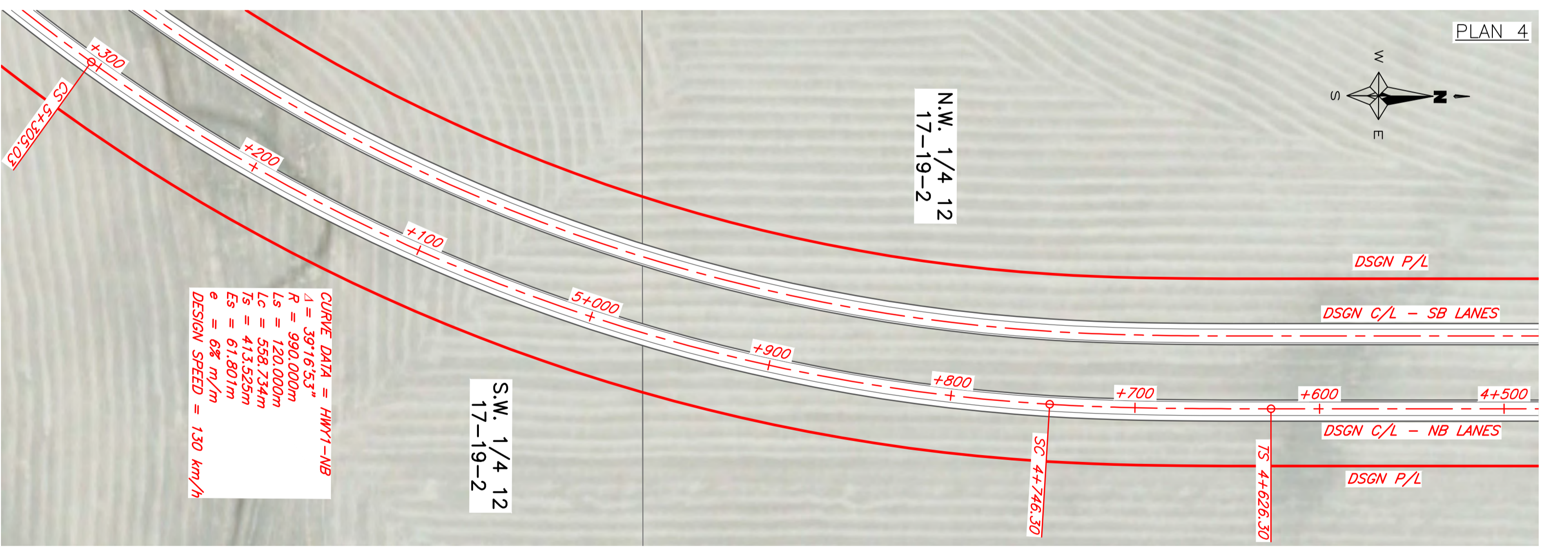
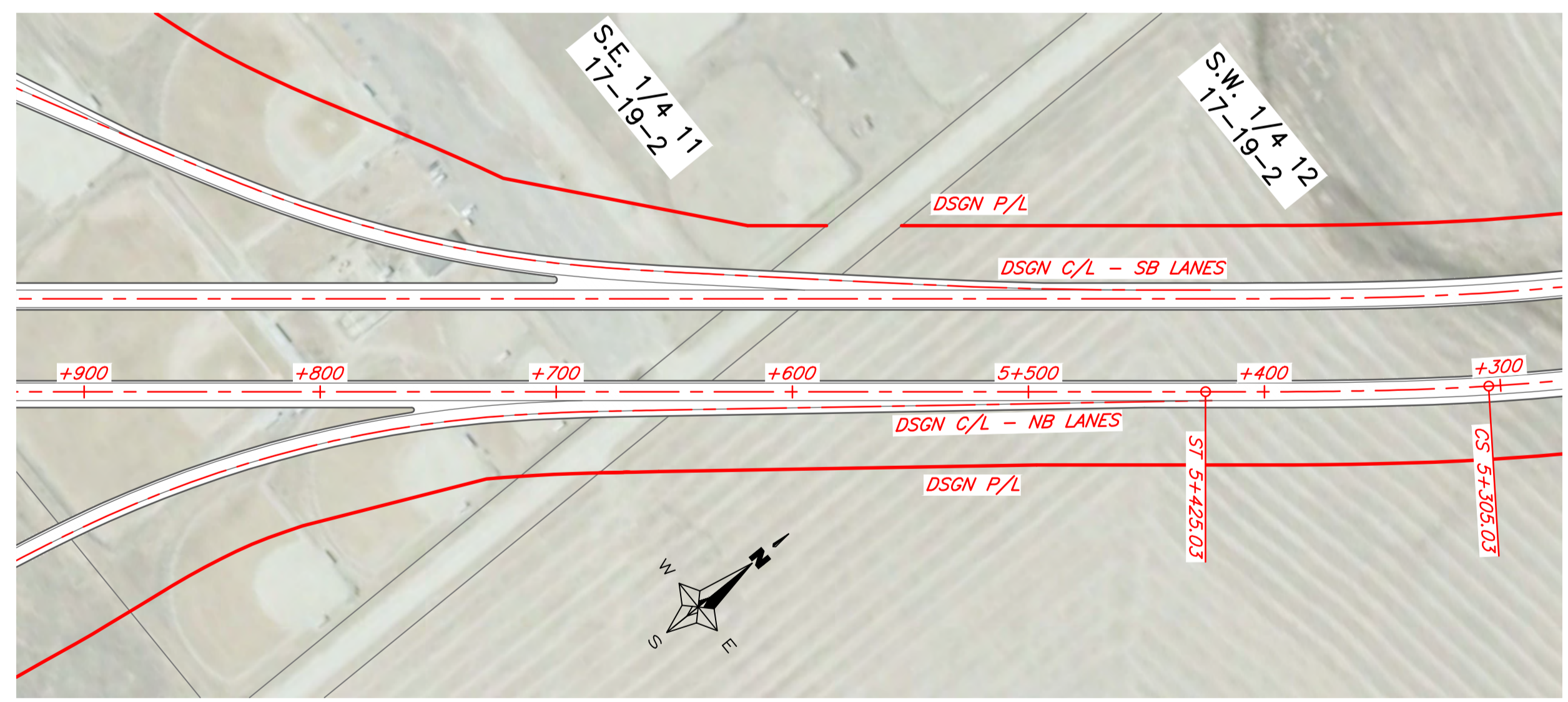
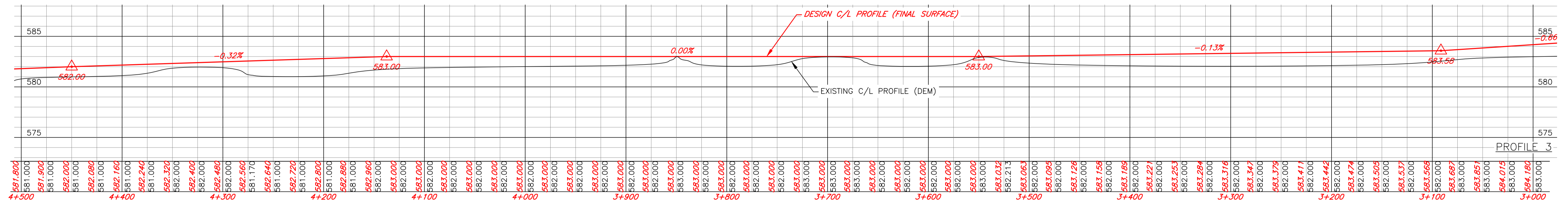
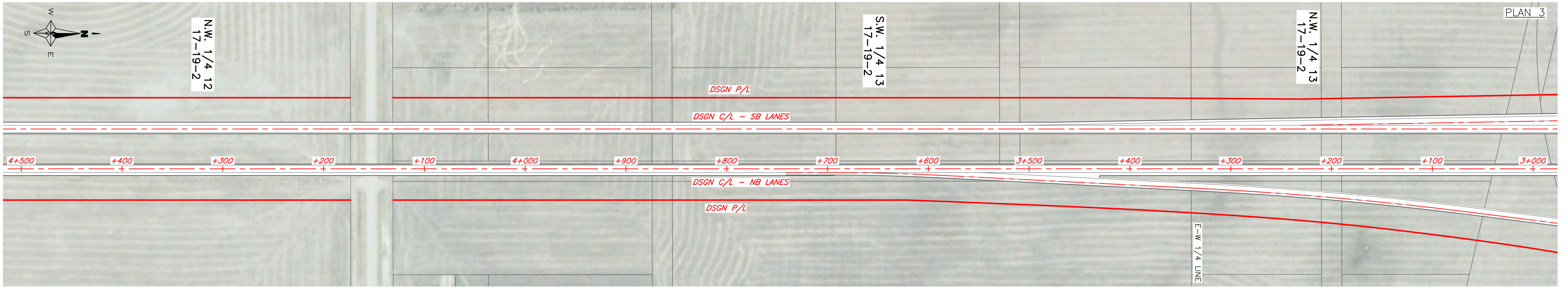
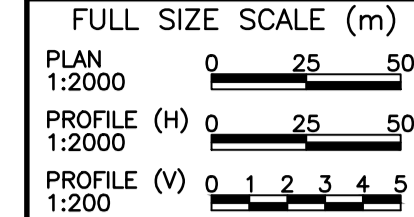
PLAN AND PROFILE
 SOUTHEAST REGINA BYPASS
 (FUNCTIONAL DESIGN)
 HWY 1 - NB LANES
 FIGURE 17.4



REVISIONS		
NO	DATE	SIGNATURE

CS	10-06	TAB NO	3B-2
PHOTO DATE	2010	SHEET	5
DRAWN BY	K. MORROW	DATE	13/10/18
DESIGNED BY	A. POLLEY	DATE	13/10/18

PLAN AND PROFILE
SOUTHEAST REGINA BYPASS
(FUNCTIONAL DESIGN)
HWY 1 - NB LANES
FIGURE 17.5



CURVE DATA = HWY1-NB

$\Delta = 191.531^\circ$

$R = 990.000m$

$LS = 120.000m$

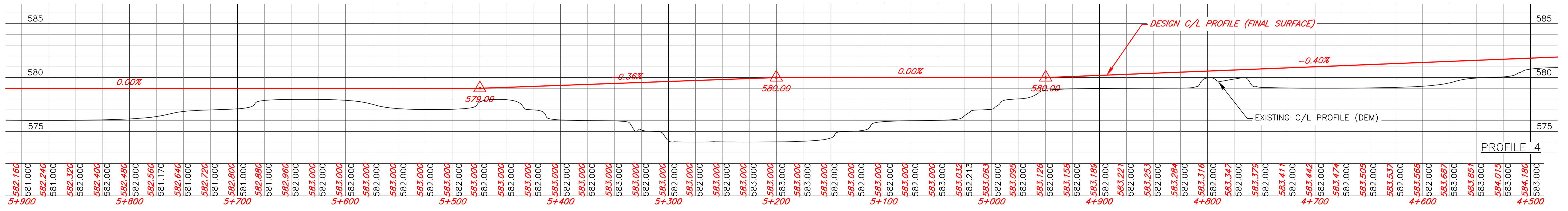
$LC = 558.234m$

$TS = 413.525m$

$ES = 61.801m$

$e = 6\% m/m$

DESIGN SPEED = 130 km/h

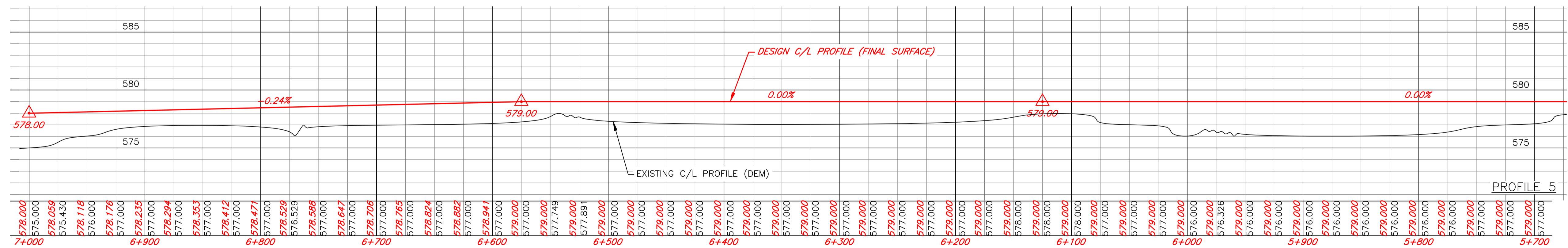
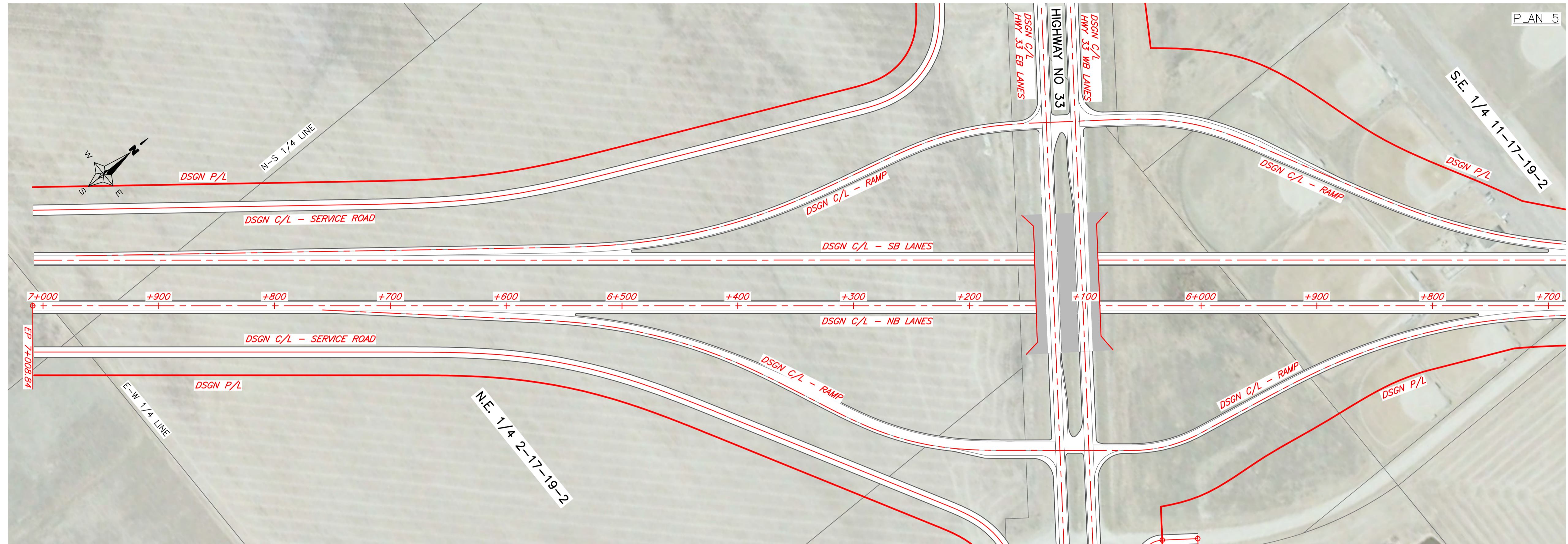


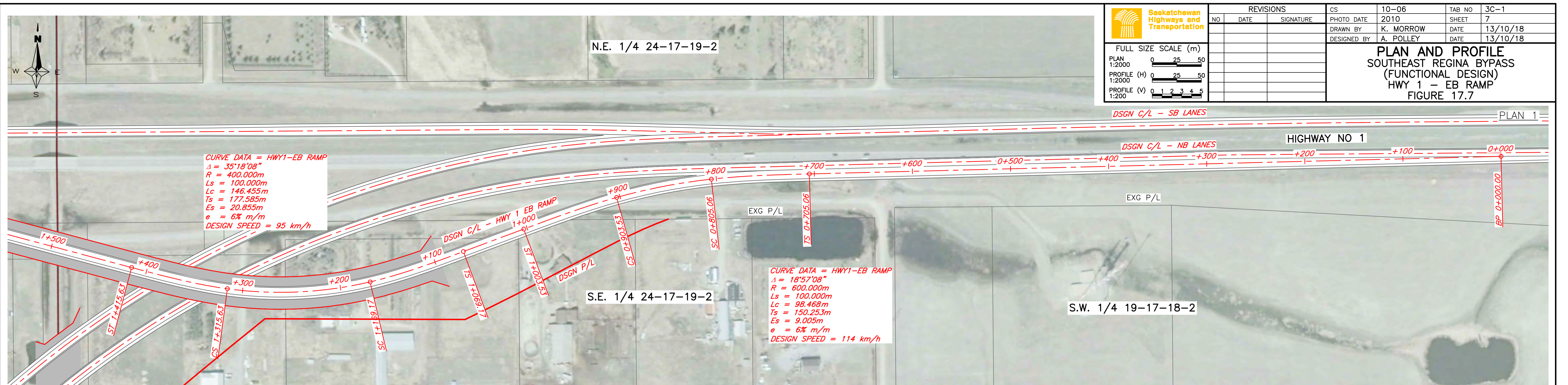
REVISIONS		
NO	DATE	SIGNATURE

CS	10-06	TAB NO	3B-3
PHOTO DATE	2010	SHEET	6
DRAWN BY	K. MORROW	DATE	13/10/18
DESIGNED BY	A. POLLEY	DATE	13/10/18

FULL SIZE SCALE (m)
 PLAN 1:2000
 PROFILE (H) 1:2000
 PROFILE (V) 1:200

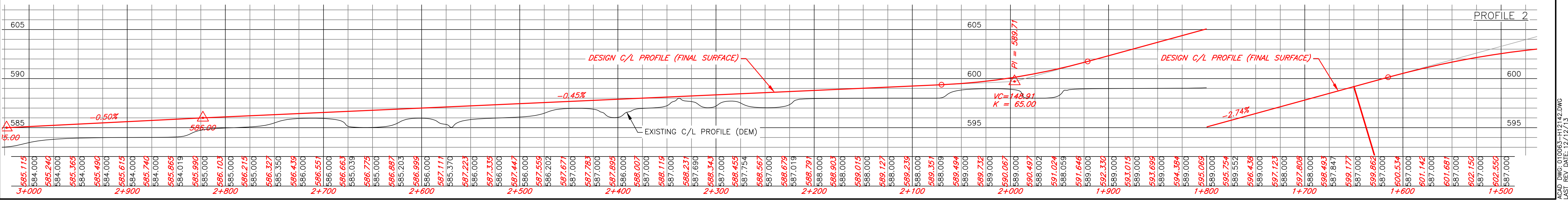
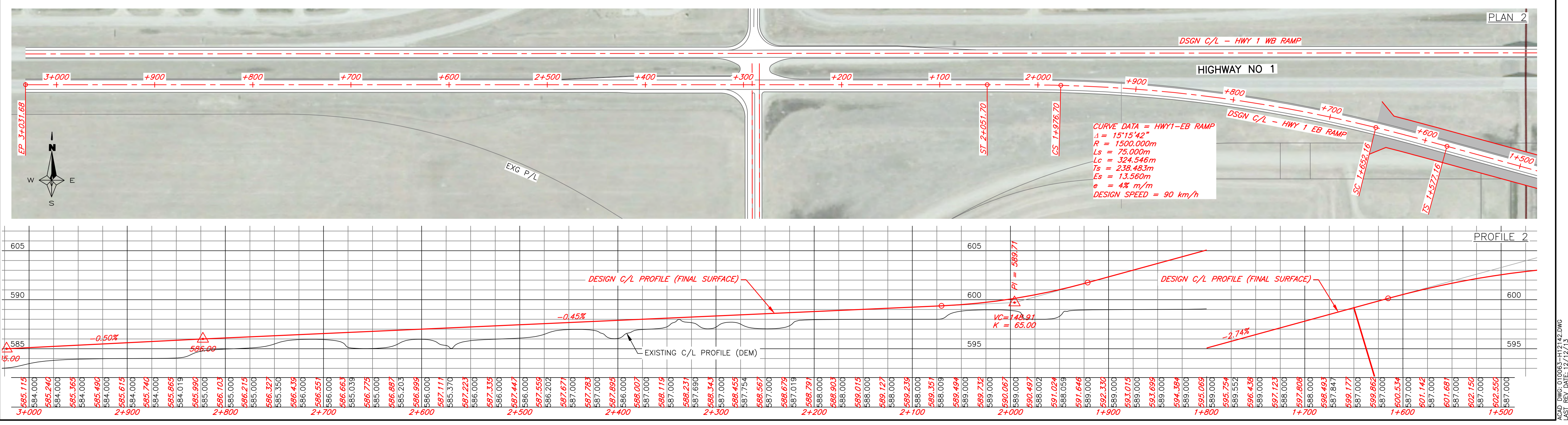
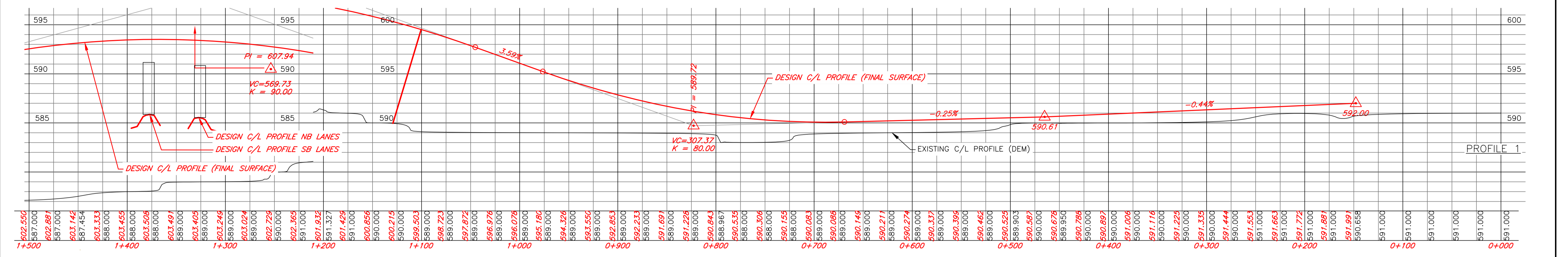
PLAN AND PROFILE
 SOUTHEAST REGINA BYPASS
 (FUNCTIONAL DESIGN)
 HWY 1 - NB LANES
 FIGURE 17.6





REVISIONS			CS	10-06	TAB NO	3C-1
NO	DATE	SIGNATURE	PHOTO DATE	2010	SHEET	7
			DRAWN BY	K. MORROW	DATE	13/10/18
			DESIGNED BY	A. POLLEY	DATE	13/10/18

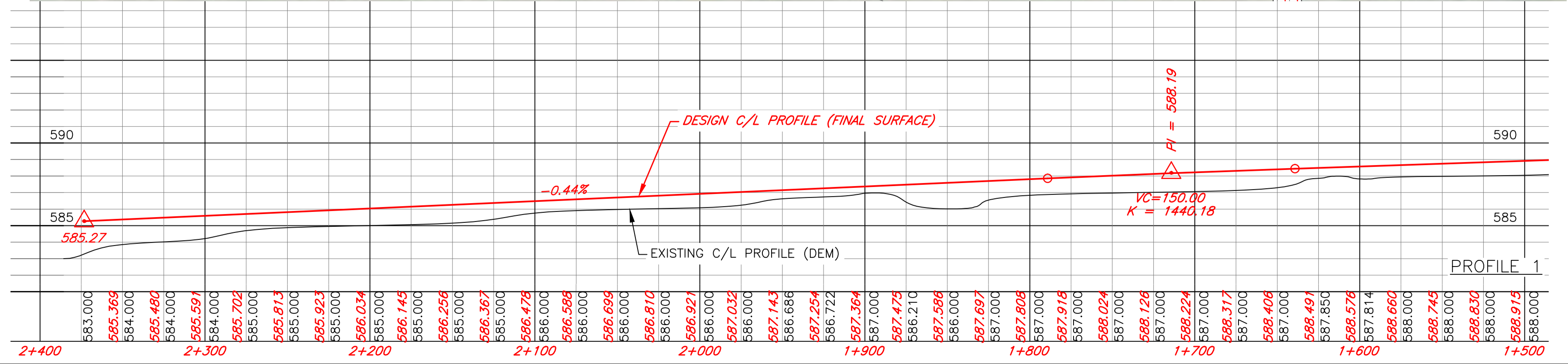
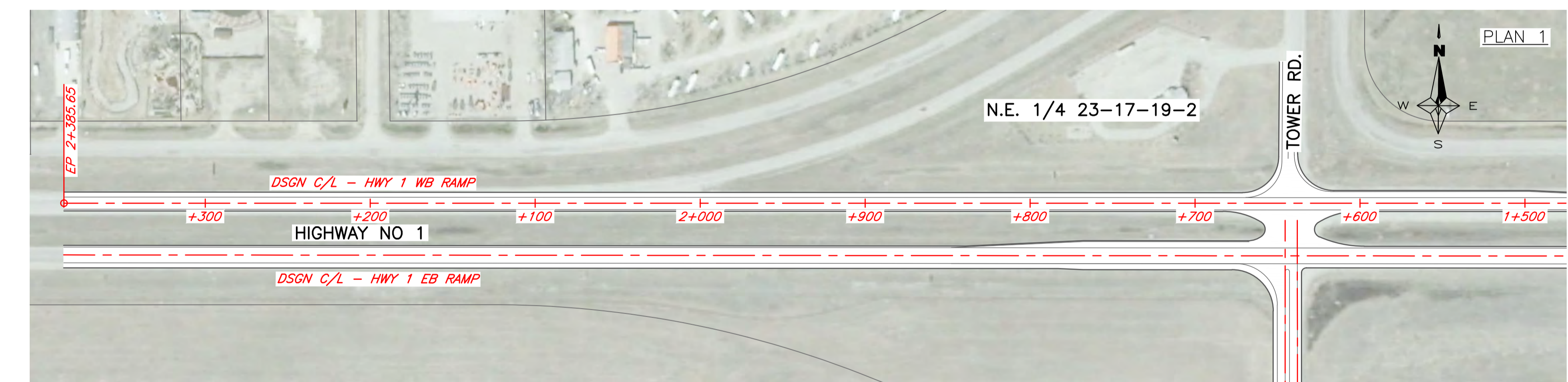
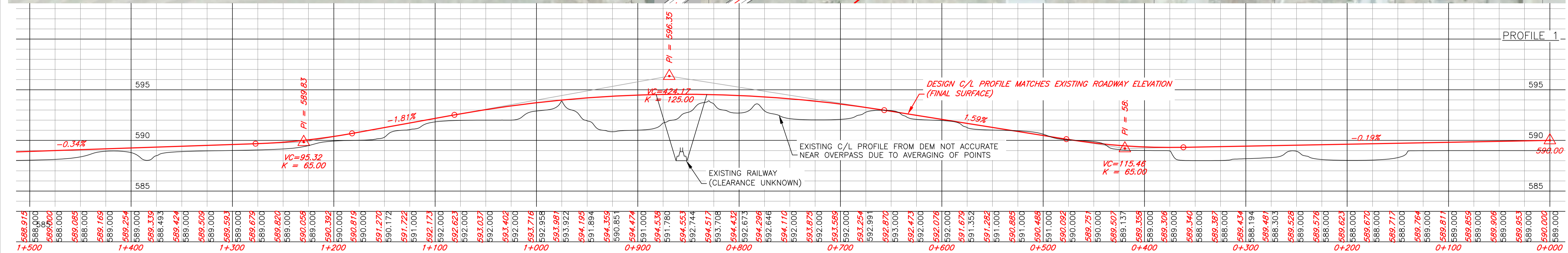
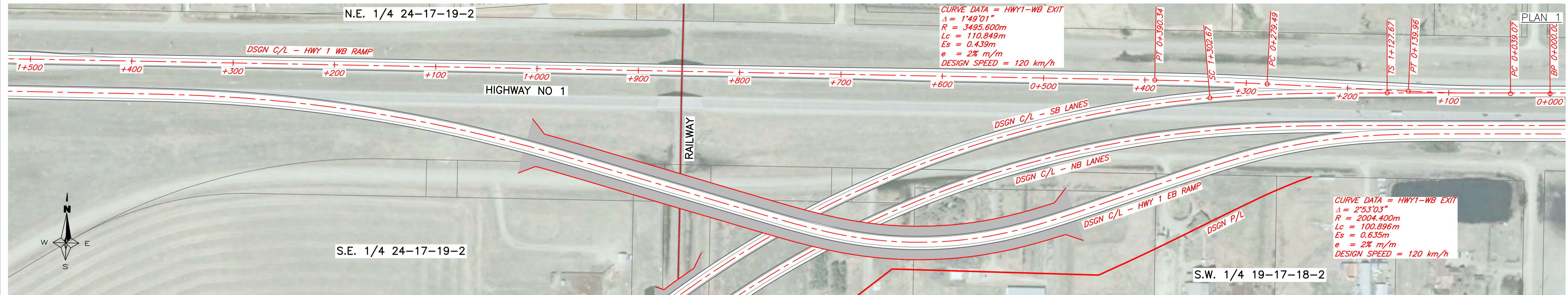
PLAN AND PROFILE
SOUTHEAST REGINA BYPASS
(FUNCTIONAL DESIGN)
HWY 1 - EB RAMP
FIGURE 17.7



ACAD DWG: 010003-H12142.DWG
 LAST REV DATE: 12/12/15

REVISIONS			CS	10-06	TAB NO	3D-1
NO	DATE	SIGNATURE	PHOTO DATE	2010	SHEET	8
			DRAWN BY	K. MORROW	DATE	13/10/18
			DESIGNED BY	A. POLLEY	DATE	13/10/18

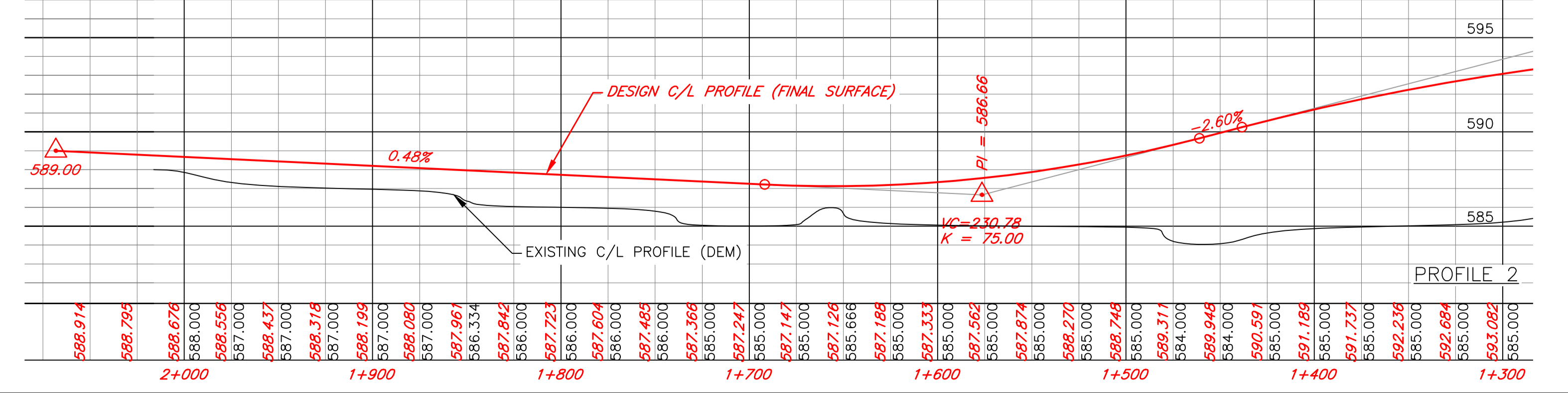
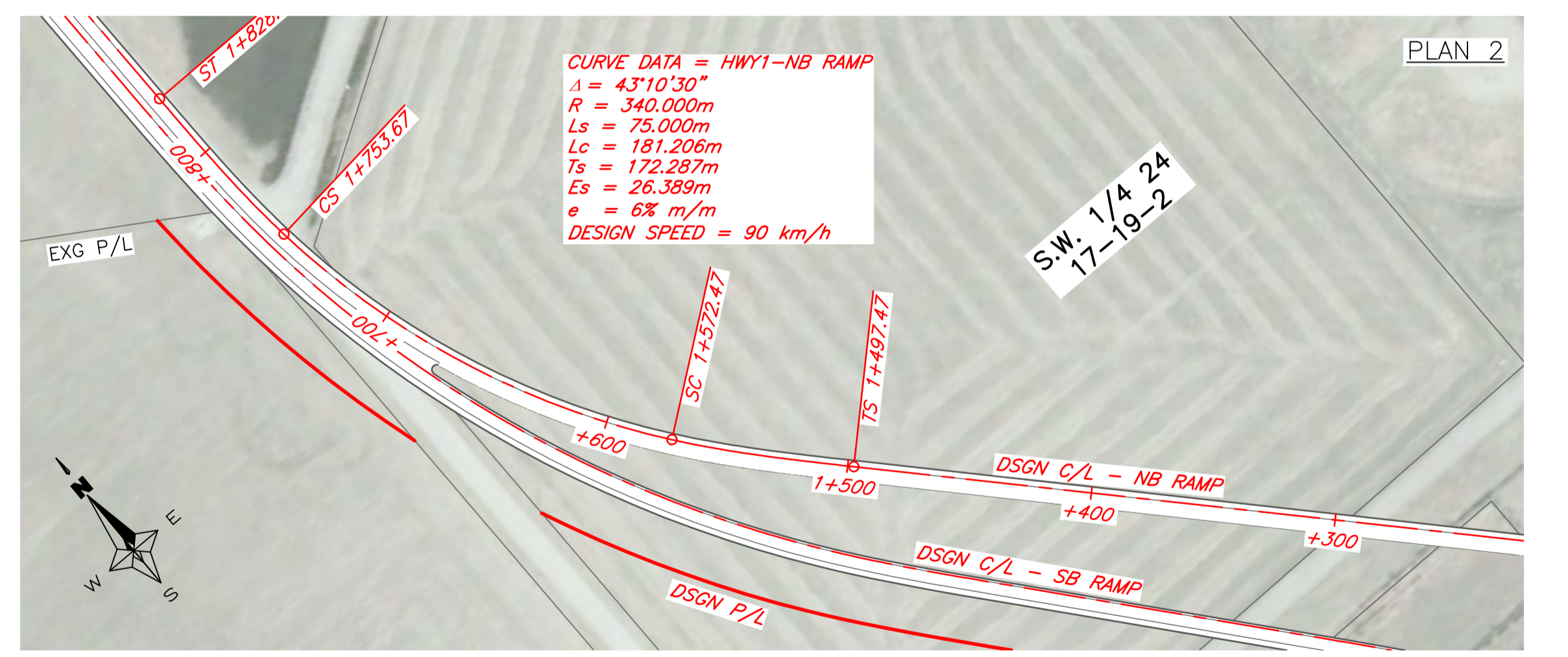
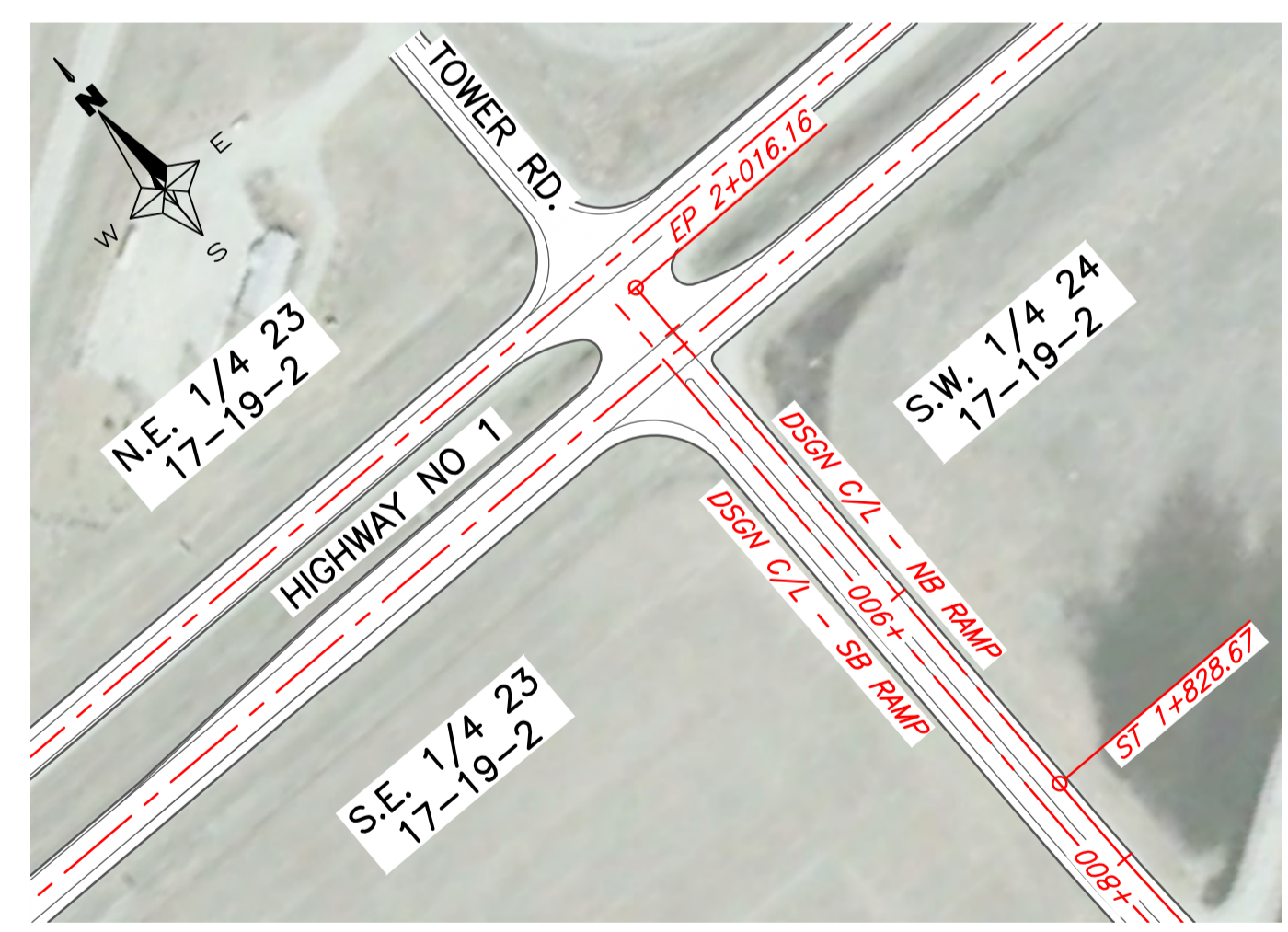
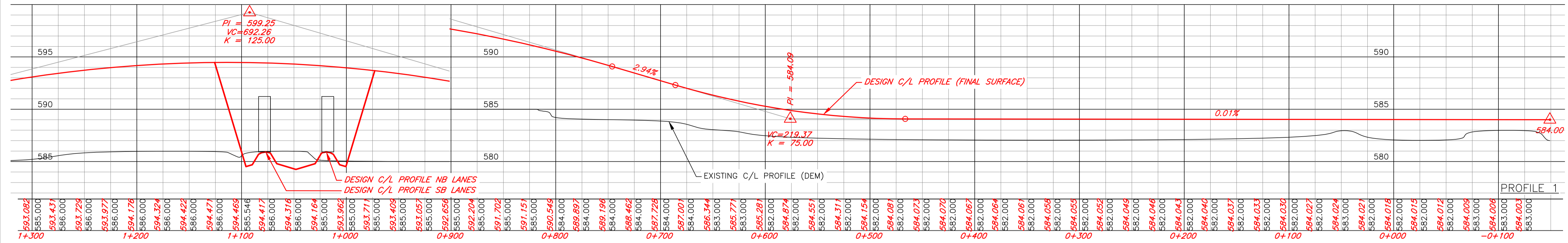
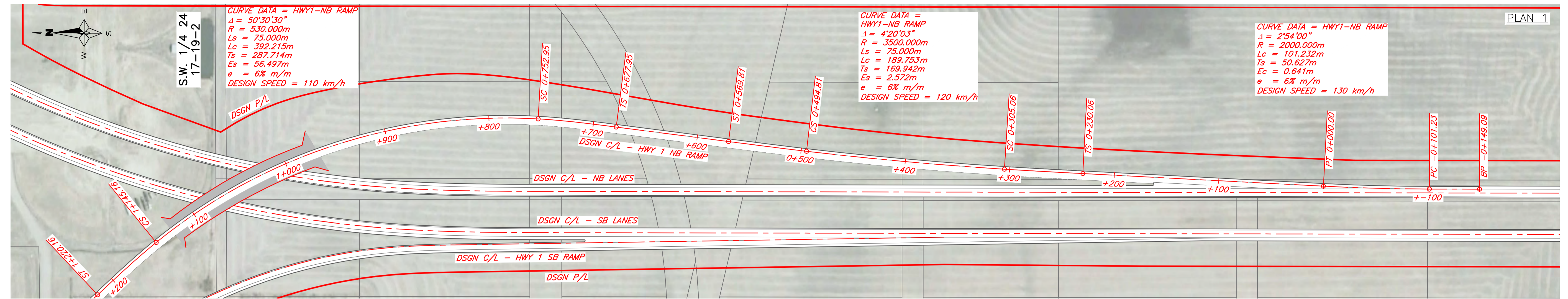
PLAN AND PROFILE
 SOUTHEAST REGINA BYPASS
 (FUNCTIONAL DESIGN)
 HWY 1 - WB EXIT RAMP
 FIGURE 17.8



REVISIONS			CS	N/A	TAB NO	3E-1
NO	DATE	SIGNATURE	PHOTO DATE	2010	SHEET	9
			DRAWN BY	K. MORROW	DATE	13/10/18
			DESIGNED BY	A. POLLEY	DATE	13/10/18

FULL SIZE SCALE (m)		
PLAN	1:2000	
PROFILE (H)	1:2000	
PROFILE (V)	1:200	

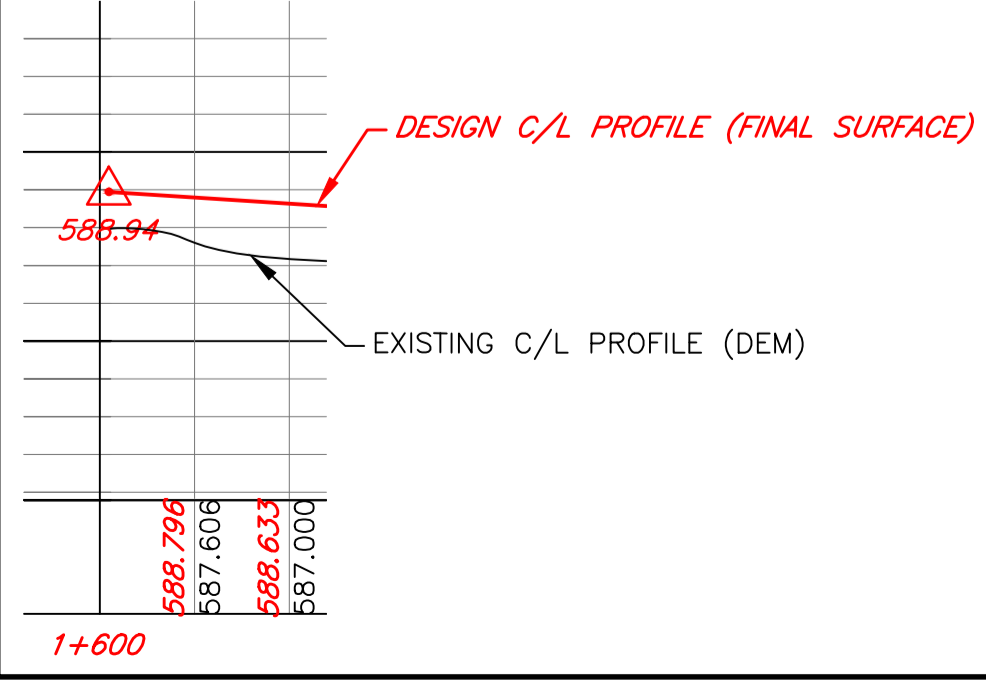
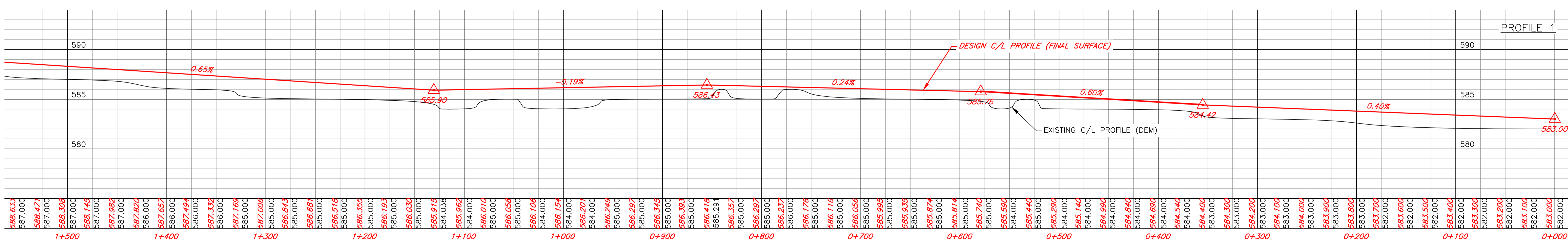
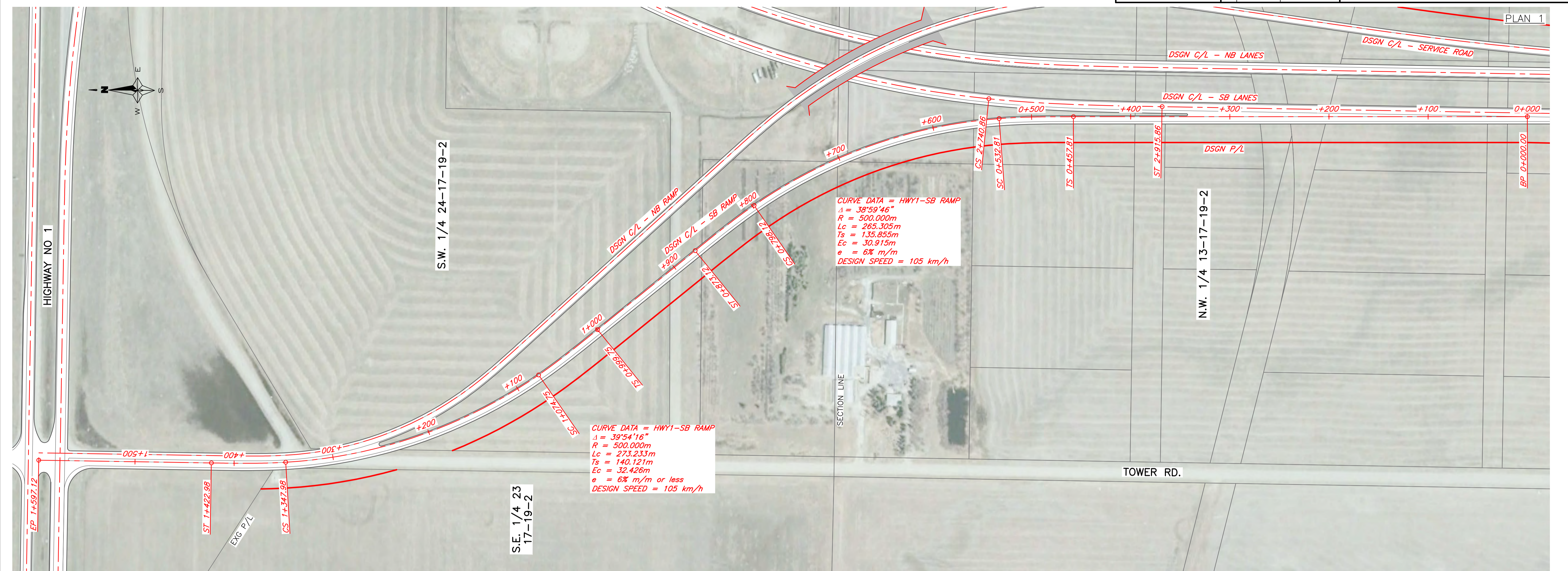
PLAN AND PROFILE
 SOUTHEAST REGINA BYPASS
 (FUNCTIONAL DESIGN)
 HWY 1 - NB RAMP
 FIGURE 17.9



REVISIONS			CS	N/A	TAB NO	3F-1
NO	DATE	SIGNATURE	PHOTO DATE	2010	SHEET	10
			DRAWN BY	K. MORROW	DATE	13/10/18
			DESIGNED BY	A. POLLEY	DATE	13/10/18

FULL SIZE SCALE (m)		
PLAN	1:2000	0 25 50
PROFILE (H)	1:2000	0 25 50
PROFILE (V)	1:200	0 1 2 3 4 5

PLAN AND PROFILE
SOUTHEAST REGINA BYPASS
(FUNCTIONAL DESIGN)
HWY 1 - SB RAMP
FIGURE 17.10

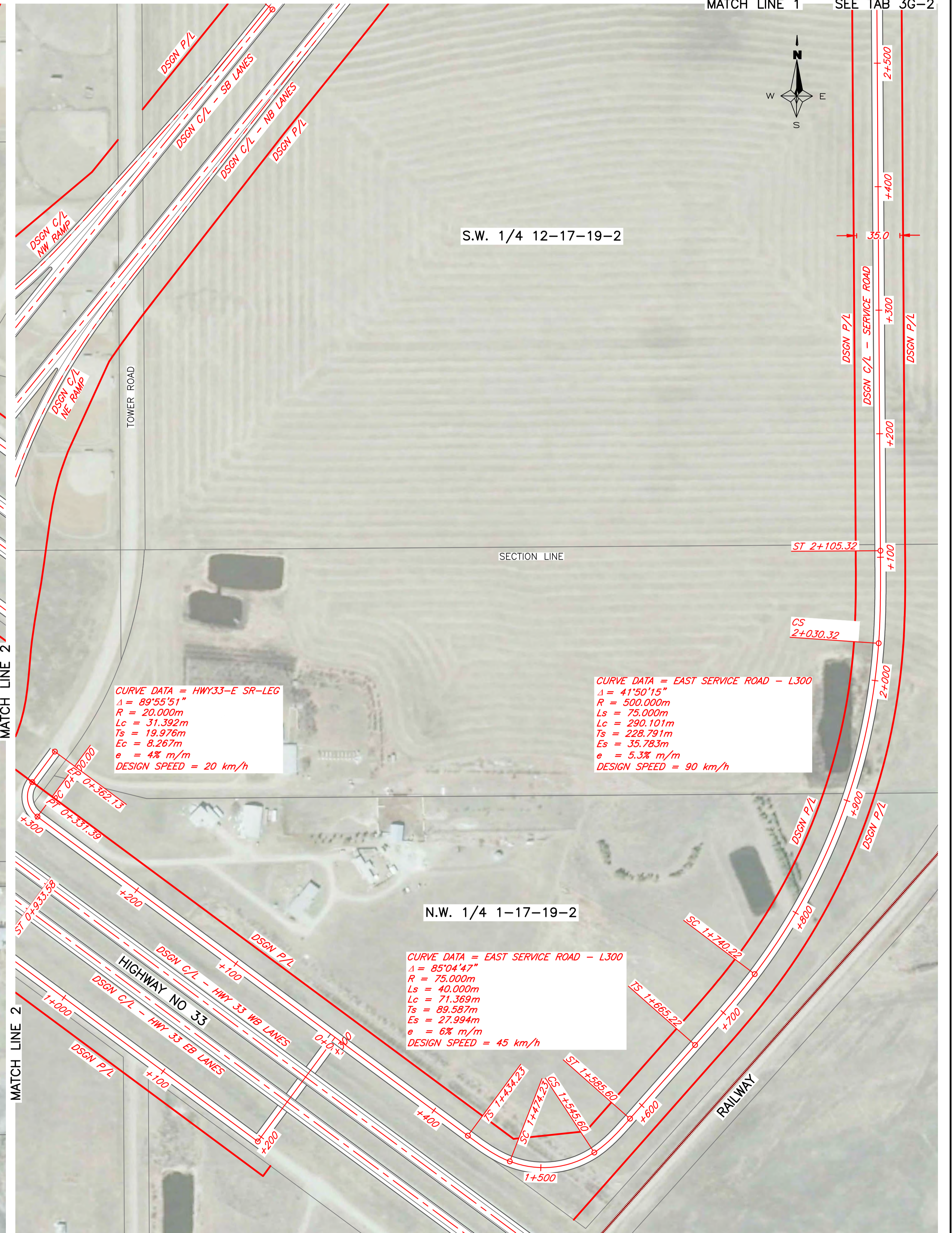
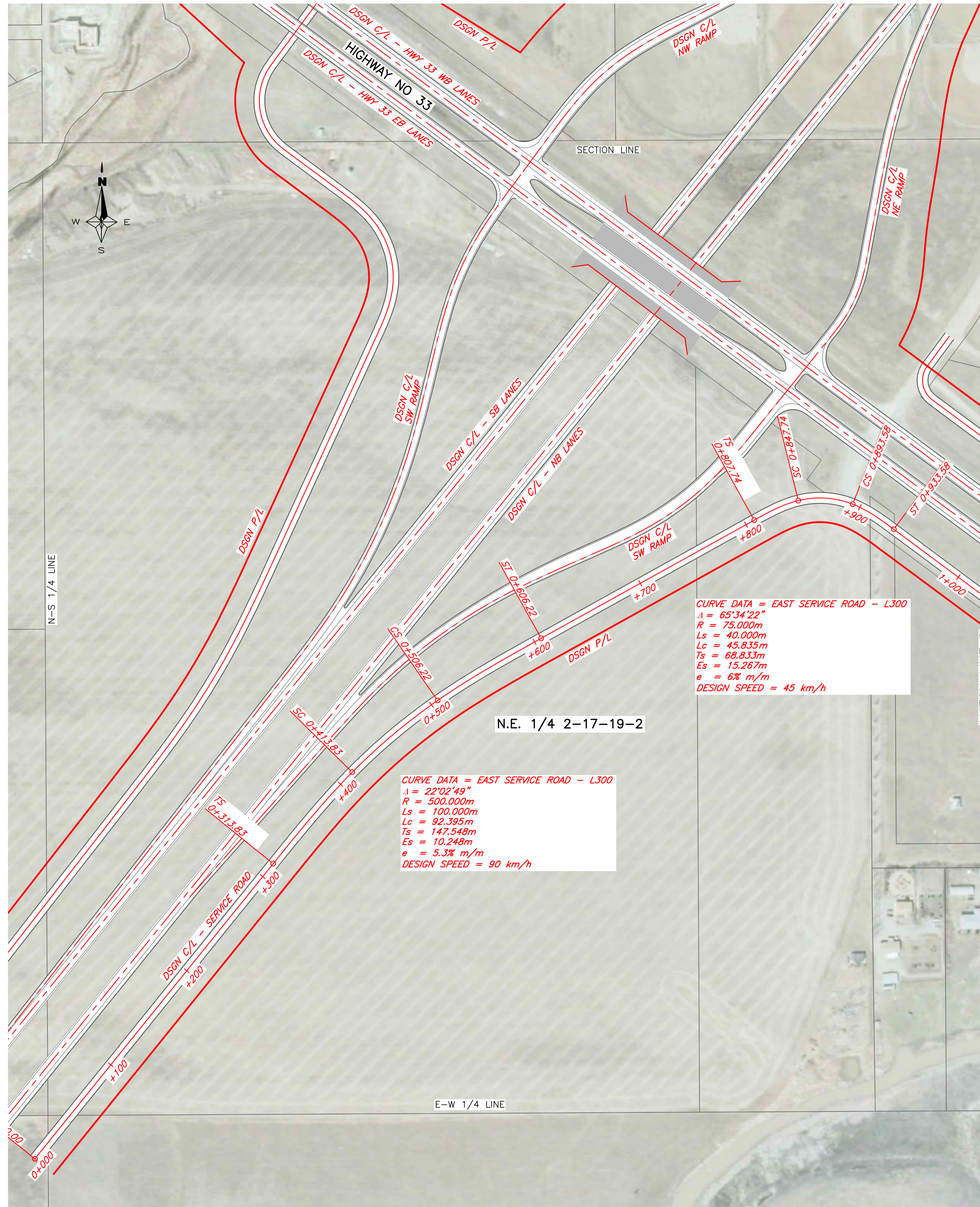


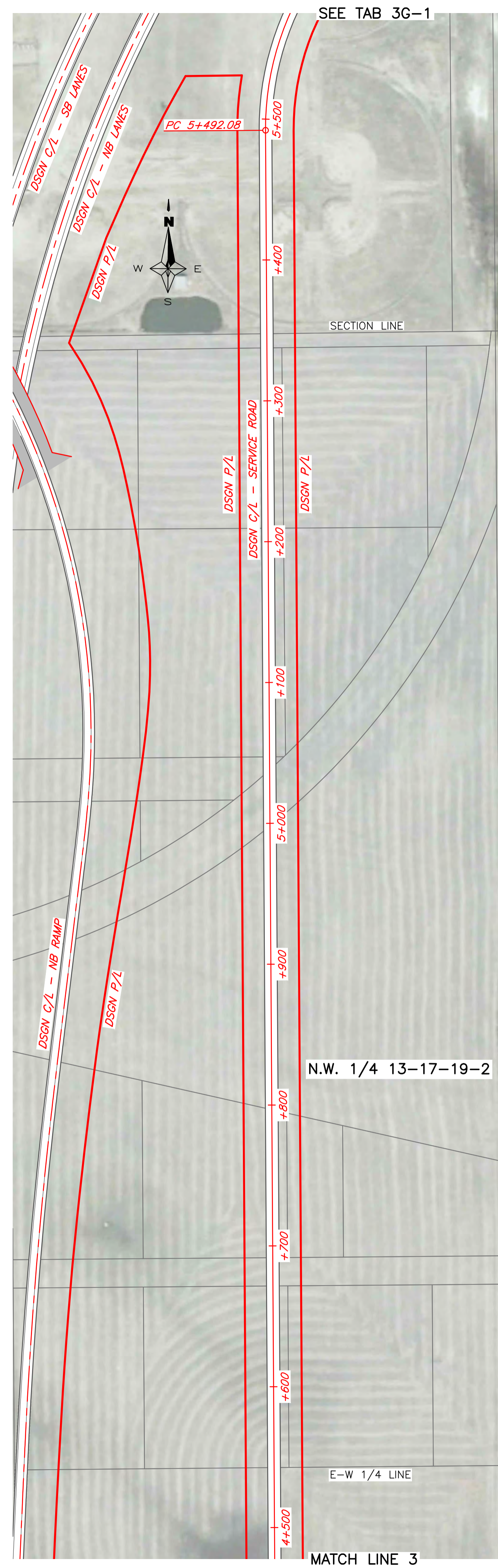
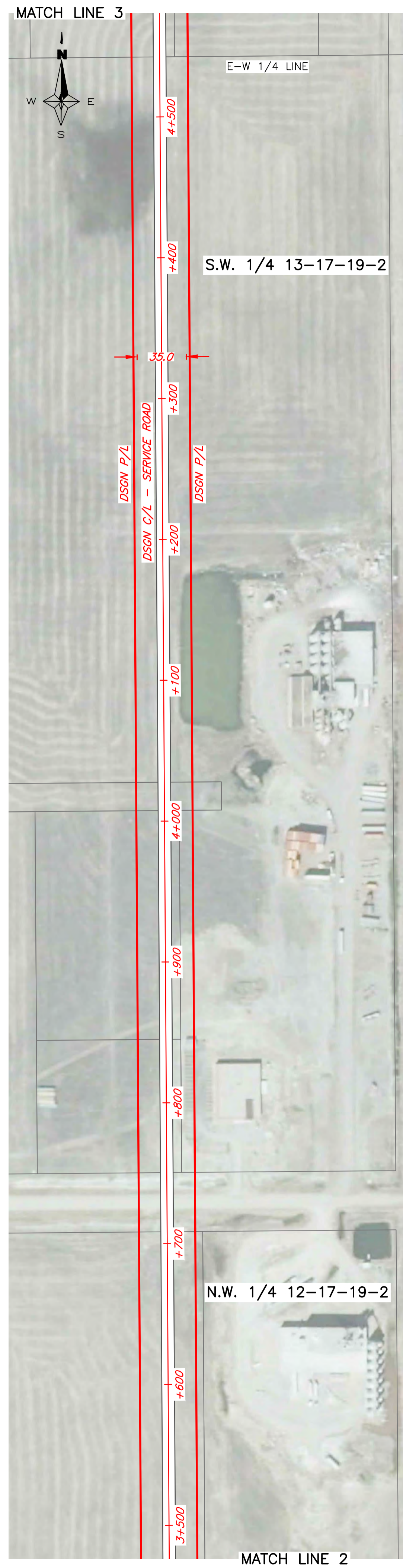
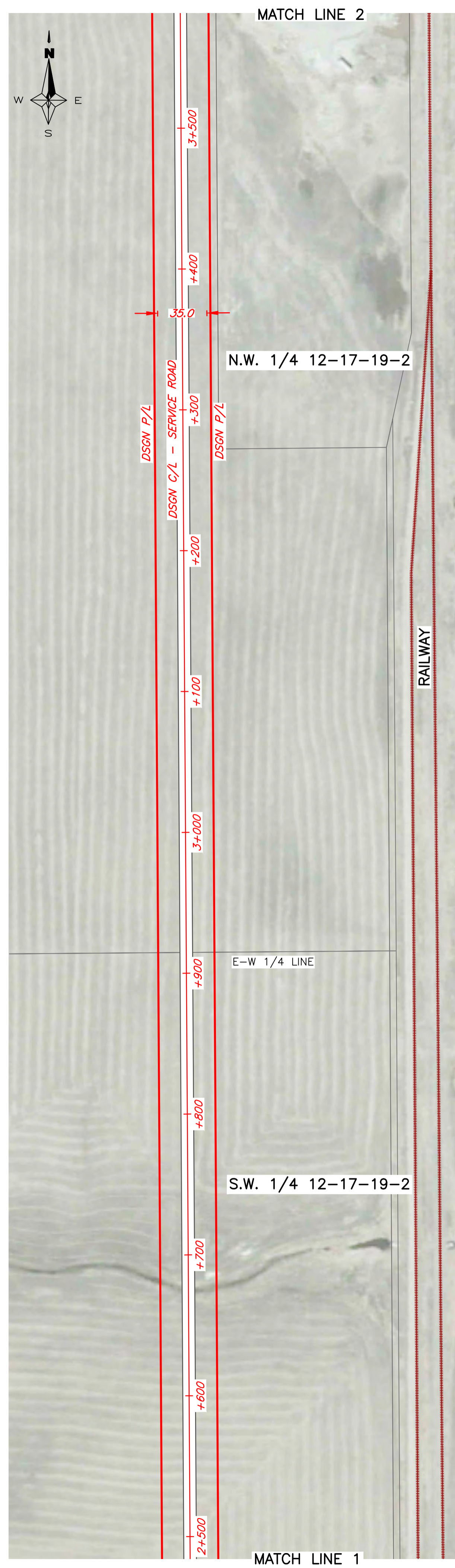
REVISIONS		
NO	DATE	SIGNATURE

CS	N/A	TAB NO	3G-1
PHOTO DATE	2010	SHEET	11
DRAWN BY	K. MORROW	DATE	13/10/18
DESIGNED BY	A. POLLEY	DATE	13/10/18

PLAN AND PROFILE
SOUTHEAST REGINA BYPASS
(FUNCTIONAL DESIGN)
EAST SERVICE ROAD
FIGURE 17.11

FULL SIZE SCALE (m)
 PLAN 1:2000
 PROFILE (H) 1:2000
 PROFILE (V) 1:200





REVISIONS			CS	N/A	TAB NO	3G-2
NO	DATE	SIGNATURE	PHOTO DATE	2010	SHEET	12
			DRAWN BY	K. MORROW	DATE	13/10/18
			DESIGNED BY	A. POLLEY	DATE	13/10/18

FULL SIZE SCALE (m)

PLAN 1:2000 0 25 50

PROFILE (H) 1:2000 0 25 50

PROFILE (V) 1:200 0 1 2 3 4 5

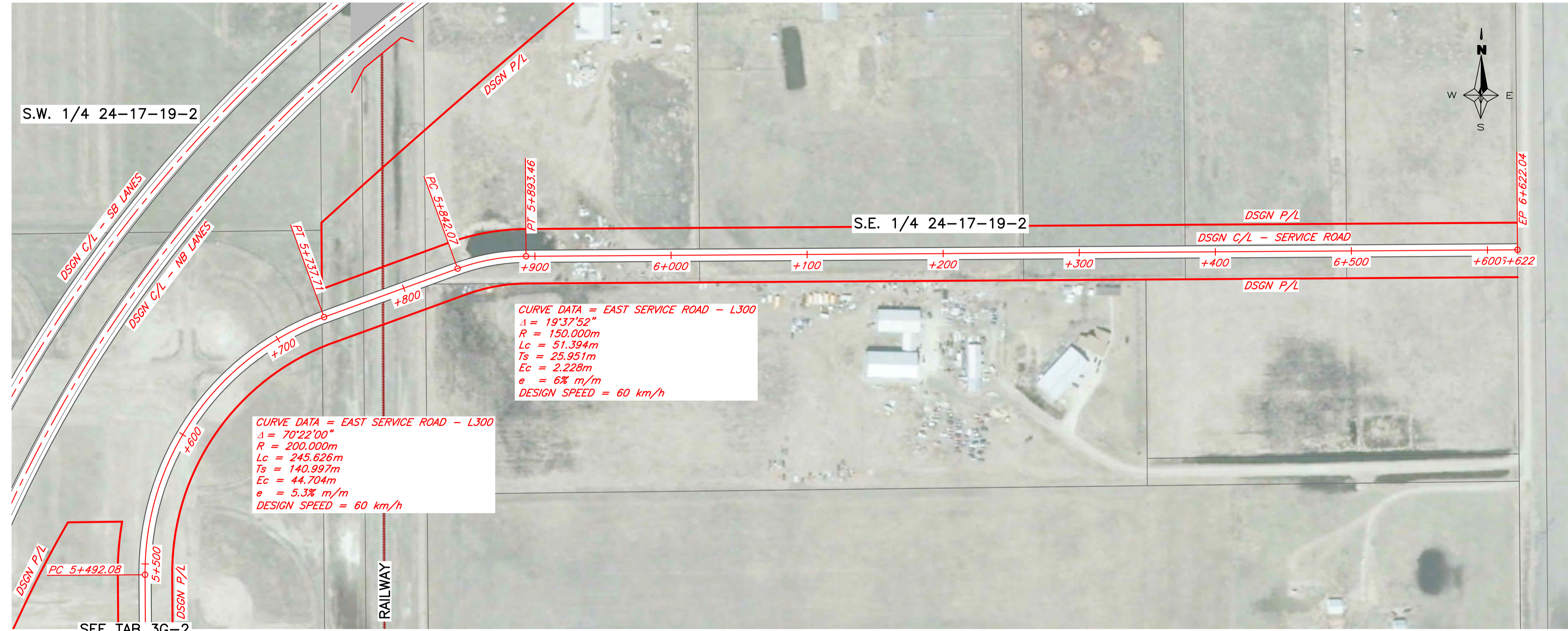
PLAN AND PROFILE
SOUTHEAST REGINA BYPASS
(FUNCTIONAL DESIGN)
EAST SERVICE ROAD
FIGURE 17.12

REVISIONS		
NO	DATE	SIGNATURE

CS	N/A	TAB NO	3G-3
PHOTO DATE	2010	SHEET	13
DRAWN BY	K. MORROW	DATE	13/10/18
DESIGNED BY	A. POLLEY	DATE	13/10/18

FULL SIZE SCALE (m)
 PLAN 1:2000 0 25 50
 PROFILE (H) 1:2000 0 25 50
 PROFILE (V) 1:200 0 1 2 3 4 5

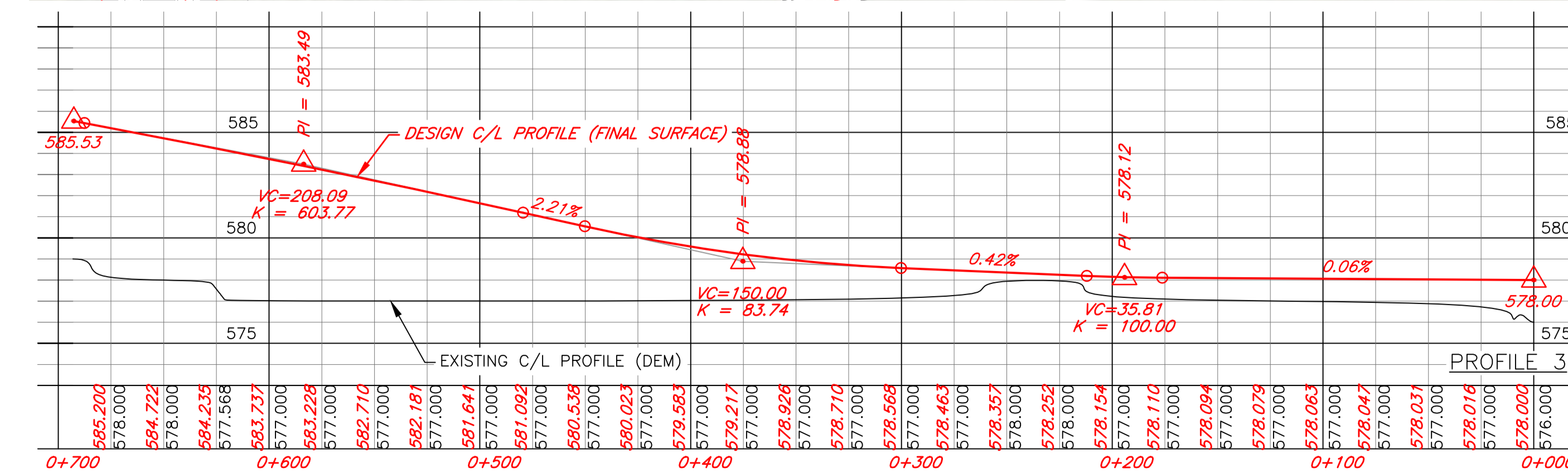
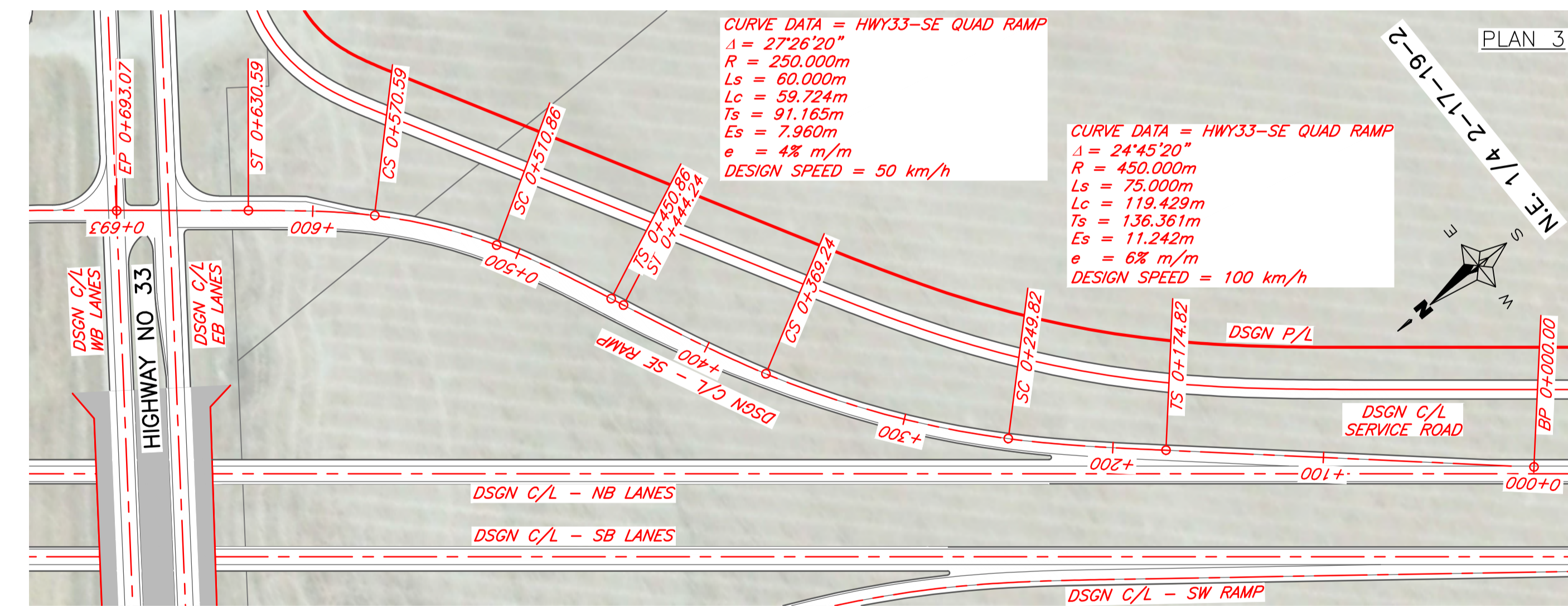
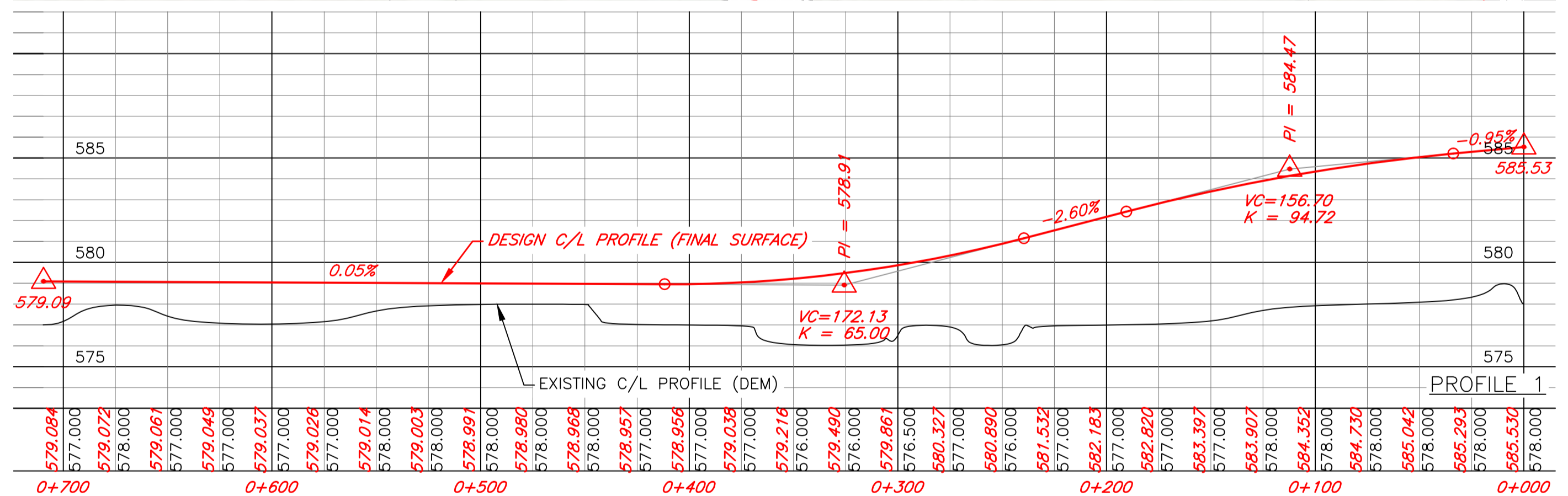
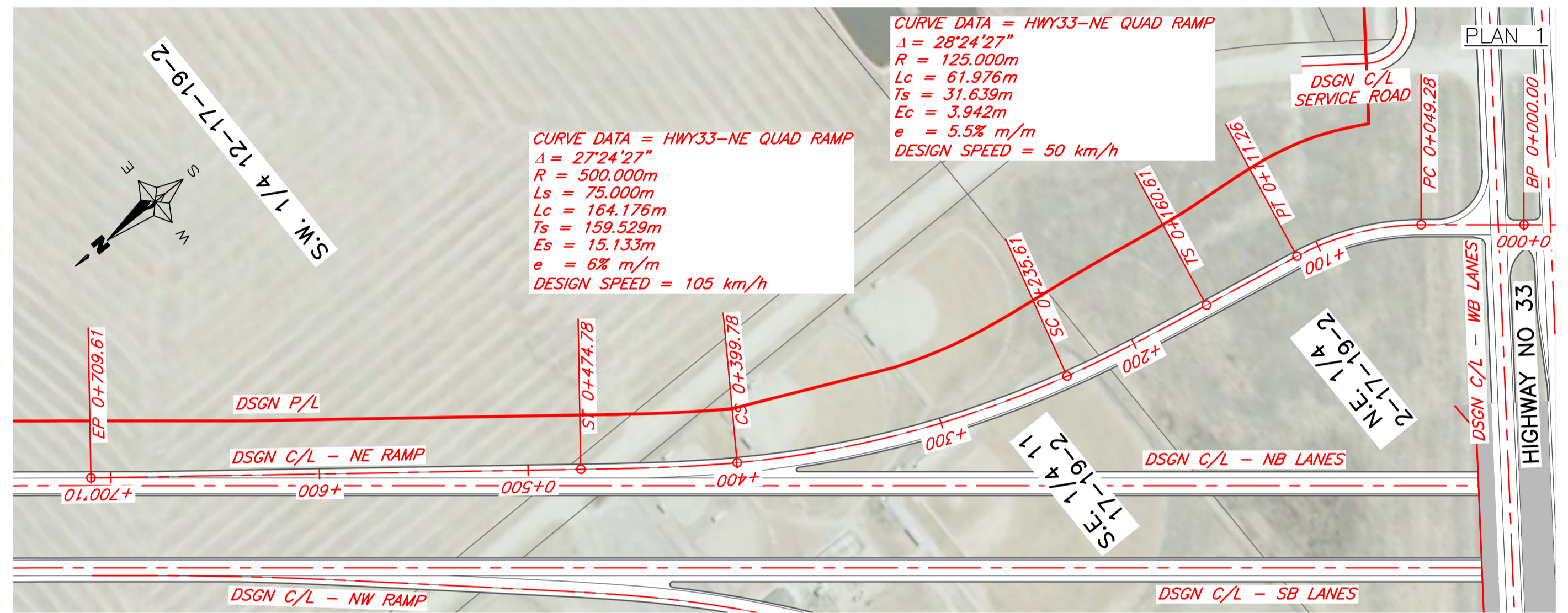
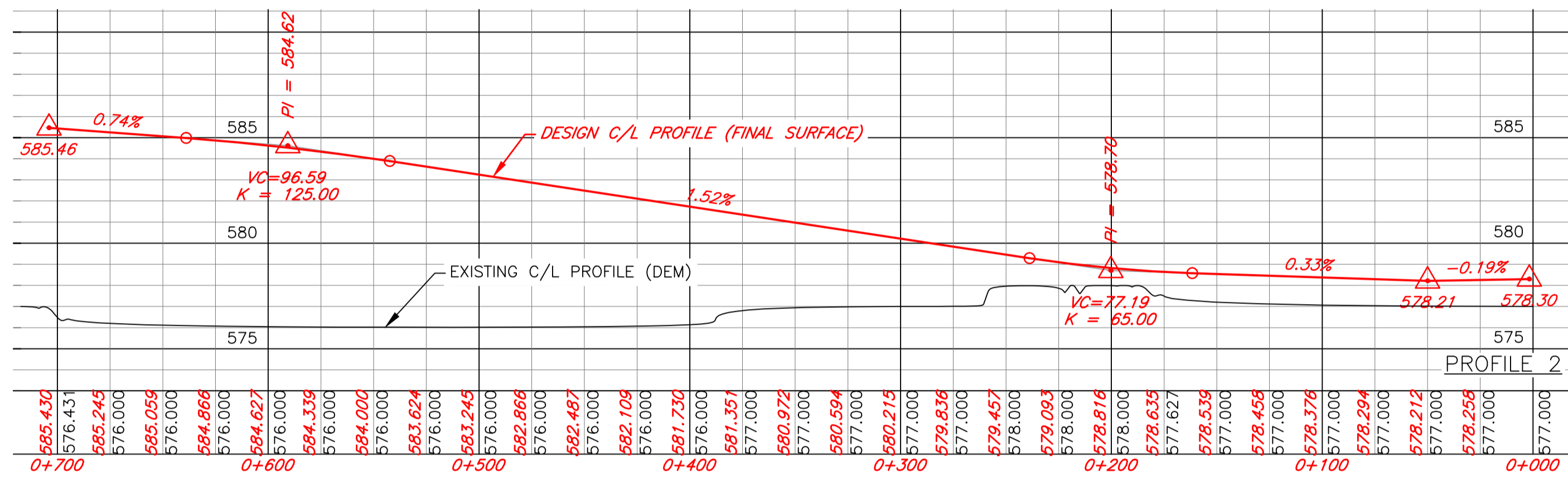
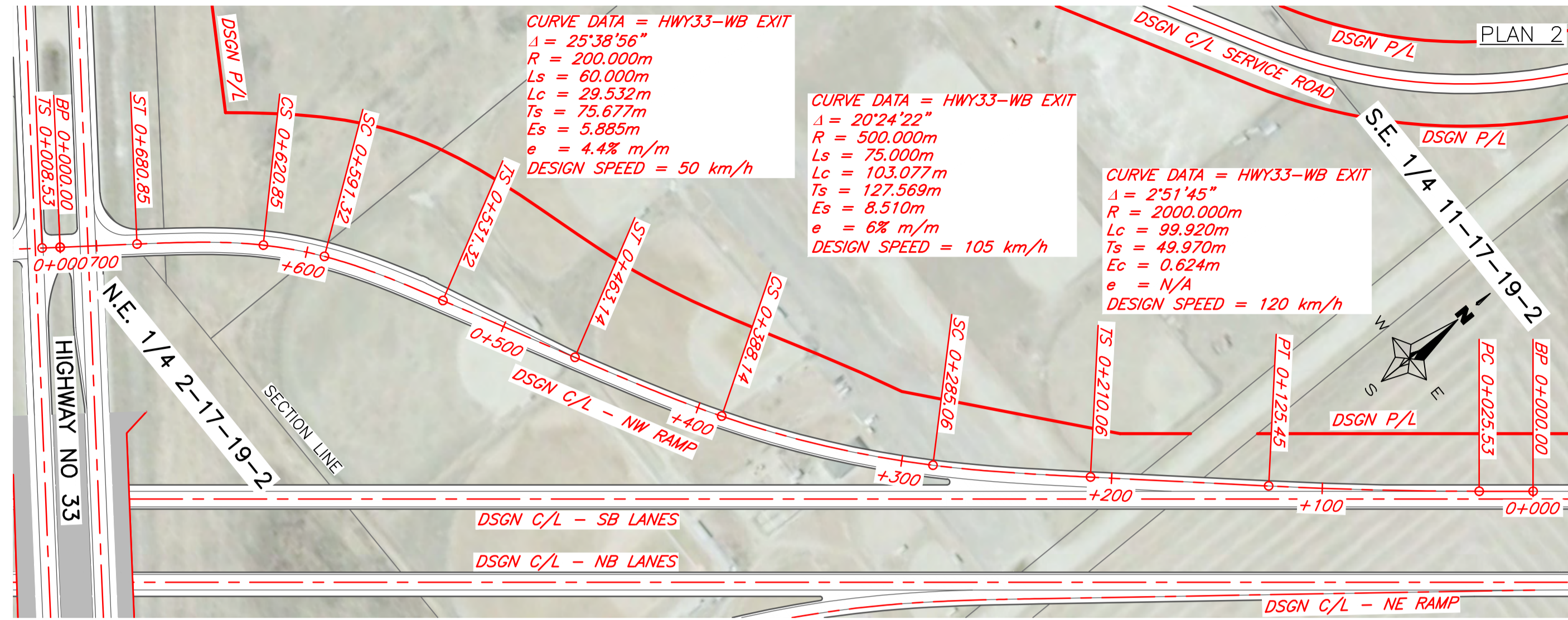
PLAN AND PROFILE
 SOUTHEAST REGINA BYPASS
 (FUNCTIONAL DESIGN)
 EAST SERVICE ROAD
 FIGURE 17.13



REVISIONS			CS	N/A	TAB NO	3H-1
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			DESIGNED BY	A. POLLEY	DATE	13/10/18

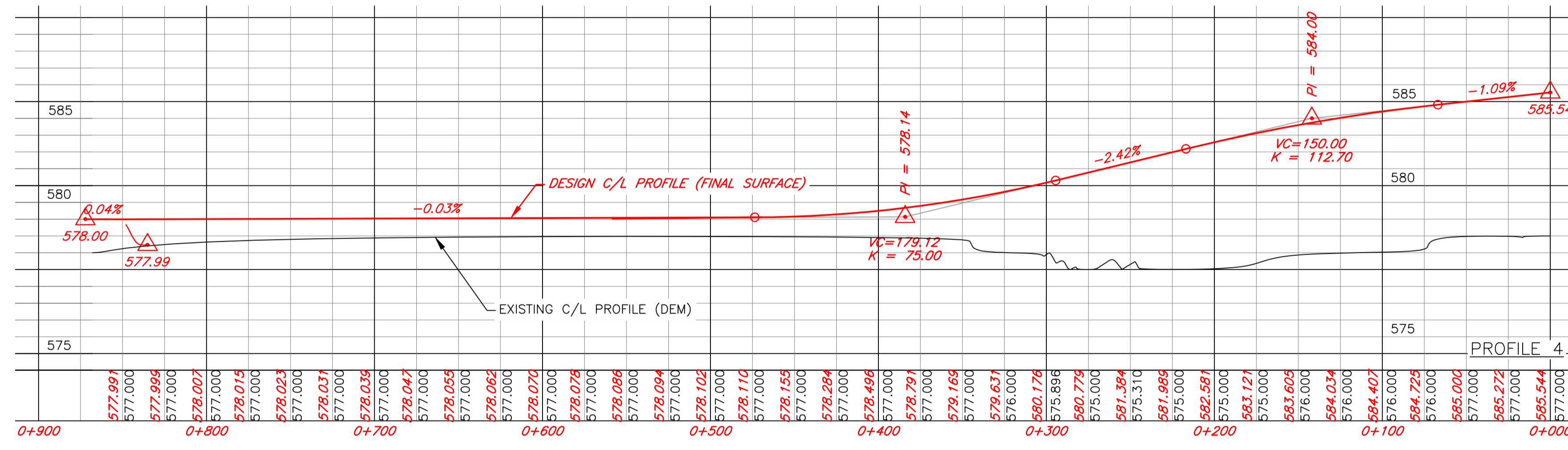
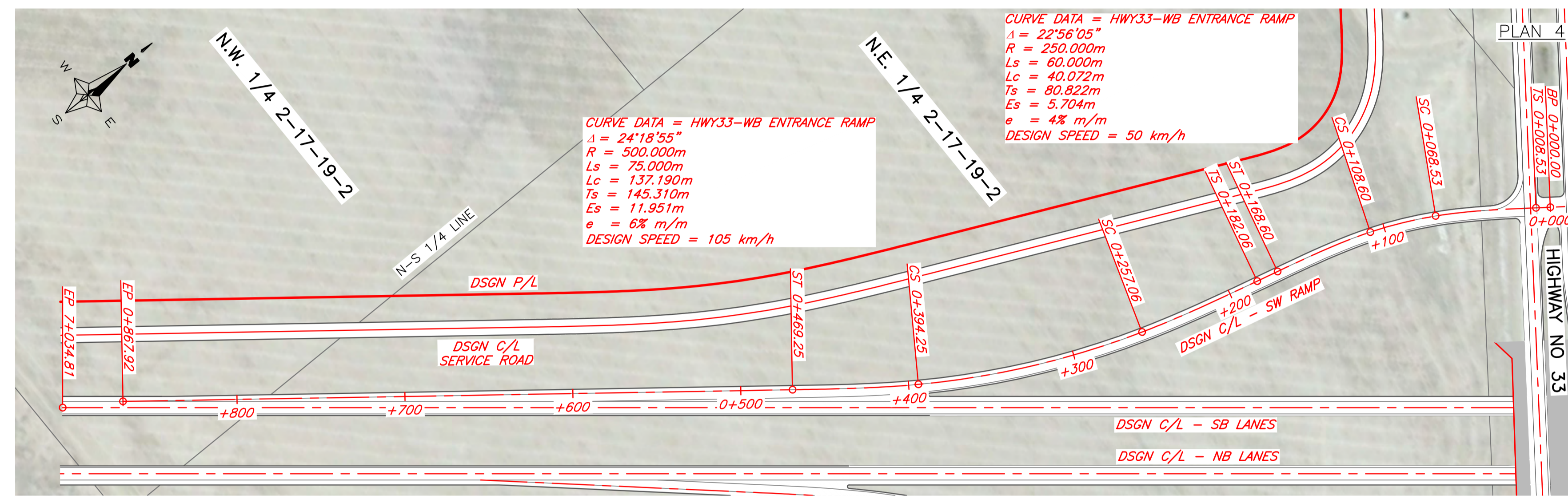
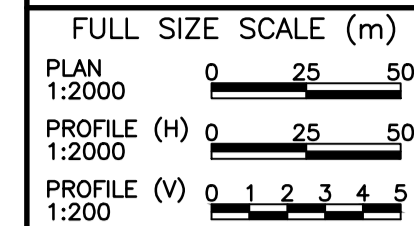
FULL SIZE SCALE (m)						
PLAN 1:2000	0	25	50			
PROFILE (H) 1:2000	0	25	50			
PROFILE (V) 1:2000	0	1	2	3	4	5

**PLAN AND PROFILE
SOUTHEAST REGINA BYPASS
(FUNCTIONAL DESIGN)
HWY 1 & HWY 33 - RAMPS
FIGURE 17.14**



REVISIONS			CS	N/A	TAB NO	3H-2
NO	DATE	SIGNATURE	PHOTO DATE	2010	SHEET	15
			DRAWN BY	K. MORROW	DATE	13/10/18
			DESIGNED BY	A. POLLEY	DATE	13/10/18

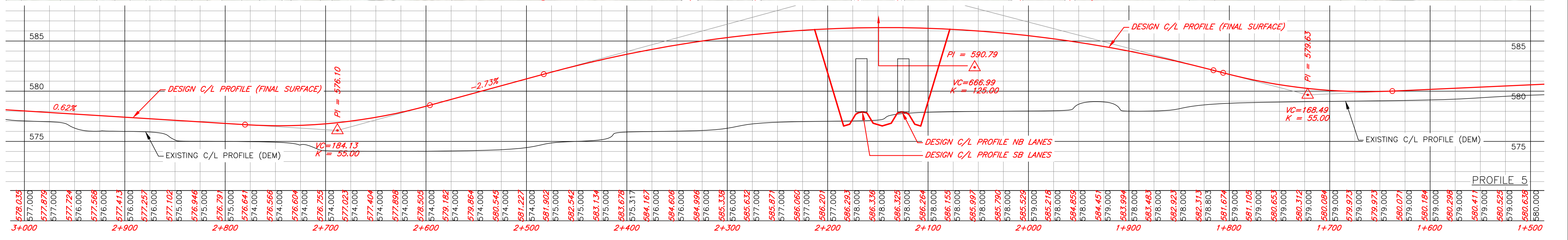
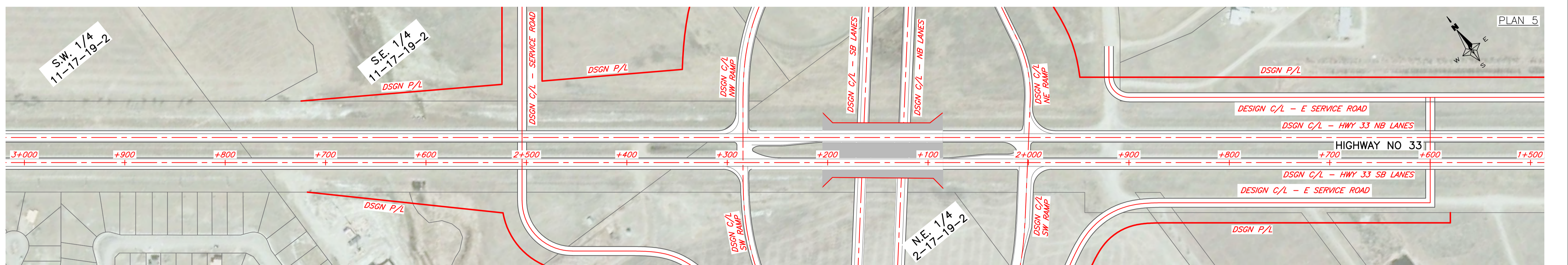
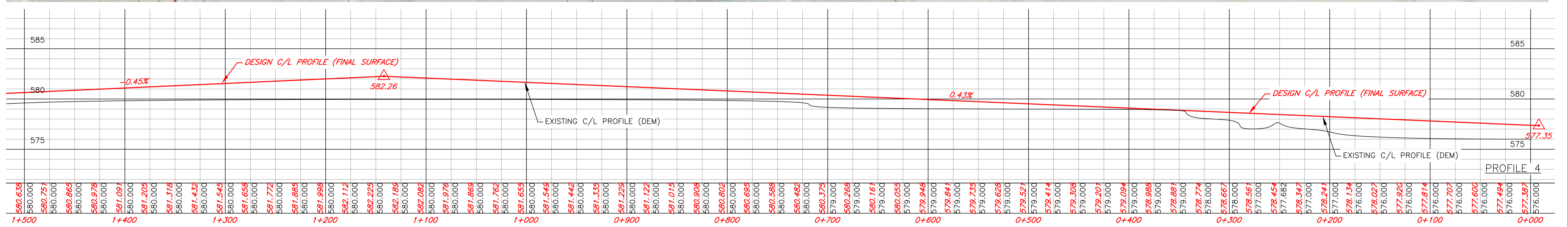
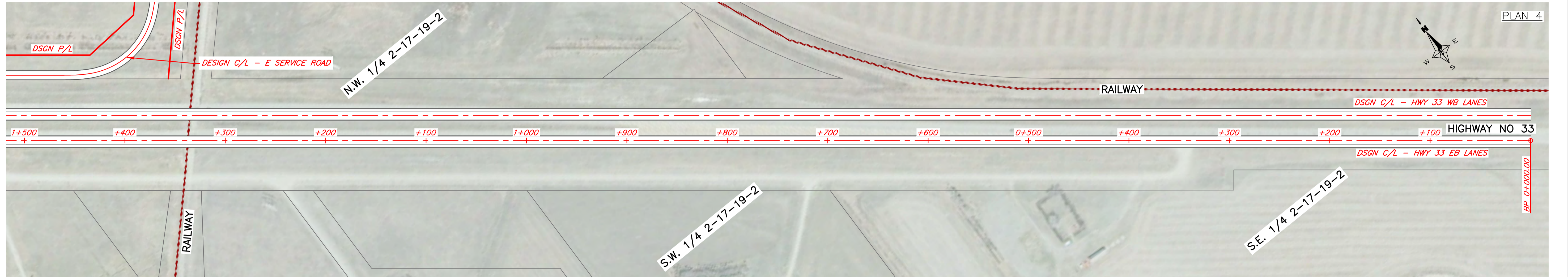
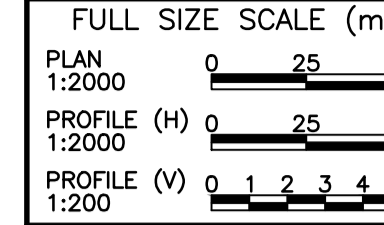
PLAN AND PROFILE
SOUTHEAST REGINA BYPASS
(FUNCTIONAL DESIGN)
HWY 1 & HWY 33 - RAMPS
FIGURE 17.15



REVISIONS		
NO	DATE	SIGNATURE

CS	N/A	TAB NO	31-1
PHOTO DATE	2010	SHEET	16
DRAWN BY	K. MORROW	DATE	13/10/18
DESIGNED BY	A. POLLEY	DATE	13/10/18

PLAN AND PROFILE
SOUTHEAST REGINA BYPASS
(FUNCTIONAL DESIGN)
HWY 33 - EB & WB LANES
FIGURE 17.16

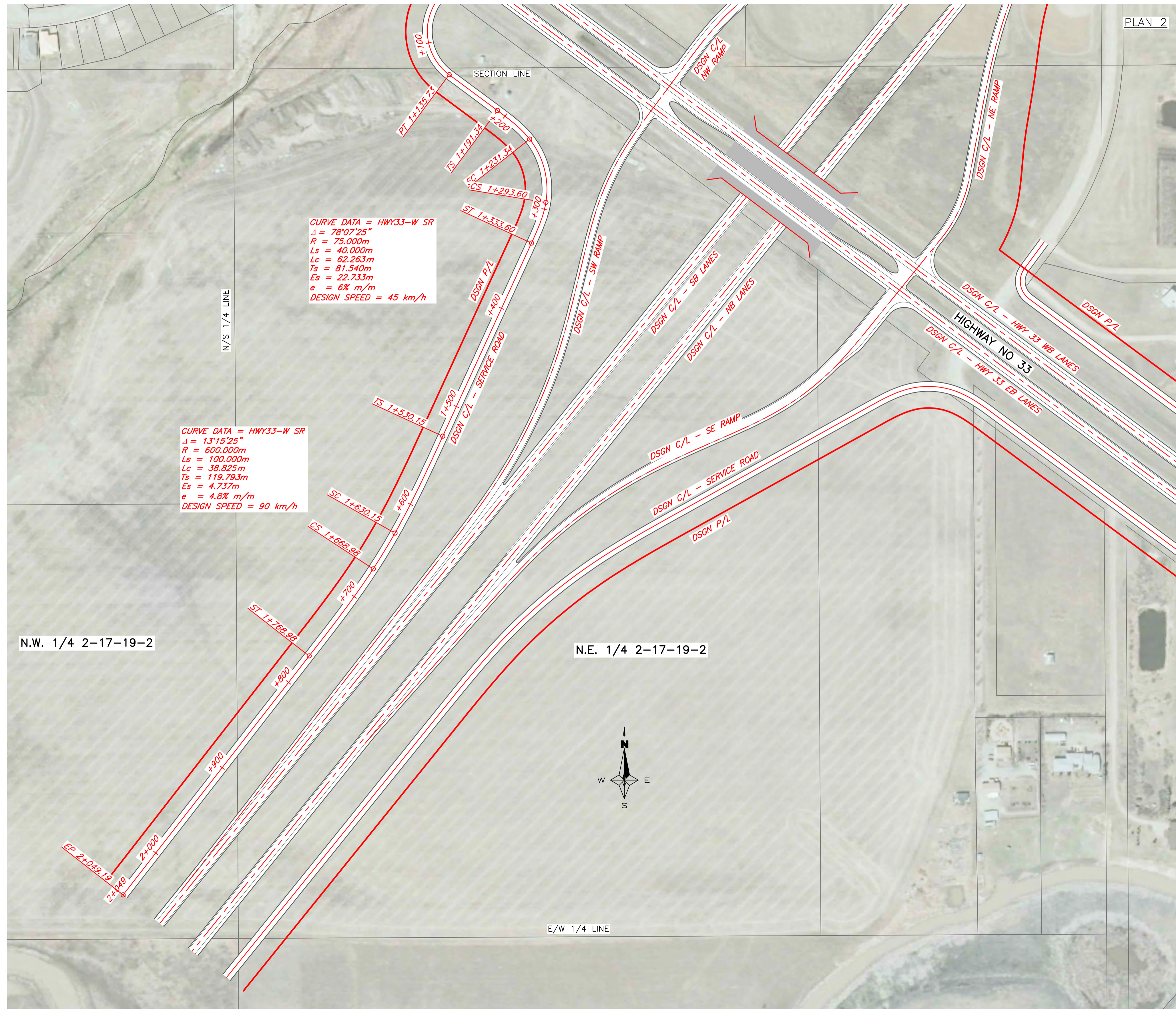


REVISIONS		
NO	DATE	SIGNATURE

CS	N/A	TAB NO	3J-2
PHOTO DATE	2010	SHEET	19
DRAWN BY	K. MORROW	DATE	13/10/18
DESIGNED BY	A. POLLEY	DATE	13/10/18

FULL SIZE SCALE (m)
 PLAN 1:2000 0 25 50
 PROFILE (H) 1:2000 0 25 50
 PROFILE (V) 1:200 0 1 2 3 4 5

PLAN AND PROFILE
 SOUTHEAST REGINA BYPASS
 (FUNCTIONAL DESIGN)
 HWY 33 - W SERVICE ROAD
 FIGURE 17.19



6.4.2 Highway 1 East Interchange

The design of the interchange ramps providing access to and from the bypass were important in establishing the recommended configurations shown in the design figures. They are as follows:

6.4.2.1 Westbound Exit Ramp

This exit ramp accommodates westbound traffic wishing the exit the highway and proceeds west on Victoria Avenue, or north onto Tower Road. As this route is currently the highway connection, there are two bridges over the rail crossing which the Ministry expressed interest in retaining where possible. The proposed design utilizes the northernmost bridge as the westbound exit ramp, which reduces infrastructure needs and will assist in minimizing disruption during construction.

Due to the large volume of traffic that require this movement, a two lane exit is proposed for this location.

6.4.2.2 Eastbound Entrance Ramp

This entrance ramp also carries a significant amount of traffic heading eastbound out of Regina. In order to reduce delays, a freeflow alignment was preferred for this movement. A two lane ramp is proposed for this movement as well. The resulting alignment is fairly linear in the horizontal alignment, with curves required to cross and merge with the proposed bypass lanes. Vertically, this ramp is required to pass over the bypass lanes east of the railway, where the main lanes are already elevating to cross the railway. The end result is a vertical clearance that essentially is two levels high. The DEM is not accurate enough to establish the height of rail to a high degree, particularly near structures, but survey data should allow for a reduction in the required fill or structure lengths by optimizing the design profile further.

The constructability of this ramp is contingent on the foundation design to support the required structure, and alternative methods of construction may be suitable for this location. Locally most interchanges have been constructed from earth fill, however this may be a candidate for the implementation of lightweight EPS fill, and may require the construction of retaining walls where adjacent development or gradelines dictate their need and economic feasibility.

6.4.2.3 Eastbound Exit Ramp

This could also be referred to as the northbound exit ramp at this interchange, this ramp accommodates traffic travelling north on the bypass which wishes to exit and proceed to the intersection of Tower Road and Victoria Avenue East. This ramp was designed with the intent to provide a reasonable freeflow movement to the north, in the event that the north leg of the intersection could become the northeast bypass or a roadway of higher priority, and also the design of the ramp should reduce the impacted footprint east of the main lanes as much as possible.

Horizontally, this ramp maintains a design speed of 110 km/h on the curve which includes the overpass structure bridging the main bypass lanes, before reducing the design speed to 90 km/h as you approach the intersection of Victoria Avenue East and Tower Road. A single lane is proposed, however the design of the overpass structure may want to consider accommodating a future lane as the volumes increase due to development.

6.4.2.4 Westbound Entrance Ramp

This ramp accommodates traffic traveling southbound from the intersection of Victoria Avenue East and Tower Road wishing to travel westbound on the bypass lanes. Horizontally this alignment provides a design speed of 110 to 120 km/h before merging with the bypass lanes. Vertically this is a level ramp with no structures required.

6.4.2.5 Victoria Avenue East and Tower Road Intersection

The necessary geometric improvements to the intersection of Victoria Avenue East and Tower Road are significantly affected by development and future road network in the area, and require further study. The location of the Northeast Bypass, adjacent development plans for the area, and future City and RM road network needs will require further review to develop a plan to address these needs once established.

6.4.3 Highway 33 Interchange

At this location, it is recommended that Highway 33 be designed to go over the bypass, as the bypass would be considered a higher priority road than Highway 33, and there is some benefit in reducing the noise and visibility of bypass traffic in the interchange area.

As development occurs and extends further east along Arcola Avenue and Highway 33, it is reasonable to assume that the design speed could be reduced accordingly. Currently, this section of roadway is posted at 100 km/h, and reduced to 80 km/h near the intersection at The Creeks development. Therefore the vertical profile of the overpass could be reduced to 100 km/h in order to reduce the footprint of the interchange and the amount of embankment and property required.

Interchange ramps at this location are relatively unconstrained and design follows Ministry standards. It is anticipated that these ramps would require signalization. A tight diamond is proposed at this location, for the following reasons:

- ▶ It allows for increased separation between the ramp terminals and proposed service road connections east and west of the interchange.
- ▶ The current alignment provides increased separation from the interchange ramps and Chuka Creek and the residential development to the west, and the existing acreage owners to the east.
- ▶ Depending on the forecasted development, the traffic volumes in the 2040 projection can still be accommodated by a double left turn, with the overall intersection operating at a Level of Service C. This would be similar to the volumes currently experienced at the Ring Road and Victoria Avenue east interchange off-ramp for the southbound to eastbound movement. Yet, there would be significantly less cross-traffic on Highway 33 than is present on Victoria Avenue.

6.4.4 Service Roads

With the proposed alignment being east of Tower Road, existing Tower Road could serve as the west service road with a short realignment at the south end to tie into Highway 33. This would be dependent on development plans for this area, but could also tie across Highway 33 to provide access to the parcels in the southwest quadrant of the interchange as well.

A new service road would be required for the entire length of the alignment to the east. This would provide landowners access to Highway 33 at the south, and would connect east to Gravel Pit Road and potentially Pilot Butte Access and the proposed interchange at that location. The alignment near existing Highway 1 would be to be relocated behind the acreage parcels fronting the existing highways. At the south terminal, the crossing location needed to provide separation from the nearest ramp intersection, as well as additional separation from the railway crossing to the east, which is currently not in use. Should this crossing be officially abandoned, a crossing further east may be feasible but would be dependent on this action.

6.5 Geotechnical Considerations

This section presents the results of a desktop review conducted by Klimochko Consulting Inc. of soil and groundwater conditions along the proposed Southeast Regina Bypass. This portion of the bypass extends from the junction of Highway No. 1 and Tower Road to a junction with Highway No. 33 located just east of where Chuka Creek crosses the highway. This portion of the proposed bypass corridor is approximately 4 kilometres long.

6.5.1 Surficial Soil

The surficial soil along the proposed bypass location is comprised of uniform, very fine-textured, cohesive, heavy clay, known locally as Regina Clay. Regina Clay has a very high plasticity index value (i.e. liquid limit – plastic limit difference) in the order of 30 – 50 percent. Unlike non-cohesive soils such as sand and gravel, cohesive soils such as Regina Clay are known to exhibit significant volume change properties (i.e. swelling upon wetting, shrinkage upon drying).

Roads constructed with Regina Clay generally exhibit more deterioration of geometric cross-slope and have higher frequency and increased severity of pavement cracking than those constructed of glacial till. One method used to reduce this material's swell/shrinkage potential consists of thoroughly incorporating a minimum of 2 percent quicklime to weight of soil in the top 600 mm of a road subgrade.

In addition, Regina Clay is often associated with slope stability problems when used in the construction of highway embankments (i.e. Belle Plaine Overpass on Hwy. No. 1). The minimum side-slope of an embankment that exceeds 3 m in height and is constructed exclusively of Regina Clay should be 6:1 and possibly more depending on height of grade. One method to increase the long-term slope stability factor

of safety of an embankment is to incorporate a layer of sand of sufficient thickness uniformly spaced throughout the embankment (e.g. 200-mm thick layer of free-draining sand every 2 m of embankment). It should be noted that the base of the clay embankment may require a thicker sand layer to accommodate an engineered drainage system required to facilitate quicker pore pressure dissipation during construction and increase overall long-term slope stability.

6.5.2 Stratigraphy

Information about soil stratigraphy near the proposed bypass was based on borehole data collected by GE Ground Engineering Ltd. (2007), Saskatchewan Ministry of Highways and Infrastructure (1973) and Saskatchewan Water Security Agency. All of these sources exhibited similar stratigraphy results with variations in the thickness and exact composition of each layer. The observed stratigraphy beginning from the surficial layer and moving downward is as follows:

- 1.** Clay
- 2.** Silt
- 3.** Till
- 4.** Sand/Gravel
- 5.** Till

For more detailed information regarding soil stratigraphy near the proposed bypass route, refer to Appendix D.

6.5.3 Static and Artesian Groundwater Conditions

GE Ground Engineering Ltd. 2007 Stratigraphic Test Hole Nos. 0552-102 & 103

Test hole 102, near the north terminal of the proposed bypass had a measured water level 2.7 m below the ground surface. Seepage and sloughing was observed between the depths of 9 and 13 m and the test hole sloughed in at 11.9 m below ground surface.

Test hole 103, located near the junction of the proposed bypass and Highway No. 33 was noted as having a sand unit at 10.5 m below ground surface that is under artesian pressure. When the test hole was drilled, this pressure caused the water level in the test hole to rise to existing grade.

Saskatchewan Ministry of Highways and Infrastructure Borehole Report – Test Hole CS 1-08 1-73

At this test hole located east of the proposed bypass, four piezometers were installed. Groundwater conditions based on the water level readings of these four piezometers were collected on two separate occasions. The results can be found in Table 21.

Table 21 – MHI Piezometer Readings

Piezometer	Piezometer Tip Elev. (feet)	Soil Zone Type	Piezometer Reading (feet below ground) *	
			Jan. 19, 1973	Jul. 7, 1974
1-73	259	Shale	39.8	26.6
1-73A	N/A	N/A	--	--
1-73B	102	Inter-Till Stratified Drift	20.0	14.7
1-73C	35	Inter-Till Gravel Seam	16.9	12.6
1-73D	25	Silt	16.9	13.0

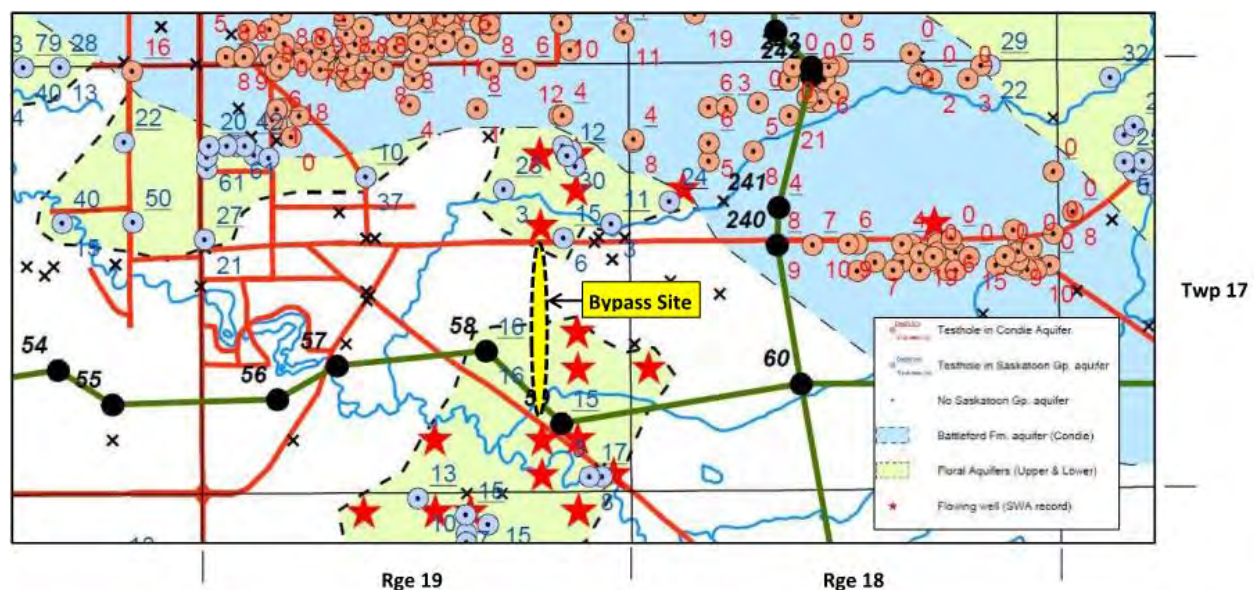
* Note that piezometer water level depths readings are shown in feet instead of metres.

Saskatchewan Water Security Agency Website (<https://gis.wsask.ca/>): Water Well Driller Reports

Groundwater data obtained from driller’s reports on Saskatchewan Water Security Agency’s website show 3 of the 16 water wells in close proximity to the proposed bypass are under artesian pressure. Furthermore, 2 of these wells are noted to be above ground (flowing) and 1 is just below ground level.

In addition to the three artesian wells identified above, Figure 18 displays a map extracted from the Saskatchewan Water Security Agency website indicating that a number of flowing wells (represented by red stars) are located north, east, and south of the proposed bypass route. It should be noted that if a thick, porous water-bearing sand/gravel seam under high artesian pressure should be exposed during excavation, the construction operation may have to be adjusted very quickly before the artesian flow gets out of hand.

Figure 18 – Artesian Groundwater Conditions



With respect to the remaining 13 water wells that were identified as being under very little if any artesian pressure, the average depth of the water level below ground surface as observed during the drilling of the well was approximately 20 ± 15 feet. More detailed information regarding the water wells that are proximate to the bypass can also be found in Appendix D.

6.5.4 Geotechnical Findings

Based on information reviewed for this study, the three items at the forefront are as follows:

- 1.** The natural moisture contents of both surficial highly plastic clay and underlying silt shown in Ground Engineering's 2007 Test Hole Nos. 102 and 103 were observed to be as much as 8 – 15 percent above their respective plastic limit value indicating both these soils are soft, wet materials that may cause some excavation problems.
- 2.** The natural moisture content of the Glacial Till underlying the Silt is shown to be at worst 3 – 4 percentage points above the material's Plastic Limit value indicating it should be relatively amenable for excavation.
- 3.** Both Ground Engineering 2007 Test Holes 102 and 103 along with data from 3 of 16 Saskatchewan Water Security Agency water well records seem to indicate that some Inter-Till Sand and/or Gravel seams within the vicinity of the proposed route may be under sufficient artesian pressure to cause water to flow above ground surface. The artesian conditions need to be identified in order to avoid problems with groundwater seepage into excavations involving concrete pile construction, deep-type borrow pits, and stream crossing structures.

It is recommended that the artesian groundwater conditions that supposedly exist on this proposed project's location be properly quantified by having a series of piezometers installed in each Inter-Till Sand and Gravel seam that is greater than 0.7 m thick within 25 m below ground surface at key sites involving deep excavations.

In addition to the above, it is recommended that additional drilling and testing be undertaken to establish structural foundation requirements and constraints. Settlement monitoring, and the installation of sand and wick drains should be reviewed and incorporated into the detailed design as required, to monitor pore water pressures and increase subgrade and foundation stability.

6.6 Structural Considerations

Discussions took place during the Value Engineering phase and the Functional Design phase with respect to structural requirements. The following general guidelines and recommendations were provided:

- ▶ MHI does not typically have bridges on superelevated curves, however they will be required to fit the geometric constraints of this project. Curved structures tend to be more aesthetically pleasing, but typically are more costly and result in increased complexity due to settlement
- ▶ Alignments should be designed to avoid having any spiral transitions on bridges, have the bridge entirely on tangent or in curve
- ▶ Skews should be reduced wherever possible. Typically skew is less than 30 degrees where possible, however bridges on increased skews can be designed but require increased length and span length
- ▶ Bridge foundations and retaining walls will be critical component of this project from a risk and cost perspective, and additional geotechnical testing should be undertaken to ensure feasibility of critical structures.

6.7 Drainage Patterns and Considerations

In general, road drainage can be directed along the road ditches, by gravity drainage, to three well defined outlets:

1. Small water course northeast of the route – This small drainage course passes under the existing Highway No. 1, carrying runoff from south to north. It originates at the east side of Emerald Park and runs west, roughly parallel to the highway to a wetland near the communications towers then north through the highway to Pilot Butte Creek. As development occurs in the area, it is anticipated that the RM of Edenwold will require developers to include detention storage to limit peak flows in severe floods to natural rates and a crossing structure with capacity similar to the existing structure will be needed.
2. Chuka Creek – The future Southeast Bypass will cross Chuka Creek north of Highway 33. Chuka Creek is a significant drainage course that can produce substantial flood lows. The Highway 33 crossing was designed for the 1:500 year flood with 3 – 1800 mm culverts. The bypass crossing will include less drainage area and have a lower design flow.
3. Wascana Creek – The Bypass will cross Wascana Creek at the downstream end of this route.

These three natural drainage courses will provide outlets for runoff from the project. The ground provides gentle slopes that should allow the highway drains to discharge efficiently. However, the relatively flat terrain may make gravity drainage of any deep excavations difficult and borrow pits may become undrained water bodies if they are too deep for gravity drainage.

With regards to the Chuka Creek crossing, Water Resource Consultants Ltd. suggested that encroachments on the flood plain with fill should not go excessively below 573.3 m. This is to ensure that there is sufficient flood plain to convey future flood flows. For further information regarding drainage issues associated with the Southeast Bypass refer to Appendix E.

7.0 UTILITIES

The chosen alignment will have approximately 140 utility crossings. Crossings types will include SaskPower overhead lines and fibre optic cables, SaskEnergy gas lines, SaskTel phone lines and duct bank, City of Regina water and gas lines, and a Plains Midstream oil pipeline.

While most crossings are minor, there are a few which may cause constructability issues or incur a significantly higher cost. The following is a list of identified critical crossings:

- ▶ SaskPower 230 kV line running N-S and crossing Highway No. 1 through the center of section 24-17-19-W2. The minimum clearance specified by SaskPower for 230 kV lines is 8.6 m and a minimum 30 m tower offset from the right-of-way. The overpasses proposed at this location will require this line to be relocated.
- ▶ SaskEnergy High Pressure Gas Line which crosses Highway No. 1 in the west of 19-17-18-W2 and crosses the proposed service road near Highway No. 33. SaskEnergy lines require a minimum cover of 1.50 m under a highway and 1.20 m under a ditch.
- ▶ Wascana Oil Pipeline which runs adjacent to SaskEnergy's gas pipeline and crosses Highway No. 1 in the west of 19-17-18-W2. Any work within 30 m of the pipeline right-of-way requires review by the company to determine case specific protection requirements.
- ▶ SaskTel Duct Bank running E-W along the south side of Highway No. 1. The crossing requirement specified by SaskTel for critical locations is a minimum cover of 1.50 m.
- ▶ CN Railway line running N-S and crossing Highway No. 1 through the center of section 24-17-19-W2. A service road may be in proximity to the line; this portion of the railway is currently not in use and future plans for the line are unknown. The Ministry requires a minimum separation of 30 m between the edge of the railway and the edge of the travel way to allow for future crossings.

All crossing locations and requirements should be verified with the appropriate governing body during detailed design and prior to any construction activity.

8.0 RIGHT-OF-WAY

Proposed right-of-way (ROW) widths are based on MHI standards where applicable, but also must consider vertical gradelines for overpasses, widths for accommodating drainage, and median widths for safety and snow storage.

Preliminary Right-of-way has been shown on the functional design drawings. It is important to recognize that vertical geometry will control the extents of right-of-way required, and that detailed topographical information was unavailable at the time of the study. Actual limits of embankment could vary significantly from the preliminary profiles shown developed from DEM data, and based on geotechnical recommendations regarding sideslopes for slope stability.

For the main bypass lanes, a standard 101.4 metre ROW is proposed as per MHI D 130-7430 classification of road. This results in a 32 metre wide median, which is measured as the distance between nearest edges of driving lanes in opposing directions. At the east terminal of the project, the lanes must tie into the existing Highway 1 lanes and ROW, which has an existing median of approximately 24.4 metres. Where the gradeline raises and the embankment width increases beyond available ROW, it is proposed that the ROW edge be offset from the edge of embankment to allow for a drainage ditch if required. This offset will be dependent on the detailed design, however a minimum offset of 15 metres from the edge of embankment would be a reasonable assumption.

The horizontal alignment of Highway 33 is proposed to match the existing geometry, with an existing median width of approximately 17.8 metres. Due to the need for embankment to raise the gradeline of Highway 33 over the bypass lanes, widening will be required and will again be dictated by embankment widths and adjacent drainage requirements. Similar to the main lanes, an offset of 15 metres from the edge of embankment may be suitable.

Offsets for interchange ramps is also dependent on the need for ditching. Should a ditch matching the adjacent highway ditch be required, an offset of 27.3 metres from the nearest lane would be required. If ditch grading is not significantly below existing ground, a reduced width would be possible.

MHI does not currently have a standard ROW width for Service Roads. The service roads constructed on new alignments on this project are expected to be dust-free, and have a proposed top width of 9.0m, with ditches on either side for drainage. Based on this information, we propose a Service Road ROW width of 40 metres be assumed, until the detailed design is complete. Drainage design via a typical open ditch will play an important role in determining the minimum width required.

9.0 COSTING

A planning level cost estimate has been developed for the recommended alignment. Table 22 itemizes the construction components and estimated quantities and unit costs used for the project. Unit costs are used for 4 lane highway cross-sections, as well as single and double lane ramps. Bridge costs are significant, but since they are based on rough DEM surfaces, clearances and profiles could vary significantly once survey data is available. Service Road costs allow for an asphalt structure. Property values have not yet been established and are not included in this estimate.

Table 22 – Planning Level Cost Estimate

LEVEL D COST ESTIMATE					
ITEM NO.	DESCRIPTION OF WORK	UNIT	ESTIMATED QUANTITY	ESTIMATED UNIT PRICE	ESTIMATED COST
1.0 ROADWAYS					
HIGHWAY LANES					
1.1	BYPASS LANES	m	7,000	\$ 3,300	\$ 23,100,000
1.2	HIGHWAY 33 - RECONSTRUCTION FOR OVERPASS	m	880	\$ 3,300	\$ 2,904,000
INTERCHANGE RAMP					
1.3	HIGHWAY 33 - WESTBOUND EXIT RAMP	m	700	\$ 1,200	\$ 840,000
1.4	HIGHWAY 33 - WESTBOUND ENTRANCE RAMP	m	870	\$ 1,200	\$ 1,044,000
1.5	HIGHWAY 33 - EASTBOUND EXIT RAMP	m	670	\$ 1,200	\$ 804,000
1.6	HIGHWAY 33 - EASTBOUND ENTRANCE RAMP	m	870	\$ 1,200	\$ 1,044,000
1.7	HIGHWAY 1 - WESTBOUND EXIT RAMP	m	500	\$ 1,700	\$ 850,000
1.8	HIGHWAY 1 - WESTBOUND ENTRANCE RAMP	m	1,600	\$ 1,200	\$ 1,920,000
1.9	HIGHWAY 1 - EASTBOUND EXIT RAMP	m	2,000	\$ 1,200	\$ 2,400,000
1.10	HIGHWAY 1 - EASTBOUND ENTRANCE RAMP	m	2,300	\$ 1,700	\$ 3,910,000
SERVICE ROADS					
1.11	EAST SERVICE ROAD - BETWEEN HIGHWAY 33 AND HIGHWAY 1	m	6,600	\$ 1,000	\$ 6,600,000
1.12	EAST SERVICE ROAD - EXTENSION OF EXISTING SERVICE ROAD SOUTH OF HIGHWAY 33	m	800	\$ 1,000	\$ 800,000
1.13	WEST SERVICE ROAD - TIE INTO EXISTING TOWER ROAD NORTH OF HIGHWAY 33	m	900	\$ 1,000	\$ 900,000
1.14	WEST SERVICE ROAD - SOUTH OF HIGHWAY 33	m	2,000	\$ 1,000	\$ 2,000,000
OTHER ITEMS					
1.15	REMOVALS	m ²	27,000	\$ 15	\$ 405,000
1.16	EARTHWORK	m ³	1,500,000	\$ 15	\$ 22,500,000
1.17	DETOURS	L.S.	1	\$ 250,000	\$ 250,000
1.18	TRAFFIC SIGNALS	ea	3	\$ 250,000	\$ 750,000
1.19	LIGHTING	L.S.	1	\$ 500,000	\$ 500,000
1.20	GEOTECHNICAL ALLOWANCE - SAND DRAINS, WICK DRAINS, SETTLEMENT MONITORING, RETAINING WALLS	L.S.	1	\$ 500,000	\$ 500,000
ENGINEERING (ROUNDED TO NEAREST 1000)					
1.19	DESIGN ENGINEERING	%	1	5%	\$ 3,676,000
1.20	CONSTRUCTION ENGINEERING	%	1	10%	\$ 7,352,000
ROADWAYS TOTAL					\$ 85,049,000
2.0 BRIDGE STRUCTURES					
2.1	RAIL OVERPASS - BYPASS LANES	m ²	1,430	\$ 4,500.00	\$ 6,435,000
2.2	EASTBOUND ENTRANCE RAMP AT HIGHWAY 1 OVER BYPASS LANES	m ²	6,270	\$ 4,500.00	\$ 28,215,000
2.3	EASTBOUND EXIT RAMP AT HIGHWAY 1 OVER BYPASS LANES	m ²	1,240	\$ 4,500.00	\$ 5,580,000
2.4	HIGHWAY 33 OVERPASS OVER BYPASS LANES	m ²	2,280	\$ 4,500.00	\$ 10,260,000
BRIDGE STRUCTURES TOTAL					\$ 50,490,000
3.0 UTILITIES/PIPELINES					
3.1	SASKTEL RELOCATIONS	each	30	\$ 7,500.00	\$ 225,000
3.2	SASKPOWER RELOCATIONS	each	20	\$ 7,500.00	\$ 150,000
3.3	SASKPOWER HIGH VOLTAGE OVERHEAD RELOCATION	each	1	\$ 1,000,000.00	\$ 1,000,000
3.4	SASKENERGY RELOCATIONS	each	4	\$ 150,000.00	\$ 600,000
3.5	SASKENERGY HPG PROTECTION	each	1	\$ 500,000.00	\$ 500,000
3.6	PLAINS MIDSTREAM OIL PIPELINE PROTECTION	each	1	\$ 500,000.00	\$ 500,000
UTILITIES/PIPELINES TOTAL					\$ 2,975,000
SUMMARY OF ESTIMATES					
1.0 ROADWAYS					\$ 85,049,000
2.0 BRIDGE STRUCTURES					\$ 50,490,000
3.0 UTILITIES/PIPELINES					\$ 2,975,000
SUMMARY SUB-TOTAL					\$ 138,514,000
CONTINGENCY (20%)					\$ 27,702,800
ESTIMATED TOTAL COST					\$ 166,216,800
\$ 166,300,000					

10.0 CONCLUSION

The Southeast Regina Bypass Functional Design Study has allowed the selection of a location for the bypass between Highway 1 and Highway 33, as well as identifies a layout for both the system interchange at Highway 1 and the service interchange at Highway 33.

The location of a bypass is typically controversial as it impacts the surrounding landowners. With the general location being set in the vicinity of Tower Road, the true test was to develop a design that would address Highway 1 traffic, but also daily commuter traffic from surrounding communities, as well as localized Regina traffic.

The recommended functional design provides the following attributes:

- ▶ Maintains high speed free-flow operation for traffic on Highway 1
- ▶ Provides a high level of service for traffic destined to Victoria Avenue
- ▶ Provides a buffer between the Southeast Regina Bypass and existing urban development
- ▶ Provides flexibility should it be decided to continue the Regina Bypass north on Tower Road
- ▶ A tight diamond moves Highway 33 interchange away from Chuka Creek and meets long term traffic volumes
- ▶ Provides flexibility for a future infrastructure at the Tower Road and Victoria Avenue intersection, should it be required
- ▶ Ability to keep all lanes on existing Highway 1 open during construction

MMM Group Ltd.

WELCOME

Southeast Regina Bypass
Functional Design Study

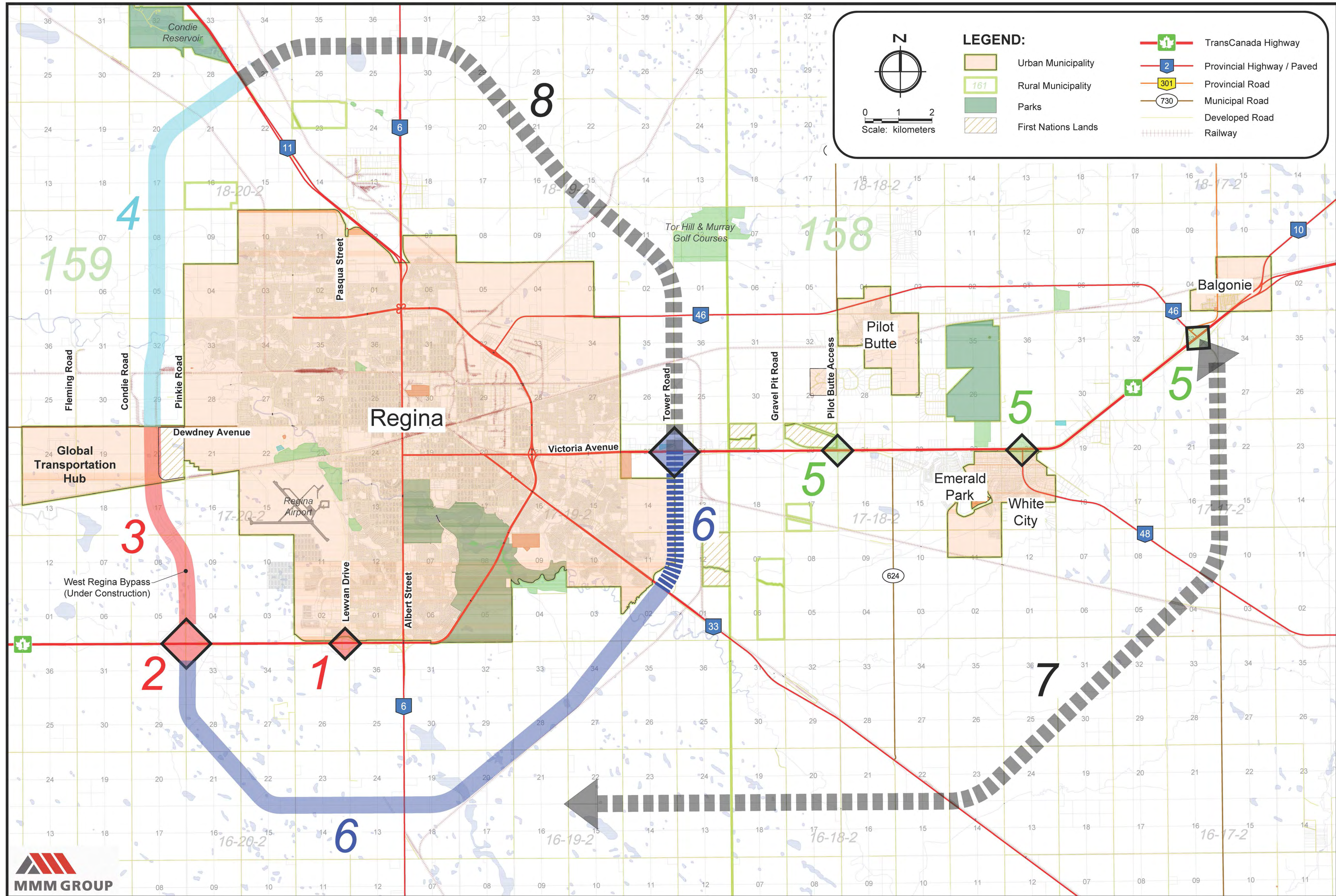
Open House 1 - June 20, 2013

Study Goals

- ▶ Design the section of the Regina Bypass between Highway 1 and Highway 33 in the vicinity of Tower Road, referred to as the Southeast Regina Bypass
- ▶ Establish the interchange requirements at Highway 1 and Highway 33
- ▶ Work with landowners and developers in the area to consider development plans
- ▶ Establish the land to be protected for this section of the Bypass

SOUTHEAST REGINA BYPASS FUNCTIONAL DESIGN STUDY

Regional Planning



Status Of The Regina Area Planning Studies

- ▶ General locations have been set and approved for the West, South, and Southeast portions of the Regina Bypass
- ▶ Functional designs showing roadway and interchange layouts are being completed for all three bypass segments
- ▶ Functional interchange plans for interchanges east of Regina (Pilot Butte Access, Highway 48, and Highway 46) are either complete or being completed
- ▶ Service Road alignments along Highway 1 East (Tower Road to Balgonie) are also being studied at this time

Regina Bypass Purpose

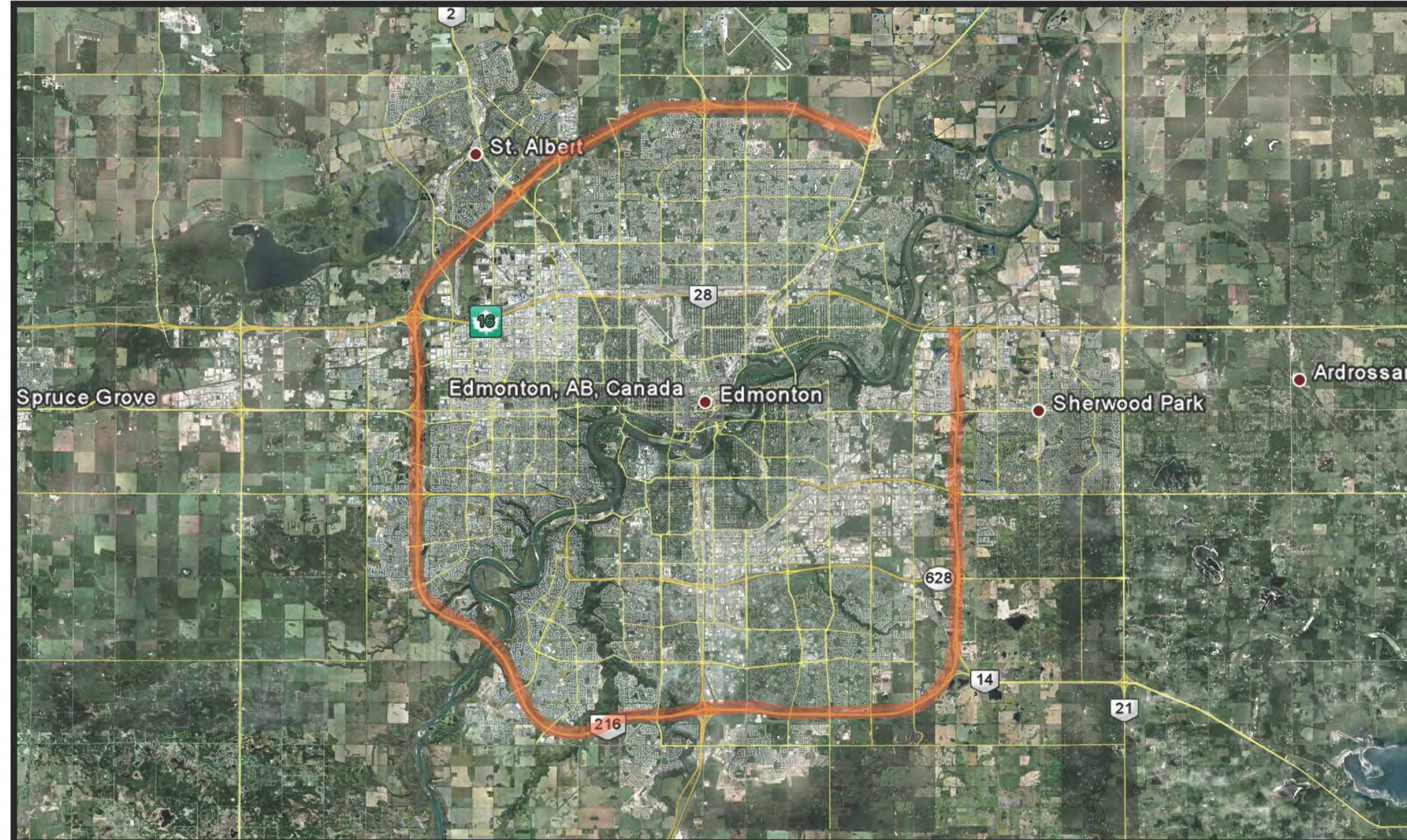
The Regina Bypass will meet the following functions:

1. Provide highway-to-highway connections (e.g. Highway 11 to Highway 33)
2. Function as the future TransCanada Highway for the portion south of Regina (i.e. from Highway 1 East to Highway 1 West)
3. Serve Global Transportation Hub traffic (e.g. large trucks from the GTH that are travelling east on Highway 1 and want to avoid Victoria Avenue)

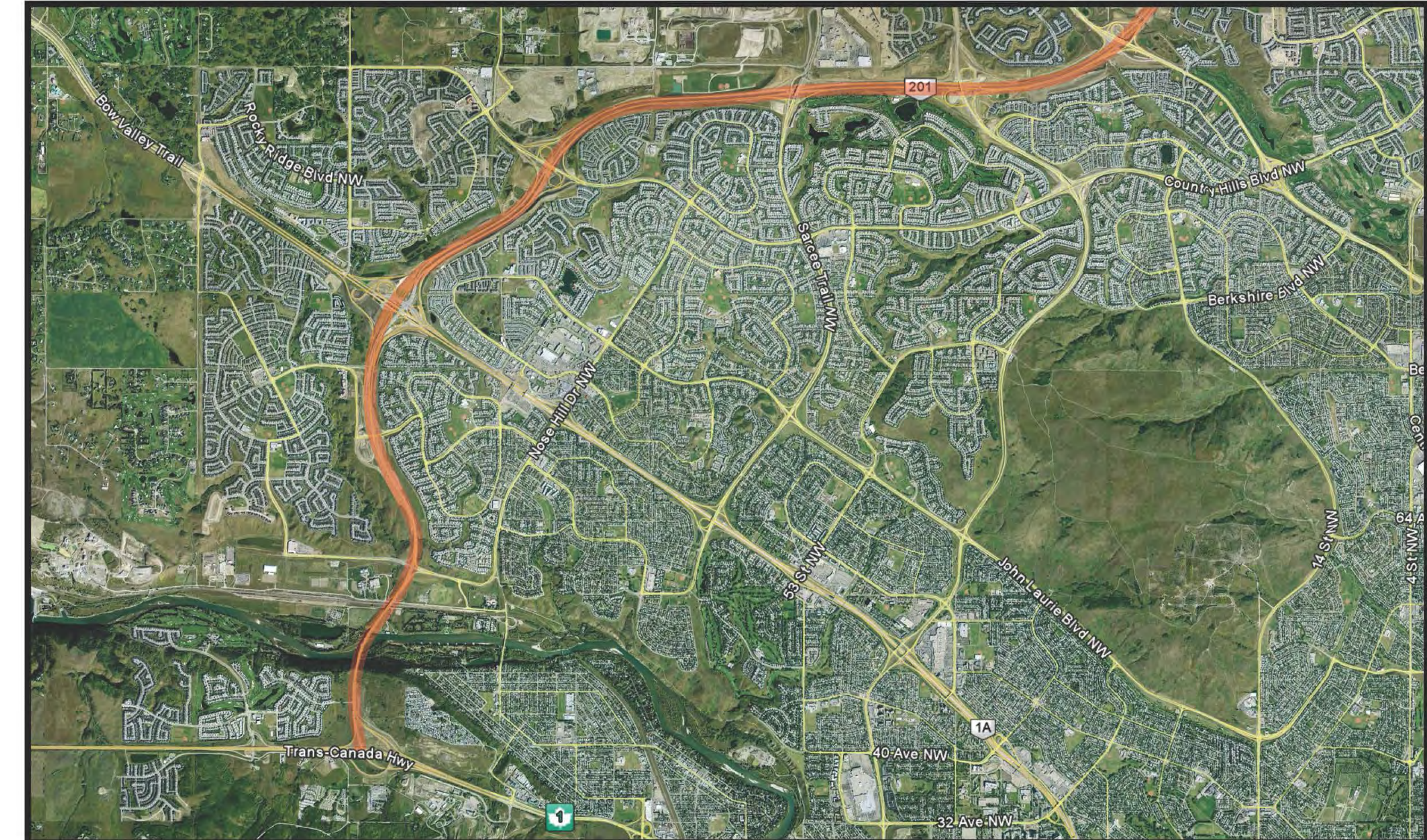
SOUTHEAST REGINA BYPASS FUNCTIONAL DESIGN STUDY

Other Bypass Examples

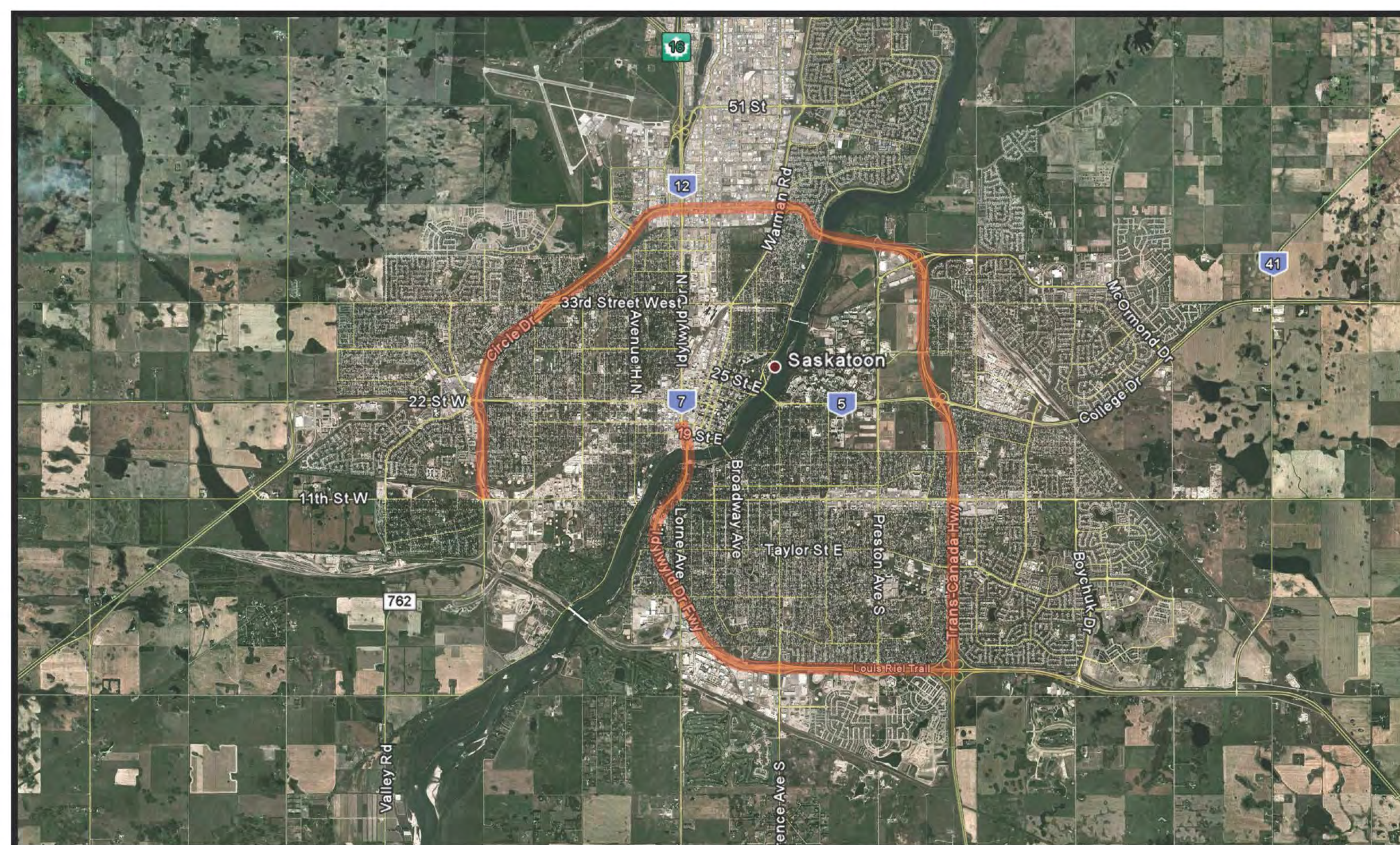
Edmonton: Anthony Henday Drive



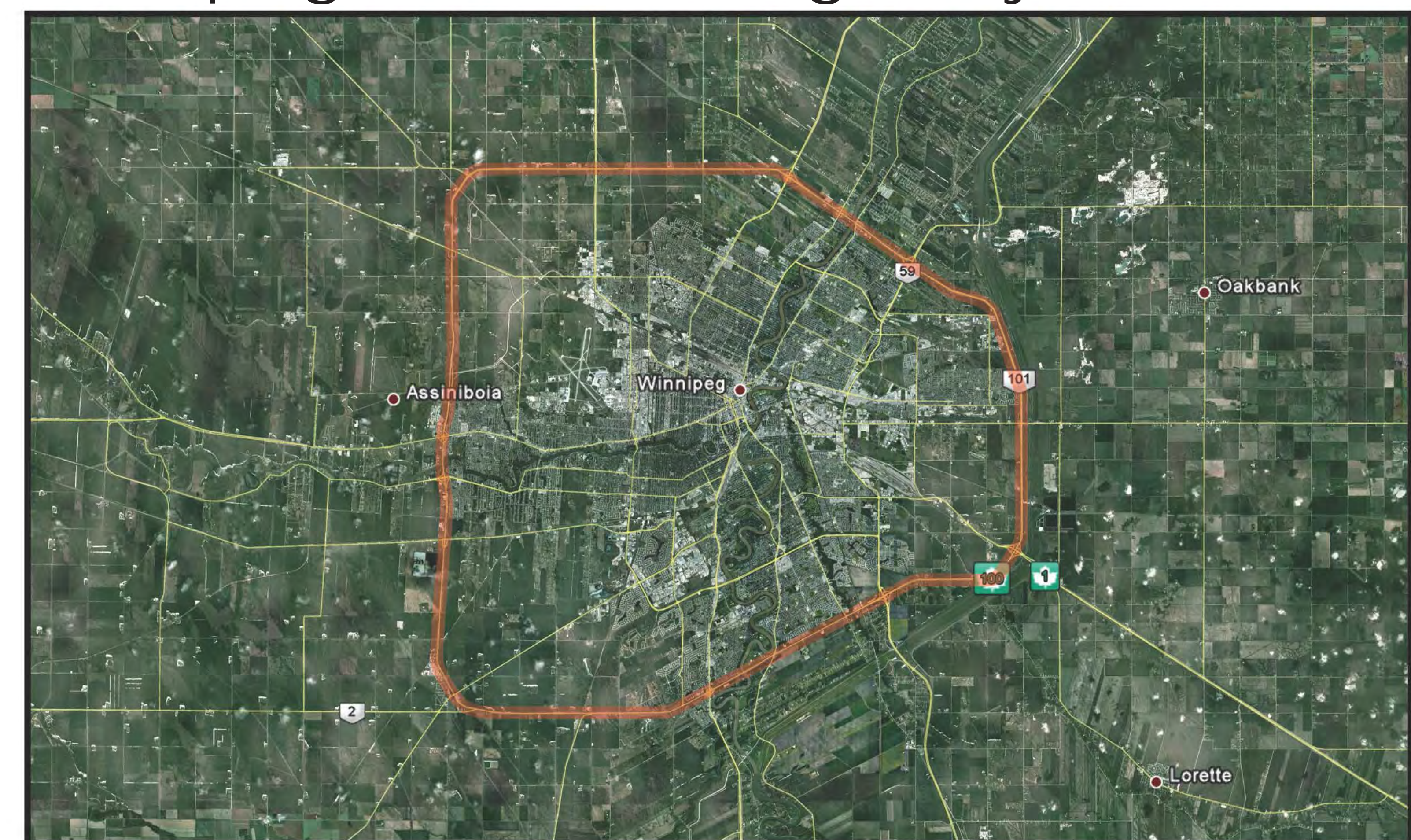
Calgary: Stoney Trail



Saskatoon: Circle Drive



Winnipeg: Perimeter Highway



Concept Development

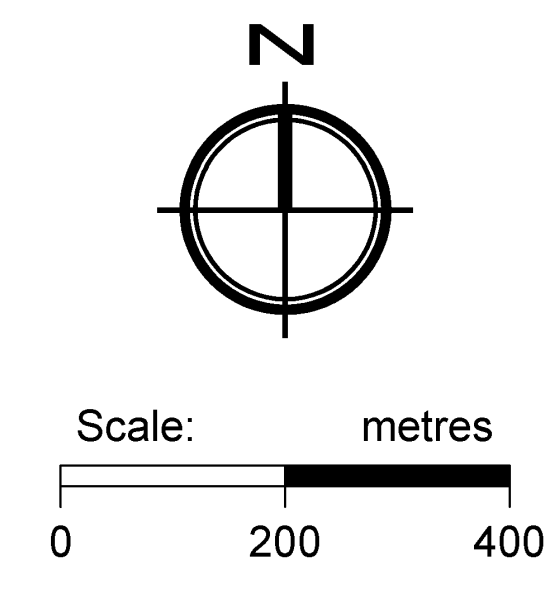
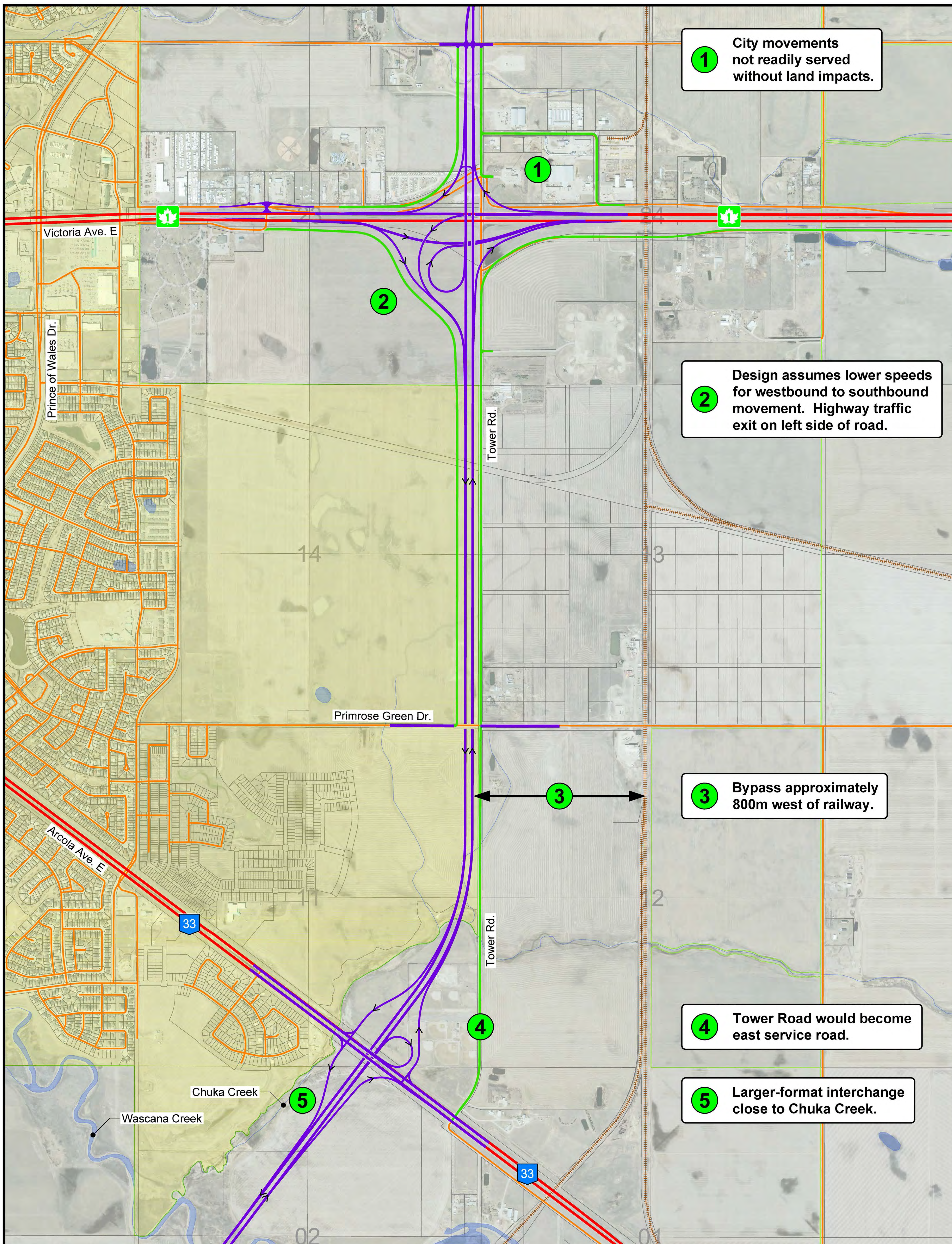
- ▶ A four-day Value Engineering workshop was conducted with technical representatives from the Ministry of Highways and Infrastructure, the City of Regina and the RM of Sherwood, as well as developers and land owners providing input and ideas
- ▶ Approximately 100 ideas related to the design of the Southeast Bypass were generated, resulting in the development of two main design concepts

GENERATED IDEAS	
Alignment Options	22
Interchange Layouts	32
Service Roads	31
Other	8
TOTAL	93

- ▶ Ideas were developed using the previously approved functional design from 2007 (i.e. Base Case), while reflecting current needs and goals

SOUTHEAST REGINA BYPASS FUNCTIONAL DESIGN STUDY

Base Case (2007 Study)



LEGEND

	HIGHWAY
	ROADWAY
	RAILWAY
	URBAN MUNICIPALITY
	RURAL MUNICIPALITY
	PROPOSED BYPASS
	PROPOSED SERVICE ROAD

1 City movements not readily served without land impacts.

2 Design assumes lower speeds for westbound to southbound movement. Highway traffic exit on left side of road.

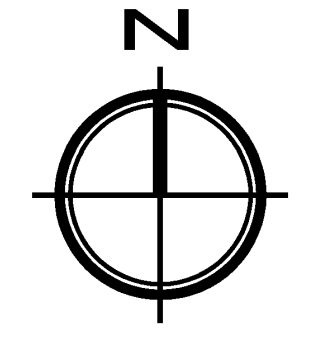
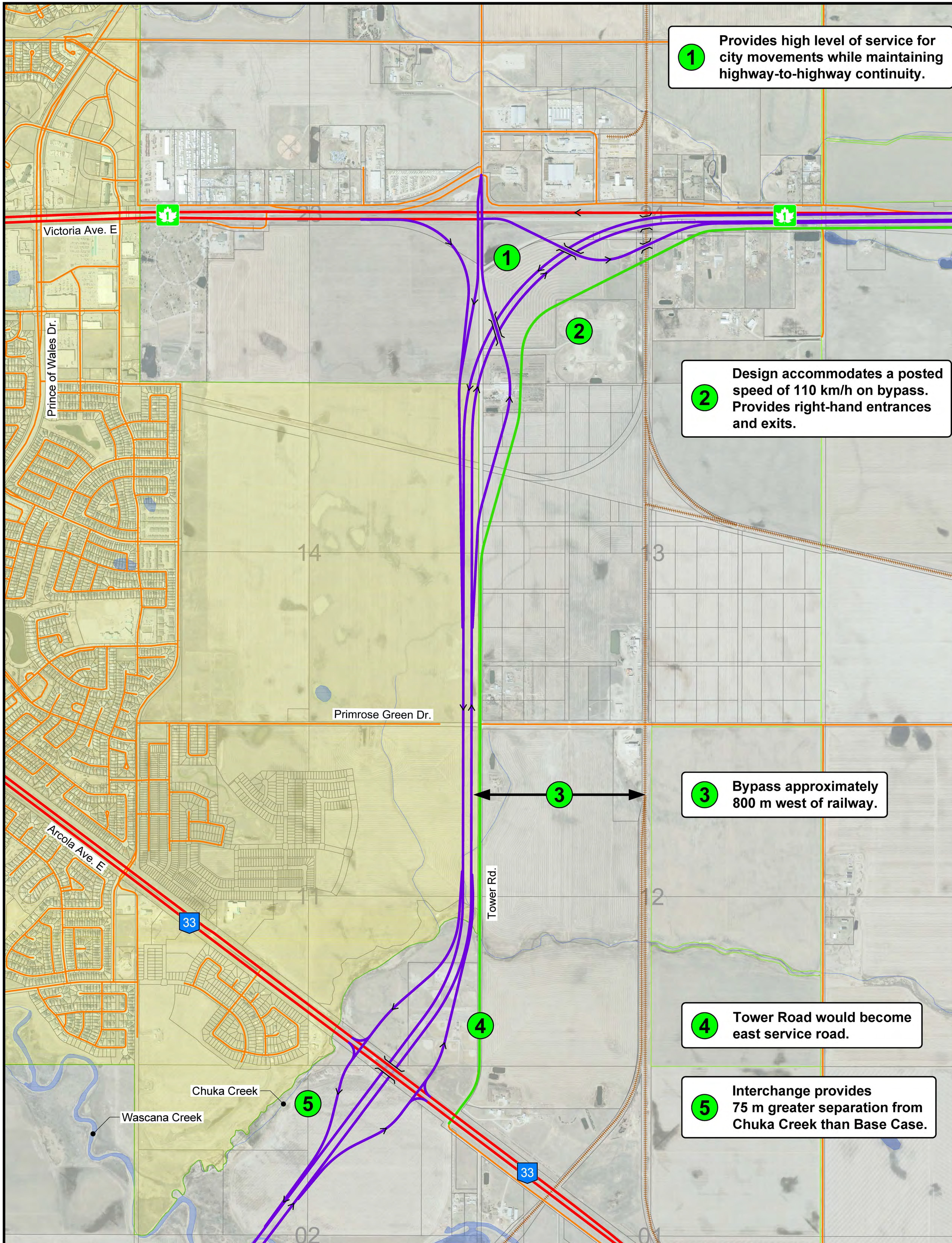
3 Bypass approximately 800m west of railway.

4 Tower Road would become east service road.

5 Larger-format interchange close to Chuka Creek.

SOUTHEAST REGINA BYPASS FUNCTIONAL DESIGN STUDY

Concept 1



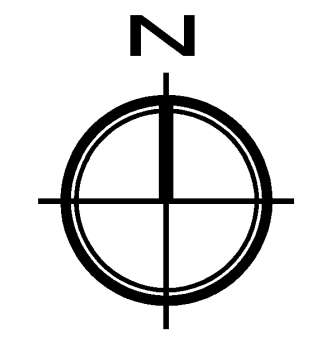
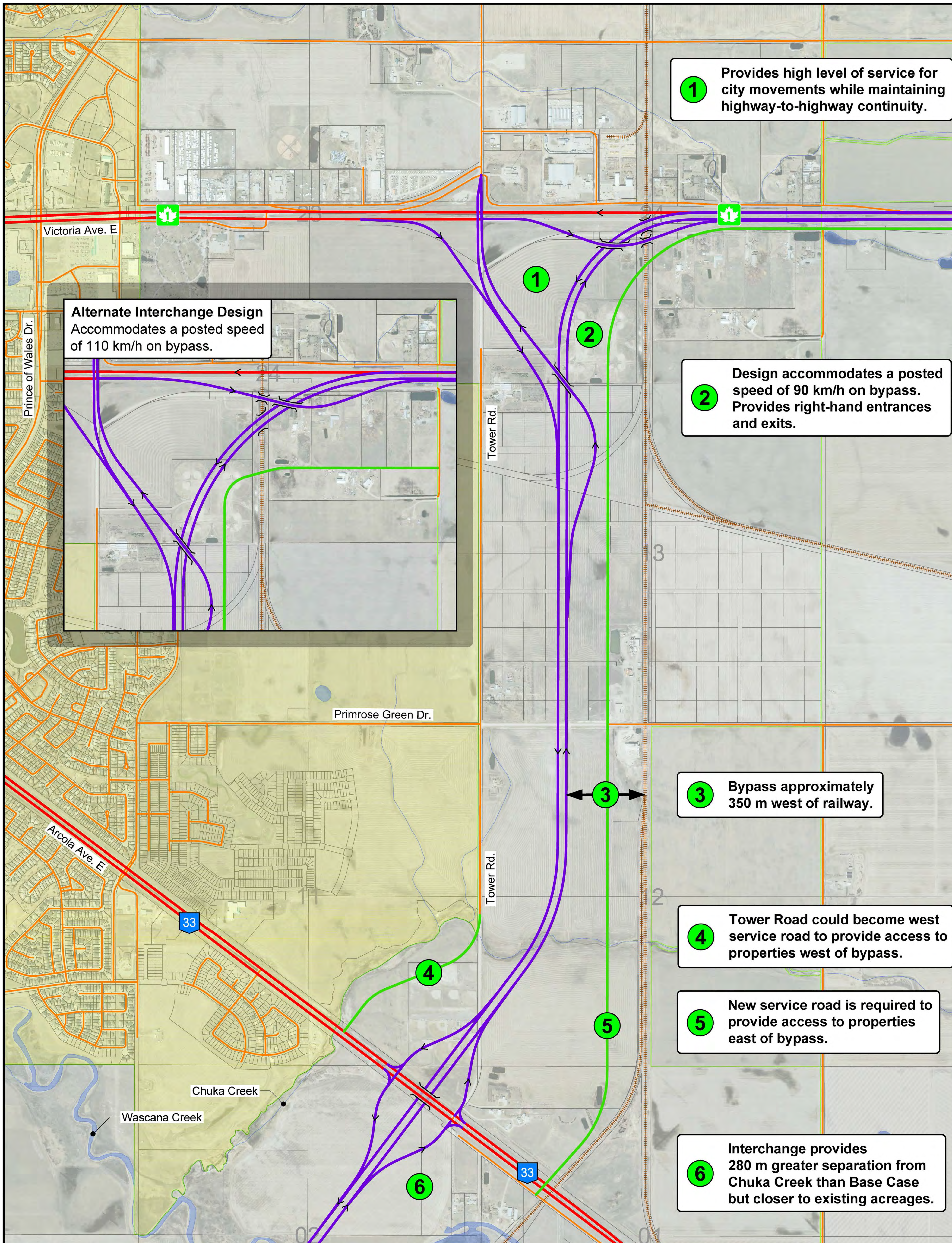
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LEGEND

- HIGHWAY
- ROADWAY
- RAILWAY
- URBAN MUNICIPALITY
- RURAL MUNICIPALITY
- PROPOSED BYPASS
- PROPOSED SERVICE ROAD

SOUTHEAST REGINA BYPASS FUNCTIONAL DESIGN STUDY

Concept 2



Scale: metres
0 200 400

LEGEND

- HIGHWAY
- ROADWAY
- RAILWAY
- URBAN MUNICIPALITY
- RURAL MUNICIPALITY
- PROPOSED BYPASS
- PROPOSED SERVICE ROAD

NEXT STEPS?

Southeast Regina Bypass Functional Design Study

- ▶ Continue to develop concepts based on feedback from stakeholders
- ▶ On-going meetings with study Technical Advisory Committee and Steering Committee
- ▶ Conduct Open House #2 - July 2013
- ▶ Complete study report by August 2013

Southeast Regina Bypass Functional Design Study
Stakeholder Comments - Open House #1 - June 20, 2013

No	Comment
1	Consultation process has been flawed. RM residents have not been properly consulted.
2	Alignment should go as far east as possible.
3	Alignment should go straight south off of Tower Road
4	Current alignment crosses Wascana Creek at the lowest point in the floodplain
5	Current alignment will devalue his land
6	Current alignment will deny him access to his land
7	Do you please thousands of present and future residents or 20-30 RM residents?
8	Concept 1 and Base case are too close to residential areas
9	Third option should be developed - move alignment further east
10	Should be more distance between Creeks subdivision and the bypass
11	Concept 1 and the Base Case are too close to the City
12	Suggest modifications such as dropping the highway below grade and berming to reduce noise and visual impact
13	Require 3-4 years lead time to relocate baseball diamonds
14	Ask that property be purchased for new ball diamonds near the current location in SE Regina
15	Would like to see a third options that moves the alignment further east
16	Should reconsider the plan and build something more like Winnipeg's perimeter road
17	Tower Road is the best location for the bypass to maintain separation from interchanges planned further east
18	Should consider westbound exit near Hwy 1 / Pilot Butte intersection
19	Tower Road is too close to the City - bypass should be at Pilot Butte at a minimum
20	Pilot Butte makes more sense as a starting point for the bypass
21	Prefers long-term option for the bypass (Balgonie)
22	Cloverleaf intersection at Hwy 1 & Tower Road
23	Traffic signals at Hwy 33 & Tower Road
24	Likes the fact that vehicles travelling west won't have to slow down to use the bypass
25	Thankful that the 2007 design will not be implemented
26	Concept 2 leaves space for residential development and creates a buffer for a time
27	Bypass should go out to Balgonie - could do away with other interchanges and would be cheaper in the long run
28	Tower Road is a poor choice for the bypass - should move it further east
29	Move the bypass further out by White City
30	Proposed route is too close the City boundary - should move it out to Balgonie
31	Bypass should be moved further east
32	West and south portions of the bypass seem adequate - should move east portion further east
33	Should be traffic signals or interchange at Hwy 1 & Tower Road intersection
34	Concept 2a addresses all concerns
35	Bypass should be moved further east to avoid prime developable land
36	Slower speeds on the curve would be better for safety reasons
37	Advantages and disadvantages of the options were not clearly communicated, costs were not provided, drawings of NE connection were not included

Southeast Regina Bypass Functional Design Study
Stakeholder Comments - Open House #1 - June 20, 2013

No	Comment
38	The base case is the better option - direct flow, reduced property requirements, land already set aside, better connection to the north
39	Planned City intersection at Memorial Drive is very close to the interchange
40	Base Case appears to be the best option - unrestricted movement, fully built out, smaller footprint
41	Concepts 1 and 2 have an at-grade intersection which will contribute to traffic congestion
42	Concept 2 is too close to my home
43	Concept 1 is the most fair choice for residents of the Creeks and acreage owners
44	Concept 1 is the most fair choice for residents of the Creeks and acreage owners
45	Concept 1 shows consideration for both the urban homeowners and the rural acreage owners
46	Assurance was given that the Tower Road alignment was fixed - now there are options for moving it east
47	Concept 2 has serious impacts to my property
48	Would like to have the same level of influence on the process as developers
49	Believes there should be more direct consultation with those directly impacted by the options
50	Would like to see the SE Regina Bypass moved as far east as possible to reduce noise and let the City grow out.
51	The SE Regina Bypass should be moved as far east as possible
52	Concept 2 would be the best location for the bypass. Further east is better because residents of the Creeks will hear traffic noise if it is closer.
53	If the bypass is built close to the Creeks development, they will hear the traffic noise
54	The SE Regina Bypass should be moved east of the railroad tracks and west of Balgonie
55	Concept 2 is preferred if the bypass has to be in the vicinity of Tower Road
56	Concept 2 is preferred - as far east as possible
57	The proposed concepts are too close to residential areas
58	Do not choose an option that results in lower speed on Hwy 1 - it makes more sense to keep traffic flowing as unrestricted as possible

WELCOME

Southeast Regina Bypass
Functional Design Study

Open House 2 - August 15, 2013

Study Goals

- ▶ Design the section of the Regina Bypass between Highway 1 and Highway 33 in the vicinity of Tower Road, referred to as the Southeast Regina Bypass
- ▶ Establish the interchange requirements at Highway 1 and Highway 33
- ▶ Work with landowners and developers in the area to consider development plans
- ▶ Establish the land to be protected for this section of the Bypass

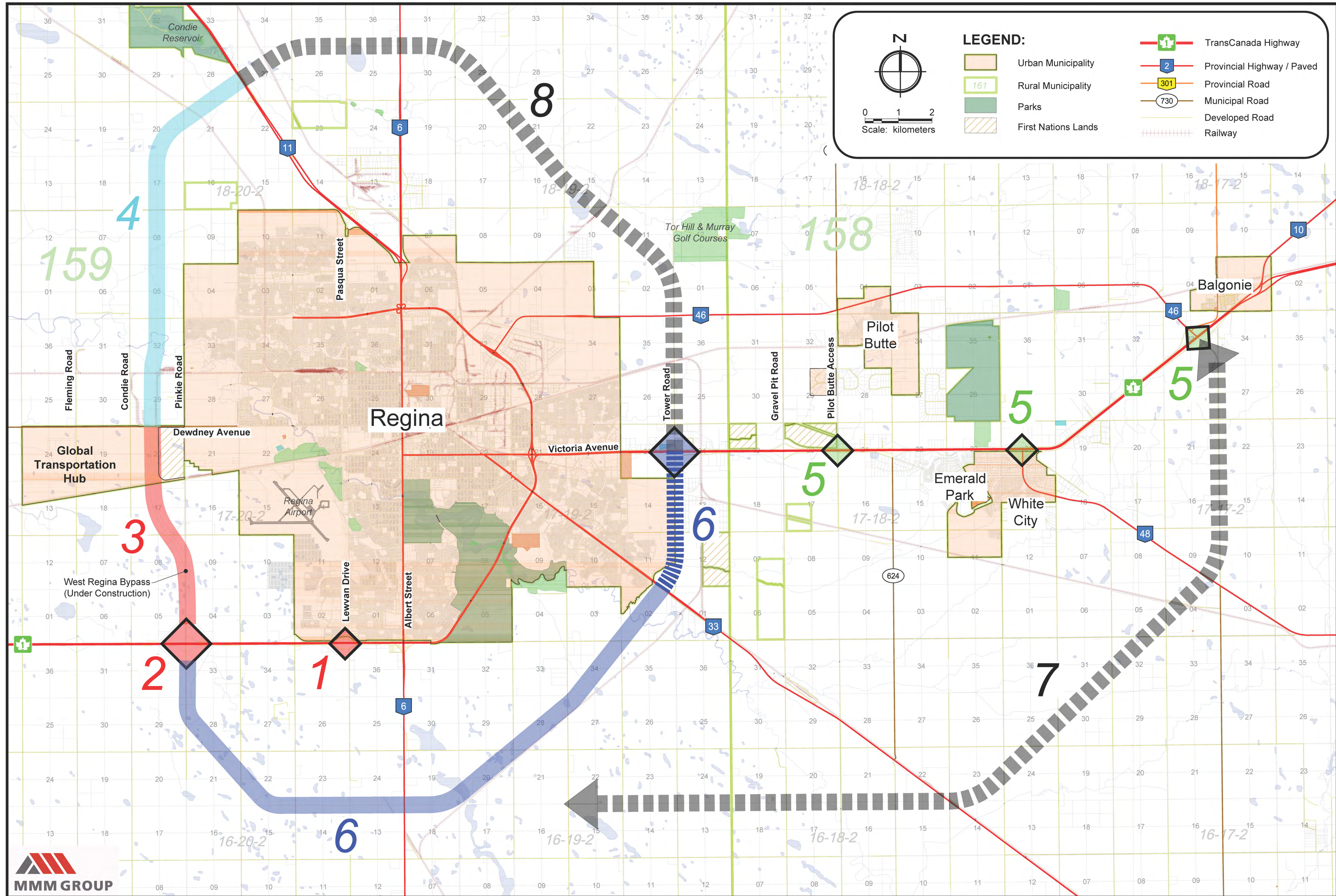
Regina Bypass Purpose

The Regina Bypass will meet the following functions:

1. Provide highway-to-highway connections (e.g. Highway 11 to Highway 33)
2. Function as the future TransCanada Highway for the portion south of Regina (i.e. from Highway 1 East to Highway 1 West)
3. Serve Global Transportation Hub traffic (e.g. large trucks from the GTH that are travelling east on Highway 1 and want to avoid Victoria Avenue)

SOUTHEAST REGINA BYPASS FUNCTIONAL DESIGN STUDY

Regional Planning



Consultation Process:

- ▶ Technical and Steering Committee meetings with the City of Regina and RM of Sherwood representation - ongoing through study
- ▶ Stakeholder meetings with landowners - June 2013
- ▶ Open House #1 - June 20, 2013
- ▶ Stakeholder meetings with landowners - July 2013
- ▶ Meetings with City and RM Councils - August 2013
- ▶ Open House #2 - August 15, 2013

Concept Development:

- ▶ A 4-day Value Engineering workshop was conducted with representatives of:
 - the Ministry
 - the City of Regina
 - the RM of Sherwood
 - major landowners

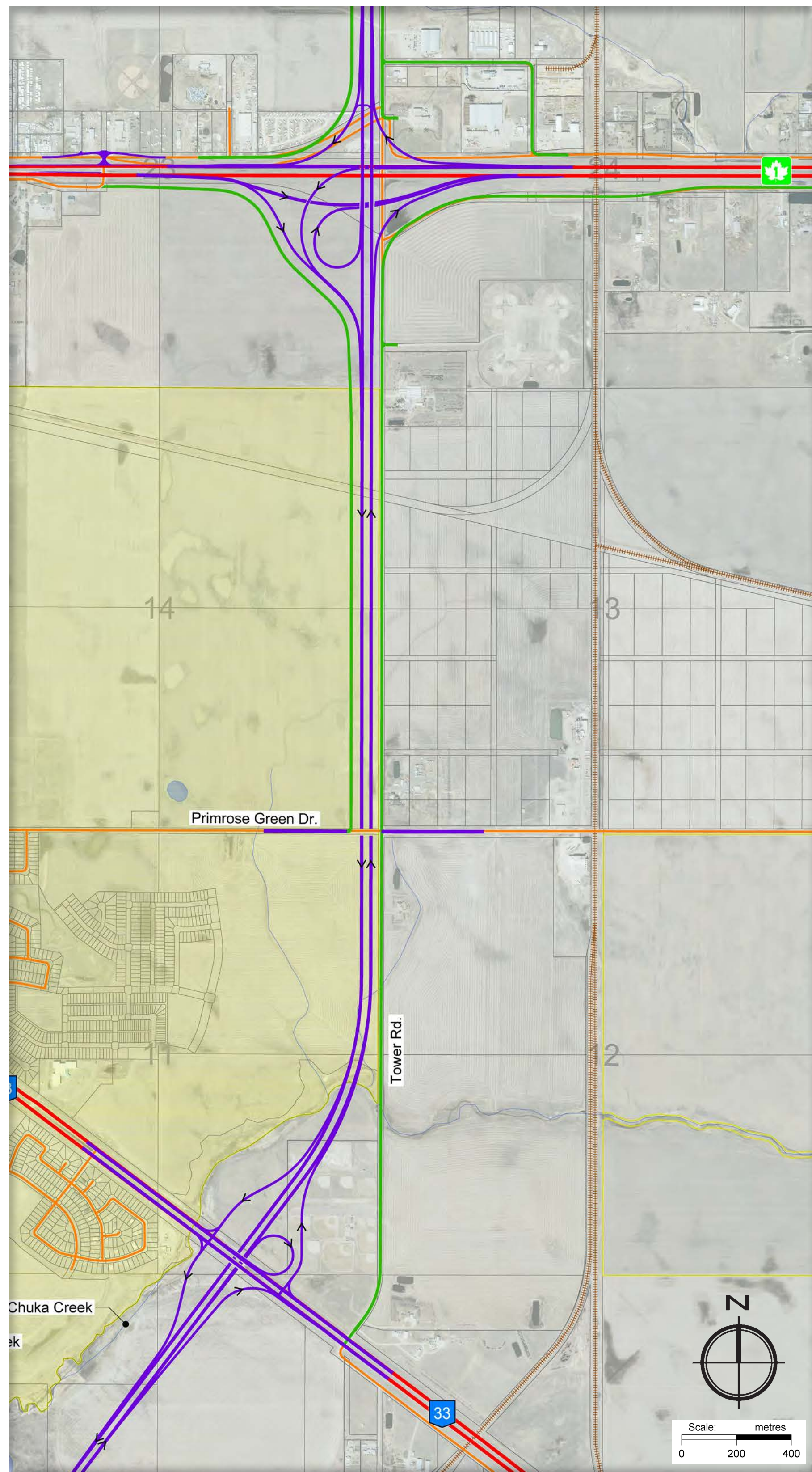
- ▶ Over 90 ideas were generated related to the design of the SE bypass, with two main alignment options (i.e. at Tower Road and 350 m east of Tower Road)

- ▶ Subsequent design work was undertaken on the concepts following the workshops

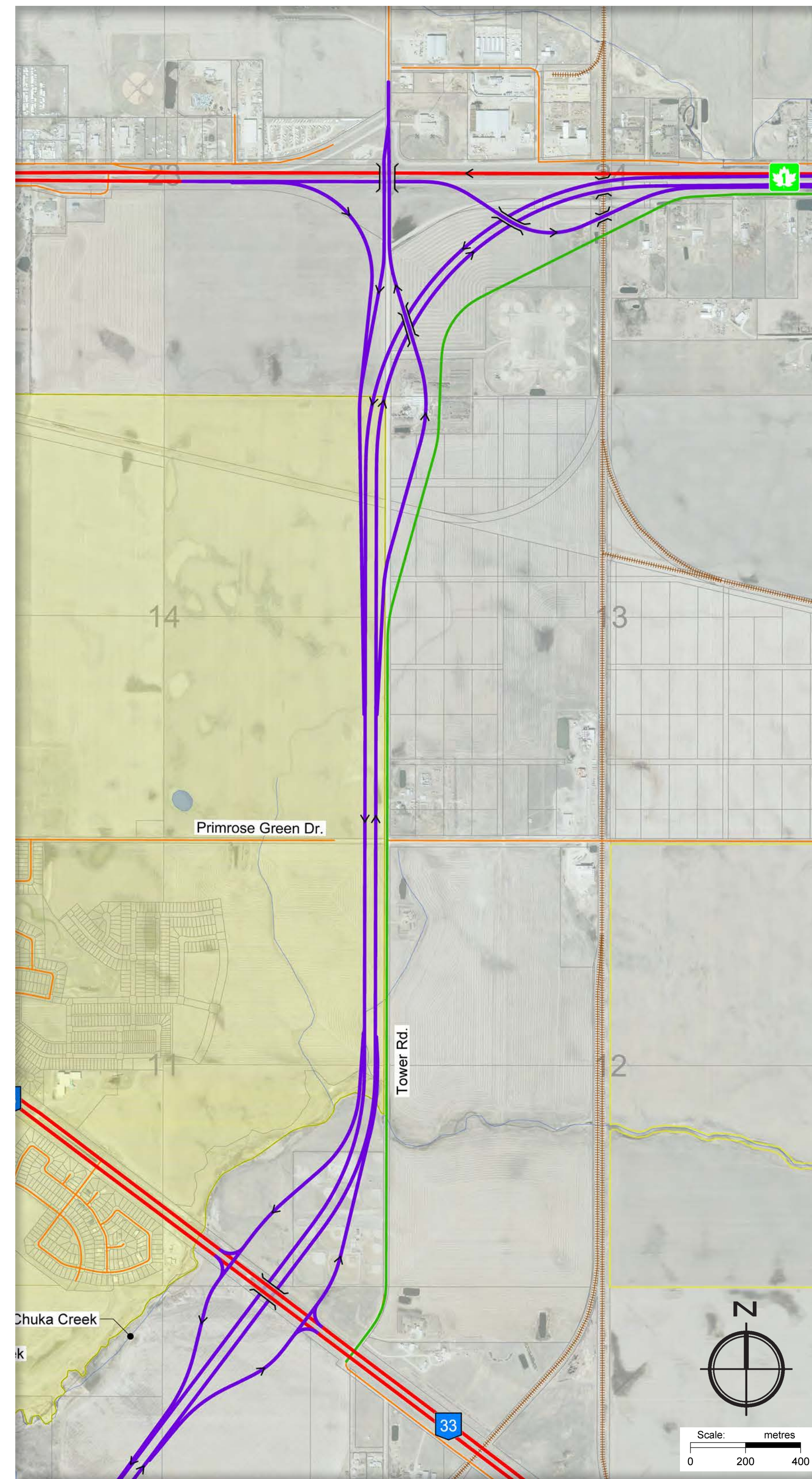
STUDY CONCEPTS

Southeast Regina Bypass Functional Design Study

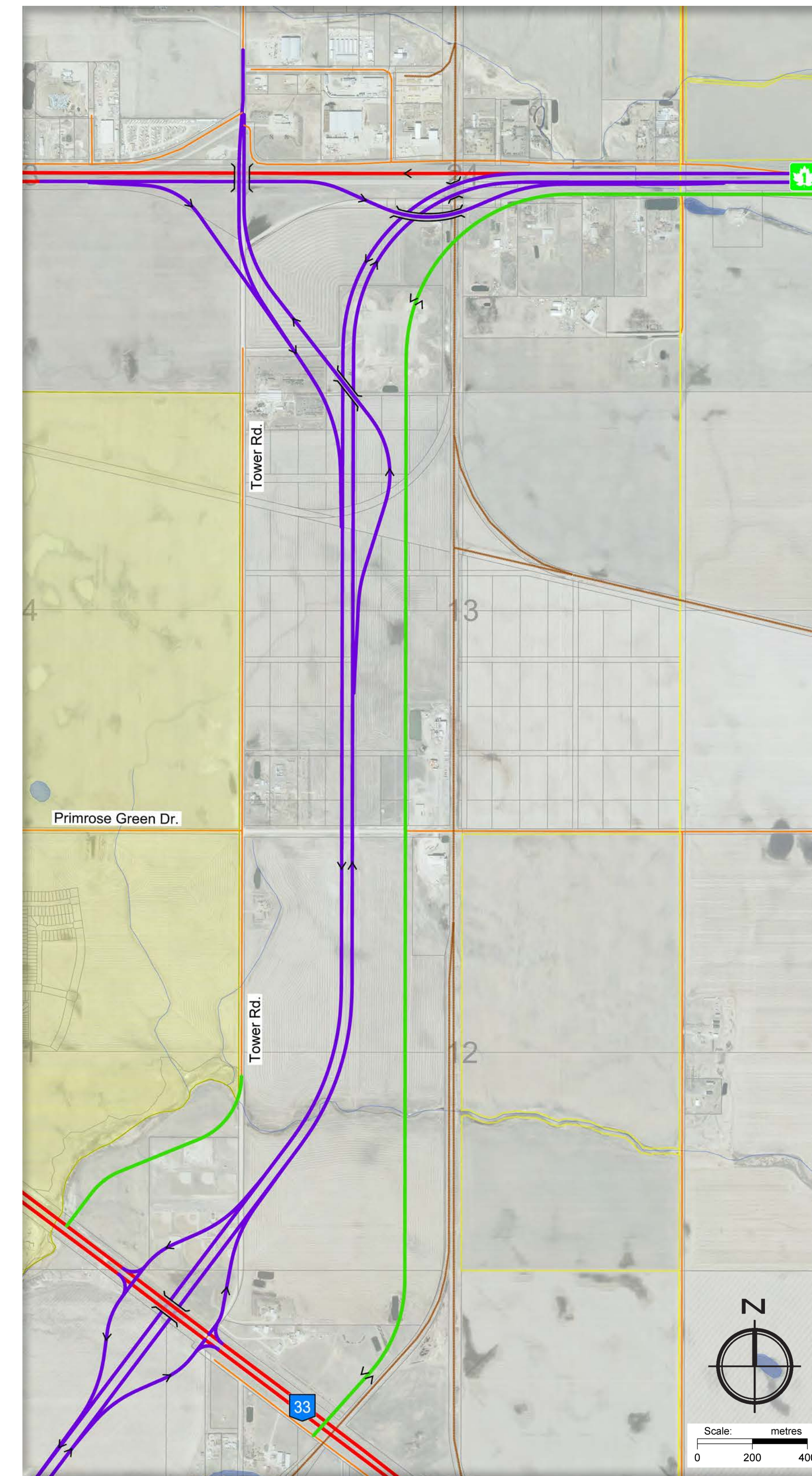
Base Case



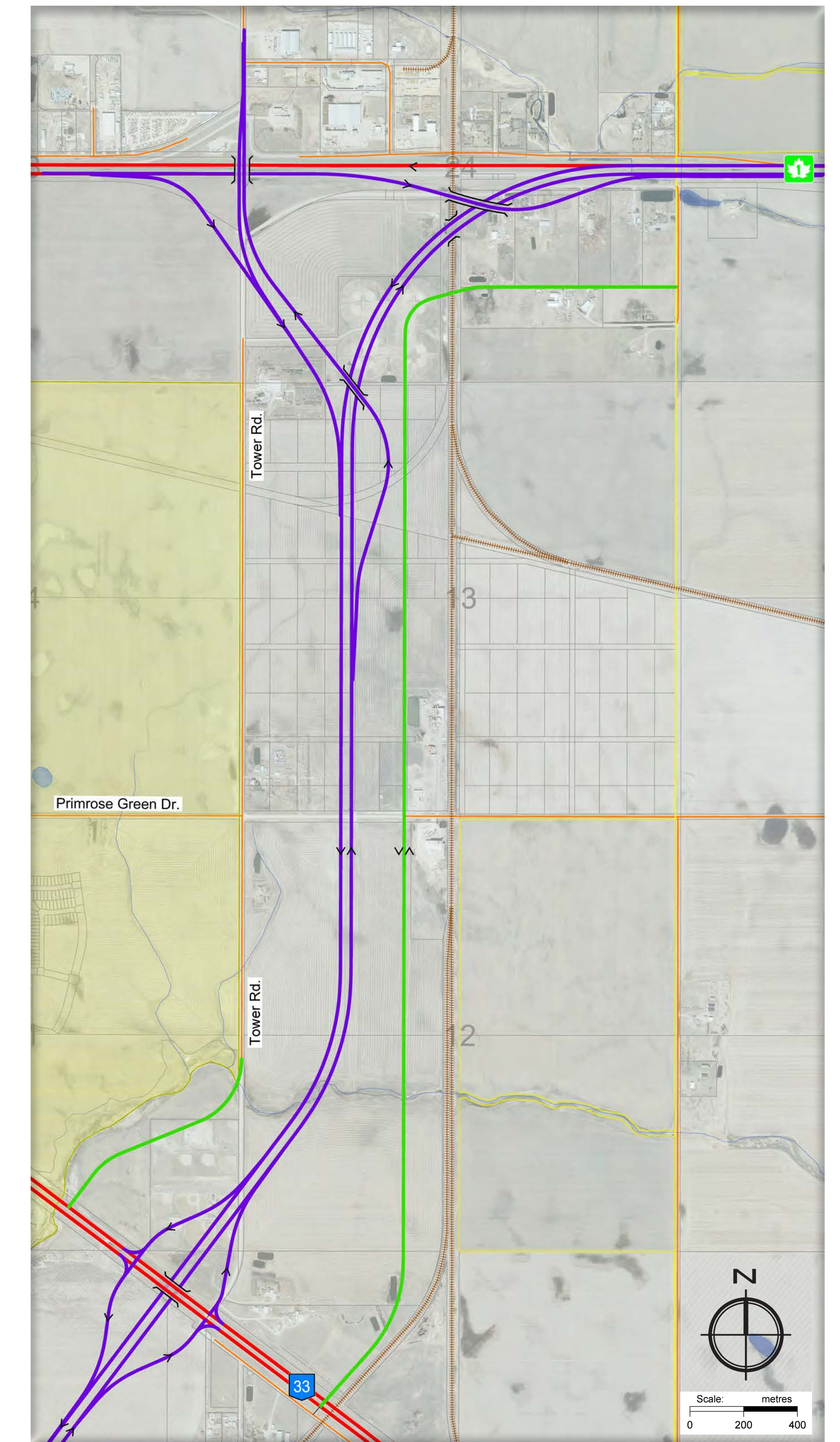
Concept 1



Concept 2



Concept 2a



LEGEND:

- HIGHWAY
- ROADWAY
- RAILWAY
- URBAN MUNICIPALITY
- RURAL MUNICIPALITY
- PROPOSED BYPASS
- PROPOSED SERVICE ROAD

Consultant Evaluation of Concepts:

EVALUATION CRITERIA	WEIGHTING	BASE	C1	C2	C2A
TransCanada Highway Functionality	25	1	4	3	4
Safety & Traffic Operations	25	2	3	3	4
Potential Phasing Opportunities / NE Bypass Functionality	5	1	3	3	4
Access to Adjacent Development	10	2	3	4	4
Property Impacts	10	4	3	3	2
Constructability	2.5	3	2	2	4
Noise	5	2	2	3	3
Environmental	2.5	2	2	2	2
Utility / Railway	2.5	3	2	2	2
Economic Development Potential	5	2	2	3	3
Right-of-way (Land Acquisition) - Acres	2.5	4	4	3	2
Construction Cost	5	4	3	2	2

WEIGHTED TOTAL:

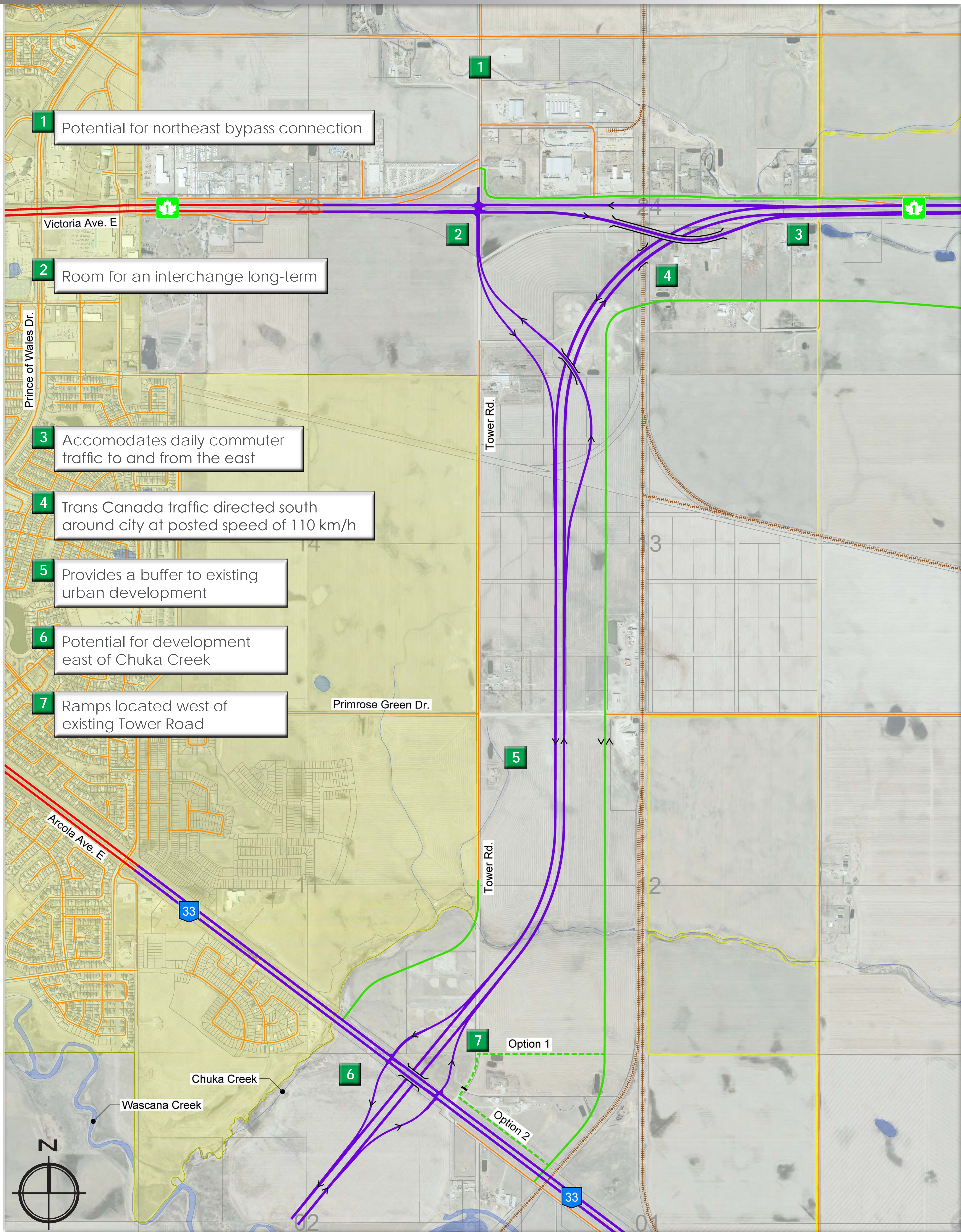
210	310	297.5	345
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Evaluation Results:

AGENCY	RESULTS - BY RANK			
	BASE	C1	C2	C2A
Study Consultant	4th	2nd	3rd	1st
MHI	4th	2nd	3rd	1st
City of Regina	4th	3rd	2nd	1st
RM of Sherwood	3rd	1st	2nd	3rd

PREFERRED OPTION

Southeast Regina Bypass Functional Design Study



LEGEND:

	HIGHWAY		PROPOSED BYPASS
	ROADWAY		PROPOSED SERVICE ROAD
	RAILWAY		TRAFFIC DIRECTION
	URBAN MUNICIPALITY		
	RURAL MUNICIPALITY		

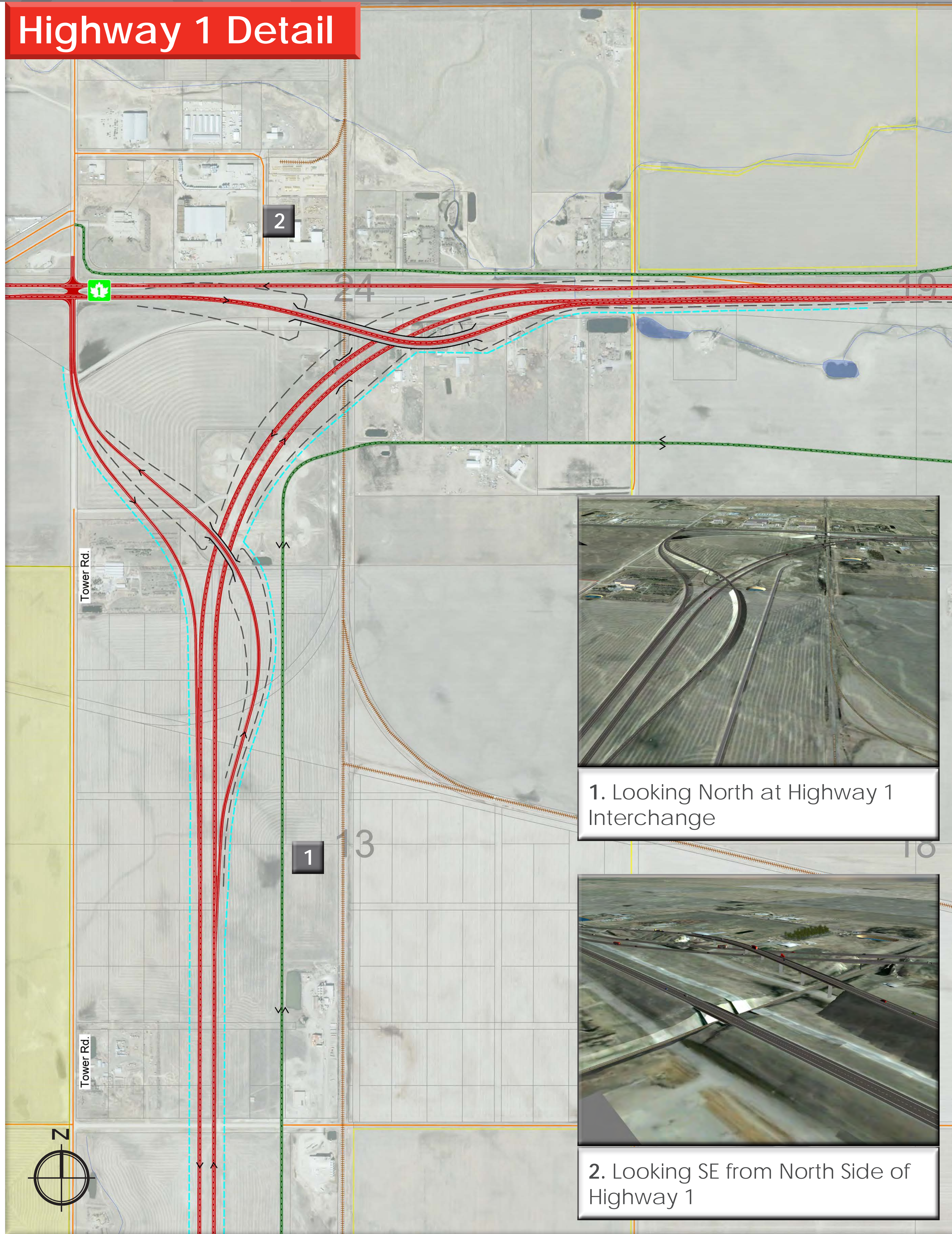
Summary of Preferred Concept:

- ▶ Maintains high speed free-flow operation for traffic on Highway 1
- ▶ Moves Highway 33 interchange away from Chuka Creek
- ▶ Provides a buffer between the Southeast Regina Bypass and existing urban development
- ▶ Provides flexibility for a future interchange at the Tower Road and Victoria Avenue intersection
- ▶ Can provide a connection to the future Northeast Regina Bypass if required
- ▶ Ability to keep all existing lanes on Highway 1 open during construction
- ▶ Greater impacts to some RM of Sherwood residents and landowners
- ▶ Higher cost and risk associated with more complex bridge structures

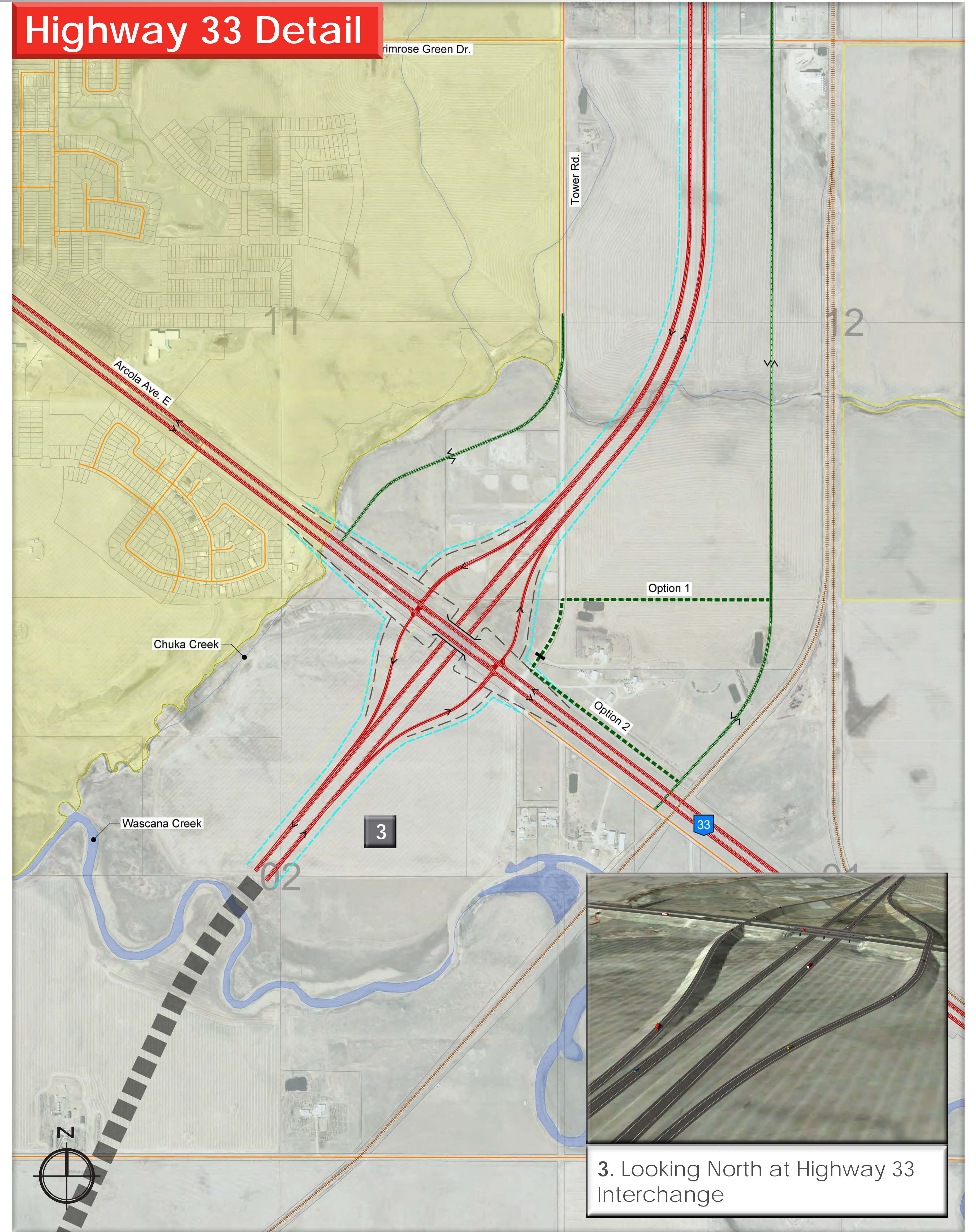
PREFERRED OPTION DETAILED VIEWS

Southeast Regina Bypass Functional Design Study

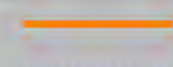


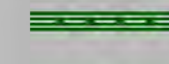

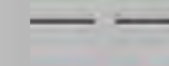


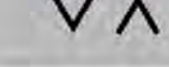
Highway 1 Detail



Highway 33 Detail



LEGEND:

	EXISTING ROADWAY		PROPOSED BYPASS
	RAILWAY		PROPOSED SERVICE ROAD
	URBAN MUNICIPALITY		ESTIMATED EMBANKMENT
	RURAL MUNICIPALITY		PRELIMINARY PROPERTY LINE
			TRAFFIC DIRECTION

NEXT STEPS?

Southeast Regina Bypass Functional Design Study - Open House #2:

- ▶ Continue to develop the design based on feedback from the open house
- ▶ Conduct further consultation with impacted stakeholders
- ▶ Prepare functional design report for submission to the Ministry
- ▶ Ministry will recommend approval of the bypass location to the Minister
- ▶ **Public notification on Ministerial approval**

Southeast Regina Bypass Functional Design Study
Stakeholder Comments - Open House #2 - August 15, 2013

No	Comment
1	A copy of the maps should have been available at the Open House
2	Have a few more Open Houses - the more the better
3	Give people hand outs at the Open Houses
4	Change the location of the Open Houses - go to different centres and buildings
5	Have people on a mailing list and send them information. Mail something out every month.
6	We own lands in the area and we fully support concept 2a. Pleased to see this plan approved and passed
7	Pleased to see S.E. plan moving further east. Concept 2a as preferred and proposed is fully supported.
8	Tower Road location is no longer suitable as the east terminal for the bypass due to recent changes in east Regina. To set restrictive parameters on only one location for the east terminal does not allow for good planning/engineering
9	The evaluation process used in this study is very subjective.
10	What impact do the public consultations have on the final location decision?
11	How does the future NE bypass fit into the functional plan?
12	The preferred bypass concept completely freezes out development of our property.

VE Workshop Agenda

The VE Workshop was a four day session that took place in Regina, Saskatchewan between May 6 and May 9, 2013. The VE Workshop agenda is presented below:

Day 1

8:00 a.m. – 8:15 a.m.	Convene and Caffeine Breakfast	
8:15 a.m. – 8:30 a.m.	Welcome and Introductions An Introduction to Value Analysis (VA) Workshop Agenda and Guidelines	Chris Gauer
8:30 a.m. – 9:00 a.m.	Information Phase (1a) Project Goals and Objectives Possible Constraints on Value Analysis Approach Presentation of Project	Bruce Belmore
9:00 a.m. – 10:00 a.m.	Information Phase (1b) Basis of Design (Current Design Concept) Rationale for Design Choices Review of Design Elements and Major Components	Bruce Belmore
10:00 a.m. – 10:15 a.m.	Break	
10:15 a.m. – 11:00 a.m.	Information Phase (1c) Landowner Issues and Concerns (10 minutes each)	
11:00 a.m. – 12:00 p.m.	Site Visit	
12:00 p.m. – 1:00 p.m.	Break for Lunch	
1:00 p.m. – 2:30 p.m.	Information Phase (1d) Review Cost Model Brainstorm Performance Criteria	Charlie Billings Chris Gauer
2:30 p.m. – 3:00 p.m.	Function Analysis Phase (1e) Present “FAST” Diagram and FAST Guidelines Brainstorm FAST Diagram Functions Identify Value Target Functions / Areas	Chris Gauer
3:00 p.m. – 3:15 p.m.	Break	
3:15 p.m. – 5:00 p.m.	Creative Phase (2a) Generate ideas according to Value Target Areas	Chris Gauer
5:00 p.m.	Adjourn Day 1	

Day 2

8:00 a.m. – 8:15 a.m.	Convene and Caffeine Breakfast	
8:15 a.m. – 10:00 a.m.	Creative Phase (2b)	Chris Gauer
10:00 a.m. – 10:15 a.m.	Break	
10:15 a.m. – 12:00 p.m.	Creative Phase (2c) Generate ideas according to Value Target Areas	Chris Gauer
12:00 p.m. – 1:00 p.m.	Break for Lunch	
1:00 p.m. – 3:00 p.m.	Evaluation Phase (3a) Weight Performance Criteria Initial Evaluation of Creative Ideas	Chris Gauer
3:00 p.m. – 3:15 p.m.	Break	
3:15 p.m. – 5:00 p.m.	Evaluation Phase (3b) Select Best Concepts for Development	Chris Gauer
5:00 p.m.	Adjourn Day 2	

Day 3

8:00 a.m. – 8:15 a.m.	Convene and Caffeine Breakfast	
8:15 a.m. – 10:00 a.m.	Development Phase (4a) Assign Sub-Teams to Develop Selected Ideas into VE Proposals Prepare VE Proposal Concepts, Estimates, Calculations, etc. Document Advantages, Disadvantages, Added Factors, Benefits Document VE Proposals Performance against Criteria	Chris Gauer
10:00 a.m. – 10:15 a.m.	Break	
10:15 a.m. – 12:00 a.m.	Development Phase (4b) Sub-Teams Present VE Proposals to Entire VE Team VE Team Discuss Results, Recommend Modifications	Chris Gauer
12:00 p.m. – 12:45 p.m.	Break for Lunch	

12:45 p.m. – 2:30 p.m.	Scenario Development Phase (5a) Create Scenarios from Development Results Document Advantages, Disadvantages, Added Factors, Benefits	Chris Gauer
2:30 p.m. – 2:45 p.m.	Break	
2:45 p.m. – 5:00 p.m.	Scenario Development Phase (5b) Document Scenario Scoring on Performance Criteria Measures	Chris Gauer
5:00 p.m.	Adjourn Day 3	

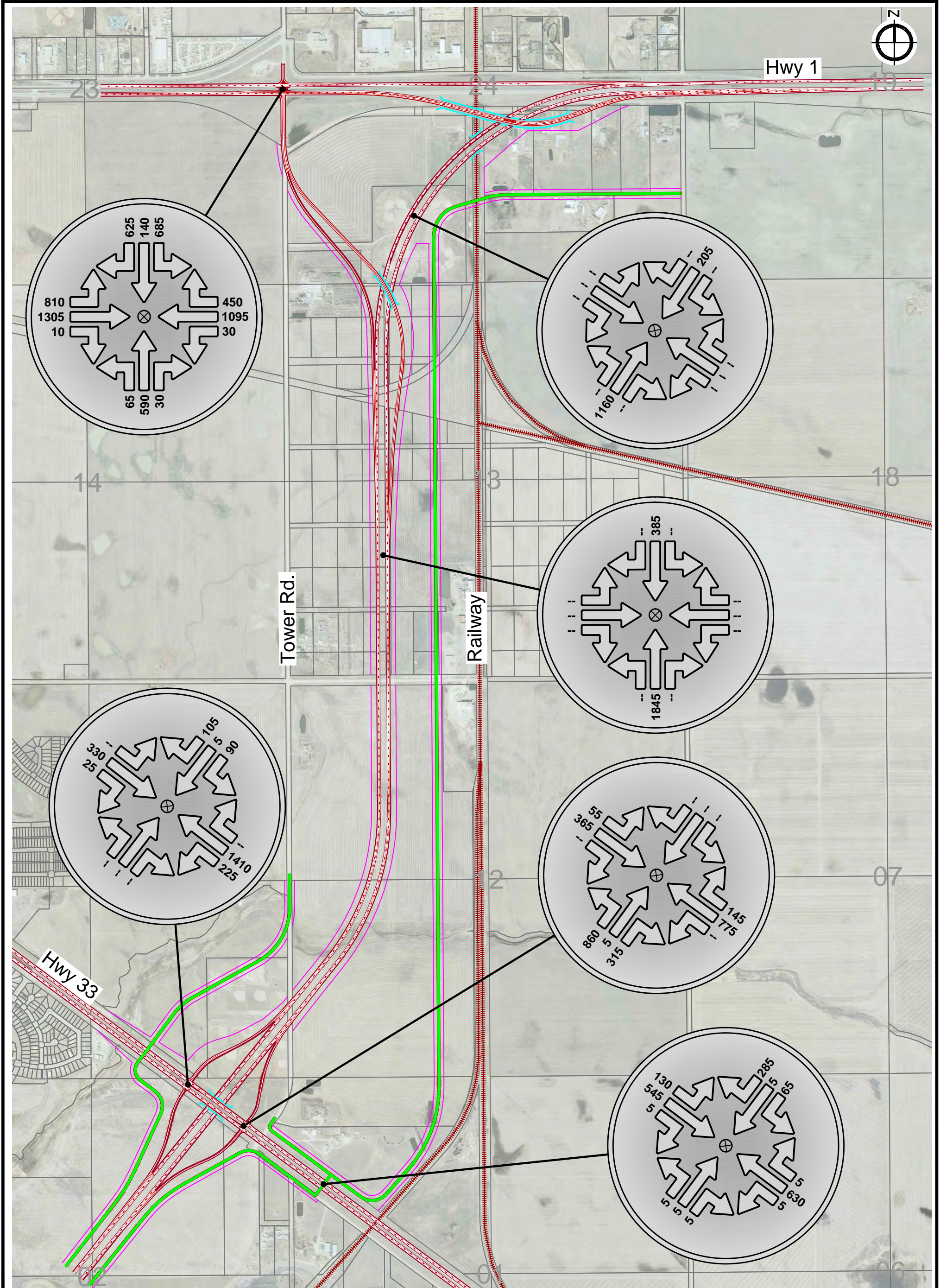
Day 4

8:00 a.m. – 8:15 a.m.	Convene and Caffeine Breakfast	
8:15 a.m. – 10:00 a.m.	Scenario Development Phase (5c) Document Evaluation Scoring and Discussions Select Recommended Scenario	Chris Gauer
10:00 a.m. – 10:15 a.m.	Break	
10:15 a.m. – 12:00 p.m.	Presentation Phase (6a) Summary of Conclusions Prepare Outline of Presentation of VA Concepts to Client	Chris Gauer
12:00 p.m. – 12:45 p.m.	Break for Lunch	
12:45 p.m. – 3:00 p.m.	Presentation Phase (6b) Prepare Presentation	All
3:00 p.m. – 3:15 p.m.	Break	
3:15 p.m. – 4:00 p.m.	Presentation	All
4:00 p.m.	Adjourn Day 4	

SCENARIO EVALUATION MATRIX

1. HOW WELL DOES THE SCENARIO SATISFY THE PERFORMANCE CRITERIA (ENTER RATING FROM 1-10, 10=BEST) 2. ENTER ASSIGNED WEIGHT TIMES RATING IN SUB TOTAL 3. SUM ACROSS AND RANK	Performance Criteria	Freeway Operation	Access	Safety	Property	Phasing	Constructability	Municipal Operations	Environment	Total Performance (P)	Comparative Estimated Total Capital Cost - \$ M (C)	P/C
	Performance Measure											
SCENARIOS	Weight →	29	13	14	9	14	2	17	2			
BASE CASE	Rating 1-10	3.00	5.00	5.00	5.00	4.00	5.00	5.00	5.00			
	Sub Total	87.00	65.00	70.00	45.00	56.00	10.00	85.00	10.00	428	128.0	3.3
SCENARIO 1: Tower Road Alignment and Directional Interchange, Existing Hwy 33 Interchange Location	Rating 1-10	9.00	8.00	5.00	4.00	9.00	8.00	5.00	6.00			
	Sub Total	261.00	104.00	70.00	36.00	126.00	16.00	85.00	12.00	710	121.0	5.9
SCENARIO 2: 400 m East Realignment and Directional Interchange, east of Hwy 33 interchange location	Rating 1-10	7.00	8.00	5.00	3.00	9.00	8.00	5.00	7.00			
	Sub Total	203.00	104.00	70.00	27.00	126.00	16.00	85.00	14.00	645	127.0	5.1
SCENARIO 3: Scenario 1 with Diamond Interchange at Tower Rd	Rating 1-10	9.00	6.00	8.00	4.00	6.00	6.00	7.00	6.00			
	Sub Total	261.00	78.00	112.00	36.00	84.00	12.00	119.00	12.00	714	150.0	4.8
SCENARIO 4: Scenario 2 with Diamond Interchange at Tower Rd	Rating 1-10	7.00	6.00	7.00	3.00	6.00	6.00	7.00	7.00			
	Sub Total	203.00	78.00	98.00	27.00	84.00	12.00	119.00	14.00	635	156.0	4.1

SEEK THE BEST - NOT PERFECTION



LEGEND:



FORECAST PEAK HOUR MOVEMENT VOLUMES



RIGHT-OF-WAY



DESIGN BRIDGES



DESIGN ROADS



DESIGN SERVICE ROADS



MMM Group Limited
601 - 1853 Hamilton St.
Regina, SK, S4P 2B9
t. 306.522.7158
www.mmm.ca

Issued Date - 2013-12-13
Aerial Imagery - N/A
Scale: metres
0 100 200

Appendix
2040 PM Peak Hour Traffic Volumes
Southeast Regina Bypass - Detailed Functional Design

Klimochko Consulting Inc.

Professional Civil/Geotechnical Consulting Engineer
2635 Lacombe Crescent • Regina, Saskatchewan • S4V 1T4
Phone: (306) 789-9849 • Cell: (306) 570-2789 • E-mail: kci@sasktel.net

Introduction

This report presents the results of a literature search of soil and groundwater conditions along the proposed Regina South-East Bypass extending from the junction of Highway No. 1 and Tower Road (i.e. CKCK TV station) in a southerly direction to a junction with Highway No. 33 (i.e. extension of the City of Regina's Arcola Avenue) to be located just east of where Chuka Creek crosses the highway. This portion of the proposed bypass corridor is approx. 4 kilometres. See **Figure 1** showing proposed bypass route.

Information and related data reviewed during the literature search for this project are noted as follows:

1. Soil Map of the Regina, Saskatchewan Area Sheet (East half of 72I); Published and printed by the Soil Research Institute, Research Branch, Canada Department of Agriculture, Ottawa, 1964
2. Preliminary Geotechnical Investigation Highway No. 1 Southeast Regina Bypass, Regina, Saskatchewan; Ground Engineering Ltd. File No. GE-0552, March 12, 2007.
3. Saskatchewan Ministry of Highways and Infrastructure Materials Testing Laboratory Borehole Test Report; Control Section 1-08, Borehole No. 1-73, File Supervision - D. Fairburn, Date - Jan 5, 1973, Location – highway median approx. 0.8 km east of CKCK TV station.
4. Saskatchewan Water Security Agency website; <https://gis.wsask.ca/> - Water Well Driller Report data
5. Saskatchewan Water Security Agency website; <https://www.wsask.ca/Water-Info/Ground-Water/Mapping/Regina-Mapsheet-72I/> - Map 7 – Saskatoon Group Aquifers; Report - Geology and Groundwater Resources of the Regina Area (72I), Saskatchewan.

Surficial Soil

As shown in **Figure 1**, the surficial soil along the proposed bypass location is comprised of uniform, very fine-textured (i.e. soil particle not visible to the naked eye), cohesive, heavy (i.e. highly plastic) clay known locally as Regina Clay. Regina Clay has a very high plasticity index value (i.e. liquid limit – plastic limit difference) in the order of 30 – 50 percent. Unlike non-cohesive soils such as sand and gravel, cohesive soils such as Regina Clay are known to exhibit significant volume change properties (i.e. swelling upon wetting, shrinkage upon drying).

Roads constructed with Regina Clay generally exhibit more deterioration of geometric cross-slope and have higher frequency and increased severity of pavement cracking than those constructed of glacial till. One method used to reduce this material's swell/shrinkage potential consists of thoroughly incorporating a minimum of 2 percent of quicklime to weight of soil in the top 600 mm of a road subgrade.

In addition, Regina Clay is often associated with slope stability problems when used in the construction of highway embankments (i.e. Belle Plaine Overpass on Hwy. No. 1). The minimum side-slope of an embankment constructed exclusively with Regina Clay higher than 3 metres should be 6:1 and possibly more depending on height of grade. One method to increase long-term slope stability factor of safety of an embankment is to incorporate a layer of sand of sufficient thickness uniformly spaced throughout the embankment (e.g. 200-mm thick layer of free-draining sand every 2 m of embankment). It's noted the base of the clay embankment may require a thicker sand layer to accommodate an engineered drainage system required for facilitating quicker pore pressure dissipation during construction and increase over-all long-term slope stability.

Subsurface Soil Conditions (Stratigraphy)

Subsurface soil conditions obtained from three data sources reviewed for this study are described as follows:

1. GE Ground Engineering Ltd. 2007 Stratigraphic Test Hole Nos. 0552-102 & 103

TH 102 – Depth: 30.5 m, GPS Loc: N 5588404.75, E 534938.58; Elevation: 583.44 m; Date: Nov 5, 2007

Stratigraphy

0.0 – 7.0 m	CLAY , silty, highly plastic, moist, oxidized, iron & manganese stains and salt crystals (fluctuating water table), dark greyish brown (2.5Y 4/2)
7.0 – 10.1 m	SILT , clayey, very moist to wet, soft to firm, oxidized, dark greyish brown (2.5Y 4/2)
10.1 - 11.0 m	TILL , clayey, moist, oxidized, stiff to hard, iron and manganese stains, and salt crystals, dark greyish brown (2.5Y 4/2)
11.0 – 13.1 m	SAND lens , gravelly, wet
13.1 – 30.5 m	TILL , same as above except unoxidized, dark gray (5Y 4/1)
Field Notes	<ol style="list-style-type: none"> 1. Seepage & sloughing observed between 9 – 13 m during drilling. 2. Water level was measured 2.7 m below ground surface 15 hours after completion. 3. Testhole sloughed in at 11.9 m below ground surface. 4. Shale lens between 25.6 and 25.9 m?

TH 103 – Depth: 16.8, GPS Loc: N 5584572.37, E 534786.68; Elevation: 573.87 m; Date: Nov 29, 2007

Stratigraphy

0.0 – 3.7m	CLAY , silty, highly plastic, moist, oxidized, iron & manganese stains and salt crystals (fluctuating water table), dark greyish brown (2.5Y 4/2)
3.7 – 6.2m	SILT , clayey, very moist to wet, soft to firm, unoxidized below 4.3 m, olive brown (2.5Y 4/1) to dark olive gray, (5Y 3/2)
6.2 – 10.5 m	TILL , clayey, moist, firm, unoxidized, dark grey (5Y 4/1)
10.5 – 14.0 m	SAND , fine to coarser with depth, unoxidized, gray (5Y 5/2, stone at 13 m)
14.0 – 16.8 m	TILL , same as above except very dark grey (5Y 3/1)
Field Notes	<ol style="list-style-type: none"> 1. Sand unit at 10.5 m below ground surface is under artesian pressure. 2. Once penetrated, the water level in the test hole rose to existing grade. 3. Test hole was sealed to grade by pumping a cement grout/bentonite mixture to displace the accumulated groundwater in the hole.

2. Saskatchewan Ministry of Highways and Infrastructure Borehole Report – Test Hole CS 1-08 1-73

TH 1-73 – RR overpass on Hwy 1, 0.8 km E of Tower Road, Elevation: 586.65 m; Date: Jan 11, 1973

Stratigraphy

0.0 – 5.8 m	CLAY , silty, calcareous, highly plastic, moist, oxidized, iron & manganese stains white salt particles, selenite crystals , dark grayish brown (2.5Y 4/2)
5.8 – 9.1 m	SILT , clayey, calcareous, very soft, wet, oxidized & unoxidized , dark greyish brown (2.5Y 4/2)
9.1 - 10.0 m	TILL , lean (silty – sandy), very little clay, calcareous, massive, not jointed, moist, oxidized & unoxidized, dark greyish brown (2.5Y 4/2 – 4/4)
10.0 – 11.0 m	Gravel , particle top size 1.2 mm, rounded to sub-rounded, inter-till gravel?
11.0 – 79.2 m	TILL , clayey, calcareous, hard, massive, moist, unoxidized, dark gray (5Y 3/2)
Field Notes	<ol style="list-style-type: none"> 1. Inter-till stratified drift zones observed at depths of 80 – 120 m and 60 – 71 m. 2. Shale, silty clay, non-calcareous, unoxidized, dry, laminated, dark grey (5Y 5/1), encountered at a depth of 73 m. 3. Four piezometers were installed at depths of 7.6, 10.7, 31.1 and 78.9 m at this location. Unfortunately, no subsequent piezometer reading values were able to be located in the files.

See **Figure 2** showing location to Ground Engineering Ltd. Test Hole Nos. 102 & 103 (2007) and Sask. MHI Test Hole No. 1-73 (1973) used to define soil stratigraphy associated with the proposed bypass route.

3. Saskatchewan Water Security Agency Website (<https://gis.wsask.ca/>): Water Well Driller Reports

Additional inferred soil and groundwater data was obtained from Saskatchewan Water Security Agency’s website containing driller’s reports for 16 water wells located within close proximity to the proposed bypass. See **Figure 3** consisting of table showing the inferred soil stratigraphy and groundwater conditions on property adjacent to the proposed route.

Using information extracted from the water well driller’s borehole logs, the inferred soil stratigraphy along the proposed bypass route is summarized as follows:

Inferred Stratigraphy

Soil Layer	Material	Approx. Thickness (feet) *
1 (Top)	Clay	22 ± 5
2	Silt	5 ± 5
3	Till	20 ± 10
4 (Btm)	Granular (water bearing)	8 ± 4

* Note that soil layer thickness is shown in feet instead of metres.

Static and Artesian Groundwater Conditions

Static and artesian groundwater conditions obtained from two data sources reviewed for this study are noted as follows:

1. GE Ground Engineering Ltd. 2007 Stratigraphic Test Hole Nos. 0552-102 & 103

TH 102 – Depth: 30.5 m, GPS Loc: N 5588404.75, E 534938.58; Elevation: 583.44 m; Date: Nov 5, 2007

Groundwater (sources of seepage)

Soil Technician Field Notes	<p>1. Water level was measured 2.7 m below ground surface 15 hours after completion.</p> <p>2. Seepage & sloughing observed between 9 – 13 m during drilling.</p> <p>3. Testhole sloughed in at 11.9 m below ground surface.</p>
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TH 103 – Depth: 16.8, GPS Loc: N 5584572.37, E 534786.68; Elevation: 573.87 m; Date: Nov 29, 2007

Groundwater (sources of seepage)

Soil Technician Field Notes	<p>1. Sand unit at 10.5 m below ground surface is under artesian pressure.</p> <p>2. Once penetrated, the water level in the test hole rose to existing grade.</p> <p>3. Test hole was sealed to grade by pumping a cement grout/bentonite mixture to displace the accumulated groundwater in the hole.</p>
------------------------------------	----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

2. Saskatchewan Ministry of Highways and Infrastructure Borehole Report – Test Hole CS 1-08 1-73

TH 1-73 – RR overpass on Hwy 1, 0.8 km E of Tower Road, Elevation: 586.65 m; Date: Jan 11, 1973

Groundwater conditions based on water level readings taken on two occasions separated by more than year apart at four piezometers installed at the above-mentioned site almost 40 ago are shown as follows:

Piezometer	Piezometer Tip Elev. (feet)	Soil Zone Type	Piezometer Rdg. (feet below ground) *	
			Jan. 19, 1973	Jul. 7, 1974
1-73	259	Shale	39.8	26.6
1-73A	na	na	--	--
1-73B	102	Inter-Till Stratified Drift	20.0	14.7
1-73C	35	Inter-Till Gravel Seam	16.9	12.6
1-73D	25	Silt	16.9	13.0

* Note that piezometer water level depths readings are shown in feet instead of metres.

Full piezometer details and readings from this location can be found in **Figure 4**.

3. Saskatchewan Water Security Agency Website (<https://gis.wsask.ca/>): Water Well Driller Reports

Groundwater data obtained from Saskatchewan Water Security Agency’s website containing driller’s reports shows 3 of the 16 water wells identified above are under artesian pressure, 2 of which are noted to be above ground (flowing), and 1 just below ground as highlighted below.

No.	Legal Land Location	Water Well Report #	Surface Elevation (ft.)	Water Well Depth (ft.)	Water Level (ft.) ①	Un-oxidized Depth (ft.)	Inferred stratigraphy taken from water-well driller report
4	SE-01-17-19-W2	117804	1900	74 or 78 (?)	2 ft. above grade	(?)	70 - 77: Sand, grey
5	SW-01-17-19-W2	011184	1890	82	1 ft. below grade	32	61 - 64; Sand, fine 67 - 71: Sand & Gravel, medium 77 - 82: Gravel, coarse
7	NW-12-17-19-W2	109970	1900	55	16 ft. ② above grade	27	45 - 55: Gravel

① Artesian water levels at this site are unconfirmed at this site due to lack of piezometers.

② This noted water level of 16 ft. above ground seems unrealistically high.

In addition to the three artesian wells identified above, see **Figure 5** comprising a map extracted from the Saskatchewan Water Security Agency website showing there a number of flowing wells (represented by red stars) located north, east, and south of the proposed bypass route. Its noted that if a thick, porous water-bearing sand/gravel seam under high artesian pressure should be exposed due to excavation, the construction operation may have to be adjusted very quickly before the artesian flow gets out of hand.

With respect to the remaining 13 of the 16 WSA water wells that were identified as being under very little if any artesian pressure at all, the average depth of the water level below ground surface as observed by the driller during the drilling of the well was approx. 20 ± 15 feet. This seems to coincide quite close to that observed at the RR Overpass on Hwy 1 keeping in the water level readings last taken in 1976.

Conclusion

Based on information reviewed for this study, the three most important items that are at the forefront are as follows:

1. The natural moisture contents of both surficial highly plastic clay and underlying silt shown in Ground Engineering’s 2007 Test Hole Nos. 102 and 103 were observed to as much as 8 – 15 percent above their respective plastic limit value indicating both these soils are soft, wet materials that may be cause some excavation problems.

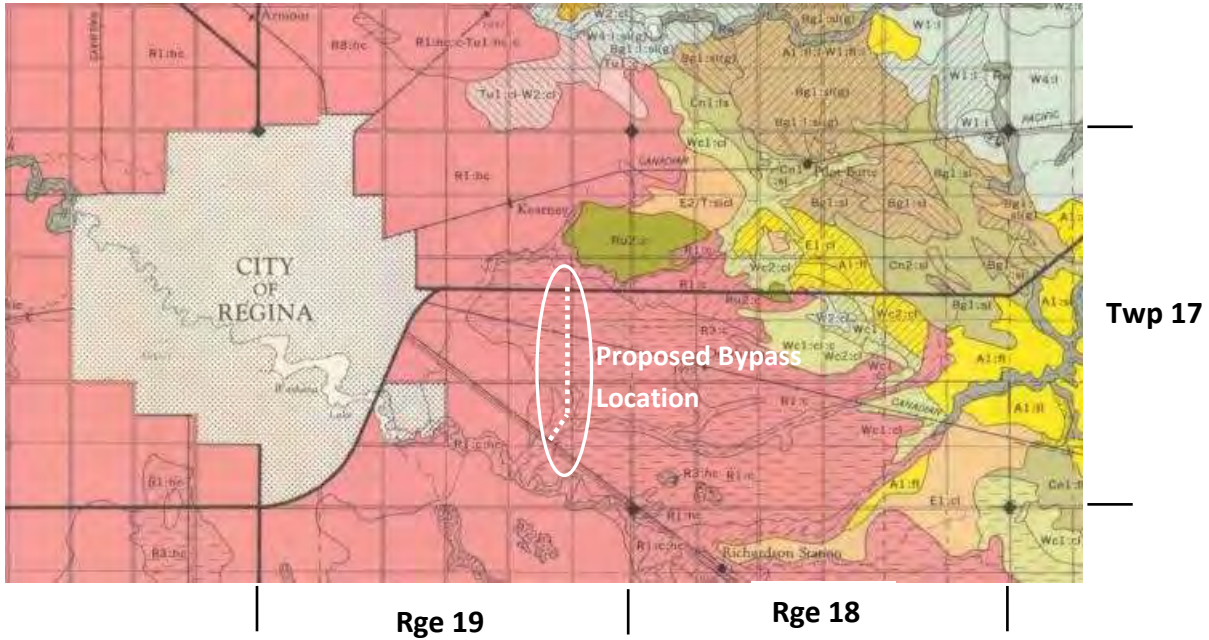
2. The natural moisture content of the Glacial Till underlying the Silt is shown to be at worst 3 – 4 percentage points above the material's Plastic Limit value indicating it should be relatively amenable for excavation.
3. Both Ground Engineering 2007 Test Holes 102 and 103 along with data from 3 of 16 Saskatchewan Water Security Agency water well records seem to indicate that some Inter-Till Sand and/or Gravel seams within the vicinity of the proposed route may be under sufficient artesian pressure to cause water to flow above ground surface. The artesian conditions need to be identified in order to keep problems with groundwater seepage into excavations involving concrete pile construction, deep-type borrow pits, and steam crossing structure).









Recommendation

It is recommended that the artesian groundwater conditions that supposedly exist on this proposed project's location be properly quantified by having a series of piezometers installed in each Inter-Till Sand and Gravel seam that is greater than 0.7 m thick within 25 m below ground surface at key sites involving deep excavations.

MMM Regina South-East Bypass Study

Figure 1 - Map showing Surficial Soil Conditions in Vicinity of Proposed Bypass Location

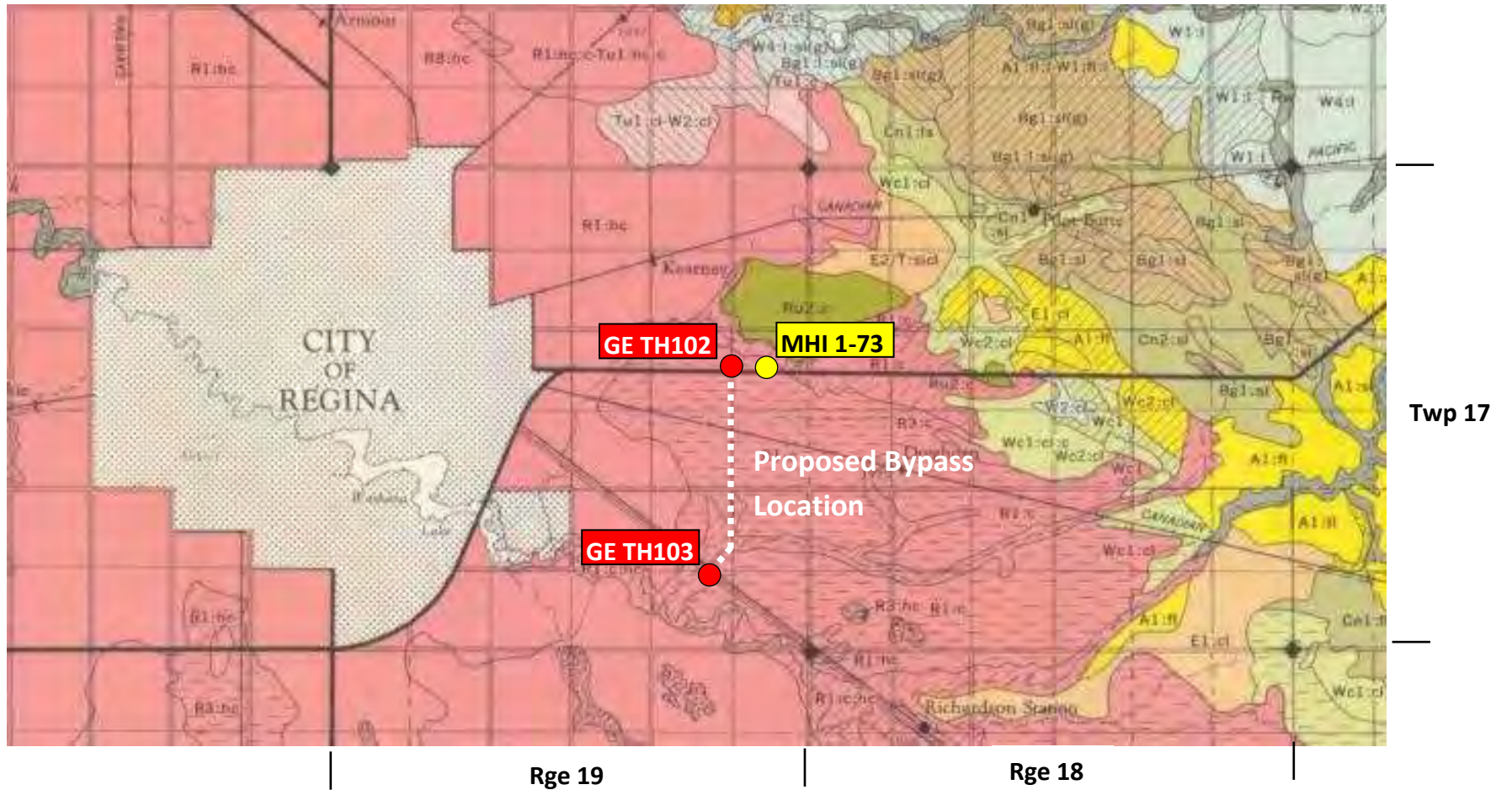


DARK BROWN SOILS						
DOMINANTLY CHERNOZEMIC						
	WEYBURN	W1	Orthic Dark Brown	Calcareous Dark Brown, Orthic Regosol and Gleysolics	Medium textured, calcareous glacial till.	Loam, sandy clay loam, light clay loam.
		W2	Orthic Dark Brown			
		W3	Orthic Dark Brown	Elevated Dark Brown		
		W4	Orthic Dark Brown	Calcareous Dark Brown and Orthic Regosol		
		W5	Orthic Dark Brown	Gleysolics		
	WEYBURN- OXBOW	WO1	Orthic Dark Brown	Orthic Black	Medium textured, calcareous glacial till.	Loam, sandy clay loam, light clay loam.
		WO2	Orthic Dark Brown	Calcareous Dark Brown, Orthic Black and Gleysolics.		
	AMULET	Am1	Orthic Dark Brown	Calcareous Dark Brown, Orthic Regosol and Gleysolics	Moderately fine textured, calcareous and gypsiferous glacial till.	Loam, clay loam, light clay.
		Am2	Orthic Dark Brown			
	BIGGAR	Bg1	Orthic Dark Brown		Coarse to moderately coarse textured glacio-fluvial deposits.	Loamy sands, sandy loam (gravely).
	ASQUITH	A1	Orthic Dark Brown		Coarse to moderately coarse textured alluvial lacustrine deposits.	Loamy sands, sandy loams, fine and very fine sandy loams.
	BRADWELL	Br1	Orthic Dark Brown		Medium to moderately fine textured, calcareous, sandy alluvial-lacustrine deposits. Br/T—shallow deposits (less than 4 ft.) overlying glacial till.	Fine and very fine sandy loams, sandy clay loam.
	ELSTOW	E1	Orthic Dark Brown	Calcareous Dark Brown	Medium to moderately fine textured, calcareous, silty alluvial-lacustrine deposits. E/T—shallow deposits (less than 4 ft.) overlying glacial till.	Loam, silt loam, clay loam, silty clay loam.
		E2	Orthic Dark Brown			
	REGINA	R1	Rego Dark Brown	Orthic Dark Brown and Gleysolics	Uniform, fine textured, calcareous lacustrine deposits.	Clay, heavy clay.
		R2	Rego Dark Brown			
		R3	Gleysolic			

*

DOMINANTLY SOLONCHIC

Figure 2 - Map showing location of GE Ground Engineering Ltd. 2007 and Sask. MHI 1973 Test Holes used to define Soil Stratigraphy



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Figure 3 - Table showing WSA Driller Report Summaries for Water Wells located in close proximity to proposed bypass route

No.	Legal Land Location	Water Well Report #	Ground Elev (ft)	Borehole Depth (ft)	Water Level (ft)	Unoxid Depth (ft)	Well Casing Depth (ft)	Well Screen Depth (ft)	Inferred stratigraphy taken from water-well driller report
1	NW-01-17-19-W2	011180	1890	120	11 (?)	29 (?)	51	56	0 - 29: Clay, brown 29 - 34: Clay, silty, grey 34 - 49: Till, grey 49 - 58: Gravel, coarse 58 - 62: Till, grey 62 - 64: Gravel, medium-coarse 64 - 73: Till, grey, gravel seams 73 - 76: Gravel, coarse 76 - 79: Till, grey 79 - 84: Silt, grey 84 - 86: Gravel, coarse 86 - 110: Till, grey 110 - 120: Shale, grey
2	NW-01-17-19-W2	011181	1880	67	10 (?)	25 (?)	62	67	0 - 25: Clay, brown, boulders (?) 25 - 50: Clay, blue (grey?) 50 - 67: Gravel, medium-coarse
3	NW-01-17-19-W2	117804	1914	60	15 (?)	(?)	52	57	0 - 25: Lake bottom (presume Clay ?) 25 - 50: Till, brown (no change to grey?) 50 - 58: Sand, coarse 58 - 60: Till, brown (not grey?)
4	SE-01-17-19-W2	117804	1900	74 (?) or 78 (?)	+2 (flowing?)	(?)	78 (?)	80 (?)	0 - 1: Topsoil 1 - 23: Till, yellow (brown?) 23 - 70: Till, sandy, grey 70 - 77: Sand, grey 77 - 80: Till, grey
5	SW-01-17-19-W2	011184	1890	82	1 (artesian but not flowing?)	32	77	82	0 - 30: Clay, brown 30 - 32: Clay, grey 32 - 48: Till, sandy, grey 48 - 49: Limestone, boulder 49 - 56: Clay, silty, grey 56 - 57: Sand, fine 57 - 61: Silt, grey 61 - 64: Sand, fine 64 - 67: Silt, grey 67 - 71: Sand & Gravel, fine-medium 71 - 77: Silt, sand streaks (lenses?) 77 - 82: Gravel, coarse 82 - 100: Shale, grey
6	NE-01-17-19-W2	104028	1886	50	10	43 (?)	38	43	0 - 1: Topsoil 1 - 38: Clay, yellow 38 - 43: Gravel 43 - 50: Till, grey
7	NW-12-17-19-W2	109970	1900	55	+16 (flowing?)	27	47	52	0 - 1: Topsoil 1 - 27: Clay, yellow (brown?) 27 - 38: Silt, grey 38 - 45: Till, grey 45 - 55: Gravel
8	NW-13-17-19-W2	011211	52	?	?	30	?	?	0 - 25: Clay, black (grey?) 25 - 30: Silt 30 - 52: Clay (glacial clay till?), black, stoney
9	SW-13-17-19-W2	007923	1900	40	(?)	12 (?)	38 (?)	40 (?)	0 - 12: Clay, yellow (brown?) 12 - 35: Clay, blue (grey?) 35 - 37: Gravel 37 - 40: Clay, blue (grey?)
10	SW-13-17-19-W2	076872	1900	45	+5 (flowing?)	6 (?)	45 (?)	20 (?)	0 - 1: Topsoil, 1 - 6: Clay, yellow (brown?) 6 - 32: Till, grey, soft 32 - 34: Gravel, grey, medium-coarse 34 - 45: Till, grey

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Figure 3 - Table showing WSA Driller Report Summaries for Water Wells located in close proximity to proposed bypass route

No.	Legal Land Location	Water Well Report #	Ground Elev (ft)	Borehole Depth (ft)	Water Level (ft)	Unoxid Depth (ft)	Well Casing Depth (ft)	Well Screen Depth (ft)	Inferred stratigraphy taken from water-well driller report
11	SE-24-17-19-W2	011232	1925	190	20	35	30	35	0 - 25: Clay, brown 25 - 35: Clay, sandy 35 - 179: Till, grey, boulders 179 - 184: Sand & Gravel 184 - 190: Till, grey
12	SE-24-17-19-W2	011233	1925	38	20	35 (?)	29 (?)	34	0 - 1: Topsoil 1 - 10: Clay, brown 10 - 19: Clay, yellow 19 - 26: Clay, silty, blue (grey?) 26 - 27: Clay, blue (grey) 27 - 35: Sand, yellow 35 - 38: Clay, blue (grey?)
13	SE-24-17-19-W2	073418	1925	78	38	30 (?)	78 (?)	70 (?)	0 - 1: Topsoil 1 - 30: Till, brown, soft 30 - 36: Sand, grey, water 36 - 40: Till, grey, hard 40 - 42: Till, grey, water 42 - 45: Till, grey, hard 45 - 62: Till, grey, soft 62 - 67: Gravel, grey, medium 67 - 78: Till, grey
14	SE-24-17-19-W2	081947	1925	76	50	40 (?)	50 (?)	76 (?)	0 - 1: Topsoil 1 - 15: Till, yellow 15 - 30: Till, brown 40 - 55: Till, grey, soft. 55: Rock 55 - 66: Gravel, grey, water 66 - 76: Till, grey, water
15	SW-24-17-19-W2	085572	1900	53	8	?	35 (?)	50 (?)	0 - 1: Topsoil 1 - 13: Till, yellow 13 - 32: Clay 32 - 35: Sand, grey, water 35 - 37: Till, grey 37 - 44: Gravel, water 44 - 49: Sand, hard 49 - 53: Till, grey
16	SW-24-17-19-W2	098488	1925	45	33	20 (?)	40	45	0 - 20: Clay 20 - 36: Till, grey 36 - 45: Sand, coarse 45 - 120: Till, grey

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Figure 4 – Piezometer Details & Readings at RR Overpass on Hwy No. 1 located 0.8 km E of Tower Road

C.S. 1-E
 Location SANDSBO RESEARCH, 3 1/2 MI. E. OF CRCK. TR.

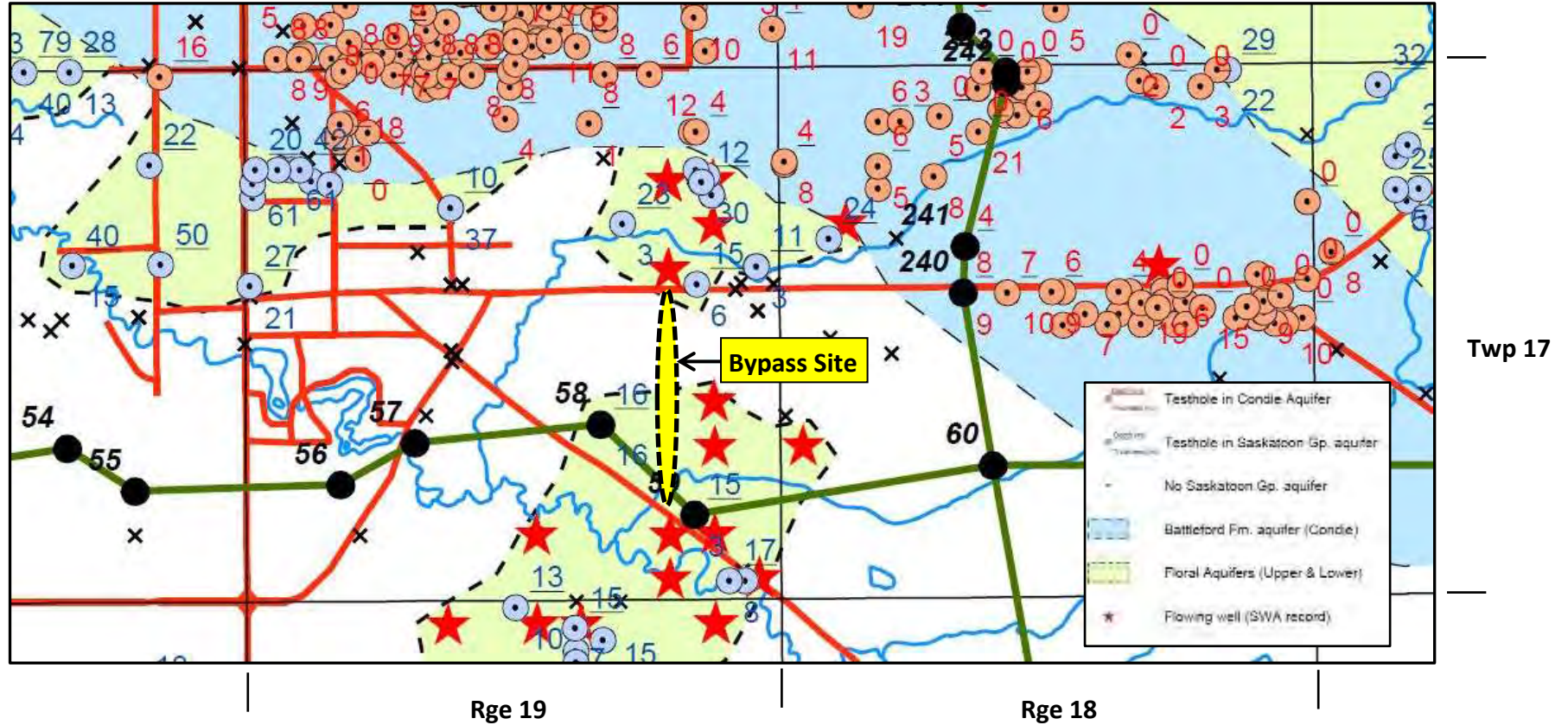
	DATE	DATE	DATE	DATE	DATE	DATE	DATE
	12/1/73	15/1/73	19/1/73	25/1/73	1/2/73	8/2/73	19/2/73
READ BY	FAIRBURN	FAIRBURN	FAIRBURN	ZELS	KOCH	KOCH	KOCH
HOLE #	READINGS	READINGS	READINGS	READINGS	READINGS	READINGS	READING
1-73	40.0	40.0	39.8	39.0	39.0	38.9	38.5
1A-73	NO PIEZOMETER						
1B-73	13.0	12.6	20.0	19.0	19.3	19.0	19.3
1C-73	7.2	16.7	16.9	16.0	17.0	17.3	17.0
1D-73	15.2	16.3	16.9	16.0	16.3	16.5	16.5

	5/3/73	26/3/73	8/5/73	30/5/73	31/6/73	10/9/73	25/10/73
	Koch	Koch	Koch	Koch	Kudopp	James	Koch
1-73	38.0	38.0	38.0	37.0	37.5	35.8	35.5
1A-73	NO PIEZOMETER						
1B-73	19.0	19.3	18.5	18.0	19.5	17.5	17.0
1C-73	17.0	17.5	17.0	17.3	19.0	14.8	14.0
1D-73	16.5	16.5	17.0	17.0	18.5	14.5	13.0

	11/4/74	22/5/74	10/7/74				
	Miller	Martin	LUTZ				
1-73	Not read	26.0	26.6				
1A-73	NO PIEZOMETER						
1B-73	15.0	15.0	14.7				
1C-73	14.0	14.1	12.6				
1D-73	13.3	13.7	13.6				

MMM Regina South-East Bypass Study

Figure 5 - Map showing Artesian Groundwater Conditions (★Flowing Wells) in vicinity of Proposed Bypass Route



Above map extracted from <https://www.wsask.ca/Global/Water%20Info/Ground%20Water/Mapping/Regina%20Mapsheets%20721/Maps/Map7.pdf>



October 15, 2013
File No. 577

MMM Group
601 - 1853 Hamilton Street
Regina, Saskatchewan
S4P 2B9

Attention: Jon Wyatt

RE: DRAINAGE ISSUES SOUTH EAST BYPASS

As follow-up to the October 7 2013 project meeting, I have prepared the following summary of drainage issues that will need to be considered in the final design of the SE Bypass from Highway #1 near Tower Road to Wascana Creek.

In general, the road drainage can be directed along the road ditches to three well defined outlets. The natural slopes can be expected to permit gravity drainage to these streams.

At the northeast end of this route, a small water course passes under the existing Highway, carrying runoff from south to north. This drainage course originates at the east side of Emerald Park and runs west, roughly parallel to the highway to a wetland near the communications towers then north through the highway to Pilot Butte Creek. This was an intermittent prairie drainage run that used to only drain agricultural land so the run off in the past was mainly spring snow melt. With the recent addition of commercial and residential development and anticipated future growth of these developments, urban storm water runoff can be expected to become more common. More frequent summer rain storm runoff can be anticipated. It is anticipated that the Rural Municipality of Edenwold will require developers to include detention storage to limit peak flows in severe floods to natural rates. A crossing structure with capacity similar to the existing structure will be needed.

North of Highway 33 (Arcola Avenue) the Bypass will cross Chuka Creek. Chuka Creek is a significant drainage course that can produce substantial flood lows. The Highway 33 crossing on Chuka Creek was designed for the 1:500 year flood with 3-1800 mm culverts. The bypass crossing will be upstream and will include a little less drainage area. It is also close to the railway crossing. Its design flow may be a little less than at Highway 33.

At the downstream end of this route the Bypass will cross Wascana Creek.

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These three natural drainage courses will provide outlets for the runoff from the project if ditches and culverts are appropriately designed. The ground provides gentle slopes that should allow the highway drains to discharge efficiently. The relatively flat terrain may make gravity drainage of any deep excavations difficult. Borrow pits may become undrained water bodies if they are too deep for gravity drainage.

The City and Province have been trying to keep the flood plain of the water courses clear of developments that could be damaged or interfere with the flow of flood waters. Chuka Creek is one of the water courses the City has been watching. At present the City limit west of Tower Road follows Chuka Creek. The City has required the developer who is currently considering plans for the north side of Chuka Creek between Highway #33 and Tower Road to maintain the City/Province standard of providing for a 1:500 year floodway. Earlier this year I completed a review of the flood risk and subdivision design north of Chuka Creek for the developer. I recommended a design flood level of 574.3 m and a safe building level of 574.8 m. I also advised that encroachments on the flood plain with fill should not go excessively below 573.3 m in order to keep sufficient flood plain to convey future flood flows. I suggested that the Floodway limit which would generally be defined by the 573.3 m contour and could be smoothed with filled areas downslope from the 573.3 m contour where backwater areas that would not assist the flow of water were filled. I have sketched a suggested limit of fill (Floodway Boundary) on the attached copy of the plan that was developed for the area north of the creek. This is well away from the main Bypass but the location of some of the service road proposals may be impacted. It should be noted that the City and Provincial water regulators have not considered the location of the Floodway limit south of the creek. This is only my recommended limit.

If I can be of further assistance, please contact me.

Yours Truly

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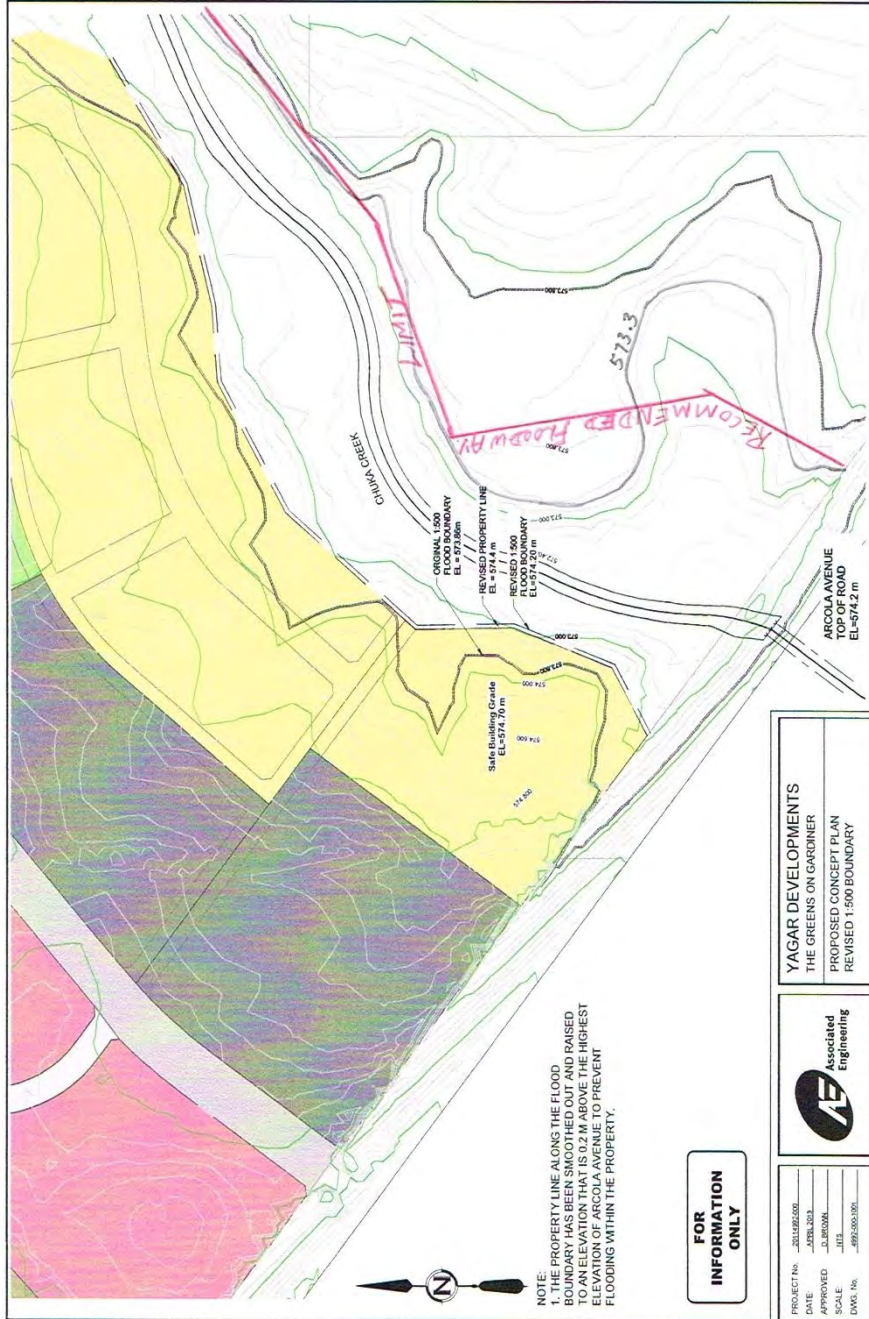


R. S. Pentland, P. Eng.

RSP/dp
577-13-10-15

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