

## DRAFT COMPREHENSIVE DEVELOPMENT REVIEW

## GREENBRYRE ESTATES – PHASE 3

Submitted to:

THE CORMAN PARK-SASKATOON PLANNING DISTRICT COMMISSION

Prepared by:

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In Association With:

CATTERALL & WRIGHT CONSULTING ENGINEERS  
WSP

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## EXECUTIVE SUMMARY

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D&S Developments Ltd. (the Developer) is applying to rezone and subdivide three parcels totaling 32.2 ha (79.5 acre), located in the SE 1/4 of Section 12, Township 36, Range 5, W3M from DAG1 to a new zoning district specific to Greenbryre Estates (DCR6) to provide for Phase 3 of the development. The proposed development is situated on lands located within the Corman Park-Saskatoon Planning District, immediately south of the City of Saskatoon, west of Boychuk Drive (Range Road 3050).

For Phase 3 of the development, the Developers believe smaller (approximately 0.35 acres), would be in the greatest demand. As such, there are 130 new single family lots proposed for this phase. Lastly, the Developer has an interest in developing a gated townhouse community on this parcel of land (84 units in total). Phase 3 of the Development will also be a part of the existing bare land condominium development. As such, all services including roads, utilities, infrastructure maintenance, and the existing recreational amenities will be paid for and managed by the Condominium Association. This CDR addresses all of Phase 3, however the developer is requesting that RM Council rezone the initial 54 residential lots (bare land condo units) to DCR6, with the remainder of Phase 3 be zoned to DCR6 with a holding provision (see attached Bare Land Condominium Plan and sketch in Appendix A).

Uptake for residential lots in Phase 1 and 2 has been exceptional and 97 homes are currently situated in the development resulting in a population of approximately 291 people. Projected population for Greenbryre at full build-out is 981 people and this number has been used to project future infrastructure needs.

A drainage and stormwater management review was undertaken as part of the municipal servicing study by Catterall & Wright Consulting Engineers. It is noted an additional two stormwater management ponds are proposed for Phase 3, not including the existing SAGR treated effluent holding pond. The ponds are connected by either open channel or piped connections. Storm water from the ponds is designed to irrigate the golf course and residential lots. A conceptual drainage plan for Phase 3 was undertaken as a part of this study. It is proposed that ponds be connected by an overland channel to flow water from one pond to the next. The system was sized to hold back-to-back 1:100 year storm events, as the intention is to not have an outlet, but rather use the runoff water as irrigation for the golf course and residential yards. It is noted that an additional factor of safety of 1.0 metre between the rear walkout elevations and High Water Level, based on a single 1:100-year storm event will be incorporated into the final grading plan. Vertical clearance to rear walkout elevations will also be maintained for back-to-back 100 year storm events. The total volumes required for storage will be confirmed within the detailed grading design.

A Traffic Impact Assessment was undertaken by WSP (formerly MMM Group) in October of 2016 with an update provided in January, 2019. The following recommendations were made within the updated TIA: (1) It was determined that the study intersections are currently operating at Level of Service (LOS) of "A", which means there are minimal delays and queue length on all approaches. Similarly, the intersections will continue to operate at LOS A at the completion of the development. As such, no additional improvements are required; (2) The speed limit along Range Road 3050 should be reduced to 60 km/h, which can transition to 80 km/h south of the

development; (3) It is recommended that a delineation lighting system be provided on the west approach (New Access Road) at the Range Road 3050 at New Access Road intersection; (4) Capacity analysis indicates that there will be minimal queuing along Range Road 3050. As such, no turning lanes will be required to accommodate traffic demand; (5) It is recommended that traffic operations along Range Road 3050 be monitored to determine the timing for turning lane improvements as further development beyond Greenbryre occurs which may result in longer queue lengths; (6) With the completion of the Highway 16 and Boychuk Drive interchange, the lighting system is provided along Boychuk Drive / Range Road 3055 up to just north of Township Road 362. As such, it is recommended that traffic volumes on Range Road 3055 be monitored as further development occurs beyond Greenbryre and that a corridor lighting system be considered as this segment becomes a more urbanized section, similar to Boychuk Drive on the north; and, (7) Boychuk Drive south of Greenbryre Lane is a low-grade gravel surface. It is recommended that a dust free improvement be considered up to the south boundary of the development.

Potable water is distributed to residents within Greenbryre Estates from a Water Treatment Plant that was constructed during Phase 1 of the development, along Boychuk Drive. The potable water is piped to the WTP by a 75 mm supply line, owned by SCS Water Group. Inc., which purchases potable water from SaskWater. According to the municipal servicing study provided by Catterall & Wright, the updated (2019) concept plan adds an additional 1.6 L/s of flow rate from the original (2012) concept, for a total of 11.7 L/s of design flow rate. As such, an additional treated water supply of 8.12 L/s is required for full buildout of Phase 3 of the development. Preliminary discussions have been undertaken with SaskWater to review a separate direct connection. SaskWater has indicated that they can supply the required 11.7 L/s. The required treated water storage for full buildout of the updated (2018) concept is 1,012 m<sup>3</sup>, which is an increase of 133.7 m<sup>3</sup> from the original (2012) concept. An additional 481 m<sup>3</sup> of storage will be required to service full buildout. The distribution pumping capacity for potable water at full buildout for the updated concept (2018) is sufficient.

According to the municipal servicing study, Greenbryre Estates will continue to use individual dual compartment septic tanks at each lot that pump into a low-pressure sewer system that eventually lead to a Submerged Attached Growth Reactor (SAGR) system. The SAGR system is sufficiently sized to handle the increased total BOD loading associated with the future developments; however, the daily effluent capacity is exceeded by 12.5 m<sup>3</sup>/day. It is noted that the BOD loading will affect the efficacy of the wastewater treatment system, however, as long as the system is within the design BOD loading parameters, it is not expected that an expansion of the SAGR system will be required. It is noted that Nexom Environmental is preparing recommendations for potential options to expand the SAGR system to increase volumetric loading, if required. Lastly, it is recommended that the system be monitored as the development proceeds to review influent and BOD levels. Water from the treated effluent holding pond then flow through an overflow manhole and is discharged into the storm water retention ponds. The ponds are utilized for irrigation within the development and golf course.

A geotechnical investigation was undertaken by P. Machibroda Engineering Ltd. (PMEL) between January and March, 2019 with the report finalized in April, 2019. A total of 12 test holes were drilled, extending to depths of 3.0 to 12.5 m below the existing ground surface. Soil stratification, groundwater conditions, position of unstable sloughing soils and the depths at which cobblestones

and/or boulders were encountered were recorded. The general soil profile consisted of topsoil or fill (silt or clay) overlying variable deposits of clay and silt (with minor occurrences of sand). The depths at which groundwater seepage and sloughing conditions were encountered ranged from 2.6 metres below ground surface to 9.3 m below ground surface on March 21, 2019. With respect to design considerations, it was determined that fill thickness in the order of 1 to 4 m (or more in isolated locations) will be required. As areas of Phase 3 are developed they will be analyzed in more detail to determine the appropriate building foundation construction. This is the same process that was used in Phase 1 and Phase 2. Individual geotechnical studies for each house would have been redundant and were not required by the RM.

It is expected that the Bareland Condominium Association will re-negotiate the contract held with the Rural Municipality for continued fire and protective services.

The proposed development is not located on land considered to be heritage sensitive, according to the Heritage Conservation Branch at the Ministry of Parks Culture and Sport. According to the Saskatchewan Conservation Data Centre, the proposed development is not located in an area considered to be home to rare or endangered animals or plants.

Public consultation was undertaken on May 30, 2019 at the Greenbryre Golf and Country Club in an effort to provide information concerning the new Zoning District that would accommodate all phases of this development, as well as specific information on Phase 3 of Greenbryre Estates. The open house was attended by approximately 30 people and response was overwhelmingly positive. One individual indicated a concern with the conceptual location of a walking path. The open space parcels within Greenbryre will be privately owned and maintained and design and development of same will take place after subdivision approval.

## 1 INTRODUCTION

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### 1.1 PURPOSE

The purpose of this document is to provide the Corman Park-Saskatoon Planning District Commission with a Comprehensive Development Review per the requirements of the District.

This review provides a framework for the rezoning of the proposed parcels of land for the purpose of developing multiple parcel country residential lots and condominium units in the SE-12-36-5 W3M. The land is currently zoned as both DAG1 – Agricultural 1 District (Phase 3) and DCR6 (portions of existing Phases 1 and 2). This CDR is requesting that Phase 3 be rezoned to DCR6, and DCR6 with a holding provision. Phases 1 and 2 of the development were recently rezoned to DCR6 to address setback issues.

The Developer is requesting that all land within Phase 3 be rezoned to this same zoning district (DCR6 and DCR6 with holding provision) to ultimately provide for a total of 130 single family residential lots and 84 condominium units.

The Developer of the project is Mr. Troy Slater of D&S Developments Ltd. The Concept Plan for the entire Development is provided on the following page, as well as within the Municipal Servicing Study in Appendix A. Questions on the proposal or the material contained within this document should be directed to Jim Walters, RPP, MCIP, Principal Planner at Crosby Hanna & Associates (306-665-3441).

### 1.2 OVERVIEW

It is the intention of the Developer to rezone and subdivide the land to provide 130 single family country residential lots as well as a gated townhouse community. The proposed development is located immediately south of the City of Saskatoon, south of Circle Drive and immediately west of Boychuk Drive / Range Road 3050. It is noted that the proposed lots in Phase 3 are approximately 0.35 acres in size, and would be accommodated by the DCR6 Zoning District.

In order to provide for, and in an effort to support Phase 3 of the Greenbryre Estates development, an amendment to the District's Zoning Bylaw, in the form of a new zoning district has recently been adopted to allow for smaller residential lots, as well as to provide for the townhouse development in the southeast corner of the site. The land affected by Phase 3 is currently zoned DAG1 – Agricultural 1 District and this CDR is requesting that Phase 3 be rezoned to DCR6 and DCR6 with the holding provision (see Appendix "A").



Figure 1. Greenbryre Estates – Phase 3 Concept Plan

Land within Phase 3 will provide for a total of 130 residential lots and 84 condominium units. It is proposed that the townhouse condominium community be gated, and all of Phase 3 of the development again be registered as a Bare land Condominium Development.

Phase 3 of the proposed development concept incorporates planning, and engineering development principles with the goal of enhancing property values, by promoting the convenient location the area has to offer, including the following:

1. The development is well situated at the intersection of Circle Drive and Boychuk Drive. It is noted that a new interchange was partially opened in 2018 which provides for seamless traffic flow into the Greenbryre Estates development.
2. The Development has existing services (potable water and wastewater) that will be extended into Phase 3 of the development.
3. The 12-hole golf course will be retained within the boundaries of the development, which will continue to provide recreational opportunities for existing and future residents, as well as residents from the surrounding region to enjoy.

The Developer also hopes to develop a new Golf Clubhouse. This replacement building would provide space for the following uses:

- Pro-shop / Clubhouse;
- Retail;
- Lockers and Showers;
- Day-spa (e.g. massage, esthetics);
- Restaurant and Lounge;
- Office space; and
- Meeting / Conference Rooms.

This building would replace the existing clubhouse building at its existing location. The timeline for construction of the new clubhouse is undetermined at this time (subject to financing and feasibility study).

The area marked “Future Park or Community facility” ultimately will be developed for use of residents and comply with the RM’s Zoning Bylaws.

The condominium association, tasked with managing all common areas within the proposed townhouse condominium community, including the park located in the south end of parcel J, will be a non-profit.

The Developer is aware that the RM has begun the South East Concept Plan and is looking forward to being an active stakeholder providing feedback as it pertains to potable water, waste water, storm water, interim rural development, transition of land use, development density and servicing to urban standards.

## 2 INVENTORY AND ANALYSIS

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### 2.1 EXISTING LAND USE

The proposed development site consists of approximately a 37.5 ha (92.6 ac) of land on the SE ¼, Section 12, Township 36, Range 5 W3M. The site is currently characterized by relatively flat cultivated farmland, interspersed with sloughs and brush.

Other land uses in the area include the City of Saskatoon including Circle Drive / Provincial Highway #16, to the north, of the development. Provincial Highway #11 is located approximately 1 km to the west (see Figure 2 - Land Use Map on following page).

The Existing Land Use Context of the Proposed Development is as Follows:

#### *North*

- |                                   |   |
|-----------------------------------|---|
| - Township Road 362 /Glazier Road | Adjacent to north boundary                |
| - Lakeview Church                 | Across Township Road 362                  |
| - Provincial Highway #16          | Approx. 300 m north of north boundary     |
| - Saskatoon Christian School      | Approx. 300 m northwest of north boundary |
| - City of Saskatoon               | Approx. 475 m north of north boundary     |
| - Baitur Rahmat Mosque            | Approx. 300 m northeast of north boundary |

#### *South*

- |   |  |
|---|--|
| - Cultivated farm land , sloughs bushland | Adjacent to south boundary             |
| - CN railway line                         | Approx. 1.4 km south of south boundary |

#### *West*

- |   |  |
|---|--|
| - Cultivated farm land, sloughs, bushland | Adjacent to west boundary              |
| - City of Saskatoon / Stonebridge         | Approx. 1.2 km m west of west boundary |
| - Highway 11                              | Approx. 1 km west of west boundary     |

#### *East*

- |                                   |                           |
|-----------------------------------|---------------------------|
| - Boychuk Drive / Range Road 3050 | Adjacent to east boundary |
| - Rae-Dawn Arabians               | Across Range Road 3050    |

### 2.2 PROPOSED LAND USE

The proposed land use is residential development which will be an expansion of the integrated residential community with the 12-hole golf course. Phase 3 of the development consists of 130 single family lots and 84 condominium units.

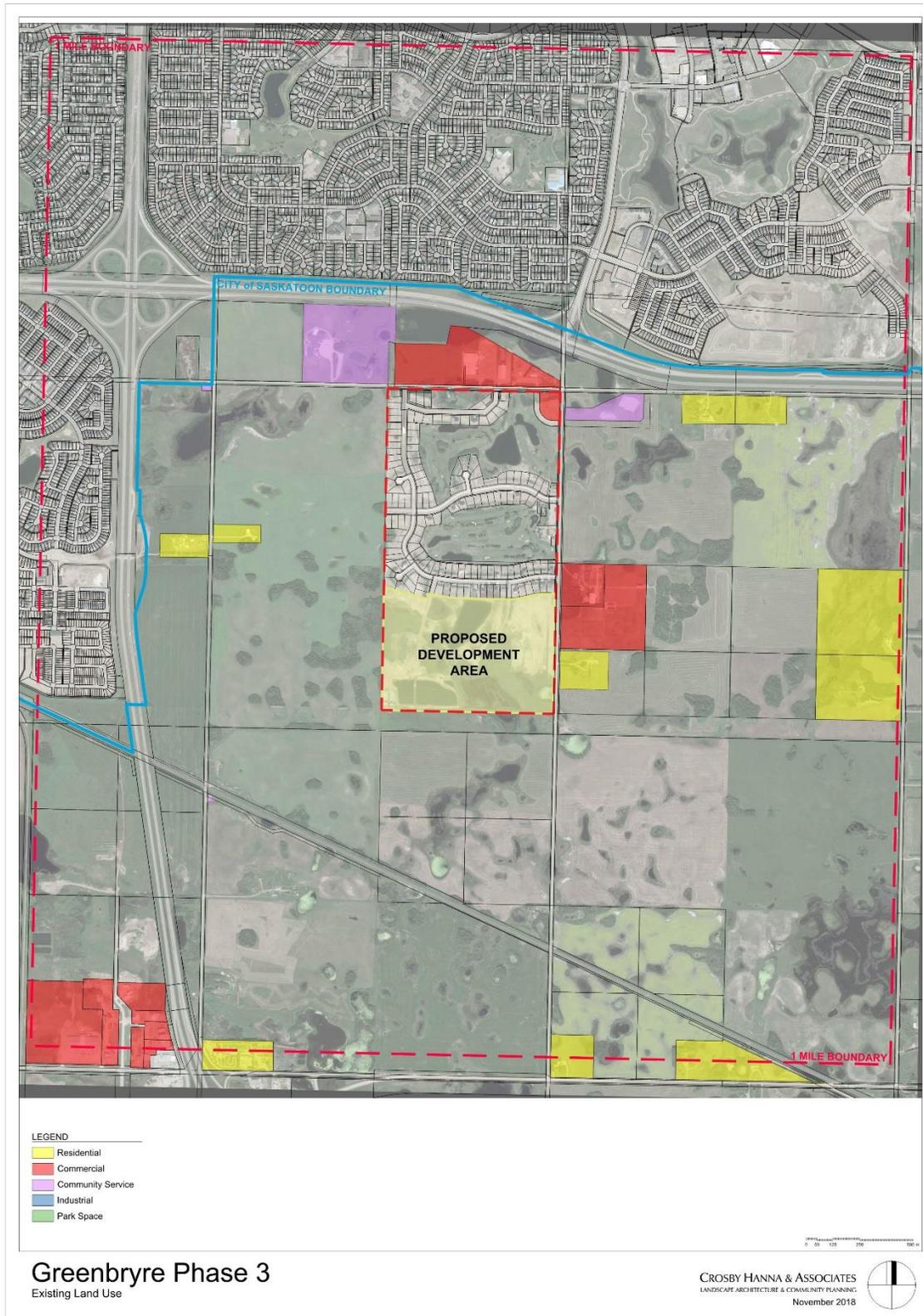


Figure 2. Existing Land Uses within one mile of proposed Greenbryre Estates Development

This phase of the development will continue with the previously developed phases in terms of integrating design elements of a sophisticated recreational lifestyle with the aesthetic and privacy of acreage living. The Developer is utilizing a series of architectural controls and conditions for site development, homes and accessory buildings for Phases 1 and 2 of development. It is noted that these provisions will also be required conditions for lot sales in Phase 3 of the development. Phase 3 of the Greenbryre Golf and Country Estates development will continue to function well within the Corman Park-Saskatoon Planning District and its residents. As a rural community, it is in close proximity to amenities in the broader region, and it is believed that there will be no conflict with existing surrounding land uses.

The area where Phase 3 of the Greenbryre development is situated has been identified for “Country Residential” adjacent to “Urban Residential Neighbourhood” in the Planning for Growth (P4G) regional plan. The proposed land uses for Phase 3 of the development would fit well within the policies of the Country Residential land use category. On the Corman Park – Saskatoon Planning District Land Use Map, the area of Phase 3 is identified as “Residential”. Additionally, the Grasswood Mixed Use Node Market Impact Study prepared for the Corman Park-Saskatoon Planning District in 2016 identifies that opportunities for large lot, high value single family housing in the Grasswood Study Area, including Greenbryre Estates. In fact, the Market Impact Study suggests that the node be developed over the next 35 years and beyond to accommodate a potential population of 11,350 people. The Study goes on further to indicate that demand and growth of single family units is projected to grow from 200 units by 2020 to 1,100 by 2030; 2,900 by 2040 and ultimately 5,000 units by 2050. Phase 3 of Greenbryre Estates will certainly help accommodate this projected growth. Similarly, forecasts for multi-family development within the Market Impact Study estimate that approximately 760 units could be required by 2050.

## 3 TRANSPORTATION AND MUNICIPAL SERVICES

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### 3.1 COMMUNITY ACCESS

In October 2016, MMM Group (now WSP) conducted a Traffic Impact Assessment (TIA) for Greenbryre Phase 3 which did not include any analysis at the intersection of Highway 16 and Boychuk Drive due to the pending interchange construction. With the completion of the construction, an updated TIA including additional analysis for the south terminal intersection of the Boychuk Drive interchange was completed by WSP in 2019. The purpose of the TIA was to determine the impact that the traffic generated by Phase 3 development would have on the adjacent road network, and to identify the roadway infrastructure necessary to safely and effectively accommodate anticipated traffic from the development. Both traffic studies are attached in Appendix B.

Located in the southwest quadrant of the intersection of Range Road 3050 and Township Road 362, just south of the Saskatoon city limits, Phase 3 development will consist of residential housing, including 129 single family homes and 88 low-rise multifamily units (note that this number has changed slightly but the overall number of units has decreased from 217 to 214). It was assumed in the TIA that the development would be complete by 2025. The TIA analyzed the traffic operations at the following study intersections:

- Range Road 3050 (Boychuk Drive) and Boychuk Interchange South;
- Range Road 3050 and Township Road 362;
- Range Road 3050 and Greenbryre Lane;
- Range Road 3050 and New Access Road.

### 3.2 EXISTING AND TOTAL TRAFFIC DEMAND

Vehicle turning movement counts (TMC) at the study intersections were collected on January 23, 2019. The data collection captured the morning (7:00 am to 10:00 am) and afternoon (3:00 pm to 6:00 pm) peak periods, corresponding to typical commute hours, including school peak hours. There is an existing school in the adjacent area, and as such, the afternoon peak hours need further consideration. Two different peak hours affecting Township Road 362 and Greenbryre Lane were identified; one primarily caused by the school and the other due to regular commuter traffic.

The morning peak hours for the study intersections were between 8:00 a.m. and 9:00 a.m. while the afternoon peak hours differed slightly:

- Boychuk Drive Interchange South Terminal – 4:30 p.m. to 5:30 p.m.
- Range Road 3050 and Township Road 362 Intersection – 4:30 p.m. to 5:30 p.m.
- Range Road 3050 and Greenbryre Lane Intersection – 4:15 p.m. to 5:15 p.m.

The peak hour traffic volumes for the morning and afternoon peak hours at each study intersection were used in the analysis to determine how the intersections currently operate. Small discrepancies of traffic volumes between the study intersections along Boychuk Drive were not balanced due to other existing accesses including the Greenbryre Crescent North and Rae-Dawn Arabians Access.

### 3.3 BACKGROUND AND TOTAL FORECAST VOLUMES

The background forecast traffic scenario is a projection of the traffic volumes anticipated without the demand from the proposed development. The projection of future traffic volume was determined by applying a 1% annual growth until the year 2025 to the existing volumes.

Total forecast traffic volumes associated with the proposed development were obtained by combining background traffic growth with the new trips associated with the development.

### 3.4 TRAFFIC OPERATIONS

Existing, background and total forecast traffic operations were assessed using Synchro 10.0, which is industry standard traffic analysis software. The current infrastructure was also used to examine existing and forecast scenarios with no additional turning lanes or traffic controls added. A Level of Service (LOS) analysis and volume-to-capacity ratio were both used to assess the effectiveness of the transportation system.

### 3.5 RECOMMENDATIONS

The following recommendations were made within the TIA:

- It was determined that the study intersections are currently operating at Level of Service (LOS) of “A”, which means there are minimal delays and queue length on all approaches. Similarly, the intersections will continue to operate at LOS A at the completion of the development. As such, no additional improvements are required.
- The speed limit along Range Road 3050 should be reduced to 60 km/h, which can transition to 80 km/h south of the development.
- It is recommended that a delineation lighting system be provided on the west approach (New Access Road) at the Range Road 3050 at New Access Road intersection.
- Capacity analysis indicates that there will be minimal queuing along Range Road 3050. As such, no turning lanes will be required to accommodate traffic demand.
- It is recommended that traffic operations along Range Road 3050 be monitored to determine the timing for turning lane improvements as further development beyond Greenbryre occurs which may result in longer queue lengths.
- With the completion of the Highway 16 and Boychuk Drive interchange, the lighting system is provided along Boychuk Drive / Range Road 3055 up to just north of Township Road 362. As such, it is recommended that traffic volumes on Range Road 3055 be monitored as further development occurs beyond Greenbryre and that a corridor lighting system be considered as this segment becomes a more urbanized section, similar to Boychuk Drive on the north.
- Boychuk Drive south of Greenbryre Lane is a low-grade gravel surface. It is recommended that a dust free improvement be considered up to the south boundary of the development.

## 3.6 INTERNAL ROADS

Phase 3 roadways will be designed in a similar nature to Phase 1 and 2 with an urban cross section consisting of concrete paved road surface with rolled curb on each side. The main difference will be a reduced right-of-way from 24.0/30.0 m to 16.0 m leaving a 4.0 m boulevard from back of curb to the front property lines. The larger right-of-ways that exist in Phase 1 and 2 were originally designed to accommodate a rural cross section, which was revised to an urban cross section late in the design stage.

It is also recommended in the Municipal Servicing Study that a reduced building setback from the front property of 6.0 m which leaves a total of 10.0 m from back of curb to front of building. Roadways will be incorporated with storm sewer catch basins for drainage collection, similar to Phases 1 and 2.

## 3.7 SEWAGE COLLECTION & WASTE WATER TREATMENT

According to the municipal servicing study completed by Catterall & Wright, attached as Appendix C, Greenbryre Estates has operated with individual dual compartment septic tanks at each lot that pump into a low-pressure sewer system that eventually lead to a Submerged Attached Growth Reactor (SAGR) system.

Each tank is equipped with dual compartments with a screen ahead of the pumps. Solids settle in the dual compartment holding tanks, and are cleaned out as required. The initial tank settlement reduces the Biological Oxygen Demand (BOD) loading at the wastewater treatment system. Wastewater from each residence is then pumped to the existing SAGR system. Treated effluent from the SAGR is then chlorinated and pumped to a treated water holding pond for temporary storage before flowing into the storm water system for irrigation.

According to the municipal servicing study, the SAGR system is classified as a continuous discharge system, designed for 343 m<sup>3</sup>/day of daily influent and 63.5 kg/day of BOD loading of 185 mg/L. By applying the updated 2019 concept, an additional 45.5 m<sup>3</sup>/day of influent and 4.49 kg/day of BOAD loading were projected for full buildout. The concept includes daily BOD loading for residential development, the proposed clubhouse, as well as potential future commercial development. It is noted within the municipal servicing study, that the SAGR system is sufficiently sized to handle the increased total BOD loading associated with the future developments; however, the daily effluent capacity is exceeded by 11.0 m<sup>3</sup>/day. It is noted that the BOD loading will affect the efficacy of the wastewater treatment system, however, as long as the system is within the design BOD loading parameters, it is not expected that an expansion of the SAGR system will be required. It is noted that Nexom Environmental is preparing recommendations for potential options to expand the SAGR system to increase volumetric loading, if required. Expansion will not require additional footprint for Phase 3, but would include internal upgrades to the existing system. Lastly, it is recommended that the system be monitored as the development proceeds to review influent and BOD levels.

Once wastewater has circulated within the SAGR beds, treated effluent is chlorinated and released to a treated effluent holding pond. The holding pond was previously installed downstream of the SAGR system as a redundant step in the wastewater treatment process to provide a holding cell for an aerated zone to help control algae, odours, and potential wildlife. Water from the treated

effluent holding pond then flow through an overflow manhole and is discharged into the storm water retention ponds. The ponds are utilized for irrigation within the development and golf course. The original (2012) concept provided 210 days of treated effluent storage for a volume of 65,000 m<sup>3</sup>. The 210 day storage for the updated (2019) concept is 74,355 m<sup>3</sup> at Normal Water Level, not including the ponds within Phases 1 and 2 of the development. The municipal servicing study has concluded that the pond storage volume will be adequate to service full buildout of Phase 3 of the development.

Remaining solids in individual septic tanks will be extracted and hauled to the City's Wastewater Treatment Plant by a licensed hauler. This is typically required one time per year for a family of four.

The Municipal Servicing Study in Appendix C summarizes the increased water / wastewater requirements from the original design to the proposed concept for Phase 3. It was recommended that once five years of flow data is available, the consumption should be revisited and the capacities recalculated. Additionally, a review of the usage for the proposed clubhouse and commercial areas should be completed when a final decision regarding their intended use has been made.

### 3.8 POTABLE WATER SUPPLY AND DISTRIBUTION

Potable water is distributed to residents within Greenbryre Estates from a Water Treatment Plant (WTP) that was constructed during Phase 1 of the development, along Boychuk Drive. The potable water is piped to the WTP by a 75 mm supply line, owned by SCS Water Group, Inc., which purchases potable water from SaskWater. According to the municipal servicing study provided by Catterall & Wright, the updated (2019) concept plan adds an additional 1.6 L/s of flow rate from the original (2012) concept, for a total of 11.7 L/s of design flow rate. The current potable water supply is allocated based on an agreement with SCS and is capped at 3.6 L/s, which will accommodate an equivalent population of 349 people (116 single family homes). Preliminary discussions with SaskWater have taken place to review a separate direct connection. SaskWater has indicated that they can supply the required 11.7 L/s (see attached email in Appendix D).

The required treated water storage for full buildout of the updated (2019) concept is 1,007 m<sup>3</sup>, which is an increase of 128.7 m<sup>3</sup> from the original (2012) concept. The constructed treated water storage capacity is 531 m<sup>3</sup> and will serve an equivalent of 586 people. An additional 476 m<sup>3</sup> of storage will be required to service full buildout.

The distribution pumping capacity for potable water at full buildout for the updated concept (2019) was calculated at 20.3 L/s, an increase of 2.2 L/s from the original (2012) concept. The existing waster distribution pumping capacity is 25.2 L/s. It is noted within the municipal servicing study that the system has been sized for peak hour demands, but does not provide fire flow capacity, although a fire truck fill is available at the WTP. Pumping redundancy is achieved with three pumps installed, leaving any two of the pumps able to meet the required distribution capacity. It is concluded that distribution pumping capacity is satisfactory to service full buildout of the development.

### 3.9 DRAINAGE AND STORMWATER MANAGEMENT

A conceptual drainage plan for Phase 3 was undertaken as a part of the municipal servicing study provided by Catterall & Wright and as included in Appendix C of this CDR. Two additional stormwater management ponds, not including the SAGR treated effluent holding pond, are proposed for this phase of the development. It is proposed that ponds be connected by an overland channel to flow water from one pond to the next. The system was sized to hold back-to-back 1:100 year storm events, as the intention is to not have an outlet, but rather use the runoff water as irrigation for the golf course and residential yards.

### 3.10 SHALLOW UTILITIES AND OTHER SERVICES

Shallow utilities are currently provided by SaskTel, SaskEnergy and SaskPower in Phases 1 and 2 of the development. It is anticipated that these utilities will once again be located within the road right-of-way to provide service to the front of each lot. Solid waste and recycling services are currently offered to existing residents through Loraas Disposal Ltd., who will also provide this service to residents of Phase 3 (see Appendix “J”)

### 3.11 FIRE AND PROTECTIVE SERVICES

It is expected that the Bare land Condominium Association will re-negotiate the contract held with the Rural Municipality for continued fire and protective services.

## **4 HERITAGE, ENVIRONMENT AND GEOTECHNICAL**

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### **4.1 HERITAGE CONSERVATION**

According to the Heritage Conservation Branch at the Ministry of Parks Culture and Sport, the proposed development is not located in an area with any potential heritage sensitivity (query attached as Appendix “E”).

### **4.2 ENVIRONMENTAL CONSIDERATIONS**

The proposed development is not located in an area considered to be environmentally sensitive, as a result of rare or endangered species of plants or animals. The results of the query to HabiSask can also be found in Appendix “E”.

### **4.3 GEOTECHNICAL ANALYSIS**

A geotechnical investigation was undertaken by P. Machibroda Engineering Ltd. (PMEL) between January and March, 2019 with the report finalized in April, 2019 (see report attached in Appendix “G”). A total of 12 test holes were drilled, extending to depths of 3.0 to 12.5 m below the existing ground surface. Soil stratification, groundwater conditions, position of unstable sloughing soils and the depths at which cobblestones and/or boulders were encountered were recorded. Four piezocone penetration tests (CPTu) were also completed and extended to depths of 18.1 to 20.8 m below existing ground surface. Local side friction resistance measurements and pore-water pressure response were also measured.

The general soil profile consisted of topsoil or fill (silt or clay) to a depth of about 0.1 to 3.2 m overlying variable deposits of clay and silt (with minor occurrences of sand), which extend to a depth of at least 12.5 m, or the maximum depth drilled. Based on CPTu interpretation, glacial till deposits may exist below a depth of 18 to 21 m.

It was concluded that the silt fill deposits were generally low to medium plastic, moist and firm to stiff. The clay fill was still, highly plastic and moist. The fill deposits contained organics and organic material at several locations. The clay deposits were firm to very stiff (predominantly stiff), highly plastic and moist. The silt deposits were typically firm to stiff, low to medium plastic (mainly medium plastic) and moist to wet.

With respect to groundwater seepage and sloughing, it was concluded that the depths at which groundwater seepage and sloughing conditions were encountered ranged from 2.6 metres below ground surface to 9.3 m below ground surface on March 21, 2019. It was noted that higher water levels and potentially water levels above current ground level (in low areas of the site) should be expected during or following spring snowmelt and/or during or following periods of precipitation.

Cobblestones and boulders were not encountered within the depth of drilling exploration at this site. However, cobblestones/boulders may exist within the fill deposits, which are of unknown origin. It was also noted that glacial till may exist at depth (below 18 to 21 m) at this site.

With respect to design considerations, it was determined that fill thickness in the order of 1 to 4 m (or more in isolated locations) will be required. It is anticipated that locally available fill materials, sourced from additional stormwater pond excavations, will be utilized.

Specific design recommendations concerning site preparation; excavations and dewatering; foundation concrete; asphalt concrete pavement structures; concrete pavement structures; embankment considerations; and, foundation considerations were provided within the report.

Similar to the previous two phases of development, the majority of lots in Phase 3 are proposed to be walkouts.

## 5 POLICY CONTEXT

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Phase 3 of the Greenbryre Estates residential development is located within the RM of Corman Park, within the Corman Park – Saskatoon Planning District. The following policy review includes an analysis of the Corman Park-Saskatoon Planning District OCP, as well as a review of the relevant policies within the Saskatoon North Partnership for Growth Regional Plan, as described in Sections 5.1 and 5.2 below. The accompanying zoning bylaw review is undertaken in Section 5.3.

### 5.1 CORMAN PARK-SASKATOON PLANNING DISTRICT OFFICIAL COMMUNITY PLAN

#### **General Development Policies (Section 5.2)**

- 5.2.1 – The Developer consulted with the Ministry of Environment (MOE) during Phase 1 of the development project to ensure that the SAGR sewage treatment system was a suitable means of wastewater treatment and disposal. The MOE ultimately granted approval to constrict the SAGR system in conjunction with Phase 1 of the development.
- 5.2.2 – The existing SAGR sewage treatment system is considered a suitable means of wastewater treatment and disposal and was previously approved for use by the Saskatoon District Health Authority and Ministry of Environment during previous phases of development.
- 5.2.3 - A servicing agreement between the Developer and the R.M. of Corman Park is expected to address the following (but is not necessarily limited to):
  - Outline the requirement for site-specific geotechnical reports;
  - Identify off-site servicing fees, payable to the R.M.;
  - Identify the value of the required performance bond or letter of credit;
  - The Developer is proposing to pay cash in lieu of the required Municipal Reserve.
- 5.2.4 – Development standards – The Developer is requesting that Phase 3 be rezoned to (DCR6), specific to Greenbryre Estates.
- 5.2.5 – A conceptual drainage plan for Phase 3 was undertaken as a part of the municipal servicing study provided by Catterall & Wright and as included in Appendix “C” of this CDR. It is proposed within the study that ponds be connected by an overland channel to flow water from one pond to the next. The system was sized to hold back-to-back 1:100 year storm events, as the intention is to not have an outlet, but rather use the runoff water as irrigation for the golf course and residential yards.

#### **General Location and Access Policies (Section 5.3)**

- 5.3.1 The proposed development will have legal and year-round, all weather physical access to a municipally maintained roadway. Internal roadways will be owned and

maintained by the condominium corporation. An initial Traffic Impact Assessment (TIA) was completed in 2016 by MMM Group (WSP) with revisions undertaken in 2019 (reports attached in Appendix B). The following recommendations were made within the TIA: (1) It was determined that the study intersections are currently operating at Level of Service (LOS) of “A”, which means there are minimal delays and queue length on all approaches. Similarly, the intersections will continue to operate at LOS A at the completion of the development. As such, no additional improvements are required; (2) The speed limit along Range Road 3050 should be reduced to 60 km/h, which can transition to 80 km/h south of the development; (3) It is recommended that a delineation lighting system be provided on the west approach (New Access Road) at the Range Road 3050 at New Access Road intersection; (4) Capacity analysis indicates that there will be minimal queuing along Range Road 3050. As such, no turning lanes will be required to accommodate traffic demand; (5) It is recommended that traffic operations along Range Road 3050 be monitored to determine the timing for turning lane improvements as further development beyond Greenbryre occurs which may result in longer queue lengths; (6) With the completion of the Highway 16 and Boychuk Drive interchange, the lighting system is provided along Boychuk Drive / Range Road 3055 up to just north of Township Road 362. As such, it is recommended that traffic volumes on Range Road 3055 be monitored as further development occurs beyond Greenbryre and that a corridor lighting system be considered as this segment becomes a more urbanized section, similar to Boychuk Drive on the north; and, (7) Boychuk Drive south of Greenbryre Lane is a low-grade gravel surface. It is recommended that a dust free improvement be considered up to the south boundary of the development.

- 5.3.2 - Hazard Lands - A municipal servicing study, including drainage analysis was completed by Catterall & Wright (see report attached as Appendix “C”). It is proposed within the study that ponds be connected by an overland channel to flow water from one pond to the next. The system was sized to hold back-to-back 1:100 year storm events, as the intention is to not have an outlet, but rather use the runoff water as irrigation for the golf course and residential yards. The proposed municipal servicing study will need to be submitted to the WSA for review prior to the onset of construction.
- 5.3.3 - Access – Phase 3 of the proposed development will continue to meet municipal regulations respecting access to and from municipally maintained roadways.
- 5.3.4 – Environmental Reserve – Phase 3 of the proposed development is a bare land and condominium development not located on any environmentally sensitive land. As such, the environmental reserve land designation will not be needed nor dedicated.
- 5.3.5. – Phase 3 of the proposed development is not located in conflict with any existing Intensive Livestock Operation or industrial properties (see attached correspondence in Appendix “G”). A Market Impact Study undertaken for the Corman Park-Saskatoon Planning District, which provides direction to the municipalities in terms of how the Grasswood Study Area grow over the next 35 years, identifies Phase 3 of the Greenbryre Estates development as “Residential”. Proposed Phase 3 complies with the Corman Park – Saskatoon Planning District Land Use Map.

## **Comprehensive Development Review (Section 5.6)**

- This document shall serve as the CDR required by the municipalities within the Corman Park-Saskatoon Planning District, as the Developer is proposing to rezone and subdivide the land for Phase 3 of the Greenbryre Estates development to DCR6. It is the intent that this document shall include a complete overview of how the proposed development successfully integrates itself physically, socially, and financially with existing properties, owners, and development in the immediate vicinity. In addition to addressing matters of land use integration, this CDR is intended to assess the capacity of the supportive municipal and provincial infrastructure as it relates the demand created by the proposed development.

## **Multi-Parcel Country Residential Servicing and Development Policies (Section 5.7)**

- 5.7.1 - Ecological Protection – According to the HabiSask Map provided by the Ministry of Environment, Phase 3 of the proposed development is not located in an area considered to be environmentally sensitive, and as such, will not contribute to the degradation of ecological systems (see query map attached as Appendix “E”).
- 5.7.3(a) - The proposed development is located in an area where existing multi-parcel residential development has been realized (Phases 1 and 2 of Greenbryre Estates). Adjacent land uses include vacant agricultural land, Rae-Dawn Arabians, Lakeview Church, the Saskatoon Christian School, and the Baitur Rahmat Mosque. It is anticipated that it will be possible to service the additional residential and commercial lots with gas, power and water as these services are already provided to residents in Phases 1 and 2 of the development. Lastly, Phase 3 of the Development will also be a part of the existing bare land condominium development. As such, all services including roads, utilities, infrastructure maintenance, and the existing recreational amenities will be paid for and managed by the Condominium Association.
- 5.7.3(b) - The proposed development includes an existing 12 hole golf course which will continue to provide for a high quality of life for existing and future residents, as well as residents situated in the surrounding communities of Saskatoon, and the greater Corman Park region. In order to provide for the new clubhouse at the Greenbryre Estates Development, subdivision of land, near the east boundary of the existing development, is required. The new clubhouse is a replacement building which would also provide space for the following uses: pro-shop/clubhouse; lockers and showers; day-spa (e.g. massage, esthetics); restaurant and lounge; office space; and meeting/conference rooms. It is noted that while the new clubhouse is being constructed on proposed Parcel W, the existing clubhouse will be moved to Condominium Unit #28 located across the street. It is suggested that this proposal could be accommodated by rezoning Condominium Unit #28 from DCR5 to DREC1 by agreement. Once the new clubhouse building is complete, it is intended that the old clubhouse building will be moved to an off-site location. Once the building is removed, it is requested that Condominium Unit #28 be rezoned to DCR6. The timeline for the development of a new clubhouse is unknown.

- 5.7.7 – Proposed Phase 3 will require DCR6 zoning. It is proposed that the townhouse community be gated, and Phase 3 of the development again be registered as a bare land condominium development. It is noted that the proposed lots in Phase 3 of this development are approximately 0.35 acres.
- 5.7.8(a) – According to the HabiSask Map provided by the Ministry of Environment, Phase 3 of the proposed development is not located in an area considered to be environmentally sensitive, and as such, will not contribute to the degradation of ecological systems (see query map attached as Appendix “E”).
- 5.7.8(b) – The proposed development has been designed so that existing sanitary sewer and potable water lines can be extended into Phase 3 of the development. Additionally, this phase of Greenbryre Estates will also be a part of the existing Bareland Condominium Development. As such, all services including roads, utilities, infrastructure maintenance, and the existing recreational amenities will be paid for and managed by the Condominium Association.
- 5.7.8 (c) - The proposed development was designed in order to complement the existing Greenbryre Estates residential development, but will also include smaller (approximately 0.35 acre in size), less expensive lots. The Developer wishes to develop a gated townhouse community on this quarter section (approximately 10 acres in area and approximately 84 units).
- 5.7.9(a) – A drainage analysis was completed by Catterall & Wright. Surface drainage will be directed to on-site storm water ponds, which will form a part of the golf course irrigation system and can also be used for irrigation of residential lots (see report attached in Appendix C).
- 5.7.9(b) – Phase 3 of the Development will also be a part of the existing Bareland Condominium Development. As such, all services including roads, utilities, infrastructure maintenance, and the existing recreational amenities will be paid for and managed by the Condominium Association.
- 5.7.10 – The Developer is requesting that the land within Phase 3 be rezoned to DCR6 to provide for a total of 130 multiple parcel country residential lots and 84 condominium units. Public consultation was undertaken on May 30th at the Greenbryre Golf and Country Club in an effort to provide information concerning the new Zoning District that would accommodate all phases of this development, as well as specific information concerning Phase 3 of Greenbryre Estates. The open house was attended by approximately 30 people and response was overwhelmingly positive. One individual indicated a concern with the conceptual location of a walking path. The open space parcels within Greenbryre will be privately owned and maintained and design and development of same will take place after subdivision approval.
- 5.7.11 – The proposed development was referred to the Prairie Spirit School Division for review. It was confirmed by Ms. Brenda Erickson that Prairie Spirit has the capacity for

any future students that could come from Phase 3 of the Greenbryre Estates development (correspondence attached in Appendix “G”).

## **Access and Location Policies (Section 5.8)**

- 5.8.1 – Phases 3 of the Greenbryre Estates development is located in an area identified for “Future Residential” on the Corman Park-Saskatoon Planning District Future Land Use Map.
- 5.8.5 – Phase 3 of the Greenbryre Estates development has been designed to complement the existing residential development that was realized in Phase 1 and 2 of the development. Although some lots are smaller in size (approximately 0.35 acres), this phase of the development will continue with the previously developed phases in terms of integrating design elements of a sophisticated recreational lifestyle with the aesthetic and privacy of acreage living. The Developer is utilizing a series of architectural controls and conditions for site development, homes and accessory buildings for Phases 1 and 2 of development. It is noted that these provisions will still be required conditions for lot sales for Phase 3 of the development.
- 5.8.6 (a) - The proposed development is not located in an area considered to be environmentally sensitive, as a result of rare or endangered species of plants or animals. The results of the query to HabiSask can be found in Appendix “E”.
- 5.8.6 (b) - According to the soil agricultural capability map provided by Agriculture and Agri-Food Canada, the soil within the development area is categorized as Class 4 land. Class 4 is defined as having severe limitations that restrict the range of crops that could be planted in the area. Income return from crops has been very low and some of the land that was farmed has been reverted to natural prairie as a better use.
- 5.8.6 (c) - The proposed development is not located in any conflict (within one mile) of an existing ILO, landfill, waste disposal site, lagoon, industrial or commercial development, or gravel deposit (see attached correspondence in Appendix “G”).
- 5.8.8 – According to the Heritage Conservation Branch at the Ministry of Parks Culture and Sport, the proposed development is not located in an area with any potential heritage sensitivity (query attached as Appendix “E”).

## **Municipal Reserve Policies (Section 5.9):**

- 5.9.1 – The Developer is proposing to pay cash-in-lieu of the Municipal Reserve requirement.

## **General Servicing Policies (Section 8.1):**

- 8.1.1 SaskPower and SaskEnergy currently run service lines in the immediate area, including to existing Greenbryre residents. It is not anticipated that servicing this

development will be difficult. Quotes will be obtained from these utilities at the appropriate time.

- 8.1.1 – In accordance with the Corman Park and Saskatoon Planning District OCP, any upgrades to existing roadways in order to accommodate the proposed development are the responsibility of the Developer.

## **General Transportation Policies (Section 8.2):**

- 8.2.1 - A Traffic Impact Assessment was undertaken by WSP (formerly MMM Group) in October of 2016 and an update was provided in January, 2019 (both reports are attached in Appendix “B”). The following recommendations were made within the TIA: (1) It was determined that the study intersections are currently operating at Level of Service (LOS) of “A”, which means there are minimal delays and queue length on all approaches. Similarly, the intersections will continue to operate at LOS A at the completion of the development. As such, no additional improvements are required; (2) The speed limit along Range Road 3050 should be reduced to 60 km/h, which can transition to 80 km/h south of the development; (3) It is recommended that a delineation lighting system be provided on the west approach (New Access Road) at the Range Road 3050 at New Access Road intersection; (4) Capacity analysis indicates that there will be minimal queuing along Range Road 3050. As such, no turning lanes will be required to accommodate traffic demand; (5) It is recommended that traffic operations along Range Road 3050 be monitored to determine the timing for turning lane improvements as further development beyond Greenbryre occurs which may result in longer queue lengths; (6) With the completion of the Highway 16 and Boychuk Drive interchange, the lighting system is provided along Boychuk Drive / Range Road 3055 up to just north of Township Road 362. As such, it is recommended that traffic volumes on Range Road 3055 be monitored as further development occurs beyond Greenbryre and that a corridor lighting system be considered as this segment becomes a more urbanized section, similar to Boychuk Drive on the north; and, (7) Boychuk Drive south of Greenbryre Lane is a low-grade gravel surface. It is recommended that a dust free improvement be considered up to the south boundary of the development.
- 8.2.1 - The proposed development will be accessed from Range Road 3050. In 2019, WSP completed a revised TIA (attached in Appendix “B”) which concluded that all study intersections are currently operating at LOS A with minimal delays and queue length on all approaches. Similarly, the intersections will continue to operate at LOS A at the completion of the development. As such, no additional improvements were recommended.
- 8.2.3 - The proposed development will meet municipal regulations respecting access to and from municipally maintained roadways.

## **Water and Sewage Management Policies (Section 8.3):**

- 8.3.1 – Potable water is distributed to residents within Greenbryre Estates from a Water Treatment Plant that was constructed during Phase 1 of the development, along Boychuk

Drive. The potable water is piped to the WTP by a 75 mm supply line, owned by SCS Water Group Inc., which purchases potable water from SaskWater. According to the municipal servicing study provided by Catterall & Wright, the updated (2019) concept plan adds an additional 1.6 L/s of flow rate from the original (2012) concept, for a total of 11.7 L/s of design flow rate. Preliminary discussions with SaskWater have taken place to review a separate direct connection, and they have confirmed that they can supply the required 11.7 L/s (see confirmation email attached in Appendix D). An additional 476 m<sup>3</sup> of storage will be required to service full buildout. The distribution pumping capacity for potable water at full buildout for the updated concept (2019) is sufficient. It is noted within the municipal servicing study that the system has been sized for peak hour demands, but does not provide fire flow capacity, although a fire truck fill is available. Pumping redundancy is achieved with three pumps installed, leaving any two of the pumps able to meet the required distribution capacity. It is concluded that distribution pumping capacity is satisfactory to service full buildout of the development.

8.3.2 – the proposed development will have individual dual compartment septic tanks at each lot that pump into a low-pressure sewer system that will eventually lead to a Submerged Attached Growth Reactor (SAGR) system. Each tank will be equipped with dual compartments with a screen ahead on the pumps. Solids will settle in the dual compartment holding tanks and will be cleaned out as required. Solids in each individual septic tank will be hauled to the City's Wastewater Treatment Plant once or twice per year by a licensed hauler. The initial tank settlement reduces the Biological Oxygen Demand (BOD) loading at the wastewater treatment system. Wastewater from each residence will then be pumped to the existing SAGR system. Treated effluent from the SAGR will then be chlorinated and pumped to a treated water holding pond for temporary storage before flowing into the storm water system for irrigation.

## **Environmental and Heritage Resource Policies (Section 10.1)**

- 10.1.1 – According to the Heritage Conservation Branch at the Ministry of Parks Culture and Sport, the proposed development is not located in an area with any potential heritage sensitivity (query attached as Appendix E).
- 10.1.2 – The proposed development is not located in an area considered to be environmentally sensitive, as a result of rare or endangered species of plants or animals. The results of the query to HabiSask can be found in Appendix E.

## **Comprehensive Development Review Policies (Section 12.4)**

- 12.4.1 - This document shall serve as the CDR required in support of the rezoning application being submitted for Phase 3 of the proposed development. Phase 3 is currently zoned DAG1. The Developer is requesting that the land within Phase 3 be rezoned to DCR6 and DCR6 with a holding provision to accommodate 130 residential lots and 84 condominium units. This is the same district that Phases 1 and 2 were recently rezoned to. It is the intent that this document shall include a complete overview of how the proposed

development successfully integrates itself physically, socially, and financially with existing properties, owners, and development in the immediate vicinity. In addition to addressing matters of land use integration, this CDR is intended to assess the capacity of the supportive municipal and provincial infrastructure as it relates the demand created by the proposed development.

## **Zoning Bylaw (Section 12.5)**

- 12.5.1 – This document shall serve as the CDR required in support of the rezoning application for all phases of the Greenbryre Estates development. It is the intent that this document shall include a complete overview of how the proposed development successfully integrates itself physically, socially, and financially with existing properties, owners, development in the immediate vicinity, and the Corman Park – Saskatoon Planning District Official Community Plan. In addition to addressing matters of land use integration, this CDR is intended to assess the capacity of the supportive municipal and provincial infrastructure as it relates the demand created by the proposed development.

## **Zoning Bylaw (Section 12.5)**

- 12.5.6 – The components of a servicing agreement will be met as described in the District’s Official Community Plan.
- 12.5.6 - A servicing agreement between the Developer and the RM of Corman Park is expected to address the following (but is not necessarily limited to):
  - Outline the provision of infrastructure including specifications;
  - Identify off-site servicing fees, payable to the RM;
  - Identify the value of the required performance bond or letter of credit; and,
  - The Developer is proposing to pay cash in lieu of the required MR.

## **Public Participation Policies (Section 12.9):**

- 12.1.1 – Public consultation was undertaken on May 30th at the Greenbryre Golf and Country Club in an effort to provide information concerning the new Zoning District that would accommodate all phases of this development, as well as specific information concerning Phase 3 of Greenbryre Estates. The open house was attended by approximately 30 people and response was overwhelmingly positive. One individual indicated a concern with the conceptual location of a walking path. The open space parcels within Greenbryre will be privately owned and maintained and design and development of same will take place after subdivision approval.

## **5.2 SASKATOON NORTH PARTNERSHIP FOR GROWTH REGIONAL PLAN**

The Saskatoon North Partnership for Growth (P4G) is a recently formalized collaborative which includes political and administrative representation from the partnering municipalities. The partnering municipalities consist of: the City of Saskatoon, the City of Warman, the City of

Martensville, the Town of Osler, the RM of Corman Park, and the Saskatoon Regional Economic Development Authority (SREDA), who plays an advisory role.

The P4G membership is comprised of two committees: a P4G Regional Oversight Committee (ROC), consisting of political representatives and senior management officials; and, a P4G Planning and Administration Committee (PAC), consisting of planning and administrative staff from each municipality and a SREDA representative.

The Greenbryre Estates development is located within the P4G region. In May 2017, a Draft of the P4G Regional Plan was presented and endorsed by the Regional Oversight Committee. The P4G Regional Plan establishes a coordinated approach to matters related to the physical, social, or economic circumstances of the Saskatoon region that may affect the development of the region as a whole, such as: land use; population; transportation; utilities; services; and, finances.

The following policies within the Regional Plan that are relevant to the proposed Greenbryre Estates development are identified and discussed below.

#### **Natural and Heritage Resource Policies (Section 4):**

- 4.01: There are no Designated Municipal or Provincial Heritage Properties located within Phase 3 of the proposed Greenbryre Estates development boundaries.
- 4.04: The proposed development is not located in an area considered to be environmentally sensitive, as a result of rare or endangered species of plants or animals. The results of the query to HabiSask can be found in Appendix “E”.
- 4.05: According to the Heritage Conservation Branch at the Ministry of Parks Culture and Sport, Phase 3 of the proposed development is not located in an area with any potential heritage sensitivity (query attached as Appendix “E”).
- 4.06: Phase 3 of the development has been designed to integrate the existing contours of the land. A total of two stormwater management ponds are connected by an overland channel to flow water from one pond to the next. Water from the ponds has been designed to irrigate the golf course and all residential lots. Additionally, Greenbryre Estates maintains connections to SaskWater’s raw water lines to recharge the ponds as needed. Lastly, walking paths have been incorporated into Phase 3 of the development to provide opportunities for existing and future residents to enjoy the beauty and natural topography of the area.

#### **Natural Hazards (Section 5):**

- 5.04: A geotechnical investigation was undertaken by P. Machibroda Engineering Ltd. (PMEL) between January and March, 2019 with the report finalized in April, 2019. A total of 12 test holes were drilled, extending to depths of 3.0 to 12.5 m below the existing ground surface. Soil stratification, groundwater conditions, position of unstable sloughing soils and the depths at which cobblestones and/or boulders were encountered were recorded. The general soil profile consisted of topsoil or fill (silt or clay) overlying variable deposits

of clay and silt (with minor occurrences of sand). The depths at which groundwater seepage and sloughing conditions were encountered ranged from 2.6 metres below ground surface to 9.3 m below ground surface on March 21, 2019. With respect to design considerations, it was determined that fill thickness in the order of 1 to 4 m (or more in isolated locations) will be required. It is noted that detailed geotechnical investigations will be required for all future developments to provide specific foundation design recommendations and design patterns. Specific design recommendations concerning site preparation; excavations and dewatering; foundation concrete; asphalt concrete pavement structures; concrete pavement structures; embankment considerations; and, foundation considerations were provided within the report.

## **General Policies (Section 7):**

- 7.01: Phase 3 of the proposed Greenbryre Estates development is located immediately to the south of the existing residential development (Phases 1 and 2) which features a 12-hole golf course. Additional surrounding land uses include agricultural land to the south and west, Boychuk Drive and Rae-Dawn Arabians to the east, vacant agricultural land to the west and the City of Saskatoon/Highway #16 to the north.
- 7.02: All three phases of the proposed development are identified as “Country Residential” on the Saskatoon North Partnership for Growth Regional Land Use Map.
- 7.06: There are no ILOs, anhydrous ammonia facilities (non-refrigerated or refrigerated), chemical plants, dangerous goods plants, bulk fuel storage facilities, aggregate resource industries, or rail facilities within the prescribed distances outlined in the P4G Regional Plan (see correspondence attached in Appendix “G”).
- 7.11(b)(c): The proposed development is located within a Country Residential category. This category is used to accommodate multi-parcel country residential development.

## **Agriculture Policies (Section 8)**

- 8.05: The proposed development is not located in any conflict (within one mile) of an existing ILO, landfill, waste disposal site, lagoon, industrial or commercial development, or gravel deposit (see attached correspondence in Appendix “G”).

## **Country Residential Policies (Section 9):**

- 9.01: The proposed Greenbryre Estates Development is located in an area identified as “Country Residential” on the Regional Land Use Map in the P4G Regional Plan.
- 9.02: The proposed development is not located in an area of significant wildlife habitat lands, or in locations where it may cause or contribute to the degradation of ecological and hydrological systems (see results of HabiSask query in Appendix “E”).
- 9.04 (a): The proposed development can be serviced by existing infrastructure and services

developed during Phases 1 and 2 of the development. Potable water is distributed to residents within Greenbryre Estates from a Water Treatment Plant that was constructed during Phase 1 of the development, along Boychuk Drive. Phase 3 of Greenbryre Estates will continue to operate with individual dual compartment septic tanks at each lot that pump into a low-pressure sewer system that eventually leads to the existing Submerged Attached Growth Reactor (SAGR) system. Phase 3 of Greenbryre Estates will also be a part of the existing Bareland Condominium Development. As such, all services including roads, utilities, infrastructure maintenance, and the existing recreational amenities will be paid for and managed by the Condominium Association.

- 9.04 (b) and (c): The proposed development includes a significant built recreational amenity, consisting of a 12-hole golf course. The golf course will continue to provide recreational opportunities that supports a high quality of life for existing and future residents of Greenbryre Estates, as well as residents situated in the surrounding City of Saskatoon and the greater Corman Park region.
- 9.05 (a): Phase 3 of the proposed development is well situated immediately south of Phases 1 and 2 of the Greenbryre Estates development. A query of HabiSask (as attached in Appendix “E”) suggests that the proposed development is not located in an area of significant wildlife habitat, or in a location that could contribute to the degradation of ecological or hydrological systems. Phase 3 of the development is also not located in an area considered to be heritage sensitive, according to the Heritage Conservation Branch (query also attached in Appendix “E”).
- 9.05 (b): A municipal servicing study, including drainage analysis was completed by Catterall & Wright (see report attached as Appendix “C”). It is proposed within the study that ponds be connected by an overland channel to flow water from one pond to the next. The system was sized to hold back-to-back 1:100 year storm events, as the intention is to not have an outlet, but rather use the runoff water as irrigation for the golf course and residential yards. The proposed development will need to be submitted to the WSA for review prior to the onset of construction.
- 9.05 (c): Potable water is distributed to residents within Greenbryre Estates from a Water Treatment Plant that was constructed during Phase 1 of the development, along Boychuk Drive. The potable water is piped to the WTP by a 75 mm supply line, owned by SCS Water Group Inc., which purchases potable water from SaskWater. According to the municipal servicing study provided by Catterall & Wright, the updated (2018) concept plan adds an additional 1.6 L/s of flow rate from the original (2012) concept, for a total of 11.7 L/s of design flow rate. As such, an additional treated water supply of 8.12 L/s is required for full buildout of Phase 3 of the development. SaskWater has indicated they can supply the required 11.7 L/s flow rate (see confirmation email attached in Appendix “D”). An additional 481 m<sup>3</sup> of storage will be required to service full buildout. The distribution pumping capacity for potable water at full buildout for the updated concept (2018) is sufficient. It is noted within the municipal servicing study that the system has been sized for peak hour demands, but does not provide fire flow capacity, although a fire truck fill is available. Pumping redundancy is achieved with three pumps installed, leaving any two

of the pumps able to meet the required distribution capacity. It is concluded that distribution pumping capacity is satisfactory to service full buildout of the development.

- 9.05 (c): Phase 3 of Greenbryre Estates will continue to operate with individual dual compartment septic tanks at each lot that pump into a low-pressure sewer system that eventually leads to the existing Submerged Attached Growth Reactor (SAGR) system.
- 9.05 (d) and 9.09: Phase 3 of the Greenbryre Estates development has been designed to complement the existing residential development that was realized in Phase 1 and 2 of the development. Although some lots are smaller in size (approximately 0.35 acres), this phase of the development will continue with the previously developed phases in terms of integrating design elements of a sophisticated recreational lifestyle with the aesthetic and privacy of acreage living. The Developer is utilizing a series of architectural controls and conditions for site development, homes and accessory buildings for Phases 1 and 2 of development. It is noted that these provisions will still be required conditions for lot sales for Phase 3 of the development.
- 9.07: Greenbryre Estates will retain the 12-hole golf course that has been incorporated as a recreational amenity within the overall development.
- 9.08: Phase 3 of Greenbryre Estates has been designed to complement the existing residential development that was realized in Phases 1 and 2 of the development. Although some lots are smaller in size (approximately 0.35 acres), this phase will continue with the integration of design elements of a sophisticated recreational lifestyle, through the incorporation of a 12-hole golf course, with the aesthetic and privacy of acreage living.
- 9.09: Phase 3 of Greenbryre Estates has been designed to complement the existing residential development that was realized in Phases 1 and 2 of the development. Although some of the proposed lots are smaller in size (approximately 0.35 acres), in addition to 84 proposed condominium units. The Developer is utilizing a series of architectural controls and conditions for site development, homes and accessory buildings for Phases 1 and 2 of development. It is noted that these provisions will still be required conditions for lot sales for Phase 3 of the development.
- 9.10 (b): The Greenbryre Estates development is located immediately south of the City of Saskatoon. The development features lots that are smaller in size than what is typically developed in a country residential subdivision. Potable water is distributed to residents within Greenbryre Estates from a Water Treatment Plant that was constructed during Phase 1 of the development, along Boychuk Drive. Phase 3 of Greenbryre Estates will continue to operate with individual dual compartment septic tanks at each lot that pump into a low-pressure sewer system that eventually leads to the existing Submerged Attached Growth Reactor (SAGR) system. Phase 3 of Greenbryre Estates will also be a part of the existing Bareland Condominium Development. As such, all services including roads, utilities, infrastructure maintenance, and the existing recreational amenities will be paid for and managed by the Condominium Association.

- 9.10 (c): As Greenbryre Estates is located within the Corman Park-Saskatoon Planning District, as well as within the boundaries of the Saskatoon North Partnership for Growth Region, the proposed development has been referred to the City of Saskatoon for review and comment.
- 9.11: Phase 3 of the proposed Greenbryre Estates development will be referred to the City of Saskatoon for review and comment, as the development is located adjacent to an Urban Future Growth Area (Future Urban Residential Neighbourhood).

## **Recreation Policies (Section 18):**

- 18.01: The proposed location and orientation of residential lots, connecting corridors and open spaces have been planned to maximize the number of properties backing onto and facing green spaces. Additionally, the 12-hole golf course will be retained.
- 18.04: This document shall serve as the CDR required for Phase 3. Phase 3 is currently zoned DAG1. The Developer is proposing to rezone Phase 3 to DCR6, a zoning district specific to Greenbryre Estates. Phase 3 includes a total of 130 residential lots and 84 condominium units. It is the intent that this document shall include a complete overview of how the proposed development successfully integrates itself physically, socially, and financially with existing properties, owners, and development in the immediate vicinity. In addition to addressing matters of land use integration, this CDR is intended to assess the capacity of the supportive municipal and provincial infrastructure as it relates the demand created by the proposed development.
- 18.05 (a): It is the intention of the Developer to complement the rural setting in the region by carefully integrating country residential lots ranging in size from 0.35 acres to 0.525 acres, along with 84 condominium units, while retaining the existing 12-hole golf course. The Developer is seeking the rezoning to DCR6 to provide for a total of 130 residential lots and 84 condominium units.
- 18.05 (b): This document shall serve as the CDR required for Phase 3 of Greenbryre Estates. It is the intent that this document include a complete overview of how the proposed development successfully integrates itself physically, socially, and financially with existing properties, owners, and development in the immediate vicinity. In addition to addressing matters of land use integration, this CDR is intended to assess the capacity of the supportive municipal and provincial infrastructure as it relates the demand created by the proposed development.
- 18.05 (c): The Developer is proposing to rezone Phase 3 to DCR6 and DCR6 with a holding provision. This will provide for a total of 130 residential lots and 84 condominium units. The Developer also wishes to subdivide out a 2.52 acre parcel of land from the existing golf course for the development of a new Golf Clubhouse. This replacement building would provide space for the following uses: (1) Pro-shop / Clubhouse; (2) Lockers and Showers; (3) Day-spa (e.g. massage, esthetics); (4) Restaurant and Lounge; (5) Office space (only for D & S / Greenbryre – same people run both businesses); and (6) Meeting /

Conference Rooms. This building would replace the existing clubhouse building. While the new clubhouse building is being constructed on Proposed Parcel W (subdivision approval pending), it is proposed that the existing clubhouse be moved to Condominium unit #28 (located across the street). We suggest that this proposal could be accommodated by rezoning Condominium Unit #28 from DCR6 to DREC1 by agreement (contract). The intent of this rezoning application is to facilitate the temporary relocation of the existing clubhouse building currently located at the Greenbryre Golf Course to Condominium Unit #28, while a new clubhouse building is constructed on Proposed Parcel W. Moving the clubhouse building across the street to Condominium Unit #28 will allow for less disruption in the operation of the golf course while the new clubhouse is being constructed on proposed Parcel W. It is estimated that the actual construction of the new clubhouse will take 2 years. Once the new clubhouse is complete, it is intended that the old clubhouse building will be moved to an off-site location. Once the old clubhouse building is removed, it is requested that Condominium Unit #28 be rezoned to the new proposed zoning district.

- 18.07: The proposed development is located immediately south of the City of Saskatoon. It is expected that a Bare Land Condominium Association will re-negotiate the contract held with the Rural Municipality for continued fire and protective services. Within the municipal servicing report prepared by Catterall & Wright, that the potable water system has been sized for peak hour demands, but does not provide fire flow capacity, although a fire truck fill is available.

## **General (Section 21)**

- 21.03: All services to Phase 3 of the proposed Greenbryre Estates development will be provided by the Developer. Potable water is distributed to residents within Greenbryre Estates from a Water Treatment Plant that was constructed during Phase 1 of the development, along Boychuk Drive. Phase 3 of Greenbryre Estates will continue to operate with individual dual compartment septic tanks at each lot that pump into a low-pressure sewer system that eventually leads to the existing Submerged Attached Growth Reactor (SAGR) system. Phase 3 of Greenbryre Estates will also be a part of the existing bare land condominium development. As such, all services including roads, utilities, infrastructure maintenance, and the existing recreational amenities will be paid for and managed by a Condominium Association.

## **Potable Water (Section 22):**

- 22.03: Potable water is distributed to residents within Greenbryre Estates from a Water Treatment Plant that was constructed during Phase 1 of the development, along Boychuk Drive. Preliminary discussions with SaskWater have taken place and they have indicated that they can provide the additional flow rate of 11.7 L/s to accommodate Phase 3 of the development (see email correspondence attached in Appendix “D”).

## **Wastewater (Section 23):**

- 23.04: Phase 3 of Greenbryre Estates will continue to operate with individual dual compartment septic tanks at each lot that pump into a low-pressure sewer system that pump

into a low-pressure sewer system that eventually leads to the existing Submerged Attached Growth Reactor (SAGR) system. The proposed means of wastewater treatment was originally reviewed and approved by the Ministry of Environment when Phase 1 of the development was approved in 2007.

- 23.07: The SAGR system that is currently in use at the existing Greenbryre Estates development represents an innovative wastewater treatment facility that was the first of its kind in the Corman Park-Saskatoon area. The key features of the SAGR system are: (1) It results in minimal sludge handling requirements, and only periodic pumping of the septic tanks is required; (2) There are minimal mechanical components; (3) The operations and maintenance costs are low; (4) Minimal operator interventions are required for system operations; (5) the biological processes are very stable, so are resistant to upsets; (6) The system itself is aesthetically pleasing; (7) The systems have an excellent track record in cold climates; and, (8) The design life of the system is approximately 20 years.

## **Stormwater and Drainage (Section 24):**

- 24.02: A municipal servicing study, including drainage analysis was completed by Catterall & Wright (see report attached as Appendix “C”). It is proposed within the study that ponds be connected by an overland channel to flow water from one pond to the next. The system was sized to hold back-to-back 1:100 year storm events, as the intention is to not have an outlet, but rather use the runoff water as irrigation for the golf course and residential yards. The proposed development will need to be submitted to the WSA for review prior to the onset of construction.
- 24.06: In undertaking the stormwater management analysis, XPSWMM modelling software was used.
- 24.10: The drainage analysis completed by Catterall & Wright indicates that stormwater be handled through ponds that are connected by an overland channel to flow water from one pond to the next. The system was sized to hold back-to-back 1:100 year storm events, as the intention is not to have an outlet, but rather use the runoff water as irrigation for the golf course and residential yards. The back-to-back events exceed the 1:100 year storm event, as required in policy 24.10 of the Saskatoon North Partnership for Growth Regional Plan. Additionally, there will be no increase in offsite flows as the water will be used for irrigation purposes.

## **Transportation (Section 25):**

- 25.03 - The proposed development will be accessed from Range Road 3050. In 2019, WSP completed a revised TIA (attached in Appendix “B”) which concluded that all study intersections are currently operating at LOS A with minimal delays and queue length on all approaches. Similarly, the intersections will continue to operate at LOS A at the completion of the development. As such, no additional improvements were recommended.

- 25.04: Phase 3 of Greenbryre Estates will also be a part of the existing Bareland Condominium Development. As such, all services including roads, utilities, infrastructure maintenance, and the existing recreational amenities will be paid for and managed by a Condominium Association.
- 25.05: The proposed development will have legal and year round, all weather physical access to a municipally maintained roadway. Additionally, Phase 3 of Greenbryre Estates will also be a part of the existing Bareland Condominium Development. As such, all services including roads will be paid for and managed by the Condominium Association.
- 25.06: The proposed development will be accessed from Range Road 3050. In 2019, WSP completed a revised TIA (attached in Appendix “B”) which concluded that all study intersections are currently operating at LOS A with minimal delays and queue length on all approaches. Similarly, the intersections will continue to operate at LOS A at the completion of the development. As such, no additional improvements were recommended.
- 25.07: Phase 3 roadways will be designed in a similar nature to Phase 1 and 2 with an urban cross section consisting of concrete paved road surface with rolled curb on each side. The revised TIA undertaken in 2019. According to the revised TIA undertaken by WSP in 2019, all study intersections are currently operating at LOS A with minimal delays and queue length on all approaches. Similarly, the intersections will continue to operate at LOS A at the completion of the development. As such, no additional improvements were recommended (see revised TIA attached in Appendix “B”).
- 25.08: Phase 3 of Greenbryre Estates will also be a part of the existing bare land condominium development. As such, all services including roads, utilities, infrastructure maintenance, and the existing recreational amenities will be paid for and managed by the Condominium Association.

## **Servicing Agreements (Section 27):**

- 27.01: A servicing agreement between the Developer and the RM of Corman Park is expected to address the following (but is not necessarily limited to):
  - Outline the provision of infrastructure including specifications;
  - Identify off-site servicing fees, payable to the RM;
  - Identify the value of the required performance bond or letter of credit;
  - The Developer is proposing to pay cash-in-lieu of the Municipal Reserve requirement.

## **5.3 CORMAN PARK-SASKATOON PLANNING DISTRICT ZONING BYLAW**

The land affected by Phase 3 is currently zoned a DAG1 – Agricultural 1 District. This CDR is requesting that the land affected by Phase 3 be rezoned to DCR6 and DCR6 with a holding provision. Development standards and regulations within the RM’s Zoning Bylaw will be met, as per Table 5-1 below.

| Site Development Standards                                 | Corman Park – Saskatoon<br>Planning District Zoning<br>Bylaw | Greenbryre Estates<br>Development                     |
|--|--|---|
| <b>Lot Size – Phase Three<br/>(DCR6)</b>                   | Minimum: 0.33 acres<br>Maximum: 10 acres                     | Min: 0.33 acres / 0.13 ha<br>Max: 0.52 acres / 0.21ha |
| <b>Lot Size – Phase Three<br/>(Town houses)<br/>(DCR6)</b> | Minimum: 0.33 acres<br>Maximum: 10 acres                     | Min: 8.3 acres / 3.36 ha<br>Max: 8.3 acres / 3.36 ha  |
| <b>Phase 3 Required Frontage</b>                           | Minimum of 19 m  | Minimum of 19 m                                       |

The minimum site size in DCR6 is 0.33 acres and the maximum density is 3 sites per acre. The policy reads:

“Residential lot density for detached country residences shall not exceed 7.4 dwelling units per hectare (3 dwelling units per acre).”

Town houses developed in phase 3 are to be based off the 4 plex design as seen in the Stonebridge neighbourhood in Saskatoon. Any town house developed will be consistent with the approved bare land condominium concepts or comprehensive development review for the subject property. Any town house development will ensure:

- 1.75 parking spaces per dwelling unit be provided, of which, 0.25 spaces per dwelling unit will be reserved for guest parking.
- Two points of vehicle access which are separated to allow for sufficient ingress and egress in case of an emergency.
- To meet the national building code requirements for dwelling groups.

## 6 STAGING AND IMPLEMENTATION

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A Concept Plan, attached within the Municipal Servicing Study in Appendix “C” details the extent of the proposed layout and subdivision of land at Phase 3 of the Greenbryre Estates development. This subdivision will need to be approved by the Community Planning Branch at the Ministry of Government Relations.

## 7 PUBLIC CONSULTATION

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A Public Open House was held on May 30, 2019 at the Greenbryre Golf and Country Club in an effort to provide information concerning the new Zoning District (DCR6) that would accommodate all phases of this development, as well as specific information concerning Phase 3 of Greenbryre Estates.

The Open House was attended by approximately 30 people (see open house letter, sign in sheet and boards attached in Appendix “I”). Most of the attendees were there to get more information and response was overwhelmingly positive, particularly from residents who had purchased corner lots in previous phases of the development. Residents were also interested in the proposed pathway system and amenity space proposed in Phase 3.

Following the Open House, two response letters were received from existing residents in the Greenbryre Estates development. These letters, and responses to such, are attached in Appendix I. The first letter identified loads of dirt being hauled from the development area without having paved Boychuk Drive in advance of the work. It was clarified in the response email that the dirt hauling related to phase 3 of the Boychuk Drive interchange project and that the appropriate permits were taken out for this work. The second email received indicated a homeowner’s request to have the proposed pathway system identified on the Concept Plan removed from the area behind their respective house. A response was provided to the homeowner indicating that a final decision on how the pathway system would be laid out has not yet been made. It is further noted that the final design of the open space parcels will be undertaken following approval of Phase 3 and these parcels will be privately owned and maintained. Both emails and responses are attached in Appendix I.

## LIST OF APPENDICES

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| APPENDIX A | BARE LAND CONDOMINIUM PLAN AND PROPOSED REZONING                             |
| APPENDIX B | TRAFFIC IMPACT ASSESSMENT UPDATE (2019) AND TRAFFIC IMPACT ASSESSMENT (2016) |
| APPENDIX C | MUNICIPAL SERVICING STUDY AND CONCEPT PLAN                                   |
| APPENDIX D | CORRESPONDENCE FROM SASKWATER  |
| APPENDIX E | HERITAGE AND ENVIRONMENTAL QUERIES   |
| APPENDIX F | GEOTECHNICAL REPORT  |
| APPENDIX G | CORRESPONDENCE WITH RM OF CORMAN PARK PLANNING DEPARTMENT                    |
| APPENDIX H | CORRESPONDENCE WITH THE PRAIRIE SPIRIT SCHOOL DIVISION                       |
| APPENDIX I | PUBLIC CONSULTATION INFORMATION  |
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# **APPENDIX A**

## **BARE LAND CONDOMINIUM PLAN AND PROPOSED REZONING**



CONDOMINIUM PLAN  
102113356

PARCEL U  
PLAN 102105335

PLAN OF PROPOSED SURFACE  
BARE LAND CONDOMINIUM FOR  
PARCELS J & K,  
PLAN NO. 102082935 &  
PARCEL T,  
PLAN NO. 102105335  
S.E. 1/4 SEC. 12  
TWP. 36, RGE. 5, W. 3RD MER.  
RM of CORMAN PARK, SASKATCHEWAN  
BY BRAD J. LUEY, S.L.S.  
SCALE 1:1000

CONDOMINIUM PLAN 102087884

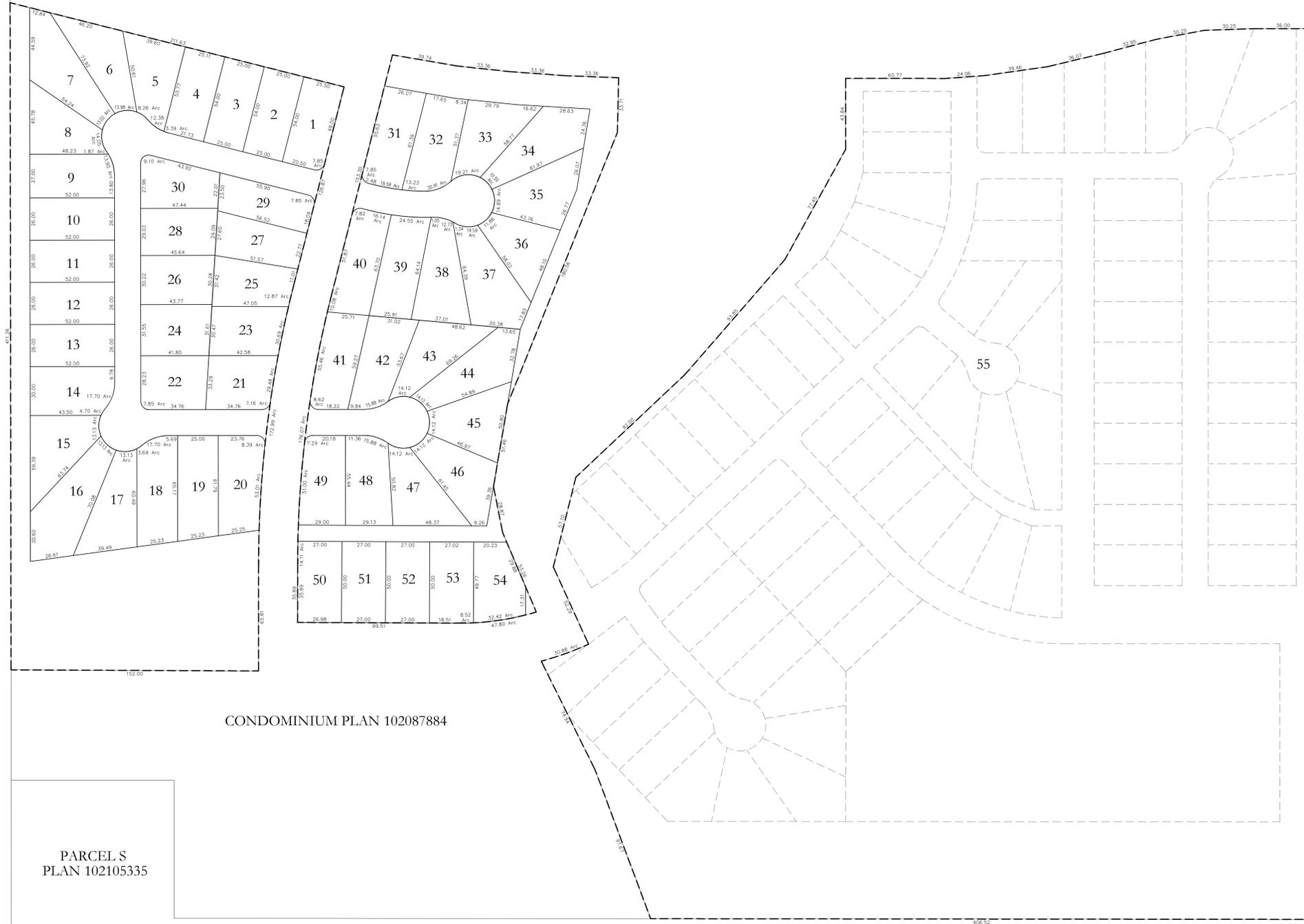
Dimensions shown are in metres and decimals thereof.  
All areas not designated with a unit number are common property.  
Portion of this plan to be approved is outlined with a bold, dashed line and contains 32.22± ha (79.62± ac).  
Distances shown are approximate and may vary from the final plan of survey by ± 0.5m.

Brad J. Luey October 2019  
Saskatchewan Land Surveyor



Registered owner:  
The signature above indicates:  
That I (we) approve the Plan of  
Proposed Subdivision as presented.

S.W. 1/4 SEC. 12-36-5-3



CONDOMINIUM PLAN 102087884

PARCEL S  
PLAN 102105335

PARCEL A  
PLAN 101456591

PARCEL A  
PLAN 101456603

CONDOMINIUM PLAN  
102113356

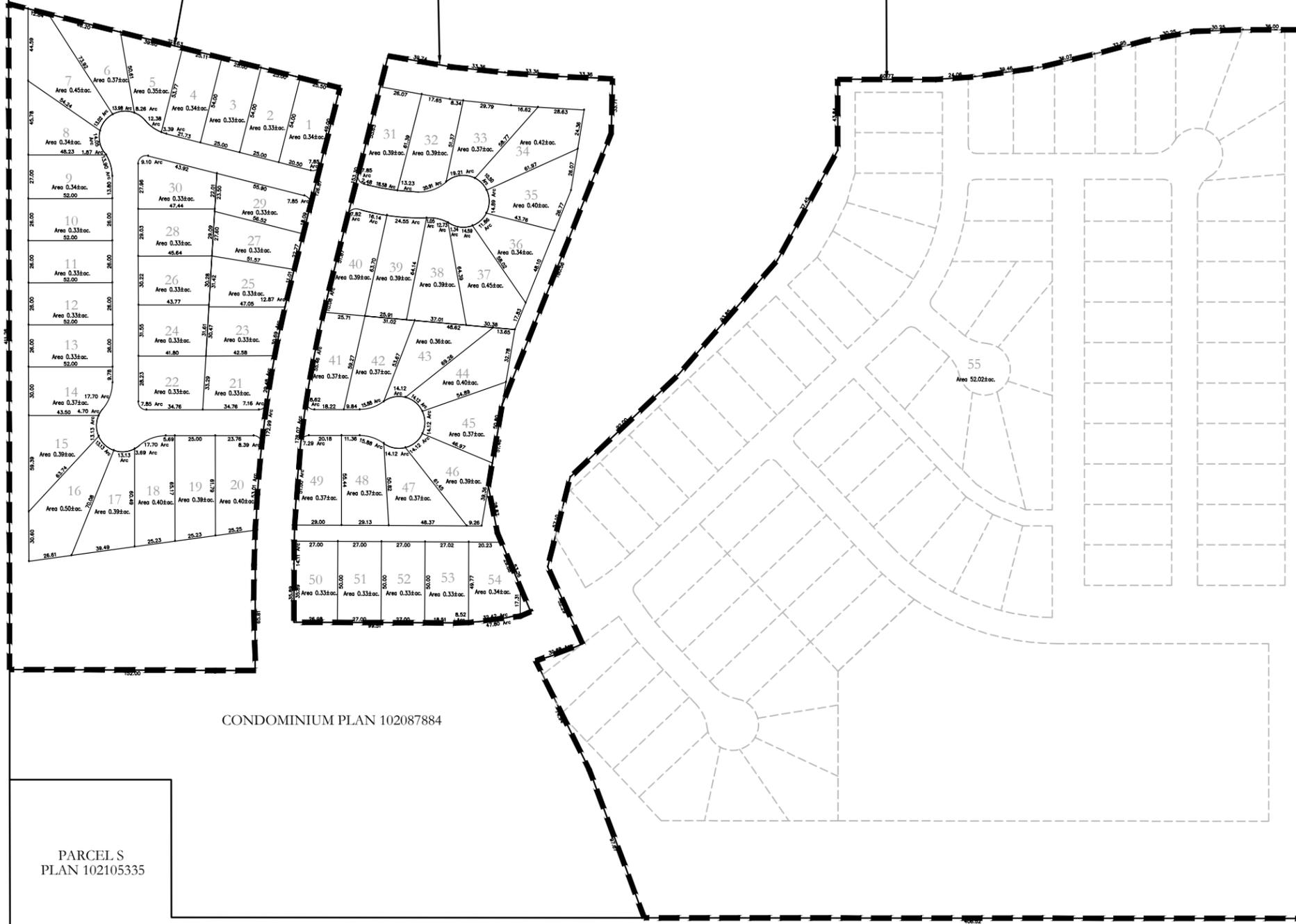
PARCEL U  
PLAN 102105335

PLAN OF PROPOSED SURFACE  
BARE LAND CONDOMINIUM FOR  
PARCELS J & K,  
PLAN NO. 102082935 &  
PARCEL T,  
PLAN NO. 102105335  
S.E. 1/4 SEC. 12  
TWP. 36, RGE. 5, W. 3RD MER.  
RM of CORMAN PARK, SASKATCHEWAN  
BY BRAD J. LUEY, S.L.S.  
SCALE 1:1000

Rezone to DCR6

Rezone to DCR6 (holding)

CONDOMINIUM PLAN 102087884



S.W. 1/4 SEC. 12-36-5-3

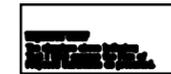
PARCEL S  
PLAN 102105335

CONDOMINIUM PLAN 102087884

PARCEL A  
PLAN 101456591

PARCEL A  
PLAN 101456603

Distances shown are to centres and deducible thereat.  
All areas not designated with a unit number are common property.  
Portion of this plan to be approved is outlined with a bold dashed line and contains 32.525 ha (79.826 ac.).  
Distances shown are approximate and may vary from the first plan of survey by 0.15m.



# **APPENDIX B**

**TRAFFIC IMPACT ASSESSMENT UPDATE (2019)  
AND TRAFFIC IMPACT ASSESSMENT (2016)**





March 14, 2019

Troy Slater  
Planning and Development Vice President,  
D&S Holmes

Dear Troy,

**RE: Greenbryre Phase 3 Traffic Impact Assessment (TIA) Update**

WSP Canada Group Limited (WSP) was retained by D&S Homes to conduct a Traffic Impact Assessment (TIA) for the Greenbryre Phase 3 Development. The initial TIA completed in 2016 did not include any analysis at the intersection of Highway 16 and Boychuk Drive due to the pending interchange construction. With the completion of the Boychuk interchange construction, this updated TIA includes additional analysis for the south terminal intersection of the Boychuk Drive interchange. The purpose of this TIA is to determine the impact that the traffic generated by Phase 3 development will have on the adjacent road network, and to identify the roadway infrastructure necessary to safely and effectively accommodate anticipated traffic from the development.

## EXISTING CONDITIONS

Highway 16 connects to Boychuk Drive / Range Road 3050 through the South Terminal of the interchange. This intersection is a stop-controlled T-intersection with the north-south approach (Boychuk Drive / Range Road 3050) operating free flow. The Highway 16 eastbound loop connects to Boychuk Drive North as a free-flow movement while the connection to Range Road 3050 South is stop controlled. The northbound right-turn to the Highway 16 eastbound on-ramp is yield-controlled. This portion of Boychuk Drive / Range Road 3050, as well as all ramp terminals, has posted speeds of 60km/h. With the construction of the interchange, intersection and corridor lighting systems are provided along Boychuk Road / Rand Road 3050 just north of Township Road 362.

The existing intersection of Range Road 3050 and Township Road 362 is two-way stop-controlled with Range Road 3050 operating free-flow. Both Range Road 3050 and Township Road 362 are two-lane undivided roadways with a posted speed of 60 km/h.

The Range Road 3050 and Greenbryre Lane intersection is a stop-controlled T-intersection with Range Road 3050 operating free-flow. The posted speeds are 80 km/h for Range Road 3050 and 30 km/h for Greenbryre Lane. There is an intersection delineation lighting system installed on Greenbryre Lane.

## PROPOSED DEVELOPMENT

The Greenbryre subdivision is located in the southwest quadrant of the intersection of Range Road 3050 and Township Road 362, just south of the Saskatoon city limit, as illustrated in **Figure 1**. Phase 3 development will consist of residential housing including 129 units of single-family detached homes, as well as 88 units of low-rise multifamily housing. The development timeframe was assumed to be completed in 2025. The TIA analyzed the traffic operations at the following study intersections:

- Range Road 3050 and Boychuk Interchange South
- Range Road 3050 and Township Road 362 intersection;
- Range Road 3050 and Greenbryre Lane intersection; and,
- Range Road 3050 and New Access Road intersection.

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wsp.com

NOTE: These design documents are prepared solely for the use by the party with whom the design professional has entered into a contract and there are no representations of any kind made by the design professional to any party with whom the design professional has not entered into a contract.



BOYCHUK INTERCHANGE SOUTH

TWP RD 362

RANGE ROAD 3050

GREENBRYRE LANE

GREENBRYRE PHASE 3

NEW ACCESS

**Legend:**

- Study Intersection
- Proposed New Access Point

DRAWING: GREENBRYRE PHASE 3 TIA UPDATES.cdr DATE: 2019-01-28 DRAWNBY: thala



203 Wellman Crescent  
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Issued Date - 02-06-2019  
Aerial Imagery -

**FIGURE 1 | PROPOSED DEVELOPMENT AND STUDY INTERSECTIONS**

GREENBRYRE PHASE 3 TIA UPDATE



## TRIP GENERATION

New trips generated by the Greenbryre Phase 3 development were updated for the morning and afternoon peak hour. Trip generation for the proposed development was established as outlined in the *Institute of Transportation Engineers (ITE) Trip Generation Manual 10<sup>th</sup> Edition* using the trip rates for Single-Family Detached Homes (ITE Code 210) and Multifamily Housing (Low-Rise) (ITE Code 220).

**Table 1** presents the trip rates and percent entering and exiting for each land use.

*Table 1 | Weekday Trip Rates*

| TYPES                          | MORNING PEAK HOUR |        |       | AFTERNOON PEAK HOUR |        |       |
|--------------------------------|-------------------|--------|-------|---------------------|--------|-------|
|                                | Trip Rates        | %Enter | %Exit | Trip Rates          | %Enter | %Exit |
| Single-Family Detached         | 0.75              | 25%    | 74%   | 0.99                | 63%    | 37%   |
| Multifamily Housing (Low-Rise) | 0.46              | 23%    | 77%   | 0.56                | 63%    | 37%   |

A summary of the new trips generated by the proposed development is summarized in **Table 2**.

*Table 2 | Total New Trips*

| TYPES                          | DWELLING UNITS | MORNING PEAK HOUR |            |            | AFTERNOON PEAK HOUR |           |            |
|--------------------------------|----------------|-------------------|------------|------------|---------------------|-----------|------------|
|                                |                | Enter             | Exit       | Total      | Enter               | Exit      | Total      |
| Single-Family Detached         | 129            | 25                | 70         | 95         | 80                  | 50        | 130        |
| Multifamily Housing (Low-Rise) | 88             | 10                | 35         | 45         | 35                  | 20        | 55         |
| <b>Total (Trips):</b>          | <b>217</b>     | <b>35</b>         | <b>105</b> | <b>140</b> | <b>115</b>          | <b>70</b> | <b>185</b> |

\* Trips are rounded to the nearest 5

## TRIP DISTRIBUTION AND ASSIGNMENT

The anticipated site-generated traffic volumes were applied to the network based on an assessment of how residents would enter or exit the site. The new traffic volumes were distributed through the road network using a comparison of the existing traffic patterns determined by the TMC, and the location of the proposed development in relation to Saskatoon. It was assumed that residents would use the Range Road 3050 and Township Road 362 intersection and ultimately the Boychuk Drive interchange as the key access point.

Based on the location of Phase 3 development, it was assumed that all new trips will utilize Range Road 3050 rather than Township Road 362. The distribution of new trips reflects vehicles entering the site using the nearest access, and exiting via the most convenient access to return to the travel route.

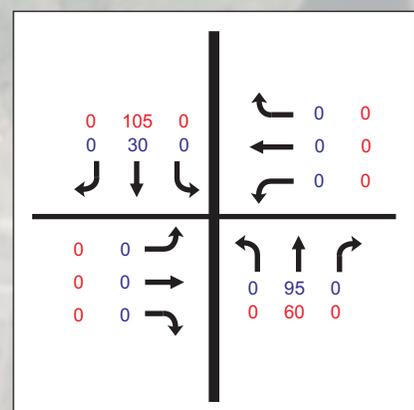
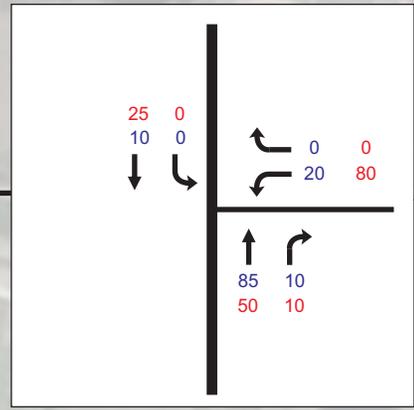
**Table 3** presents a summary of the assumed traffic volume assignment for the morning and afternoon peak hour.

*Table 3 | Trip Distribution and Assignment Assumptions*

| ROADWAY         | DIRECTION IN / OUT | DISTRIBUTION (%) | NEW TRIPS (VPH) |            |
|-----------------|--------------------|------------------|-----------------|------------|
|                 |                    |                  | Morning         | Afternoon  |
| Range Road 3050 | North              | 90%              | 125             | 165        |
| Range Road 3050 | South              | 10%              | 15              | 20         |
| <b>Total</b>    |                    | <b>100%</b>      | <b>140</b>      | <b>185</b> |

**Figure 2** illustrates the new trips generated by the proposed development for the morning and afternoon peak hours.

NOTE: These design documents are prepared solely for the use by the party with whom the design professional has entered into a contract and there are no representations of any kind made by the design professional to any party with whom the design professional has not entered into a contract.



BOYCHUK INTERCHANGE SOUTH

TWP RD 362

RANGE ROAD 3050

GREENBRYRE LANE

NEW ACCESS

65 40  
25 5

40 50  
5 5

40 5  
5 5

20 45  
5 5

0 45  
5 20

0 0  
5 5

**New Trips**  
Morning Peak Hour  
 AM IN = 35 vph  
 AM OUT = 105 vph  
  
Afternoon Peak Hour  
 PM IN = 115 vph  
 PM OUT = 70 vph



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Issued Date - 02-06-2019  
 Aerial Imagery -

**FIGURE 2 | NEW TRIPS MORNING AND AFTERNOON PEAK HOUR TRAFFIC VOLUMES**

GREENBRYRE PHASE 3 TIA UPDATE



## TRAFFIC INFORMATION

Vehicle turning movement counts (TMC) at the study intersections were collected on January 23, 2019. The data collection captured the morning (7:00 a.m. to 10:00 a.m.) and afternoon (3:00 p.m. to 6:00 p.m.) peak periods, corresponding to typical commute hours which include school peak hours. Since there is a school in the adjacent area, there are additional peak hours. These do not impact the morning peak, however for the afternoon peak, there are two peak hours that need to be considered. These two peaks only affected Township Road 362 and Greenbryre Lane; one peak is primarily caused by the school while the other one is due to regular commuter traffic for typical work days. For the purposes of this study, regular peak hours are examined. The morning peak hours for the study intersections are between 8:00 a.m. and 9:00 a.m. while the afternoon peak hours slightly differed:

- Boychuk Drive Interchange South Terminal – 4:30 p.m. to 5:30 p.m.
- Range Road 3050 and Township Road 362 Intersection – 4:30 p.m. to 5:30 p.m.
- Range Road 3050 and Greenbryre Lane – 4:15 p.m. to 5:15 p.m.

The peak hour traffic volumes for the morning and afternoon peak hours at each study intersection, as illustrated in **Figure 2**, were used in the analysis to determine how the intersections currently operate. Small discrepancies of traffic volumes between the study intersections along Boychuk Drive were not balanced due to other existing accesses including the Greenbryre Crescent North and Rae-Dawn Arabians Access.

## BACKGROUND FORECAST VOLUMES

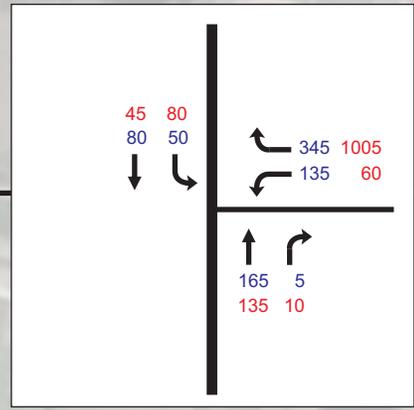
The background forecast traffic scenario is a projection of the traffic volumes anticipated without the demand from the proposed development. This projection of future traffic volume was determined by applying a 1% annual growth, until the year 2025, to the existing volumes.

**Figure 3** illustrates the background forecast volumes anticipated at the completion of the Phase 3 development for morning and afternoon peak hours.

## TOTAL FORECAST VOLUMES

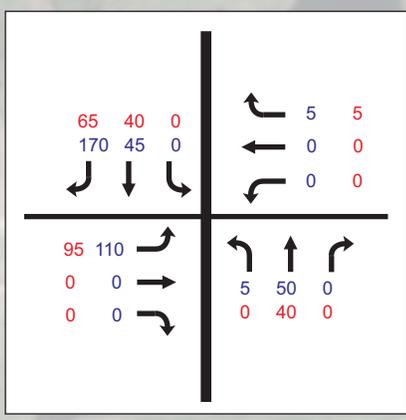
Total forecast traffic volumes associated with the proposed development are obtained by combining the background traffic growth with the new trips associated with the development. The total forecast traffic volumes for the full build-out development are presented in **Figure 5** for the morning and afternoon peak hours.

NOTE: These design documents are prepared solely for the use by the party with whom the design professional has entered into a contract and there are no representations of any kind made by the design professional to any party with whom the design professional has not entered into a contract.



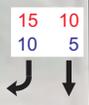
**BOYCHUK INTERCHANGE SOUTH**

**TWP RD 362**



**RANGE ROAD 3050**

**GREENBRYRE LANE**



**Legend:**  
 AM / PM Peak Hour Volumes  
 (rounded to nearest 5)

**FIGURE 3 | EXISTING MORNING AND AFTERNOON PEAK HOUR TRAFFIC VOLUMES**

GREENBRYRE PHASE 3 TIA UPDATE

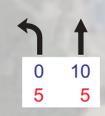
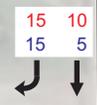
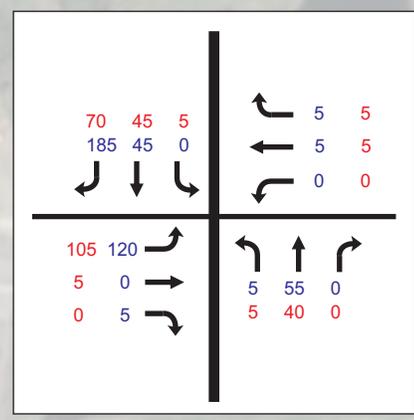
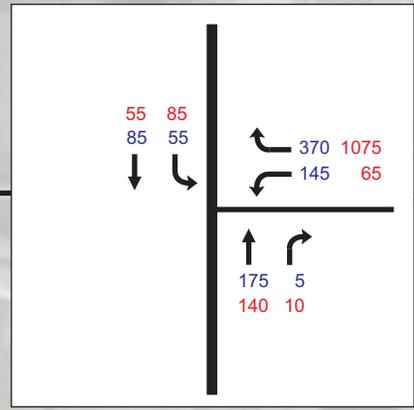


203 Wellman Crescent  
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 fax: 306.665.8589

Issued Date - 02-06-2019  
 Aerial Imagery -

DRAWING: GREENBRYRE PHASE 3 TIA UPDATES.cdr DATE: 2019-01-28 DRAWNBY: thala

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BOYCHUK INTERCHANGE SOUTH

TWP RD 362

RANGE ROAD 3050

GREENBRYRE LANE

**Legend:**  
 AM / PM Peak Hour Volumes  
 (rounded to nearest 5)



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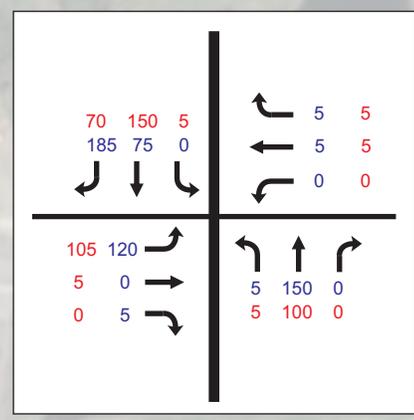
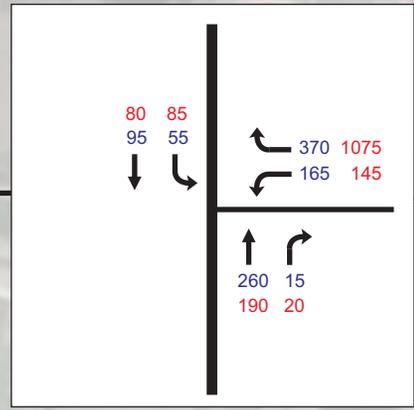
Issued Date - 02-06-2019  
 Aerial Imagery -

**FIGURE 4 | BACKGROUND FORECAST MORNING AND AFTERNOON PEAK HOUR VOLUMES**

GREENBRYRE PHASE 3 TIA UPDATE

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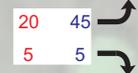
**BOYCHUK INTERCHANGE SOUTH**

**TWP RD 362**

**RANGE ROAD 3050**

**GREENBRYRE LANE**

**NEW ACCESS**



**Legend:**  
 AM / PM Peak Hour Volumes  
 (rounded to nearest 5)



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**FIGURE 5 | TOTAL FORECAST MORNING AND AFTERNOON PEAK HOUR VOLUMES**

GREENBRYRE PHASE 3 TIA UPDATE

DRAWING: GREENBRYRE PHASE 3 TIA UPDATES.cdr DATE: 2019-01-28 DRAWNBY: thala



## TRAFFIC OPERATIONS

Existing, background and total forecast traffic operations have been assessed using Synchro 10.0 (industry-standard traffic analysis software). The current infrastructure was used to examine existing and forecast scenarios with no additional turning lanes or traffic controls added. **Tables 4 and 5** summarize the analyses for the morning and afternoon peak hours, respectively.

A Level of Service (LOS) analysis assesses the effectiveness of a transportation system alphabetically from A to F, with LOS A equating to the best operating conditions and LOS F representing the failure of a movement or intersection. LOS D is typically considered the limit of acceptable operation for intersections similar to the study intersections because excessive delays tend to occur beyond this threshold.

The volume-to-capacity (v/c) ratio is representative of congestion and available capacity, and may be used to identify a movement's ability to accommodate fluctuations in traffic flow. V/C values of 0.80 or greater are typically indicative of a system that has reached its limit of operational effectiveness. The 95<sup>th</sup> percentile queue length represents the maximum back of queue a movement may experience with 95<sup>th</sup> percentile traffic volumes.

The analysis results are summarized as follows:

**Boychuk Drive Interchange South:** currently operates at LOS A and will continue to operate at LOS A for all forecast scenarios with minimal delays and queue length. The highest 95<sup>th</sup> percentile queue length is expected to be 29 m during the morning peak hour for the Westbound Left-turn at the ramp.

**Range Road 3050 and Township Road 362 Intersection:** overall intersection operates at LOS A during the morning and afternoon peak hour and is expected to operate at LOS A for the background and total forecast scenarios. Although the eastbound approach is anticipated to reach LOS C and LOS D for the background and total forecast scenarios, the highest 95<sup>th</sup> percentile queue length is anticipated to be 27 m during the morning peak hour. The highest v/c ratio is anticipated to be 0.21 during the afternoon peak hour for the eastbound approach, which is well below the capacity limit.

**Range Road 3050 and Greenbryre Lane Intersection:** currently operates at LOS A and will continue to operate at LOS A for all forecast scenarios with minimal delays and queue length.

**Range Road 3050 and New Access Road Intersection:** once constructed, will operate at LOS A for all scenarios. Although the Boychuk Drive and New Access Road intersection is anticipated to have minimal traffic volumes at total forecast scenarios, it is recommended that the study intersection be stop-controlled providing Boychuk Drive with free flow operations.

In addition, Boychuk Drive may become an urban cross-section as development continues to occur south of Highway 16. The intersection spacing suggests that reducing the speed to 60 km/h will assist in changing the driver's perception of Boychuk Drive adjacent to the proposed development. Boychuk Drive between Highway 16 and Greenbryre Lane currently has a dust free surface while Boychuk Drive is a gravel surface south of Greenbryre Lane. This portion of the roadway is a low standard road and there is likely continual maintenance required. Although the majority of the vehicles on this road are anticipated to be light-weight, road users may perceive the existing condition of the road surface as unacceptable and result in complaints received by the R.M. of Corman Park, if not improved. Paving Boychuk Drive to the south boundary of the development would be beneficial to the development.



Table 4 | Existing, Background and Total Forecast LOS Analysis – Morning Peak Hour

|  |               | Eastbound |      |      | Westbound |      |      | Northbound |      |      | Southbound |      |      | Overall LOS |
|--|---------------|-----------|------|------|-----------|------|------|------------|------|------|------------|------|------|-------------|
|  |               | LT        | TH   | RT   | LT        | TH   | RT   | LT         | TH   | RT   | LT         | TH   | RT   |             |
| <b>Boychuk Drive Interchange South and Range Road 3050</b> |               |           |      |      |           |      |      |            |      |      |            |      |      |             |
| <b>Existing</b>  | V/C Ratio     |           |      |      | 0.40      |      | 0.00 |            |      | 0.00 |            | 0.00 |      | 0.06        |
|  | Control Delay |           |      |      | 17        |      | 0    |            |      | 0    |            | 0    |      | 8           |
|  | LOS           |           | -    |      | C         |      | A    |            |      | A    |            | A    |      | A           |
|  | 95th Queue    |           |      |      | 13        |      | 0    |            |      | 0    |            | 0    |      | 1           |
| <b>Background Forecast</b>                                 | V/C Ratio     |           |      |      | 0.46      |      | 0.00 |            |      | 0.00 |            | 0.00 |      | 0.06        |
|  | Control Delay |           |      |      | 19        |      | 0    |            |      | 0    |            | 0    |      | 8           |
|  | LOS           |           | -    |      | C         |      | A    |            |      | A    |            | A    |      | A           |
|  | 95th Queue    |           |      |      | 16        |      | 0    |            |      | 0    |            | 0    |      | 1           |
| <b>Total Forecast</b>                                      | V/C Ratio     |           |      |      | 0.63      |      | 0.00 |            |      | 0.00 |            | 0.00 |      | 0.07        |
|  | Control Delay |           |      |      | 29        |      | 0    |            |      | 0    |            | 0    |      | 8           |
|  | LOS           |           | -    |      | D         |      | A    |            |      | A    |            | A    |      | A           |
|  | 95th Queue    |           |      |      | 29        |      | 0    |            |      | 0    |            | 0    |      | 1           |
| <b>Range Road 3050 and Township Road 362</b>               |               |           |      |      |           |      |      |            |      |      |            |      |      |             |
| <b>Existing</b>  | V/C Ratio     |           | 0.37 |      |           | 0.02 |      |            | 0.01 |      |            |      | 0.00 |             |
|  | Control Delay |           | 15   |      |           | 10   |      |            | 8    |      |            |      | 0    |             |
|  | LOS           |           | B    |      |           | B    |      |            | A    |      |            |      | A    |             |
|  | 95th Queue    |           | 12   |      |           | 1    |      |            | 0    |      |            |      | 0    |             |
| <b>Background Forecast</b>                                 | V/C Ratio     |           | 0.42 |      |           | 0.03 |      |            | 0.01 |      |            |      | 0.00 |             |
|  | Control Delay |           | 16   |      |           | 11   |      |            | 8    |      |            |      | 0    |             |
|  | LOS           |           | C    |      |           | B    |      |            | A    |      |            |      | A    |             |
|  | 95th Queue    |           | 15   |      |           | 1    |      |            | 0    |      |            |      | 0    |             |
| <b>Total Forecast</b>                                      | V/C Ratio     |           | 0.61 |      |           | 0.04 |      |            | 0.01 |      |            |      | 0.00 |             |
|  | Control Delay |           | 28   |      |           | 13   |      |            | 8    |      |            |      | 0    |             |
|  | LOS           |           | D    |      |           | B    |      |            | A    |      |            |      | A    |             |
|  | 95th Queue    |           | 27   |      |           | 1    |      |            | 0    |      |            |      | 0    |             |
| <b>Range Road 3050 and Greenbryre Lane Intersection</b>    |               |           |      |      |           |      |      |            |      |      |            |      |      |             |
| <b>Existing</b>  | V/C Ratio     | 0.03      |      | 0.03 |           |      |      |            | 0.00 |      |            |      | 0.00 |             |
|  | Control Delay | 9         |      | 9    |           |      |      |            | 0    |      |            |      | 0    |             |
|  | LOS           | A         |      | A    |           |      |      |            | A    |      |            |      | A    |             |
|  | 95th Queue    | 1         |      | 1    |           |      |      |            | 0    |      |            |      | 0    |             |
| <b>Background Forecast</b>                                 | V/C Ratio     | 0.03      |      | 0.03 |           |      |      |            | 0.00 |      |            |      | 0.00 |             |
|  | Control Delay | 9         |      | 9    |           |      |      |            | 0    |      |            |      | 0    |             |
|  | LOS           | A         |      | A    |           |      |      |            | A    |      |            |      | A    |             |
|  | 95th Queue    | 1         |      | 1    |           |      |      |            | 0    |      |            |      | 0    |             |
| <b>Total Forecast</b>                                      | V/C Ratio     | 0.12      |      | 0.12 |           |      |      |            | 0.00 |      |            |      | 0.00 |             |
|  | Control Delay | 10        |      | 10   |           |      |      |            | 0    |      |            |      | 0    |             |
|  | LOS           | A         |      | A    |           |      |      |            | A    |      |            |      | A    |             |
|  | 95th Queue    | 3         |      | 3    |           |      |      |            | 0    |      |            |      | 0    |             |
| <b>Range Road 3050 and New Access Road Intersection</b>    |               |           |      |      |           |      |      |            |      |      |            |      |      |             |
| <b>Total Forecast</b>                                      | V/C Ratio     | 0.06      |      | 0.06 |           |      |      |            | 0.00 |      |            |      | 0.00 |             |
|  | Control Delay | 9         |      | 9    |           |      |      |            | 7    |      |            |      | 0    |             |
|  | LOS           | A         |      | A    |           |      |      |            | A    |      |            |      | A    |             |
|  | 95th Queue    | 1         |      | 1    |           |      |      |            | 0    |      |            |      | 0    |             |



Table 5 | Existing, Background and Total Forecast LOS Analysis – Afternoon Peak Hour

|  |               | Eastbound |      |      | Westbound |      |      | Northbound |    |      | Southbound |    |      | Overall LOS |
|--|---------------|-----------|------|------|-----------|------|------|------------|----|------|------------|----|------|-------------|
|  |               | LT        | TH   | RT   | LT        | TH   | RT   | LT         | TH | RT   | LT         | TH | RT   |             |
| <b>Boychuk Drive Interchange South and Range Road 3050</b> |               |           |      |      |           |      |      |            |    |      |            |    |      |             |
| <b>Existing</b>  | V/C Ratio     |           |      |      | 0.12      |      | 0.00 |            |    | 0.00 | 0.00       |    | 0.07 |             |
|  | Control Delay |           |      |      | 12        |      | 0    |            |    | 0    | 0          |    | 8    |             |
|  | LOS           |           | -    |      | B         |      | A    |            |    | A    | A          |    | A    | -           |
|  | 95th Queue    |           |      |      | 3         |      | 0    |            |    | 0    | 0          |    | 1    |             |
| <b>Background Forecast</b>                                 | V/C Ratio     |           |      |      | 0.14      |      | 0.00 |            |    | 0.00 | 0.00       |    | 0.07 |             |
|  | Control Delay |           |      |      | 13        |      | 0    |            |    | 0    | 0          |    | 8    |             |
|  | LOS           |           | -    |      | B         |      | A    |            |    | A    | A          |    | A    | -           |
|  | 95th Queue    |           |      |      | 4         |      | 0    |            |    | 0    | 0          |    | 1    |             |
| <b>Total Forecast</b>                                      | V/C Ratio     |           |      |      | 0.35      |      | 0.00 |            |    | 0.00 | 0.00       |    | 0.07 |             |
|  | Control Delay |           |      |      | 17        |      | 0    |            |    | 0    | 0          |    | 8    |             |
|  | LOS           |           | -    |      | C         |      | A    |            |    | A    | A          |    | A    | -           |
|  | 95th Queue    |           |      |      | 11        |      | 0    |            |    | 0    | 0          |    | 1    |             |
| <b>Range Road 3050 and Township Road 362</b>               |               |           |      |      |           |      |      |            |    |      |            |    |      |             |
| <b>Existing</b>  | V/C Ratio     |           | 0.13 |      |           | 0.01 |      |            |    | 0.00 |            |    | 0.00 |             |
|  | Control Delay |           | 10   |      |           | 9    |      |            |    | 8    |            |    | 7    |             |
|  | LOS           |           | B    |      |           | A    |      |            |    | A    |            |    | A    |             |
|  | 95th Queue    |           | 4    |      |           | 0    |      |            |    | 0    |            |    | 0    |             |
| <b>Background Forecast</b>                                 | V/C Ratio     |           | 0.16 |      |           | 0.01 |      |            |    | 0.00 |            |    | 0.00 |             |
|  | Control Delay |           | 11   |      |           | 9    |      |            |    | 8    |            |    | 7    |             |
|  | LOS           |           | B    |      |           | A    |      |            |    | A    |            |    | A    |             |
|  | 95th Queue    |           | 4    |      |           | 0    |      |            |    | 0    |            |    | 0    |             |
| <b>Total Forecast</b>                                      | V/C Ratio     |           | 0.21 |      |           | 0.02 |      |            |    | 0.00 |            |    | 0.00 |             |
|  | Control Delay |           | 13   |      |           | 10   |      |            |    | 8    |            |    | 8    |             |
|  | LOS           |           | B    |      |           | B    |      |            |    | A    |            |    | A    |             |
|  | 95th Queue    |           | 6    |      |           | 1    |      |            |    | 0    |            |    | 0    |             |
| <b>Range Road 3050 and Greenbryre Lane Intersection</b>    |               |           |      |      |           |      |      |            |    |      |            |    |      |             |
| <b>Existing</b>  | V/C Ratio     |           | 0.01 | 0.01 |           |      |      |            |    | 0.00 |            |    | 0    |             |
|  | Control Delay |           | 9    | 9    |           |      |      |            |    | 7    |            |    | 0    |             |
|  | LOS           |           | A    | A    |           |      |      |            |    | A    |            |    | A    |             |
|  | 95th Queue    |           | 0    | 0    |           |      |      |            |    | 0    |            |    | 0    |             |
| <b>Background Forecast</b>                                 | V/C Ratio     |           | 0.02 | 0.02 |           |      |      |            |    | 0.00 |            |    | 0    |             |
|  | Control Delay |           | 9    | 9    |           |      |      |            |    | 7    |            |    | 0    |             |
|  | LOS           |           | A    | A    |           |      |      |            |    | A    |            |    | A    |             |
|  | 95th Queue    |           | 1    | 1    |           |      |      |            |    | 0    |            |    | 0    |             |
| <b>Total Forecast</b>                                      | V/C Ratio     |           | 0.09 | 0.09 |           |      |      |            |    | 0.01 |            |    | 0    |             |
|  | Control Delay |           | 10   | 10   |           |      |      |            |    | 8    |            |    | 0    |             |
|  | LOS           |           | A    | A    |           |      |      |            |    | A    |            |    | A    |             |
|  | 95th Queue    |           | 2    | 2    |           |      |      |            |    | 0    |            |    | 0    |             |
| <b>Range Road 3050 and New Access Road Intersection</b>    |               |           |      |      |           |      |      |            |    |      |            |    |      |             |
| <b>Total Forecast</b>                                      | V/C Ratio     |           | 0.03 | 0.03 |           |      |      |            |    | 0.00 |            |    | 0    |             |
|  | Control Delay |           | 9    | 9    |           |      |      |            |    | 7    |            |    | 0    |             |
|  | LOS           |           | A    | A    |           |      |      |            |    | A    |            |    | A    |             |
|  | 95th Queue    |           | 1    | 1    |           |      |      |            |    | 0    |            |    | 0    |             |



## SUMMARY OF RECOMMENDATION

Although there is a slight increase in the total residential units (178 units to 217 units), there are minimal impacts generated by the proposed development to the road network. It should be noted that the recommendations identified are not intended to replace those previously made in the 2016 TIA but to identify any potential changes due to the construction of the Boychuk interchange. The following recommendations have resulted from the completion of this TIA:

- The study intersections are currently operating at LOS A with minimal delays and queue length on all approaches. Similarly, the intersections will continue to operate at LOS A at the completion of the development. As such, no additional improvements are required.
- Consider reducing the speed limit along Range Road 3050 to 60 km/h which can transition to 80 km/h south of the development.
- It is recommended that a delineation lighting system be provided on the west approach (New Access Road) at the Range Road 3050 and New Access Road intersection.
- Capacity analysis indicates that there will be minimal queuing along Range Road 3050. As such, no turning lanes will be required to accommodate traffic demand. It is recommended that traffic operations along Range Road 3050 be monitored to determine the timing for turning lane improvements as further development beyond Greenbrye occurs which may result in longer queue lengths.
- With the completion of the Highway 16 and Boychuk Drive interchange, the lighting system is provided along Boychuk Drive / Range Road 3055 up to just north of Township Road 362. As such, it is recommended that traffic volumes on Range Road 3055 be monitored as further development continues to occur beyond Greenbrye and that a corridor lighting system be considered as this segment becomes a more urbanized section, similar to Boychuk Drive on the north.
- Boychuk Drive south of Greenbrye Lane is a low-grade gravel surface. It is recommended that a dust free improvement be considered up to the south boundary of the development.

\* \* \* \* \*

We trust that this review has been completed to your satisfaction. Please contact me by phone at (306)518-0231 or email me at [Nathan.Gray@wsp.com](mailto:Nathan.Gray@wsp.com) if you have any questions about the information contained in this letter.

Yours sincerely,



Nathan Gray, P.Eng., PTOE  
Manager, Transportation Planning SK  
NG/BS

| Intersection             |      |      |      |       |      |      |
|--------------------------|------|------|------|-------|------|------|
| Int Delay, s/veh         | 6.2  |      |      |       |      |      |
| Movement                 | WBL  | WBR  | NBT  | NBR   | SBL  | SBT  |
| Lane Configurations      | ↘    | ↗    | ↑    | ↗     | ↘    | ↑    |
| Traffic Vol, veh/h       | 134  | 346  | 165  | 4     | 51   | 81   |
| Future Vol, veh/h        | 134  | 346  | 165  | 4     | 51   | 81   |
| Conflicting Peds, #/hr   | 0    | 0    | 0    | 0     | 0    | 0    |
| Sign Control             | Stop | Stop | Free | Free  | Free | Free |
| RT Channelized           | -    | Free | -    | Yield | -    | None |
| Storage Length           | 0    | 0    | -    | 0     | 0    | -    |
| Veh in Median Storage, # | 0    | -    | 0    | -     | -    | 0    |
| Grade, %                 | 0    | -    | 0    | -     | -    | 0    |
| Peak Hour Factor         | 68   | 68   | 68   | 68    | 68   | 68   |
| Heavy Vehicles, %        | 3    | 3    | 3    | 3     | 3    | 3    |
| Mvmt Flow                | 197  | 509  | 243  | 6     | 75   | 119  |

| Major/Minor          | Minor1 | Major1 | Major2 |   |       |
|----------------------|--------|--------|--------|---|-------|
| Conflicting Flow All | 512    | -      | 0      | 0 | 243   |
| Stage 1              | 243    | -      | -      | - | -     |
| Stage 2              | 269    | -      | -      | - | -     |
| Critical Hdwy        | 6.43   | -      | -      | - | 4.13  |
| Critical Hdwy Stg 1  | 5.43   | -      | -      | - | -     |
| Critical Hdwy Stg 2  | 5.43   | -      | -      | - | -     |
| Follow-up Hdwy       | 3.527  | -      | -      | - | 2.227 |
| Pot Cap-1 Maneuver   | 520    | 0      | -      | - | 1317  |
| Stage 1              | 795    | 0      | -      | - | -     |
| Stage 2              | 774    | 0      | -      | - | -     |
| Platoon blocked, %   |        | -      | -      | - | -     |
| Mov Cap-1 Maneuver   | 490    | -      | -      | - | 1317  |
| Mov Cap-2 Maneuver   | 490    | -      | -      | - | -     |
| Stage 1              | 795    | -      | -      | - | -     |
| Stage 2              | 730    | -      | -      | - | -     |

| Approach             | WB   | NB | SB  |
|----------------------|------|----|-----|
| HCM Control Delay, s | 17.2 | 0  | 3.1 |
| HCM LOS              | C    |    |     |

| Minor Lane/Major Mvmt | NBT | NBRWBLn1 | WBLn2 | SBL | SBT   |
|-----------------------|-----|----------|-------|-----|-------|
| Capacity (veh/h)      | -   | -        | 490   | -   | 1317  |
| HCM Lane V/C Ratio    | -   | -        | 0.402 | -   | 0.057 |
| HCM Control Delay (s) | -   | -        | 17.2  | 0   | 7.9   |
| HCM Lane LOS          | -   | -        | C     | A   | A     |
| HCM 95th %tile Q(veh) | -   | -        | 1.9   | -   | 0.2   |

| Intersection             |      |      |      |      |      |      |      |      |      |      |      |      |
|--------------------------|------|------|------|------|------|------|------|------|------|------|------|------|
| Int Delay, s/veh         | 4.5  |      |      |      |      |      |      |      |      |      |      |      |
| Movement                 | EBL  | EBT  | EBR  | WBL  | WBT  | WBR  | NBL  | NBT  | NBR  | SBL  | SBT  | SBR  |
| Lane Configurations      |      | ↕    |      |      | ↕    |      |      | ↕    |      |      | ↕    |      |
| Traffic Vol, veh/h       | 112  | 0    | 1    | 0    | 2    | 5    | 3    | 52   | 0    | 0    | 43   | 172  |
| Future Vol, veh/h        | 112  | 0    | 1    | 0    | 2    | 5    | 3    | 52   | 0    | 0    | 43   | 172  |
| Conflicting Peds, #/hr   | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| Sign Control             | Stop | Stop | Stop | Stop | Stop | Stop | Free | Free | Free | Free | Free | Free |
| RT Channelized           | -    | -    | None |
| Storage Length           | -    | -    | -    | -    | -    | -    | -    | -    | -    | -    | -    | -    |
| Veh in Median Storage, # | -    | 0    | -    | -    | 0    | -    | -    | 0    | -    | -    | 0    | -    |
| Grade, %                 | -    | 0    | -    | -    | 0    | -    | -    | 0    | -    | -    | 0    | -    |
| Peak Hour Factor         | 53   | 53   | 53   | 53   | 53   | 53   | 53   | 53   | 53   | 53   | 53   | 53   |
| Heavy Vehicles, %        | 2    | 2    | 2    | 2    | 2    | 2    | 2    | 2    | 2    | 2    | 2    | 2    |
| Mvmt Flow                | 211  | 0    | 2    | 0    | 4    | 9    | 6    | 98   | 0    | 0    | 81   | 325  |

| Major/Minor          | Minor2 |       | Minor1 |       | Major1 |       | Major2 |   |   |       |   |   |
|----------------------|--------|-------|--------|-------|--------|-------|--------|---|---|-------|---|---|
| Conflicting Flow All | 361    | 354   | 244    | 355   | 516    | 98    | 406    | 0 | 0 | 98    | 0 | 0 |
| Stage 1              | 244    | 244   | -      | 110   | 110    | -     | -      | - | - | -     | - | - |
| Stage 2              | 117    | 110   | -      | 245   | 406    | -     | -      | - | - | -     | - | - |
| Critical Hdwy        | 7.12   | 6.52  | 6.22   | 7.12  | 6.52   | 6.22  | 4.12   | - | - | 4.12  | - | - |
| Critical Hdwy Stg 1  | 6.12   | 5.52  | -      | 6.12  | 5.52   | -     | -      | - | - | -     | - | - |
| Critical Hdwy Stg 2  | 6.12   | 5.52  | -      | 6.12  | 5.52   | -     | -      | - | - | -     | - | - |
| Follow-up Hdwy       | 3.518  | 4.018 | 3.318  | 3.518 | 4.018  | 3.318 | 2.218  | - | - | 2.218 | - | - |
| Pot Cap-1 Maneuver   | 595    | 571   | 795    | 600   | 463    | 958   | 1153   | - | - | 1495  | - | - |
| Stage 1              | 760    | 704   | -      | 895   | 804    | -     | -      | - | - | -     | - | - |
| Stage 2              | 888    | 804   | -      | 759   | 598    | -     | -      | - | - | -     | - | - |
| Platoon blocked, %   |        |       |        |       |        |       |        | - | - | -     | - | - |
| Mov Cap-1 Maneuver   | 583    | 568   | 795    | 596   | 460    | 958   | 1153   | - | - | 1495  | - | - |
| Mov Cap-2 Maneuver   | 583    | 568   | -      | 596   | 460    | -     | -      | - | - | -     | - | - |
| Stage 1              | 755    | 704   | -      | 890   | 799    | -     | -      | - | - | -     | - | - |
| Stage 2              | 870    | 799   | -      | 757   | 598    | -     | -      | - | - | -     | - | - |

| Approach             | EB   |  | WB |  | NB  |  | SB |  |
|----------------------|------|--|----|--|-----|--|----|--|
| HCM Control Delay, s | 14.7 |  | 10 |  | 0.4 |  | 0  |  |
| HCM LOS              | B    |  | B  |  |     |  |    |  |

| Minor Lane/Major Mvmt | NBL   | NBT | NBR | EBLn1WBLn1 | SBL   | SBT  | SBR |
|-----------------------|-------|-----|-----|------------|-------|------|-----|
| Capacity (veh/h)      | 1153  | -   | -   | 584        | 732   | 1495 | -   |
| HCM Lane V/C Ratio    | 0.005 | -   | -   | 0.365      | 0.018 | -    | -   |
| HCM Control Delay (s) | 8.1   | 0   | -   | 14.7       | 10    | 0    | -   |
| HCM Lane LOS          | A     | A   | -   | B          | B     | A    | -   |
| HCM 95th %tile Q(veh) | 0     | -   | -   | 1.7        | 0.1   | 0    | -   |

| Intersection             |      |      |      |      |      |      |
|--------------------------|------|------|------|------|------|------|
| Int Delay, s/veh         | 4    |      |      |      |      |      |
| Movement                 | EBL  | EBR  | NBL  | NBT  | SBT  | SBR  |
| Lane Configurations      | TT   |      |      | TT   | TT   |      |
| Traffic Vol, veh/h       | 23   | 0    | 0    | 11   | 4    | 12   |
| Future Vol, veh/h        | 23   | 0    | 0    | 11   | 4    | 12   |
| Conflicting Peds, #/hr   | 0    | 0    | 0    | 0    | 0    | 0    |
| Sign Control             | Stop | Stop | Free | Free | Free | Free |
| RT Channelized           | -    | None | -    | None | -    | None |
| Storage Length           | 0    | -    | -    | -    | -    | -    |
| Veh in Median Storage, # | 0    | -    | -    | 0    | 0    | -    |
| Grade, %                 | 0    | -    | -    | 0    | 0    | -    |
| Peak Hour Factor         | 74   | 74   | 74   | 74   | 74   | 74   |
| Heavy Vehicles, %        | 2    | 2    | 2    | 2    | 2    | 2    |
| Mvmt Flow                | 31   | 0    | 0    | 15   | 5    | 16   |

| Major/Minor          | Minor2 | Major1 |       | Major2 |   |
|----------------------|--------|--------|-------|--------|---|
| Conflicting Flow All | 28     | 13     | 21    | 0      | 0 |
| Stage 1              | 13     | -      | -     | -      | - |
| Stage 2              | 15     | -      | -     | -      | - |
| Critical Hdwy        | 6.42   | 6.22   | 4.12  | -      | - |
| Critical Hdwy Stg 1  | 5.42   | -      | -     | -      | - |
| Critical Hdwy Stg 2  | 5.42   | -      | -     | -      | - |
| Follow-up Hdwy       | 3.518  | 3.318  | 2.218 | -      | - |
| Pot Cap-1 Maneuver   | 987    | 1067   | 1595  | -      | - |
| Stage 1              | 1010   | -      | -     | -      | - |
| Stage 2              | 1008   | -      | -     | -      | - |
| Platoon blocked, %   |        |        |       | -      | - |
| Mov Cap-1 Maneuver   | 987    | 1067   | 1595  | -      | - |
| Mov Cap-2 Maneuver   | 987    | -      | -     | -      | - |
| Stage 1              | 1010   | -      | -     | -      | - |
| Stage 2              | 1008   | -      | -     | -      | - |

| Approach             | EB  | NB | SB |
|----------------------|-----|----|----|
| HCM Control Delay, s | 8.8 | 0  | 0  |
| HCM LOS              | A   |    |    |

| Minor Lane/Major Mvmt | NBL  | NBT | EBLn1 | SBT | SBR |
|-----------------------|------|-----|-------|-----|-----|
| Capacity (veh/h)      | 1595 | -   | 987   | -   | -   |
| HCM Lane V/C Ratio    | -    | -   | 0.031 | -   | -   |
| HCM Control Delay (s) | 0    | -   | 8.8   | -   | -   |
| HCM Lane LOS          | A    | -   | A     | -   | -   |
| HCM 95th %tile Q(veh) | 0    | -   | 0.1   | -   | -   |

| Intersection             |      |      |      |       |      |      |
|--------------------------|------|------|------|-------|------|------|
| Int Delay, s/veh         | 4.1  |      |      |       |      |      |
| Movement                 | WBL  | WBR  | NBT  | NBR   | SBL  | SBT  |
| Lane Configurations      | ↘    | ↗    | ↑    | ↗     | ↘    | ↑    |
| Traffic Vol, veh/h       | 60   | 1007 | 133  | 8     | 79   | 46   |
| Future Vol, veh/h        | 60   | 1007 | 133  | 8     | 79   | 46   |
| Conflicting Peds, #/hr   | 0    | 0    | 0    | 0     | 0    | 0    |
| Sign Control             | Stop | Stop | Free | Free  | Free | Free |
| RT Channelized           | -    | Free | -    | Yield | -    | None |
| Storage Length           | 0    | 0    | -    | 0     | 0    | -    |
| Veh in Median Storage, # | 0    | -    | 0    | -     | -    | 0    |
| Grade, %                 | 0    | -    | 0    | -     | -    | 0    |
| Peak Hour Factor         | 85   | 85   | 85   | 85    | 85   | 85   |
| Heavy Vehicles, %        | 1    | 1    | 1    | 1     | 1    | 1    |
| Mvmt Flow                | 71   | 1185 | 156  | 9     | 93   | 54   |

| Major/Minor          | Minor1 | Major1 | Major2 |
|----------------------|--------|--------|--------|
| Conflicting Flow All | 396    | -      | 0      |
| Stage 1              | 156    | -      | -      |
| Stage 2              | 240    | -      | -      |
| Critical Hdwy        | 6.41   | -      | -      |
| Critical Hdwy Stg 1  | 5.41   | -      | -      |
| Critical Hdwy Stg 2  | 5.41   | -      | -      |
| Follow-up Hdwy       | 3.509  | -      | -      |
| Pot Cap-1 Maneuver   | 611    | 0      | -      |
| Stage 1              | 875    | 0      | -      |
| Stage 2              | 802    | 0      | -      |
| Platoon blocked, %   |        | -      | -      |
| Mov Cap-1 Maneuver   | 571    | -      | -      |
| Mov Cap-2 Maneuver   | 571    | -      | -      |
| Stage 1              | 875    | -      | -      |
| Stage 2              | 750    | -      | -      |

| Approach             | WB   | NB | SB  |
|----------------------|------|----|-----|
| HCM Control Delay, s | 12.2 | 0  | 4.9 |
| HCM LOS              | B    |    |     |

| Minor Lane/Major Mvmt | NBT | NBRWBLn1WBLn2 | SBL   | SBT |
|-----------------------|-----|---------------|-------|-----|
| Capacity (veh/h)      | -   | -             | 571   | -   |
| HCM Lane V/C Ratio    | -   | -             | 0.124 | -   |
| HCM Control Delay (s) | -   | -             | 12.2  | -   |
| HCM Lane LOS          | -   | -             | B     | A   |
| HCM 95th %tile Q(veh) | -   | -             | 0.4   | -   |

| Intersection             |      |      |      |      |      |      |      |      |      |      |      |      |
|--------------------------|------|------|------|------|------|------|------|------|------|------|------|------|
| Int Delay, s/veh         | 4.2  |      |      |      |      |      |      |      |      |      |      |      |
| Movement                 | EBL  | EBT  | EBR  | WBL  | WBT  | WBR  | NBL  | NBT  | NBR  | SBL  | SBT  | SBR  |
| Lane Configurations      |      | ↕    |      |      | ↕    |      |      | ↕    |      |      | ↕    |      |
| Traffic Vol, veh/h       | 96   | 1    | 0    | 0    | 1    | 7    | 1    | 38   | 0    | 2    | 40   | 64   |
| Future Vol, veh/h        | 96   | 1    | 0    | 0    | 1    | 7    | 1    | 38   | 0    | 2    | 40   | 64   |
| Conflicting Peds, #/hr   | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| Sign Control             | Stop | Stop | Stop | Stop | Stop | Stop | Free | Free | Free | Free | Free | Free |
| RT Channelized           | -    | -    | None |
| Storage Length           | -    | -    | -    | -    | -    | -    | -    | -    | -    | -    | -    | -    |
| Veh in Median Storage, # | -    | 0    | -    | -    | 0    | -    | -    | 0    | -    | -    | 0    | -    |
| Grade, %                 | -    | 0    | -    | -    | 0    | -    | -    | 0    | -    | -    | 0    | -    |
| Peak Hour Factor         | 88   | 88   | 88   | 88   | 88   | 88   | 88   | 88   | 88   | 88   | 88   | 88   |
| Heavy Vehicles, %        | 2    | 2    | 2    | 2    | 2    | 2    | 2    | 2    | 2    | 2    | 2    | 2    |
| Mvmt Flow                | 109  | 1    | 0    | 0    | 1    | 8    | 1    | 43   | 0    | 2    | 45   | 73   |

| Major/Minor          | Minor2 |       | Minor1 |       | Major1 |       |       | Major2 |   |       |   |   |
|----------------------|--------|-------|--------|-------|--------|-------|-------|--------|---|-------|---|---|
| Conflicting Flow All | 136    | 131   | 82     | 131   | 167    | 43    | 118   | 0      | 0 | 43    | 0 | 0 |
| Stage 1              | 86     | 86    | -      | 45    | 45     | -     | -     | -      | - | -     | - | - |
| Stage 2              | 50     | 45    | -      | 86    | 122    | -     | -     | -      | - | -     | - | - |
| Critical Hdwy        | 7.12   | 6.52  | 6.22   | 7.12  | 6.52   | 6.22  | 4.12  | -      | - | 4.12  | - | - |
| Critical Hdwy Stg 1  | 6.12   | 5.52  | -      | 6.12  | 5.52   | -     | -     | -      | - | -     | - | - |
| Critical Hdwy Stg 2  | 6.12   | 5.52  | -      | 6.12  | 5.52   | -     | -     | -      | - | -     | - | - |
| Follow-up Hdwy       | 3.518  | 4.018 | 3.318  | 3.518 | 4.018  | 3.318 | 2.218 | -      | - | 2.218 | - | - |
| Pot Cap-1 Maneuver   | 835    | 760   | 978    | 841   | 726    | 1027  | 1470  | -      | - | 1566  | - | - |
| Stage 1              | 922    | 824   | -      | 969   | 857    | -     | -     | -      | - | -     | - | - |
| Stage 2              | 963    | 857   | -      | 922   | 795    | -     | -     | -      | - | -     | - | - |
| Platoon blocked, %   |        |       |        |       |        |       |       | -      | - | -     | - | - |
| Mov Cap-1 Maneuver   | 827    | 758   | 978    | 838   | 725    | 1027  | 1470  | -      | - | 1566  | - | - |
| Mov Cap-2 Maneuver   | 827    | 758   | -      | 838   | 725    | -     | -     | -      | - | -     | - | - |
| Stage 1              | 921    | 823   | -      | 968   | 856    | -     | -     | -      | - | -     | - | - |
| Stage 2              | 953    | 856   | -      | 920   | 794    | -     | -     | -      | - | -     | - | - |

| Approach             | EB |  | WB  |  | NB  |  | SB  |  |
|----------------------|----|--|-----|--|-----|--|-----|--|
| HCM Control Delay, s | 10 |  | 8.7 |  | 0.2 |  | 0.1 |  |
| HCM LOS              | B  |  | A   |  |     |  |     |  |

| Minor Lane/Major Mvmt | NBL   | NBT | NBR | EBLn1WBLn1 | SBL   | SBT   | SBR |
|-----------------------|-------|-----|-----|------------|-------|-------|-----|
| Capacity (veh/h)      | 1470  | -   | -   | 826        | 976   | 1566  | -   |
| HCM Lane V/C Ratio    | 0.001 | -   | -   | 0.133      | 0.009 | 0.001 | -   |
| HCM Control Delay (s) | 7.5   | 0   | -   | 10         | 8.7   | 7.3   | 0   |
| HCM Lane LOS          | A     | A   | -   | B          | A     | A     | A   |
| HCM 95th %tile Q(veh) | 0     | -   | -   | 0.5        | 0     | 0     | -   |

| Intersection             |      |      |      |      |      |      |
|--------------------------|------|------|------|------|------|------|
| Int Delay, s/veh         | 2.9  |      |      |      |      |      |
| Movement                 | EBL  | EBR  | NBL  | NBT  | SBT  | SBR  |
| Lane Configurations      | TT   |      |      | TT   | TT   |      |
| Traffic Vol, veh/h       | 12   | 0    | 2    | 3    | 11   | 13   |
| Future Vol, veh/h        | 12   | 0    | 2    | 3    | 11   | 13   |
| Conflicting Peds, #/hr   | 0    | 0    | 0    | 0    | 0    | 0    |
| Sign Control             | Stop | Stop | Free | Free | Free | Free |
| RT Channelized           | -    | None | -    | None | -    | None |
| Storage Length           | 0    | -    | -    | -    | -    | -    |
| Veh in Median Storage, # | 0    | -    | -    | 0    | 0    | -    |
| Grade, %                 | 0    | -    | -    | 0    | 0    | -    |
| Peak Hour Factor         | 85   | 85   | 85   | 85   | 85   | 85   |
| Heavy Vehicles, %        | 2    | 2    | 2    | 2    | 2    | 2    |
| Mvmt Flow                | 14   | 0    | 2    | 4    | 13   | 15   |

| Major/Minor          | Minor2 | Major1 |       | Major2 |   |
|----------------------|--------|--------|-------|--------|---|
| Conflicting Flow All | 29     | 21     | 28    | 0      | 0 |
| Stage 1              | 21     | -      | -     | -      | - |
| Stage 2              | 8      | -      | -     | -      | - |
| Critical Hdwy        | 6.42   | 6.22   | 4.12  | -      | - |
| Critical Hdwy Stg 1  | 5.42   | -      | -     | -      | - |
| Critical Hdwy Stg 2  | 5.42   | -      | -     | -      | - |
| Follow-up Hdwy       | 3.518  | 3.318  | 2.218 | -      | - |
| Pot Cap-1 Maneuver   | 986    | 1056   | 1585  | -      | - |
| Stage 1              | 1002   | -      | -     | -      | - |
| Stage 2              | 1015   | -      | -     | -      | - |
| Platoon blocked, %   |        |        |       | -      | - |
| Mov Cap-1 Maneuver   | 985    | 1056   | 1585  | -      | - |
| Mov Cap-2 Maneuver   | 985    | -      | -     | -      | - |
| Stage 1              | 1001   | -      | -     | -      | - |
| Stage 2              | 1015   | -      | -     | -      | - |

| Approach             | EB  | NB  | SB |
|----------------------|-----|-----|----|
| HCM Control Delay, s | 8.7 | 2.9 | 0  |
| HCM LOS              | A   |     |    |

| Minor Lane/Major Mvmt | NBL   | NBT | EBLn1 | SBT | SBR |
|-----------------------|-------|-----|-------|-----|-----|
| Capacity (veh/h)      | 1585  | -   | 985   | -   | -   |
| HCM Lane V/C Ratio    | 0.001 | -   | 0.014 | -   | -   |
| HCM Control Delay (s) | 7.3   | 0   | 8.7   | -   | -   |
| HCM Lane LOS          | A     | A   | A     | -   | -   |
| HCM 95th %tile Q(veh) | 0     | -   | 0     | -   | -   |

| Intersection             |      |      |      |       |      |      |
|--------------------------|------|------|------|-------|------|------|
| Int Delay, s/veh         | 6.9  |      |      |       |      |      |
| Movement                 | WBL  | WBR  | NBT  | NBR   | SBL  | SBT  |
| Lane Configurations      | ↘    | ↗    | ↑    | ↗     | ↘    | ↑    |
| Traffic Vol, veh/h       | 145  | 370  | 175  | 5     | 55   | 85   |
| Future Vol, veh/h        | 145  | 370  | 175  | 5     | 55   | 85   |
| Conflicting Peds, #/hr   | 0    | 0    | 0    | 0     | 0    | 0    |
| Sign Control             | Stop | Stop | Free | Free  | Free | Free |
| RT Channelized           | -    | Free | -    | Yield | -    | None |
| Storage Length           | 0    | 0    | -    | 0     | 0    | -    |
| Veh in Median Storage, # | 0    | -    | 0    | -     | -    | 0    |
| Grade, %                 | 0    | -    | 0    | -     | -    | 0    |
| Peak Hour Factor         | 68   | 68   | 68   | 68    | 68   | 68   |
| Heavy Vehicles, %        | 3    | 3    | 3    | 3     | 3    | 3    |
| Mvmt Flow                | 213  | 544  | 257  | 7     | 81   | 125  |

| Major/Minor          | Minor1 | Major1 | Major2 |   |       |
|----------------------|--------|--------|--------|---|-------|
| Conflicting Flow All | 544    | -      | 0      | 0 | 257   |
| Stage 1              | 257    | -      | -      | - | -     |
| Stage 2              | 287    | -      | -      | - | -     |
| Critical Hdwy        | 6.43   | -      | -      | - | 4.13  |
| Critical Hdwy Stg 1  | 5.43   | -      | -      | - | -     |
| Critical Hdwy Stg 2  | 5.43   | -      | -      | - | -     |
| Follow-up Hdwy       | 3.527  | -      | -      | - | 2.227 |
| Pot Cap-1 Maneuver   | 498    | 0      | -      | - | 1302  |
| Stage 1              | 784    | 0      | -      | - | -     |
| Stage 2              | 759    | 0      | -      | - | -     |
| Platoon blocked, %   |        |        |        |   |       |
| Mov Cap-1 Maneuver   | 467    | -      | -      | - | 1302  |
| Mov Cap-2 Maneuver   | 467    | -      | -      | - | -     |
| Stage 1              | 784    | -      | -      | - | -     |
| Stage 2              | 712    | -      | -      | - | -     |

| Approach             | WB | NB | SB  |
|----------------------|----|----|-----|
| HCM Control Delay, s | 19 | 0  | 3.1 |
| HCM LOS              | C  |    |     |

| Minor Lane/Major Mvmt | NBT | NBRWBLn1WBLn2 | SBL   | SBT |
|-----------------------|-----|---------------|-------|-----|
| Capacity (veh/h)      | -   | -             | 467   | -   |
| HCM Lane V/C Ratio    | -   | -             | 0.457 | -   |
| HCM Control Delay (s) | -   | -             | 19    | 0   |
| HCM Lane LOS          | -   | -             | C     | A   |
| HCM 95th %tile Q(veh) | -   | -             | 2.3   | -   |

| Intersection             |      |      |      |      |      |      |      |      |      |      |      |      |
|--------------------------|------|------|------|------|------|------|------|------|------|------|------|------|
| Int Delay, s/veh         | 5.1  |      |      |      |      |      |      |      |      |      |      |      |
| Movement                 | EBL  | EBT  | EBR  | WBL  | WBT  | WBR  | NBL  | NBT  | NBR  | SBL  | SBT  | SBR  |
| Lane Configurations      |      | ↕    |      |      | ↕    |      |      | ↕    |      |      | ↕    |      |
| Traffic Vol, veh/h       | 120  | 0    | 5    | 0    | 5    | 5    | 5    | 55   | 0    | 0    | 45   | 185  |
| Future Vol, veh/h        | 120  | 0    | 5    | 0    | 5    | 5    | 5    | 55   | 0    | 0    | 45   | 185  |
| Conflicting Peds, #/hr   | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| Sign Control             | Stop | Stop | Stop | Stop | Stop | Stop | Free | Free | Free | Free | Free | Free |
| RT Channelized           | -    | -    | None |
| Storage Length           | -    | -    | -    | -    | -    | -    | -    | -    | -    | -    | -    | -    |
| Veh in Median Storage, # | -    | 0    | -    | -    | 0    | -    | -    | 0    | -    | -    | 0    | -    |
| Grade, %                 | -    | 0    | -    | -    | 0    | -    | -    | 0    | -    | -    | 0    | -    |
| Peak Hour Factor         | 53   | 53   | 53   | 53   | 53   | 53   | 53   | 53   | 53   | 53   | 53   | 53   |
| Heavy Vehicles, %        | 2    | 2    | 2    | 2    | 2    | 2    | 2    | 2    | 2    | 2    | 2    | 2    |
| Mvmt Flow                | 226  | 0    | 9    | 0    | 9    | 9    | 9    | 104  | 0    | 0    | 85   | 349  |

| Major/Minor          | Minor2 |       | Minor1 |       | Major1 |       | Major2 |   |   |       |   |   |
|----------------------|--------|-------|--------|-------|--------|-------|--------|---|---|-------|---|---|
| Conflicting Flow All | 391    | 382   | 260    | 386   | 556    | 104   | 434    | 0 | 0 | 104   | 0 | 0 |
| Stage 1              | 260    | 260   | -      | 122   | 122    | -     | -      | - | - | -     | - | - |
| Stage 2              | 131    | 122   | -      | 264   | 434    | -     | -      | - | - | -     | - | - |
| Critical Hdwy        | 7.12   | 6.52  | 6.22   | 7.12  | 6.52   | 6.22  | 4.12   | - | - | 4.12  | - | - |
| Critical Hdwy Stg 1  | 6.12   | 5.52  | -      | 6.12  | 5.52   | -     | -      | - | - | -     | - | - |
| Critical Hdwy Stg 2  | 6.12   | 5.52  | -      | 6.12  | 5.52   | -     | -      | - | - | -     | - | - |
| Follow-up Hdwy       | 3.518  | 4.018 | 3.318  | 3.518 | 4.018  | 3.318 | 2.218  | - | - | 2.218 | - | - |
| Pot Cap-1 Maneuver   | 568    | 551   | 779    | 573   | 439    | 951   | 1126   | - | - | 1488  | - | - |
| Stage 1              | 745    | 693   | -      | 882   | 795    | -     | -      | - | - | -     | - | - |
| Stage 2              | 873    | 795   | -      | 741   | 581    | -     | -      | - | - | -     | - | - |
| Platoon blocked, %   |        |       |        |       |        |       |        | - | - | -     | - | - |
| Mov Cap-1 Maneuver   | 550    | 547   | 779    | 563   | 435    | 951   | 1126   | - | - | 1488  | - | - |
| Mov Cap-2 Maneuver   | 550    | 547   | -      | 563   | 435    | -     | -      | - | - | -     | - | - |
| Stage 1              | 739    | 693   | -      | 875   | 789    | -     | -      | - | - | -     | - | - |
| Stage 2              | 847    | 789   | -      | 732   | 581    | -     | -      | - | - | -     | - | - |

| Approach             | EB   |  | WB   |  | NB  |  | SB |  |
|----------------------|------|--|------|--|-----|--|----|--|
| HCM Control Delay, s | 16.1 |  | 11.2 |  | 0.7 |  | 0  |  |
| HCM LOS              | C    |  | B    |  |     |  |    |  |

| Minor Lane/Major Mvmt | NBL   | NBT | NBR | EBLn1WBLn1 | SBL   | SBT  | SBR |
|-----------------------|-------|-----|-----|------------|-------|------|-----|
| Capacity (veh/h)      | 1126  | -   | -   | 557        | 597   | 1488 | -   |
| HCM Lane V/C Ratio    | 0.008 | -   | -   | 0.423      | 0.032 | -    | -   |
| HCM Control Delay (s) | 8.2   | 0   | -   | 16.1       | 11.2  | 0    | -   |
| HCM Lane LOS          | A     | A   | -   | C          | B     | A    | -   |
| HCM 95th %tile Q(veh) | 0     | -   | -   | 2.1        | 0.1   | 0    | -   |

| Intersection             |      |      |      |      |      |      |
|--------------------------|------|------|------|------|------|------|
| Int Delay, s/veh         | 4    |      |      |      |      |      |
| Movement                 | EBL  | EBR  | NBL  | NBT  | SBT  | SBR  |
| Lane Configurations      | TT   |      |      | TT   | TT   |      |
| Traffic Vol, veh/h       | 25   | 0    | 0    | 10   | 5    | 15   |
| Future Vol, veh/h        | 25   | 0    | 0    | 10   | 5    | 15   |
| Conflicting Peds, #/hr   | 0    | 0    | 0    | 0    | 0    | 0    |
| Sign Control             | Stop | Stop | Free | Free | Free | Free |
| RT Channelized           | -    | None | -    | None | -    | None |
| Storage Length           | 0    | -    | -    | -    | -    | -    |
| Veh in Median Storage, # | 0    | -    | -    | 0    | 0    | -    |
| Grade, %                 | 0    | -    | -    | 0    | 0    | -    |
| Peak Hour Factor         | 74   | 74   | 74   | 74   | 74   | 74   |
| Heavy Vehicles, %        | 2    | 2    | 2    | 2    | 2    | 2    |
| Mvmt Flow                | 34   | 0    | 0    | 14   | 7    | 20   |

| Major/Minor          | Minor2 | Major1 |       | Major2 |   |
|----------------------|--------|--------|-------|--------|---|
| Conflicting Flow All | 31     | 17     | 27    | 0      | 0 |
| Stage 1              | 17     | -      | -     | -      | - |
| Stage 2              | 14     | -      | -     | -      | - |
| Critical Hdwy        | 6.42   | 6.22   | 4.12  | -      | - |
| Critical Hdwy Stg 1  | 5.42   | -      | -     | -      | - |
| Critical Hdwy Stg 2  | 5.42   | -      | -     | -      | - |
| Follow-up Hdwy       | 3.518  | 3.318  | 2.218 | -      | - |
| Pot Cap-1 Maneuver   | 983    | 1062   | 1587  | -      | - |
| Stage 1              | 1006   | -      | -     | -      | - |
| Stage 2              | 1009   | -      | -     | -      | - |
| Platoon blocked, %   |        |        |       | -      | - |
| Mov Cap-1 Maneuver   | 983    | 1062   | 1587  | -      | - |
| Mov Cap-2 Maneuver   | 983    | -      | -     | -      | - |
| Stage 1              | 1006   | -      | -     | -      | - |
| Stage 2              | 1009   | -      | -     | -      | - |

| Approach             | EB  | NB | SB |
|----------------------|-----|----|----|
| HCM Control Delay, s | 8.8 | 0  | 0  |
| HCM LOS              | A   |    |    |

| Minor Lane/Major Mvmt | NBL  | NBT | EBLn1 | SBT | SBR |
|-----------------------|------|-----|-------|-----|-----|
| Capacity (veh/h)      | 1587 | -   | 983   | -   | -   |
| HCM Lane V/C Ratio    | -    | -   | 0.034 | -   | -   |
| HCM Control Delay (s) | 0    | -   | 8.8   | -   | -   |
| HCM Lane LOS          | A    | -   | A     | -   | -   |
| HCM 95th %tile Q(veh) | 0    | -   | 0.1   | -   | -   |

| Intersection             |      |      |      |       |      |      |
|--------------------------|------|------|------|-------|------|------|
| Int Delay, s/veh         | 4.2  |      |      |       |      |      |
| Movement                 | WBL  | WBR  | NBT  | NBR   | SBL  | SBT  |
| Lane Configurations      | ↙    | ↗    | ↑    | ↗     | ↙    | ↑    |
| Traffic Vol, veh/h       | 65   | 1075 | 140  | 10    | 85   | 55   |
| Future Vol, veh/h        | 65   | 1075 | 140  | 10    | 85   | 55   |
| Conflicting Peds, #/hr   | 0    | 0    | 0    | 0     | 0    | 0    |
| Sign Control             | Stop | Stop | Free | Free  | Free | Free |
| RT Channelized           | -    | Free | -    | Yield | -    | None |
| Storage Length           | 0    | 0    | -    | 0     | 0    | -    |
| Veh in Median Storage, # | 0    | -    | 0    | -     | -    | 0    |
| Grade, %                 | 0    | -    | 0    | -     | -    | 0    |
| Peak Hour Factor         | 85   | 85   | 85   | 85    | 85   | 85   |
| Heavy Vehicles, %        | 1    | 1    | 1    | 1     | 1    | 1    |
| Mvmt Flow                | 76   | 1265 | 165  | 12    | 100  | 65   |

| Major/Minor          | Minor1 | Major1 | Major2 |
|----------------------|--------|--------|--------|
| Conflicting Flow All | 430    | -      | 0      |
| Stage 1              | 165    | -      | -      |
| Stage 2              | 265    | -      | -      |
| Critical Hdwy        | 6.41   | -      | -      |
| Critical Hdwy Stg 1  | 5.41   | -      | -      |
| Critical Hdwy Stg 2  | 5.41   | -      | -      |
| Follow-up Hdwy       | 3.509  | -      | -      |
| Pot Cap-1 Maneuver   | 584    | 0      | -      |
| Stage 1              | 867    | 0      | -      |
| Stage 2              | 782    | 0      | -      |
| Platoon blocked, %   |        | -      | -      |
| Mov Cap-1 Maneuver   | 543    | -      | -      |
| Mov Cap-2 Maneuver   | 543    | -      | -      |
| Stage 1              | 867    | -      | -      |
| Stage 2              | 727    | -      | -      |

| Approach             | WB   | NB | SB  |
|----------------------|------|----|-----|
| HCM Control Delay, s | 12.7 | 0  | 4.7 |
| HCM LOS              | B    |    |     |

| Minor Lane/Major Mvmt | NBT | NBRWBLn1WBLn2 | SBL   | SBT |
|-----------------------|-----|---------------|-------|-----|
| Capacity (veh/h)      | -   | -             | 543   | -   |
| HCM Lane V/C Ratio    | -   | -             | 0.141 | -   |
| HCM Control Delay (s) | -   | -             | 12.7  | 0   |
| HCM Lane LOS          | -   | -             | B     | A   |
| HCM 95th %tile Q(veh) | -   | -             | 0.5   | -   |

| Intersection             |      |      |      |      |      |      |      |      |      |      |      |      |
|--------------------------|------|------|------|------|------|------|------|------|------|------|------|------|
| Int Delay, s/veh         | 4.6  |      |      |      |      |      |      |      |      |      |      |      |
| Movement                 | EBL  | EBT  | EBR  | WBL  | WBT  | WBR  | NBL  | NBT  | NBR  | SBL  | SBT  | SBR  |
| Lane Configurations      |      | ↕    |      |      | ↕    |      |      | ↕    |      |      | ↕    |      |
| Traffic Vol, veh/h       | 105  | 5    | 0    | 0    | 5    | 5    | 5    | 40   | 0    | 5    | 45   | 70   |
| Future Vol, veh/h        | 105  | 5    | 0    | 0    | 5    | 5    | 5    | 40   | 0    | 5    | 45   | 70   |
| Conflicting Peds, #/hr   | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| Sign Control             | Stop | Stop | Stop | Stop | Stop | Stop | Free | Free | Free | Free | Free | Free |
| RT Channelized           | -    | -    | None |
| Storage Length           | -    | -    | -    | -    | -    | -    | -    | -    | -    | -    | -    | -    |
| Veh in Median Storage, # | -    | 0    | -    | -    | 0    | -    | -    | 0    | -    | -    | 0    | -    |
| Grade, %                 | -    | 0    | -    | -    | 0    | -    | -    | 0    | -    | -    | 0    | -    |
| Peak Hour Factor         | 88   | 88   | 88   | 88   | 88   | 88   | 88   | 88   | 88   | 88   | 88   | 88   |
| Heavy Vehicles, %        | 2    | 2    | 2    | 2    | 2    | 2    | 2    | 2    | 2    | 2    | 2    | 2    |
| Mvmt Flow                | 119  | 6    | 0    | 0    | 6    | 6    | 6    | 45   | 0    | 6    | 51   | 80   |

| Major/Minor          | Minor2 |       | Minor1 |       | Major1 |       |       | Major2 |   |       |   |   |
|----------------------|--------|-------|--------|-------|--------|-------|-------|--------|---|-------|---|---|
| Conflicting Flow All | 166    | 160   | 91     | 163   | 200    | 45    | 131   | 0      | 0 | 45    | 0 | 0 |
| Stage 1              | 103    | 103   | -      | 57    | 57     | -     | -     | -      | - | -     | - | - |
| Stage 2              | 63     | 57    | -      | 106   | 143    | -     | -     | -      | - | -     | - | - |
| Critical Hdwy        | 7.12   | 6.52  | 6.22   | 7.12  | 6.52   | 6.22  | 4.12  | -      | - | 4.12  | - | - |
| Critical Hdwy Stg 1  | 6.12   | 5.52  | -      | 6.12  | 5.52   | -     | -     | -      | - | -     | - | - |
| Critical Hdwy Stg 2  | 6.12   | 5.52  | -      | 6.12  | 5.52   | -     | -     | -      | - | -     | - | - |
| Follow-up Hdwy       | 3.518  | 4.018 | 3.318  | 3.518 | 4.018  | 3.318 | 2.218 | -      | - | 2.218 | - | - |
| Pot Cap-1 Maneuver   | 798    | 732   | 967    | 802   | 696    | 1025  | 1454  | -      | - | 1563  | - | - |
| Stage 1              | 903    | 810   | -      | 955   | 847    | -     | -     | -      | - | -     | - | - |
| Stage 2              | 948    | 847   | -      | 900   | 779    | -     | -     | -      | - | -     | - | - |
| Platoon blocked, %   |        |       |        |       |        |       |       | -      | - | -     | - | - |
| Mov Cap-1 Maneuver   | 784    | 726   | 967    | 792   | 690    | 1025  | 1454  | -      | - | 1563  | - | - |
| Mov Cap-2 Maneuver   | 784    | 726   | -      | 792   | 690    | -     | -     | -      | - | -     | - | - |
| Stage 1              | 899    | 807   | -      | 951   | 844    | -     | -     | -      | - | -     | - | - |
| Stage 2              | 933    | 844   | -      | 890   | 776    | -     | -     | -      | - | -     | - | - |

| Approach             | EB   |  | WB  |  | NB  |  | SB  |  |
|----------------------|------|--|-----|--|-----|--|-----|--|
| HCM Control Delay, s | 10.5 |  | 9.4 |  | 0.8 |  | 0.3 |  |
| HCM LOS              | B    |  | A   |  |     |  |     |  |

| Minor Lane/Major Mvmt | NBL   | NBT | NBR | EBLn1WBLn1 | SBL   | SBT   | SBR |
|-----------------------|-------|-----|-----|------------|-------|-------|-----|
| Capacity (veh/h)      | 1454  | -   | -   | 781        | 825   | 1563  | -   |
| HCM Lane V/C Ratio    | 0.004 | -   | -   | 0.16       | 0.014 | 0.004 | -   |
| HCM Control Delay (s) | 7.5   | 0   | -   | 10.5       | 9.4   | 7.3   | 0   |
| HCM Lane LOS          | A     | A   | -   | B          | A     | A     | A   |
| HCM 95th %tile Q(veh) | 0     | -   | -   | 0.6        | 0     | 0     | -   |

| Intersection             |      |      |      |      |      |      |
|--------------------------|------|------|------|------|------|------|
| Int Delay, s/veh         | 3.4  |      |      |      |      |      |
| Movement                 | EBL  | EBR  | NBL  | NBT  | SBT  | SBR  |
| Lane Configurations      | TT   |      |      | TT   | TT   |      |
| Traffic Vol, veh/h       | 15   | 0    | 5    | 5    | 10   | 15   |
| Future Vol, veh/h        | 15   | 0    | 5    | 5    | 10   | 15   |
| Conflicting Peds, #/hr   | 0    | 0    | 0    | 0    | 0    | 0    |
| Sign Control             | Stop | Stop | Free | Free | Free | Free |
| RT Channelized           | -    | None | -    | None | -    | None |
| Storage Length           | 0    | -    | -    | -    | -    | -    |
| Veh in Median Storage, # | 0    | -    | -    | 0    | 0    | -    |
| Grade, %                 | 0    | -    | -    | 0    | 0    | -    |
| Peak Hour Factor         | 85   | 85   | 85   | 85   | 85   | 85   |
| Heavy Vehicles, %        | 2    | 2    | 2    | 2    | 2    | 2    |
| Mvmt Flow                | 18   | 0    | 6    | 6    | 12   | 18   |

| Major/Minor          | Minor2 | Major1 | Major2 |   |   |   |
|----------------------|--------|--------|--------|---|---|---|
| Conflicting Flow All | 39     | 21     | 30     | 0 | - | 0 |
| Stage 1              | 21     | -      | -      | - | - | - |
| Stage 2              | 18     | -      | -      | - | - | - |
| Critical Hdwy        | 6.42   | 6.22   | 4.12   | - | - | - |
| Critical Hdwy Stg 1  | 5.42   | -      | -      | - | - | - |
| Critical Hdwy Stg 2  | 5.42   | -      | -      | - | - | - |
| Follow-up Hdwy       | 3.518  | 3.318  | 2.218  | - | - | - |
| Pot Cap-1 Maneuver   | 973    | 1056   | 1583   | - | - | - |
| Stage 1              | 1002   | -      | -      | - | - | - |
| Stage 2              | 1005   | -      | -      | - | - | - |
| Platoon blocked, %   |        |        |        | - | - | - |
| Mov Cap-1 Maneuver   | 969    | 1056   | 1583   | - | - | - |
| Mov Cap-2 Maneuver   | 969    | -      | -      | - | - | - |
| Stage 1              | 998    | -      | -      | - | - | - |
| Stage 2              | 1005   | -      | -      | - | - | - |

| Approach             | EB  | NB  | SB |
|----------------------|-----|-----|----|
| HCM Control Delay, s | 8.8 | 3.6 | 0  |
| HCM LOS              | A   |     |    |

| Minor Lane/Major Mvmt | NBL   | NBT | EBLn1 | SBT | SBR |
|-----------------------|-------|-----|-------|-----|-----|
| Capacity (veh/h)      | 1583  | -   | 969   | -   | -   |
| HCM Lane V/C Ratio    | 0.004 | -   | 0.018 | -   | -   |
| HCM Control Delay (s) | 7.3   | 0   | 8.8   | -   | -   |
| HCM Lane LOS          | A     | A   | A     | -   | -   |
| HCM 95th %tile Q(veh) | 0     | -   | 0.1   | -   | -   |

| Intersection             |      |      |      |       |      |      |
|--------------------------|------|------|------|-------|------|------|
| Int Delay, s/veh         | 8.9  |      |      |       |      |      |
| Movement                 | WBL  | WBR  | NBT  | NBR   | SBL  | SBT  |
| Lane Configurations      | ↘    | ↗    | ↑    | ↗     | ↘    | ↑    |
| Traffic Vol, veh/h       | 165  | 370  | 260  | 15    | 55   | 95   |
| Future Vol, veh/h        | 165  | 370  | 260  | 15    | 55   | 95   |
| Conflicting Peds, #/hr   | 0    | 0    | 0    | 0     | 0    | 0    |
| Sign Control             | Stop | Stop | Free | Free  | Free | Free |
| RT Channelized           | -    | Free | -    | Yield | -    | None |
| Storage Length           | 0    | 0    | -    | 0     | 0    | -    |
| Veh in Median Storage, # | 0    | -    | 0    | -     | -    | 0    |
| Grade, %                 | 0    | -    | 0    | -     | -    | 0    |
| Peak Hour Factor         | 68   | 68   | 68   | 68    | 68   | 68   |
| Heavy Vehicles, %        | 3    | 3    | 3    | 3     | 3    | 3    |
| Mvmt Flow                | 243  | 544  | 382  | 22    | 81   | 140  |

| Major/Minor          | Minor1 | Major1 | Major2 |   |       |
|----------------------|--------|--------|--------|---|-------|
| Conflicting Flow All | 684    | -      | 0      | 0 | 382   |
| Stage 1              | 382    | -      | -      | - | -     |
| Stage 2              | 302    | -      | -      | - | -     |
| Critical Hdwy        | 6.43   | -      | -      | - | 4.13  |
| Critical Hdwy Stg 1  | 5.43   | -      | -      | - | -     |
| Critical Hdwy Stg 2  | 5.43   | -      | -      | - | -     |
| Follow-up Hdwy       | 3.527  | -      | -      | - | 2.227 |
| Pot Cap-1 Maneuver   | 413    | 0      | -      | - | 1171  |
| Stage 1              | 688    | 0      | -      | - | -     |
| Stage 2              | 748    | 0      | -      | - | -     |
| Platoon blocked, %   |        |        |        |   |       |
| Mov Cap-1 Maneuver   | 385    | -      | -      | - | 1171  |
| Mov Cap-2 Maneuver   | 385    | -      | -      | - | -     |
| Stage 1              | 688    | -      | -      | - | -     |
| Stage 2              | 696    | -      | -      | - | -     |

| Approach             | WB | NB | SB |
|----------------------|----|----|----|
| HCM Control Delay, s | 29 | 0  | 3  |
| HCM LOS              | D  |    |    |

| Minor Lane/Major Mvmt | NBT | NBRWBLn1 | WBLn2 | SBL | SBT   |
|-----------------------|-----|----------|-------|-----|-------|
| Capacity (veh/h)      | -   | -        | 385   | -   | 1171  |
| HCM Lane V/C Ratio    | -   | -        | 0.63  | -   | 0.069 |
| HCM Control Delay (s) | -   | -        | 29    | 0   | 8.3   |
| HCM Lane LOS          | -   | -        | D     | A   | A     |
| HCM 95th %tile Q(veh) | -   | -        | 4.1   | -   | 0.2   |

| Intersection             |      |      |      |      |      |      |      |      |      |      |      |      |
|--------------------------|------|------|------|------|------|------|------|------|------|------|------|------|
| Int Delay, s/veh         | 6.7  |      |      |      |      |      |      |      |      |      |      |      |
| Movement                 | EBL  | EBT  | EBR  | WBL  | WBT  | WBR  | NBL  | NBT  | NBR  | SBL  | SBT  | SBR  |
| Lane Configurations      |      | ↕    |      |      | ↕    |      |      | ↕    |      |      | ↕    |      |
| Traffic Vol, veh/h       | 120  | 0    | 5    | 0    | 5    | 5    | 5    | 150  | 0    | 0    | 75   | 185  |
| Future Vol, veh/h        | 120  | 0    | 5    | 0    | 5    | 5    | 5    | 150  | 0    | 0    | 75   | 185  |
| Conflicting Peds, #/hr   | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| Sign Control             | Stop | Stop | Stop | Stop | Stop | Stop | Free | Free | Free | Free | Free | Free |
| RT Channelized           | -    | -    | None |
| Storage Length           | -    | -    | -    | -    | -    | -    | -    | -    | -    | -    | -    | -    |
| Veh in Median Storage, # | -    | 0    | -    | -    | 0    | -    | -    | 0    | -    | -    | 0    | -    |
| Grade, %                 | -    | 0    | -    | -    | 0    | -    | -    | 0    | -    | -    | 0    | -    |
| Peak Hour Factor         | 53   | 53   | 53   | 53   | 53   | 53   | 53   | 53   | 53   | 53   | 53   | 53   |
| Heavy Vehicles, %        | 2    | 2    | 2    | 2    | 2    | 2    | 2    | 2    | 2    | 2    | 2    | 2    |
| Mvmt Flow                | 226  | 0    | 9    | 0    | 9    | 9    | 9    | 283  | 0    | 0    | 142  | 349  |

| Major/Minor          | Minor2 |       | Minor1 |       | Major1 |       | Major2 |   |   |       |   |   |
|----------------------|--------|-------|--------|-------|--------|-------|--------|---|---|-------|---|---|
| Conflicting Flow All | 627    | 618   | 317    | 622   | 792    | 283   | 491    | 0 | 0 | 283   | 0 | 0 |
| Stage 1              | 317    | 317   | -      | 301   | 301    | -     | -      | - | - | -     | - | - |
| Stage 2              | 310    | 301   | -      | 321   | 491    | -     | -      | - | - | -     | - | - |
| Critical Hdwy        | 7.12   | 6.52  | 6.22   | 7.12  | 6.52   | 6.22  | 4.12   | - | - | 4.12  | - | - |
| Critical Hdwy Stg 1  | 6.12   | 5.52  | -      | 6.12  | 5.52   | -     | -      | - | - | -     | - | - |
| Critical Hdwy Stg 2  | 6.12   | 5.52  | -      | 6.12  | 5.52   | -     | -      | - | - | -     | - | - |
| Follow-up Hdwy       | 3.518  | 4.018 | 3.318  | 3.518 | 4.018  | 3.318 | 2.218  | - | - | 2.218 | - | - |
| Pot Cap-1 Maneuver   | 396    | 405   | 724    | 399   | 322    | 756   | 1072   | - | - | 1279  | - | - |
| Stage 1              | 694    | 654   | -      | 708   | 665    | -     | -      | - | - | -     | - | - |
| Stage 2              | 700    | 665   | -      | 691   | 548    | -     | -      | - | - | -     | - | - |
| Platoon blocked, %   |        |       |        |       |        |       |        | - | - | -     | - | - |
| Mov Cap-1 Maneuver   | 379    | 401   | 724    | 391   | 319    | 756   | 1072   | - | - | 1279  | - | - |
| Mov Cap-2 Maneuver   | 379    | 401   | -      | 391   | 319    | -     | -      | - | - | -     | - | - |
| Stage 1              | 687    | 654   | -      | 701   | 658    | -     | -      | - | - | -     | - | - |
| Stage 2              | 675    | 658   | -      | 682   | 548    | -     | -      | - | - | -     | - | - |

| Approach             | EB   |  | WB   |  | NB  |  | SB |  |
|----------------------|------|--|------|--|-----|--|----|--|
| HCM Control Delay, s | 27.9 |  | 13.4 |  | 0.3 |  | 0  |  |
| HCM LOS              | D    |  | B    |  |     |  |    |  |

| Minor Lane/Major Mvmt | NBL   | NBT | NBR | EBLn1WBLn1 | SBL   | SBT  | SBR |
|-----------------------|-------|-----|-----|------------|-------|------|-----|
| Capacity (veh/h)      | 1072  | -   | -   | 386        | 449   | 1279 | -   |
| HCM Lane V/C Ratio    | 0.009 | -   | -   | 0.611      | 0.042 | -    | -   |
| HCM Control Delay (s) | 8.4   | 0   | -   | 27.9       | 13.4  | 0    | -   |
| HCM Lane LOS          | A     | A   | -   | D          | B     | A    | -   |
| HCM 95th %tile Q(veh) | 0     | -   | -   | 3.9        | 0.1   | 0    | -   |

| Intersection             |      |      |      |      |      |      |
|--------------------------|------|------|------|------|------|------|
| Int Delay, s/veh         | 4.2  |      |      |      |      |      |
| Movement                 | EBL  | EBR  | NBL  | NBT  | SBT  | SBR  |
| Lane Configurations      | TT   |      |      | TT   | TT   |      |
| Traffic Vol, veh/h       | 75   | 5    | 0    | 55   | 10   | 40   |
| Future Vol, veh/h        | 75   | 5    | 0    | 55   | 10   | 40   |
| Conflicting Peds, #/hr   | 0    | 0    | 0    | 0    | 0    | 0    |
| Sign Control             | Stop | Stop | Free | Free | Free | Free |
| RT Channelized           | -    | None | -    | None | -    | None |
| Storage Length           | 0    | -    | -    | -    | -    | -    |
| Veh in Median Storage, # | 0    | -    | -    | 0    | 0    | -    |
| Grade, %                 | 0    | -    | -    | 0    | 0    | -    |
| Peak Hour Factor         | 74   | 74   | 74   | 74   | 74   | 74   |
| Heavy Vehicles, %        | 2    | 2    | 2    | 2    | 2    | 2    |
| Mvmt Flow                | 101  | 7    | 0    | 74   | 14   | 54   |

| Major/Minor          | Minor2 | Major1 |       | Major2 |   |
|----------------------|--------|--------|-------|--------|---|
| Conflicting Flow All | 115    | 41     | 68    | 0      | 0 |
| Stage 1              | 41     | -      | -     | -      | - |
| Stage 2              | 74     | -      | -     | -      | - |
| Critical Hdwy        | 6.42   | 6.22   | 4.12  | -      | - |
| Critical Hdwy Stg 1  | 5.42   | -      | -     | -      | - |
| Critical Hdwy Stg 2  | 5.42   | -      | -     | -      | - |
| Follow-up Hdwy       | 3.518  | 3.318  | 2.218 | -      | - |
| Pot Cap-1 Maneuver   | 881    | 1030   | 1533  | -      | - |
| Stage 1              | 981    | -      | -     | -      | - |
| Stage 2              | 949    | -      | -     | -      | - |
| Platoon blocked, %   |        |        |       | -      | - |
| Mov Cap-1 Maneuver   | 881    | 1030   | 1533  | -      | - |
| Mov Cap-2 Maneuver   | 881    | -      | -     | -      | - |
| Stage 1              | 981    | -      | -     | -      | - |
| Stage 2              | 949    | -      | -     | -      | - |

| Approach             | EB  | NB | SB |
|----------------------|-----|----|----|
| HCM Control Delay, s | 9.6 | 0  | 0  |
| HCM LOS              | A   |    |    |

| Minor Lane/Major Mvmt | NBL  | NBT | EBLn1 | SBT | SBR |
|-----------------------|------|-----|-------|-----|-----|
| Capacity (veh/h)      | 1533 | -   | 889   | -   | -   |
| HCM Lane V/C Ratio    | -    | -   | 0.122 | -   | -   |
| HCM Control Delay (s) | 0    | -   | 9.6   | -   | -   |
| HCM Lane LOS          | A    | -   | A     | -   | -   |
| HCM 95th %tile Q(veh) | 0    | -   | 0.4   | -   | -   |

| Intersection             |      |      |      |      |      |      |
|--------------------------|------|------|------|------|------|------|
| Int Delay, s/veh         | 6    |      |      |      |      |      |
| Movement                 | EBL  | EBR  | NBL  | NBT  | SBT  | SBR  |
| Lane Configurations      | TT   |      |      | TT   | TT   |      |
| Traffic Vol, veh/h       | 45   | 5    | 5    | 10   | 10   | 5    |
| Future Vol, veh/h        | 45   | 5    | 5    | 10   | 10   | 5    |
| Conflicting Peds, #/hr   | 0    | 0    | 0    | 0    | 0    | 0    |
| Sign Control             | Stop | Stop | Free | Free | Free | Free |
| RT Channelized           | -    | None | -    | None | -    | None |
| Storage Length           | 0    | -    | -    | -    | -    | -    |
| Veh in Median Storage, # | 0    | -    | -    | 0    | 0    | -    |
| Grade, %                 | 0    | -    | -    | 0    | 0    | -    |
| Peak Hour Factor         | 92   | 92   | 92   | 92   | 92   | 92   |
| Heavy Vehicles, %        | 2    | 2    | 2    | 2    | 2    | 2    |
| Mvmt Flow                | 49   | 5    | 5    | 11   | 11   | 5    |

| Major/Minor          | Minor2 | Major1 |       | Major2 |   |
|----------------------|--------|--------|-------|--------|---|
| Conflicting Flow All | 35     | 14     | 16    | 0      | 0 |
| Stage 1              | 14     | -      | -     | -      | - |
| Stage 2              | 21     | -      | -     | -      | - |
| Critical Hdwy        | 6.42   | 6.22   | 4.12  | -      | - |
| Critical Hdwy Stg 1  | 5.42   | -      | -     | -      | - |
| Critical Hdwy Stg 2  | 5.42   | -      | -     | -      | - |
| Follow-up Hdwy       | 3.518  | 3.318  | 2.218 | -      | - |
| Pot Cap-1 Maneuver   | 978    | 1066   | 1602  | -      | - |
| Stage 1              | 1009   | -      | -     | -      | - |
| Stage 2              | 1002   | -      | -     | -      | - |
| Platoon blocked, %   |        |        |       | -      | - |
| Mov Cap-1 Maneuver   | 975    | 1066   | 1602  | -      | - |
| Mov Cap-2 Maneuver   | 975    | -      | -     | -      | - |
| Stage 1              | 1006   | -      | -     | -      | - |
| Stage 2              | 1002   | -      | -     | -      | - |

| Approach             | EB  | NB  | SB |
|----------------------|-----|-----|----|
| HCM Control Delay, s | 8.9 | 2.4 | 0  |
| HCM LOS              | A   |     |    |

| Minor Lane/Major Mvmt | NBL   | NBT | EBLn1 | SBT | SBR |
|-----------------------|-------|-----|-------|-----|-----|
| Capacity (veh/h)      | 1602  | -   | 983   | -   | -   |
| HCM Lane V/C Ratio    | 0.003 | -   | 0.055 | -   | -   |
| HCM Control Delay (s) | 7.3   | 0   | 8.9   | -   | -   |
| HCM Lane LOS          | A     | A   | A     | -   | -   |
| HCM 95th %tile Q(veh) | 0     | -   | 0.2   | -   | -   |

| Intersection             |      |      |      |       |      |      |
|--------------------------|------|------|------|-------|------|------|
| Int Delay, s/veh         | 5.9  |      |      |       |      |      |
| Movement                 | WBL  | WBR  | NBT  | NBR   | SBL  | SBT  |
| Lane Configurations      | ↘    | ↗    | ↑    | ↗     | ↘    | ↑    |
| Traffic Vol, veh/h       | 145  | 1075 | 190  | 20    | 85   | 80   |
| Future Vol, veh/h        | 145  | 1075 | 190  | 20    | 85   | 80   |
| Conflicting Peds, #/hr   | 0    | 0    | 0    | 0     | 0    | 0    |
| Sign Control             | Stop | Stop | Free | Free  | Free | Free |
| RT Channelized           | -    | Free | -    | Yield | -    | None |
| Storage Length           | 0    | 0    | -    | 0     | 0    | -    |
| Veh in Median Storage, # | 0    | -    | 0    | -     | -    | 0    |
| Grade, %                 | 0    | -    | 0    | -     | -    | 0    |
| Peak Hour Factor         | 85   | 85   | 85   | 85    | 85   | 85   |
| Heavy Vehicles, %        | 1    | 1    | 1    | 1     | 1    | 1    |
| Mvmt Flow                | 171  | 1265 | 224  | 24    | 100  | 94   |

| Major/Minor          | Minor1 | Major1 | Major2      |
|----------------------|--------|--------|-------------|
| Conflicting Flow All | 518    | -      | 0 0 224 0   |
| Stage 1              | 224    | -      | - - - -     |
| Stage 2              | 294    | -      | - - - -     |
| Critical Hdwy        | 6.41   | -      | - - 4.11 -  |
| Critical Hdwy Stg 1  | 5.41   | -      | - - - -     |
| Critical Hdwy Stg 2  | 5.41   | -      | - - - -     |
| Follow-up Hdwy       | 3.509  | -      | - - 2.209 - |
| Pot Cap-1 Maneuver   | 520    | 0      | - - 1351 -  |
| Stage 1              | 816    | 0      | - - - -     |
| Stage 2              | 759    | 0      | - - - -     |
| Platoon blocked, %   |        | -      | - - - -     |
| Mov Cap-1 Maneuver   | 482    | -      | - - 1351 -  |
| Mov Cap-2 Maneuver   | 482    | -      | - - - -     |
| Stage 1              | 816    | -      | - - - -     |
| Stage 2              | 703    | -      | - - - -     |

| Approach             | WB   | NB | SB  |
|----------------------|------|----|-----|
| HCM Control Delay, s | 16.5 | 0  | 4.1 |
| HCM LOS              | C    |    |     |

| Minor Lane/Major Mvmt | NBT | NBRWBLn1WBLn2 | SBL     | SBT |
|-----------------------|-----|---------------|---------|-----|
| Capacity (veh/h)      | -   | - 482         | - 1351  | -   |
| HCM Lane V/C Ratio    | -   | - 0.354       | - 0.074 | -   |
| HCM Control Delay (s) | -   | - 16.5        | 0 7.9   | -   |
| HCM Lane LOS          | -   | - C           | A A     | -   |
| HCM 95th %tile Q(veh) | -   | - 1.6         | - 0.2   | -   |

| Intersection             |      |      |      |      |      |      |      |      |      |      |      |      |
|--------------------------|------|------|------|------|------|------|------|------|------|------|------|------|
| Int Delay, s/veh         | 3.6  |      |      |      |      |      |      |      |      |      |      |      |
| Movement                 | EBL  | EBT  | EBR  | WBL  | WBT  | WBR  | NBL  | NBT  | NBR  | SBL  | SBT  | SBR  |
| Lane Configurations      |      | ↕    |      |      | ↕    |      |      | ↕    |      |      | ↕    |      |
| Traffic Vol, veh/h       | 105  | 5    | 0    | 0    | 5    | 5    | 5    | 100  | 0    | 5    | 150  | 70   |
| Future Vol, veh/h        | 105  | 5    | 0    | 0    | 5    | 5    | 5    | 100  | 0    | 5    | 150  | 70   |
| Conflicting Peds, #/hr   | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| Sign Control             | Stop | Stop | Stop | Stop | Stop | Stop | Free | Free | Free | Free | Free | Free |
| RT Channelized           | -    | -    | None |
| Storage Length           | -    | -    | -    | -    | -    | -    | -    | -    | -    | -    | -    | -    |
| Veh in Median Storage, # | -    | 0    | -    | -    | 0    | -    | -    | 0    | -    | -    | 0    | -    |
| Grade, %                 | -    | 0    | -    | -    | 0    | -    | -    | 0    | -    | -    | 0    | -    |
| Peak Hour Factor         | 88   | 88   | 88   | 88   | 88   | 88   | 88   | 88   | 88   | 88   | 88   | 88   |
| Heavy Vehicles, %        | 2    | 2    | 2    | 2    | 2    | 2    | 2    | 2    | 2    | 2    | 2    | 2    |
| Mvmt Flow                | 119  | 6    | 0    | 0    | 6    | 6    | 6    | 114  | 0    | 6    | 170  | 80   |

| Major/Minor          | Minor2 |       | Minor1 |       | Major1 |       | Major2 |   |   |       |   |   |
|----------------------|--------|-------|--------|-------|--------|-------|--------|---|---|-------|---|---|
| Conflicting Flow All | 354    | 348   | 210    | 351   | 388    | 114   | 250    | 0 | 0 | 114   | 0 | 0 |
| Stage 1              | 222    | 222   | -      | 126   | 126    | -     | -      | - | - | -     | - | - |
| Stage 2              | 132    | 126   | -      | 225   | 262    | -     | -      | - | - | -     | - | - |
| Critical Hdwy        | 7.12   | 6.52  | 6.22   | 7.12  | 6.52   | 6.22  | 4.12   | - | - | 4.12  | - | - |
| Critical Hdwy Stg 1  | 6.12   | 5.52  | -      | 6.12  | 5.52   | -     | -      | - | - | -     | - | - |
| Critical Hdwy Stg 2  | 6.12   | 5.52  | -      | 6.12  | 5.52   | -     | -      | - | - | -     | - | - |
| Follow-up Hdwy       | 3.518  | 4.018 | 3.318  | 3.518 | 4.018  | 3.318 | 2.218  | - | - | 2.218 | - | - |
| Pot Cap-1 Maneuver   | 601    | 576   | 830    | 604   | 547    | 939   | 1316   | - | - | 1475  | - | - |
| Stage 1              | 780    | 720   | -      | 878   | 792    | -     | -      | - | - | -     | - | - |
| Stage 2              | 871    | 792   | -      | 778   | 691    | -     | -      | - | - | -     | - | - |
| Platoon blocked, %   |        |       |        |       |        |       |        | - | - | -     | - | - |
| Mov Cap-1 Maneuver   | 588    | 570   | 830    | 595   | 542    | 939   | 1316   | - | - | 1475  | - | - |
| Mov Cap-2 Maneuver   | 588    | 570   | -      | 595   | 542    | -     | -      | - | - | -     | - | - |
| Stage 1              | 776    | 716   | -      | 874   | 788    | -     | -      | - | - | -     | - | - |
| Stage 2              | 855    | 788   | -      | 768   | 688    | -     | -      | - | - | -     | - | - |

| Approach             | EB   |  | WB   |  | NB  |  | SB  |  |
|----------------------|------|--|------|--|-----|--|-----|--|
| HCM Control Delay, s | 12.8 |  | 10.3 |  | 0.4 |  | 0.2 |  |
| HCM LOS              | B    |  | B    |  |     |  |     |  |

| Minor Lane/Major Mvmt | NBL   | NBT | NBR | EBLn1WBLn1 | SBL   | SBT   | SBR |
|-----------------------|-------|-----|-----|------------|-------|-------|-----|
| Capacity (veh/h)      | 1316  | -   | -   | 587        | 687   | 1475  | -   |
| HCM Lane V/C Ratio    | 0.004 | -   | -   | 0.213      | 0.017 | 0.004 | -   |
| HCM Control Delay (s) | 7.7   | 0   | -   | 12.8       | 10.3  | 7.5   | 0   |
| HCM Lane LOS          | A     | A   | -   | B          | B     | A     | A   |
| HCM 95th %tile Q(veh) | 0     | -   | -   | 0.8        | 0.1   | 0     | -   |

| Intersection             |      |      |      |      |      |      |
|--------------------------|------|------|------|------|------|------|
| Int Delay, s/veh         | 2.9  |      |      |      |      |      |
| Movement                 | EBL  | EBR  | NBL  | NBT  | SBT  | SBR  |
| Lane Configurations      | T    |      |      | T    |      | T    |
| Traffic Vol, veh/h       | 55   | 5    | 10   | 25   | 50   | 80   |
| Future Vol, veh/h        | 55   | 5    | 10   | 25   | 50   | 80   |
| Conflicting Peds, #/hr   | 0    | 0    | 0    | 0    | 0    | 0    |
| Sign Control             | Stop | Stop | Free | Free | Free | Free |
| RT Channelized           | -    | None | -    | None | -    | None |
| Storage Length           | 0    | -    | -    | -    | -    | -    |
| Veh in Median Storage, # | 0    | -    | -    | 0    | 0    | -    |
| Grade, %                 | 0    | -    | -    | 0    | 0    | -    |
| Peak Hour Factor         | 85   | 85   | 85   | 85   | 85   | 85   |
| Heavy Vehicles, %        | 2    | 2    | 2    | 2    | 2    | 2    |
| Mvmt Flow                | 65   | 6    | 12   | 29   | 59   | 94   |

| Major/Minor          | Minor2 | Major1 |       | Major2 |   |
|----------------------|--------|--------|-------|--------|---|
| Conflicting Flow All | 159    | 106    | 153   | 0      | 0 |
| Stage 1              | 106    | -      | -     | -      | - |
| Stage 2              | 53     | -      | -     | -      | - |
| Critical Hdwy        | 6.42   | 6.22   | 4.12  | -      | - |
| Critical Hdwy Stg 1  | 5.42   | -      | -     | -      | - |
| Critical Hdwy Stg 2  | 5.42   | -      | -     | -      | - |
| Follow-up Hdwy       | 3.518  | 3.318  | 2.218 | -      | - |
| Pot Cap-1 Maneuver   | 832    | 948    | 1428  | -      | - |
| Stage 1              | 918    | -      | -     | -      | - |
| Stage 2              | 970    | -      | -     | -      | - |
| Platoon blocked, %   |        |        |       | -      | - |
| Mov Cap-1 Maneuver   | 825    | 948    | 1428  | -      | - |
| Mov Cap-2 Maneuver   | 825    | -      | -     | -      | - |
| Stage 1              | 910    | -      | -     | -      | - |
| Stage 2              | 970    | -      | -     | -      | - |

| Approach             | EB  | NB  | SB |
|----------------------|-----|-----|----|
| HCM Control Delay, s | 9.7 | 2.2 | 0  |
| HCM LOS              | A   |     |    |

| Minor Lane/Major Mvmt | NBL   | NBT | EBLn1 | SBT | SBR |
|-----------------------|-------|-----|-------|-----|-----|
| Capacity (veh/h)      | 1428  | -   | 834   | -   | -   |
| HCM Lane V/C Ratio    | 0.008 | -   | 0.085 | -   | -   |
| HCM Control Delay (s) | 7.5   | 0   | 9.7   | -   | -   |
| HCM Lane LOS          | A     | A   | A     | -   | -   |
| HCM 95th %tile Q(veh) | 0     | -   | 0.3   | -   | -   |

| Intersection             |      |      |      |      |      |      |
|--------------------------|------|------|------|------|------|------|
| Int Delay, s/veh         | 2.6  |      |      |      |      |      |
| Movement                 | EBL  | EBR  | NBL  | NBT  | SBT  | SBR  |
| Lane Configurations      | T    |      |      | T    |      | T    |
| Traffic Vol, veh/h       | 20   | 5    | 5    | 15   | 15   | 40   |
| Future Vol, veh/h        | 20   | 5    | 5    | 15   | 15   | 40   |
| Conflicting Peds, #/hr   | 0    | 0    | 0    | 0    | 0    | 0    |
| Sign Control             | Stop | Stop | Free | Free | Free | Free |
| RT Channelized           | -    | None | -    | None | -    | None |
| Storage Length           | 0    | -    | -    | -    | -    | -    |
| Veh in Median Storage, # | 0    | -    | -    | 0    | 0    | -    |
| Grade, %                 | 0    | -    | -    | 0    | 0    | -    |
| Peak Hour Factor         | 92   | 92   | 92   | 92   | 92   | 92   |
| Heavy Vehicles, %        | 2    | 2    | 2    | 2    | 2    | 2    |
| Mvmt Flow                | 22   | 5    | 5    | 16   | 16   | 43   |

| Major/Minor          | Minor2 | Major1 | Major2 |   |   |   |
|----------------------|--------|--------|--------|---|---|---|
| Conflicting Flow All | 64     | 38     | 59     | 0 | - | 0 |
| Stage 1              | 38     | -      | -      | - | - | - |
| Stage 2              | 26     | -      | -      | - | - | - |
| Critical Hdwy        | 6.42   | 6.22   | 4.12   | - | - | - |
| Critical Hdwy Stg 1  | 5.42   | -      | -      | - | - | - |
| Critical Hdwy Stg 2  | 5.42   | -      | -      | - | - | - |
| Follow-up Hdwy       | 3.518  | 3.318  | 2.218  | - | - | - |
| Pot Cap-1 Maneuver   | 942    | 1034   | 1545   | - | - | - |
| Stage 1              | 984    | -      | -      | - | - | - |
| Stage 2              | 997    | -      | -      | - | - | - |
| Platoon blocked, %   |        |        |        | - | - | - |
| Mov Cap-1 Maneuver   | 939    | 1034   | 1545   | - | - | - |
| Mov Cap-2 Maneuver   | 939    | -      | -      | - | - | - |
| Stage 1              | 981    | -      | -      | - | - | - |
| Stage 2              | 997    | -      | -      | - | - | - |

| Approach             | EB  | NB  | SB |
|----------------------|-----|-----|----|
| HCM Control Delay, s | 8.9 | 1.8 | 0  |
| HCM LOS              | A   |     |    |

| Minor Lane/Major Mvmt | NBL   | NBT | EBLn1 | SBT | SBR |
|-----------------------|-------|-----|-------|-----|-----|
| Capacity (veh/h)      | 1545  | -   | 957   | -   | -   |
| HCM Lane V/C Ratio    | 0.004 | -   | 0.028 | -   | -   |
| HCM Control Delay (s) | 7.3   | 0   | 8.9   | -   | -   |
| HCM Lane LOS          | A     | A   | A     | -   | -   |
| HCM 95th %tile Q(veh) | 0     | -   | 0.1   | -   | -   |



# MMM GROUP

Prepared for: D&S Homes

## GREENBRYRE PHASE 3 DEVELOPMENT

TRAFFIC IMPACT ASSESSMENT

5416218 | October 2016

## STANDARD LIMITATIONS

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## REVISION LOG

| Revision # | Revised By | Date       | Issue / Revision Description |
|------------|------------|------------|------------------------------|
| 1          | A.Thai     | 10/13/2016 | Report                       |
|            |            |            |                              |
|            |            |            |                              |
|            |            |            |                              |
|            |            |            |                              |

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## 1.0 INTRODUCTION

MMM Group, a division of WSP Company (MMM | WSP) was retained by D&S Homes to conduct a Traffic Impact Assessment (TIA) for the Greenbryre Phase 3 Development. The purpose of this TIA is to determine the impact that the traffic generated by Phase 3 development will have on the adjacent road network, and to identify the roadway infrastructure necessary to safely and effectively accommodate anticipated traffic from the development.

### 1.1 Proposed Development

The Greenbryre subdivision is located in the southwest quadrant of the intersection of Boychuk Drive and Glazier Road, just south of the Saskatoon city limit, as illustrated in Figure 1. Phase 3 development will consist of residential housing including single-family detached homes, as well as condominium / townhouses. The site plan also identifies a new building which will be used to replace the existing clubhouse. The development timeframe was assumed to be completed in 2025.

Due to the timing of the development and the anticipated completion date for the Highway 16 and Boychuk Drive interchange, an analysis of this intersection was not included in this TIA. However, the City of Saskatoon's projected traffic volumes for the interchange were used to derive the background forecast volumes. The TIA analyzed the traffic operations at the following study intersections:

- Boychuk Drive and Glazier Road intersection;
- Boychuk Drive and Greenbryre Lane intersection; and,
- Boychuk Drive and New Access Road intersection.

### 1.2 Existing Conditions

The existing intersection of Boychuk Drive and Glazier Road is two-way stop-controlled with Boychuk Drive operating free-flow. Both Boychuk Drive and Glazier Road are two-lane undivided roadways with a posted speed of 80 km/h and 60 km/h, respectively. It was identified that the existing Boychuk Drive and Glazier Road intersection will be relocated approximately 150 m south of its current location, as part of the Highway 16 and Boychuk Drive interchange project.

The Boychuk Drive and Greenbryre Lane intersection is a stop-controlled T-intersection with Boychuk Drive operating free-flow. The posted speeds are 80 km/h for Boychuk Drive and 30 km/h for Greenbryre Lane. There is an intersection delineation lighting system installed on Greenbryre Lane.

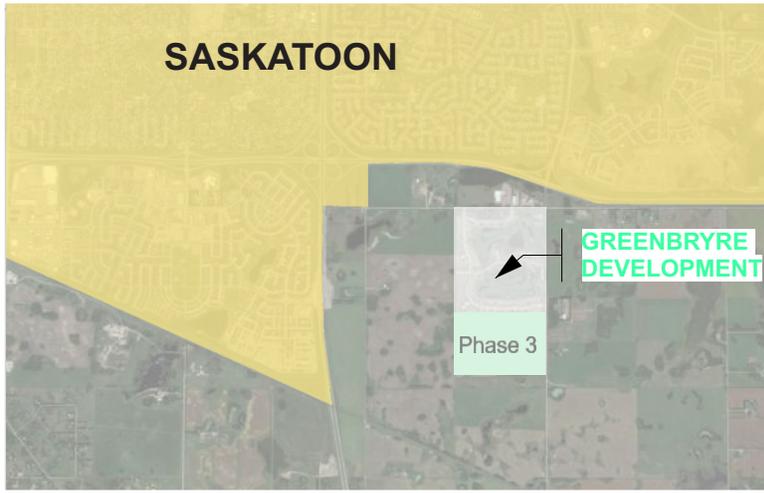
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# CONTEXT AREA



## Legend:

-  Study Area
-  Study Intersections



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## Figure No 1 Study Area

Greenbryre Phase 3 Development TIA

## 2.0 TRAFFIC INFORMATION

Vehicle turning movement counts (TMC) at the study intersections were collected on September 8, 2016. The data collection captured the morning (7:00 a.m. to 9:00 a.m.) and afternoon (4:00 p.m. to 6:00 p.m.) peak periods, corresponding to typical commute hours. The morning peak hours for the study intersections are between 8:00 a.m. and 9:00 a.m. while the afternoon peak hours slightly differed:

- Boychuk Drive and Glazier Road Intersection – 4:30 p.m. to 5:30 p.m.
- Boychuk Drive and Greenbryre Lane – 5:00 p.m. to 6:00 p.m.

The peak hour traffic volumes for the morning and afternoon peak hours at each study intersection, as illustrated in Figure 2, were used in the analysis to determine how the intersections currently operate, which is presented in Section 4.0. Small discrepancies of traffic volumes between the study intersections along Boychuk Drive were not balanced due to other existing accesses including the Greenbryre Crescent North and Rae-Dawn Arabians Access.

### 2.1 Background Forecast Volumes

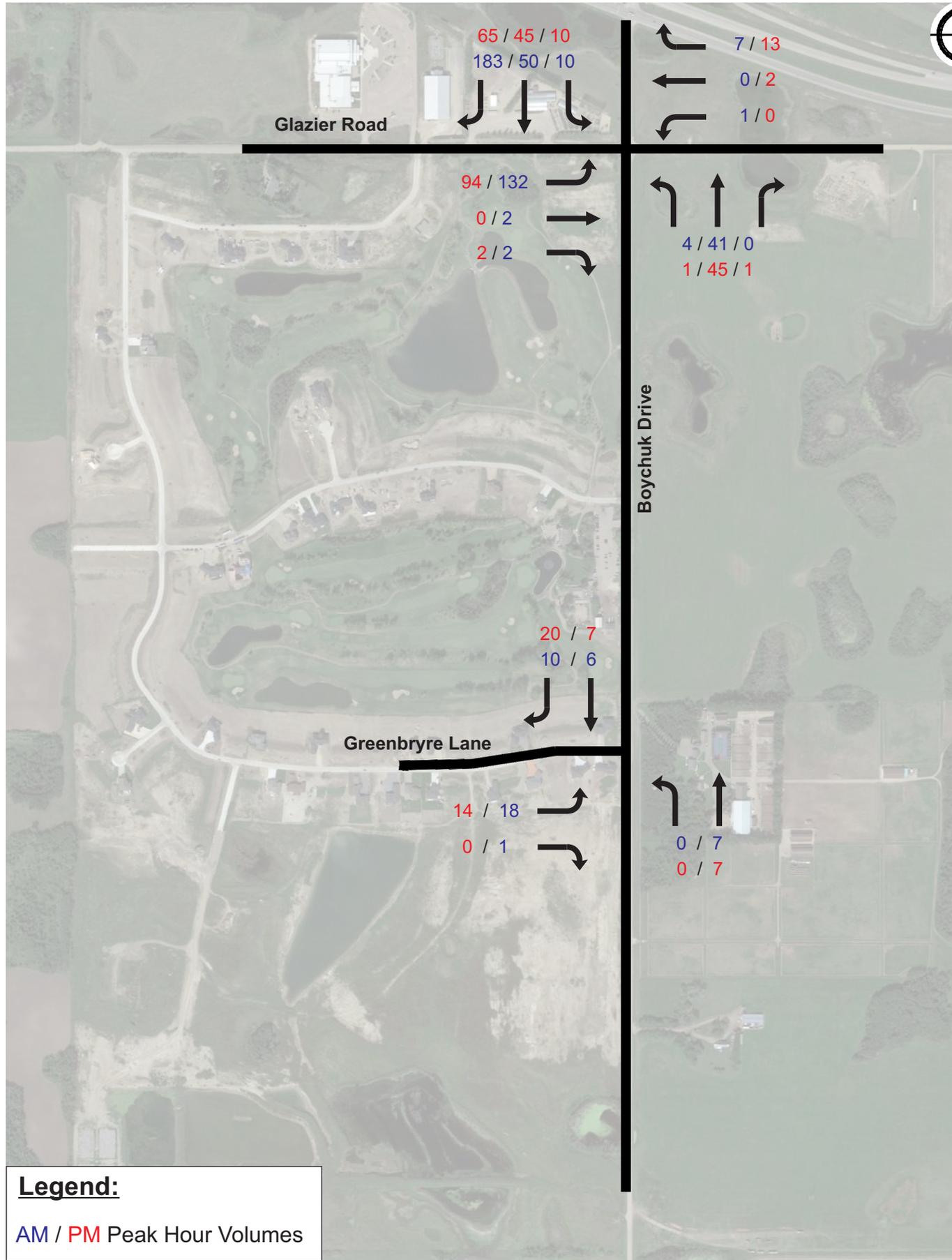
The background forecast traffic scenario is a projection of the traffic volumes anticipated without the demand from the proposed development. The background growth at the Boychuk Drive and Glazier Road intersection was derived from the future traffic volumes obtained from the Highway 16 and Boychuk Drive interchange and the volumes projected for the completion of Greenbryre Phase 2 development. The distribution of turning movement volumes along Boychuk Drive were determined using the existing traffic patterns obtained from the TMC.

Since the future traffic volumes at the interchange did not provide traffic data for the east-west road (Glazier Road), the background forecast volumes for the eastbound and westbound turning movements were determined by applying a 1% annual growth to the existing volumes. In addition, a comparison of the volumes between the two scenarios identified that the morning peak hour southbound approaching volumes of projected volumes at the interchange are less than the existing volumes. The southbound turning movement volumes for the background forecast scenario was determined by applying a 1% annual growth to the existing count for the worst case scenario.

Figure 3 illustrates the background forecast volumes anticipated at the completion of the Phase 3 development for morning and afternoon peak hours.

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**Legend:**  
 AM / PM Peak Hour Volumes

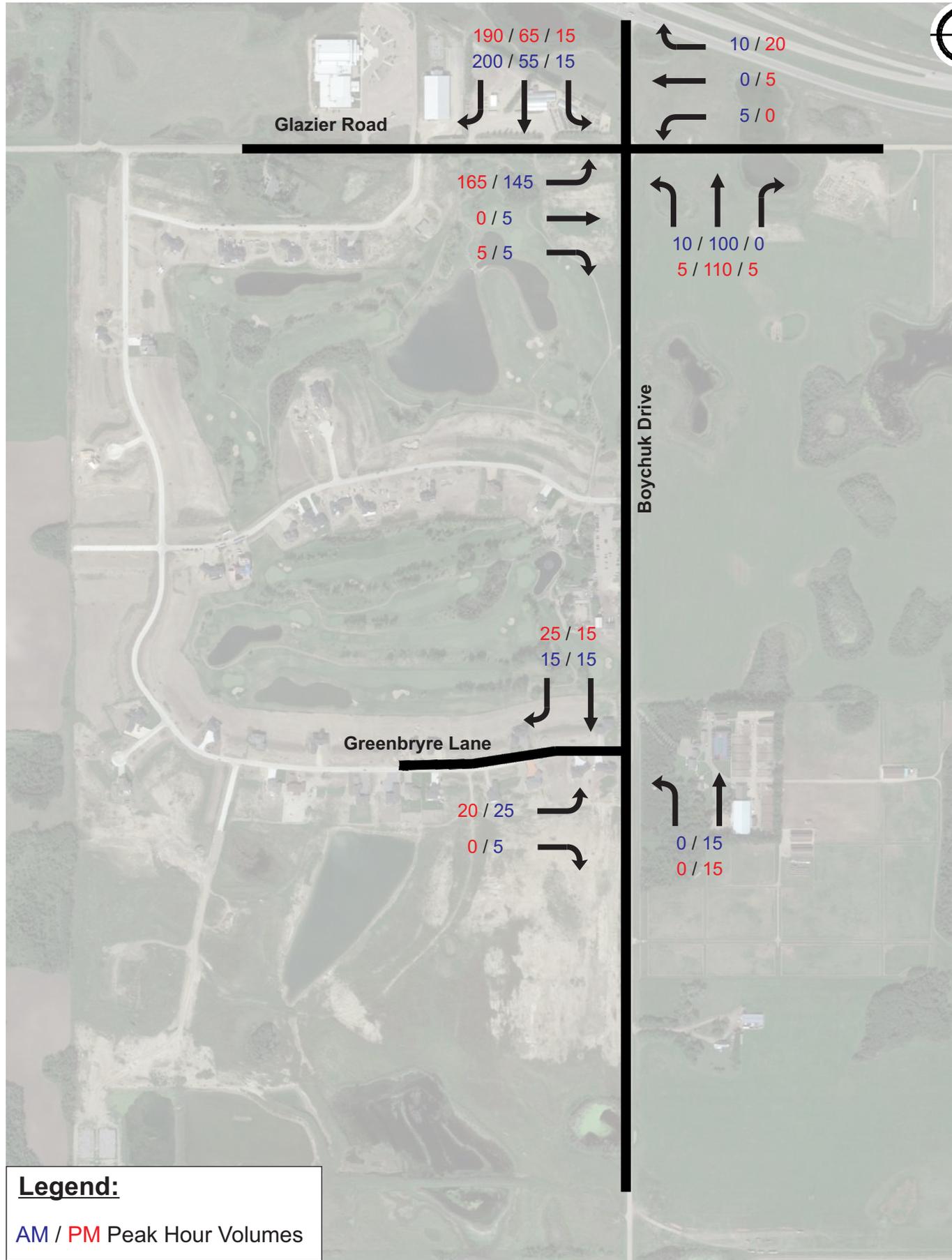


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**Figure 2**  
**Existing Traffic Volumes**  
 Greenbryre Phase 3 Development TIA

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**Figure 3**  
**Background Forecast Volumes**  
 Greenbryre Phase 3 Development TIA

### 3.0 TRIP GENERATION

New trips generated by the Greenbryre Phase 3 development were estimated for the morning and afternoon peak hour. Trip generation for the proposed development was established as outlined in the *Institute of Transportation Engineers (ITE) Trip Generation Manual 9th Edition* using the trip rates for Single-Family Detached Homes (ITE Code 210) and Residential Condominium / Townhouses (ITE Code 230). Since the new club house will be a replacement of the existing, it was assumed that there will be no additional trips.

Table 1 presents the trip rates and percent entering and exiting for each land use.

**Table 1 | Weekday Trip Rates**

| Types                    | Morning Peak Hour |        |       | Afternoon Peak Hour |        |       |
|--------------------------|-------------------|--------|-------|---------------------|--------|-------|
|                          | Trip Rates        | %Enter | %Exit | Trip Rates          | %Enter | %Exit |
| Single-Family Detached   | 0.75              | 25%    | 75%   | 1.00                | 63%    | 37%   |
| Condominium / Townhouses | 0.44              | 17%    | 83%   | 0.52                | 67%    | 33%   |

A summary of the new trips generated by the proposed development is summarized in Table 2.

**Table 2 | Total New Trips**

| Types                    | Dwelling Units | Size (Ac)   | Morning Peak Hour |           |            | Afternoon Peak Hour |           |            |
|--------------------------|----------------|-------------|-------------------|-----------|------------|---------------------|-----------|------------|
|                          |                |             | Enter             | Exit      | Total      | Enter               | Exit      | Total      |
| Single-Family Detached   | 130            | 45.5        | 25                | 75        | 100        | 80                  | 50        | 130        |
| Condominium / Townhouses | 48             | 5.8         | 5                 | 20        | 25         | 15                  | 10        | 25         |
| <b>Total</b>             | <b>178</b>     | <b>51.3</b> | <b>30</b>         | <b>95</b> | <b>125</b> | <b>95</b>           | <b>60</b> | <b>155</b> |

\* Trips are rounded to the nearest 5

### 3.1 TRIP DISTRIBUTION AND ASSIGNMENT

The anticipated site-generated traffic volumes were applied to the network based on an assessment of how residents would enter or exit the site. The new traffic volumes were distributed through the road network using a comparison of the existing traffic patterns determined by the TMC, and the location of the proposed development in relation to Saskatoon. It was assumed that residents would use the Boychuk Drive and Glazier Road intersection and ultimately the Highway 16 and Boychuk Drive intersection as the key access point.

Based on the location of Phase 3 development, it was assumed that all new trips will utilize Boychuk Drive rather than Glazier Road. In addition, the distribution of the new trips took into consideration the traffic patterns anticipated at the completion of the Highway 16 and Boychuk Drive interchange. The distribution of new trips reflects vehicles entering the site using the nearest access, and exiting via the most convenient access to return to the travel route.

Table 3 presents a summary of the assumed traffic volume assignment for the morning and afternoon peak hour.

**Table 3 | Trip Distribution and Assignment Assumptions**

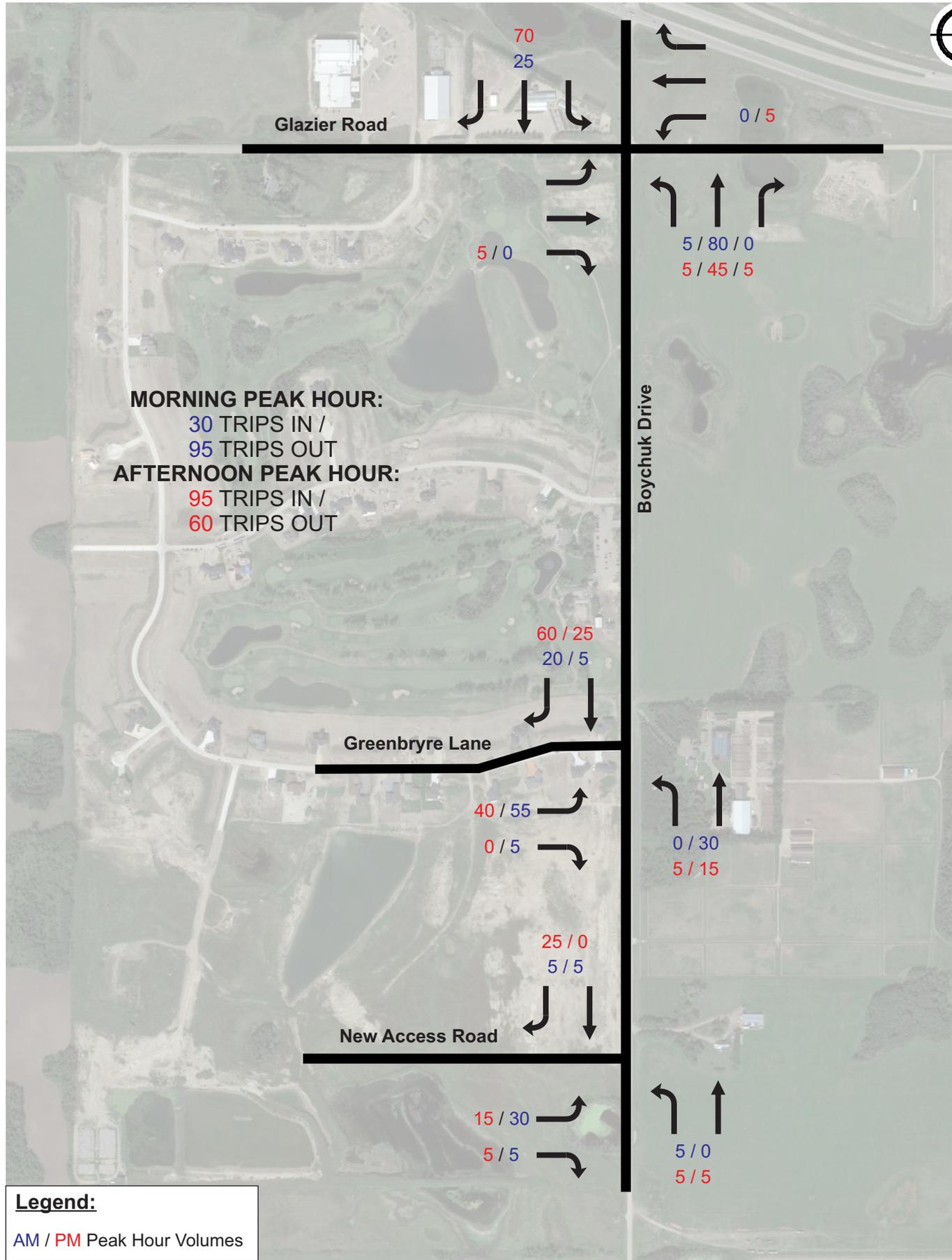
| Roadway       | Direction In / Out | Distribution (%) | New Trips (vph) |            |
|---------------|--------------------|------------------|-----------------|------------|
|               |                    |                  | Morning         | Afternoon  |
| Boychuk Drive | North              | 90%              | 110             | 140        |
| Boychuk Drive | South              | 10%              | 15              | 15         |
| <b>Total</b>  |                    | <b>100%</b>      | <b>125</b>      | <b>155</b> |

Figure 4 illustrates the new trips generated by the proposed development for the morning and afternoon peak hours.

## 3.2 TOTAL FORECAST VOLUMES

Total forecast traffic volumes associated with the proposed development are obtained by combining the background traffic growth with the new trips associated with the development. The total forecast traffic volumes for the full build-out development are presented in Figure 5 for the morning and afternoon peak hours.

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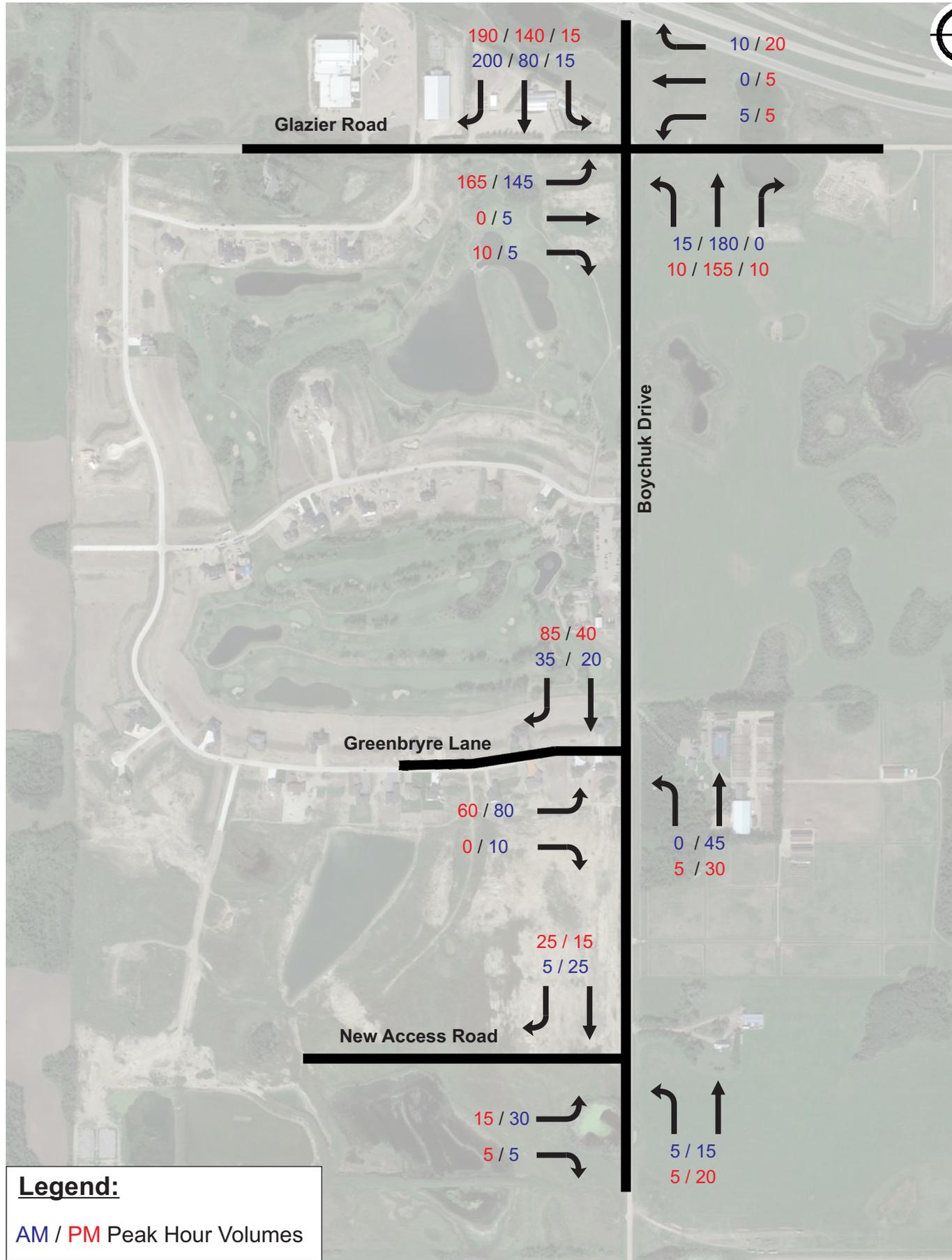
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**Figure No 4**  
**New Trips**  
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**Legend:**  
 AM / PM Peak Hour Volumes



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**Figure 5**  
**Total Forecast Volumes**  
 Greenbryre Phase 3 Development TIA

## 4.0 TRAFFIC OPERATIONS

Existing, background and total forecast traffic operations have been assessed using Synchro 9.0 (industry-standard traffic analysis software). The existing lane configuration of the Boychuk Drive and Glazier Road intersection was used to examine the current operational conditions while the background and total forecast scenarios were examined using the realigned intersection location anticipated upon the interchange at Highway 16 being constructed. In addition, the current infrastructure was used to examine existing and forecast scenarios with no additional turning lanes or traffic controls added. Tables 4 and 5 summarize the analyses for the morning and afternoon peak hours, respectively.

A Level of Service (LOS) analysis assesses the effectiveness of a transportation system alphabetically from A to F, with LOS A equating to the best operating conditions and LOS F representing the failure of a movement or intersection. LOS D is typically considered the limit of acceptable operation for intersections similar to the study intersections because excessive delays tend to occur beyond this threshold.

The volume-to-capacity (v/c) ratio is representative of congestion and available capacity, and may be used to identify a movement's ability to accommodate fluctuations in traffic flow. V/C values of 0.80 or greater are typically indicative of a system that has reached its limit of operational effectiveness. The 95<sup>th</sup> percentile queue length represents the maximum back of queue a movement may experience with 95<sup>th</sup> percentile traffic volumes.

The analysis results are summarized as follows:

- **Boychuk Drive and Glazier Road Intersection:** overall intersection operates at LOS A during the morning and afternoon peak hour and is expected to operate at LOS A for the background and total forecast scenarios. Although the eastbound approach is anticipated to reach LOS C for the background and total forecast scenarios, the highest 95<sup>th</sup> percentile queue length is anticipated to be 18 m during the morning peak hour, which is slightly more than two vehicles in length. The highest v/c ratio is anticipated to be 0.46 during the afternoon peak hour for the eastbound approach, which is well below the capacity limit.
- **Boychuk Drive and Greenbryre Lane Intersection:** currently operates at LOS A and will continue to operate at LOS A for all forecast scenarios with minimal delays and queue length.
- **Boychuk Drive and New Access Road Intersection:** once constructed, will operate at LOS A for all scenarios.

**Table 4 | Existing, Background and Total Forecast LOS Analysis – Morning Peak Hour**

|   |            | EASTBOUND |    |      | WESTBOUND |    |    | NORTHBOUND |    |    | SOUTHBOUND |      |    | Overall<br>LOS |
|---|------------|-----------|----|------|-----------|----|----|------------|----|----|------------|------|----|----------------|
|   |            | LT        | TH | RT   | LT        | TH | RT | LT         | TH | RT | LT         | TH   | RT |                |
| <b>Boychuk Drive and Glazier Road Intersection</b>    |            |           |    |      |           |    |    |            |    |    |            |      |    |                |
| <b>Existing</b>                                       | 95th Queue | 6         |    |      | 1         |    |    | 1          |    |    | 1          |      |    | <b>A</b>       |
|   | V/C Ratio  | 0.19      |    |      | 0.03      |    |    | 0          |    |    | 0.01       |      |    |                |
|   | LOS        | B         |    |      | A         |    |    | A          |    |    | A          |      |    |                |
| <b>Background Forecast</b>                            | 95th Queue | 7         |    |      | 1         |    |    | 1          |    |    | 1          |      |    | <b>A</b>       |
|   | V/C Ratio  | 0.24      |    |      | 0.02      |    |    | 0.01       |    |    | 0          |      |    |                |
|   | LOS        | B         |    |      | A         |    |    | A          |    |    | A          |      |    |                |
| <b>Total Forecast</b>                                 | 95th Queue | 13        |    |      | 1         |    |    | 1          |    |    | 1          |      |    | <b>A</b>       |
|   | V/C Ratio  | 0.37      |    |      | 0.03      |    |    | 0.01       |    |    | 0.01       |      |    |                |
|   | LOS        | C         |    |      | B         |    |    | A          |    |    | A          |      |    |                |
| <b>Boychuk Drive and Greenbryre Lane Intersection</b> |            |           |    |      |           |    |    |            |    |    |            |      |    |                |
| <b>Existing</b>                                       | 95th Queue | 1         |    | 1    |           |    |    | 0          |    |    |            | 0    |    | <b>A</b>       |
|   | V/C Ratio  | 0.02      | -  | 0.02 |           |    |    | 0          | -  |    |            | 0.04 |    |                |
|   | LOS        | A         |    | A    |           |    |    | A          |    |    |            | A    |    |                |
| <b>Background Forecast</b>                            | 95th Queue | 1         |    | 1    |           |    |    | 0          |    |    |            | 0    |    | <b>A</b>       |
|   | V/C Ratio  | 0.04      | -  | 0.04 |           |    |    | 0          | -  |    |            | 0.02 |    |                |
|   | LOS        | A         |    | A    |           |    |    | A          |    |    |            | A    |    |                |
| <b>Total Forecast</b>                                 | 95th Queue | 3         |    | 3    |           |    |    | 0          |    |    |            | 0    |    | <b>A</b>       |
|   | V/C Ratio  | 0.11      | -  | 0.11 |           |    |    | 0          | -  |    |            | 0.04 |    |                |
|   | LOS        | A         |    | A    |           |    |    | A          |    |    |            | A    |    |                |
| <b>Boychuk Drive and New Access Road Intersection</b> |            |           |    |      |           |    |    |            |    |    |            |      |    |                |
| <b>Total Forecast</b>                                 | 95th Queue | 1         |    | 1    |           |    |    | 1          |    |    |            | 0    |    | <b>A</b>       |
|   | V/C Ratio  | 0.04      | -  | 0.04 |           |    |    | 0          | -  |    |            | 0.02 |    |                |
|   | LOS        | A         |    | A    |           |    |    | A          |    |    |            | A    |    |                |

**Table 5 | Existing, Background and Total Forecast LOS Analysis – Afternoon Peak Hour**

|   |            | EASTBOUND |    |      | WESTBOUND |    |    | NORTHBOUND |    |    | SOUTHBOUND |      |    | Overall<br>LOS |
|---|------------|-----------|----|------|-----------|----|----|------------|----|----|------------|------|----|----------------|
|   |            | LT        | TH | RT   | LT        | TH | RT | LT         | TH | RT | LT         | TH   | RT |                |
| <b>Boychuk Drive and Glazier Road Intersection</b>    |            |           |    |      |           |    |    |            |    |    |            |      |    |                |
| <b>Existing</b>                                       | 95th Queue | 4         |    |      | 1         |    |    | 0          |    |    | 1          |      |    | <b>A</b>       |
|   | V/C Ratio  | 0.15      |    |      | 0.02      |    |    | 0          |    |    | 0.01       |      |    |                |
|   | LOS        | B         |    |      | A         |    |    | A          |    |    | A          |      |    |                |
| <b>Background Forecast</b>                            | 95th Queue | 12        |    |      | 1         |    |    | 1          |    |    | 1          |      |    | <b>A</b>       |
|   | V/C Ratio  | 0.36      |    |      | 0.03      |    |    | 0          |    |    | 0.01       |      |    |                |
|   | LOS        | C         |    |      | B         |    |    | A          |    |    | A          |      |    |                |
| <b>Total Forecast</b>                                 | 95th Queue | 18        |    |      | 2         |    |    | 1          |    |    | 1          |      |    | <b>A</b>       |
|   | V/C Ratio  | 0.46      |    |      | 0.06      |    |    | 0.01       |    |    | 0.01       |      |    |                |
|   | LOS        | C         |    |      | B         |    |    | A          |    |    | A          |      |    |                |
| <b>Boychuk Drive and Greenbryre Lane Intersection</b> |            |           |    |      |           |    |    |            |    |    |            |      |    |                |
| <b>Existing</b>                                       | 95th Queue | 1         |    | 0    |           |    |    | 0          |    |    |            | 0    |    | <b>A</b>       |
|   | V/C Ratio  | 0.02      | -  | 0    |           |    |    | 0          | -  |    |            | 0.4  |    |                |
|   | LOS        | A         |    | A    |           |    |    | A          |    |    |            | A    |    |                |
| <b>Background Forecast</b>                            | 95th Queue | 1         |    | 0    |           |    |    | 0          |    |    |            | 0    |    | <b>A</b>       |
|   | V/C Ratio  | 0.03      | -  | 0    |           |    |    | 0          | -  |    |            | 0.05 |    |                |
|   | LOS        | A         |    | A    |           |    |    | A          |    |    |            | A    |    |                |
| <b>Total Forecast</b>                                 | 95th Queue | 3         |    | 3    |           |    |    | 1          |    |    |            | 0    |    | <b>A</b>       |
|   | V/C Ratio  | 0.1       | -  | 0.1  |           |    |    | 0          | -  |    |            | 0.1  |    |                |
|   | LOS        | A         |    | A    |           |    |    | A          |    |    |            | A    |    |                |
| <b>Boychuk Drive and New Access Road Intersection</b> |            |           |    |      |           |    |    |            |    |    |            |      |    |                |
| <b>Total Forecast</b>                                 | 95th Queue | 1         |    | 1    |           |    |    | 1          |    |    |            | 0    |    | <b>A</b>       |
|   | V/C Ratio  | 0.02      | -  | 0.02 |           |    |    | 0          | -  |    |            | 0.03 |    |                |
|   | LOS        | A         |    | A    |           |    |    | A          |    |    |            | A    |    |                |

Although the Boychuk Drive and New Access Road intersection is anticipated to have minimal traffic volumes at total forecast scenarios, it is recommended that the study intersection be stop-controlled providing Boychuk Drive with free flow operations.

In addition, Boychuk Drive may become an urban cross-section as development continues to occur south of Highway 16. The intersection spacing suggests that reducing the speed to 60 km/h will assist in changing the driver's perception of Boychuk Drive adjacent to the proposed development. Boychuk Drive between Highway 16 and Greenbryre Lane currently has a dust free surface while Boychuk Drive is a gravel surface south of Greenbryre Lane. This portion of the roadway is a low standard road and there is likely continual maintenance required. Although the majority of the vehicles on this road are anticipated to be light-weight, road users may perceive the existing condition of the road surface as unacceptable and result in complaints received by the R.M. of Corman Park, if not improved. Paving Boychuk Drive to the south boundary of the development would be beneficial to the development.

## 5.0 WARRANT ASSESSMENTS

Illumination and turning lane warrants were assessed to improve operations and safety on Boychuk Drive at the intersections with Glazier Road, Greenbryre Lane, and New Access Road. The warrant analyses were conducted using the existing intersection configurations and the full build-out development volumes. For the purpose of this study, the Ministry of Highways and Infrastructure (MHI) Design Manual 2621-1 and 2621-2 guidelines were used to assess the illumination warrants and MHI Standard Plan 20614 was used to assess the right-turn lane requirement along Boychuk Drive. It should be noted that these warrants were developed for highway conditions of 100 km/h design speed or higher.

Since MHI warrants were developed for highway assessment, Boychuk Drive was considered the major roadway for the analysis. In addition, the Annual Average Daily Traffic (AADT) volumes used in the analysis were estimated from the afternoon peak hour, assuming a typical 10% of the daily traffic for the afternoon peak.

### Illumination Warrants

Intersection area lighting includes illumination of the intersection and the adjacent approaches while the delineation lighting only provides partial lighting at the intersection. Intersection area and delineation lighting warrant analyses were conducted on Boychuk Drive at the intersections with Glazier Road and New Access Road.

Traffic volume warrants were used for the intersection area lighting assessment, as per MHI Intersection Area Lighting (DM 2621-2). The traffic volumes required to meet the warrant criteria are 1500 AADT or greater for the major roadway and 1000 AADT or greater for the intersecting roadway. The Boychuk Drive and Glazier Road intersection traffic volumes meet the warrant requirement when assessed for the full build-out phase where volumes are approximately 2625 AADT on Boychuk Drive and 2050 AADT on Glazier Road. Assuming a functional classification factor of 1.00 for local road, the study intersection has a ranking index of 538 points. However, the Boychuk Drive and New Road Access intersection does not meet the warrant requirement with 325 AADT on Boychuk Drive and 200 AADT on New Access Road.

As per MHI Intersection Delineation Guidelines (DM 2621-1), all rural and urban intersection with provincial highways qualify for delineation lighting where the traffic volumes for the intersection roadway exceeds 150 vehicles-per-day (vpd). The warrant also assessed the lighting priority ranking points and resulted in 19 points at the Boychuk Drive and New Access Road intersection.

The analysis of lighting warrants provide an indication that a series of lights along Boychuk Drive, particularly at the Greenbryre access points and Glazier Road, should be considered to improve safety and operations along this corridor.

### **Intersection Treatment Warrants**

Intersection treatments were considered for Boychuk Drive at the intersections with Glazier Road, Greenbryre Lane, and New Access Road. The right-turn lane warrant assesses the right-turn volumes to the advancing volumes at an intersection, as per MHI Standard Plan 20614, and is not warranted if the plotted point falls to the left of the curve. The applicable warrant analyses were summarized in Figures 6, 7, 8 and 9.

The intersection of Boychuk Drive and Glazier Road was assessed for southbound right-turn lane for the existing and total forecast traffic volumes, as summarized in Figures 6 and 7. The southbound right-turn lane is warranted for the existing and both forecast scenarios. However, due to the timing of the Highway 16 and Boychuk Drive interchange construction, the feasibility of the improvement should be examined further in consultation with the City of Saskatoon, MHI, and R.M of Corman Park.

An analysis was conducted for the southbound right-turn from Boychuk Drive onto Greenbryre Lane during the afternoon peak hour, as presented in Figure 8. The southbound right-turn movement from Boychuk Drive onto Greenbryre Lane was analyzed for the afternoon peak hour, and meets the warrant criteria. While the study intersection meets the warrant requirement, the construction of a southbound right-turn lane at the study intersection may not provide additional benefits due to low southbound traffic volumes (approximately two vehicles per minute).

A right-turn lane warrant analysis was conducted for the Boychuk Drive and New Access Road intersection using the afternoon peak hour volumes at full build-out development. The study intersection does not meet the warrant requirement at the completion of Phase 3 development, as shown in Figure 9.

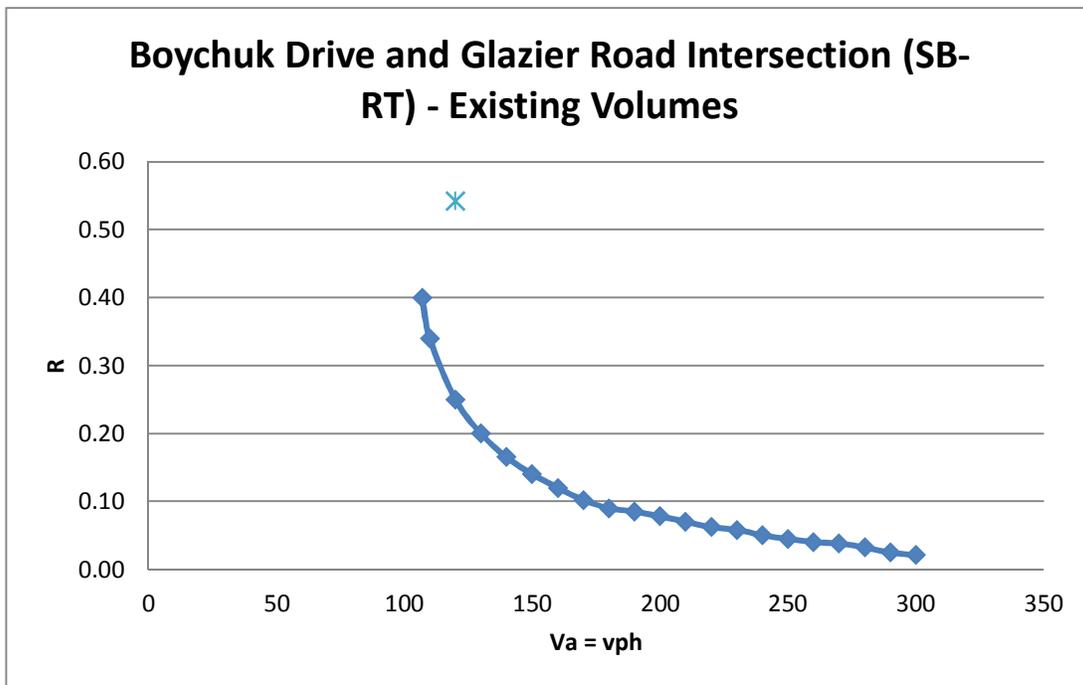
The analysis was completed using MHI's turning lane warrants. However, the traffic volumes adjacent to the development are relatively low and turning lanes require additional maintenance cost along this roadway. It is not typical for a rural road within the RM to have turning lanes constructed with such low overall volume. Turning lanes and / or the urban cross-section of Boychuk Drive may be implemented when extensive development occurs south of Highway 16, when additional capacity is required within the available right-of-way.

# Greenbrye Phase 3 Traffic Impact Assessment

Project No. 5416218

## Afternoon Peak Hour Right-turn Warrant Analysis

**Figure No.:** 6  
**Intersection:** Boychuk Drive and Glazier Road Intersection  
**Scenario:** Existing Volumes  
**Traffic Volume Scenario** Afternoon Peak Hour  
**Advancing Volume:** 120  
**Right Turn Volume:** 65  
**Right-turn Warranted:** Yes

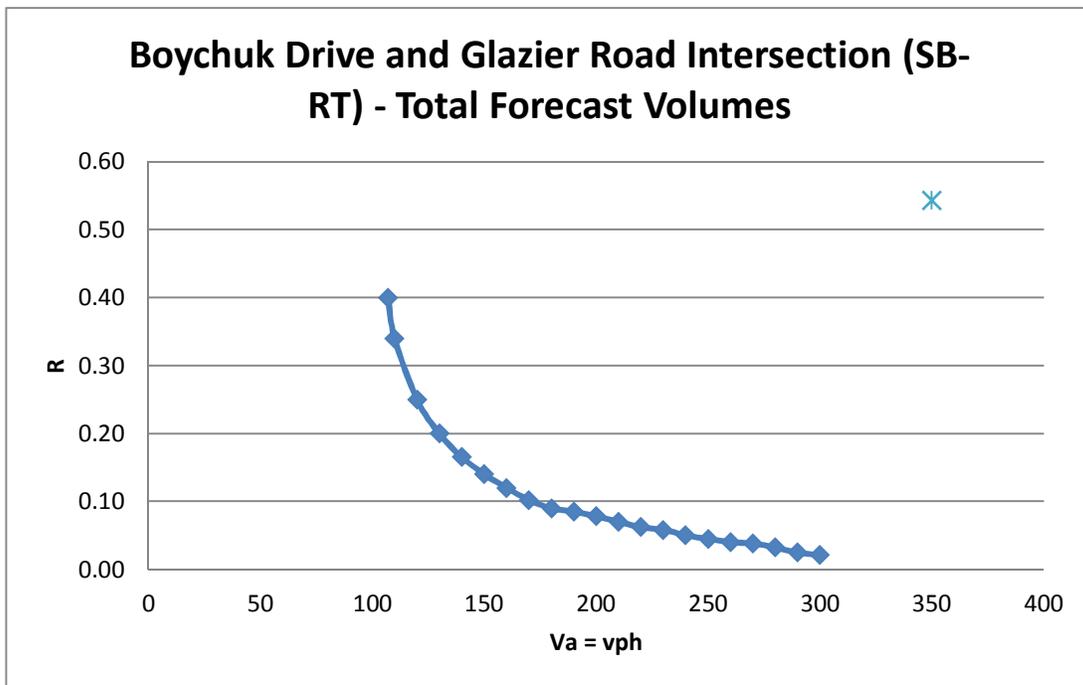


# Greenbryre Phase 3 Traffic Impact Assessment

Project No. 5416218

## Afternoon Peak Hour Right-turn Warrant Analysis

**Figure No.:** 7  
**Intersection:** Boychuk Drive and Glazier Road Intersection  
**Scenario:** Full Build-Out  
**Traffic Volume Scenario:** Afternoon Peak Hour  
**Advancing Volume:** 350  
**Right Turn Volume:** 190  
**Right-turn Warranted:** Yes

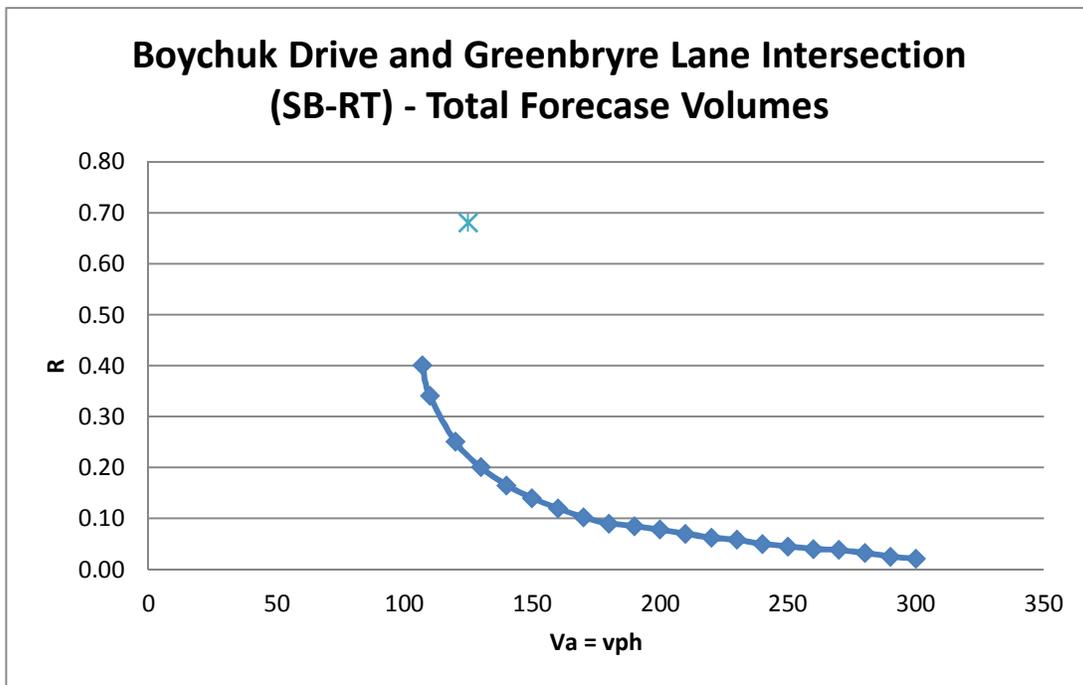


# Greenbrye Phase 3 Traffic Impact Assessment

Project No. 5416218

## Afternoon Peak Hour Right-turn Warrant Analysis

**Figure No.:** 8  
**Intersection:** Boychuk Drive and Greenbrye Lane Intersection  
**Scenario:** Full Build-Out  
**Traffic Volume Scenario:** Afternoon Peak Hour  
**Advancing Volume:** 125  
**Right Turn Volume:** 85  
**Right-turn Warranted:** Yes

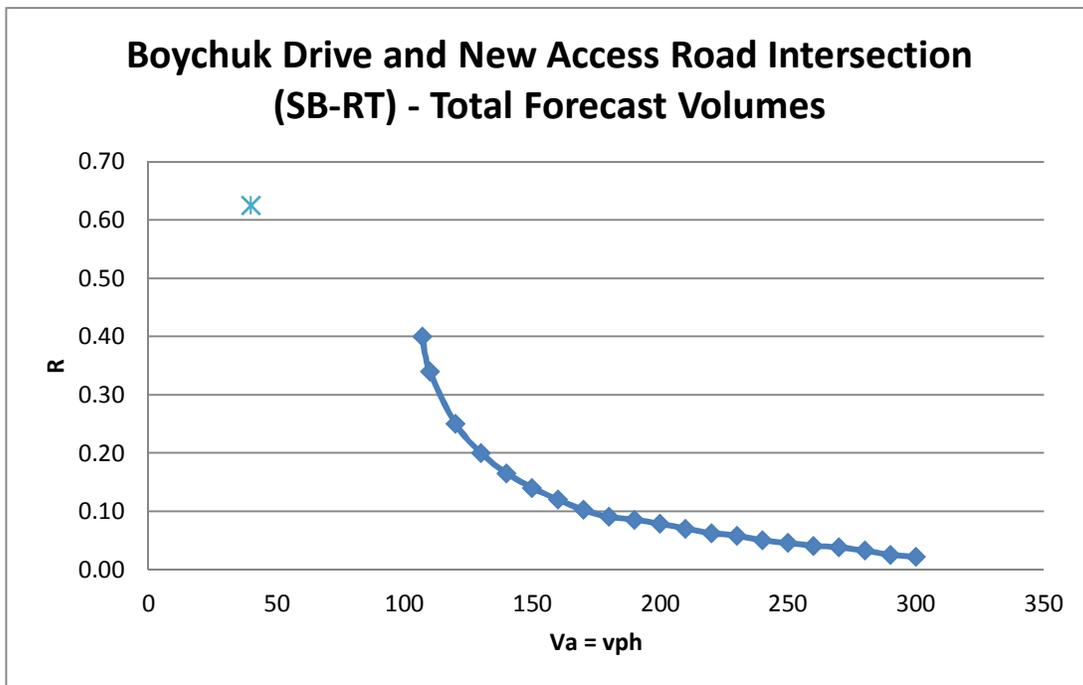


# Greenbrye Phase 3 Traffic Impact Assessment

Project No. 5416218

## Afternoon Peak Hour Right-turn Warrant Analysis

|                                |  |
|--------------------------------|--|
| <b>Figure No.:</b>             | 9  |
| <b>Intersection:</b>           | Boychuk Drive and New Access Road Intersection |
| <b>Scenario:</b>               | Full Build-Out                                 |
| <b>Traffic Volume Scenario</b> | Afternoon Peak Hour                            |
| <b>Advancing Volume:</b>       | 40   |
| <b>Right Turn Volume:</b>      | 25   |
| <b>Right-turn Warranted:</b>   | No   |



## 6.0 SUMMARY OF RECOMMENDATION

The study intersections are currently operating at LOS A with minimal delays and queue length on all approaches. Similarly, the intersections will continue to operate at LOS A at the completion of the development where the maximum v/c ratio is at 46%, well below capacity limit. The following recommendations have resulted from the completion of this TIA:

- Reduce the speed limit along Boychuk Drive to 60 km/h which can transition to 80 km/h south of the development.
- The existing traffic volumes at the intersection of Boychuk Drive and Glazier Road meet the southbound right-turn lane warrant requirement. However, due to the timing of the Highway 16 and Boychuk Drive interchange construction and the low overall volume of this road, further examination and consultation should be completed with the City of Saskatoon, MHI and R.M. of Corman Park to determine if all parties deem this measure necessary.
- With the turning movement volumes anticipated at the Boychuk Drive and Glazier Road intersection, this intersection should be fitted with improved illumination. An area lighting system can be considered. Similar to the right-turn lane, the provision of a lighting system should be consulted with the City of Saskatoon, MHI and R.M. of Corman Park as part of the interchange construction.
- Boychuk Drive south of Greenbryre Lane is a low grade gravel surface. It is recommended that a dust free improvement be considered up to the south boundary of the development.
- The southbound right-turn movement at the Boychuk Drive and Greenbryre Lane intersection meets the MHI warrant requirement for a turning lane. However, it is recommended that the study intersection be monitored for further increase in traffic volumes as the improvement will not likely provide additional benefits to the Greenbryre Phase 3 development.
- No right-turn lane is warranted at the Boychuk Drive and New Access Road intersection. It is recommended that New Access Road be stop-controlled with Boychuk Drive operating free-flow.
- Although the intersection has a low priority ranking of 19 points, it is recommended that a delineation lighting system be considered at the Boychuk Drive and New Access Road intersection.

**APPENDIX C**  
**MUNICIPAL SERVICING STUDY**  
**AND CONCEPT PLAN**





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Tel: (306) 343-7280, Fax: (306) 956-3199

**PRELIMINARY**  
NOT FOR CONSTRUCTION

**LEGEND:**

- SINGLE FAMILY WALKOUT
- SINGLE FAMILY NON WALKOUT
- MULTI-FAMILY
- POND
- PARKS/MUNICIPAL
- SAGR TREATED WATER POND
- EXIST. ROAD
- DESIGN ROAD
- PATH
- STREAM
- BRIDGE
- PHASE 3 BOUNDARY

129 SINGLE FAMILY LOTS  
~88 CONDO UNITS (BASED ON  
4 PLEX SAME SIZE AS  
STONEBRIDGE DEVELOPMENT)

**SCALE VERIFICATION**

WHEN DRAWING IS PLOTTED FULL  
SIZE THIS LINE IS 60mm IN LENGTH.

DATE REVISION

18/10/30 ISSUED TO OWNER

OWNER  
**GREENBRYRE  
ESTATES**

LOCATION  
SE1/4, 12-36-5-W3M

PROJECT  
PHASE 3 CONCEPTUAL  
SERVICING

SHEET TITLE  
CONCEPTUAL PLAN

SCALE 1:1250 DESIGNED CRB

DRAWN GCW CHECKED

DATE 18/10/24 SHEET 2 of 6

DRAWING NUMBER 452-016 FIG2



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November 15, 2018 (Revised November 22, 2019)

D&S Developments II Joint Venture  
Suite 200 - 203 Stonebridge Blvd  
Saskatoon SK S7T 0G3

via email: troy@dshomes.ca

Attention: Mr. Troy Slater

Re: Greenbryre Estates – Phase 3 Preliminary Servicing Study

Catterall & Wright was asked to review and update the servicing requirements for Phase 3 of Greenbryre Estates located on SE 1/4 12-36-5-W3M within the Rural Municipality of Corman Park. This includes review of existing and proposed infrastructure for water, wastewater, drainage, storm water management, and roadways for Phase 3. The boundary for Phase 3 is shown on the Overall Development site plan included on Drawing No. 452-016 Fig 1. The following provides a review of each category.

### Background

The original concept plan for Phase 3 was updated and now includes 130 single family lots and the potential for 84 condo units as shown on Drawing No. 452-016 Fig 2. In addition, future commercial development in the north-east corner of Greenbryre Estates and provisions for a new golf course clubhouse were considered in our capacity review, as shown on Drawing No. 452-016 Fig 1. The revised concept increases the original projected residential population for Greenbryre Estates from 750 to 981 people. As of November 2019, the water treatment plant (WTP) records indicate that 97 homes are connected to the distribution system. Based on the number of homes connected to the WTP, we calculate the current population to be approximately 291 people.

### Drainage & Storm Water Management

Greenbryre Estates manages storm water with a combination of overland drainage and storm sewer that directs runoff to storm water retention ponds. As shown Drawing No. 452-016 Fig 1, there are five retention ponds in Phase 1 & 2 and two ponds proposed for full buildout of Phase 3, not including the SAGR treated effluent holding pond. The ponds are connected with by either open channel or piped connections. Storm water from the ponds is designed to irrigate the golf course and all residential lots. Greenbryre Estates also maintains connections to SaskWater's raw water lines to recharge the ponds as needed.

A topographical GPS ground survey and an Unmanned Aerial Vehicle (UAV) survey were completed to review the existing ground contours and generate an orthomosaic image of the site, as shown on Drawing No. 452-016 Fig 3. With consideration of the existing contours, Drawing No. 452-016 Fig 4 outlines the conceptual drainage for Phase 3. Pond sizes are conceptual and are based on the current conceptual plan for Phase 3. The ponds are connected by an overland channel to flow water from one pond to the next. The system is sized to hold back-to-back 100-year storm events, as the intention is to



not have an outlet, but rather use the runoff water as irrigation for the golf course and residential yards. An additional factor of safety of 1.0 metre between the rear walkout elevations and High Water Level (HWL), based on a single 1:100-year storm event, will be incorporated into the final grading plan. Vertical clearance to rear walkout elevations will also be maintained for back-to-back 100-year storm events. The total volumes required for storage will be confirmed with detailed grading design.

Similar to the previous phases, the majority of lots in Phase 3 are proposed to be walkouts. A geotechnical study is recommended considering that large amounts of fill that will be required for roadways and walkout style lots.

### Wastewater Infrastructure

Greenbryre Estates operates with individual dual compartment septic tanks at each lot that pump into a low-pressure sewer system. Each tank is equipped with dual compartments with a screen ahead of the pumps. Solids settle in the dual compartment holding tanks, and are cleaned out as required. The initial tank settlement reduces the Biological Oxygen Demand (BOD) loading at the wastewater treatment system. Wastewater from each residence is pumped to a Submerged Attached Growth Reactor (SAGR) system. Treated effluent from the SAGR is chlorinated and pumped to a treated water holding pond for temporary storage before flowing into the storm water system for irrigation purposes. The pressure sewer and SAGR system are shown on Drawing 452-016 Fig 5.

The SAGR system is classified as a continuous discharge system, and has been designed for 343 m<sup>3</sup>/day of daily influent and 63.5 kg/day of Biological Oxygen Demand (BOD) loading at an average BOD loading of 185 mg/L. BOD loading to the SAGR was determined by applying the following criteria:

- Residential daily BOD loading = 2/3 of 0.77 kg/person per day.
- Proposed clubhouse BOD loading = 235 mg/L at average day flows.
- Future commercial BOD loading = 235 mg/L at average day flows.

The updated (2019) concept adds an additional 45.5 m<sup>3</sup>/day of influent and 4.49 kg/day of BOD loading at full buildout of the development. The SAGR is sufficiently sized to handle the increased total BOD loading of 60.5 kg/day; however, the daily influent capacity has been exceeded by 11.0 m<sup>3</sup>/day. BOD loading will affect the efficacy of the wastewater treatment system, but as long as the system is within the design BOD loading parameters, we do not expect expansion of the SAGR will be required. For reference purposes, Nexom Environmental will prepare recommendations for potential options to expand the SAGR system to increase volumetric loading if required. Expansion will not require additional footprint for Phase 3, but would include internal upgrades to the existing system. The system should be monitored as development proceeds to review influent and BOD levels.

A setback of 60 m from Full Supply Level (FSL) of the treated water holding pond (Capacity 19,400m<sup>3</sup>) is required, as shown on the Conceptual Servicing Plan. A 60 m setback from the SAGR is required; however, it should be noted that the FSL of the treated water holding pond (Capacity 19,400m<sup>3</sup>) will be the closest proximity to the proposed development.



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Once wastewater has circulated within the SAGR beds, treated effluent is chlorinated and released to a treated effluent holding pond. The treated effluent holding pond (Capacity 19,400m<sup>3</sup>) was installed downstream of the SAGR as a redundant step in the wastewater treatment process to provide a holding cell for an aerated zone to help control algae, odours, and wildlife if they become a problem. No aeration is currently provided to the pond, and if required, would entail the installation of diffusers and additional blowers. The treated effluent holding pond is considered part of the treatment process and cannot be altered without revisiting the existing permit to operate. Water from the treated effluent holding pond flows through an overflow manhole and is discharged into the storm water retention ponds. The storm water retention ponds are utilized for irrigation within the development and golf course. The original (2012) concept provided 210 days of treated effluent storage for a volume of 65,000 m<sup>3</sup>. The 210 day storage for the updated (2019) concept is 74,335 m<sup>3</sup>; an increase of 9,335 m<sup>3</sup>. The proposed storage volume within Phase 3 is projected to be 115,000 m<sup>3</sup> at Normal Water Level, not including the ponds within Phase 1 & 2. The pond storage volume will be adequate to service full buildout.

Table 1 summarizes the increased water/wastewater requirements from the original design to the proposed concept for Phase 3. The original concept anticipated commercial development in the northeast corner of the site to be a hotel. The proposed clubhouse and future commercial area's potable use (and consumption) is unknown. For water consumption estimating, an equivalent population of 60 people/ha for the proposed clubhouse and 72 people/ha for the commercial area were used.

Flow data collected between 2014 and 2018 from the Water Treatment Plant was considered for the capacity analysis of this study. Consumption was lower than projected; however, a calibration issue on the flow meter was noted in November of 2017, creating a low confidence in the data provided prior to the calibration. Without reliable data to predict a trend, the original design values were used to calculate flows:

- Consumption: 318 Litres per Capita Day (LPCD).
- Population projections: 3 people per single family unit & 2 people per condo unit.

It is recommended that Greenbryre and Catterall & Wright continue to track and monitor flow data to determine consumption values as the development proceeds.



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*Table 1 – Original versus Updated Concept Water/Wastewater Design Values*

| <i>Greenbryre Phase 3 Conceptual Servicing Wastewater Flow and Loading</i> | <i>Pre-Design (2012) Full Buildout</i> | <i>Updated (2019) Full Buildout (Ph. 3 Conceptual)</i> |
|--|--|--|
| <b>Residential</b>   |  |  |
| Full Buildout No. of Single Family Lots                                    | 250 lots                               | 271 lots   |
| Full Buildout No. of Condos  | 0 condos                               | 84 condos  |
| Design Persons/House   | 3 ppl                                  | 3 ppl  |
| Design Persons/Condo   | 2 ppl                                  | 2 ppl  |
| Estimated Persons  | 750 ppl                                | 981 ppl  |
| Daily Water Consumption  | 318 lpcd                               | 318 lpcd   |
| *BOD (2/3 of .077kg/day)   | 38.5 kg/day                            | 50.4 kg/day  |
| Avg. Daily Flow  | 238,500 L/day                          | 311,958 L/day  |
| Yearly Volume  | 87,053 m <sup>3</sup>                  | 113,865 m <sup>3</sup>                                 |
| <b>Golf Course Clubhouse</b>   |  |  |
| Avg. Daily Water Consumption   | 10,000 L/day                           | 19,100 L/day   |
| BOD 235 mg/L   | 2.35 kg/day                            | 4.49 kg/day  |
| Yearly Volume  | 3,650 m <sup>3</sup>                   | 6,972 m <sup>3</sup>                                   |
| <b>Commercial Development (10,000ft<sup>2</sup>)</b>                       |  |  |
| Avg. Daily Water Consumption   | 60,000 L/day                           | 22,900 L/day   |
| BOD 235 mg/L   | 14.10 kg/day                           | 5.38 kg/day  |
| Assumed Occupancy(60% of 365 days)   | 219 days                               | 365 days   |
| Yearly Volume  | 13,140 m <sup>3</sup>                  | 8,359 m <sup>3</sup>                                   |
| <b>Total Estimated BOD &amp; Volumes</b>                                   |  |  |
| Total BOD 235 mg/L   | 54.95 kg/day                           | 60.23 kg/day   |
| Influent BOD 235 mg/L  | 178 mg/L                               | 170 mg/L   |
| Total Daily Flow   | 308,500 L/day                          | 353,958 L/day  |
| Yearly Volume  | 103,843 m <sup>3</sup>                 | 129,195 m <sup>3</sup>                                 |
| Min. Storage Volume (210 days).  | 64,785 m <sup>3</sup>                  | 74,331 m <sup>3</sup>                                  |



### Water Infrastructure

Potable water is distributed to residents from a Water Treatment Plant (WTP) constructed in Phase 1 of Greenbryre Estates along Boychuk Drive, shown on Drawing No. 452-016 Fig 1. The potable water is piped to the Water Treatment Plant by a 75 mm supply line, owned by SCS Water Group Inc., which purchases potable water from SaskWater. The updated (2019) concept plan adds an additional 1.6 L/s of flow rate from the original (2012) concept, for a total of 11.7 L/s of design flow rate. The current potable water supply is allocated based on an agreement with SCS and is capped at 3.6 L/s, which will accommodate an equivalent population of 349 people (116 single family homes). Preliminary discussions with SaskWater have taken place to review a separate direct connection. SaskWater has indicated that they can supply the required 11.7 L/s.

The required treated water storage for full buildout of the updated (2019) concept is 1,007 m<sup>3</sup>, which is an increase of 128.7 m<sup>3</sup> from the original (2012) concept. The constructed treated water storage capacity is 531 m<sup>3</sup> and will service an equivalent population of 586 people (195 single family homes). An additional 476 m<sup>3</sup> of storage capacity will be required to service full buildout.

The updated (2019) concept distribution pumping capacity for potable water at full buildout is 20.3 L/s, which is an increase of 2.2 L/s from the original (2012). The existing water distribution pumping capacity is 25.2 L/s. The system has been sized for peak hour demands, and does not provide fire flow capacity although a fire truck fill is available at the WTP. Pumping redundancy is achieved with the three pumps installed, leaving any two of the pumps able to meet the required distribution capacity. The distribution pumping capacity is satisfactory to service full buildout.

### Roadways

Phase 3 roadways will be designed in a similar nature to Phase 1 & 2 with an urban cross section consisting of concrete paved road surface with rolled curb on each side, as shown on Drawing No. 452-016 Fig 6. The main difference will be a reduced right of way from 24.0/30.0 m to 16.0 m leaving a 4.0 m boulevard from back of curb to the front property lines. The larger right of ways that exist in Phase 1 & 2 were originally designed to accommodate a rural cross section, which was revised to an urban cross section late in the design stage. We also recommend a reduced building setback from the front property of 6.0 m which leaves a total of 10.0 m from back of curb to front of building as shown on the 'Proposed Right of Way Section' on Drawing No. 452-016 Fig 6. Roadways will be incorporated with storm sewer catch basins for drainage collection, similar to Phase 1 & 2. A geotechnical report should be completed for Phase 3 to review material, determine road structure and recommendations for construction.



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### Summary

From the original per capita water usage of 318 LPCD we have identified infrastructure requiring expansion:

- Treated water storage capacity requires an additional 476 m<sup>3</sup> of storage.
- Treated water supply requires an additional 8.12 L/s for a total of 11.7 L/s at full buildout.
- The Wastewater SAGR system may require internal expansion to handle an increased daily influent of 11 m<sup>3</sup>/day at full buildout; however, this is not the critical component for treatment as long as BOD loading is within the SAGR design limits.

Once five years of flow data is available, the consumption should be revisited and the capacities recalculated to determine if room for additional development exists. A review of the usage for the proposed clubhouse and commercial areas should be completed when a final decision regarding their intended use has been made.

Storm water retention ponds and overland circulating drainage channels will be required for both storm water management and to generate fill for the development. Concrete roads will be installed with recommendations for a reduced right of way and reduced setback distance to building fronts.

If any questions arise from our review of the existing and proposed infrastructure, please contact our office to discuss further.

Yours truly,

**Catterall & Wright**

Per:

Carleen Bartel, P.Eng.

encl.

cc: Mr. Jim Walters, MCIP RPP, Crosby Hanna & Associates



**CATTERALL & WRIGHT**  
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SASKATOON SK S7H 0S5  
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**PRELIMINARY**  
NOT FOR CONSTRUCTION

- LEGEND:**
- SINGLE FAMILY WALKOUT
  - SINGLE FAMILY NON WALKOUT
  - MULTI-FAMILY
  - FUTURE COMMERCIAL
  - FUTURE AMENITY
  - PARKS/MUNICIPAL
  - SAGR TREATED WATER POND
  - POND
  - EXIST. POND
  - PATH
  - STREAM
  - PHASE 3 BOUNDARY

SCALE VERIFICATION  
WHEN DRAWING IS PLOTTED FULL SIZE THIS LINE IS 60mm IN LENGTH.

| DATE     | REVISION        |
|----------|-----------------|
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| 18/10/30 | ISSUED TO OWNER |

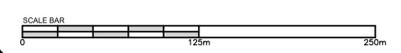
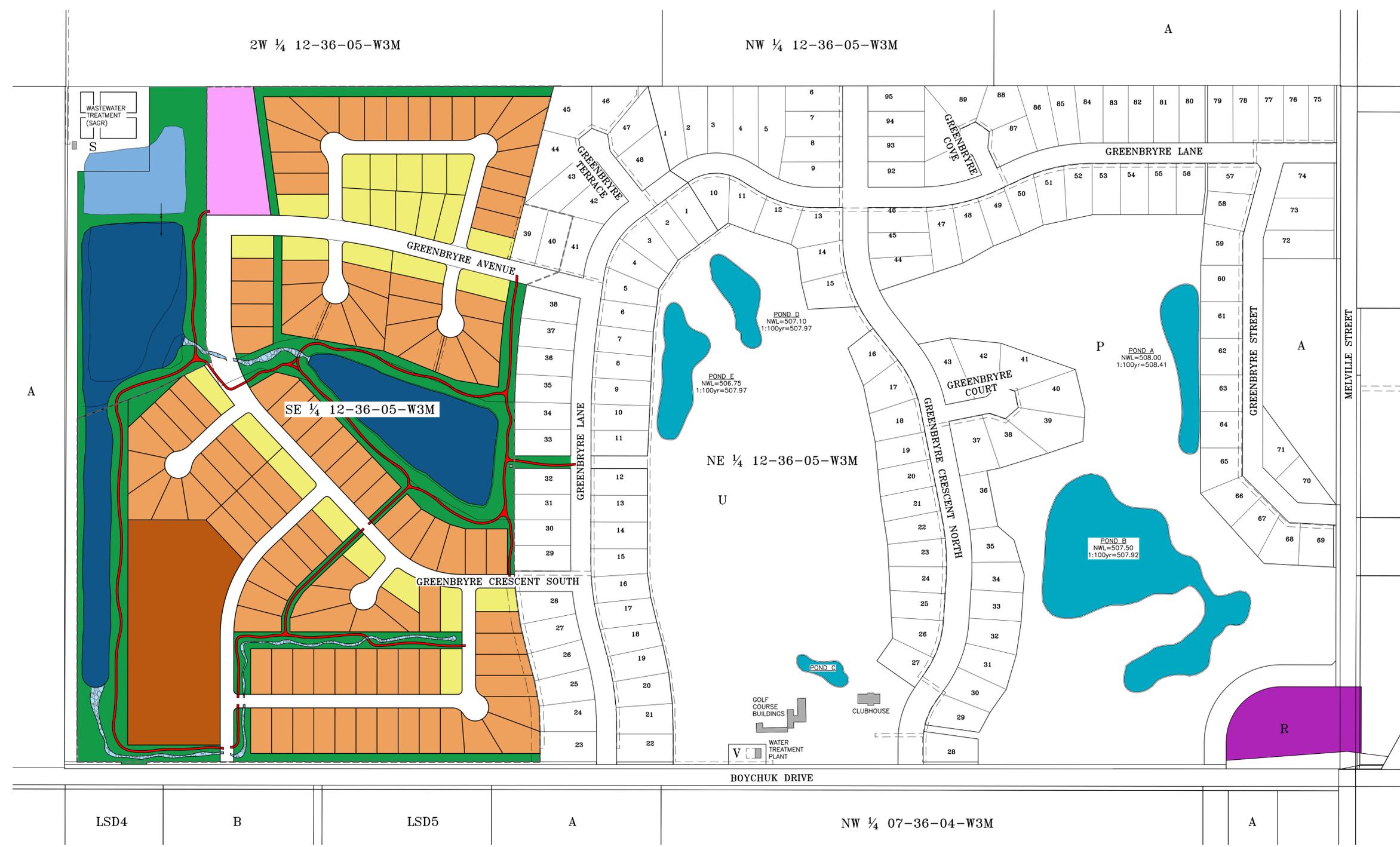
OWNER  
**GREENBRYRE ESTATES**

LOCATION  
SE1/4, 12-36-5-W3M

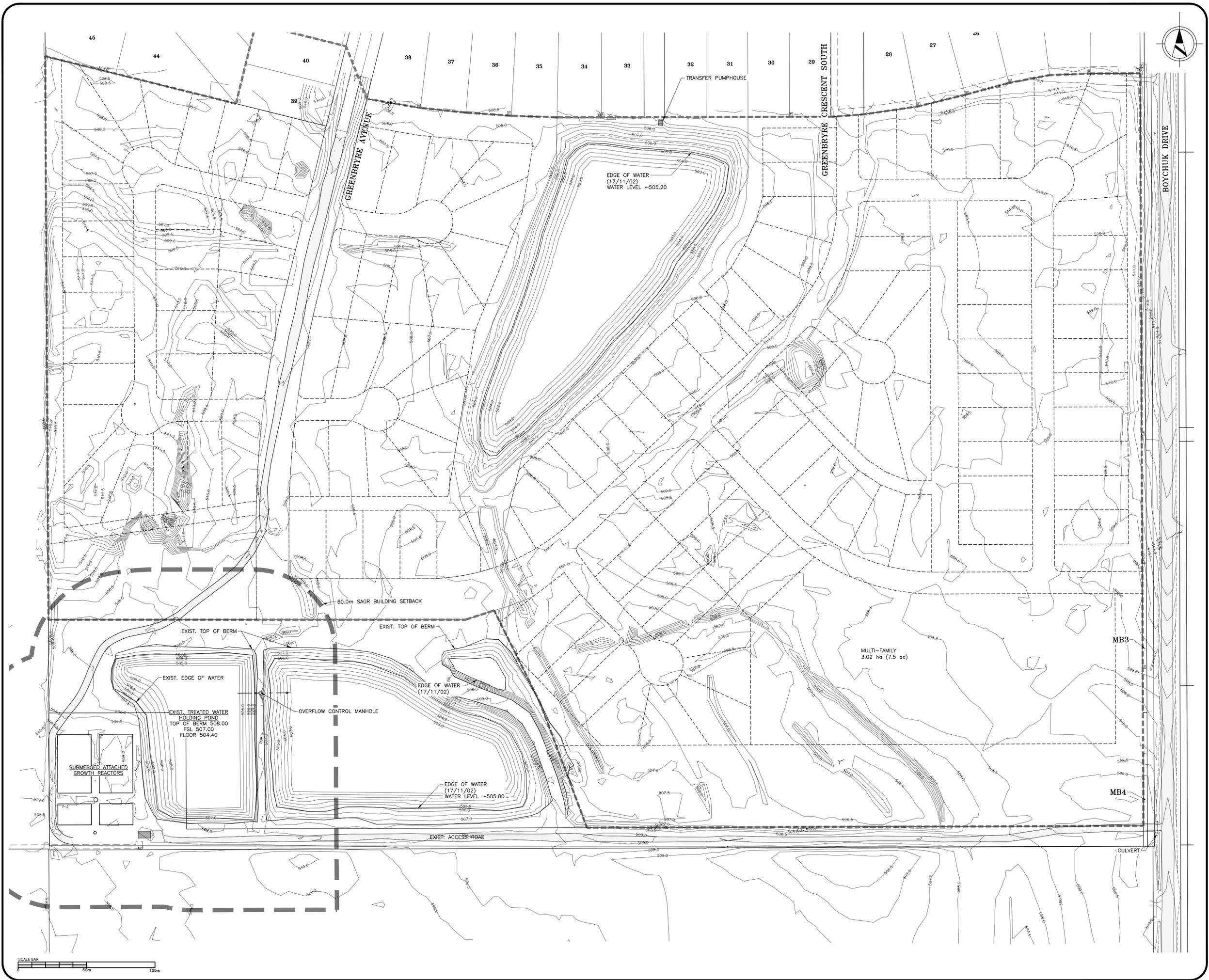
PROJECT  
PHASE 3 CONCEPTUAL SERVICING

SHEET TITLE  
OVERALL DEVELOPMENT

|                |              |          |        |
|----------------|--------------|----------|--------|
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| DRAWN          | GCW          | CHECKED  |        |
| DATE           | 18/10/24     | SHEET    | 1 of 6 |
| DRAWING NUMBER | 452-016 FIG1 |          |        |







**CATERALL & WRIGHT**  
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SASKATOON SK S7H 0S5  
Tel: (306) 343-7280, Fax: (306) 956-3199

**PRELIMINARY**  
NOT FOR CONSTRUCTION

**LEGEND:**

- PHASE 3 BOUNDARY
- EXIST. CONTOUR

**SCALE VERIFICATION**

WHEN DRAWING IS PLOTTED FULL SIZE THIS LINE IS 60mm IN LENGTH.

| DATE | REVISION |
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19/11/22 ISSUED TO OWNER  
18/10/30 ISSUED TO OWNER

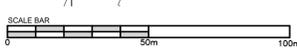
OWNER  
**GREENBRYRE ESTATES**

LOCATION  
SE1/4, 12-36-5-W3M

PROJECT  
PHASE 3 CONCEPTUAL SERVICING

SHEET TITLE  
EXISTING SITE CONDITIONS

|                |              |          |        |
|----------------|--------------|----------|--------|
| SCALE          | 1:1250       | DESIGNED | CRB    |
| DRAWN          | GCW          | CHECKED  |        |
| DATE           | 18/10/24     | SHEET    | 3 of 6 |
| DRAWING NUMBER | 452-016 FIG3 |          |        |





**CATTERALL & WRIGHT**  
CONSULTING ENGINEERS  
1221 - 8th Street East  
SASKATOON SK S7H 0S5  
Tel: (306) 343-7280, Fax: (306) 956-3199

**PRELIMINARY**  
NOT FOR CONSTRUCTION

**LEGEND:**

- SINGLE FAMILY WALKOUT
- SINGLE FAMILY NON WALKOUT
- MULTI-FAMILY
- POND
- PARKS/MUNICIPAL
- SAGR TREATED WATER POND
- EXIST. ROAD
- DESIGN ROAD
- PATH
- STREAM
- BRIDGE
- PHASE 3 BOUNDARY
- STORM SEWER OUTFALL
- OVERLAND FLOW DIRECTION
- UNDERGROUND STORM SEWER

**SCALE VERIFICATION**

WHEN DRAWING IS PLOTTED FULL SIZE THIS LINE IS 60mm IN LENGTH.

| DATE     | REVISION        |
|----------|-----------------|
| 19/11/22 | ISSUED TO OWNER |
| 18/10/30 | ISSUED TO OWNER |

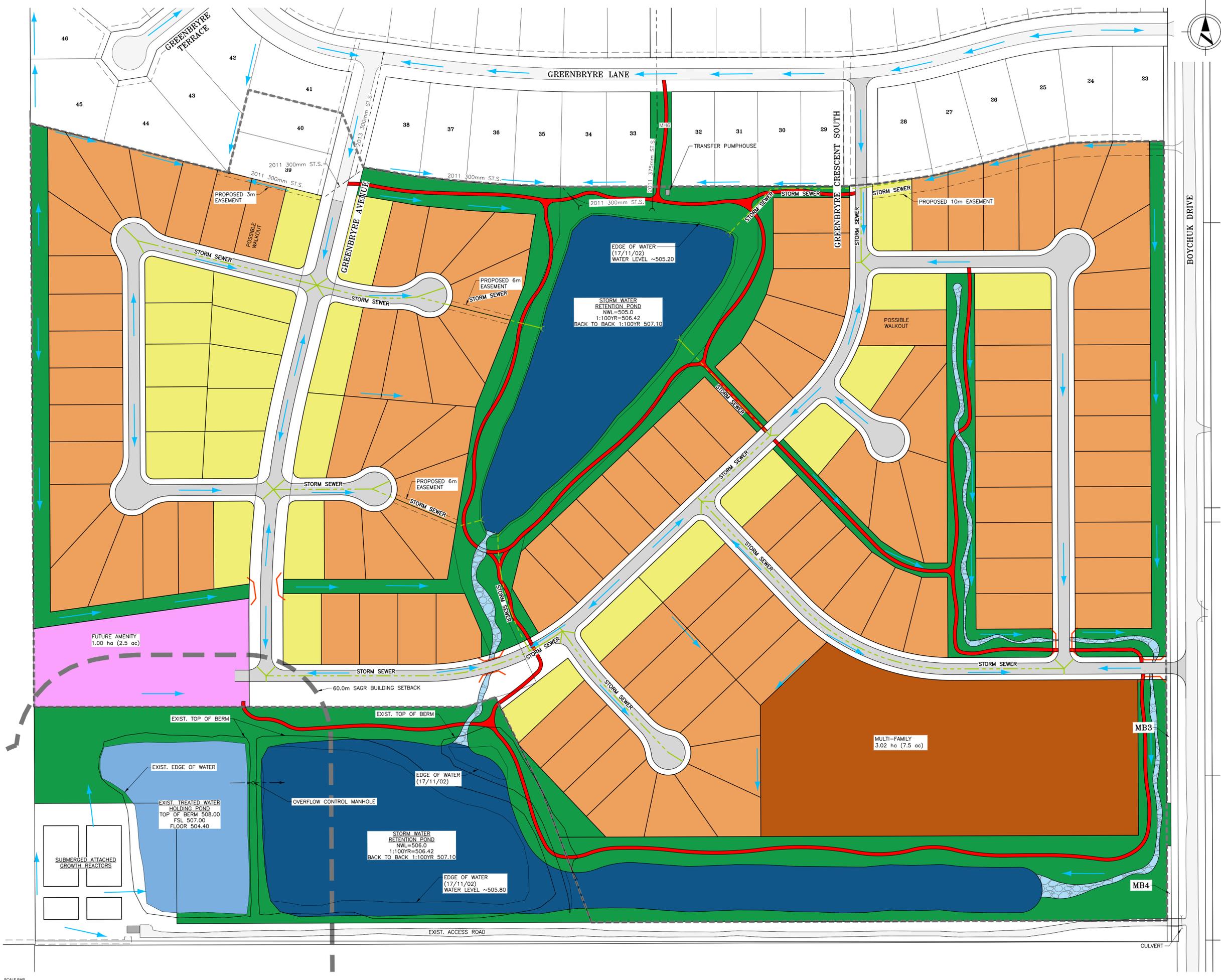
OWNER  
**GREENBRYRE ESTATES**

LOCATION  
SE1/4, 12-36-5-W3M

PROJECT  
PHASE 3 CONCEPTUAL SERVICING

SHEET TITLE  
**CONCEPTUAL DRAINAGE PLAN**

| SCALE               | DESIGNED |
|---------------------|----------|
| 1:1250              | CRB      |
| DRAWN               | CHECKED  |
| GCW                 |          |
| DATE                | SHEET    |
| 18/10/24            | 4 of 6   |
| DRAWING NUMBER      |          |
| <b>452-016 FIG4</b> |          |



C:\Users\perry\Documents\452-016-FIG4.dwg 22/10/24 10:58:41



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CONSULTING ENGINEERS  
1221 - 8th Street East  
SASKATOON SK S7H 0S5  
Tel: (306) 343-7280, Fax: (306) 956-3199

**PRELIMINARY**  
NOT FOR CONSTRUCTION

**LEGEND:**

- SINGLE FAMILY WALKOUT
- SINGLE FAMILY NON WALKOUT
- MULTI-FAMILY
- POND
- PARKS/MUNICIPAL
- SAGR TREATED WATER POND
- EXIST. ROAD
- DESIGN ROAD
- PATH
- STREAM
- PHASE 3 BOUNDARY
- WATER MAIN
- PRESSURE SEWER

**SCALE VERIFICATION**

WHEN DRAWING IS PLOTTED FULL SIZE THIS LINE IS 60mm IN LENGTH.

| DATE     | REVISION        |
|----------|-----------------|
| 19/11/22 | ISSUED TO OWNER |
| 18/10/30 | ISSUED TO OWNER |

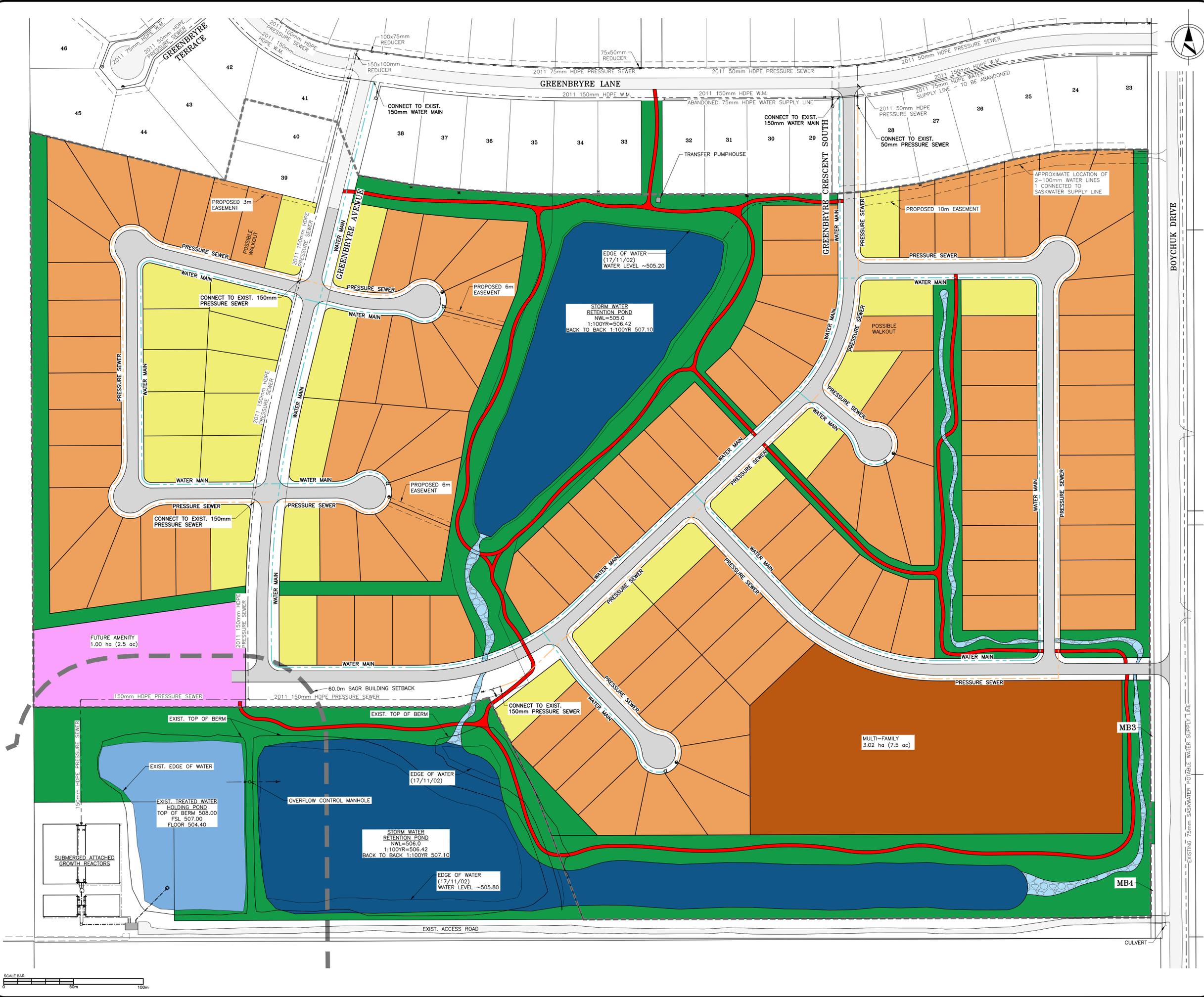
OWNER  
**GREENBRYRE ESTATES**

LOCATION  
SE1/4, 12-36-5-W3M

PROJECT  
PHASE 3 CONCEPTUAL SERVICING

SHEET TITLE  
**CONCEPTUAL SERVICING PLAN**

|                                       |                 |
|---------------------------------------|-----------------|
| SCALE<br>1:1250                       | DESIGNED<br>CRB |
| DRAWN<br>GCW                          | CHECKED         |
| DATE<br>18/10/24                      | SHEET<br>5 of 6 |
| DRAWING NUMBER<br><b>452-016 FIG5</b> |                 |





**CATTERALL & WRIGHT**  
CONSULTING ENGINEERS  
1221 - 8th Street East  
SASKATOON SK S7H 0S5  
Tel: (306) 343-7280, Fax: (306) 956-3199

**PRELIMINARY**  
NOT FOR CONSTRUCTION

- LEGEND:**
- SINGLE FAMILY WALKOUT
  - SINGLE FAMILY NON WALKOUT
  - MULTI-FAMILY
  - POND
  - PARKS/MUNICIPAL
  - SAGR TREATED WATER POND
  - EXIST. ROAD
  - DESIGN ROAD
  - PATH
  - STREAM
  - BRIDGE
  - PHASE 3 BOUNDARY

SCALE VERIFICATION

WHEN DRAWING IS PLOTTED FULL SIZE THIS LINE IS 60mm IN LENGTH.

| DATE     | REVISION        |
|----------|-----------------|
| 19/11/22 | ISSUED TO OWNER |
| 18/10/30 | ISSUED TO OWNER |

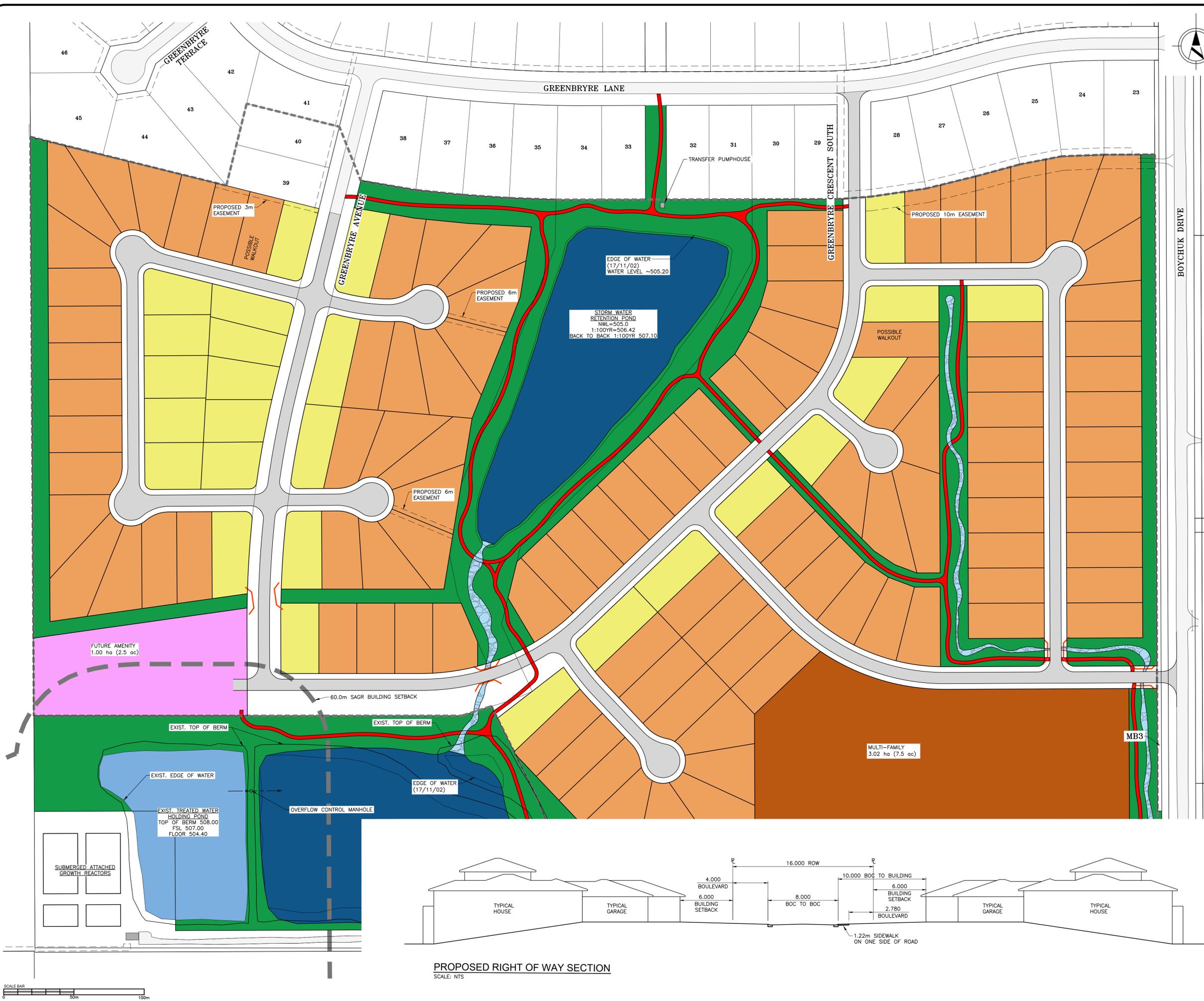
OWNER  
**GREENBRYRE ESTATES**

LOCATION  
SE1/4, 12-36-5-W3M

PROJECT  
PHASE 3 CONCEPTUAL SERVICING

SHEET TITLE  
CONCEPTUAL ROADWAYS PLAN

| SCALE          | DESIGNED     |
|----------------|--------------|
| 1:1250         | CRB          |
| DRAWN          | CHECKED      |
| GCW            |              |
| DATE           | SHEET        |
| 18/10/24       | 6 of 6       |
| DRAWING NUMBER | 452-016 FIG6 |



**APPENDIX D**  
**CORRESPONDENCE FROM SASKWATER**



## Maggie Schwab

---

**From:** Carleen Bartel <c.bartel@cwce.ca>  
**Sent:** Wednesday, April 10, 2019 10:31 AM  
**To:** Maggie Schwab  
**Subject:** FW: Greenbryre - Phase 3 Geotechnical Study  
**Attachments:** image002.png; image001.png

Carleen Bartel, P.Eng.  
Principal Design Engineer | Project Manager Catterall & Wright | Consulting Engineers  
1221 8th Street East, Saskatoon, SK S7H 0S5 [www.cwce.ca](http://www.cwce.ca) | Facebook | LinkedIn  
Office: (306)343-7280 | Cell: (306)260-6712 | Fax: (306)956-3199

CONFIDENTIALITY NOTICE: This email was intended for a specific recipient. It may contain information that is privileged and/or confidential. If the reader is not the intended recipient, use or distribution of this information is prohibited. If you have received this communication in error, please notify the sender by telephone or return email and delete or destroy all copies of the message.

-----Original Message-----

From: Troy Slater [<mailto:troy@dshomes.ca>]  
Sent: December 14, 2018 10:15 AM  
To: Carleen Bartel <c.bartel@cwce.ca>  
Subject: FW: Greenbryre - Phase 3 Geotechnical Study

Hi Carleen,

I received this email from Chad at Saskwater letting us know that they have enough water supply for Greenbryre Estates.

Troy Slater  
O.306.374.4774 or C.306.612.4545

-----Original Message-----

From: Chad Braun <[Chad.Braun@saskwater.com](mailto:Chad.Braun@saskwater.com)>  
Sent: December 13, 2018 11:27 AM  
To: Troy Slater <[troy@dshomes.ca](mailto:troy@dshomes.ca)>  
Subject: Re: Greenbryre - Phase 3 Geotechnical Study

Hello Troy,

Subject to City of Saskatoon approval SaskWater's system can handle 11.7l/s per your inquiry.

Let me know if there is any further information you require.

Regards,

Chad Braun  
306-631-5650



# **APPENDIX E**

## **HERITAGE AND ENVIRONMENTAL QUERIES**





## PARKS, CULTURE AND SPORT

---

### ABOUT PARKS, CULTURE AND SPORT

---

*Inquiry was made on September 7, 2017 at 10:46 AM*

You are inquiring about the heritage sensitivity of the following land location:

**Quarter-section:**

SE

**Section:**

12

**Township:**

36

**Range:**

5

**Meridian:**

3

This quarter-section is **NOT** heritage sensitive.

It is not necessary to submit the project to the Heritage Conservation Branch for screening. These results can be printed for submission to other regulatory bodies (e.g. Saskatchewan Environment, Saskatchewan Industry and Resources). Please email [arms@gov.sk.ca](mailto:arms@gov.sk.ca) if you have any questions.

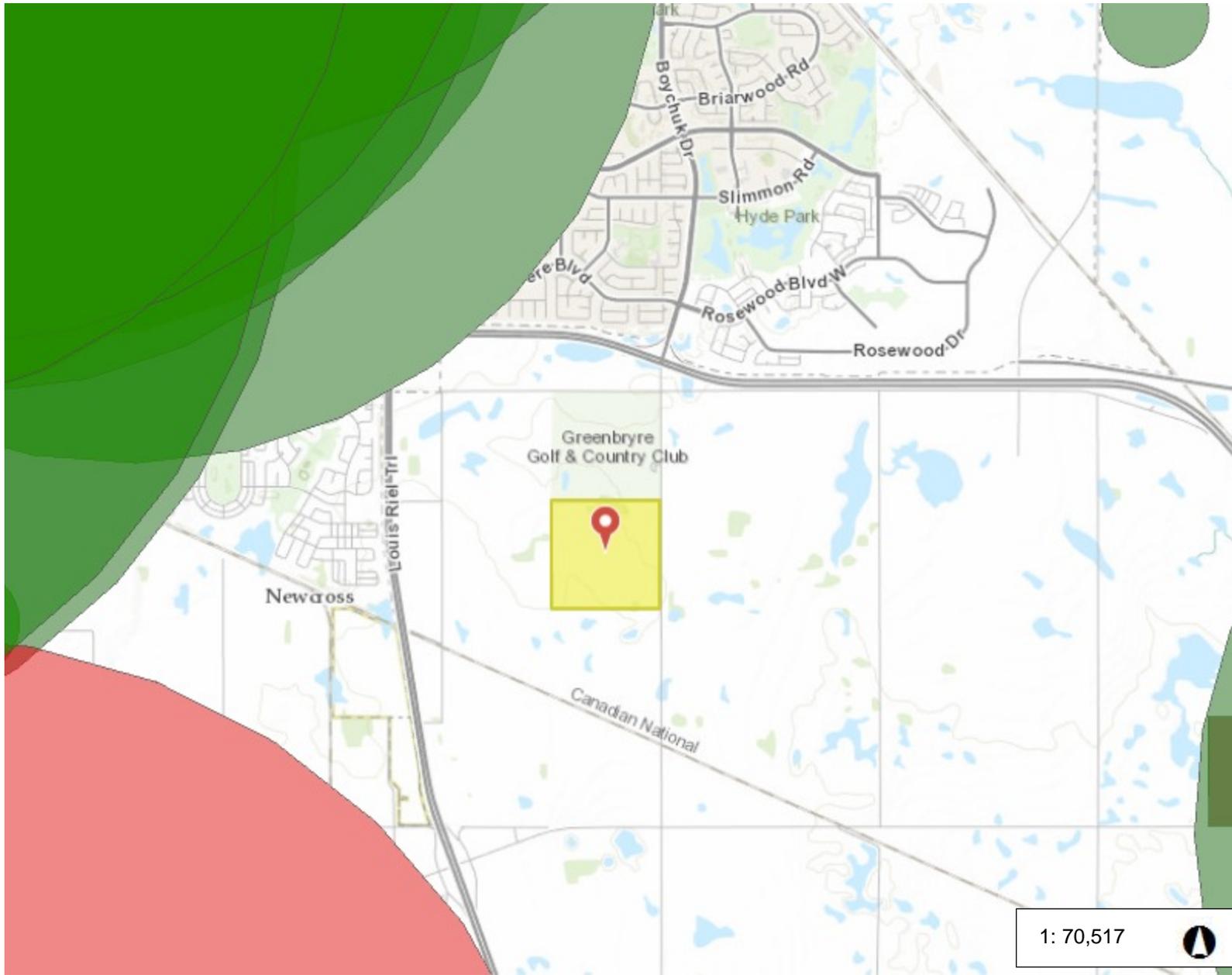
*Inquiry was made on September 7, 2017 at 10:46 AM*

[Home](#) / [About PCS](#) / [Heritage](#) / [Developers' Online Screening Tool](#) / [Land Locations Search](#)

---

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# Greenbryre Phase III Environmental Query



- Legend**
- Provincial Boundary
  - Rare and Endangered Species**
    - Vertebrate Animal
    - Invertebrate Animal
    - Animal Assemblage
    - Vascular Plant
    - Nonvascular Plant
    - Other (Botanical)
    - Fungus
  - National Park
  - Provincial Park
  - Terrestrial Wildlife Habitat Inve

1: 70,517



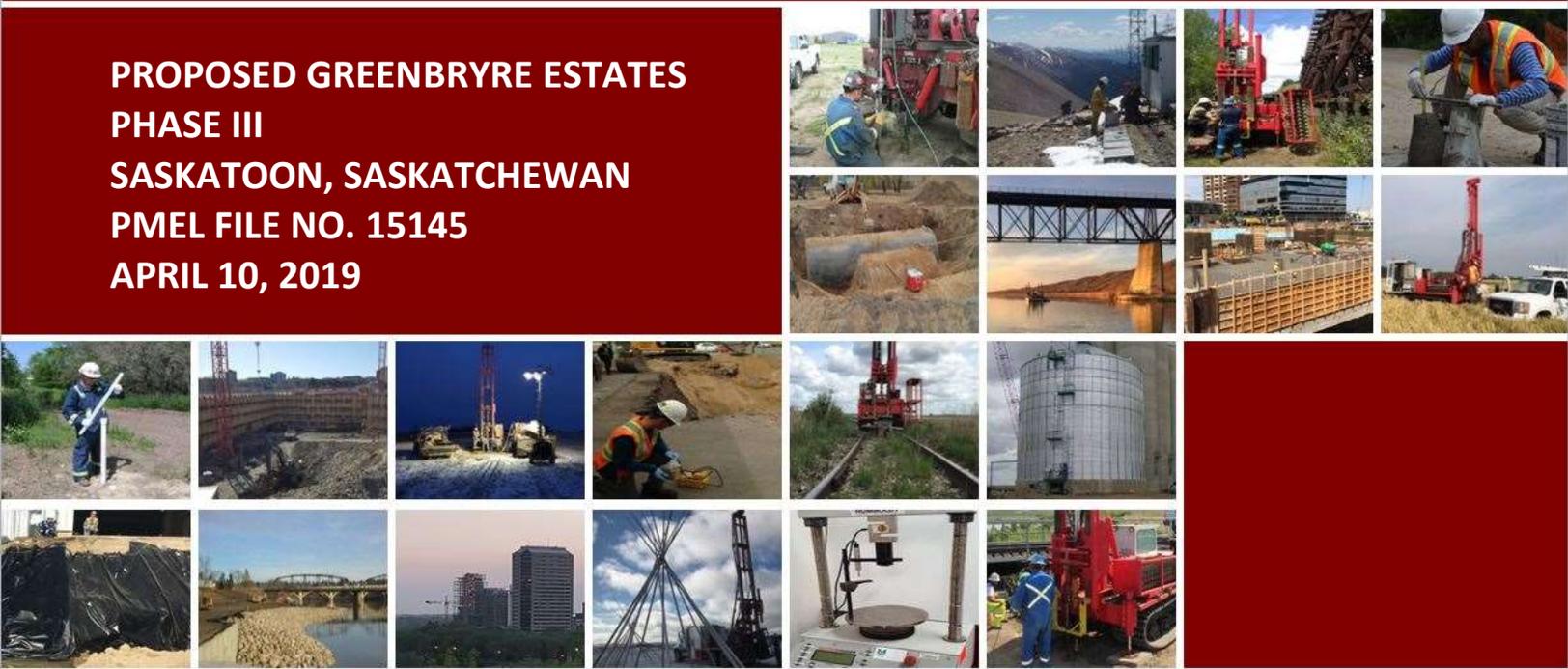
**Notes**

**APPENDIX F**  
**GEO TECHNICAL REPORT**



# INITIAL GEOTECHNICAL INVESTIGATION

**PROPOSED GREENBRYRE ESTATES  
PHASE III  
SASKATOON, SASKATCHEWAN  
PMEL FILE NO. 15145  
APRIL 10, 2019**



**PREPARED FOR:  
Greenbryre Joint Venture C/O Catterall & Wright**

**ATTENTION: Carleen Bartel, P. Eng., Principal Design Engineer**

**PROJECT:** Initial Geotechnical Investigation  
Proposed Greenbryre Estates Phase III  
Saskatoon, Saskatchewan  
PMEL File No. 15145  
April 10, 2019

**PREPARED FOR:** Greenbryre Joint Venture C/O Catterall & Wright  
1221 8<sup>th</sup> Street East  
Saskatoon, SK S7H 0S5

**ATTENTION:** Carleen Bartel, P. Eng., Principal Design Engineer

**DISTRIBUTION:** Greenbryre Joint Venture C/O Catterall & Wright – One Copy  
P. Machibroda Engineering Ltd. – One Copy

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# **1 INTRODUCTION**

## **1.1 GENERAL**

The following report has been prepared on the subsurface conditions existing at the site of the proposed Greenbryre Estates Phase III development to be constructed in Saskatoon, Saskatchewan.

The terms of reference for this investigation were presented in P. Machibroda Engineering Ltd. (PMEL) Proposal No. 15145, dated November 28, 2018. Written authorization to proceed with the investigation was provided in the signed Consultant Agreement between Greenbryre Joint Venture and PMEL, dated December 6, 2018.

## **1.2 SITE LOCATION AND DESCRIPTION**

The site is located within the SE¼-12-36-5-W3M near the south-east city limits of Saskatoon, Saskatchewan. The site is bordered by Boychuk Drive to the east, a dirt road/right of way and undeveloped land to the south, undeveloped land to the west and the existing Greenbryre Estates Phase I and II developments to the north. The pre-development site was relatively flat-lying (elevation of ~508 to 511 m) with several low spots/sloughs. Site grading completed to date has created man-made stormwater runoff ponds, and fill has been placed over portions of the site (existing elevations range from less than 503 m to more than 513 m). A Site Plan showing the location of the study area and Test Holes has been shown on Drawing No. 15145-1.

# **2 FIELD INVESTIGATION**

## **2.1 FIELD DRILLING PROGRAM**

The field test drilling and soil sampling was conducted between January 15 and March 12, 2019.

Twelve test holes, located as shown on the Site Plan, Drawing No. 15145-1, were dry drilled using our track and truck-mounted, continuous flight auger drilling rigs. The test holes were 150 mm in diameter and extended to depths of 3.0 to 12.5 m below the existing ground surface. Test hole drill logs, as shown on the attached Field Drill Logs, Drawing Nos. 15145-2 to 13, inclusive, were compiled during test drilling to record the soil stratification, the groundwater conditions, the position of unstable sloughing soils and the depths at which cobblestones and/or boulders were encountered.

Disturbed samples of auger cuttings, collected during test drilling, were sealed in plastic bags to minimize moisture loss. The soil samples were taken to our laboratory for analysis.

Standard penetration tests (N-Index), utilizing a safety hammer with automatic trip were performed during test drilling.

The coordinates and ground surface elevations at the test hole locations were provided by Catterall & Wright.

## **2.2 PIEZOCONE PENETRATION TESTING**

Four piezocone penetration tests (CPTu) were completed. The CPTu soundings were extended to depths of 18.1 to 20.8 m below existing ground surface. The CPTu locations have been shown on the Site Plan, Drawing No. 15145-1.

The piezocone penetration tests consisted of pushing a cone, on the end of a series of rods, into the ground at a constant rate while near continuous measurements were recorded at the cone tip (i.e.,  $q_t$ ). Local side friction resistance measurements (i.e.,  $f_s$ ) were recorded on a friction sleeve located directly behind the cone tip. Pore-water pressure response ( $u$ ) generated from the advancement of the cone into the soil was measured via a pore pressure filter located between the cone tip and friction sleeve. The piezocone tip had an apex angle of  $60^\circ$  and a  $15 \text{ cm}^2$  base area. The friction sleeve had a perimeter area of  $225 \text{ cm}^2$ .

The equipment and procedures for conducting the cone penetration testing were undertaken in accordance with ASTM D-5778, “Standard Test Method for Performing Electronic Friction Cone and Piezocone Testing of Soils”.

The test plots recorded during the cone soundings have been presented in Appendix B.

## **3 SOIL AND GROUNDWATER CONDITIONS**

### **3.1 SOIL PROFILE**

The general soil profile consisted of topsoil or fill (silt or clay) to a depth of about 0.1 to 3.2 m overlying variable deposits of clay and silt (with minor occurrences of sand), which extended to a depth of at least 12.5 m, the maximum depth drilled. Based on CPTu interpretation, glacial till deposits may exist below a depth of about 18 to 21 m.

The silt fill deposits were generally low to medium plastic, moist and firm to stiff. The clay fill was stiff, highly plastic and moist. The fill deposits contained organics and organic material at several locations. The clay deposits were firm to very stiff (predominantly stiff), highly plastic and moist. The silt deposits were typically firm to stiff, low to medium plastic (mainly medium plastic) and moist to wet.

### **3.2 GROUNDWATER CONDITIONS, SLOUGHING**

Groundwater seepage and sloughing conditions were encountered during test drilling. The depths at which groundwater seepage and sloughing conditions were encountered have been shown on the test hole logs. A summary of the groundwater levels recorded in the piezometers installed during this investigation has been presented in Table I.

**TABLE I RECORDED GROUNDWATER LEVELS**

| Test Hole No. | Piezometer Rim Elevation (metres) | Ground Surface Elevation (metres) | Groundwater Depth (metres) | Groundwater Elevation (metres) |
|---------------|-----------------------------------|-----------------------------------|----------------------------|--------------------------------|
|               |                                   |                                   | March 21, 2019             | March 21, 2019                 |
| 19-1          | 508.9                             | 507.9                             | 2.8                        | 505.1                          |
| 19-2          | 509.1                             | 508.1                             | 3.2                        | 504.9                          |
| 19-3          | 508.3                             | 507.3                             | 2.6                        | 504.7                          |
| 19-4          | 510.3                             | 509.3                             | 3.9                        | 505.4                          |
| 19-5          | 509.1                             | 508.0                             | 2.7                        | 505.3                          |
| 19-6          | 510.1                             | 509.0                             | 3.5                        | 505.5                          |
| 19-7          | 508.9                             | 507.9                             | >3.0 (DRY)                 | <504.9 (DRY)                   |
| 19-8          | 513.0                             | 512.0                             | 7.2                        | 504.8                          |
| 19-9          | 509.3                             | 508.3                             | >3.0 (DRY)                 | <505.3 (DRY)                   |
| 19-10         | 514.0                             | 513.0                             | 9.3                        | 503.7                          |
| 19-11         | 509.1                             | 508.0                             | >3.0 (DRY)                 | <505.0 (DRY)                   |
| 19-12         | 509.7                             | 508.9                             | >3.0 (DRY)                 | <505.9 (DRY)                   |

The piezometers may not have stabilized, particularly the deep piezometers installed in Test Hole Nos. 19-8 and 19-10). Higher water levels should be expected during and/or following spring snowmelt and/or periods of precipitation.

### 3.3 COBBLESTONES AND BOULDERS

Cobbles/boulders were not encountered within the depth of drilling exploration at this site (i.e., 12.5 m). However, cobbles/boulders may exist within the fill deposits, which are of unknown origin.

Glacial till may exist at depth (below ~18 to 21 m) at this site. Glacial till consists of a heterogeneous mixture of gravel, sand, silt and clay-sized particles. Glacial till inherently contains sorted deposits of the above particle sizes as well as a random distribution of larger particle sizes in the cobblestone range (60 to 200 mm) and boulder-sized range (larger than 200 mm). Intertill/intra till deposits of cobblestones, boulders, boulder pavements and isolated deposits of saturated sand or gravel should be anticipated.

It should be recognized that the statistical probability of encountering cobbles/boulders in the twelve, small diameter test holes drilled at this site was low. The frequency of encountering such deposits will increase proportionately with the number/depth of piles installed.

## **4 LABORATORY ANALYSIS**

The soil classification and index tests performed during this investigation consisted of a visual classification of the soil, moisture contents, Atterberg limits, unit weights, grain size distribution analysis and water-soluble sulphate contents.

The results of the soil classification and index tests conducted on representative samples of soil have been plotted on the drill logs alongside the corresponding depths at which the samples were recovered, as shown on Drawing Nos. 15145-2 to 13, inclusive.

The results of grain size distribution analyses have been shown plotted in Appendix C.

## **5 DESIGN CONSIDERATIONS**

The subsurface soil conditions consisted of topsoil or variable fill deposits (unknown origin and placement history), followed by variable deposits of clay and silt then possibly glacial till.

The groundwater level measured in the installed piezometers was situated at depths of 2.6 to 9.3 m below existing ground surface (elevation of 503.7 to 505.5 m) on March 21, 2019. Higher water levels and potentially water levels above current ground level (in low areas of the site) should be expected during or following spring snowmelt and/or during or following periods of precipitation.

The development area is approximately 800 m x 550 m in size and will reportedly include the construction of single-family residences (129), multi-family residences (88 x 4-plex condo units) and associated site development (concrete-surfaced roads, buried utilities, stormwater ponds, drainage channels and bridges/culverts).

It is understood that the site will be developed to allow for the construction of walkout basements for the majority of the residences via the construction of fill embankments, which will generally follow the alignment of the roads. Based on a visual observation of the current site conditions (essentially undeveloped), it is anticipated that fill thicknesses in the order of 1 to 4 m (or more in isolated locations) will be required. It is anticipated that locally available fill materials, sourced from additional stormwater pond excavations, will be utilized.

The construction of road embankments will induce settlement of the subgrade soils to an appreciable depth, which could affect the performance of foundations, grade-supported elements (floor slabs, sidewalks, roads etc.) and any utilities that may cross under the embankments.

The potential depth of frost penetration for the soils at this site could range from approximately 1.5 to 2.5 m, depending on surface cover and severity of winter. Frost depths of as much as 1.8 m were recorded during the field investigation. The depth of frost penetration will be greater where granular fills/soils are present. Buried utilities should be based below the depth of frost penetration or protected against frost action with strategically placed insulation (PMEL can provide insulation recommendations upon request).

The mandate of this investigation is to provide specific design recommendations for site preparation, excavations and dewatering, foundation concrete and traffic structures only. General design considerations have been provided for embankments and foundations.

Detailed geotechnical investigations will be required for all future developments to provide specific foundation design recommendations and design parameters.

## 6 SPECIFIC DESIGN RECOMMENDATIONS

### 6.1 SITE PREPARATION

All organic material, loose soil, uncontrolled fill and deleterious materials should be removed from the construction area. Staining and root intrusion from the overlying organic material and roots may be encountered during excavation within the subsurface mineral soils. If these conditions are suspected, a representative of the Geotechnical Consultant should inspect the site during excavation to verify the depth of organic topsoil which should be removed in preparation of the site for construction. Additional information regarding topsoil composition and soil structure is presented in Appendix D.

The general intent of initial site preparation is to make the subgrade suitably stable for construction activities. It is recommended that the subgrade soils within the development footprint are compacted to the below specified densities. Soils which meet the required compaction level should be stable to support construction activities.

It is anticipated that conventional site preparation (scarifying, moisture conditioning and re-compacting the soils) will suffice for many areas of this site, but that additional measures will be required where soft/wet soils exist. Soils which are unstable during site preparation and fail to achieve the required compaction will require additional treatment, which may include over-excavation and replacement and/or geosynthetic stabilization. The need for additional treatment should be reviewed by the Geotechnical Consultant during the field construction with respect to the actual conditions and project requirements.

In areas with variable subgrade soils, proof rolling may be an acceptable alternative to density testing and should be reviewed by the Geotechnical Consultant.

The following minimum density requirements are recommended for this site.

|                        |  |
|------------------------|--|
| <b>Building Areas</b>  | 96 percent standard Proctor density at optimum moisture content; |
| <b>Traffic Areas</b>   | 96 percent standard Proctor density at optimum moisture content; |
| <b>Landscape Areas</b> | 90 percent standard Proctor density at optimum moisture content. |

Fill, required to bring the subgrade surface to the design elevation in construction areas, may consist of naturally deposited, locally available soils. All proposed subgrade fill should be approved by the Geotechnical Consultant prior to placement. The fill should be placed in thin lifts (maximum 150 mm loose) and uniformly compacted to 96 percent of standard Proctor density at optimum moisture content.

Utility trench excavations are susceptible to settlement and should be adequately backfilled and compacted. The magnitude of settlement is directly related to the level of compaction of the backfill material. Well compacted fills will settle a small percentage of the fill thickness whereas poorly compacted fills can settle appreciably, particularly if frozen soils are incorporated in the backfill. Efforts should be made to meet the specified compaction level in areas sensitive to settlement.

The site should be graded to provide positive site drainage away from all work areas and structures prior to, during and following construction.

## **6.2 EXCAVATIONS AND DEWATERING**

Temporary excavations should be designed and excavated in accordance with current Saskatchewan Occupational Health and Safety Regulations. The Contractor is solely responsible for protecting the excavation by shoring, sloping, benching and/or other means as required to maintain the stability of both the excavation sides and the bottom.

Within the proposed depth of excavation at this site, the soil deposits may be classified as “Type 3” soils. Sideslopes should be no steeper than 1 horizontal to 1 vertical (1H:1V) in Type 3 soils, as measured from the bottom of the excavation. Slope flattening will be required if unstable conditions are encountered during excavation (i.e., wet sand or silt). Continuous visual monitoring of the sideslopes should be undertaken to assess whether flatter sideslopes are required to maintain stability

Based on the observed groundwater conditions, the groundwater table at this site is estimated to be within 2 to 3 m of existing grade at most locations. Higher groundwater conditions could be present at the site in low areas of the site and during or following spring snowmelt and/or periods of precipitation.

Excavation below the water table will encounter construction difficulties associated with groundwater seepage and sloughing conditions. De-watering of the excavations will be required during construction. De-watering should be conducted over the time period for which the excavations are left open. A sump (or multiple sumps, if required) should be set up at the deepest excavation points and the floor of the excavation sloped to the sump(s) to handle groundwater seepage and precipitation runoff. A self-actuated sump pump(s) should be operated on a continuous basis and should be discharged well away from the excavations. Dewatering wells may be required at some locations if conventional dewatering techniques are insufficient.

The stability of the excavation will be affected by wetting and drying of the exposed excavation walls, the length of time that the excavation remains open and the consistency and structure of the subgrade soils.

Excavated soil should be stockpiled away from the crest of the excavation to minimize potential sloughing of the excavation walls due to the soil surcharge loading. Similarly, equipment and construction materials should also be placed away from the crest of the excavation.

Depending on lateral constraints, excavations at this site may be completed with unbraced, sloped side walls. If there is insufficient room for excavation cuts, due to close proximity to other structures, then a temporary shoring system would be required.

### 6.3 FOUNDATION CONCRETE

The results of water-soluble sulphate testing on soil samples recovered from the subject site have been summarized in Table II.

**TABLE II WATER-SOLUBLE SULPHATE TEST RESULTS**

| Test Hole No. | Depth (metres) | Soil Type | Water Soluble Sulphate (%) | Class of Exposure | Degree of Sulphate Exposure |
|---------------|----------------|-----------|----------------------------|-------------------|-----------------------------|
| 19-1          | 1.5            | Clay      | 2.1                        | S-1               | Very Severe                 |
| 19-3          | 3 – 3.4        | Clay      | 1.2                        | S-2               | Severe                      |
| 19-4          | 0.75           | Silt Fill | 1.6                        | S-2               | Severe                      |
| 19-5          | 0.75           | Clay      | 4.2                        | S-1               | Very Severe                 |
| 19-9          | 1.5            | Silt      | 5.8                        | S-1               | Very Severe                 |

An examination of Table II revealed that the measured sulphate concentration of the tested soils was between 1.2 and 5.8 %, which is considered severe to very severe in terms of potential degree of sulphate attack. As such, it is recommended to utilize sulphate resistant cement for all foundation concrete in contact with the subgrade soils. All concrete at this site should be manufactured in accordance with current CSA standards.

It should be recognized that water soluble sulphate salts, combined with moist soils or low pH soils could render the soil highly corrosive to some types of metals in contact with the soil.

As per CSA A23.1 standards, Type HS cement should not be used in concrete exposed to both chlorides and sulphates. Rather, blended cement and supplementary cementing materials should be utilized to meet the requirements of both the chloride and sulphate exposure classes. A designer competent in concrete mix design with previous experience in environments with both sulphates and chlorides should complete the concrete mix design.

### 6.4 ASPHALT CONCRETE PAVEMENT STRUCTURES

#### 6.4.1 DESIGN TRAFFIC LOADING

Upon review of the proposed development layout provided by Catterall & Wright, the road system will consist of a combination of curvilinear roads (3), loop roads (2), and cul-de-sacs (4).

WSP is in the process of completing a Traffic Impact Assessment (TIA) for Greenbryre Phase III. A draft version of the TIA (dated March 14, 2019) was provided to PMEL on March 18, 2019.

Based on a review of the draft TIA and email correspondence between PMEL and WSP (included in Appendix E), the following design information was assumed for the roadways within Greenbryre Phase III:

- 20 year design life
- All roadways are classified as local – residential roadways
- Full build-out/site occupancy was assumed to be achieved in 2025
- Average Annual Daily Traffic (AADT):
  - Curvilinear and Loop Roads: At full build-out/site occupancy the AADT is anticipated to be between 500 to 1,000 vehicles per day (vpd)
  - Cul De Sac Roads: Each cul de sac has between 7 and 12 lots and it is anticipated that traffic on the cul de sac roads will consist mainly of traffic to those lots only. An estimated AADT of about 105 vpd (i.e., 12 lots, 2.5 vehicles per home and 3.5 trips per vehicle per day) at full build-out/site occupancy was assumed.
- Growth Rate:
  - From 2019 to 2025 (build-out) - it is anticipated that the occupancy of the neighbourhood will increase at a high growth rate.
  - From 2025 (build-out) to 2038 - it is anticipated that the growth rate will decrease to 0% as occupancy will be at or near 100%.
- Directional split – 50%
- 100% of commercial traffic will travel in the design lane.
- Percentage of Commercial Traffic:
  - From 2019 to 2025 (build-out) - the percentage of commercial traffic will be high as residential development will be occurring.
  - After build out is complete (i.e., after 2025) - it is anticipated that commercial traffic will be minimal (i.e., 2%) and will consist mainly of garage/recycling trucks, delivery trucks, etc.
- Commercial Traffic Type:
  - From 2019 to 2025 (build-out) – commercial truck traffic is anticipated to consist of construction trucks, delivery trucks, and garbage trucks (i.e., tractor semi-trailer combinations).
  - From 2025 (build-out) to 2038 – commercial truck traffic will consist predominately of garbage and delivery trucks (i.e., single unit trucks)
- Buses:
  - it was assumed that there will be separate buses for elementary and high school students from Greenbryre to the City of Saskatoon. It was unknown if all students attend the same school, so two buses per age group were assumed (i.e., 8 bus trips per day).
  - It was assumed that the buses will not travel within the cul de sacs.

A summary of the design traffic assumptions and loadings have been shown in Table III. Detailed calculations have been included in Appendix E.

**TABLE III DESIGN TRAFFIC ASSUMPTIONS AND LOADINGS**

| Parameter                                |             | Curvilinear and Loop Roads | Cul de Sac Roads |
|--|-------------|----------------------------|------------------|
| Design Life (years)                      |             | 20                         | 20               |
| AADT (year 2019)                         |             | 280                        | 30               |
| Buses (per day)                          |             | 8                          | 0                |
| Commercial Traffic (%)                   | 2019 - 2025 | 5%                         | 10%              |
|  | 2026-2038   | 2%                         | 2%               |
| Directional Split                        |             | 50%                        |                  |
| Load Distribution Factor - Truck         | 2019 - 2025 | Single Unit Trucks         | 50%              |
|  |             | Tractor Semi-Trailer       | 50%              |
|  | 2025 - 2038 | Single Unit Trucks         | 100%             |
|  |             | Tractor Semi-Trailer       | 0%               |
| Load Equivalency Factor                  |             | Single Unit Trucks         | 1.2              |
|  |             | Tandem Axle                | 2.0              |
|  |             | Bus                        | 3.0              |
| Blended Load Equivalency Factor - Trucks |             | 2019-2025                  | 1.6              |
|  |             | 2025-2038                  | 1.2              |
| Annual Growth (%)                        |             | 2019 - 2025                | 20%              |
|  |             | 2025 - 2038                | 0%               |
| Design Traffic Loading (ESALs)           |             | 172,722                    | 17,906           |

Note: Based on full build-out/site occupancy in 2025 - as per WSP TIA and email.

### 6.4.2 DESIGN INPUTS

The pavement structure was designed in accordance with the AASHTO design guidelines (AASHTO 1993).

The following pavement design inputs were utilized:

- Soaked CBR: It is understood that the subgrade will be built up using locally available fill (predominantly clay and silt). As the subgrade at the design subgrade elevation is unknown, a soaked California Bearing Ratio (CBR) of 2.5 was assumed for the roadway design. Laboratory testing should be conducted once the roadway has been built up to design subgrade elevation to confirm the CBR value of the road subgrade. The pavement structure thickness(es) may be adjusted based on the results of the laboratory analysis.
- Subgrade Resilient Modulus =  $17.6 \text{ (CBR)}^{0.64} = 31.6 \text{ MPa}$

- Reliability:
  - Curvilinear and Loop Roads - 80% (i.e., ESALs Range 100,000 – 1,000,000)
  - Cul de Sac Roads – 75% (i.e., ESALs Range <100,000)
- Standard Normal Deviate (function of reliability):
  - Curvilinear and Loop Roads = -0.841
  - Cul de Sac Roads = -0.674
- Initial Serviceability Index = 4.2
- Terminal Serviceability Index = 2.5
- Serviceability Loss = 1.7
- Overall Standard Deviation = 0.45
- Layer Coefficients:
  - Asphalt Concrete = 0.40
  - Base Course (CBR 65) = 0.13
  - Sub Base Course (CBR 20) = 0.10
  - Drainage Coefficient (Base and Sub-base) = 0.8 (i.e., fair drainage with moisture levels approaching saturation greater than 25% of the time)

### 6.4.3 RECOMMENDED PAVEMENT STRUCTURE

The pavement structure was designed in accordance with AASHTO design guidelines (AASHTO 1993), design traffic, and above-mentioned design inputs. The pavement structure recommendations have been presented in Table IV.

**TABLE IV RECOMMENDED ASPHALT CONCRETE TRAFFIC STRUCTURE**

| Pavement Structure                | Layer Thickness (mm)       |                  |
|-----------------------------------|----------------------------|------------------|
|                                   | Curvilinear and Loop Roads | Cul de Sac Roads |
| Asphalt Concrete                  | 90                         | 70               |
| Granular Base (Min CBR = 65)      | 125                        | 150              |
| Granular Sub-Base (Min CBR = 20)  | 300                        | 150              |
| Geotextile <sup>1</sup>           | As Required                | As Required      |
| Subgrade Preparation <sup>2</sup> | -                          | -                |
| <b>Total</b>                      | <b>515</b>                 | <b>370</b>       |

<sup>1</sup> High strength geotextile/geogrid will be required where deflection or rutting of the subgrade soils are encountered following a proof roll on the prepared subgrade.

<sup>2</sup> Refer to Section 6.1 for subgrade preparation recommendations.

### 6.4.4 CONSTRUCTION RECOMMENDATIONS

The following minimum recommendations should be incorporated into the construction of the pavement structures.

1. Prepare the site in accordance with Section 6.1. Level and compact the upper 150 mm of subgrade soil to 96 percent of standard Proctor density at optimum moisture content.

2. Subgrade fill, if required, may consist of locally available soils. Subgrade fill should be placed in thin lifts (150 mm loose, maximum) and compacted to 96 percent of standard Proctor density at optimum moisture content.
3. It is recommended that PMEL conduct a visual site assessment and proof roll the prepared subgrade prior to construction of the traffic structures. Remediation (i.e., over-excavation and replacement and/or geotextile/geogrid reinforcement) will be required for areas of the roadway where deflection/rutting of the subgrade is observed at the time of the proof roll. The amount of over-excavation required will be dependent upon the severity of the deficiency observed. Recommendations for remediation, if required, would be provided based on the field conditions observed at the time of the visual assessment.
4. All granular fill placed above the subgrade should be placed in thin lifts (150 mm loose) and compacted to 98 percent of standard Proctor density at optimum moisture content. The granular sub-base and base course material should meet the aggregate gradation requirements provided in Table V.

**TABLE V AGGREGATE GRADATION REQUIREMENTS**

| Grain Size (mm)      | Percent Passing |                 |
|----------------------|-----------------|-----------------|
|                      | Base-Course     | Sub-Base Course |
| 50.0                 | --              | 100             |
| 25.0                 | 100             | 75 – 100        |
| 18.0                 | 87 – 100        | --              |
| 12.5                 | 72 – 93         | 52 – 100        |
| 5.0                  | 45 – 77         | 30 – 75         |
| 2.0                  | 29 – 56         | 20 – 55         |
| 0.900                | 18 – 39         | --              |
| 0.400                | 13 – 26         | 8 – 30          |
| 0.160                | 7 – 16          | --              |
| 0.071                | 6 – 11          | 3 – 15          |
| Plasticity Index (%) | 0 – 6           | 0 – 6           |
| % Fracture (Min)     | 50              | --              |

City of Saskatoon Specifications.

5. Positive surface drainage is recommended to reduce the potential for moisture infiltration through the pavement structure.
6. Surface water should be prevented from seeping back under the outer edges of the traffic structure.
7. Where possible, grades should be designed such that the granular materials can freely discharge into ditches or into a sub-surface drainage system; this will provide a capillary break to maintain an unsaturated condition in the overlying traffic structure (this is especially important in low-lying/wetland areas).
8. Periodic maintenance such as crack sealing will be required for pavement surfaces.

9. If concrete catch basins are installed, a series of small holes (25 mm diameter minimum) should be drilled through the catch basin to allow for drainage of free water which may collect adjacent to the catch basin. A layer of non-woven geotextile should be used to encapsulate the catch basin and the surrounding (free-draining) backfill material to prevent clogging of the drainage holes.
10. Damage to the pavement related to frost heave around structures constructed within the pavement (i.e., manholes, curbs, backs of curbs, etc.) may occur. Consideration could be given to constructing 3H:1V frost tapers (constructed with granular fill) at these structures which should reduce the potential for pavement cracking around the structure. Frost tapers are also recommended at transitions between the curvilinear/loop and cul de sac road pavement structures.
11. Damage to the pavement related to a change in stiffness where asphalt concrete pavements transition into concrete is common. To reduce the potential for damage, a stiffness transition zone could be constructed at the transition between pavement types. The suggested configuration of the stiffness transition zone has been shown in Figure I.

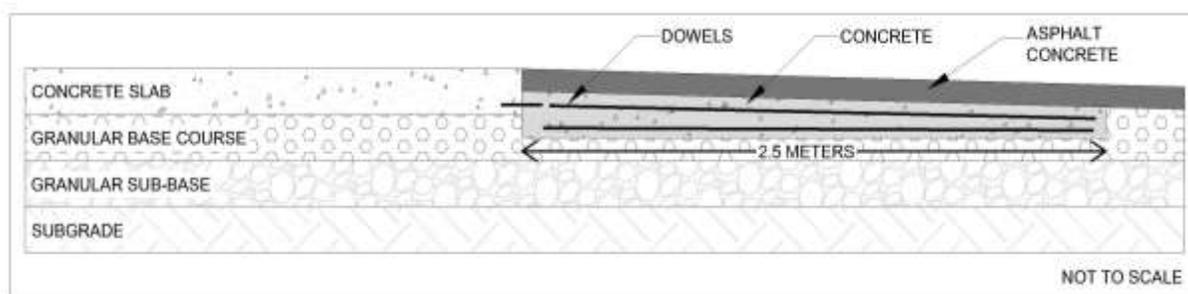


Figure I Stiffness Transition

## 6.5 CONCRETE PAVEMENT STRUCTURES

It is understood that the subgrade will be built up using locally available fill (predominantly clay and silt). The silt and clay soils will be susceptible to movements related to moisture fluctuations in the soil profile and frost heave. Settlement of the fill and underlying subgrade should also be expected, as previously discussed. AASHTO (AASHTO 1993) recommends jointed reinforced concrete pavement (JCRP) for roadways where the probability of transverse cracking during pavement life is high due to soil movement and/or temperature/moisture change stresses.

The road system within Greenbryre Phases I and II reportedly consists of JCRP without load transfer devices (i.e., dowels at the joints). It is understood that the concrete pavement structures in Phases I and II are performing satisfactorily to date.

### 6.5.1 DESIGN TRAFFIC LOADING

The road system within Greenbryre Phase III will consist of a combination of curvilinear roads (3), loop roads (2), and cul-de-sacs (4). The design traffic loading for the curvilinear/loop and cul de sac roads is 172,722 ESALs and 17,906 ESALs, respectively. Detailed traffic loading information has been summarized in Section 6.4.1 and Appendix E.

## 6.5.2 DESIGN PARAMETERS

The following design parameters were utilized to determine the concrete slab thickness:

- Modulus of Subgrade Reaction:
  - 19.0 MPa/m (70 pci) for 150 mm of granular base course
  - 21.8 MPa/m (80 pci) for 200 mm of granular base course
  - 34 Mpa/m (125 pci) for 250 mm of granular base course
- Reliability:
  - Curvilinear and Loop Roads - 80% (i.e., ESALs Range 100,000 – 1,000,000)
  - Cul de Sac Roads – 75% (i.e., ESALs Range <100,000)
- Standard Normal Deviate (function of reliability):
  - Curvilinear and Loop Roads = -0.841
  - Cul de Sac Roads = -0.674
- Initial Serviceability Index = 4.2
- Terminal Serviceability Index = 2.5
- Serviceability Loss = 1.7
- Overall Standard Deviation = 0.45
- Modulus of Rupture = 4.5 MPa (650 psi)
- Modulus of Elasticity of Concrete = 26,774 MPa, based on concrete compressive strength of 32 MPa (3,883,206.32 psi)

## 6.5.3 RECOMMENDED STRUCTURE THICKNESSES

The pavement structure was designed in accordance with AASHTO design guidelines (AASHTO 1993), design traffic, and above-mentioned design inputs. Using the design inputs and traffic information summarized in Sections 6.4.1 and 6.4.2, the following concrete thicknesses are recommended.

**TABLE VI RECOMMENDED CONCRETE TRAFFIC STRUCTURE**

| Pavement Structure                         | Layer Thickness (mm)       |                              |                           |                              |
|--|----------------------------|------------------------------|---------------------------|------------------------------|
|  | Curvilinear and Loop Roads |                              | Cul de Sac                |                              |
|  | With load transfer dowels  | Without load transfer dowels | With load transfer dowels | Without load transfer dowels |
| Concrete (Min 32 MPa compressive strength) | 130                        | 160                          | 125 <sup>1</sup>          | 125 <sup>1</sup>             |
| Granular Base (Min CBR = 65)               | 250                        | 250                          | 150                       | 200                          |
| Geotextile <sup>2</sup>                    | As Required                | As Required                  | As Required               | As Required                  |
| Subgrade Preparation <sup>3</sup>          | (150)                      | (150)                        | (150)                     | (150)                        |
| <b>Total</b>                               | <b>380</b>                 | <b>410</b>                   | <b>275</b>                | <b>325</b>                   |

<sup>1</sup> Minimum recommended concrete thickness for pavements which will be subjected to heavy truck traffic loading.

<sup>2</sup> High strength geotextile/geogrid will be required where deflection or rutting of the subgrade soils are encountered following a proof roll on the prepared subgrade.

<sup>3</sup> Refer to Section 6.1 for subgrade preparation recommendations.

## 6.5.4 CONSTRUCTION RECOMMENDATIONS

The construction recommendations provided for asphalt concrete pavement structures presented in Section 6.4.4 would apply, with the following provisions for the concrete surfacing layer.

**TABLE VII CONCRETE LAYER DETAILS**

| Construction Detail         | Curvilinear/Loop Roads    |                              | Cul de Sac                |                              |
|-----------------------------|---------------------------|------------------------------|---------------------------|------------------------------|
|                             | With load transfer dowels | Without load transfer dowels | With load transfer dowels | Without load transfer dowels |
| Reinforced and Jointed      | Yes                       | Yes                          | Yes                       | Yes                          |
| Joint Spacing (metres)      | 3                         | 3.6                          | 3                         | 3                            |
| Maximum Slab Width (metres) | 3.75                      | 4.5                          | 3.75                      | 3.75                         |
| Dowels at Joints            | Yes                       | No                           | Yes                       | No                           |
| Dowel Spacing (mm)          | 450                       | --                           | 450                       | --                           |

### **Frost Considerations**

The subgrade soils are considered frost susceptible. Over-excavation of additional soil and replacement with stable granular fill could be considered to mitigate potential differential movements associated with frost action. The potential depth of frost penetration is estimated to be in the order of 1.5 to 2.5 m. Over-excavation of approximately half the depth of frost and replacement with granular fill would greatly reduce the effects of frost action if potential movements need to be minimized.

## 7 EMBANKMENT CONSIDERATIONS

Prior to construction of the embankment, the work area should be prepared in accordance with the recommendations presented in Section 6.1.

It is understood that the embankments will be constructed using locally available soils. It is anticipated that most locally sourced soils will be above optimum moisture content. As such, moisture conditioning of borrow materials will be required. Embankment sideslopes of 3H : 1V may suffice, but 4H : 1V slopes are recommended if highly plastic clay soils are utilized as fill. The embankment fill should be uniformly compacted in thin lifts to 96 percent of standard Proctor density at optimum moisture content. Quality control testing should be completed during embankment construction to ensure materials are suitable and that the minimum specified compaction is achieved. Embankments that are constructed in accordance with these recommendations are expected to undergo self-settlement in the order of 1 to 1.5% of the embankment thickness (self-settlement is anticipated to take several months to a few years to complete, depending on soils used and level of compaction).

In addition to self-settlement of the embankment fill, long term consolidation settlement of the ground resulting from the newly placed embankment fill will occur. The estimated consolidation settlements have been presented in Table VIII. The settlement estimates are based on empirical consolidation parameters, assumed hydraulic properties and a uniform soil profile, and are provided for design planning purposes only. The settlement estimates are based on embankments with 3H : 1V sideslopes and 7.5 m top widths. Actual settlement responses will vary depending on actual soil profiles, hydraulic properties and embankment conditions/geometry.

**TABLE VIII ESTIMATED CONSOLIDATION SETTLEMENT DUE TO EMBANKMENT CONSTRUCTION**

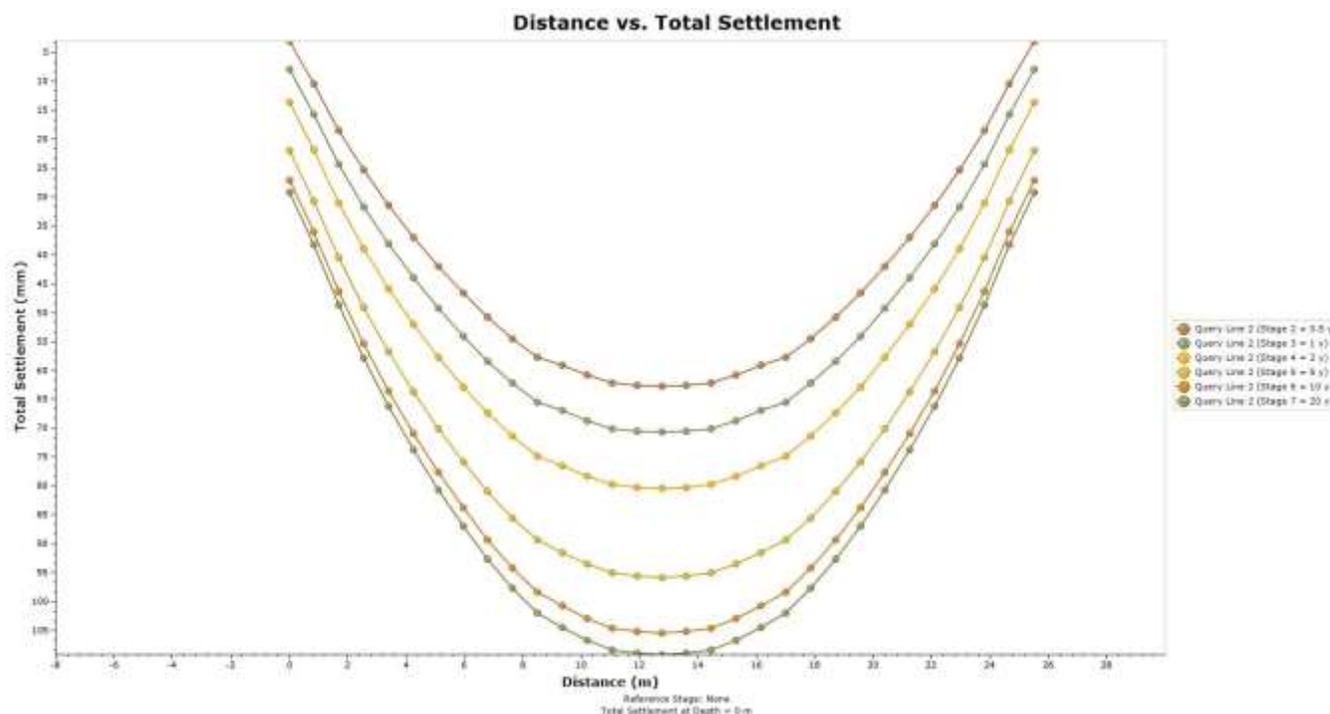
| Embankment Height (metres) | Estimated Settlement (mm) <sup>1</sup> |     |     |     |     |                 |
|----------------------------|--|-----|-----|-----|-----|-----------------|
|                            | Time After Construction (years)        |     |     |     |     |                 |
|                            | 0.5                                    | 1   | 2   | 5   | 10  | 20 <sup>2</sup> |
| 1                          | 30                                     | 35  | 40  | 45  | 50  | 50              |
| 2                          | 55                                     | 65  | 70  | 80  | 85  | 90              |
| 3                          | 65                                     | 70  | 80  | 95  | 105 | 110             |
| 4                          | 75                                     | 85  | 95  | 115 | 130 | 135             |
| 5                          | 85                                     | 95  | 110 | 135 | 150 | 155             |
| 6                          | 95                                     | 105 | 125 | 150 | 165 | 175             |

<sup>1</sup> Accuracy of settlement estimates is anticipated to be +/- 25 to 50%.

<sup>2</sup> Settlements beyond a time period of 20 years are expected to be insignificant.

The settlement estimates presented above represent the settlement of the ground surface at the base of the embankments. The magnitude of settlement will decrease as depth increases (for example, a buried pipe based at a depth of 3 m will settle less than a similar pipe based at a depth of 0.5 m).

The magnitude of settlement will be greatest under the centre of the embankments, and will decrease (eventually to zero) with distance away from the centre of the embankment (refer to Figure II for a typical settlement profile). Structures supported on/within the embankments will undergo settlements that roughly mirror the settlement of the ground surface, and must be designed to accommodate these movements.



**Figure II Settlement Profile Resulting From a 3 Metre High Embankment**

It is recommended that a time period of at least 6 months to 1 year (or more) should be allotted prior to constructing any permanent and/or movement sensitive structures on, within or below the embankments, with longer wait times being preferred. Settlement monitoring should be completed on an ongoing basis to track actual settlement magnitudes and rates. Settlement monitoring data should be considered when deciding on the timeframe for construction of permanent and/or movement-sensitive structures at the site.

If accelerated construction timeframes are required, wick drains could be utilized to expedite settlements (the overall magnitude of settlement will not reduce).

## 8 FOUNDATION CONSIDERATIONS

As discussed above, structures supported on, within or below the embankments will undergo settlements that roughly mirror the settlement of the ground surface, and must be designed to accommodate movements that may occur between the time of construction and the completion of settlement. Settlement monitoring should be completed at strategic locations/depths on an ongoing basis to confirm actual settlement magnitudes and rates. It is considered critical to defer construction of permanent and/or movement sensitive structures on, within or below the embankments until the magnitude and rate of settlement are within tolerable limits for the proposed structures. If an adequate time has not elapsed for settlement to occur and/or if structures are not designed to accommodate movements, cracking and structure distress will occur.

Adequate foundation drainage systems will be required for all structures based near or below the groundwater table.

It is understood that the majority of the single-family residences will be developed within the embankments (i.e., garages closest to the street/centre of the embankment, walkout basements on the embankment slopes), and that foundations for these structures will preferentially consist of footings for the house and piles for the garage and decks. It is understood that similar structures within Greenbryre Estates Phase I and II have been utilized and are performing satisfactorily to date. Provided that an adequate degree of settlement has occurred and settlement rates are sufficiently low, similarly constructed residences should perform similarly within the Phase III development. Footings should be based within naturally deposited soils and piles should extend a sufficient depth into naturally deposited soils. Foundation movements associated with residual consolidation settlement and soil moisture/volume changes should be expected.

It is anticipated that the multi-family residences (i.e., 4-plexes) will not have walkout basements and that these structures will be constructed near existing ground level (i.e., relatively thin and uniform fill thickness). Footing foundations may perform satisfactorily for these structures if some differential movements associated with soil moisture/volume changes can be tolerated. Pile foundations are recommended for more heavily loaded structures and where foundation movements are to be minimized. Feasible pile alternatives at this site include driven piles (steel pipe piles, treated timber piles or pre-cast concrete piles), helical screw piles or continuous flight auger (CFA), cast-in-place concrete piles. Conventional drilled piles could also perform satisfactorily, but construction difficulties associated with seepage/sloughing conditions should be expected and temporary casing will likely be required.

Grade-supported concrete slabs supported on fill soils will be subject to settlement associated with self-settlement of the fill and consolidation of the supporting soils (as discussed above). Garage floors for the single family homes have the potential to undergo the most settlement due to their location at the top of the fill embankment. If possible, pouring the concrete slab should be delayed to near the end of the home construction to allow the subgrade to settle as much as possible. Slabs at all locations will be subject to movements associated with soil moisture/volume changes and frost action (for slabs exposed to freezing conditions). Grade-supported concrete slabs must be designed to accommodate differential movements and cracking without causing distress to structural elements/facilities supported by the slabs. If slab movements cannot be tolerated, pile-supported slabs will be required.

It is anticipated that culverts and/or bridges will be utilized at water body crossings. Culverts may be grade-supported but will require a stable base support. Piles, footings or mechanically stabilized earth (MSE) structures are potential options for bridge structures, depending on local soil conditions and bridge loading.

## 9 LIMITATIONS

The presentation of the summary of the field drill logs and design consideration and recommendations has been completed as authorized. Twelve, 150 mm diameter test holes were dry drilled using our continuous flight, solid stem auger drilling equipment. Field drill logs were compiled for the Test Holes during test drilling which, we believe, were representative of the subsurface conditions at the Test Hole locations at the time of test drilling.

Four piezocone penetration tests were conducted during the field investigation. The inferred subsoil stratigraphy has been shown on the attached CPTu plots.

Variations in the subsurface conditions from that shown on the drill logs and CPTu plots at locations other than the exact test locations should be anticipated. If conditions should differ from those reported here, then we should be notified immediately in order that we may examine the conditions in the field and reassess our recommendations in the light of any new findings.

The Terms of Reference for this geotechnical investigation did not include any environmental assessment of the site. No detectable evidence of environmentally sensitive materials such as hydrocarbon odour was detected during the actual time of the field test drilling program. If, on the basis of any knowledge, other than that formally communicated to us, there is reason to suspect that environmentally sensitive materials may exist, then additional test holes should be drilled and samples recovered for chemical analysis.

The subsurface investigation necessitated the drilling of deep test holes. The test holes were backfilled at the completion of test drilling. Please be advised that some settlement of the backfill materials will occur which may leave a depression or an open hole. It is the responsibility of the client to inspect the site and backfill, as required, to ensure that the ground surface at each Test Hole location is maintained level with the existing grade.

This report has been prepared for the exclusive use of Greenbryre Joint Venture, Catterall & Wright and their agents for specific application to the proposed Greenbryre Estates Phase III, to be developed in Saskatoon, Saskatchewan. It has been prepared in accordance with generally accepted geotechnical engineering practices and no other warranty, express or implied, is made.

Any use which a Third Party makes of this report, or any reliance on decisions to be made based on it, is the responsibility of such Third Party. Governing Agencies such as municipal, provincial, or federal agencies having jurisdictions with respect to this development and/or construction of the facilities described herein have full jurisdiction with respect to the described development. Any other unspecified subsequent development would be considered Third Party and would, therefore, require prior review by PMEL. PMEL accepts no responsibility for damages, if any, suffered by any Third Party as a result of decisions made or actions based on this report.

The acceptance of responsibility for the detailed design/construction recommendations presented in this report with respect to site preparation, excavations and dewatering, foundation concrete and traffic structures are contingent on adequate and/or full-time inspection (as required, based on site conditions at the time of construction) by a representative of the Geotechnical Consultant. PMEL will not accept any responsibility on this project for any unsatisfactory performance if adequate and/or full-time inspection is not performed by a representative of PMEL.

With the exception of site preparation, excavations and dewatering, foundation concrete and traffic structures (for which specific design recommendations have been presented), the recommendations presented in this report are for preliminary purposes only. Detailed, specific geotechnical investigations will be required once the specific project details and locations have been finalized. PMEL will not accept responsibility on this project for any unsatisfactory performance if the preliminary recommendations presented in this report are utilized for the final design in lieu of conducting detailed, specific geotechnical investigations.

If this report has been transmitted electronically, it has been digitally signed and secured with personal passwords to lock the document. Due to the possibility of digital modification, only originally signed reports and those reports sent directly by PMEL can be relied upon without fault.

We trust that this report fulfills your requirements for this project. Should you require additional information, please contact us.

**P. MACHIBRODA ENGINEERING LTD.**



Cory Zubrowski, P. Eng.

|   |              |           |
|---|--------------|-----------|
| Association of Professional Engineers &<br>Geoscientists of Saskatchewan<br><b>CERTIFICATE OF AUTHORIZATION</b><br>P. MACHIBRODA ENGINEERING LTD.<br>Number 172<br>Permission to Consult held by: |              |           |
| Discipline  | Sk. Reg. No. | Signature |
| Geotechnical  | 12138        |           |
|   |              | 19-04-10  |

Jennifer Krasowski, P. Eng.

Reviewed by: Kelly Pardoski, P. Eng.  
CZ/JK/KP

## 10 REFERENCES

Abo-Hashema, Mostafa, *AASHTO Design Equations for Flexible and Rigid Pavement*, computer program, University of Idaho.

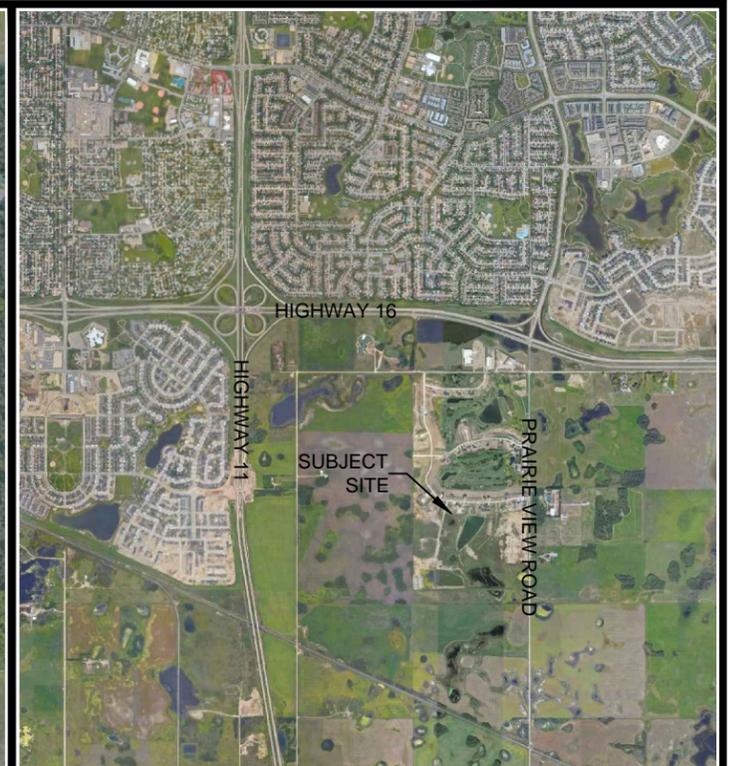
American Association of State Highway and Transportation Officials (AASHTO). (1993). *Guide for design of pavement structures*, Washington, D.C.

Gray, Nathan, P.Eng., PTOE. (2019). *Greenbryre Phase 3 Traffic Impact Assessment – Draft*, Saskatoon, WSP.

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# DRAWINGS

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**KEY PLAN**  
NOT TO SCALE

NOTE:  
 1. THIS DRAWING IS FOR CONCEPTUAL PURPOSES ONLY. ACTUAL LOCATIONS MAY VARY AND NOT ALL STRUCTURES ARE SHOWN.  
 2. THIS DRAWING WAS COMPILED FROM GOOGLE EARTH PRO ©2018, IMAGE ©2018 DIGITALGLOBE, (IMAGERY DATE: 8/23/15).

**LEGEND**

-  -PMEL PIEZOCONE PENETRATION TEST
-  -PMEL TEST HOLE (PIEZOMETER INSTALLED)

**P. MACHIBRODA ENGINEERING LTD.**



CONSULTING  
 GEOENVIRONMENTAL  
 GEOTECHNICAL  
 ENGINEERS

806 - 48th STREET EAST  
 SASKATOON, SK  
 S7K 3Y4

DRAWING TITLE:  
**SITE PLAN  
 TEST HOLE AND PIEZOCONE LOCATIONS**

PROJECT:  
**PROPOSED GREENBRYRE ESTATES PHASE III  
 SASKATOON, SK**

APPROVED BY:  
**CZ**

DRAWN BY:  
**SD**

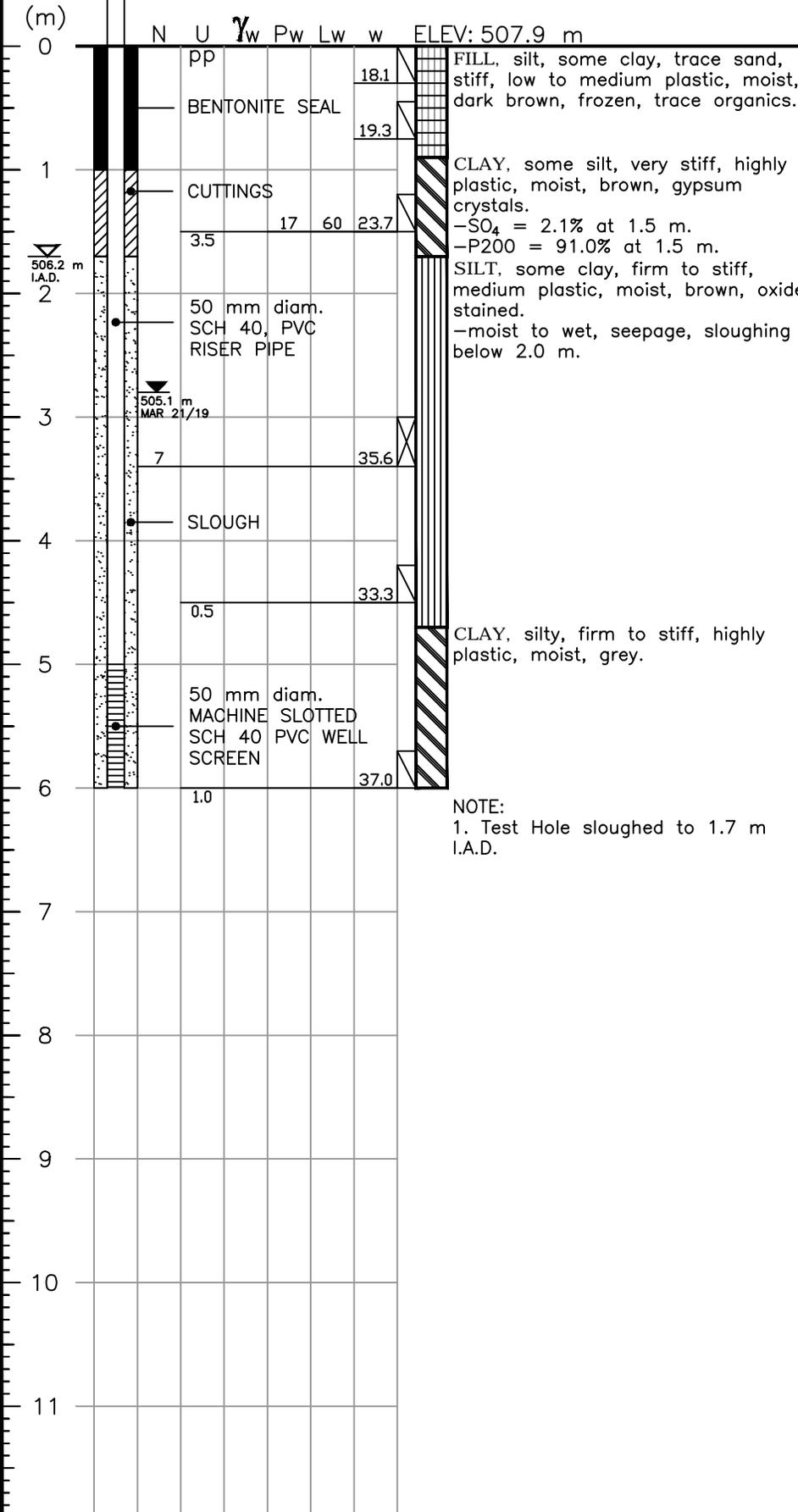
DATE: MARCH, 2019  
 SCALE: 1:3000

DRAWING NUMBER:  
**15145-1**

PIEZO. ELEV.= 508.9 m

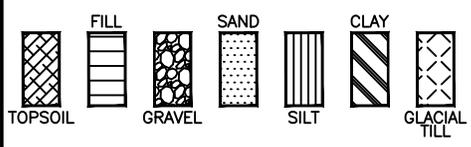
### TEST HOLE 19-1

DEPTH (m)



NOTE:  
1. Test Hole sloughed to 1.7 m I.A.D.

LEGEND:



- w.....WATER CONTENT (PERCENT OF DRY SOIL WEIGHT)
- Lw...LIQUID LIMIT
- Pw...PLASTIC LIMIT
- $\gamma_w$ ...WET UNIT WEIGHT (kN/m<sup>3</sup>)
- U.....UNCONFINED COMPRESSIVE STRENGTH (kPa)
- pp...POCKET PENETROMETER (kg/cm<sup>2</sup>)
- N.....STANDARD PENETRATION TEST (SAFETY HAMMER w/AUTOMATIC TRIP) (50/125 = BLOWS/SAMPLER PENETRATION [mm])
- SO<sub>4</sub>.....SULPHATE CONTENT (PERCENT OF DRY SOIL WEIGHT)
- P200...% PASSING No. 200 SIEVE
- I.A.D.....IMMEDIATELY AFTER DRILLING
- ▼...RECORDED WATER LEVEL (TEST HOLE I.A.D.)
- ▼...RECORDED WATER LEVEL (PIEZO)



LIMITATIONS: THE FIELD DRILL LOG IS A SUMMARY OF THE SUBSURFACE CONDITIONS ENCOUNTERED AT THE SPECIFIC TEST HOLE LOCATION AT THE TIME OF TEST DRILLING. SUBSURFACE CONDITIONS MAY VARY AT OTHER LOCATIONS OF THIS SITE AND, IN TIME, MAY CHANGE AT THIS SPECIFIC TEST HOLE LOCATION.

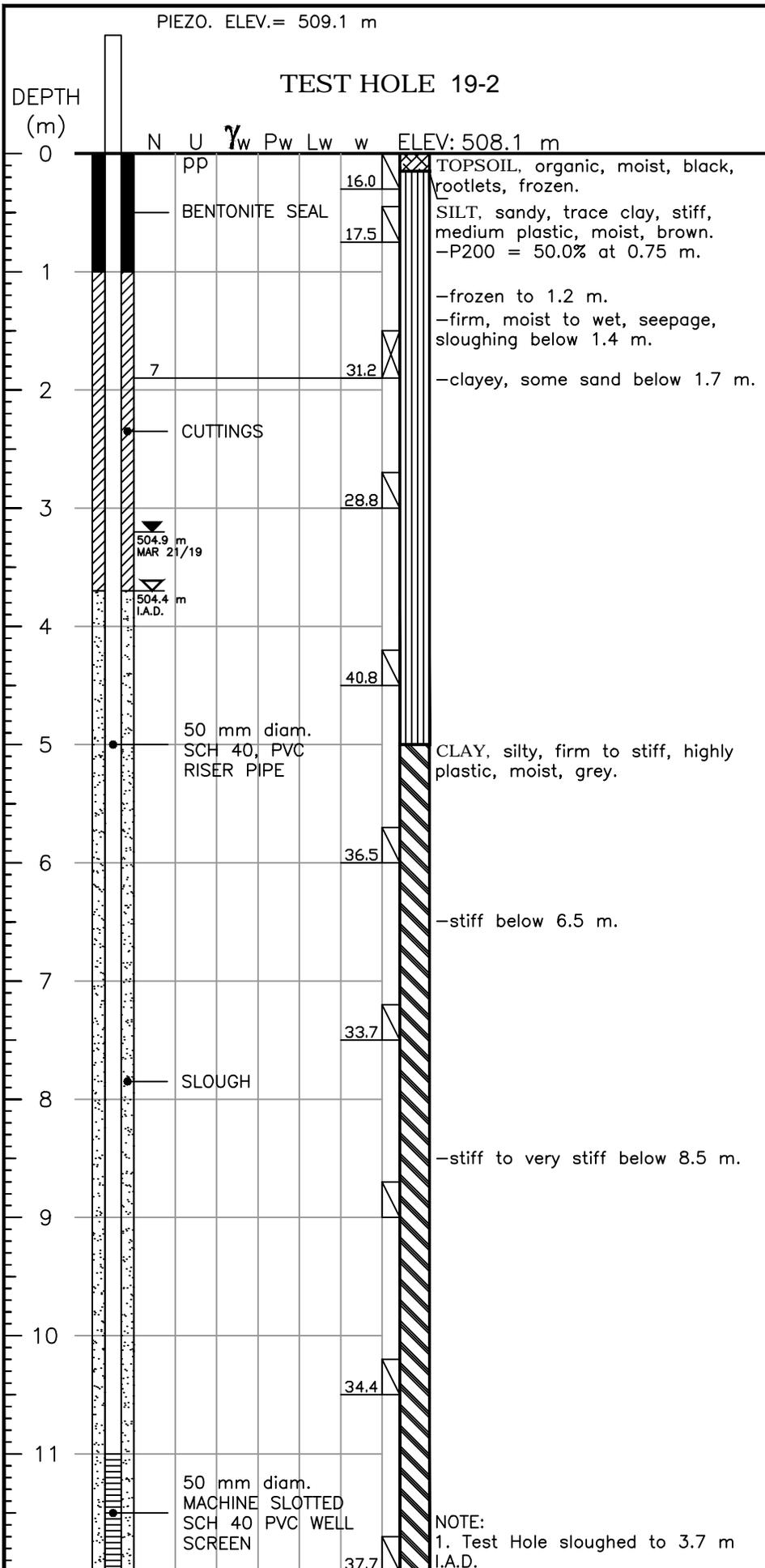
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ENGINEERING  
LTD.**

### FIELD DRILL LOG AND SOIL TEST RESULTS

PROJECT:  
PROPOSED GREENBRYRE ESTATES PHASE III

LOCATION:  
  
SASKATOON, SK  
NORTHING: 5770875 EASTING: 390974

DATE DRILLED: JAN 15/19  
DRAWING NUMBER: 15145-2



**LEGEND:**

|         |      |        |      |      |      |              |
|---------|------|--------|------|------|------|--------------|
|         |      |        |      |      |      |              |
| TOPSOIL | FILL | GRAVEL | SAND | SILT | CLAY | GLACIAL TILL |

- w.....WATER CONTENT (PERCENT OF DRY SOIL WEIGHT)
  - Lw...LIQUID LIMIT
  - Pw...PLASTIC LIMIT
  - $\gamma_w$ ...WET UNIT WEIGHT (kN/m<sup>3</sup>)
  - U.....UNCONFINED COMPRESSIVE STRENGTH (kPa)
  - pp...POCKET PENETROMETER (kg/cm<sup>2</sup>)
  - N.....STANDARD PENETRATION TEST (SAFETY HAMMER w/AUTOMATIC TRIP) (50/125 = BLOWS/SAMPLER PENETRATION [mm])
  - SO<sub>4</sub>.....SULPHATE CONTENT (PERCENT OF DRY SOIL WEIGHT)
  - P200...% PASSING No. 200 SIEVE
  - I.A.D.....IMMEDIATELY AFTER DRILLING
  - ▽...RECORDED WATER LEVEL (TEST HOLE I.A.D.)
  - ▼...RECORDED WATER LEVEL (PIEZO)
- |             |             |          |
|-------------|-------------|----------|
|             |             |          |
| SHELBY TUBE | SPLIT SPOON | CUTTINGS |

LIMITATIONS: THE FIELD DRILL LOG IS A SUMMARY OF THE SUBSURFACE CONDITIONS ENCOUNTERED AT THE SPECIFIC TEST HOLE LOCATION AT THE TIME OF TEST DRILLING. SUBSURFACE CONDITIONS MAY VARY AT OTHER LOCATIONS OF THIS SITE AND, IN TIME, MAY CHANGE AT THIS SPECIFIC TEST HOLE LOCATION.

|  |                                      |
|--|--------------------------------------|
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|--|--------------------------------------|

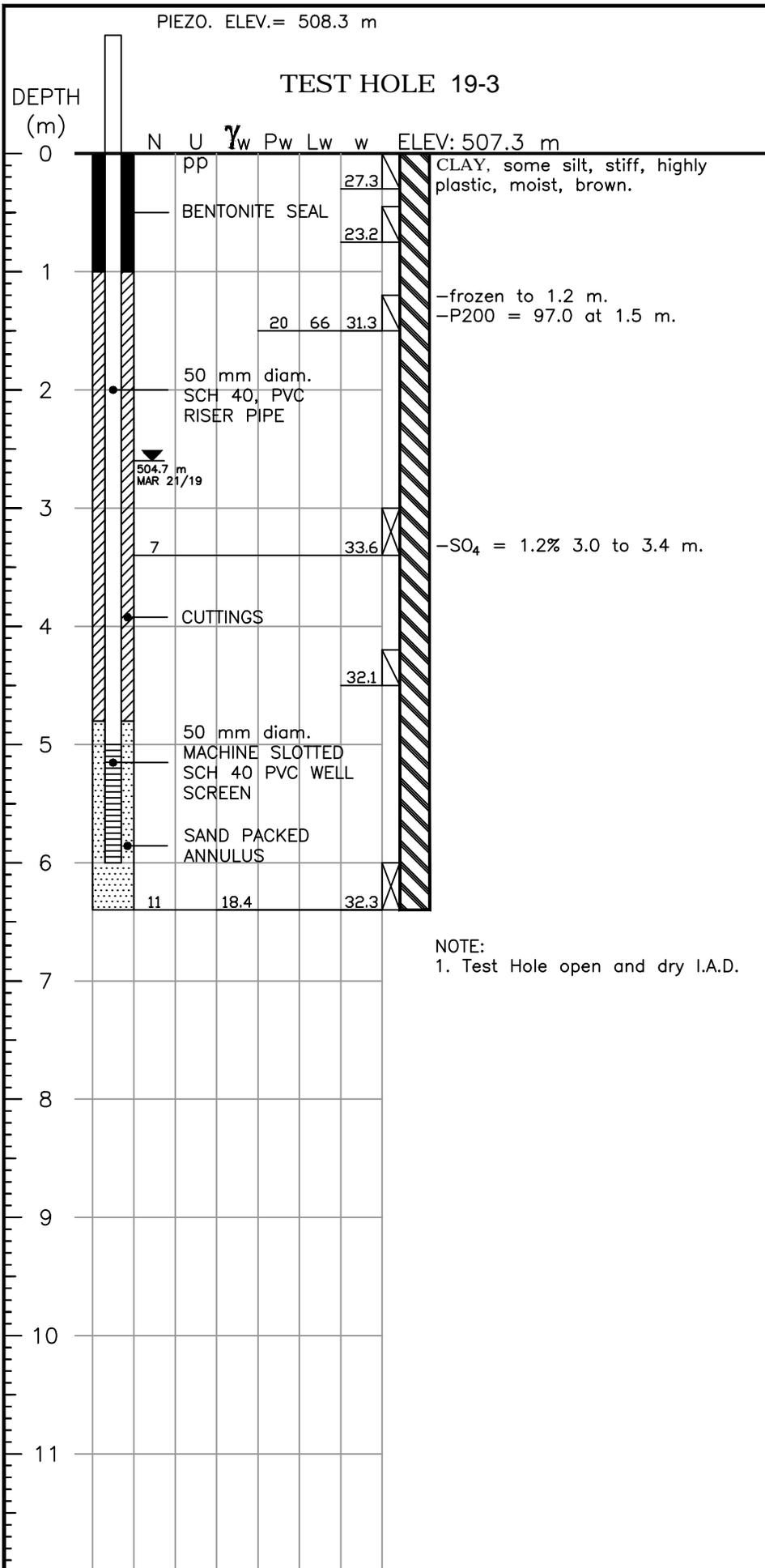
### FIELD DRILL LOG AND SOIL TEST RESULTS

PROJECT:  
PROPOSED GREENBRYRE ESTATES PHASE III

LOCATION:  
  
SASKATOON, SK

NORTHING: 5770748 EASTING: 390813

|                            |                            |
|----------------------------|----------------------------|
| DATE DRILLED:<br>JAN 15/19 | DRAWING NUMBER:<br>15145-3 |
|----------------------------|----------------------------|



**LEGEND:**

|         |      |        |      |      |      |              |
|---------|------|--------|------|------|------|--------------|
|         |      |        |      |      |      |              |
| TOPSOIL | FILL | GRAVEL | SAND | SILT | CLAY | GLACIAL TILL |

- w.....WATER CONTENT (PERCENT OF DRY SOIL WEIGHT)
- Lw...LIQUID LIMIT
- Pw...PLASTIC LIMIT
- $\gamma_w$ ...WET UNIT WEIGHT (kN/m<sup>3</sup>)
- U.....UNCONFINED COMPRESSIVE STRENGTH (kPa)
- pp...POCKET PENETROMETER (kg/cm<sup>2</sup>)
- N.....STANDARD PENETRATION TEST (SAFETY HAMMER w/AUTOMATIC TRIP) (50/125 = BLOWS/SAMPLER PENETRATION [mm])
- SO<sub>4</sub>.....SULPHATE CONTENT (PERCENT OF DRY SOIL WEIGHT)
- P200...% PASSING No. 200 SIEVE
- I.A.D.....IMMEDIATELY AFTER DRILLING
- ▼...RECORDED WATER LEVEL (TEST HOLE I.A.D.)
- ▼...RECORDED WATER LEVEL (PIEZO)
- SHELBY TUBE
- SPLIT SPOON
- CUTTINGS

LIMITATIONS: THE FIELD DRILL LOG IS A SUMMARY OF THE SUBSURFACE CONDITIONS ENCOUNTERED AT THE SPECIFIC TEST HOLE LOCATION AT THE TIME OF TEST DRILLING. SUBSURFACE CONDITIONS MAY VARY AT OTHER LOCATIONS OF THIS SITE AND, IN TIME, MAY CHANGE AT THIS SPECIFIC TEST HOLE LOCATION.

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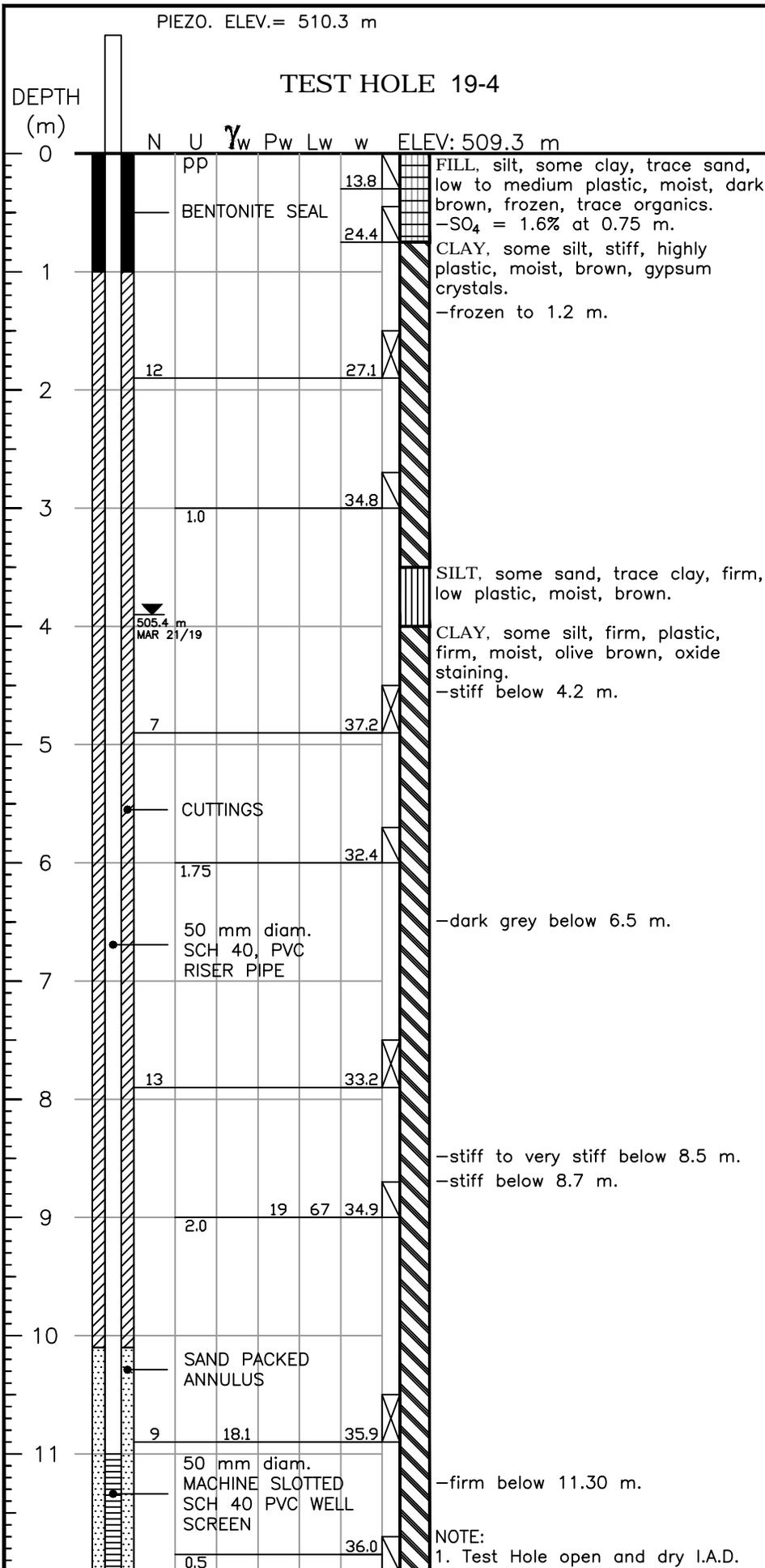
**FIELD DRILL LOG  
AND  
SOIL TEST RESULTS**

PROJECT:  
PROPOSED GREENBRYRE ESTATES  
PHASE III

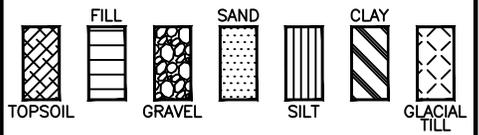
LOCATION:  
  
SASKATOON, SK

NORTHING: 5770597 EASTING: 390968

|                            |                            |
|----------------------------|----------------------------|
| DATE DRILLED:<br>JAN 15/19 | DRAWING NUMBER:<br>15145-4 |
|----------------------------|----------------------------|



**LEGEND:**



- w.....WATER CONTENT (PERCENT OF DRY SOIL WEIGHT)
- Lw...LIQUID LIMIT
- Pw...PLASTIC LIMIT
- $\gamma_w$ ...WET UNIT WEIGHT (kN/m<sup>3</sup>)
- U.....UNCONFINED COMPRESSIVE STRENGTH (kPa)
- pp...POCKET PENETROMETER (kg/cm<sup>2</sup>)
- N.....STANDARD PENETRATION TEST (SAFETY HAMMER w/AUTOMATIC TRIP) (50/125 = BLOWS/SAMPLER PENETRATION [mm])
- SO<sub>4</sub>.....SULPHATE CONTENT (PERCENT OF DRY SOIL WEIGHT)
- P200...% PASSING No. 200 SIEVE
- I.A.D.....IMMEDIATELY AFTER DRILLING
- ▼...RECORDED WATER LEVEL (TEST HOLE I.A.D.)
- ▼...RECORDED WATER LEVEL (PIEZO)



LIMITATIONS: THE FIELD DRILL LOG IS A SUMMARY OF THE SUBSURFACE CONDITIONS ENCOUNTERED AT THE SPECIFIC TEST HOLE LOCATION AT THE TIME OF TEST DRILLING. SUBSURFACE CONDITIONS MAY VARY AT OTHER LOCATIONS OF THIS SITE AND, IN TIME, MAY CHANGE AT THIS SPECIFIC TEST HOLE LOCATION.



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### FIELD DRILL LOG AND SOIL TEST RESULTS

PROJECT:  
PROPOSED GREENBRYRE ESTATES  
PHASE III

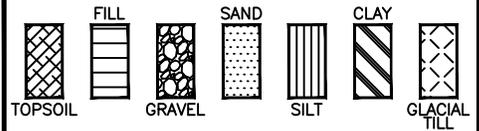
LOCATION:  
  
SASKATOON, SK

NORTHING: 5770650 EASTING: 390709

|                            |                            |
|----------------------------|----------------------------|
| DATE DRILLED:<br>JAN 15/19 | DRAWING NUMBER:<br>15145-5 |
|----------------------------|----------------------------|

TEST HOLE 19-5

LEGEND:



- w.....WATER CONTENT (PERCENT OF DRY SOIL WEIGHT)
- Lw...LIQUID LIMIT
- Pw...PLASTIC LIMIT
- $\gamma_w$ ...WET UNIT WEIGHT (kN/m<sup>3</sup>)
- U.....UNCONFINED COMPRESSIVE STRENGTH (kPa)
- pp...POCKET PENETROMETER (kg/cm<sup>2</sup>)
- N.....STANDARD PENETRATION TEST (SAFETY HAMMER w/AUTOMATIC TRIP) (50/125 = BLOWS/SAMPLER PENETRATION [mm])
- SO<sub>4</sub>.....SULPHATE CONTENT (PERCENT OF DRY SOIL WEIGHT)
- P200...% PASSING No. 200 SIEVE
- I.A.D.....IMMEDIATELY AFTER DRILLING
- ▼...RECORDED WATER LEVEL (TEST HOLE I.A.D.)
- ▼...RECORDED WATER LEVEL (PIEZO)
- SHELBY TUBE
- ⊠ SPLIT SPOON
- CUTTINGS

LIMITATIONS: THE FIELD DRILL LOG IS A SUMMARY OF THE SUBSURFACE CONDITIONS ENCOUNTERED AT THE SPECIFIC TEST HOLE LOCATION AT THE TIME OF TEST DRILLING. SUBSURFACE CONDITIONS MAY VARY AT OTHER LOCATIONS OF THIS SITE AND, IN TIME, MAY CHANGE AT THIS SPECIFIC TEST HOLE LOCATION.



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FIELD DRILL LOG  
AND  
SOIL TEST RESULTS

PROJECT:  
PROPOSED GREENBRYRE ESTATES  
PHASE III

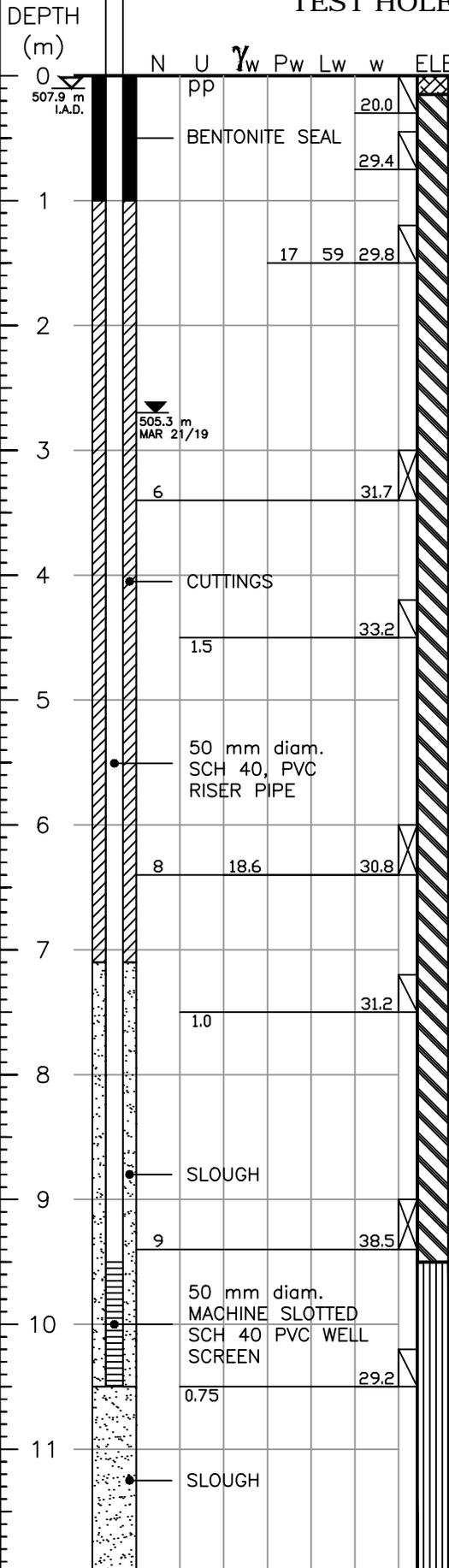
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SASKATOON, SK

NORTHING: 5770422 EASTING: 391082

DATE DRILLED:  
JAN 15/19

DRAWING NUMBER:  
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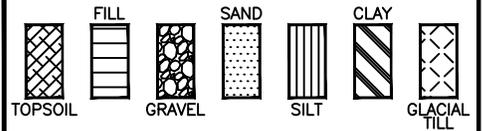
TEST HOLE 19-5

DEPTH  
(m)

| DEPTH (m) | N  | U  | $\gamma_w$ | Pw | Lw | w    |
|-----------|----|----|------------|----|----|------|
| 12        |    | pp |            |    |    |      |
| 12.1      | 11 |    |            |    |    | 36.1 |
| 13        |    |    |            |    |    |      |
| 14        |    |    |            |    |    |      |
| 15        |    |    |            |    |    |      |
| 16        |    |    |            |    |    |      |
| 17        |    |    |            |    |    |      |
| 18        |    |    |            |    |    |      |
| 19        |    |    |            |    |    |      |
| 20        |    |    |            |    |    |      |
| 21        |    |    |            |    |    |      |
| 22        |    |    |            |    |    |      |
| 23        |    |    |            |    |    |      |

SILT, some clay, trace sand, firm to stiff, medium plastic, moist, brown.  
 CLAY, trace silt, stiff, highly plastic, moist, brown.  
 NOTE:  
 1. Test Hole sloughed to 7.1 m I.A.D.

LEGEND:



- w.....WATER CONTENT (PERCENT OF DRY SOIL WEIGHT)
- Lw...LIQUID LIMIT
- Pw...PLASTIC LIMIT
- $\gamma_w$ ...WET UNIT WEIGHT (kN/m)
- U.....UNCONFINED COMPRESSIVE STRENGTH (kPa)
- pp...POCKET PENETROMETER (kg/cm<sup>2</sup>)
- N.....STANDARD PENETRATION TEST (SAFETY HAMMER w/AUTOMATIC TRIP) (50/125 = BLOWS/SAMPLER PENETRATION [mm])
- SO<sub>4</sub>.....SULPHATE CONTENT (PERCENT OF DRY SOIL WEIGHT)
- P200...% PASSING No. 200 SIEVE
- I.A.D.....IMMEDIATELY AFTER DRILLING
- ∇...RECORDED WATER LEVEL (TEST HOLE I.A.D.)
- ▼...RECORDED WATER LEVEL (PIEZO)
- SHELBY TUBE
- ⊠ SPLIT SPOON
- CUTTINGS

LIMITATIONS: THE FIELD DRILL LOG IS A SUMMARY OF THE SUBSURFACE CONDITIONS ENCOUNTERED AT THE SPECIFIC TEST HOLE LOCATION AT THE TIME OF TEST DRILLING. SUBSURFACE CONDITIONS MAY VARY AT OTHER LOCATIONS OF THIS SITE AND, IN TIME, MAY CHANGE AT THIS SPECIFIC TEST HOLE LOCATION.



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FIELD DRILL LOG  
AND  
SOIL TEST RESULTS

PROJECT:  
PROPOSED GREENBRYRE ESTATES  
PHASE III

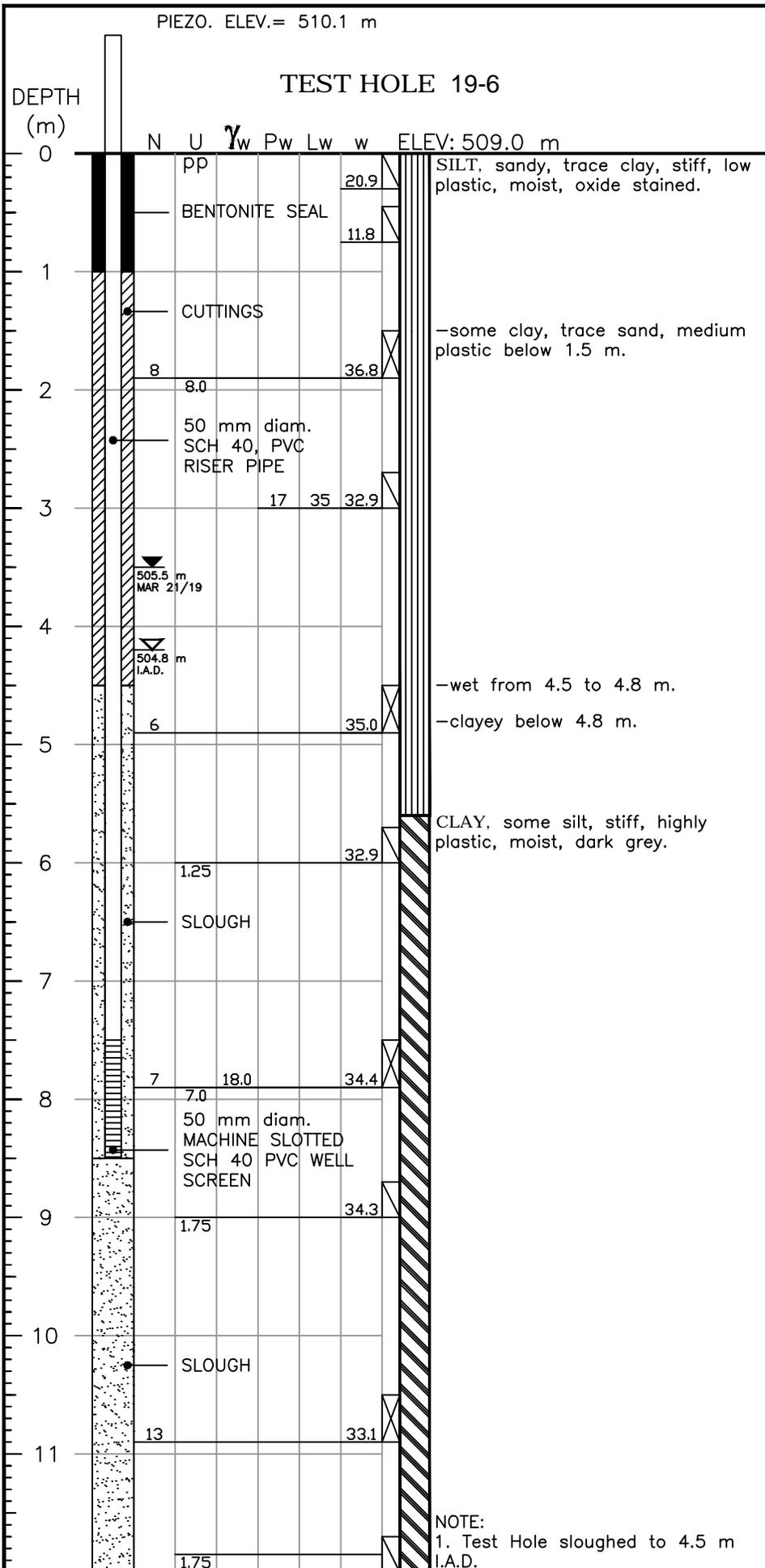
LOCATION:

SASKATOON, SK

NORTHING: 5770422 EASTING: 391082

DATE DRILLED:  
JAN 15/19

DRAWING NUMBER:  
15145-6A



**LEGEND:**

|         |      |        |      |      |      |              |
|---------|------|--------|------|------|------|--------------|
|         |      |        |      |      |      |              |
| TOPSOIL | FILL | GRAVEL | SAND | SILT | CLAY | GLACIAL TILL |

- w.....WATER CONTENT (PERCENT OF DRY SOIL WEIGHT)
- Lw...LIQUID LIMIT
- Pw...PLASTIC LIMIT
- $\gamma_w$ ...WET UNIT WEIGHT (kN/m<sup>3</sup>)
- U.....UNCONFINED COMPRESSIVE STRENGTH (kPa)
- pp...POCKET PENETROMETER (kg/cm<sup>2</sup>)
- N.....STANDARD PENETRATION TEST (SAFETY HAMMER w/AUTOMATIC TRIP) (50/125 = BLOWS/SAMPLER PENETRATION [mm])
- SO<sub>4</sub>.....SULPHATE CONTENT (PERCENT OF DRY SOIL WEIGHT)
- P200...% PASSING No. 200 SIEVE
- I.A.D.....IMMEDIATELY AFTER DRILLING
- ▼...RECORDED WATER LEVEL (TEST HOLE I.A.D.)
- ▼...RECORDED WATER LEVEL (PIEZO)
- SHELBY TUBE
- SPLIT SPOON
- CUTTINGS

LIMITATIONS: THE FIELD DRILL LOG IS A SUMMARY OF THE SUBSURFACE CONDITIONS ENCOUNTERED AT THE SPECIFIC TEST HOLE LOCATION AT THE TIME OF TEST DRILLING. SUBSURFACE CONDITIONS MAY VARY AT OTHER LOCATIONS OF THIS SITE AND, IN TIME, MAY CHANGE AT THIS SPECIFIC TEST HOLE LOCATION.

|  |                                      |
|--|--------------------------------------|
|  | P. MACHIBRODA<br>ENGINEERING<br>LTD. |
|--|--------------------------------------|

### FIELD DRILL LOG AND SOIL TEST RESULTS

PROJECT:  
PROPOSED GREENBRYRE ESTATES PHASE III

LOCATION:  
  
SASKATOON, SK

NORTHING: 5770417 EASTING: 391321

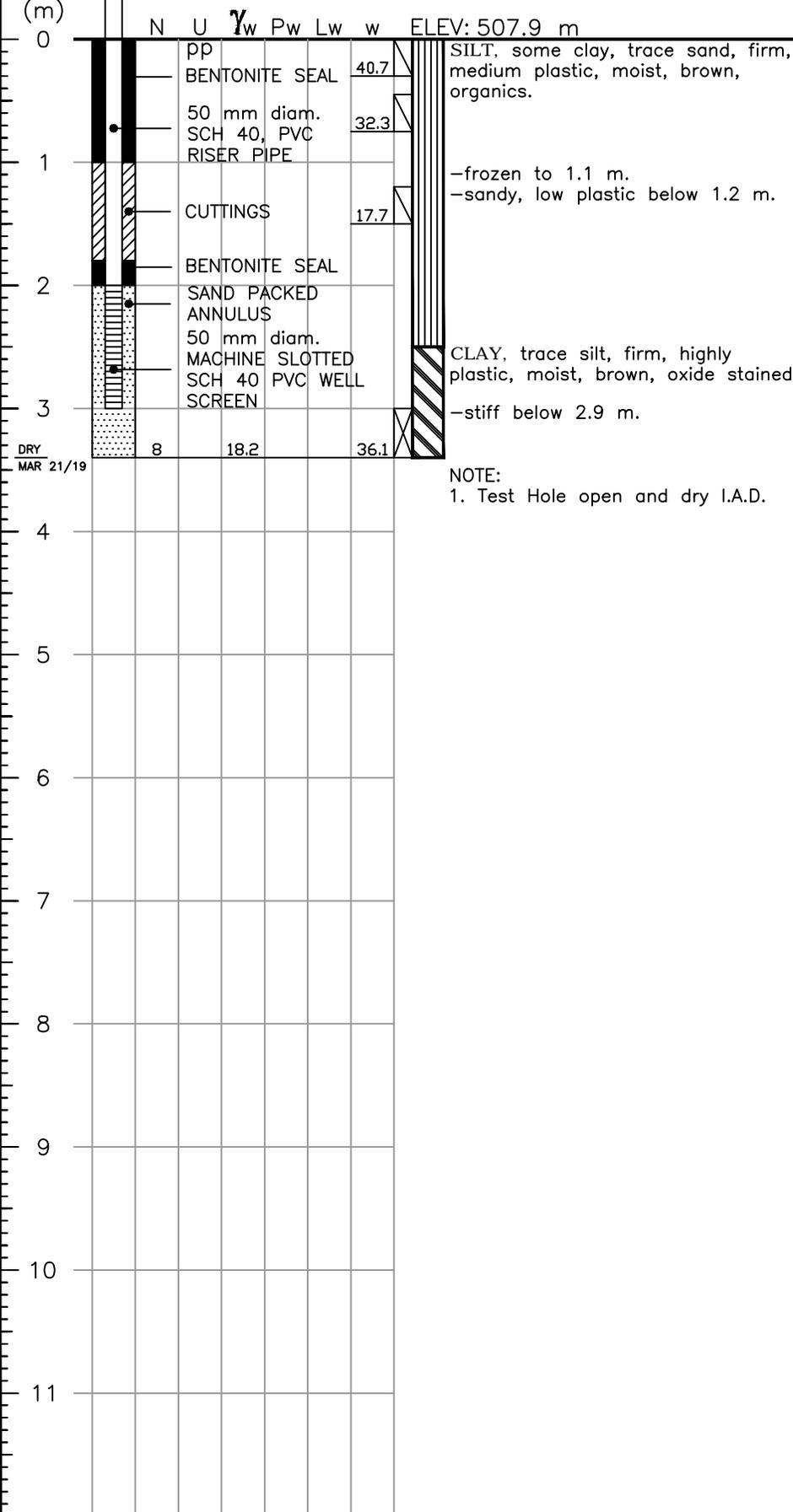
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|----------------------------|----------------------------|
| DATE DRILLED:<br>JAN 15/19 | DRAWING NUMBER:<br>15145-7 |
|----------------------------|----------------------------|

NOTE:  
1. Test Hole sloughed to 4.5 m I.A.D.

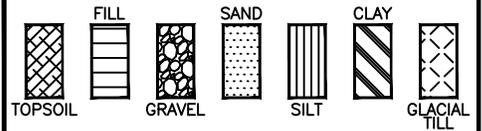
PIEZO. ELEV.= 508.9 m

### TEST HOLE 19-7

DEPTH (m)



LEGEND:



- w.....WATER CONTENT (PERCENT OF DRY SOIL WEIGHT)
- Lw...LIQUID LIMIT
- Pw...PLASTIC LIMIT
- $\gamma_w$ ...WET UNIT WEIGHT (kN/m<sup>3</sup>)
- U.....UNCONFINED COMPRESSIVE STRENGTH (kPa)
- pp...POCKET PENETROMETER (kg/cm<sup>2</sup>)
- N.....STANDARD PENETRATION TEST (SAFETY HAMMER w/AUTOMATIC TRIP) (50/125 = BLOWS/SAMPLER PENETRATION [mm])
- SO<sub>4</sub>.....SULPHATE CONTENT (PERCENT OF DRY SOIL WEIGHT)
- P200...% PASSING No. 200 SIEVE
- I.A.D.....IMMEDIATELY AFTER DRILLING
- ∇...RECORDED WATER LEVEL (TEST HOLE I.A.D.)
- ∇...RECORDED WATER LEVEL (PIEZO)
- SHELBY TUBE
- ⊠ SPLIT SPOON
- CUTTINGS

LIMITATIONS: THE FIELD DRILL LOG IS A SUMMARY OF THE SUBSURFACE CONDITIONS ENCOUNTERED AT THE SPECIFIC TEST HOLE LOCATION AT THE TIME OF TEST DRILLING. SUBSURFACE CONDITIONS MAY VARY AT OTHER LOCATIONS OF THIS SITE AND, IN TIME, MAY CHANGE AT THIS SPECIFIC TEST HOLE LOCATION.



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#### FIELD DRILL LOG AND SOIL TEST RESULTS

PROJECT:  
PROPOSED GREENBRYRE ESTATES  
PHASE III

LOCATION:

SASKATOON, SK

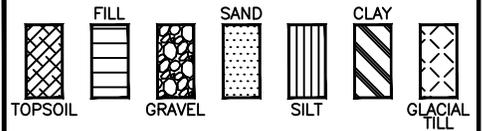
NORTHING: 5770748 EASTING: 390813

DATE DRILLED:  
FEB 21/19

DRAWING NUMBER:  
15145-8

TEST HOLE 19-8

LEGEND:



- w.....WATER CONTENT (PERCENT OF DRY SOIL WEIGHT)
- Lw...LIQUID LIMIT
- Pw...PLASTIC LIMIT
- $\gamma_w$ ...WET UNIT WEIGHT (kN/m<sup>3</sup>)
- U.....UNCONFINED COMPRESSIVE STRENGTH (kPa)
- pp...POCKET PENETROMETER (kg/cm<sup>2</sup>)
- N.....STANDARD PENETRATION TEST (SAFETY HAMMER w/AUTOMATIC TRIP) (50/125 = BLOWS/SAMPLER PENETRATION [mm])
- SO<sub>4</sub>.....SULPHATE CONTENT (PERCENT OF DRY SOIL WEIGHT)
- P200...% PASSING No. 200 SIEVE
- I.A.D.....IMMEDIATELY AFTER DRILLING
- ▽...RECORDED WATER LEVEL (TEST HOLE I.A.D.)
- ▼...RECORDED WATER LEVEL (PIEZO)
- SHELBY TUBE
- ⊠ SPLIT SPOON
- CUTTINGS

LIMITATIONS: THE FIELD DRILL LOG IS A SUMMARY OF THE SUBSURFACE CONDITIONS ENCOUNTERED AT THE SPECIFIC TEST HOLE LOCATION AT THE TIME OF TEST DRILLING. SUBSURFACE CONDITIONS MAY VARY AT OTHER LOCATIONS OF THIS SITE AND, IN TIME, MAY CHANGE AT THIS SPECIFIC TEST HOLE LOCATION.



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FIELD DRILL LOG  
AND  
SOIL TEST RESULTS

PROJECT:  
PROPOSED GREENBRYRE ESTATES  
PHASE III

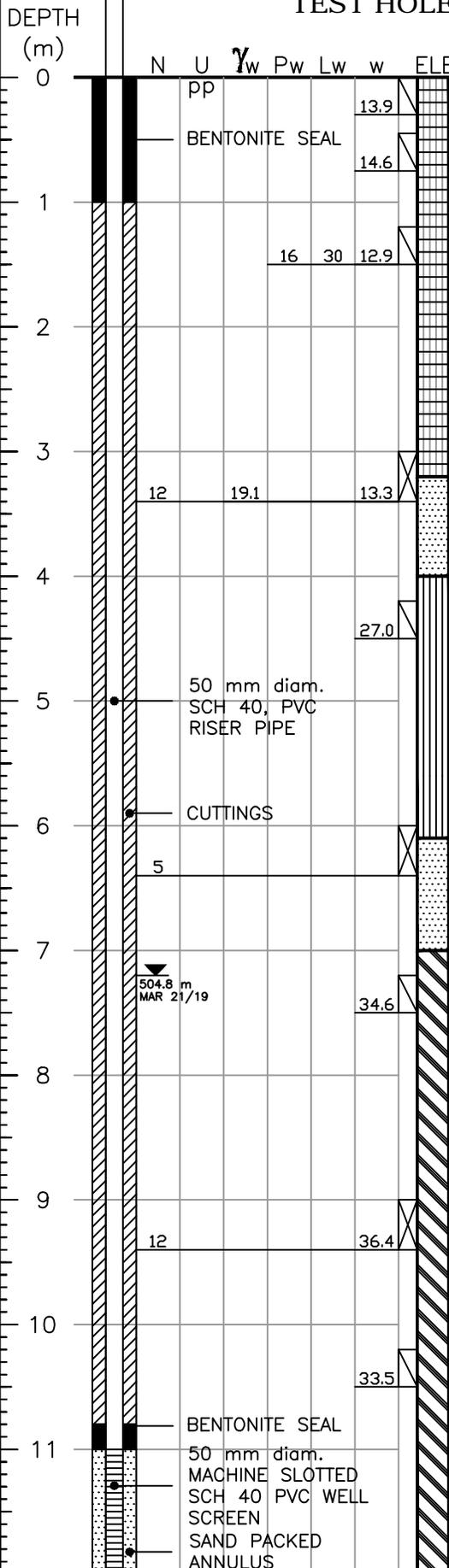
LOCATION:

SASKATOON, SK

NORTHING: 5770577 EASTING: 391420

DATE DRILLED:  
FEB 21/19

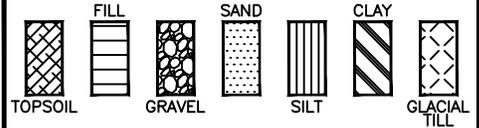
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15145-9



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TEST HOLE 19-8

LEGEND:



DEPTH (m)

| DEPTH (m) | N  | U  | $\gamma_w$ | P <sub>w</sub> | L <sub>w</sub> | w    |
|-----------|----|----|------------|----------------|----------------|------|
| 12        | 10 | pp | 18.5       |                |                | 34.6 |
| 13        |    |    |            |                |                |      |
| 14        |    |    |            |                |                |      |
| 15        |    |    |            |                |                |      |
| 16        |    |    |            |                |                |      |
| 17        |    |    |            |                |                |      |
| 18        |    |    |            |                |                |      |
| 19        |    |    |            |                |                |      |
| 20        |    |    |            |                |                |      |
| 21        |    |    |            |                |                |      |
| 22        |    |    |            |                |                |      |
| 23        |    |    |            |                |                |      |

CLAY, trace silt, stiff, highly plastic, moist, grey, gypsum crystals.

NOTE:  
1. Test Hole open and dry I.A.D.

- w.....WATER CONTENT (PERCENT OF DRY SOIL WEIGHT)
- L<sub>w</sub>...LIQUID LIMIT
- P<sub>w</sub>...PLASTIC LIMIT
- $\gamma_w$ ...WET UNIT WEIGHT (kN/m<sup>3</sup>)
- U.....UNCONFINED COMPRESSIVE STRENGTH (kPa)
- pp...POCKET PENETROMETER (kg/cm<sup>2</sup>)
- N.....STANDARD PENETRATION TEST (SAFETY HAMMER w/AUTOMATIC TRIP) (50/125 = BLOWS/SAMPLER PENETRATION [mm])
- SO<sub>4</sub>.....SULPHATE CONTENT (PERCENT OF DRY SOIL WEIGHT)
- P200...% PASSING No. 200 SIEVE
- I.A.D.....IMMEDIATELY AFTER DRILLING
- ∇...RECORDED WATER LEVEL (TEST HOLE I.A.D.)
- ▼...RECORDED WATER LEVEL (PIEZO)
- SHELBY TUBE
- ⊠ SPLIT SPOON
- CUTTINGS

LIMITATIONS: THE FIELD DRILL LOG IS A SUMMARY OF THE SUBSURFACE CONDITIONS ENCOUNTERED AT THE SPECIFIC TEST HOLE LOCATION AT THE TIME OF TEST DRILLING. SUBSURFACE CONDITIONS MAY VARY AT OTHER LOCATIONS OF THIS SITE AND, IN TIME, MAY CHANGE AT THIS SPECIFIC TEST HOLE LOCATION.



P. MACHIBRODA  
ENGINEERING  
LTD.

FIELD DRILL LOG  
AND  
SOIL TEST RESULTS

PROJECT:  
PROPOSED GREENBRYRE ESTATES  
PHASE III

LOCATION:

SASKATOON, SK

NORTHING: EASTING:

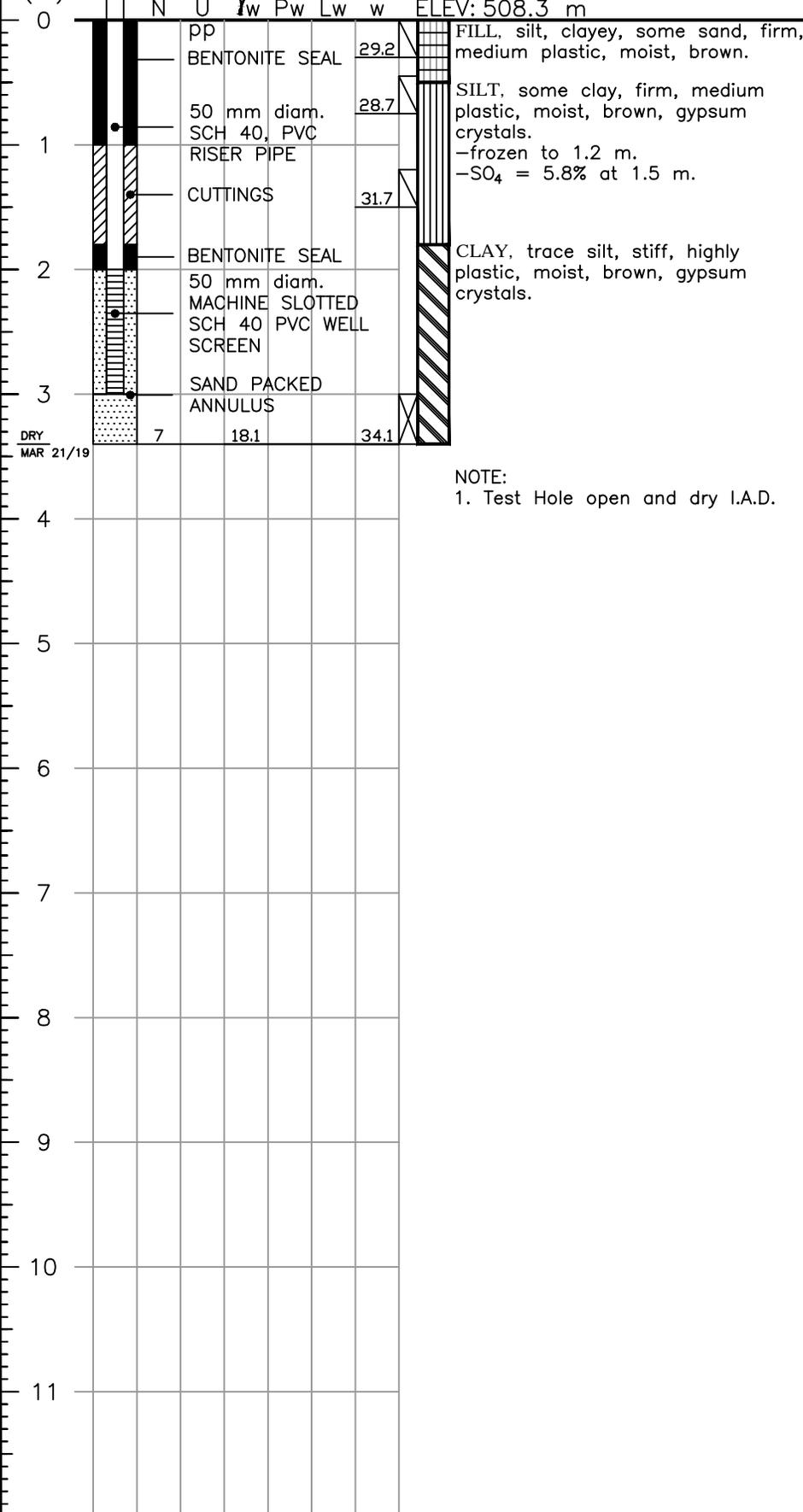
DATE DRILLED:  
FEB 21/19

DRAWING NUMBER:  
15145-9A

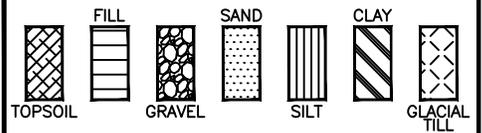
PIEZO. ELEV.= 509.3 m

### TEST HOLE 19-9

DEPTH  
(m)



LEGEND:



- w.....WATER CONTENT (PERCENT OF DRY SOIL WEIGHT)
- Lw...LIQUID LIMIT
- Pw...PLASTIC LIMIT
- $\gamma_w$ ...WET UNIT WEIGHT (kN/m<sup>3</sup>)
- U.....UNCONFINED COMPRESSIVE STRENGTH (kPa)
- pp...POCKET PENETROMETER (kg/cm<sup>2</sup>)
- N.....STANDARD PENETRATION TEST (SAFETY HAMMER w/AUTOMATIC TRIP) (50/125 = BLOWS/SAMPLER PENETRATION [mm])
- SO<sub>4</sub>.....SULPHATE CONTENT (PERCENT OF DRY SOIL WEIGHT)
- P200...% PASSING No. 200 SIEVE
- I.A.D.....IMMEDIATELY AFTER DRILLING
- ∇...RECORDED WATER LEVEL (TEST HOLE I.A.D.)
- ∇...RECORDED WATER LEVEL (PIEZO)
- SHELBY TUBE
- ⊠ SPLIT SPOON
- CUTTINGS

LIMITATIONS: THE FIELD DRILL LOG IS A SUMMARY OF THE SUBSURFACE CONDITIONS ENCOUNTERED AT THE SPECIFIC TEST HOLE LOCATION AT THE TIME OF TEST DRILLING. SUBSURFACE CONDITIONS MAY VARY AT OTHER LOCATIONS OF THIS SITE AND, IN TIME, MAY CHANGE AT THIS SPECIFIC TEST HOLE LOCATION.



P. MACHIBRODA  
ENGINEERING  
LTD.

#### FIELD DRILL LOG AND SOIL TEST RESULTS

PROJECT:  
PROPOSED GREENBRYRE ESTATES  
PHASE III

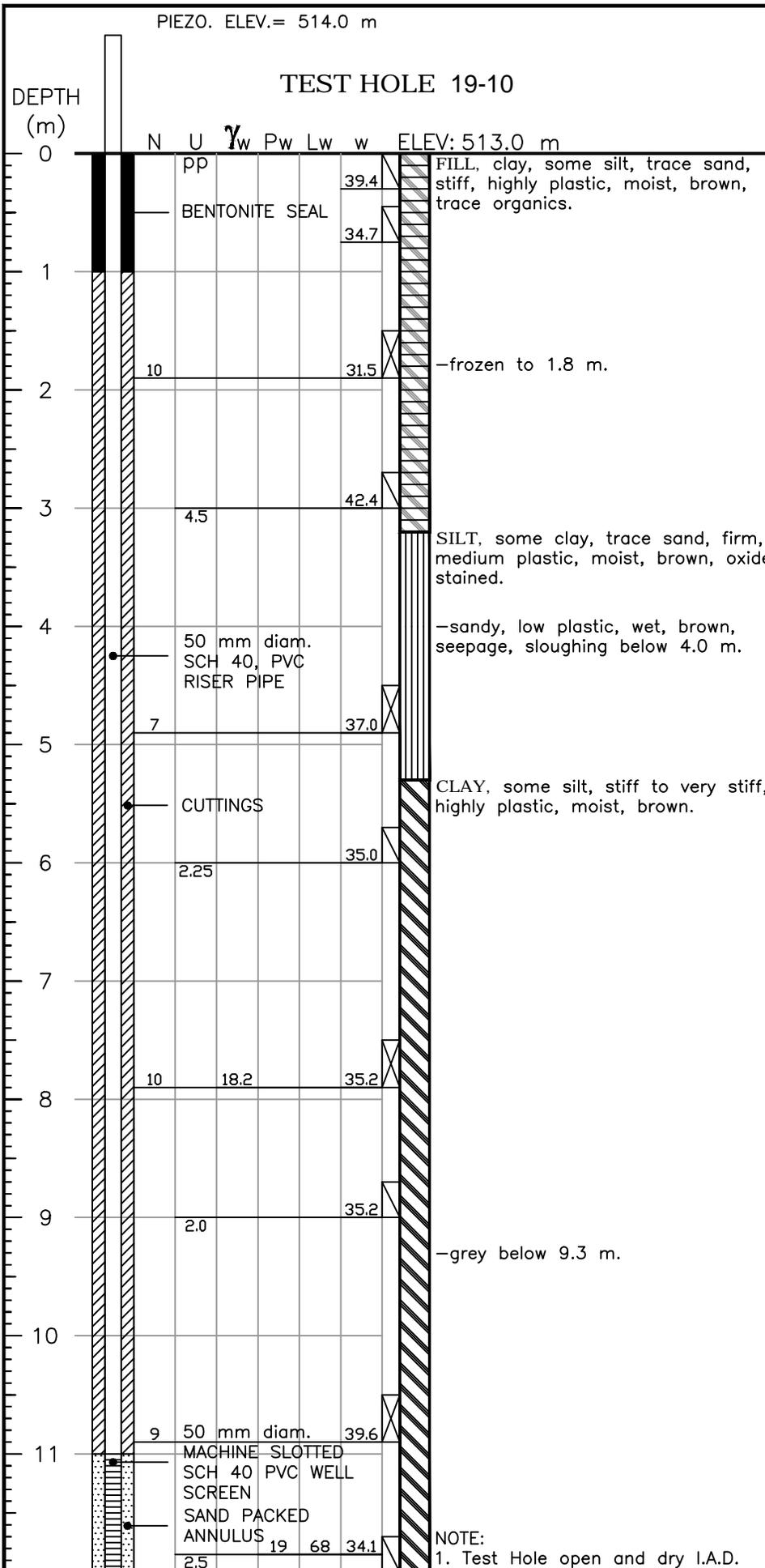
LOCATION:

SASKATOON, SK

NORTHING: 5770883 EASTING: 391391

DATE DRILLED:  
FEB 21/19

DRAWING NUMBER:  
15145-10



**LEGEND:**

|         |      |        |      |      |      |              |
|---------|------|--------|------|------|------|--------------|
|         |      |        |      |      |      |              |
| TOPSOIL | FILL | GRAVEL | SAND | SILT | CLAY | GLACIAL TILL |

- w.....WATER CONTENT (PERCENT OF DRY SOIL WEIGHT)
  - Lw...LIQUID LIMIT
  - Pw...PLASTIC LIMIT
  - $\gamma_w$ ...WET UNIT WEIGHT (kN/m<sup>3</sup>)
  - U.....UNCONFINED COMPRESSIVE STRENGTH (kPa)
  - pp...POCKET PENETROMETER (kg/cm<sup>2</sup>)
  - N.....STANDARD PENETRATION TEST (SAFETY HAMMER w/AUTOMATIC TRIP) (50/125 = BLOWS/SAMPLER PENETRATION [mm])
  - SO<sub>4</sub>.....SULPHATE CONTENT (PERCENT OF DRY SOIL WEIGHT)
  - P200...% PASSING No. 200 SIEVE
  - I.A.D.....IMMEDIATELY AFTER DRILLING
  - ▽...RECORDED WATER LEVEL (TEST HOLE I.A.D.)
  - ▼...RECORDED WATER LEVEL (PIEZO)
- |             |             |          |
|-------------|-------------|----------|
|             |             |          |
| SHELBY TUBE | SPLIT SPOON | CUTTINGS |

LIMITATIONS: THE FIELD DRILL LOG IS A SUMMARY OF THE SUBSURFACE CONDITIONS ENCOUNTERED AT THE SPECIFIC TEST HOLE LOCATION AT THE TIME OF TEST DRILLING. SUBSURFACE CONDITIONS MAY VARY AT OTHER LOCATIONS OF THIS SITE AND, IN TIME, MAY CHANGE AT THIS SPECIFIC TEST HOLE LOCATION.

**P. MACHIBRODA  
ENGINEERING  
LTD.**

**FIELD DRILL LOG  
AND  
SOIL TEST RESULTS**

PROJECT:  
**PROPOSED GREENBRYRE ESTATES  
PHASE III**

LOCATION:  
  
**SASKATOON, SK**

NORTHING: 5770734 EASTING: 391311

|                                   |                                    |
|-----------------------------------|------------------------------------|
| DATE DRILLED:<br><b>MAR 12/19</b> | DRAWING NUMBER:<br><b>15145-11</b> |
|-----------------------------------|------------------------------------|

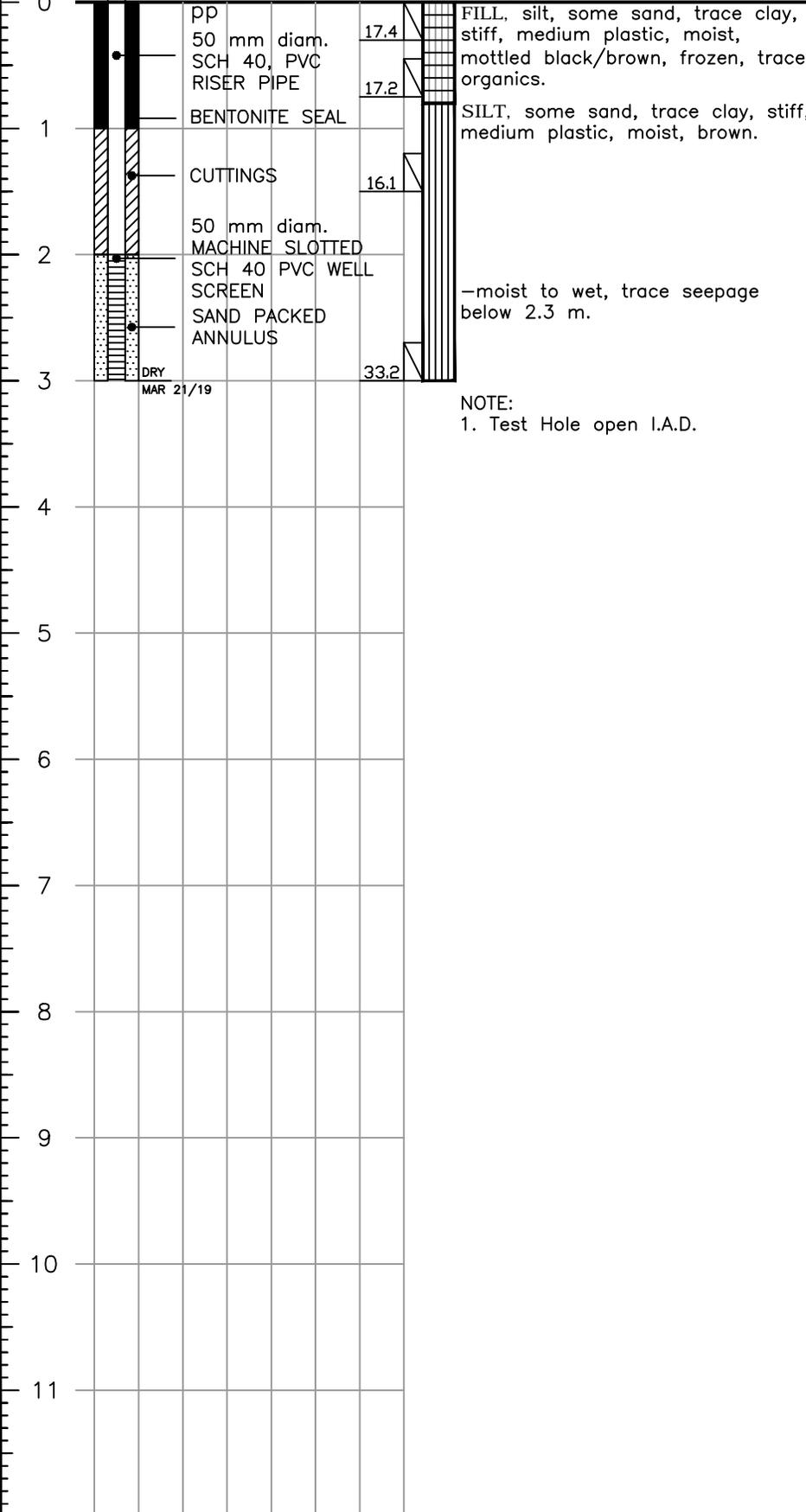
NOTE:  
1. Test Hole open and dry I.A.D.

PIEZO. ELEV.= 509.1 m

TEST HOLE 19-11

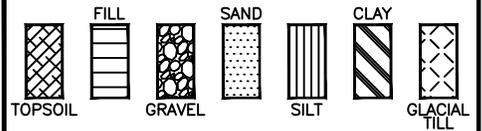
DEPTH (m)

N U  $\gamma_w$  Pw Lw w ELEV: 508.0 m



NOTE:  
1. Test Hole open I.A.D.

LEGEND:



- w.....WATER CONTENT (PERCENT OF DRY SOIL WEIGHT)
- Lw...LIQUID LIMIT
- Pw...PLASTIC LIMIT
- $\gamma_w$ ...WET UNIT WEIGHT (kN/m<sup>3</sup>)
- U.....UNCONFINED COMPRESSIVE STRENGTH (kPa)
- pp...POCKET PENETROMETER (kg/cm<sup>2</sup>)
- N.....STANDARD PENETRATION TEST (SAFETY HAMMER w/AUTOMATIC TRIP) (50/125 = BLOWS/SAMPLER PENETRATION [mm])
- SO<sub>4</sub>.....SULPHATE CONTENT (PERCENT OF DRY SOIL WEIGHT)
- P200...% PASSING No. 200 SIEVE
- I.A.D.....IMMEDIATELY AFTER DRILLING
- ∇...RECORDED WATER LEVEL (TEST HOLE I.A.D.)
- ▼...RECORDED WATER LEVEL (PIEZO)
- SHELBY TUBE
- ⊠ SPLIT SPOON
- CUTTINGS

LIMITATIONS: THE FIELD DRILL LOG IS A SUMMARY OF THE SUBSURFACE CONDITIONS ENCOUNTERED AT THE SPECIFIC TEST HOLE LOCATION AT THE TIME OF TEST DRILLING. SUBSURFACE CONDITIONS MAY VARY AT OTHER LOCATIONS OF THIS SITE AND, IN TIME, MAY CHANGE AT THIS SPECIFIC TEST HOLE LOCATION.



P. MACHIBRODA  
ENGINEERING  
LTD.

FIELD DRILL LOG  
AND  
SOIL TEST RESULTS

PROJECT:  
PROPOSED GREENBRYRE ESTATES  
PHASE III

LOCATION:

SASKATOON, SK

NORTHING: 5770773 EASTING: 391127

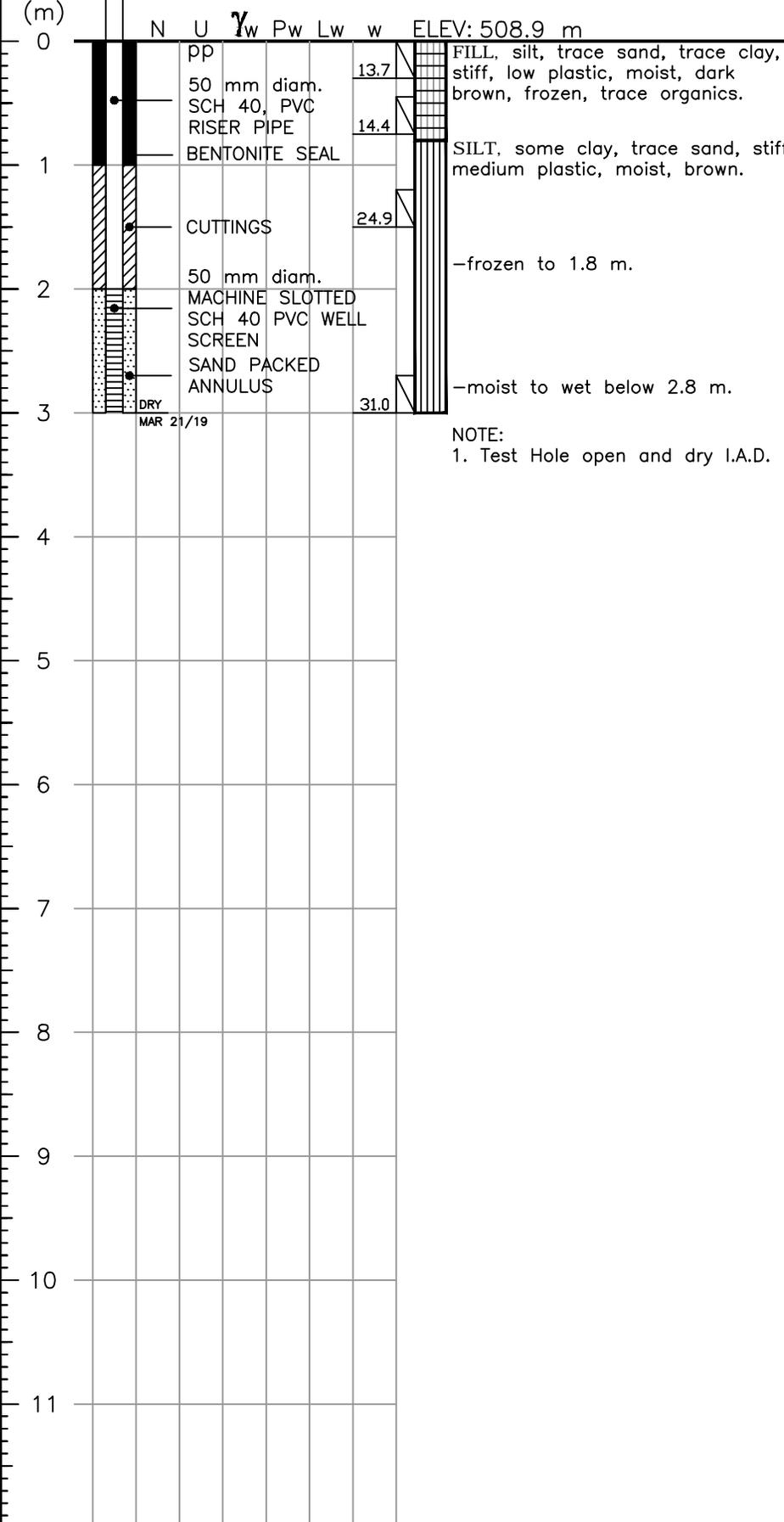
DATE DRILLED:  
MAR 12/19

DRAWING NUMBER:  
15145-12

PIEZO. ELEV.= 509.7 m

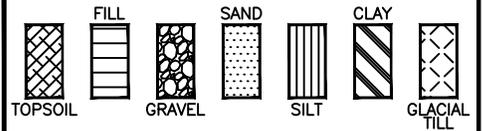
### TEST HOLE 19-12

DEPTH (m)



NOTE:  
1. Test Hole open and dry I.A.D.

LEGEND:



- w.....WATER CONTENT (PERCENT OF DRY SOIL WEIGHT)
- Lw...LIQUID LIMIT
- Pw...PLASTIC LIMIT
- $\gamma_w$ ...WET UNIT WEIGHT (kN/m<sup>3</sup>)
- U.....UNCONFINED COMPRESSIVE STRENGTH (kPa)
- pp...POCKET PENETROMETER (kg/cm<sup>2</sup>)
- N.....STANDARD PENETRATION TEST (SAFETY HAMMER w/AUTOMATIC TRIP) (50/125 = BLOWS/SAMPLER PENETRATION [mm])
- SO<sub>4</sub>.....SULPHATE CONTENT (PERCENT OF DRY SOIL WEIGHT)
- P200...% PASSING No. 200 SIEVE
- I.A.D.....IMMEDIATELY AFTER DRILLING
- ∇...RECORDED WATER LEVEL (TEST HOLE I.A.D.)
- ▼...RECORDED WATER LEVEL (PIEZO)
- SHELBY TUBE
- ⊠ SPLIT SPOON
- CUTTINGS

LIMITATIONS: THE FIELD DRILL LOG IS A SUMMARY OF THE SUBSURFACE CONDITIONS ENCOUNTERED AT THE SPECIFIC TEST HOLE LOCATION AT THE TIME OF TEST DRILLING. SUBSURFACE CONDITIONS MAY VARY AT OTHER LOCATIONS OF THIS SITE AND, IN TIME, MAY CHANGE AT THIS SPECIFIC TEST HOLE LOCATION.



P. MACHIBRODA  
ENGINEERING  
LTD.

#### FIELD DRILL LOG AND SOIL TEST RESULTS

PROJECT:  
PROPOSED GREENBRYRE ESTATES  
PHASE III

LOCATION:

SASKATOON, SK

NORTHING: EASTING:

DATE DRILLED:  
MAR 12/19

DRAWING NUMBER:  
15145-13

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## **APPENDIX A**

Explanation of Terms on  
Test Hole Logs

---

## CLASSIFICATION OF SOILS

**Coarse-Grained Soils:** Soils containing particles that are visible to the naked eye. They include gravels and sands and are generally referred to as cohesionless or non-cohesive soils. Coarse-grained soils are soils having more than 50 percent of the dry weight larger than particle size 0.080 mm.

**Fine-Grained Soils:** Soils containing particles that are not visible to the naked eye. They include silts and clays. Fine-grained soils are soils having more than 50 percent of the dry weight smaller than particle size 0.080 mm.

**Organic Soils:** Soils containing a high natural organic content.

### Soil Classification By Particle Size

| Soil Type | Particles of Size |
|-----------|-------------------|
| Clay      | < 0.002 mm        |
| Silt      | 0.002 – 0.060 mm  |
| Sand      | 0.06 – 2.0 mm     |
| Gravel    | 2.0 – 60 mm       |
| Cobbles   | 60 – 200 mm       |
| Boulders  | >200 mm           |

### TERMS DESCRIBING CONSISTENCY OR CONDITION

**Coarse-grained soils:** Described in terms of compactness condition and are often interpreted from the results of a Standard Penetration Test (SPT). The standard penetration test is described as the number of blows, N, required to drive a 51 mm outside diameter (O.D.) split barrel sampler into the soil a distance of 0.3 m (from 0.15 m to 0.45 m) with a 63.5 kg weight having a free fall of 0.76 m.

| Compactness Condition | SPT N-Index (blows per 0.3 m) |
|-----------------------|-------------------------------|
| Very loose            | 0-4                           |
| Loose                 | 4-10                          |
| Compact               | 10-30                         |
| Dense                 | 30-50                         |
| Very dense            | Over 50                       |

**Fine-Grained Soils:** Classified in relation to undrained shear strength.

| Consistency | Undrained Shear Strength (kPa) | N Value (Approximate) | Field Identification   |
|-------------|--------------------------------|-----------------------|--|
| Very Soft   | <12                            | 0-2                   | Easily penetrated several centimetres by the fist.                       |
| Soft        | 12-25                          | 2-4                   | Easily penetrated several centimetres by the thumb.                      |
| Firm        | 25-50                          | 4-8                   | Can be penetrated several centimetres by the thumb with moderate effort. |
| Stiff       | 50-100                         | 8-15                  | Readily indented by the thumb, but penetrated only with great effort.    |
| Very Stiff  | 100-200                        | 15-30                 | Readily indented by the thumb nail.                                      |
| Hard        | >200                           | >30                   | Indented with difficulty by the thumbnail.                               |

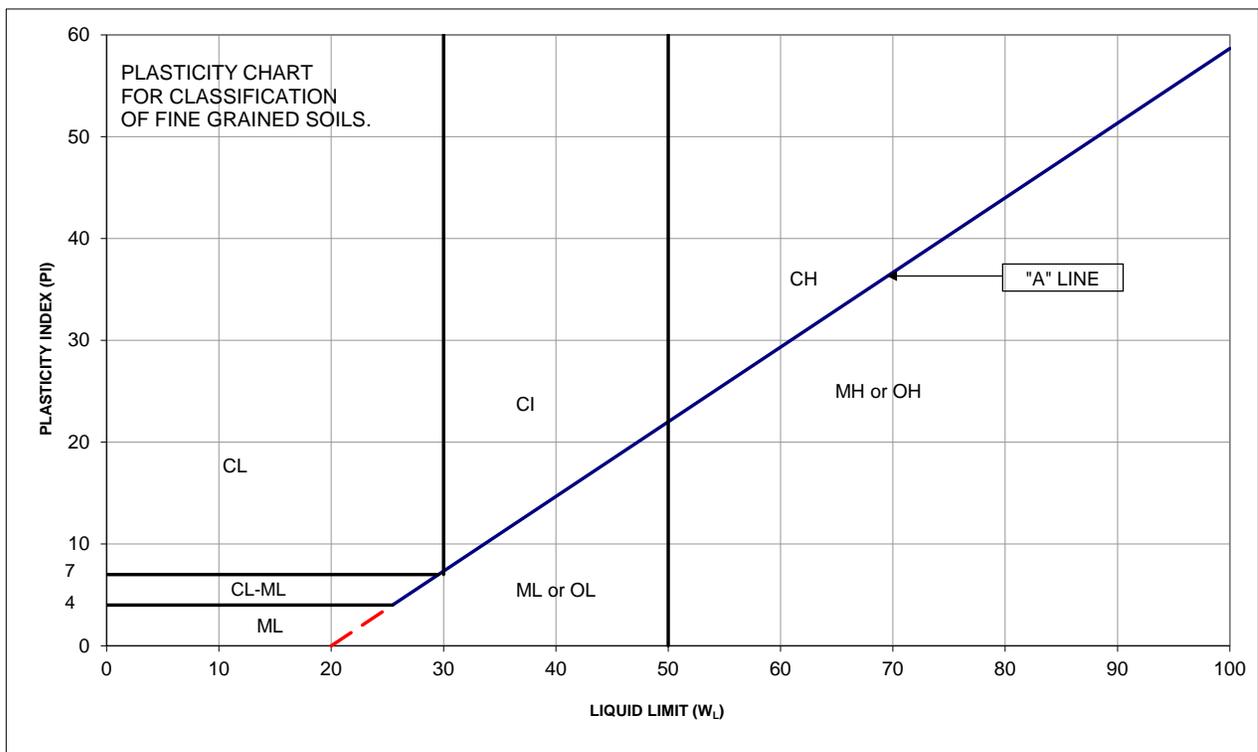
**Organic Soils:** Readily identified by colour, odour, spongy feel and frequently by fibrous texture.

### DESCRIPTIVE TERMS COMMONLY USED TO CHARACTERIZE SOILS

|               |   |
|---------------|---|
| Poorly Graded | - predominance of particles of one grain size.  |
| Well Graded   | - having no excess of particles in any size range with no intermediate sizes lacking. |
| Mottled       | - marked with different coloured spots.   |
| Nuggety       | - structure consisting of small prismatic cubes.                                      |
| Laminated     | - structure consisting of thin layers of varying colour and texture.                  |
| Slickensided  | - having inclined planes of weakness that are slick and glossy in appearance.         |
| Fissured      | - containing shrinkage cracks.  |
| Fractured     | - broken by randomly oriented interconnecting cracks in all 3 dimensions              |

**SOIL CLASSIFICATION SYSTEM (MODIFIED U.S.C.)**

| MAJOR DIVISION   |   | GROUP SYMBOL                     | TYPICAL DESCRIPTION   | LABORATORY CLASSIFICATION CRITERIA  |
|--|---|----------------------------------|---|---|
| HIGHLY ORGANIC SOILS   |   | Pt                               | PEAT AND OTHER HIGHLY ORGANIC SOILS   | STRONG COLOUR OR ODOUR AND OFTEN FIBROUS TEXTURE  |
| COARSE-GRAINED SOILS (MORE THAN HALF BY WEIGHT LARGER THAN NO. 200 SIEVE SIZE) | GRAVELS<br>More than half coarse fraction larger than No. 4 sieve size  | CLEAN GRAVELS                    | GW<br>WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES <5% FINES                         | $C_u = \frac{D_{60}}{D_{10}} > 4$ $C_c = \frac{(D_{30})^2}{D_{60} \times D_{10}} = 1 \text{ to } 3$ |
|  |   |                                  | GP<br>POORLY-GRADED GRAVELS AND GRAVEL-SAND MIXTURES <5% FINES                    | NOT MEETING ALL ABOVE REQUIREMENTS FOR GW   |
|  |   | DIRTY GRAVELS                    | GM<br>SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES >12% FINES                         | ATTERBERG LIMITS BELOW "A" LINE OR $PI < 4$   |
|  |   |                                  | GC<br>CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES >12% FINES                        | ATTERBERG LIMITS ABOVE "A" LINE WITH $PI > 7$   |
|  | SANDS<br>More than half coarse fraction smaller than No. 4 sieve size   | CLEAN SANDS                      | SW<br>WELL-GRADED SANDS, GRAVELLY SANDS MIXTURES <5% FINES                        | $C_u = \frac{D_{60}}{D_{10}} > 6$ $C_c = \frac{(D_{30})^2}{D_{60} \times D_{10}} = 1 \text{ to } 3$ |
|  |   |                                  | SP<br>POORLY-GRADED SANDS OR GRAVELLY SANDS <5% FINES                             | NOT MEETING ALL GRADATION REQUIREMENTS FOR SW   |
|  |   | DIRTY SANDS                      | SM<br>SILTY SANDS, SAND-SILT MIXTURES >12% FINES                                  | ATTERBERG LIMITS BELOW "A" LINE OR $PI < 4$   |
|  |   |                                  | SC<br>CLAYEY SANDS, SAND-CLAY MIXTURES >12% FINES                                 | ATTERBERG LIMITS ABOVE "A" LINE WITH $PI > 7$   |
| FINE-GRAINED SOILS (MORE THAN HALF BY WEIGHT PASSING NO. 200 SIEVE SIZE)       | SILTS<br>Below "A" line on plasticity chart; negligible organic content | ML                               | INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY SANDS OF SLIGHT PLASTICITY | $W_L < 50$  |
|  |   | MH                               | INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS, FINE SANDY OR SILTY SOILS             | $W_L > 50$  |
|  | CLAYS<br>Above "A" line on plasticity chart; negligible organic content | CL                               | INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY, OR SILTY CLAYS, LEAN CLAYS    | $W_L < 30$  |
|  |   | CI                               | INORGANIC CLAYS OF MEDIUM PLASTICITY, SILTY CLAYS                                 | $W_L > 30 < 50$   |
|  |   | CH                               | INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS                                     | $W_L > 50$  |
|  | ORGANIC SILTS & ORGANIC CLAYS<br>Below "A" line on plasticity chart     | OL                               | ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY                           | $W_L < 50$  |
| OH   |   | ORGANIC CLAYS OF HIGH PLASTICITY | $W_L > 50$  |   |

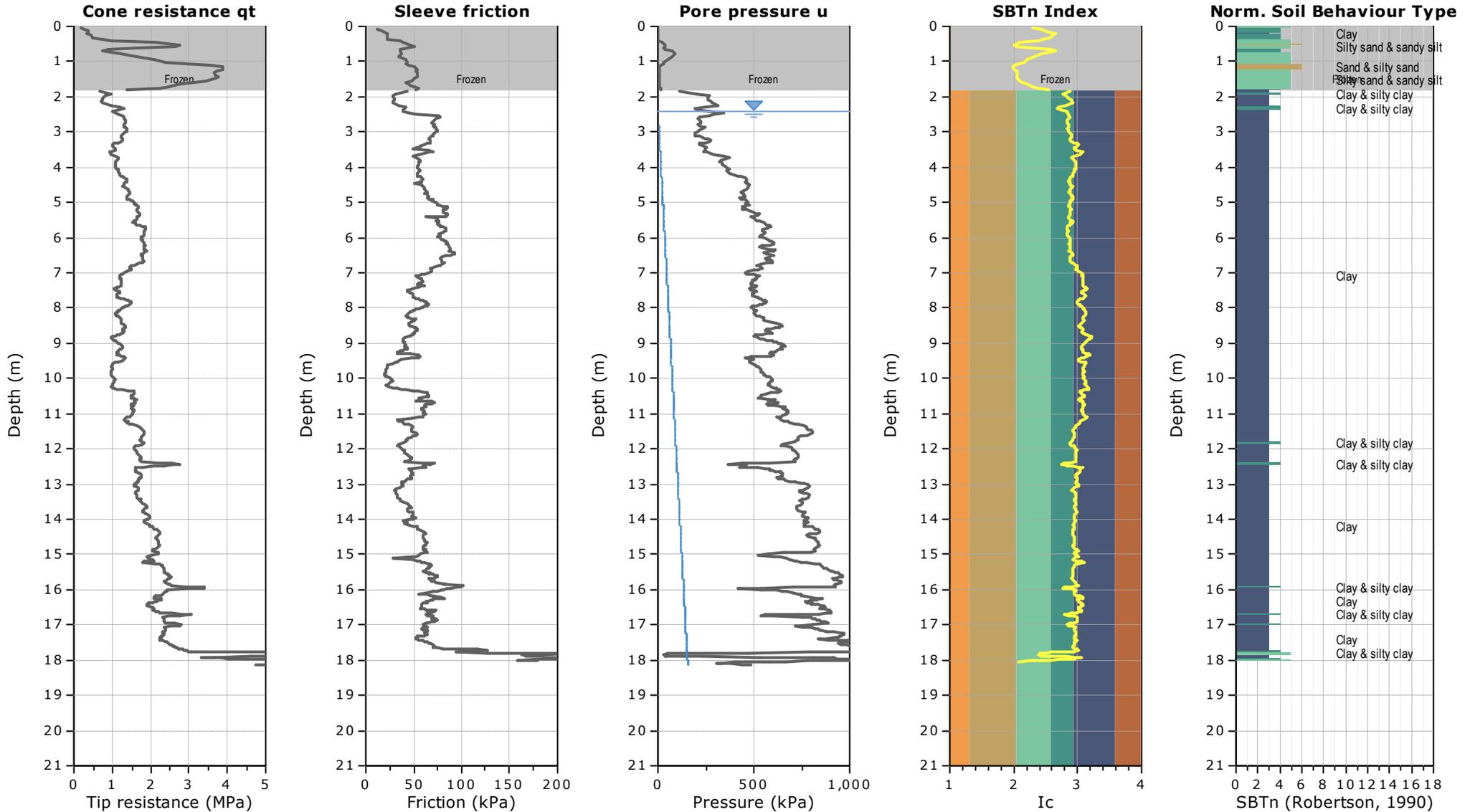


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# APPENDIX B

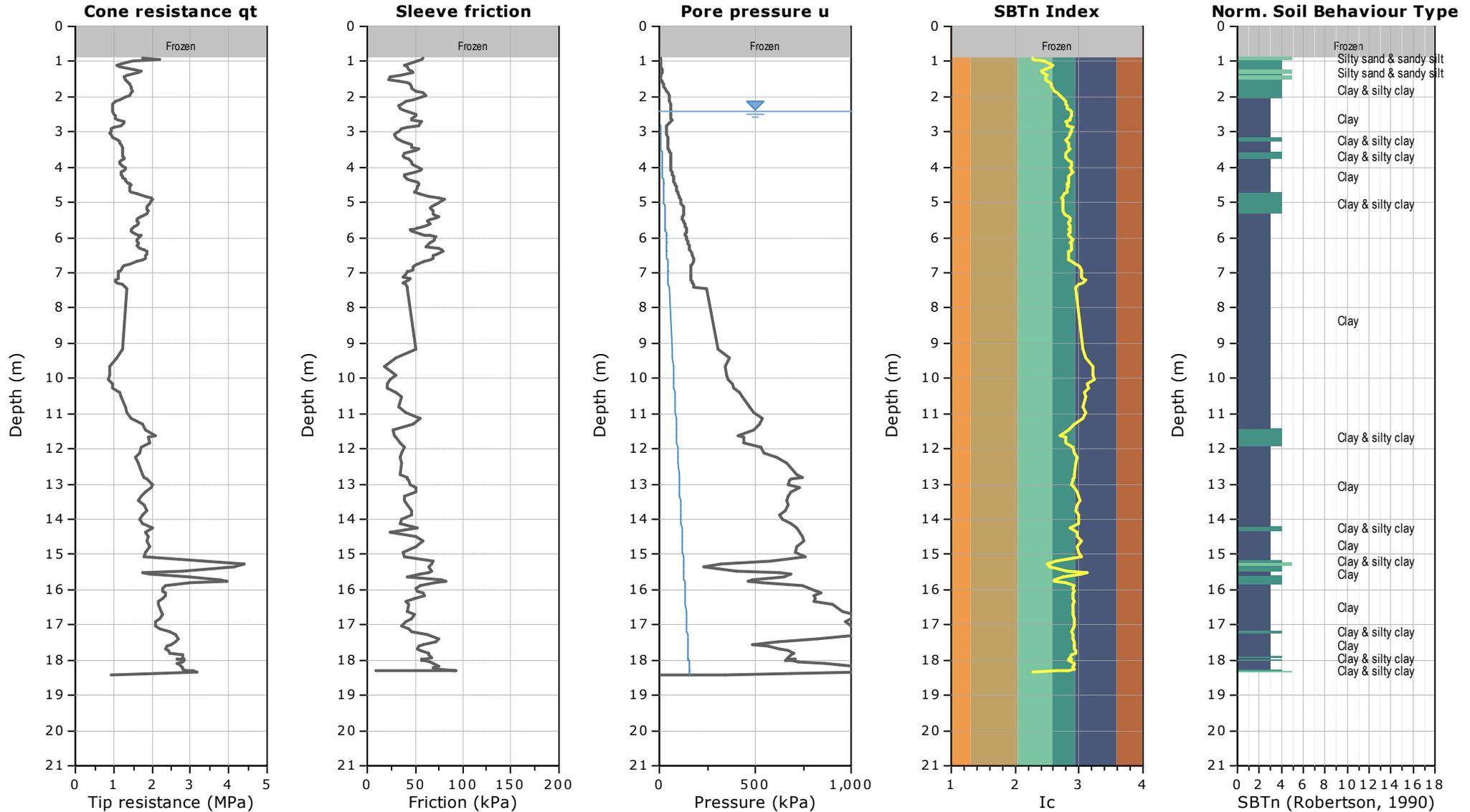
CPTu Plots

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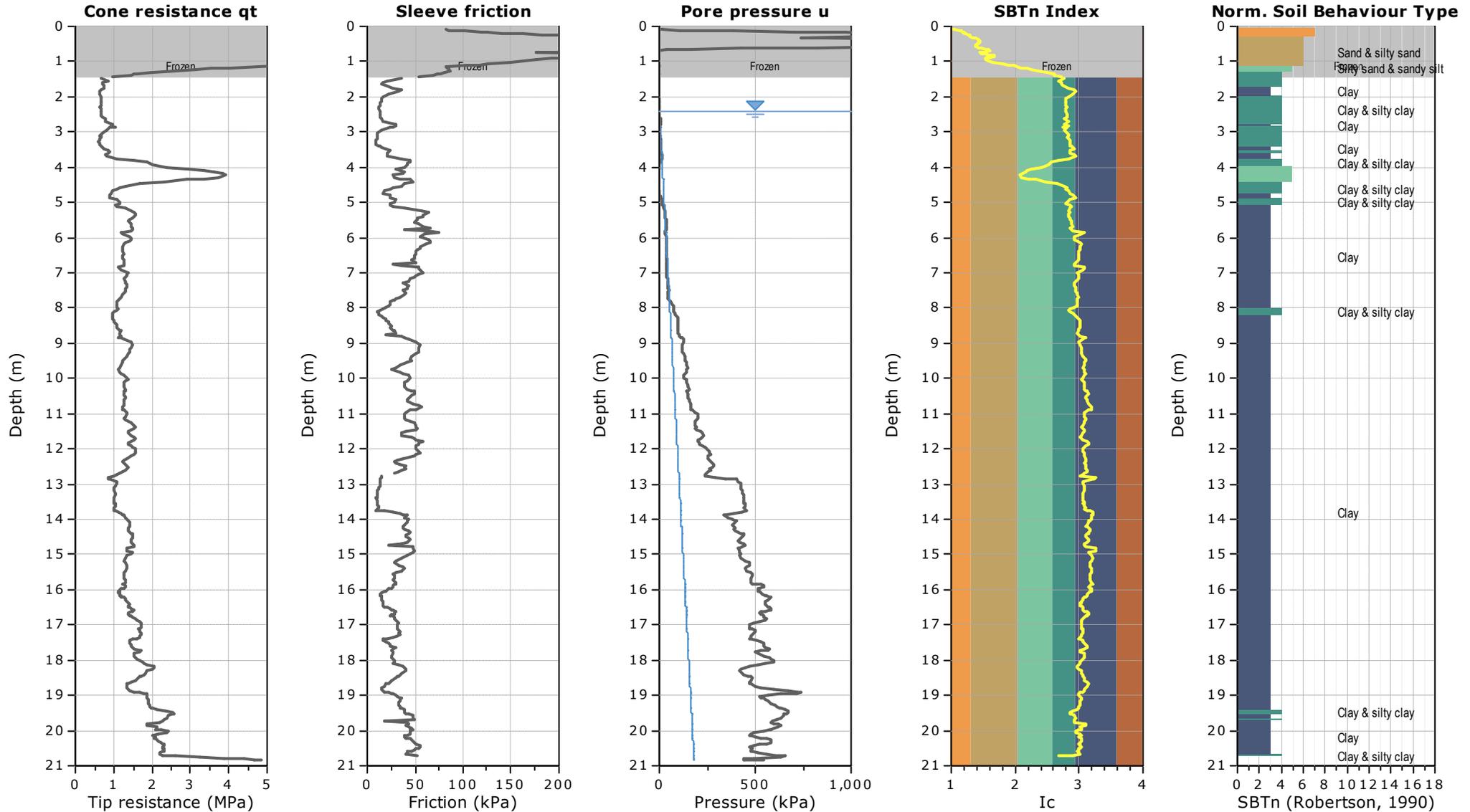


**Project:** Proposed Greenbryre Estates Phase III  
**Location:** Saskatoon, SK



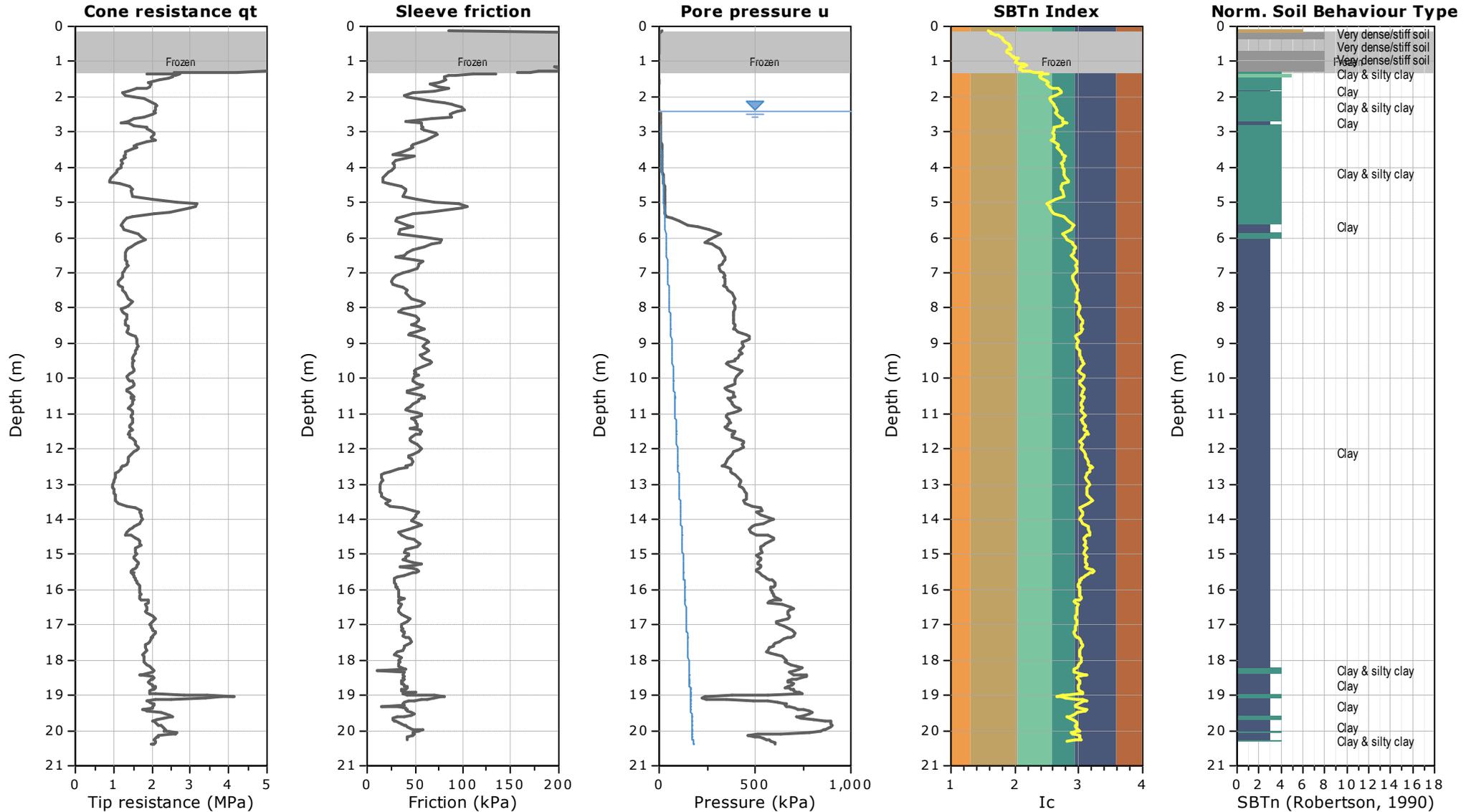


**Project:** Proposed Greenbryre Estates Phase III  
**Location:** Saskatoon, SK





**Project:** Proposed Greenbryre Estates Phase III  
**Location:** Saskatoon, SK



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# **APPENDIX C**

Grain Size Distribution  
Analysis Results

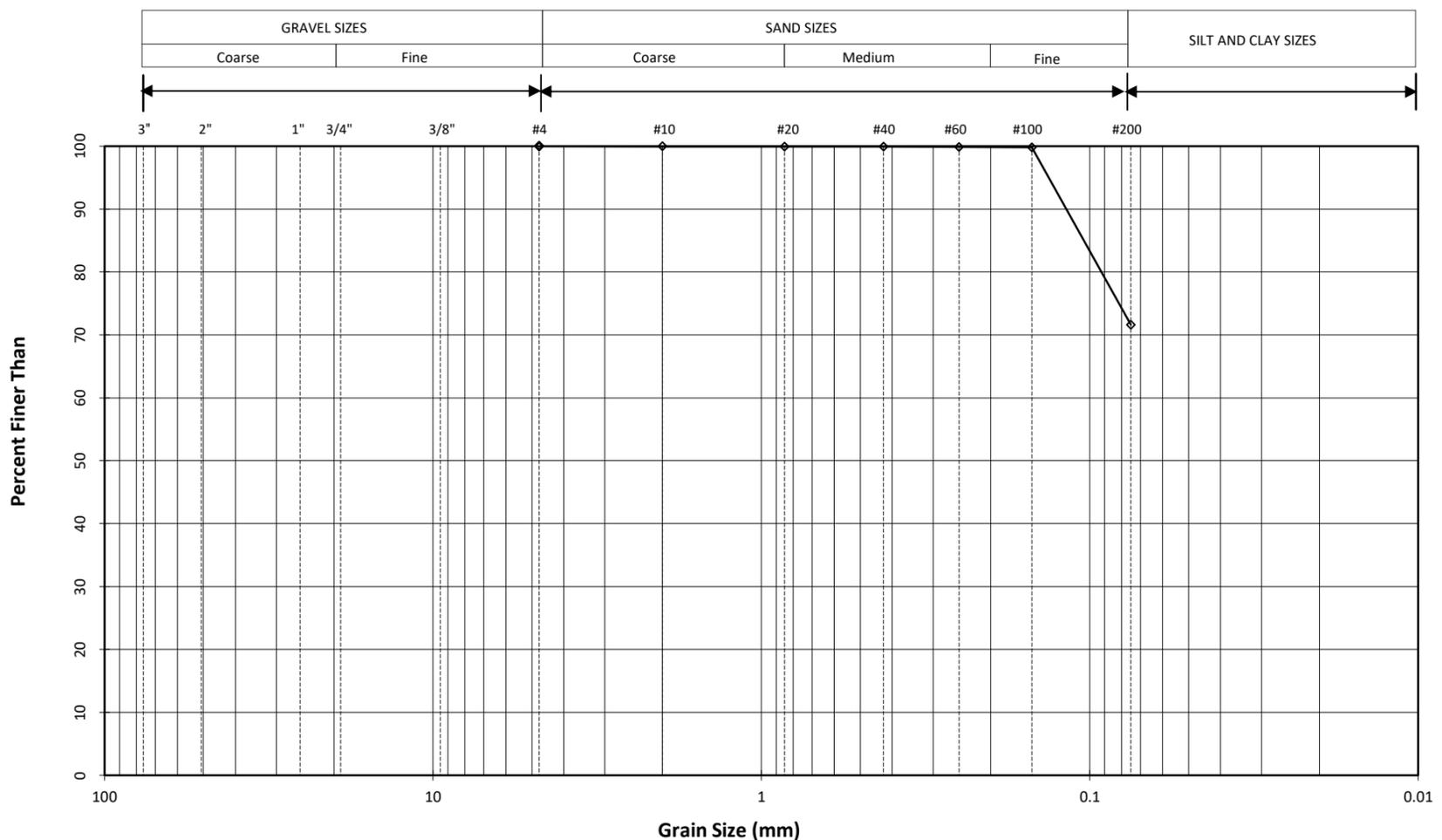
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**Project:** Greenbryre Estates Phase III  
**Location:** Saskatoon, SK.  
**Project No.:** 15145  
**Date Tested:** March 20, 2019  
**Test Hole No:** 19-7  
**Sample No.:** 55  
**Depth:** 1.5

| Sieve | Diameter<br>mm | %<br>Finer |
|-------|----------------|------------|
|       | 76.200         | 100        |
|       | 63.500         | 100        |
|       | 50.000         | 100        |
|       | 37.500         | 100        |
|       | 25.000         | 100        |
|       | 19.000         | 100        |
|       | 12.500         | 100        |
|       | 9.500          | 100        |
|       | 4.750          | 100        |
|       | 2.000          | 100        |
|       | 0.850          | 100        |
|       | 0.425          | 100        |
|       | 0.250          | 100        |
|       | 0.150          | 100        |
|       | 0.075          | 72         |

**Material Description:**

|                     |                    |                             |
|---------------------|--------------------|-----------------------------|
| % Gravel Sizes<br>0 | % Sand Sizes<br>28 | % Silt and Clay Sizes<br>72 |
|---------------------|--------------------|-----------------------------|

**Remarks:**


DRAWING NO.

**Appendix C-2**

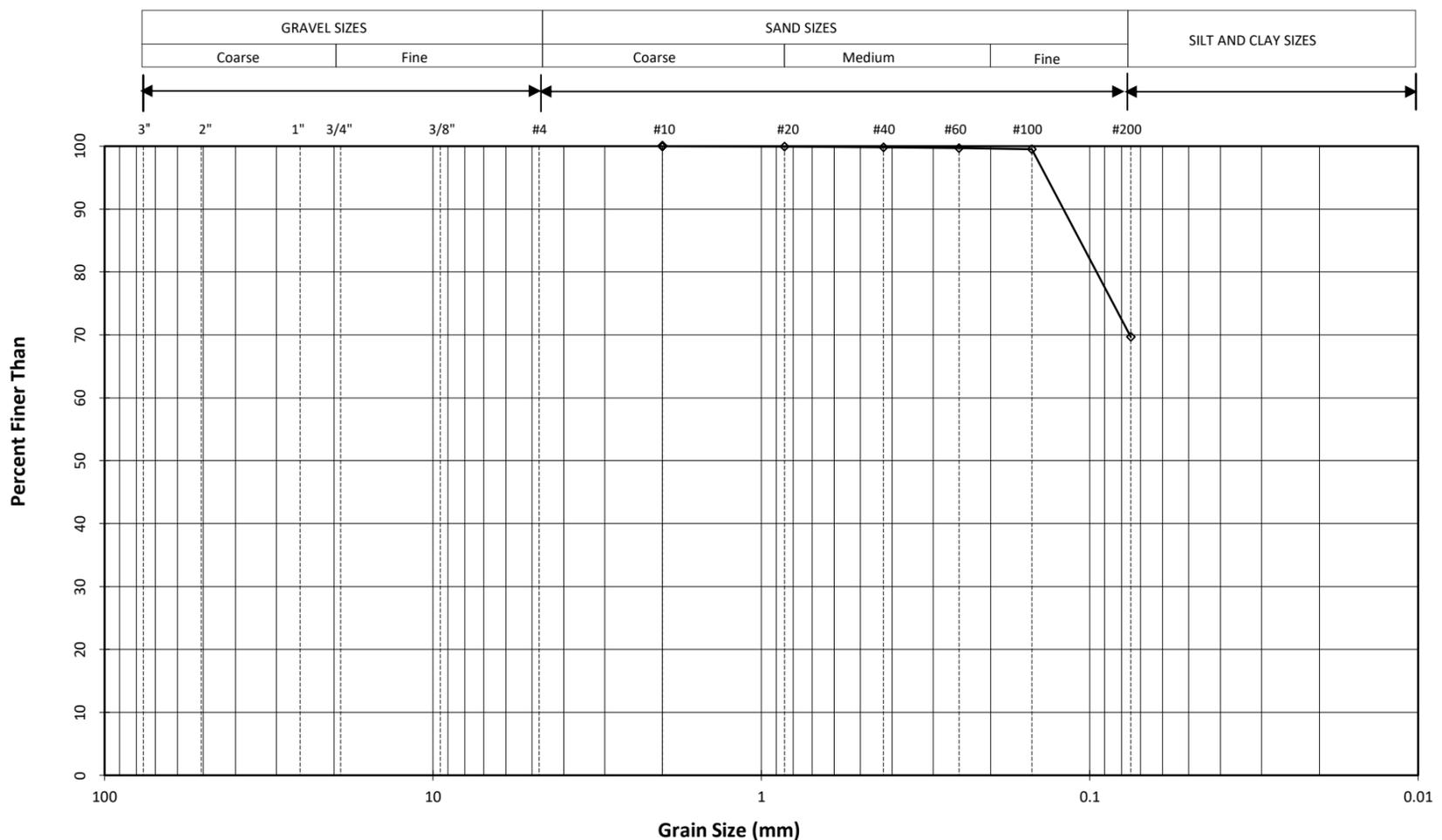
WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE  
 WITH ASTM C136 AND C117 STANDARDS  
 P. MACHIBRODA ENGINEERING LTD.  
 PER *Preston Schergerwitz*

**Project:** Greenbryre Estates Phase III  
**Location:** Saskatoon, SK.  
**Project No.:** 15145  
**Date Tested:** March 20, 2019  
**Test Hole No:** 19-6  
**Sample No.:** 44  
**Depth:** 0.8

| Sieve | Diameter<br>mm | %<br>Finer |
|-------|----------------|------------|
|       | 76.200         | 100        |
|       | 63.500         | 100        |
|       | 50.000         | 100        |
|       | 37.500         | 100        |
|       | 25.000         | 100        |
|       | 19.000         | 100        |
|       | 12.500         | 100        |
|       | 9.500          | 100        |
|       | 4.750          | 100        |
|       | 2.000          | 100        |
|       | 0.850          | 100        |
|       | 0.425          | 100        |
|       | 0.250          | 100        |
|       | 0.150          | 99         |
|       | 0.075          | 70         |

**Material Description:**

|                     |                    |                             |
|---------------------|--------------------|-----------------------------|
| % Gravel Sizes<br>0 | % Sand Sizes<br>30 | % Silt and Clay Sizes<br>70 |
|---------------------|--------------------|-----------------------------|

**Remarks:**


DRAWING NO.

**Appendix C-1**

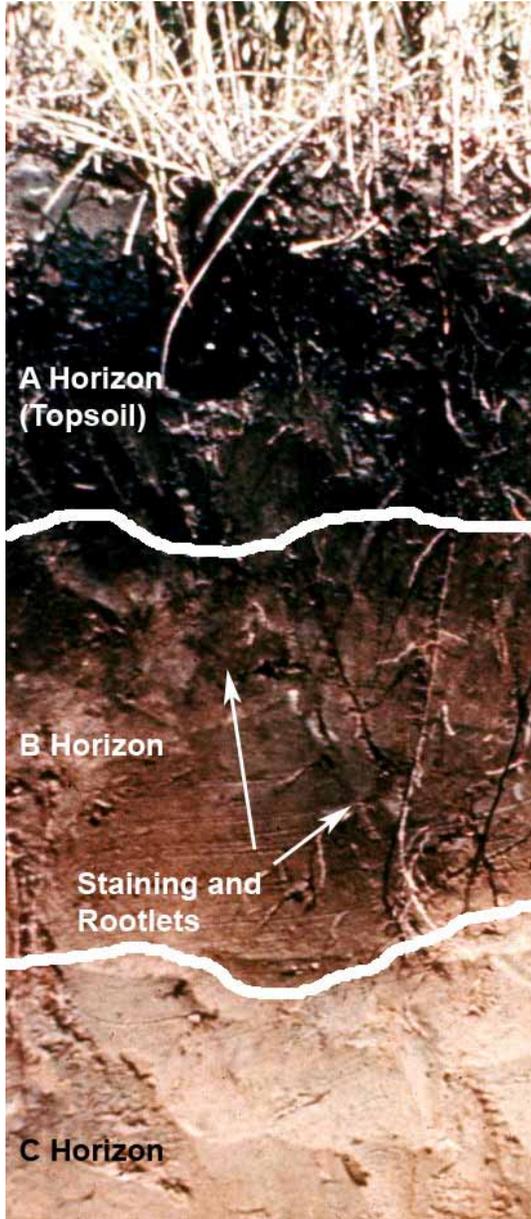
WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE  
 WITH ASTM C136 AND C117 STANDARDS  
 P. MACHIBRODA ENGINEERING LTD.  
 PER *Preston Scherwitz*

---

## **APPENDIX D**

Topsoil, Organic Matter  
and Organics

---



#### A Horizon

The A horizon is the topsoil layer of the soil strata. It is characterized by a build up of organic matter, and a lower unit weight than subsequent layers. The organic matter content of this layer is typically 4-10% by mass.

The colour of this horizon varies from dark black to brown, depending on surface vegetation and climatic conditions.

#### B Horizon

Typically reddish brown in colour and contains accumulations of matter that have been washed down from the A Horizon. The B horizon is generally composed of clay that has been washed out of the A Horizon, but can also contain iron, calcium and sodium deposits as well.

#### C Horizon

Unweathered parent soil.

Topsoil is a mixture of mineral soil and organic matter. The organic matter is developed from decaying biological material (leaves, grass, trees, animals, etc.) and contributes to the brown to black colour of the soil. Following the topsoil is the B horizon which is a transition layer, where staining from the overlying topsoil is common. This results in a darker colour of the soil immediately below the organic topsoil layer. Depending on the surface vegetation, rootlets may be present below the depth of topsoil. However it should be recognized that these rootlets are not the same as organic matter in topsoil.

Physically speaking in comparison to mineral soil, topsoil has a significantly lower bulk density and a lower unit weight as compared to the underlying parent soil. This is due to larger pore spaces and non mineral materials in the soil matrix. Along with lower density, topsoil is often spongy and colloidal/fibrous. The following figure is of a typical prairie soil. Each horizon is labelled accordingly to demonstrate a typical soil profile.

#### Reference

Henry L. 2003. Henry's Handbook of Soil and Water, Henry Perspectives, Saskatoon, SK.

---

# APPENDIX E

Traffic Information

---

## Cindy Bettin

---

**From:** Gray, Nathan <Nathan.Gray@wsp.com>  
**Sent:** Monday, March 25, 2019 9:49 PM  
**To:** Jennifer Krasowski  
**Cc:** Thai, Amy  
**Subject:** FW: Traffic - Roadways within Greenbryre Phase 3

Hello Jennifer,

Please see the information below.

Let me know if you have any further questions.

Thanks,

Nathan

---

**From:** Thai, Amy  
**Sent:** March-25-19 2:25 PM  
**To:** Gray, Nathan <Nathan.Gray@wsp.com>  
**Subject:** RE: Traffic - Roadways within Greenbryre Phase 3

Hi Nathan, please see below.

- Would you classify the main access roads (Greenbryre Drive, Greenbryre Crescent North, and Greenbryre Avenue) as residential – collector roads and the other cul de sac roads as residential – local; or would they all be classified as residential – local roads?
  - All roadways within the boundary of the development are local roads.
- What would be the AADT for the roads (at year 1)? Should I use a different AADT for the Cul de Sac roads? I noted on Figure 5 it said the AM/PM peak hour traffic but wasn't sure how to back calculate that to the AADT.
  - The PM peak hour traffic volumes are typically between 8% - 12% of the AADT. Please note that the PM volumes in the report are for the total phase 3 development. The volumes on each road would slightly differ depending on the number of units on that road, and are anticipated to be between 500 – 1000 vehicles per day.
- On page 5 – it mentioned a 1% growth factor until 2025. I am assuming 2025 is the assumed year to when development of the lots is nearing completion and occupancy is near 100%? So based on that is this a correct assumption: construction year 2019, growth factor of 1% from 2019 to 2025, then growth factor of 0% after 2025.
  - 2025 was assumed to be the full build-out horizon and full site occupancy. The background growth (growth without the development) would be less than 1% annually after full build-out.
- What percent trucks would you recommend? 2%? Would it be the same for the Cul de Sac roads? Will this number be affected by build out (i.e., higher percentage of trucks until 2025 during development of the lots and then less after 2025 when development is minimal?)
  - As it is a residential area, we do not anticipate large numbers of heavy vehicles, aside from school buses, garbage and delivery trucks. There may be higher %heavy vehicles during construction of the internal lots. However, heavy vehicles are expected to be < 2% for daily operations after the completion of the development.

- What type (or types) of commercial vehicle would you assume? If multiple types, what would be the percent of each type? Do you have recommended Load Equivalency Values for the truck types?
  - [See above.](#)
- How many buses per day? Is this the same for the cul de sac roads?
  - [See above.](#)

Amy

---

**From:** Gray, Nathan  
**Sent:** March-21-19 2:11 PM  
**To:** Thai, Amy <[Amy.Thai@wsp.com](mailto:Amy.Thai@wsp.com)>  
**Subject:** FW: Traffic - Roadways within Greenbryre Phase 3

Hey, let's discuss this.

nathan

---

**From:** Jennifer Krasowski <[j.krasowski@machibroda.com](mailto:j.krasowski@machibroda.com)>  
**Sent:** March-21-19 12:44 PM  
**To:** Gray, Nathan <[Nathan.Gray@wsp.com](mailto:Nathan.Gray@wsp.com)>  
**Cc:** Carleen Bartel <[c.bartel@cwce.ca](mailto:c.bartel@cwce.ca)>; [troy@dshomes.ca](mailto:troy@dshomes.ca); Cory Zubrowski <[c.zubrowski@machibroda.com](mailto:c.zubrowski@machibroda.com)>  
**Subject:** RE: Traffic - Roadways within Greenbryre Phase 3

Thanks Nathan.

**Jennifer Krasowski, P.Eng.**

**P. Machibroda Engineering Ltd.**

806 - 48th Street East | Saskatoon, SK | S7K 3Y4  
T: 1-306-665-8444

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**From:** Gray, Nathan [<mailto:Nathan.Gray@wsp.com>]  
**Sent:** March-21-19 12:18 PM  
**To:** Jennifer Krasowski  
**Cc:** Carleen Bartel; [troy@dshomes.ca](mailto:troy@dshomes.ca); Cory Zubrowski  
**Subject:** RE: Traffic - Roadways within Greenbryre Phase 3

Hello Jennifer,

I apologize as I was out of the office for the past couple of days on the road.

I am sure we can provide information for you to answer the questions below.

Talk to you soon,

**TRAFFIC INFORMATION**

**TABLE D1 Provided and Assumed Traffic Data**

| Parameter                                |                    | Curvilinear & Loop Roads | Cul de Sac Roads |
|--|--------------------|--------------------------|------------------|
| Design Life (years)                      |                    | 20                       | 20               |
| AADT (year 2019)                         |                    | 280                      | 30               |
| Buses (per day)                          |                    | 8                        | 0                |
| % Commercial                             | 2019 - 2025        | 5%                       | 10%              |
|  | 2026-2038          | 2%                       | 2%               |
| Directional Split                        |                    | 50%                      |                  |
| Load Distribution Factor - Truck         | 2019 - 2025        | Single Unit Trucks       | 50%              |
|  |                    | Tractor Semi-Trailer     | 50%              |
|  | 2025 - 2038        | Single Unit Trucks       | 100%             |
|  |                    | Tractor Semi-Trailer     | 0%               |
| Load Equivalency Factor                  | Single Unit Trucks | 1.2                      |                  |
|  | Tandem Axle        | 2.0                      |                  |
|  | Bus                | 3.0                      |                  |
| Blended Load Equivalency Factor - Trucks | 2019-2025          | 1.6                      |                  |
|  | 2025-2038          | 1.2                      |                  |
| Annual Growth (%)                        | 2019 - 2025        | 20%                      |                  |
|  | 2025 - 2038        | 0%                       |                  |

Note: Based on full build-out/site occupancy in 2025 - as per WSP TIA and email.

**DESIGN TRAFFIC VOLUME - CURVILINEAR & LOOP ROADS**

**TABLE D2 Cumulative Truck Traffic ESALs- Main Roads**

| Year | Growth Rate (per year) | AADT    | AADT - Design Lane <sup>2</sup> | Total Trucks - Design Lane (per day) <sup>3</sup> | Total Trucks - Design Lane (per year) <sup>4</sup> | ESALs - Trucks (per year) <sup>5</sup> | Cumulative ESALs - Trucks |
|------|------------------------|---------|---------------------------------|---|--|--|---------------------------|
| 0    | 2019                   | 280.0   | 140.0                           | 7.0   | 2,555.0  | 4,088.0                                | 4,088.0                   |
| 1    | 2020                   | 336.0   | 168.0                           | 8.4   | 3,066.0  | 4,905.6                                | 8,993.6                   |
| 2    | 2021                   | 403.2   | 201.6                           | 10.1  | 3,679.2  | 5,886.7                                | 14,880.3                  |
| 3    | 2022                   | 483.8   | 241.9                           | 12.1  | 4,415.0  | 7,064.1                                | 21,944.4                  |
| 4    | 2023                   | 580.6   | 290.3                           | 14.5  | 5,298.0  | 8,476.9                                | 30,421.3                  |
| 5    | 2024                   | 696.7   | 348.4                           | 17.4  | 6,357.7  | 10,172.3                               | 40,593.5                  |
| 6    | 2025                   | 836.1   | 418.0                           | 20.9  | 7,629.2  | 12,206.7                               | 52,800.2                  |
| 7    | 2026                   | 1,003.3 | 501.6                           | 10.0  | 3,662.0  | 4,394.4                                | 57,194.6                  |
| 8    | 2027                   | 1,003.3 | 501.6                           | 10.0  | 3,662.0  | 4,394.4                                | 61,589.0                  |
| 9    | 2028                   | 1,003.3 | 501.6                           | 10.0  | 3,662.0  | 4,394.4                                | 65,983.5                  |
| 10   | 2029                   | 1,003.3 | 501.6                           | 10.0  | 3,662.0  | 4,394.4                                | 70,377.9                  |
| 11   | 2030                   | 1,003.3 | 501.6                           | 10.0  | 3,662.0  | 4,394.4                                | 74,772.3                  |
| 12   | 2031                   | 1,003.3 | 501.6                           | 10.0  | 3,662.0  | 4,394.4                                | 79,166.7                  |
| 13   | 2032                   | 1,003.3 | 501.6                           | 10.0  | 3,662.0  | 4,394.4                                | 83,561.1                  |
| 14   | 2033                   | 1,003.3 | 501.6                           | 10.0  | 3,662.0  | 4,394.4                                | 87,955.5                  |
| 15   | 2034                   | 1,003.3 | 501.6                           | 10.0  | 3,662.0  | 4,394.4                                | 92,349.9                  |
| 16   | 2035                   | 1,003.3 | 501.6                           | 10.0  | 3,662.0  | 4,394.4                                | 96,744.3                  |
| 17   | 2036                   | 1,003.3 | 501.6                           | 10.0  | 3,662.0  | 4,394.4                                | 101,138.8                 |
| 18   | 2037                   | 1,003.3 | 501.6                           | 10.0  | 3,662.0  | 4,394.4                                | 105,533.2                 |
| 19   | 2038                   | 1,003.3 | 501.6                           | 10.0  | 3,662.0  | 4,394.4                                | 109,927.6                 |
| 20   | 2039                   | 1,003.3 | 501.6                           | 10.0  | 3,662.0  | 4,394.4                                | 114,322.0                 |

Where:

<sup>1</sup> 'AADT' = AADT(20XX) \* (1+Growth Rate)

<sup>2</sup> 'AADT-Design Lane' = 'AADT' \* 'Directional Split' \* 'Load Distribution Factor (Truck)'

<sup>3</sup> 'Total Trucks - Design Lane (per day)' = 'AADT - Design Lane' \* 'Percent Commercial Traffic'

<sup>4</sup> 'Total Trucks - Design Lane (per year)' = 'Total Trucks - Design Lane' \* 365

<sup>5</sup> 'ESALs - Trucks (per year)' = Blended Truck LEF \* 'Total Trucks - Design Lane (per year)'

**Design ESALS/lane**

Commercial = 114,322 Cumulative Truck Traffic for Design Life from Table D2  
Buses = 58,400 Buses/day \* 365 \* Design Life

**Design Traffic Volume (Access Roads) = 172,722 ESALS**

**DESIGN TRAFFIC VOLUME - CUL DE SAC ROADS**

**TABLE D3 Cumulative Truck Traffic ESALs - Cul De Sac Roads**

| Year | Growth Rate (per year) | AADT | AADT - Design Lane <sup>2</sup> | Total Trucks - Design Lane (per day) <sup>3</sup> | Total Trucks - Design Lane (per year) <sup>4</sup> | ESALs - Trucks (per year) <sup>5</sup> | Cumulative ESALs - Trucks |
|------|------------------------|------|---------------------------------|---|--|--|---------------------------|
| 0    | 2019                   | 20%  | 30.0                            | 15.0  | 1.5  | 547.5                                  | 876.0                     |
| 1    | 2020                   | 20%  | 36.0                            | 18.0  | 1.8  | 657.0                                  | 1,927.2                   |
| 2    | 2021                   | 20%  | 43.2                            | 21.6  | 2.2  | 788.4                                  | 3,188.6                   |
| 3    | 2022                   | 20%  | 51.8                            | 25.9  | 2.6  | 946.1                                  | 4,702.4                   |
| 4    | 2023                   | 20%  | 62.2                            | 31.1  | 3.1  | 1,135.3                                | 6,518.8                   |
| 5    | 2024                   | 20%  | 74.6                            | 37.3  | 3.7  | 1,362.4                                | 8,698.6                   |
| 6    | 2025                   | 20%  | 89.6                            | 44.8  | 4.5  | 1,634.8                                | 11,314.3                  |
| 7    | 2026                   | 0%   | 107.5                           | 53.7  | 1.1  | 392.4                                  | 11,785.2                  |
| 8    | 2027                   | 0%   | 107.5                           | 53.7  | 1.1  | 392.4                                  | 12,256.0                  |
| 9    | 2028                   | 0%   | 107.5                           | 53.7  | 1.1  | 392.4                                  | 12,726.8                  |
| 10   | 2029                   | 0%   | 107.5                           | 53.7  | 1.1  | 392.4                                  | 13,197.7                  |
| 11   | 2030                   | 0%   | 107.5                           | 53.7  | 1.1  | 392.4                                  | 13,668.5                  |
| 12   | 2031                   | 0%   | 107.5                           | 53.7  | 1.1  | 392.4                                  | 14,139.3                  |
| 13   | 2032                   | 0%   | 107.5                           | 53.7  | 1.1  | 392.4                                  | 14,610.1                  |
| 14   | 2033                   | 0%   | 107.5                           | 53.7  | 1.1  | 392.4                                  | 15,081.0                  |
| 15   | 2034                   | 0%   | 107.5                           | 53.7  | 1.1  | 392.4                                  | 15,551.8                  |
| 16   | 2035                   | 0%   | 107.5                           | 53.7  | 1.1  | 392.4                                  | 16,022.6                  |
| 17   | 2036                   | 0%   | 107.5                           | 53.7  | 1.1  | 392.4                                  | 16,493.5                  |
| 18   | 2037                   | 0%   | 107.5                           | 53.7  | 1.1  | 392.4                                  | 16,964.3                  |
| 19   | 2038                   | 0%   | 107.5                           | 53.7  | 1.1  | 392.4                                  | 17,435.1                  |
| 20   | 2039                   | 0%   | 107.5                           | 53.7  | 1.1  | 392.4                                  | 17,906.0                  |

Where:

- <sup>1</sup> 'AADT' = AADT(20XX) \* (1+Growth Rate)
- <sup>2</sup> 'AADT-Design Lane' = 'AADT' \* 'Directional Split' \* 'Load Distribution Factor (Truck)'
- <sup>3</sup> 'Total Trucks - Design Lane (per day)' = 'AADT - Design Lane' \* 'Percent Commercial Traffic'
- <sup>4</sup> 'Total Trucks - Design Lane (per year)' = 'Total Trucks - Design Lane' \* 365
- <sup>5</sup> 'ESALs - Trucks (per year)' = Blended Truck LEF\* 'Total Trucks - Design Lane (per year)'

**Design ESALS/lane**

Commercial = 17,906 Cumulative Truck Traffic for Design Life from Table D2  
Buses = 0 Buses/day \* 365 \* Design Life

**Design Traffic Volume (Cul De Sac Roads) = 17,906 ESALS**

**Table V - Curvilinear & Loop Roads**

|                                   |            |                 |
|-----------------------------------|------------|-----------------|
| 18-kip ESAL                       | <b>W18</b> | 172,722         |
| Reliability                       | <b>R</b>   | 80%             |
| Serviceability                    | <b>PSI</b> | 1.7             |
| Terminal Serviceability Index     | <b>Pt</b>  | 2.5             |
| Initial Design Serviceability     | <b>Po</b>  | 4.2             |
| Standard Normal Deviate           | <b>Zr</b>  | -0.841          |
| Standard Error                    | <b>So</b>  | 0.45            |
| Resilient Modulus (function CBR)  | <b>MR</b>  | 4,593 psi       |
| CBR                               | <b>CBR</b> | 2.5             |
| asphalt layer coeff (polymer mod) | <b>a1</b>  | 0.4             |
| asphalt layer coeff               | <b>a1a</b> | 0.4             |
| base coeff                        | <b>a2</b>  | 0.13            |
| subbase coeff                     | <b>a3</b>  | 0.1             |
| drainage rock coeff               | <b>a4</b>  | 0.1             |
| drainage coeff - base             | <b>m2</b>  | 0.8             |
| drainage coeff - subbase          | <b>m3</b>  | 0.8             |
| drainage coeff - drainage rock    | <b>m4</b>  | 1               |
| Based on CBR of subgrade          | <b>SN</b>  | 2.87 in         |
|                                   | <b>SN</b>  | <b>71.75</b> mm |

| Option 1     |    |            |       |             |                      |
|--------------|----|------------|-------|-------------|----------------------|
| Layer        |    | (mm)       | SN    |             |                      |
| D1*          | AC | 90         | SN1*  | 36.0        | D1*(a1)              |
| D1A*         | AC | 0          | SN1A* | 0.0         | D1A*(a1a)            |
| D2*          | B  | 150        | SN2*  | 15.6        | D2*(m2)(a2)          |
| D3*          | SB | 300        | SN3*  | 24.0        | D3*(m3)(a3)          |
| D4*          | DA | 0          | SN4*  | 0.0         | D4*(m4)(a4)          |
| <b>TOTAL</b> |    | <b>540</b> |       | <b>75.6</b> | SN1*+SN1A*+SN2*+SN3* |

**Table VI - Cul de Sac Roads**

|                                   |            |                 |
|-----------------------------------|------------|-----------------|
| 18-kip ESAL                       | <b>W18</b> | 17,906          |
| Reliability                       | <b>R</b>   | 75%             |
| Serviceability                    | <b>PSI</b> | 1.7             |
| Terminal Serviceability Index     | <b>Pt</b>  | 2.5             |
| Initial Design Serviceability     | <b>Po</b>  | 4.2             |
| Standard Normal Deviate           | <b>Zr</b>  | -0.674          |
| Standard Error                    | <b>So</b>  | 0.45            |
| Resilient Modulus (function CBR)  | <b>MR</b>  | 4,593 psi       |
| CBR                               | <b>CBR</b> | 2.5             |
| asphalt layer coeff (polymer mod) | <b>a1</b>  | 0.4             |
| asphalt layer coeff               | <b>a1a</b> | 0.4             |
| base coeff                        | <b>a2</b>  | 0.13            |
| subbase coeff                     | <b>a3</b>  | 0.1             |
| drainage rock coeff               | <b>a4</b>  | 0.1             |
| drainage coeff - base             | <b>m2</b>  | 0.8             |
| drainage coeff - subbase          | <b>m3</b>  | 0.8             |
| drainage coeff - drainage rock    | <b>m4</b>  | 1               |
| Based on CBR of subgrade          | <b>SN</b>  | 1.93 in         |
|                                   | <b>SN</b>  | <b>48.25</b> mm |

| Option 1     |    |            |       |             |                      |
|--------------|----|------------|-------|-------------|----------------------|
| Layer        |    | (mm)       | SN    |             |                      |
| D1*          | AC | 70         | SN1*  | 28.0        | D1*(a1)              |
| D1A*         | AC | 0          | SN1A* | 0.0         | D1A*(a1a)            |
| D2*          | B  | 150        | SN2*  | 15.6        | D2*(m2)(a2)          |
| D3*          | SB | 150        | SN3*  | 12.0        | D3*(m3)(a3)          |
| D4*          | DA | 0          | SN4*  | 0.0         | D4*(m4)(a4)          |
| <b>TOTAL</b> |    | <b>370</b> |       | <b>55.6</b> | SN1*+SN1A*+SN2*+SN3* |

Notes:

1) All values were determined using the AASHTO 1993 design method

# **APPENDIX G**

**CORRESPONDENCE WITH RM OF CORMAN  
PARK PLANNING DEPARTMENT**



## Maggie Schwab

---

**From:** Cory Boudreau <cboudreau@rmcormanpark.ca>  
**Sent:** Wednesday, November 28, 2018 9:44 AM  
**To:** Maggie Schwab  
**Subject:** RE: Greenbryre Phase III Development  
**Attachments:** Grasswood\_SUMMARY REPORT\_Revised\_Reduced.pdf; 2018-10-10 - DPC Report - Grasswood.pdf

My apologies Maggie,

I did not realize I missed responding back to you.  
I am not familiar with Phase III of Greenbryre Estates.  
With the new P4G Policies, which I am also not involved in at the moment, I am unaware of any conflicts.

The existing phases, and immediately adjacent parcels are not within separation distances of any ILO or Industrial properties.  
The area known as the Grasswood Mixed Use Node, has recently gone through a Market Impact Study which may also speak about land use conflicts.  
I have yet to have the opportunity to review the document myself but I have attached it for your reference.

Hope this helps!

Regards,

**Cory Boudreau, B.A**

*Planner I,  
R.M. of Corman Park 344  
111 Pinehouse Drive, Saskatoon, SK. S7K 5W1  
Ph: (306)975-1665 Fax: (306)242-6965*



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**From:** Maggie Schwab [mailto:mschwab@crosbyhanna.ca]  
**Sent:** Wednesday, November 28, 2018 8:45 AM  
**To:** Cory Boudreau <cboudreau@rmcormanpark.ca>  
**Subject:** Greenbryre Phase III Development

Hi Cory,

I wanted to follow up with you with respect to my query concerning Greenbryre Phase III.

Can you check to see if there are any potential land use conflicts within the prescribed separation distances as indicated in the Corman Park-Saskatoon Planning District OCP?

Thanks,  
maggie

**Maggie Schwab**

**CROSBY HANNA & ASSOCIATES**

407C 1st Ave N, Saskatoon, SK S7K 1X5

306.665.3441 | [www.crosbyhanna.ca](http://www.crosbyhanna.ca)

---

**From:** Maggie Schwab

**Sent:** Thursday, June 28, 2018 2:32 PM

**To:** Cory Boudreau <[cboudreau@rmcormanpark.ca](mailto:cboudreau@rmcormanpark.ca)>

**Subject:** Greenbryre Phase III Development

Good Afternoon Cory,

We have been retained by a Developer to complete the CDR for Phase III of the Greenbryre Estates development. Phase III consists of a 37.5 ha (92.6 acre) parcel, located in the SE 1/4 of Section 12, Township 36, Range 5, W3M.

Are there any potential land use conflicts within the prescribed separation distances as indicated in the Corman Park-Saskatoon Planning District OCP?

Thanks,

**Maggie Schwab** MA, MCIP, RPP

**CROSBY HANNA & ASSOCIATES**

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# **APPENDIX H**

## **CORRESPONDENCE WITH THE PRAIRIE SPIRIT SCHOOL DIVISION**



## Maggie Schwab

---

**From:** Brenda Erickson <brenda.erickson@spiritsd.ca>  
**Sent:** Wednesday, December 5, 2018 4:15 PM  
**To:** Maggie Schwab  
**Subject:** RE: Expansion of Development in Corman Park

Good afternoon, Maggie:

Prairie Spirit has the capacity for any future students that could come from this development.

Please let me know if you have any questions about this.

Thank you,

Brenda Erickson  
Communication Manager, Prairie Spirit School Division

---

**From:** Maggie Schwab <mschwab@crosbyhanna.ca>  
**Sent:** November 28, 2018 9:14 AM  
**To:** Brenda Erickson <brenda.erickson@spiritsd.ca>  
**Subject:** Expansion of Development in Corman Park

Good Morning Brenda,

We have been retained by a Developer to help facilitate the rezoning and subdivision of Phase III of Greenbryre Estates. This phase of the development is located in the SE ¼ of Section 12-36-5 W3M within the RM of Corman Park (west of Boychuck Drive). The Concept Plan for Phase III includes 129 single family lots and 88 condo units.

Could you please provide me with an email confirming that the Prairie Spirit School Division has the capacity to accommodate any future students that could reside at this phase of development?

Should you have any questions or concerns, please feel free to email or call me.

Kindest regards,

**Maggie Schwab** MA, MCIP, RPP

**CROSBY HANNA & ASSOCIATES**

407C 1st Ave N

Saskatoon, SK S7K 1X5

t : 306.665.3441

f : 306.652.9613

e : [mschwab@crosbyhanna.ca](mailto:mschwab@crosbyhanna.ca)

[www.crosbyhanna.ca](http://www.crosbyhanna.ca)

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**APPENDIX I**  
**PUBLIC CONSULTATION INFORMATION**



## Jim Walters

---

**From:** Jim Walters  
**Sent:** Monday, June 3, 2019 9:57 AM  
**To:** [REDACTED]  
**Cc:** [REDACTED]  
**Subject:** RE: Phase 3 development of Greenbryre Estates

Hi Dary and Pam,

Thank-you for the email. I believe the dirt you have seen moved in phase 3 relates to the Boychuk Drive interchange project. It is out understanding that the proper permits have been taken out for this. I can't really speak to what Corman Park has promised ratepayers. The roads in phase 3 will be constructed similarly to those in phase 1 and 2. This will be articulated in a servicing agreement between the RM and Greenbryre.

**Jim Walters** MCIP RPP

**CROSBY HANNA & ASSOCIATES**

407C 1st Ave N

Saskatoon, SK S7K 1X5

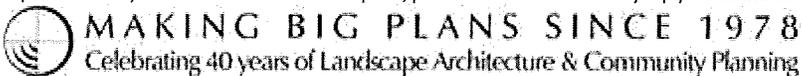
t : 306.665.3441

e : [jwalters@crosbyhanna.ca](mailto:jwalters@crosbyhanna.ca)

[www.crosbyhanna.ca](http://www.crosbyhanna.ca)

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**From:** dpchilliak@sasktel.net <dpchilliak@sasktel.net>  
**Sent:** Sunday, June 02, 2019 10:10 AM  
**To:** Jim Walters <jwalters@crosbyhanna.ca>  
**Subject:** Phase 3 development of Greenbryre Estates

At the informal meeting this past Thursday one of your associates told us that you still need approval from Corman Park before any work can start. So how were you allowed to haul hundreds of loads of dirt already when this has not been approved by them yet?

Secondly Corman Park told home owners that dust control or paving would be done before any work could start on this development, which nothing has been done to Range road 3050 and work has been going on for months. Your associate also said that all roads have to be paved before work could start, so were there proper permits for this?

If you could please respond with clarification on the phase 3 development.

Thanks  
Dary & Pam Chilliak

## Katrina Grise

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**From:** Jim Walters  
**Sent:** Wednesday, April 1, 2020 2:51 PM  
**To:** Katrina Grise  
**Subject:** FW: Grennbryre walkway proposal  
**Attachments:** 20190530\_192018 (2).jpg

**James (Jim) Walters** RPP MCIP

CROSBY HANNA & ASSOCIATES

**Due to COVID-19 Crosby Hanna & Associates is suspending in-person meetings and limiting access to both of our offices. We remain in operation, however, and request that you communicate with us via email or phone.**

407C 1st Ave N

Saskatoon, SK S7K 1X5

t : 306.665.3441

e : [jwalters@crosbyhanna.ca](mailto:jwalters@crosbyhanna.ca)

[www.crosbyhanna.ca](http://www.crosbyhanna.ca)

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**From:** [REDACTED]  
**Sent:** Saturday, June 22, 2019 7:25 PM  
**To:** [REDACTED]  
**Cc:** [REDACTED]  
**Subject:** Re: Grennbryre walkway proposal

Hello Jim,

I appreciate you getting back to me and letting me know you received my email. I feel that my concerns have been heard and that you will be taking them into consideration when you are designing this area. I understand that it is very early in the process and that a final decision on a pathway has not been made. That is why I feel this is the right time to address the concerns and to figure out possible solutions to the issues.

To help me understand the process I contacted the RM of Corman Park and spoke to Rebecca Row. She explained that nothing has been brought to the RM yet and that it sounds like it is very early in the process. It was her advice to me to contact Troy and Crosby Hanna with my concerns about the proposed pathway and to begin a dialog to hopefully work out a solution. She said this is something that should be discussed and hopefully figured out before it is brought to the RM for submission. She told me that at the time of submission the RM would be looking at the concerns and at the correspondence to see what steps have been taken to address the concerns.

After talking to Rebecca Row and understanding the process that these issues can be looked at before things get too far, I feel much more confident that a viable solution can be reached. Although we were told by the developer when we purchased our lot that there would never be a walkway around the lake, I do understand that as this point some kind of a pathway is inevitable. I think that in our earlier email we have given a reasonable solution by omitting the small section of pathway directly behind our lot that would still allow for a pathway and would address our main privacy issue.

(I have attached the drawing again). Please let me know what you think of this idea or what other solutions you might have so we can have this issue worked out before the final submission to the RM.

Thank you,  
Kenton Miller

On 2019-06-19 10:39 a.m., Jim Walters wrote:

Hi Kenton, thank you for taking the time to attend the open house and send us this email. We will include your comments in our final submission to the RM of Corman Park. A final decision on how the pathway system will be laid out has not yet been made at this time.

**Jim Walters** MCIP RPP  
**CROSBY HANNA & ASSOCIATES**  
407C 1st Ave N  
Saskatoon, SK S7K 1X5  
t : 306.665.3441  
e : [jwalters@crosbyhanna.ca](mailto:jwalters@crosbyhanna.ca)  
[www.crosbyhanna.ca](http://www.crosbyhanna.ca)

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**MAKING BIG PLANS SINCE 1978**  
Celebrating 40 years of Landscape Architecture & Community Planning

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**From:** [REDACTED]  
**Sent:** Wednesday, June 12, 2019 8:41 AM  
**To:** Jim Walters <[jwalters@crosbyhanna.ca](mailto:jwalters@crosbyhanna.ca)>  
**Subject:** Grennbryre walkway proposal

To Jim Walters

We are writing this email with regards to the Proposed Greenbryre Estates Phase 3

When we were looking to purchase our lot in Greenbryre Estates, we were looking to purchase on the lake/pond. We asked many questions about the lot. We already knew that eventually there would be a phase 3 with more housing. Our concerns or questions were specifically whether there would ever be a walkway by the lake behind our lot. We were explicitly told by the developer, "No." It was explained that the water edge and the shoreline did not allow for a walkway. The slope was too significant and would not allow for a walkway.

We chose lot 33 and designed and built our house with this understanding in mind. You can imagine that this is very disappointing for us to hear that a significant change to the previous Phase 3 Concept Plan is being proposed. We deliberately did not purchase a lot on the golf course as we wanted more privacy. We chose this lot because of what we were told. Also, the concept map at the time of our land purchase showed lots 33 and 34 to be considerably closer to the lake than the other lots. This was yet

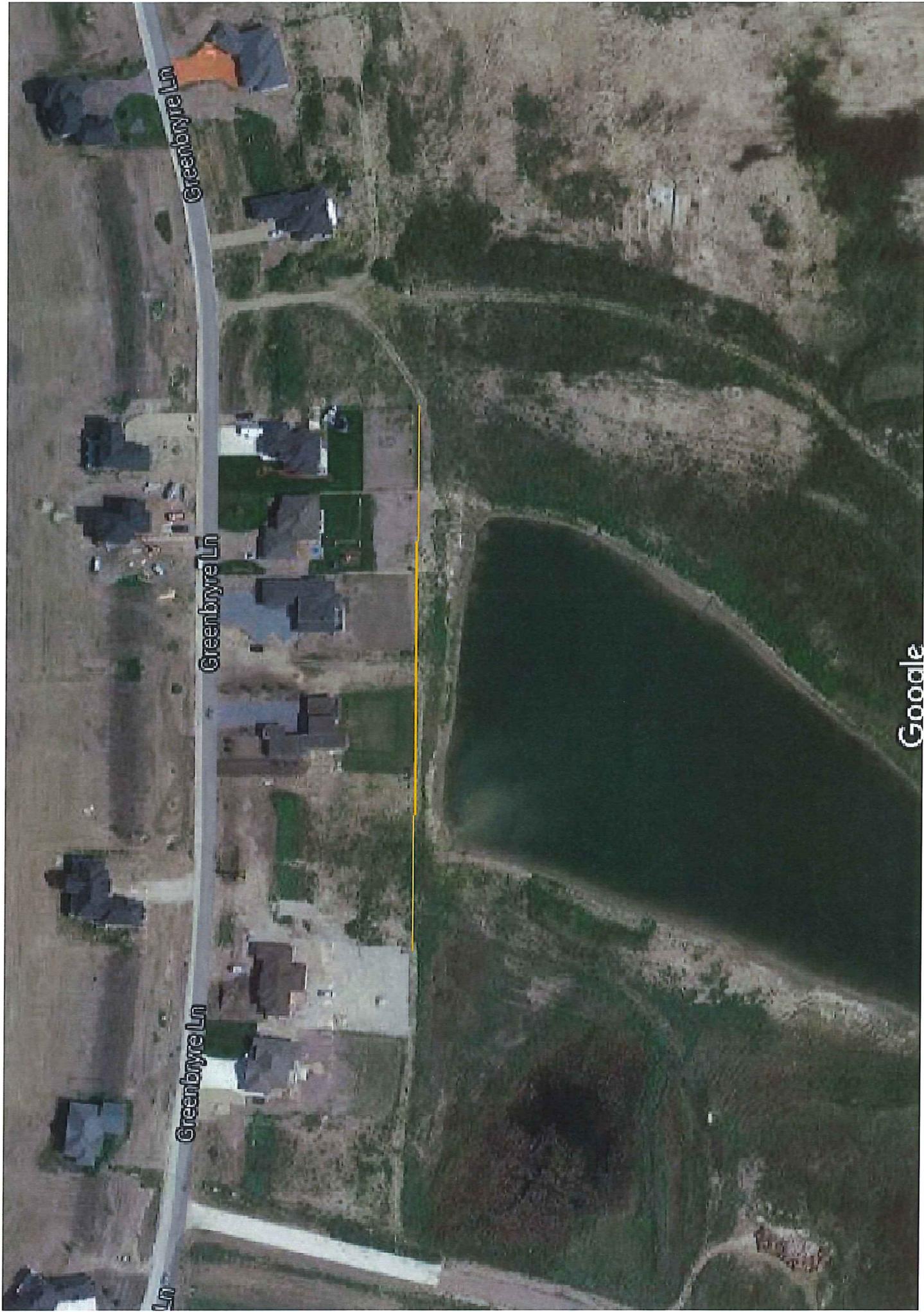
another reason why we purchased lot 33. This proposed walkway is now coming after the homes have been built.

We are hoping that you would look at potential solutions to solve this privacy issue. One suggestion is to omit a small section of pathway that is directly behind our property (see attached drawing). This would give a pathway much like what is around the other lakes in Saskatoon (see attached images). In fact, I was not able to find one lake in Saskatoon where the pathway goes all the way around the entire lake. This would still allow many different walkway routes and solve our main privacy issue. The space between our property and the lake is significantly less than the other lots, leaving less distance for a walkway between private lots and the lake (see attached image). At the very least, another suggestion is to consider the placement of the walkway – distance from the property line (thus allowing more space) and placement of the pathway (lower elevation would diminish sight lines into yards and homes).

We would request that our concerns for privacy be considered in the final design.

Thank you,

Kenton & Lesley Miller



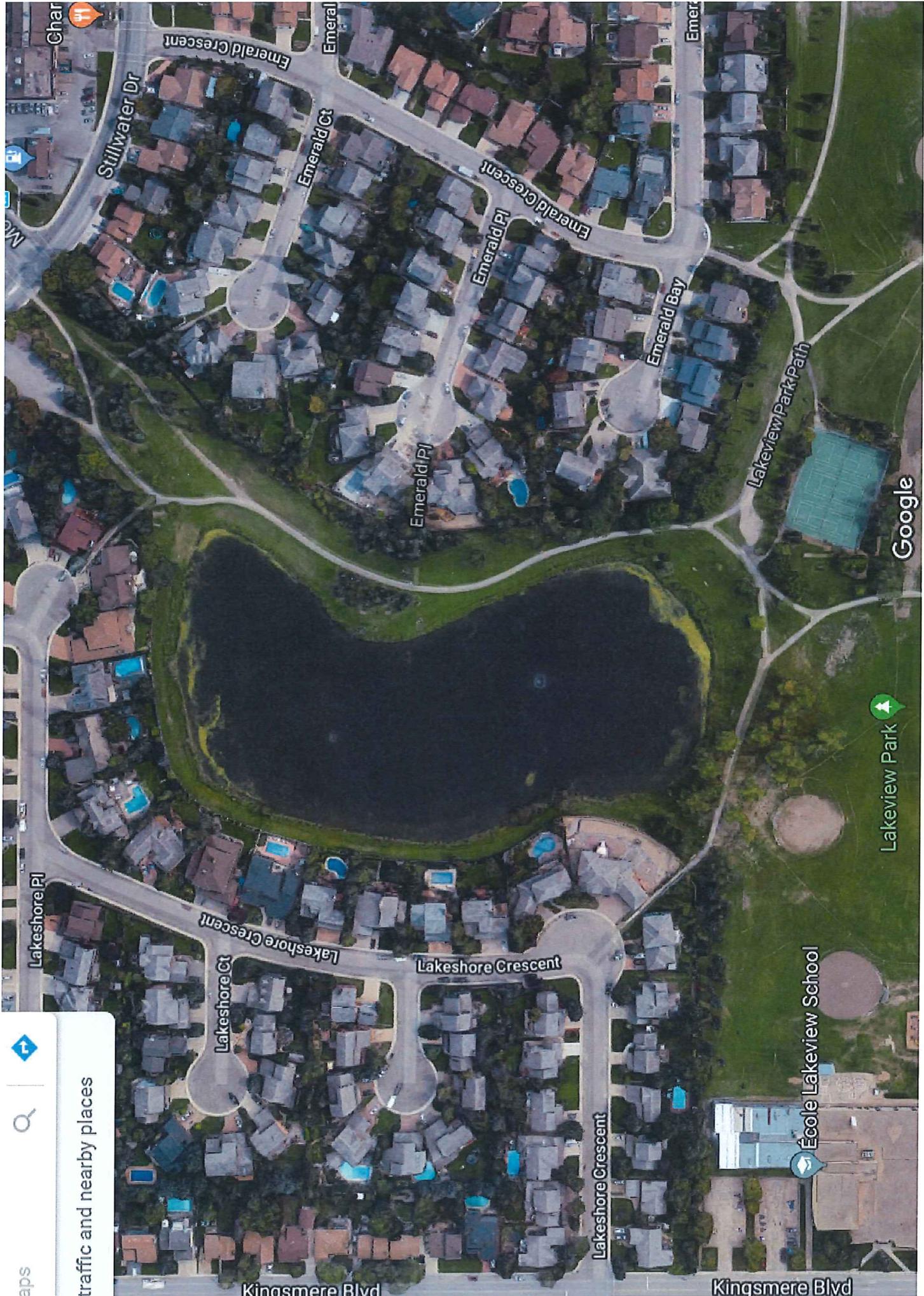
Greenbryre Ln

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Greenbryre Ln

Google





aps

traffic and nearby places

École Lakeview School

Lakeview Park

Google

Kingsmere Blvd

Kingsmere Blvd

**APPENDIX J**  
**CORRESPONDENCE WITH**  
**LORASS DISPOSAL**





July 16, 2020

**Greenbryre Estates c/o D & S Homes**  
#203 – 200 Stonebridge Blvd  
Saskatoon, SK S7T 0G3

**Attn: Troy Slater**

Re: 2020/ 2021 Services

This letter is notice to whom it may concern, that Loraas will continue to provide services for waste & recycle during the next phase of development at Greenbryre Estates.

If you require any further information or have any questions do not hesitate to contact me.

Thank you,

**Ryan Gay**

**Territory Representative**  
**Loraas Disposal North Inc.**  
805 – 47<sup>th</sup> Street East, Saskatoon, SK S7K 8G7  
p: (306)242-2300 c: (306) 221-4885  
e: [ryan.gay@loraas.ca](mailto:ryan.gay@loraas.ca) web: [www.loraas.ca](http://www.loraas.ca)

