OJA Holdings Ltd.





Pradera Estates

Comprehensive Development Review



GREEN VIEW HOMES

Associated Engineering 75 YEARS

August 2023

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Executive Summary

Legal Land Location:	NE 13-35-05-W3M and SE 24-35-5-W3M
Registered Owner:	OJA Holdings Ltd.
Gross Land Area:	126.43 ha
Existing Zoning:	AG – Agricultural District
Proposed Zoning:	CR-1 – Country Residential 1 District
	CR-4 Country Residential District
	C – Commercial District
Ownership:	Fee Simple Subdivision
Lot Summary:	CR1 - 24 lots
	CR4 - 72 lots
	C - 4 lots
Jurisdiction:	RM of Corman Park No. 344
Potable Water:	Dundurn Rural Water Utility
Wastewater:	Private On-site Systems

Pradera Estates is a comprehensively planned community located in South Corman Park lying directly east of Highway 11 and between Baker and Victor Road. The developer is a green home builder and the proposed development envisions offering a variety of green residential development options including acreages that provide a suitable land area to keep horses or small numbers of livestock. The development also includes smaller estate lots for families seeking a larger yard than is provided in Saskatoon but without the maintenance requirements of large lot acreages. The development is planned to provide a full range of amenities including a trail network, park space, solar powered community centre, playground, rink and toboggan hill in the south end of the property.

The development includes four proposed commercial properties situated along Highway 11, intended to take advantage of the visibility provided along this major transportation corridor.

The site has been deliberately designed to recognize the relationship between the various planned forms of development within the subject property and to acknowledge the existing uses external to the site. The highway focused commercial development insulates the less intensive internal residential uses from the noise and activity generated by the highway. The larger lot acreages provide flexibility to the property owner to create physical separation from the nearby commercial development and acts as a transition to the smaller estate lots along the western boundary of the property.

Public land dedication has been focused in the south end of the subject property acknowledging the potential resumption of operation of an intensive livestock operation situated in the adjacent quarter section to the south by adding additional distance between planned residences and the operation.

A full range of services are being constructed to support development in the plan area including paved roadways, a centralized low-pressure treated waterline and privately owned on-site wastewater systems.

1 Introduction

1.1 Purpose

The report has been prepared on behalf of Green View Homes (the Developer) to support an application to rezone 124.5 ha (307.7 ac) located within the NE 13-35-05-W3M and SE 24-35-5-W3M from AG – Agricultural District to CR-1 – Country Residential 1 District, CR-4 Country Residential District, and C – Commercial District and to subdivide 95 country residential lots and three commercial lots in multiple phases.

This Comprehensive Development Review (CDR) report describes the Developer's intentions for subdivision, development and servicing of the property over time. Given the size of the plan area, this development will be phased with the composition and timing for each phase depending upon market conditions and the logical extension of services.

As per Section 5.2.3.1. of the RM of Corman Park Official Community Plan (OCP) a Comprehensive Development Review (CDR) report must be prepared which provides the RM Council and Administration with an 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, a CDR is intended to also assess the capacity of the supportive municipal and provincial infrastructure as it relates the demand created by the proposed development.

Although subdivision and development of Pradera Estates is intended to be phased, this submission is intended to provide enough details to support a request to rezone the entire subject property with a holding provision applied to the lands located outside of the initial phase of subdivision. It is our understanding that Council will consider the removal of this holding provision upon receipt of further subdivision applications that align with the general intention of development as described by this report and the execution of servicing agreements for each successive phase.



2 Plan Context

Pradera Estates is located approximately 6 km south of Saskatoon along Highway No. 11 in the RM of Corman Park No. 344 (RM) as illustrated in Figure 2.1. The project area lies midway between Baker Road to the north and Victor Road to the south. This area of the RM has historically been an area of high demand for country residential development.

2.1 Location and Physiographic Conditions

The subject property is conveniently located near Saskatoon offering a short commute for residents to access employment and typical urban services. The location balances the convenience of proximity to Saskatoon with the less intensive living environment of an acreage, making it an attractive option for residency.

Lands within the project area are relatively flat with the highest elevation lying in the southwest of the property at a geodetic elevation of 513 m with the natural low located at an elevation of 507 m along Prairie View Road to the east of the property. Most of the site lies at elevations ranging between 508 m and 510 m. The low-lying areas along the eastern boundary of the site provide a suitable and natural location to situate storm retention areas to reduce site grading and to mimic the natural drainage properties on the site. The gentle slopes within the property are considered suitable for development and do not exhibit any slope stability hazard.

The site has historically been cultivated and farmed. The extents of cultivation within the property have varied over time based upon annual variations in climatic conditions. The predominant land cover is agricultural crop with some intermittent forest and scrub land in natural low-lying areas. The sandy subsurface characteristics represented in this area supports the lack any permanent wetlands within the property. The intention is to minimize the alteration of the lands as much as possible, retaining and incorporating natural vegetation to act as buffers from non-compatible uses and to provide additional privacy between neighbouring properties.

A geotechnical investigation was completed for the project area during the spring of 2021. The investigation consisted of drilling 46 boreholes to depths of up to 12 m below the existing ground surface to characterize subsurface soil and ground water conditions. The geotechnical investigation also includes recommendations for site preparation; excavations and dewatering; footings; concrete raft foundations; deep foundations; foundation drainage; foundation walls; floors; and, foundation concrete.

The report indicates that subsurface soils consist of primarily sand deposits overlaid by clay and silt. The clay deposits are firm to very stiff, medium to plastic and moist. The silt layer is firm to stiff, low to medium plastic and moist to wet. The sand layer is characterized as loose to compact, poorly graded, fine grained and moist initially becoming wet below the groundwater table which was located at an average of 2.8 m below existing grade. Groundwater levels are expected to fluctuate seasonally as much as 1 m with highest levels in spring or during/following spring thaw or periods of precipitation.

The report indicates that subsurface soils consist of primarily sand deposits overlaid by clay and silt. The clay deposits are firm To minimize the potential for groundwater-related issues, the geotechnical report recommends that all basements/crawlspaces should be at least 1 m above the groundwater elevation. A Groundwater Contour Map is included in the geotechnical report identifying the minimum building elevations for each site. On lots where the 1 m separation cannot be achieved basements will be prohibited, building sites will need to be raised by fill or an alternative foundation design as may be deemed acceptable to the RM.

A copy of the preliminary geotechnical report is attached to this report as Appendix A.

The soil capability rating for the subject property is Class 4M based upon the Canada Land Inventory Soil Capability for Agriculture maps. The "M" subclass represents lands that have a general deficiency in moisture holding capacities and are more prone to drought. Class 4 soils are considered marginal due to the severe limitations that restrict the choice of crops, or require special conservation practices and very careful management, or both. The severe limitations seriously affect one or more of the following practices: timing and ease of tillage; planting and harvesting; choice of crops; and methods of conservation. These soils are low to medium in productivity for a narrow to wide range of common field crops but may have higher productivity for a specially adapted crop. The Corman Park OCP supports country residential development on lands with this soil class.

2.2 Environmental Conditions

A desktop biophysical screening was completed for the site using the HABISask on-line GIS database to determine the existence of known native or sensitive vegetation or sensitive habitat that would influence the form and location of development within the subject property.

The screening noted the potential presence of the Olive-backed Pocket Mouse which is considered endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). The olive-backed pocket mouse is nocturnal and lives underground in an extensive burrow system with tunnels that may reach a depth of 2 m and spread for 3 m on either side of the entrance. Its natural habitat is grassland in arid and semi-arid upland areas, usually with sparse vegetation and sometimes with scattered trees such as the aspen or cottonwood and plants such as the fringed sagebrush. Its burrows are found in both sandy and clayey soils.

This mouse has a species conservation rank of S3 making the mouse a moderate risk of extinction or extirpation due to its restricted range, population level and status. Given the intention to limit ground disturbance and the conversion of grassed areas beyond the construction of roadways and buildings within the site, the potential risk of impact of development on mouse habitat is anticipated to be minimal.

2.3 Legal Encumbrances and Built Conditions

A review of the property title information provided by the Information Services Corporation confirmed that there are no registered easements or utility rights-of-way within the property that would influence the form and configuration of development within the site or affect the subdivision of the property.

The site contains two structures including a small grain bin and a shed along Prairie View Road. It is expected that as the site is developed these two structures will be removed.

2.4 Existing and Surrounding Uses

Figure 2.2 illustrates the current location of buildings and uses within 1.6 km of the subject property. The land directly abutting the site is predominantly undeveloped farmland with exception of the Prairie View Chapel and Crematorium located to the east across Prairie View Road.

The Prairie View Crematorium hosts both human and animal cremations and operates seven days a week, 24 hours per day. There are no provincial or municipal setback requirements for this use relative to residential or commercial development. These types of facilities can coexist in any location evidenced by the situation of the Cherished Memories Funeral Service and Crematory, in Martensville which backs directly onto existing residential development with only a rear lane separating the two properties. Based upon a review of aerial imagery, the Cherished Memories crematorium lies approximately 40 m west of the closest residence which is a far shorter separation then the estimated 240 m separation represented by this plan.

The Ministry of Justice, Consumer Protection Division was contacted to confirm whether there are any legislative obstacles related to the crematorium and its proximity to the planned development. The Director of Enforcement from Consumer Protection Division confirmed that The Funeral and Cremation Services Act and its regulations are silent on this aspect and there are no requirements under the Act for minimum setback distances from crematoriums and residential development. This correspondence is attached in Appendix B.

There are approximately 28 single parcel country residences and farmsteads distributed around the site in each direction. Several multi-parcel country residential developments are located northwest of the property including the Casa Rio East, Grasswood and South Point Estates developments. The demand for country residency has been consistently high in this region of the municipality, enabling the municipality to concentrate like-minded developments to reduce the potential for land use

conflicts and enabling the RM to focus investments into the common public infrastructure required to support this form of development.

There are two greenhouses in the vicinity of the site including the Clement Greenhouse to the southeast along Highway 11 and the former Day Grow Greenhouse located along the north side of Baker Road. An equestrian facility is located east of Highway 11 in the SW 19-35-4-W3M. None of these land uses have any influence on the proposed development of Pradera Estates.

According to RM records, there is an approved 330 animal unit intensive livestock operation located approximately 500 metres south of the project area. Based upon communications with the owner of the ILO operation, it has not been operational for over a decade and significant investments would need to be made to the facilities to meet current provincial operational standards. Section 4.2.9. of the OCP states:

4.2.9. If an Intensive Livestock Operation has ceased to operate for a period of 12 months or more, other uses, as defined in Table 1, are exempt from the separation distance in order to subdivide or develop the lands. (Bylaw 31/19, Approved January 29, 2020)

As a result of this policy, the location of the ILO has no bearing on the location, form or configuration of development within the subject property. Despite this fact, the conceptual plan for development proposes to situate all municipal reserve lands in the southernmost end of the plan area to maximize the separation provided between this discontinued operation and planned residences in the subject property.

2.5 Phase I Environmental Site Assessment

A Phase I Environmental Site Assessment (ESA) was completed for the project area to determine the likelihood of soil contamination based upon its historical use and the use of adjacent properties. The assessment followed the protocols defined in the Canadian Standards Association, Standard CSA Z768-01 (R2016) – Phase I Environmental Site Assessment and was conducted in consideration of the legislation and regulations relevant to contaminated sites in Saskatchewan, as stipulated in the Saskatchewan Environmental Code (Government of Saskatchewan 2015); adhering to the Saskatchewan Environmental Management and Protection Act (RSS 2010 c. E-10.22).

The scope of work included reviewing relevant historical documents and visually inspecting the land and surrounding area for signs of contamination (i.e., staining and odours) or areas of potential environmental concern (APECs).

No previous environmental reports have been completed for the project area. A Freedom of Information (FOIP) Request was submitted to the Ministry of Environment (MOE) – Environmental Protection Branch for any environmental information including but not limited to tanks, spills, environmental infractions, complaints, orders, investigations, remediation, site assessments, remediation plans/reports, site plans and fire information for the project area. Responses were received on June 22, 2021 stating that there were no available records responsive to the requests.

The SaskSpills database revealed no records of spills or hazardous materials storage associated with the project area or neighbouring properties. Further, no spills were identified on or around the project area during the site inspection.

A search of the Water Security Agency (WSA) Saskatchewan Ground Water Resources GIS Web Mapping application for water well drilling records (WSA 2018) identified 21 wells within a 500 m radius of the project area. The wells are used for domestic purposes (18), research (2), and unknown (1).

A site inspection was conducted on Friday, June 18, 2021. During the site inspection, the following was noted:

- No hazardous substances were noted on-site at the time of inspection.
- No solid waste management practices were noted on-site at the time of inspection.
- No wastewater management practices were noted on-site at the time of inspection.
- No heating and/or cooling systems were noted on-site at the time of inspection.
- No stains or odors were noted on-site at the time of inspection.
- No above-ground or below-ground storage tanks were noted on-site at the time of inspection.
- No mechanical equipment was noted on-site at the time of inspection.
- No pits and lagoons were noted on-site at the time of inspection.

The findings of the Phase I ESA indicate low potential of contamination and that current or past activities have not led to significant soil, vapour, and/or groundwater contamination beneath the project area. Past and present land use of neighbouring properties, the positions of these properties relative to the project area with respect to inferred groundwater flow, and their respective distances from the site indicate low potential of contamination. The report confirmed that no further investigation was warranted.

A copy of the Phase 1 ESA report is attached to this report as Appendix C.

2.6 Cultural and Heritage Resources

A desktop screening was conducted for the site using the on-line heritage screening tool published by the Heritage Conservation Branch to confirm that the project area is not considered heritage sensitive and that no further consultation or approvals are required prior to subdivision and development. A copy of this query is attached in Appendix D.

2.7 Utility Servicing

2.7.1 Transportation Infrastructure

The property lies west of Highway 11 and access to the municipal road network is currently provided from existing intersections at Prairie View Road and Township Road 352 (Victor Road). Based upon the current access management plan for Highway 11, the permanent highway intersections along this stretch of highway includes Township Road 360 (Grasswood Road), Township Road 354 (Baker Road) and Victor Road.

Victor Road lies south of the subject property and includes a median crossing at its intersection with Highway 11 enabling full directional travel. The current intersection includes delineation lighting and a southbound right turning lane connecting to Victor Road.

The intersection of Highway 11 and Prairie View Road includes a centre median crossing enabling full directional travel but does not include any delineation lighting or turning lanes. This intersection is considered a temporary highway access which means that it may be closed by the Ministry of Highways where warranted based upon an evaluation of traffic volumes relative to the functional safety of the intersection.

Baker Road lies north of the subject property and includes full directional turning movements, delineation lighting, a southbound right-hand turning lane as well as a northbound acceleration lane. Baker Road is a one of several primary access roads connecting existing country residential developments to the provincial highway network.

Based upon the recommendations of a Traffic Impact Assessment (TIA) prepared for the development, the principal means of access to the subject property will be provided from Prairie View Road which is a gravel surfaced all weather roadway constructed in a 20-metre ROW. There is no easement or dedication for road widening on Prairie View Road at this location and it is anticipated the RM will require a 5 m dedication for future road widening. The TIA recommended the following:

Development Related Recommendations include:

1. Maintain development access at Prairie View Road until intersection operation falls below LOS D or until additional area development is planned to support a service road to Baker Road;
2. Construct a southbound right turn lane at Prairie View Road before the first year of development; and
3. Install intersection area lighting at Prairie View Road before full build-out.

Should additional area development traffic drive the need for a service road:

1. Close the west leg of Prairie View Road and construct a two-lane service road from Baker Road to Prairie View Road parallel to Highway No. 11;
2. Install a yield sign at the T-intersection created by the service road connection with Baker Road; and
3. Install area lighting at Victor Road before full build-out.

Planned Improvements by MoH include:

1. Installing a southbound left turn lane at Baker Road before 2037. This improvement is warranted based on background traffic volumes.
2. Installing a northbound right turn lane at Victor Road before 2037. This improvement is warranted based on background

traffic volumes.

3. Installing area lighting at Baker Road before full build-out.

A copy of the TIA report is attached as Appendix E. The TIA

2.7.2 Potable Water Distribution

The Dundurn Rural Water Utility operates a water distribution network which extends along the east side of Highway 11. A 300 mm water distribution line crosses the highway at Baker Road, providing a tie-in location to extend potable water service to the subject property. The water utility was contacted and confirmed their ability to provide low pressure rural water service to the site. A copy of this correspondence is attached in Appendix B.

2.7.3 Wastewater Collection

There are no communal wastewater treatment facilities in the area to service the proposed development of Pradera Estates. The development anticipates the use of private on-site wastewater treatment systems as are currently being used in surrounding multi-parcel country residential developments. A hydrogeological investigation was conducted by P. Machibroda Engineering Ltd. confirming the suitability of using private on-site wastewater treatment systems and defining the minimum specification for these systems. This report concluded one or more of the following soil treatment systems/on-site wastewater treatment systems types to be suitable based on the soil and hydrogeological conditions at the site:

- Holding Tanks
- Type II Mounds
- Chamber Systems
- Absorption Field System

In accordance with the Government of Saskatchewan On-site Wastewater Disposal Guide(GOS,2018), the following on-site wastewater treatment systems are not considered to be suitable for use at the site:

- Lagoons are not acceptable as all the lots are smaller than 4 hectares.
- Jets and Type 1 mounds are not acceptable as the proposed subdivision is high density and is considered a sensitive area

A copy of the full report is attached to this report as Appendix F.

2.7.6. Stormwater Management

There are no existing constructed drainage courses or ponds within the site. It is anticipated that stormwater will be managed through the construction of surficial drainage courses and ponds within the property. These engineered improvements will be designed according to mimic the natural movement of run-off within the site and comply with applicable provincial and municipal requirements.

2.7.5 Shallow Utilities

The location of known shallow utilities in the area are illustrated in Figure 2.3. The availability of natural gas, electricity and telecommunications is not anticipated to influence the form and configuration of development.

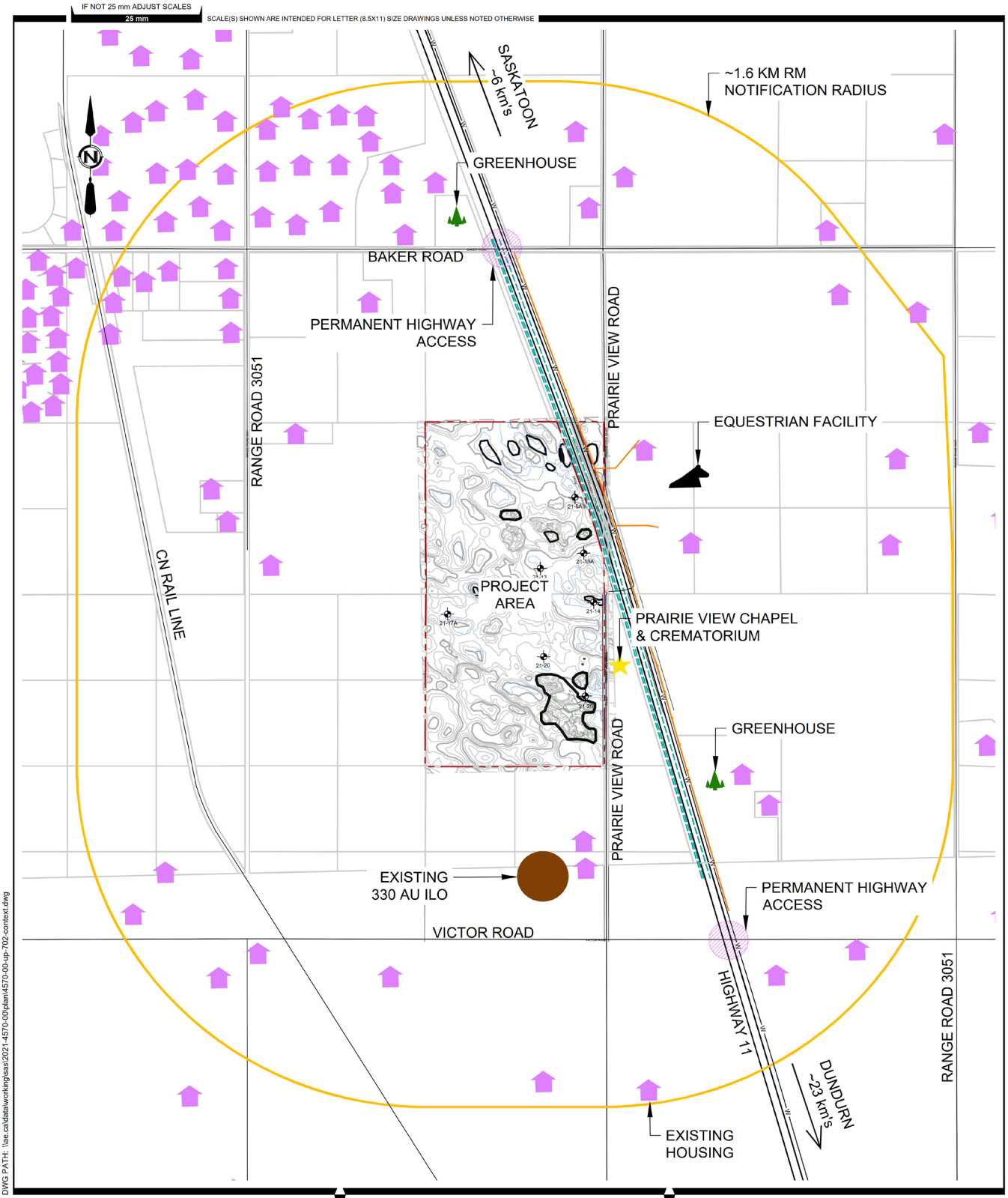
2.8 Policy and Regulatory Framework

2.8.1 RM of Corman Park Official Community Plan

Development within the subject property is governed by the policies established within the RM of Corman Official Community Plan. The following section outlines the key policies that influence the form, location, intensity and configuration of development within the subject property. A table detailing all the pertinent policies is reproduced in Appendix G.

Section 4 of the OCP establishes minimum separation distances that are to be provided between intensive livestock operations (ILOs) and potentially conflicting or impacted developments to ensure that the negative impacts of proximity are mitigated. As previously noted, there are no operating ILOs within the maximum 1.6 km distance of the subject property. A 330-animal unit ILO previously operated in SW 13-35-5-W3M but this operation ceased operations over a decade ago and would require significant investment in upgraded facilities to meet current provincial operational standards.

The country residential land policies provided in Section 5 prioritize the RM's need to promote a variety and adequate supply of residential land that includes significant natural or built amenities, promotes environmental and social innovation, and



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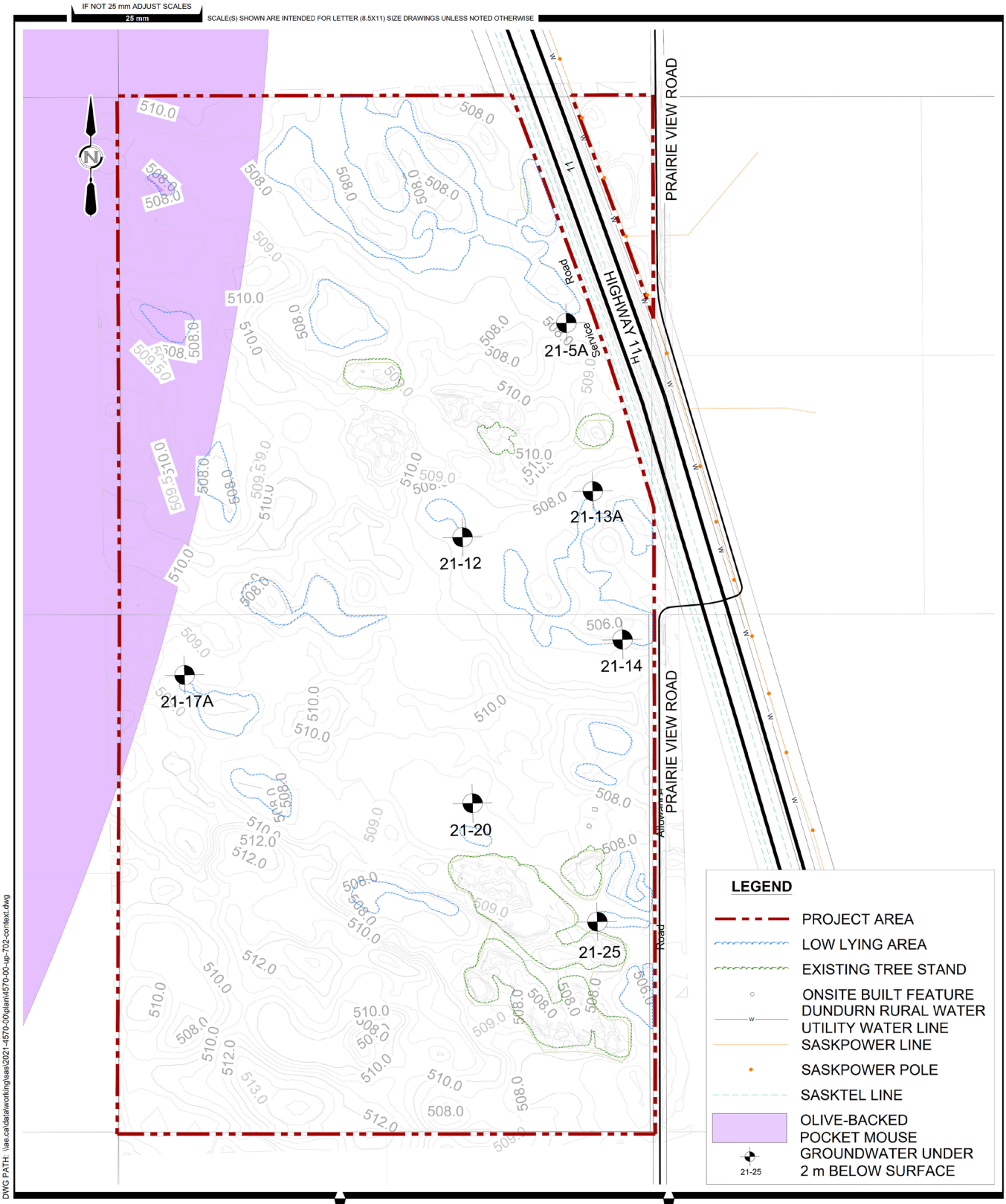
BEST MANAGED COMPANIES
Platinum member

AE PROJECT No.	20214570-00
SCALE	NTS
APPROVED	B. DELAINEY
DATE	2022APR25
REV	0
DESCRIPTION	ISSUED FOR REPORT

FIGURE 2.1 PLAN CONTEXT

PRADERA ESTATES
COMPREHENSIVE DEVELOPMENT REVIEW

PLANNING



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FIGURE 2.2 DEVELOPMENT INFLUENCES

PRADERA ESTATES
COMPREHENSIVE DEVELOPMENT REVIEW

PLANNING

increases housing options available to people wishing to live in Corman Park. The country residential land use policies also seek to ensure the development is economically feasible and serviceable by water, transportation, and shallow utilities. This section of the OCP also establishes location criteria for new multi-parcel country residential subdivisions which include:

- Locating new development on lands of "marginal" soil capability as defined by the Canada Land Inventory (CLI) Soil Class Rating System;
- Locating new development on lands that do not exhibit hazardous conditions due to soil instability, slopes or flooding;
- Locating new development near existing similar forms of development to minimize the disruption of agricultural activity and reduce the likelihood of land use conflict; and
- Locating new development outside of the separation distances established for hazardous industries, rural industrial developments, solid or liquid waste disposal facilities; and
- Situating new development along existing municipally maintained roadways.

The country residential policies prioritize developments that include substantive community and recreational amenities and housing which diversifies the current stock. The policies state that the form, configuration and intensity of development will be influenced by the capacity of supportive infrastructure and the natural carrying capacity of the land. Wherever possible, the configuration of the development should minimize the alteration of natural conditions and limits the size of any phase of subdivision to a maximum of 64 ha (160 acres) unless the proposed development includes a substantive recreational amenity.

The commercial land policies represented in Section 7 of the OCP prioritize the need to locate highway focused commercial development along major transportation corridors and at permanent highway access points. The OCP further encourages commercial development to situate at nodes with highway and major municipal road intersections and discourages strip commercial development that would impact the function and potential expansion of municipal roadways. Any commercial developments are encouraged to display a high visual quality.

Section 9 of the OCP seeks to protect natural and historical resources from development that would negatively impact these resources. This section of the OCP also recognizes and direct development outside the impacts of a 1:500 flood event.

2.8.2 RM of Corman Park Zoning Bylaw

The Zoning Bylaw is the companion document, and the principal means for implementing the direction presented in the OCP. The Zoning Bylaw contains regulations that informs physical development within the subject property including but not limited to establishing minimum lot size requirements, maximum building heights and setback distances between certain types of land uses. The proposed development of Pradera Estates anticipates the application of the CR1 – Country Residential 1 District, CR4 – Country Residential 4 District, and C – Commercial District.

The **CR1 District** is intended to accommodate a country residential development in a rural environment where the essential land requirement is for a building site and space rather than for productive agricultural purposes. The CR1 provides for larger country residential lots ranging from 1.34 ha and 3.65 ha in size with an overall average lot size requirement of 2.47 acres.

The **CR4 District** accommodates a comprehensively planned and integrated residential and recreational development. The CR4 provides for smaller lot country residential lots ranging from 0.22 ha and 1.01 ha in size with an overall residential density not exceeding 2 lots per acre. To offset the recreational opportunities lost due to the smaller lot size, a recreational feature is encouraged as a part of this zoning district.

The **C District** accommodates commercial uses which service the rural community or the traveling public. The commercial district provides for properties to be 2.47 acres or greater in size. As an example, the range of uses provides for entertainment, everyday essential items like groceries, personal services, vehicle sales, animal hospitals, financial institutions, commercial storage, and gas bars.

In addition to establishing land use specific regulations that will influence the form, location, intensity and configuration of development within Pradera Estates, the zoning bylaw also includes general regulations pertaining to the conservation of wildlife habitat, protection of heritage resources, development in hazard areas, wastewater collection and disposal, stormwater management, servicing and access.

3 Development Concept

The development concept takes advantage of the property's topography to minimize the need to grade lots and direct runoff water to the lowest-lying areas. The design incorporates the existing tree stands in the large lot CR development areas and the municipal utility (MU) parcels to maximize their retention and allow residents to use the natural features during site planning of their lot to create physical and visual buffers providing privacy from neighbouring properties.

Pradera Estates proposes five land uses including large lot CR1, small lot CR4, commercial, municipal utility properties (MU) and municipal reserve (MR). The objective of the residential uses is to offer a variety of lot shapes and sizes that meet the demand of a diversified population. This variety of residential lots provides residents opportunities to configure their lot to meet their individual needs.

There are 24 large lots (CR1) planned as part of the overall subdivision design ranging in size between 1.34 ha and 3.65 ha. The large lot sites provide residents with maximum flexibility in the placement and configuration of their houses to suit the needs of the individual and offers significant space to meet personal recreational needs. The large lot development provides residents with the opportunity to keep horses and small numbers of livestock on their property.



71 small lots (CR4) are planned as part of the subdivision design ranging in size between 0.22 ha and 1.01 ha. Small acreage lots offer more space than urban lots but require less maintenance than larger acreages. Smaller lots seem to be desirable in the RM based on other developments south of Saskatoon. The lots offer sufficient area to accommodate houses of various sizes and support personal recreational needs.

Four commercial lots are planned along the frontage of the plan adjacent to Highway 11. These sites range in size between 1.70 ha and 4.82 ha. Three commercial lots are on the west side of Highway 11, and a single commercial lot is planned to situate on the east side of the highway. The lots either front onto a future highway service road or a municipal grid road creating easy access for traffic/trucks and eliminating the external traffic from entering the internal/local roads. The proposed subdivision and development of the commercial parcel situated along the east side of Highway 11 will require the acquisition of additional right-of-way to support its improvement to an appropriate standard to support development.

The commercial properties face Highway 11, providing visibility to the traveling public while also potentially servicing the local commercial needs of residents. Integrating limited commercial development at this location offers local employment opportunities for residents without impacting the use and enjoyment of nearby residential sites. The types of businesses

locating here will be dictated by the permitted uses provided in the RM's commercial zoning district.



Three municipal utility parcels are planned for Pradera Estates, ranging in size between 4.30 ha and 7.45 ha. The MU parcels are in the lowest-lying areas on the site to provide for the development of stormwater ponds. The space is large enough to include a multi-purpose pathway meandering around the pond and connecting with a pathway network so people can navigate the area. The MU3 pond will be stocked annually with fish to provide another recreation opportunity.

The MU spaces will include soft and hard landscape features to feel welcoming and create an enjoyable experience as people explore the area. The landscaping will be located at the entrance to and along the pathways and ponds. The landscape features will be hardy to the region to ensure the longevity and health of the landscape features remains.

A total of 9.82 ha is being dedicated within four municipal reserve parcels ranging in size between 0.06 ha and 9.48 ha.

A large park space is planned on the south end of the subject property providing for passive and active recreational activities and featuring a toboggan hill, outdoor skating rink, playground structure and multi-use recreational centre.

- The toboggan hill will be constructed during site grading using excess topsoil and clay.



- The outdoor skating rink will be designed to be used across all four seasons providing an opportunity for in-line skating, lacrosse and basketball during summer months.
- The open field space will support informal recreational uses in ball sports, Frisbee, or other similar outdoor sports activities.
- The playground equipment will be located near the multi-use recreational centre.
- The park area will include a multi-use recreational centre with a dedicated off-street parking area to ensure that visitors have a convenient off-street location to park their vehicles. The multi-use recreational centre will be available for rent by anyone looking to host a variety of small scale community/public events including spiritual recreational programs and classes, banquets and meetings.

The park area is fully accessible to residents from a network of multi-purpose pathways which constitutes the balance of municipal dedications.

All public amenities and facilities will be designed using maintenance free, durable and long-lasting materials considering the three R's where possible (Reduce, Reused, Recycle). Vegetated areas will employ drought tolerant grasses and tree species to limit irrigation requirements. It is expected that a portion of the taxes collected from the development will be directed towards contracting the regular maintenance of the proposed public amenities.



The proposed development pattern focuses on transitioning land uses from higher intensity uses adjacent to the highway to less intensive uses internal to the site. Commercial development is the highest intensity of use proposed for this development and, therefore, is located along the subject property's eastern boundary and the municipal utility parcels.

The municipal utility parcels provide a buffer between the commercial development and nearby residential acreages.

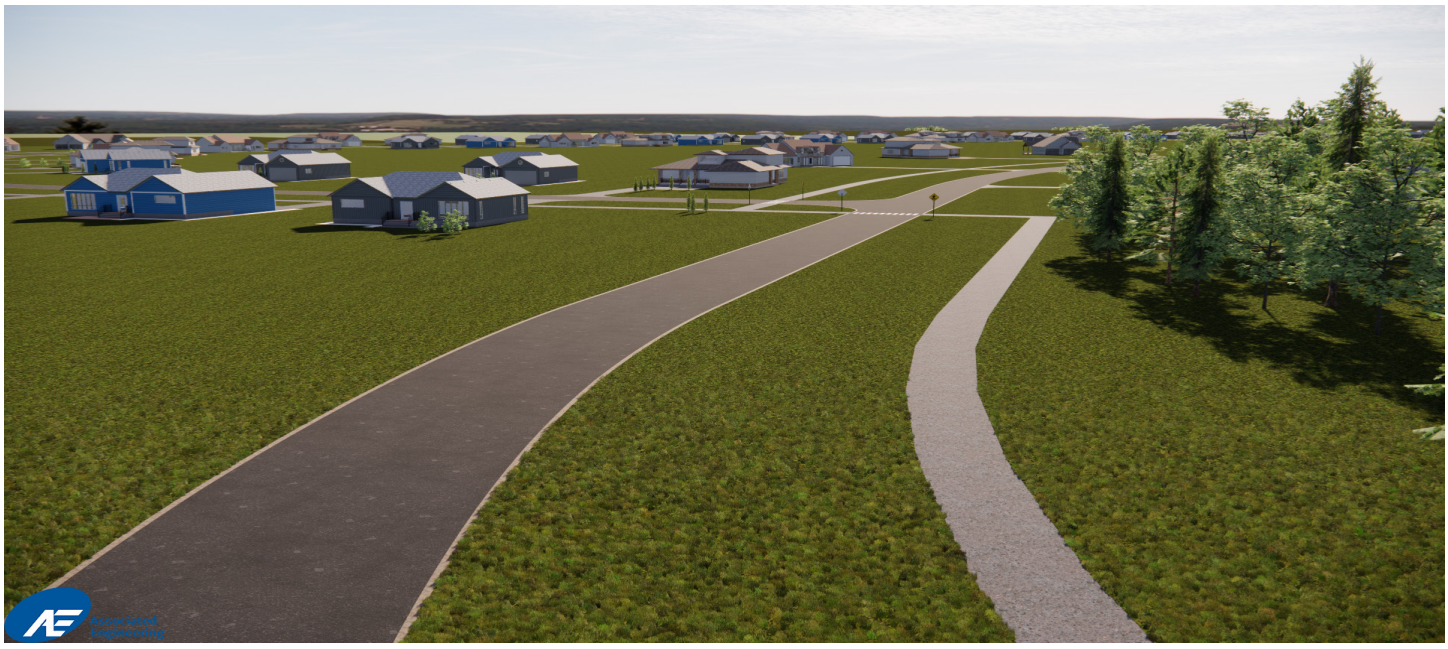
The large lot CR development is placed between the smaller lot CR and commercial uses because it provides more flexibility in situating a house on a lot. The larger lot size allows residents to create physical separation within their site through the placement of the dwelling and landscaping.

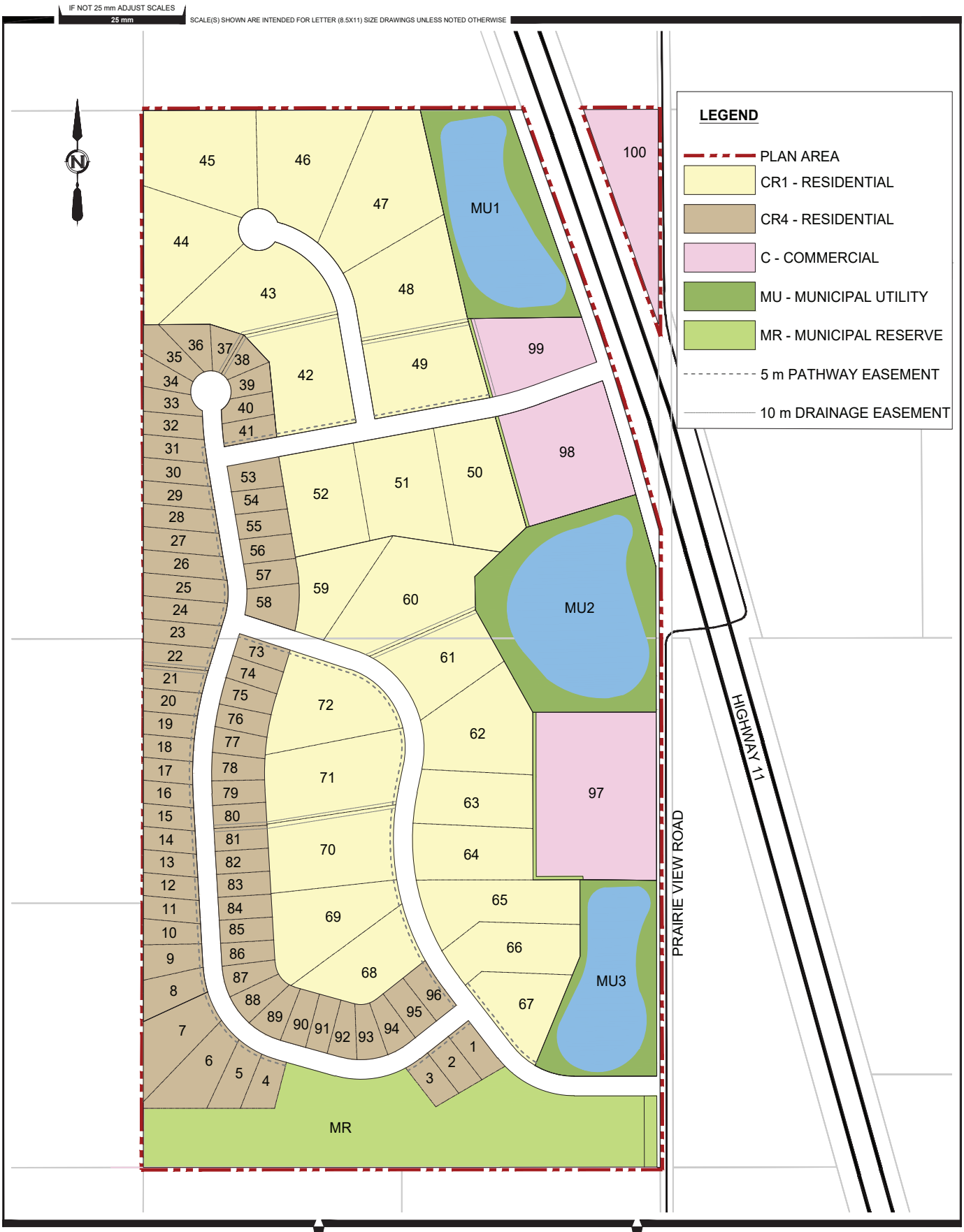
The small lot CR development has limited opportunities to use private land to insulate the residence from more intensive uses near the highway corridor. Situating these lots adjacent to large lot acreages to the east and undeveloped farmland to the west ensures that residents can use and enjoy their properties.

Like other country residential developments in South Corman Park, the internal road network is configured as a crescent with no connection to neighbouring lands. This roadway configuration is appropriate for the intended form of development, limiting traffic to local users while reducing the overall roadway length.

Land Use	# Lots	Area (ha)	%GDA
Gross Development Area (GDA)	**96**	**126.43**	**100**
CR1 - Country Residential 1 District	24	51.05	40
CR4 - Country Residential 4 District	72	24.68	20
C - Commercial District	4	11.54	9
MU - Municipal Utility		16.78	13
MR - Parks and Recreation		9.86	8
Roadways		12.52	10

Based upon an estimated net developable area of 109.65 ha with 86.8% of the land area designated for residential purposes and the remaining 13.4% designated for commercial development, the total MR dedication is estimated to be 10.24 ha.





PLOT DATE: 5/4/2022 10:38:23 AM
SAVE DATE: 5/4/2022 10:36:42 AM SAVED BY: PAWLUSKIM
DWG PATH: \\ae.ca\data\working\sas\2021-4570-00\plan\4570-00-up-703-land-use-plan-rev4.dwg

Associated Engineering

BEST MANAGED COMPANIES CANADA
Platinum member

AE PROJECT No.	20214570-00
SCALE	NTS
APPROVED	B. DELAINEY
DATE	2022MAY04
REV	0
DESCRIPTION	ISSUED FOR REPORT

FIGURE 3 - LAND USE PLAN
PRADERA ESTATES
COMPREHENSIVE DEVELOPMENT REVIEW

PLANNING

4 Conceptual Servicing

4.1 Potable Water

A 100 mm low-pressure water service line will be constructed connecting the development to an existing distribution line to the north operated by the Dundurn Rural Water Utility. This system will not be capable of providing fire flows to the parcels and lot owners will be responsible for installing their own private reservoirs and pressure systems. The water line will be constructed within the roadway ditches to provide easy access to the line for future service connections and repairs without having to excavate within the internal paved roadway.

The Dundurn Rural Water Utility (DRWU) was contacted and confirmed their ability to provide potable water for Pradera Estates. A formal water service contract is expected to be executed with the water utility following the execution of a municipal servicing agreement and as a condition of ministerial approval for the subdivision of the initial phase. A copy of this correspondence is attached in Appendix B.

4.2 Wastewater Management

The collection and disposal of wastewater within each proposed residential site will be managed through the construction of privately owned advanced treatment on-site wastewater treatment systems (OWTS). A hydrogeological investigation was performed by P. Machibroda Engineering Ltd. (PMEL) confirming that the physical conditions within the subject property are suitable to support this form of sewage treatment. The scope of this investigation included a desktop study, multiple field investigations involving the installation and monitoring of ground water monitoring wells equipped with piezometers, laboratory testing, an OWTS feasibility assessment, and preparation of a summary report.

4.3 Grading and Drainage Management

A conceptual drainage and stormwater management plan was prepared for the site in conformance with the general regulations of the RM of Corman Park Zoning Bylaw. According to the RM regulations, the site needs to account for and store the surface water runoff associated with a 1:100-year storm event, controlling the eventual off-site discharge of this collected run-off at a pre-development rate. A copy of the plan and accompanying technical memo is attached as Appendix H.

The conceptual drainage plan was shared with the Water Security Agency (WSA) and was subsequently approved. A copy of this correspondence in attached in Appendix B.

4.4 Transportation

Pradera Estates is planned to rely exclusively on Prairie View Road to provide access to and from Highway 11. A TIA was prepared and subsequently approved by the Ministry of Highways confirming that the current intersection is capable of accommodating the forecasted volume of traffic generated by the full build-out of the development while retaining a suitable level of service. It is our understanding that the RM of Corman Park has recently adopted a policy requiring all municipal roads connecting proposed multi-parcel country residential to nearby paved municipal or provincial roadways to be upgraded to a paved standard. It is expected that 750 m of Prairie View Road extending from the southernmost entrance of the development to the highway intersection will be required to be upgraded in phases as required by the staged subdivision and development of the lands.

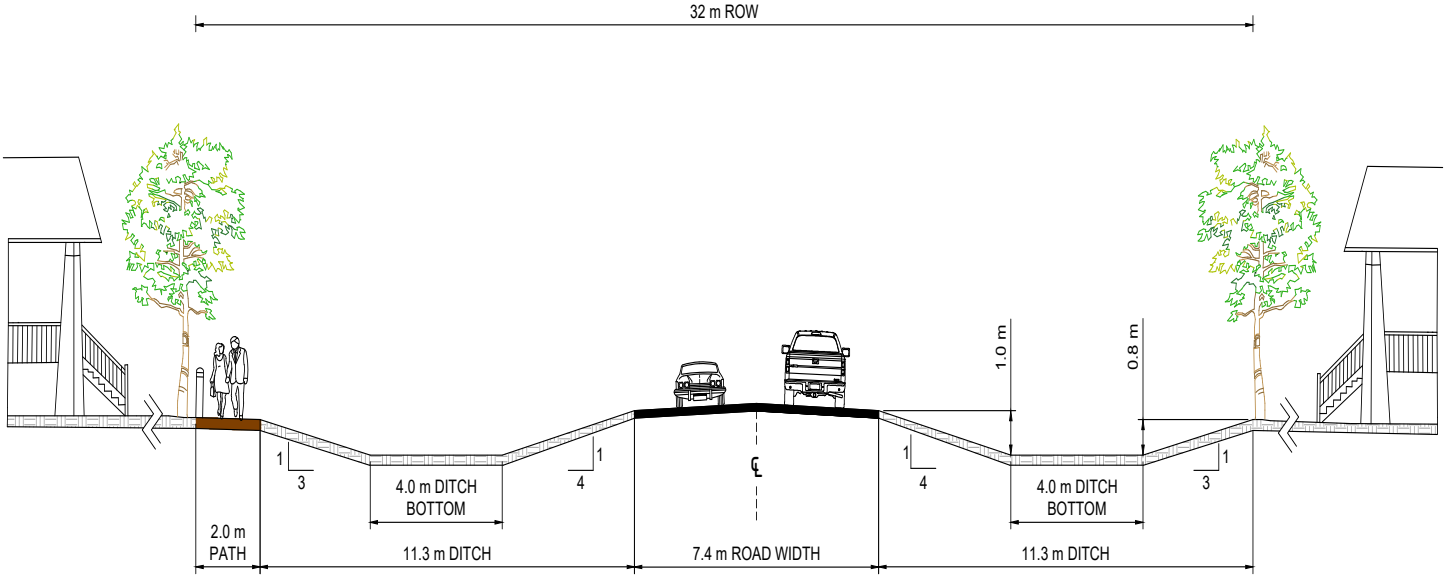
The TIA report assumes traffic generated by the development will utilize the shortest route to the site. Although the site is currently accessible from Victor Road to the south, this route adds approximately 1.5 km to the trip, significantly reducing the likelihood that this

intersection will see any changes in traffic as a result of the development. By terminating the extent of pavement to generally align with the proposed south access, internally generated traffic is encouraged to utilize Prairie View Road exclusively, further reinforcing that Victor Road will not be impacted by the development.

In addition to considering the full build-out of Pradera Estates, the TIA report also anticipates a scenario in the future where development of land surrounding the subject property may trigger the potential closure of the Prairie View intersection and the construction of a service road connecting the proposed development to Baker Road to the north. Although the development of Pradera Estates does not trigger the closure of the current intersection or the need to construct a service road to the north to connect the development to Baker Road, the development plan for the site accounts for the planned dedication of the lands necessary to construct this future service road in the future as demanded.

The TIA report recommends that a southbound right turn lane should be constructed in conjunction with the initiation of development within the subdivision and that intersection area lighting is installed at the Prairie View intersection in conjunction with future phases and prior to full build-out. It is anticipated that a partnership agreement will be executed with the Ministry to define the developer's responsibility for constructing these improvements.

The internal road network is planned to be constructed to a paved standard in compliance with the RM's published country residential road standards as appended to this report as Appendix H. The figure below illustrates the proposed cross section for the internal roads.



4.5 Shallow Utilities

The Developer has been in contact with SaskPower, SaskEnergy, and SaskTel. It is anticipated that this development can be easily serviced by power, gas, and telecommunication utilities. SaskPower, SaskEnergy, and SaskTel have confirmed their ability to provide utility service in writing (attached as Appendix B).

A letter attached in Appendix B confirms that Loraas Disposal can provide waste and recycling removal services at the proposed Pradera Estates development. The plan is to use an individual curbside pickup, which is more convenient and accessible to each lot owner.

4.6 Community Services

4.6.1 School

The proposed development was referred to the Prairie Spirit School Division for review. It was confirmed that two schools would serve any students living at the proposed Pradera Estates development. The two schools include South Corman Park School (K to Grade 6) and Clavet Composite School (Pre-K to Grade 12). Mr. Bob Bayles, Deputy Director of Division Services, confirmed that Pradera Estates would impact both of these schools at the developments full build-out. South Corman Park is 74% utilized currently and would have the ability to absorb growth. Clavet continues to have enrollment pressure and, as of the fall 2021, was over 90% utilized. The Prairie Spirit School Division continues to work on increasing it's capacity. Mr. Bob Bayles also confirmed the school division may have to add a bus in both transportation areas depending on the speed of

growth, that would be a decision to be made at that time.

4.6.2 Fire and Protective Services

The RM provides fire protection to its residents in the Pradera Estates area through an agreement with the City of Saskatoon Fire and Protection Services. The coverage area in the agreement with Saskatoon responds to the south and east RM boundaries as well as north to Penner/Pasture Road and west to Range Road 3070. Fire Hall No. 6 will respond from the City with one engine, a tanker, a brush truck, and a rescue truck during an emergency event. Once at the emergency site, the City Fire Department will request additional equipment if required.

Police services will be provided by the Corman Park Police Service and the Saskatoon Detachment of the RCMP. The RCMP is primarily responsible for criminal matters in the RM. The Corman Park Police have a specific mandate to enforce provincial statutes, municipal bylaws, and provide assistance to other police agencies as required within the RM.

4.7 Development Phasing

The subdivision and development of the lands is expected to occur over multiple phases beginning from the north end of the site and progressing south. The size and timing for each phase will be determined based upon market demand and the logical extension of new services to the property. The information presented in this report is conceptual in nature and subject to change over time at the discretion of the developer. It is assumed that a servicing agreement will be executed with each Plan of Proposed Subdivision submitted to confirm the responsibilities for property servicing. The developer acknowledges that any subdivision plans submitted that are not consistent with this report shall be accompanied by additional information to support the deviation.

Municipal reserve dedications and amenity construction is expected to occur in phases as well in conjunction with the dedication and construction of roadways necessary to provide access to the proposed amenity areas.

Although subdivision and development within Pradera Estates are intended to be phased, this submission anticipates that the RM Council will consent to rezoning the entire subject property in conjunction with the initial phase of subdivision with a holding provision applied the lands located outside of the initial phase. Our understanding is that Council will consider the removal of this holding provision upon receipt of subsequent subdivision applications accompanied by updated servicing cost estimates for each additional phase.

5 Public and Regulatory Consultation

5.1 Public Open House

Associated Engineering hosted a come-and-go open house event on April 27th, 2022, from 6:30 pm to 8:30 pm at the South Corman Park School (Log Cabin). Residents within 1.6 km of the subject property were notified of the event by direct mail three and a half weeks before the event. The event had ten recorded attendees. Before the event started, Associated Engineering received five phone calls regarding the project. All the conversations were positive and supportive of the proposed development. The only concern raised from the phone calls was regarding access to the development from Baker Road.

Below is a summary of topics raised during the open house.

The impact of residential development on the operation and potential expansion of an approved Intensive Livestock Operation to the south of the property.

The approved 300 animal unit ILO is located approximately 500 m south of the south boundary of Pradera Estates. The ILO has not operated for over 11 years based upon the information supplied by the operator. Although the license from Saskatchewan Agriculture and Food (SAF) never expires, the operation must maintain the minimum operational standards as defined by SAF. Based upon conversations with the operator, he has no imminent plans to re-initiate operations for various reasons including the significant capital investment that would be required to bring the current facilities up to the current standard. The operator expressed concern that the introduction of country residential development within Pradera Estates would inhibit his ability to reestablish the facility in the future if desired.

It is our understanding that discretionary use approval has been previously provided by the RM and that this approval does not expire despite the time that has elapsed since it last operated. In the absence of a sunset clause on the municipal approval, it is our understanding that the operation could be re initiated at any time without notifying the RM and without obstruction from the neighbouring country residential development. The only impact of the proposed country residential development on the operation is that it would limit the operator's ability to expand the capacity of the ILO as this would trigger a new discretionary use application and approval which would trigger the application of the reciprocal setback distances applied through the Official Community Plan.

The RM recently adopted new policies related to the siting of development near ILO operations. These new policies include the following:

4.2.9 If an Intensive Livestock Operation has ceased to operate for a period of 12 months or more, other uses, as defined in Table 1, are exempt from the separation distance in order to subdivide or develop the lands.

Since the neighbouring ILO has been inoperable for over a decade, the development of Pradera Estates is exempt from adhering to the setback distances represented in the OCP which would require a 1.2 km separation distance to be applied to account for the potential expansion of the facility to 600 animal units. An active 300 animal unit ILO requires a separation distance of 800 m.

The boundary of the closest residential property within the proposed development lies nearly 100 m north of the south property boundary and slightly less than 600 metres from the closest barn within the ILO, nearly meeting the 800 m separation if it had applied. The situation of the municipal reserve lands along the south boundary of the site was deliberate to maximize the separation from the barns in the event the operation is re initiated without eroding the development potential of the site.

The type of wastewater treatment systems planned to be used within the development.

Several attendees requested information concerning the type of wastewater treatment facilities planned to be utilized within the development. Some level of concern was raised concerning the use of private on-site wastewater treatment systems within the development based upon recent issues being experienced with a specific brand of treatment system in another neighbouring development. Development within Pradera Estates is planned to utilize private on-site wastewater systems throughout including holding tanks within the commercial areas and Type II Mounds, Chamber Systems and Absorption Field Systems within residential properties.

P. Machibroda Engineering Ltd. was contracted by the developer to prepare a hydrogeological report to determine:

- If aquifers (if any), proximate the proposed subdivision, are considered hydrogeologically isolated from sewage effluent;
- The sensitivity of the proposed subdivision in accordance with the Saskatchewan On-site Wastewater Disposal Guide (GOS, 2018);
- If sewage effluent will degrade the groundwater quality of shallow aquifers proximate the proposed subdivision to an unacceptable level; and
- If the proposed subdivision is suitable for successful long-term utilization of OWTS.

This report confirmed the suitability of using on-site treatment systems but recommends package treatment systems to ensure that the effluent quality entering the receiving environment will not adversely impact downstream groundwater users and/or the environment. Specific details concerning the investigation and its findings is provided in the Hydrogeological Report which is attached as Appendix F.

The location and suitability of the proposed access to the site and the cumulative impact of additional forecasted traffic associated with the proposed development on the existing highway intersections.

Several questions focused on confirming the intended means of accessing the site from Highway 11. It was made clear that the primary access point to and from the site will be from Prairie View Road with a slight chance that some traffic may use Victor Road in the future despite the fact that it is far less convenient and adds nearly 1.6 km onto the trip. Concerns were raised regarding the lack of improvements to these intersections. It was acknowledged that Associated Engineering had prepared a Traffic Impact Assessment that forecasted the volume of traffic generated by full development of the subject property and made recommendations for intersection upgrades based upon maintaining acceptable levels of service. The TIA report concluded that the intersection at Prairie View would perform satisfactorily as the principle point of access from Highway 11 through full build-out within Pradera Estates subject to the construction of a southbound right-hand turning lane and erection of intersection delineation lighting at the Prairie View Road intersection. Based upon conversations during and leading up to the event, the primary concern was that Pradera Estates would result in congestion at the Baker Road intersection. Despite the TIA confirming that a connection to Baker Road was not warranted, the development concept includes dedication of the land necessary to support the eventual construction of a service road to the north if warranted by the Ministry of Highways.

The timing for initiation of development.

Some attendees inquired about when the development would get underway and how long it would take to complete. Setting a specific timeline for full build-out of the area is challenging due to the large base of land involved in the development and the external factors that will influence the rate of development. It is expected that if approved, construction could be initiated as early as the fall 2022 or alternatively spring 2023.

There was a sense of excitement about when the first house would be built and how long we thought it would take to complete the entire project. As mentioned above, the first house will depend on the construction of the roads, waterlines, and ponds. As for complete build-out, the market will dictate how long it takes the Developer to complete the project.

Will the development be exclusive to a single home builder?

A comment was made about who the preferred home builders will be. The Developer holds the right to sell lots to whomever he chooses and at this point, there is no set specific list of preferred home builders for Casa Pradera.

Appendix A - Geotechnical Report

GEOTECHNICAL INVESTIGATION

GEOTECHNICAL INVESTIGATION
PROPOSED GREENVIEW ESTATES
SUBDIVISION
SE-24-35-5-W3M AND NE-13-35-5-W3M
SOUTH OF SASKATOON, SASKATCHEWAN
PMEL FILE NO. 17789
MAY 17, 2021





PREPARED FOR:
Oja Holdings Ltd.

ATTENTION: Mr. Jonathon Abrametz, President

P.MACHIBRODA
ENGINEERING LTD.
DOWN TO EARTH SOLUTIONS

P.MACHIBRODA
ENGINEERING LTD.

PROJECT: Geotechnical Investigation

Proposed Greenview Estates Subdivision
SE-24-35-5-W3M and NE-13-35-5-W3M
South of Saskatoon, Saskatchewan
PMEL File No. 17789
May 17, 2021

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Appendix B CPTu Plots
Appendix C Grain Size Distribution Analysis Test Results
Appendix D Topsoil, Organic Matter and Organics

1 INTRODUCTION

1.1 GENERAL

The following report has been prepared on the subsurface soil conditions existing at the site of the proposed Greenview Estates subdivision to be constructed within SE-24-35-5-W3M and NE-13-35-5-W3M, south of Saskatoon, Saskatchewan.

The terms of reference for this investigation were presented in P. Machibroda Engineering Ltd. (PMEL) Proposal No. 17789 dated March 8, 2021. Written authorization to proceed with this investigation was provided in the signed Consulting Agreement between Oja Holdings Ltd. and PMEL, dated March 26, 2021.

1.2 SITE LOCATION

The subject site is located within SE-24-35-5-W3M and NE-13-35-5-W3M, approximately 6 km south of Saskatoon, Saskatchewan. The site is bound by Highway No. 11 and a grid road to the east and farmland in all other directions. The study area is relatively flat-lying for the most part with slight topographic undulations in some areas; the elevations at our test locations ranged from about 507 to 512 m (highest elevations near the south side of the site). Treed areas and low-lying areas exist in some areas. The site is currently utilized as farmland. A Site Plan showing the location of the study area and test locations has been shown on Drawing No. 17789-1.

2 FIELD INVESTIGATION

The field test drilling, soil sampling, piezocone penetration testing (CPTu) and piezometer installation was conducted between April 9 and 22, 2021. Groundwater monitoring was conducted on April 22 and May 5, 2021.

The coordinates and ground surface elevation at each test location were provided by Digital Planimetrics Inc.

2.1 FIELD DRILLING PROGRAM

Forty-six boreholes (drilled at 29 separate locations), located as shown on the Site Plan, Drawing No. 17789-1, were dry drilled using our truck-mounted, continuous flight auger drilling rig. The boreholes were 150 mm in diameter and extended to depths of 3 to 12 m below the existing ground surface.

Borehole drill logs, as shown on the attached Field Drill Logs, Drawing Nos. 17789-2 to 30, 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.

2.2 Piezocone Penetration Testing

Fourteen CPTu's, located as shown on the Site Plan, Drawing No. 17789-1, were conducted during the field investigation. The CPTu soundings were extended to depths of 14.1 to 20.8 m below existing ground surface.

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° and a 15 cm² base area. The friction sleeve had a perimeter area of 225 cm².

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 a surficial sand deposit (thickness ranging from 1.2 m to greater than 10 m) overlying variable deposits of clay, silt and sand, which extended to a depth of at least 20.8 m, the maximum depth investigated. Based on a review of the CPTu plots, glacial till may have been encountered at depth at some CPTu locations (cannot be confirmed as no samples of till were recovered).

The sand was loose to compact, poorly graded, fine grained and moist initially, becoming wet below the groundwater table. The clay deposits were firm to very stiff, medium to highly plastic and moist. The silt was firm to stiff, low to 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 borehole 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 LEVEL

Borehole No.	Piezometer Rim Elevation (m)	Ground Surface Elevation (m)	Groundwater Depth (m) (2021)		Groundwater Elevation (m) (2021)	
			April 22	May 5	April 22	May 5
21-1A	509.6	508.5	2.3	2.2	506.2	506.3
21-2	509.5	508.5	2.3	2.3	506.3	506.2
21-3A	509.5	508.5	2.4	2.3	506.1	506.2
21-4	508.9	507.9	2.0	2.0	505.9	505.9
21-5A	509.0	507.9	2.0	1.9	505.9	506.0
21-6	510.4	509.4	3.6	3.6	505.8	505.8
21-7A	510.4	509.4	3.5	3.4	505.9	506.0
21-8	510.1	509.0	DRY	3.0	DRY	506.0
21-9A	509.8	508.8	2.3	2.3	506.5	506.5
21-10	510.0	508.9	2.4	2.4	506.5	506.5
21-11A	509.3	508.3	2.1	2.0	506.2	506.3
21-12	508.6	507.5	1.7	1.6	505.8	505.9
21-13A	508.1	507.1	1.8	1.8	505.3	505.3
21-14	507.9	506.9	1.9	1.8	505.0	505.1
21-15A	509.7	508.6	2.4	2.4	506.2	506.2
21-16	510.7	509.7	3.2	3.2	506.5	506.5
21-17A	509.1	508.1	1.5	1.5	506.6	506.6
21-18	510.9	509.8	3.3	3.3	506.5	506.5
21-19A	509.9	508.7	2.1	2.2	506.6	506.5
21-20	509.0	508.0	1.5	1.5	506.5	506.5
21-21A	510.1	509.3	3.5	3.5	505.8	505.8
21-21B	510.4	509.3	3.6	3.5	505.7	505.8
21-22A	510.4	509.4	3.1	3.1	506.3	506.3
21-23	512.9	511.8	5.5	5.4	506.3	506.4
21-24A	509.9	508.9	3.0	3.0	505.9	505.9
21-25	508.0	506.9	1.5	1.4	505.5	505.5
21-26A	509.4	508.3	3.1	3.0	505.2	505.3
21-27	511.9	510.9	5.5	5.5	505.4	505.4
21-28	513.1	511.9	5.7	5.7	506.2	506.2
21-28A	513.2	512.2	DRY	DRY	DRY	DRY
21-28B	514.0	512.9	DRY	DRY	DRY	DRY
21-29	510.7	509.7	3.8	3.8	505.9	505.9

Upon review of Table I, the groundwater table was recorded at a depth of 1.4 to 5.7 m (average of 2.8 m) below existing grade on May 5, 2021 (elevation of 505.1 to 506.6 m). Groundwater levels should be expected to fluctuate seasonally by as much as 1 m (with the highest groundwater level in the spring and/or during/following spring thaw and/or periods of precipitation).

A groundwater contour map has been remove shown plotted on Drawing No. 17709-31.

3.3 Cobblestones and Boulders

Cobblestones and/or boulders were not encountered within the depth of exploration.

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, water-soluble sulphate contents and grain size distribution analysis.

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. 17789-2 to 30, inclusive.

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

5 Design Recommendations

Based on the foregoing outline of soil test results, the following foundation considerations and design recommendations have been presented.

5.1 Design Considerations

It is understood that the proposed subdivision will encompass the majority of two quarter sections of land adjacent to Highway No. 11 (the north-eastern most portion of the north quarter will not be developed). The subdivision will reportedly consist primarily of residential development with some commercial lots along the highway. Associated roadways/buried utilities will also be constructed as part of site development.

The mandate of this investigation is to provide detailed recommendations to support design of the proposed residential development foundations, and to provide baseline information for the proposed commercial developments. Additional geotechnical investigations will be required in the future to provide site-specific geotechnical recommendations for the commercial developments.

Recommendations for traffic structures will be presented in a separate report once the necessary design information becomes available.

The subsurface soil conditions consisted of sand overlying variable deposits of clay, silt and sand. The groundwater table was recorded at a depth of 1.4 to 5.7 m below existing grade on May 5, 2021 (elevation of 505.1 to 506.6 m). Groundwater levels should be expected to fluctuate seasonally by as much as 1 m (with the highest groundwater level in the spring and/or during/following spring thaw and/or periods of precipitation).

It is understood that houses, garages and decks will be constructed within the proposed subdivision. It is anticipated that basements will preferably be constructed (where feasible). Where basement construction is not feasible due to high groundwater conditions, structural floors over (shallower) crawlspaces or at-grade structures with grade-supported concrete slabs are recommended.

To minimize the potential for groundwater-related issues, all basements/crawlspaces should be based at least 1 m above the current groundwater elevation (refer to Drawing No. 17789-31 for a groundwater elevation contour map). Existing topographical information along with future site grading plans should be used to determine whether or not basements/crawlspaces are feasible and to determine where structures should be situated within given lots to satisfy the groundwater clearance criteria.

The subgrade soils are frost susceptible and the potential depth of frost penetration could range from about 2 to 3 m, depending on surface cover and severity of the winter.

Footings or concrete raft foundations should be viable foundation alternatives for the anticipated structures within the proposed subdivision. The magnitude of frost-related differential movements can be reduced by ensuring adequate site/foundation drainage and utilizing strategically placed extruded polystyrene insulation adjacent to the foundations.

A deep foundation system consisting of helical screw piles is expected to be the most practical/economical deep foundation alternative for the anticipated structures to be constructed within the proposed subdivision.

Recommendations have been prepared for site preparation; excavations and dewatering; site classification for seismic site response; limit states resistance factors and serviceability; footings; concrete raft foundations; deep foundations; foundation drainage; foundation walls; floors; and, foundation concrete.

5.2 SITE PREPARATION

All trees, vegetation, roots, organic topsoil, loose fill and deleterious materials should be removed from the construction area. Topsoil thicknesses ranging from 0 to 700 mm were encountered in our boreholes during test drilling. Due to the large aerial extent of the site, deeper thicknesses of topsoil may be encountered, particularly in vegetated or low-lying areas. 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.

Building Areas	96 percent standard Proctor density at optimum moisture content;
Traffic Areas	96 percent standard Proctor density at optimum moisture content;
Landscape Areas	90 percent standard Proctor density at optimum moisture content.

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 at this site. 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.

Fill, required to bring the subgrade surface to the design elevation in construction areas, should preferably consist of granular material or non-expansive fine-grained soil (i.e., low to medium plastic). 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.

5.3 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.

The groundwater table was recorded at a depth of 1.4 to 5.7 m below existing grade on May 5, 2021 (elevation of 505.1 to 506.6 m). Groundwater levels should be expected to fluctuate seasonally by as much as 1 m (with the highest groundwater level in the spring and/or during/following spring thaw and/or periods of precipitation).

Excavation below the water table should be avoided wherever practical. Excavations below the groundwater table will encounter construction difficulties associated with groundwater seepage and sloughing conditions, particularly where saturated sand/silt soils are encountered (these soils will flow into excavations). 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. If conventional dewatering methods are ineffective, dewatering wells may be required.

Sideslopes should be no steeper than 1.5H : 1V above the groundwater table and no steeper than 3H : 1V to 4H : 1V below the groundwater table (as measured from the bottom of the excavation). Slope flattening will be required if unstable conditions are encountered during excavation. Continuous visual monitoring of the sideslopes should be undertaken to assess whether flatter sideslopes are required to maintain stability.

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.

5.4 SITE CLASSIFICATION FOR SEISMIC SITE RESPONSE

Based on the consistency of the subgrade soils encountered at the subject site and Table 4.1.8.4A of the 2015 National Building Code, the site classification for seismic site response falls within Class D.

5.5 LIMIT STATES RESISTANCE FACTORS AND SERVICEABILITY

The National Building Code of Canada (NBCC, 2015) requires the use of limit states design for the design of buildings and their structural components, including the design of shallow and deep foundations.

It is expected that the designer is familiar with the limit states design method and only a brief discussion will be presented. For a detailed discussion, it is recommended to review the NBCC (2015) and/or the Canadian Foundation Engineering Manual (CFEM, 2006).

Limit states are defined as those conditions under which a structure ceases to fulfill the function for which it was designed (i.e., unsatisfactory performance). In limit states design, two conditions are assessed with respect to performance, these are:

- ultimate limit states (ULS), and
- serviceability limit states (SLS)

Ultimate limit states are concerned with the collapse mechanisms of the structure (i.e., safety), whereas serviceability limit states consider mechanisms that restrict or constrain the intended use, function or occupancy of the structure.

As per NBCC (2015), the factored soil resistance utilized for foundation design may be determined using the following resistance factors applied to the ultimate resistance values presented in the following subsections of the report.

Shallow foundations:

- Compressive Resistance, $\Phi = 0.5$
- Sliding, Based on Friction (c=0), $\Phi = 0.8$

Deep foundations:

- Compressive Resistance, $\Phi = 0.4$
- Tensile Resistance, $\Phi = 0.3$

The above resistance factors have been provided to reflect that semi-empirical methods were used to derive the soil bearing resistances presented in this report using the laboratory and in-situ data collected during this investigation.

To satisfy serviceability limit states, a settlement analysis of the foundation must also be evaluated to ensure the structures are not negatively impacted by excessive settlement at the design load. Estimated foundation settlements have been provided in Sections 5.6, 5.7 and 5.8.2.

Piles exposed to lateral loads are typically designed to restrict lateral deflection of the pile head to tolerable limits. Lateral pile head deflection can be determined using the concepts presented in Section 5.8.3.

5.6 FOOTINGS

A footing foundation based within naturally deposited, undisturbed soil above the elevation of the groundwater table should perform satisfactorily. If the foundation is constructed during freezing conditions, the subgrade soil at the design footing elevation must be protected from freezing. If it is not practical to keep the subgrade from freezing then a deep foundation system should be constructed.

To minimize the potential for groundwater-related issues, all basements/crawlspaces should be based at least 1 m above the current groundwater elevation (refer to Drawing No. 17789-31 for a groundwater elevation contour map). Existing topographical information along with future site grading plans should be used to determine whether or not basements/crawlspaces are feasible, to determine where structures should be situated within given lots to satisfy the groundwater clearance criteria and to determine at what depths footings should be based. Based on existing topography, full-depth basements will be feasible at some locations whereas basements/crawlspaces may not be feasible at other locations (unless site grading/filling is completed).

The following minimum recommendations should be incorporated into the design of a footing foundation. The recommendations are applicable to footings supporting vertical concentric loading only; footings subject to eccentric/unbalanced loading will require additional assessment.

1. Footings should be founded on naturally deposited, undisturbed soil (footings shall not be based on fill unless approved by the Geotechnical Consultant). Footing depths will vary within the subdivision depending on local topography and groundwater conditions, but all footings should be based at a minimum depth of 0.75 m below finished ground surface.

2. For permanently heated, at-grade structures (i.e., no basement or crawlspace), the footings should be based at a minimum depth of 1.8 m below finished grade. Where a heated basement or crawl-space is constructed, footings should be based at a minimum depth of 1.2 m below finished grade. These minimum depths are applicable only where the building envelope insulation is designed to allow heat loss to the foundation. If insulation is placed beneath the floor slab, an uninsulated strip width of at least 1 m is recommended adjacent to all exterior grade beams/foundation caps to allow for heat loss to the foundation. In unheated areas and/or where heat loss from the building to the foundation is not allowed, footings should be based below the potential depth of frost penetration (i.e., 3 m) or protected against frost action with strategically placed extruded polystyrene insulation.

3. If site topography/groundwater conditions do not allow for the construction of footings that meet the criteria outlined in point 2 above, the footings should be protected from frost action using extruded polystyrene insulation. The extents and thickness of insulation necessary to protect the foundation from frost will depend on heat-loss effects from the overlying building. In all cases, a continuous layer of insulation should be placed over the exterior face of the foundation wall/grade beam, extending vertically a minimum of 300 mm above grade. The lateral section of insulation should be based a minimum of 300 mm below finished grade to provide protection from damage and positively sloped to promote drainage away from the foundation. Suggested recommendations for insulation thickness/length have been summarized below (heat loss to the foundations must be allowed, as discussed above).

- For footings supporting continually heated structures (heated to at least 18˚C year-round), the insulation should be a minimum of 50 mm in thickness and should extend laterally a minimum of 1.8 m beyond the perimeter of the footing foundation.
- For footings supporting continually heated structures (heated to a nominal temperature of at least 7˚C year-round), the insulation should be a minimum of 75 mm in thickness and should extend laterally a minimum of 2.4 m beyond the perimeter of the footing foundation.
- For footings supporting unheated structures or seasonally heated structures, the insulation should be a minimum of 125 mm in thickness and should extend laterally a minimum of 2.4 m beyond the perimeter of the footing foundation. In this case, the insulation will need to be placed on all sides of the foundations rather than just the external face and the supported walls must have an insulated layer directly above the foundation wall/grade beam to prevent frost from short-circuiting through the wall.

In all cases, the thickness and lateral extent of the insulation should be increased by 1/3 (33 percent) at the building corners.

If insulation is not utilized, frost-related movements should be expected and must be accepted to the Owner.

4. Footings based on naturally deposited, undisturbed soil may be designed to exert an unfactored ULS bearing pressure of 300 kPa and an SLS bearing pressure of 75 kPa (to limit settlements to less than 25 mm). A maximum spread footing dimension of 1.5 m and a maximum strip footing width of 1 m was considered to determine the SLS bearing pressure; for larger footing sizes, an updated settlement analysis will be required.

5. A representative of the Geotechnical Consultant should inspect the footing excavations prior to construction of the footings to verify that adequate soil conditions exist. After inspection, placement of a mud slab or well compacted layer of crushed granular base course material (minimum 75 mm thickness) over the prepared foundation level is recommended to provide protection from disturbance.

6. A minimum strip footing width of 500 mm is recommended. A minimum dimension of 1,000 mm is recommended for square and rectangular footings.

7. If the subgrade soil is disturbed during excavation below the design depth, then the disturbed soil should be removed to an undisturbed, level surface. Fill, required to raise the subgrade elevation to the underside of the footings, should be concrete

8. Footings should not be constructed on desiccated, frozen or wet subgrade soil. Frost should not be allowed to penetrate beneath the footings prior to, during or after construction.

9. The finished grade should be landscaped to provide for positive site drainage away from the structure.

5.7 CONCRETE RAFT FOUNDATIONS

The following minimum recommendations should be incorporated into the design of a reinforced concrete raft foundation. Conceptual raft foundation details have been shown on Figure No. 1.

1. All deleterious and organic material should be removed from the raft footprint. After removal of any unsuitable material and/or overexcavation required to reach the design subgrade level, scarify and compact the surface of the subgrade to 96 percent of standard Proctor density at optimum moisture content.

2. Overexcavate and replace soft areas with structural granular fill placed and compacted in thin lifts (150 mm loose) to 96 percent of standard Proctor density at optimum moisture content. High-strength geogrid/geotextile may be required to provide soil stabilization and separation where soft/wet/loose soil conditions are encountered. The need for special measures (i.e., over-excavation, geotextile, geogrid, and/or additional gravel fill) in soft/wet/loose areas must be subject to review by the Geotechnical Consultant during field construction.

3. Subgrade fill, if required, should preferably consist of locally available soils or imported granular fill, placed in thin lifts (maximum 150 mm loose) and compacted to 96 percent of standard Proctor density at optimum moisture content.

4. If possible, grade the subgrade surface to promote drainage to the outer edges of the foundation (allowing overland drainage away from the foundation) with a minimum cross slope of 5 percent.

5. A minimum of 300 mm of granular base course fill is recommended beneath the underside of the raft (Saskatchewan Ministry of Highways and Infrastructure Type 33 aggregate or approved equivalent). The granular fill should extend laterally away from the edge of the raft a distance at least equal to the fill thickness. The granular fill should be placed in thin lifts (maximum 150 mm loose) and compacted to 98 percent of standard Proctor density at optimum moisture content.

6. The slab thickenings, bearing on compacted granular fill over the prepared subgrade soil, may be designed to exert an unfactored ULS bearing pressure of 300 kPa. The SLS bearing pressure to limit foundation settlements to 25 mm or less is 75 kPa. The estimated settlement is based on typical slab thickening dimensions of 1 m or less. If a lesser settlement is required and/or larger slab thickening dimension will be constructed, PMEL should be re-evaluate the recommended SLS bearing capacity.

7. Extruded polystyrene insulation is recommended alongside the thickened edge foundation to minimize potential movements due to frost. The insulation should be placed adjacent to the foundation and should be positively sloped to direct water away from the foundation. For heated buildings, a vertical sheet of insulation should also be placed above the horizontal insulation, extending up to the insulated exterior wall. For unheated structures, the insulation should extend beneath the entire floor slab area. Recommended insulation details (thickness, extents etc.) have been shown on Figure I. If insulation is not utilized, frost-related movements should be expected and must be accepted to the Owner.

8. Reinforce the concrete slab and articulate the slab at regular intervals to provide for controlled cracking.

9. Separation joints should be used to isolate the raft from any structures/utilities that are not supported by the raft.

10. Provide positive site drainage away from the foundation.

11. The foundation should not be constructed on desiccated, wet, or frozen subgrade soil or base. Frost should not be allowed to penetrate beneath the foundation just prior to or during construction.

FIGURE 1A:
GENERAL
INSULATED
FOUNDATION
CONCEPT

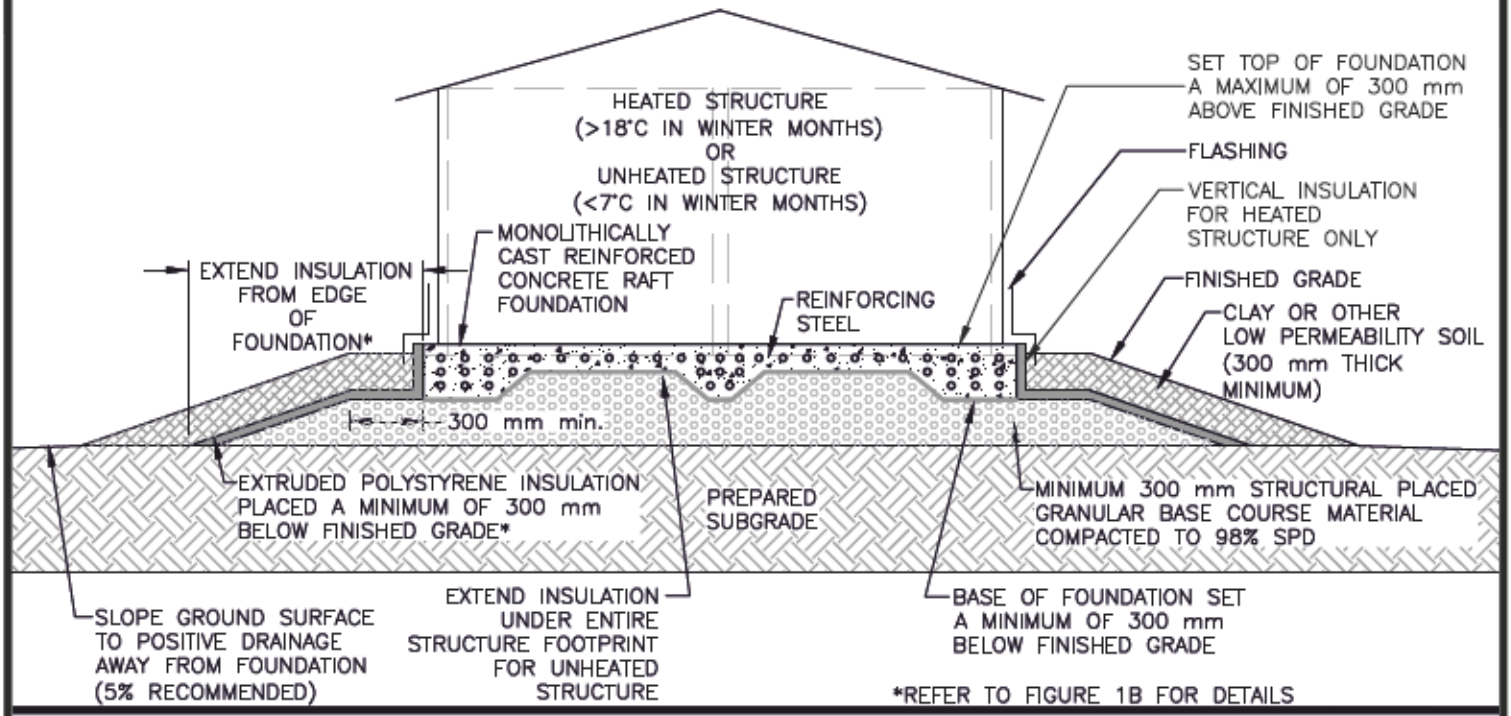
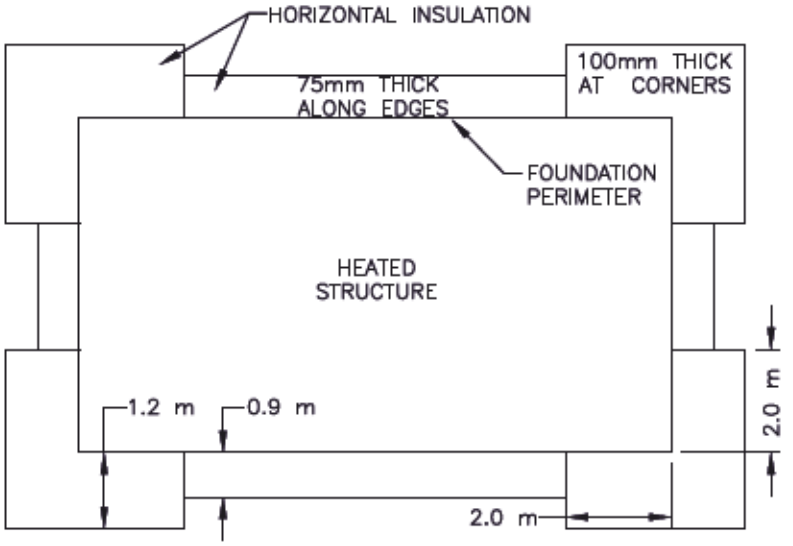


FIGURE 1B:
EXTENTS OF INSULATION



FOR UNHEATED BUILDING, INSULATION THICKNESS = 200 mm AND LATERAL EXTENT FROM FOUNDATION PERIMETER = 2.7 m; INSULATION MUST EXTEND UNDER THE ENTIRE STRUCTURE FOOTPRINT

NOTE:
1. THIS DRAWING IS FOR CONCEPTUAL PURPOSES ONLY. ACTUAL LOCATIONS MAY VARY AND NOT ALL STRUCTURES ARE SHOWN.

CONSULTING
GEOENVIRONMENTAL
GEOTECHNICAL
ENGINEERS

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DRAWING TITLE: CONCRETE RAFT FOUNDATION		
PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION SE-24-35-05-W3M AND NE-13-35-05-W3M, SOUTH OF SASKATOON, SK		
APPROVED BY: CZ	DRAWN BY: TP	DRAWING NUMBER: 17789-FIGURE1
DATE: MAY, 2021	SCALE: NOT TO SCALE	

5.8 DEEP FOUNDATIONS

5.8.1 HELICAL SCREW PILES

Helical screw piles are installed by rotating a steel pipe, equipped with one or more helix flightings, into the ground. For single helix screw piles, pile capacity is derived from shearing resistance along the pile shaft (i.e., shaft resistance) as well as end bearing capacity of the helix. For multi-helix piles, pile capacity may be derived from the sum of the shearing resistance along the portion of pile shaft above the uppermost helix and end bearing capacity of each helix. The helical plates should be spaced a minimum of 3 helix diameters apart.

The ULS and SLS soil resistance values for design of screw piles have been presented below.

TABLE II SHAFT RESISTANCE (SCREW PILES)

Depth (m) [1]	Shaft Resistance (kPa)	
	Unfactored ULS	SLS
0 to 2	0	0
Below 2	25	10

[1] Depth below existing ground level.

TABLE III END BEARING RESISTANCE (SCREW PILES)

Depth (m) [1]	End Bearing Resistance (kPa)	
	Unfactored ULS	SLS
Below 5	650	225

[1] Depth below existing ground level.
[2] Torque monitoring must be conducted to confirm that piles are based in hard/dense soils.

Notes:

1. For the purposes of this report, design depths have been referenced to existing grade. The structural engineer must consider finished grade elevation relative to existing grade. If existing grade is altered significantly, PMEL should be consulted to confirm the design parameters.

2. The uppermost (embedded) 2 m of the pile shaft should be neglected in terms of axial capacity.

3. Piles beneath a heated building (i.e., continuously ≥ 15°C) may be designed to have helixes based a minimum depth of 6 m below existing grade, provided the building envelope insulation is designed to allow heat loss to the foundation (i.e., uninsulated floor) and the piles will not be exposed to a prolonged period of freezing conditions prior to the initial heating of the building (i.e., during construction). Where insulation is placed beneath the floor slab, an uninsulated strip width of at least 1 m is recommended adjacent to all exterior grade beams/foundation caps.

4. In unheated areas and/or where heat loss from the building to the foundation is not allowed, screw piles should be based a minimum depth of 8 m below existing ground surface to provide protection from frost action. Alternately, strategically placed insulation and/or piles that incorporate a bond breaker over the pile shaft within the depth of frost penetration (i.e., outer polyethylene sleeve that is isolated from the shaft and allowed to move freely with potential ground movements) could be considered to minimize risk of frost jacking and reduce required pile lengths. PMEL can review potential alternatives upon request.

5. When determining the compressive shaft resistance of the pile shaft, the portion of the pile shaft within 1D above the uppermost helix should be discounted due to interaction effects between the pile shaft and helix. For piles subject to tensile loads, the zone of zero shaft resistance should be increased to 2D above the uppermost helix.

6. Compressive end bearing capacity may be calculated utilizing the effective soil contact area of the helix (i.e., overall cross-sectional area for the lowest helix, helix area minus shaft area for upper helixes). Piles subject to tensile loads should use the effective area of the helix (i.e., helix area minus shaft area) when determining uplift pile capacity.

7. A minimum centre-to-centre pile spacing of 2.5D is recommended, where D=helix diameter. Lesser spacings may be acceptable, but must be approved by the Geotechnical Consultant.

8. The helical plate shall be normal to the central shaft (within 3 degrees) over its entire length. Multiple helixes (if applicable) should be spaced at increments of the helix pitch to ensure that all helixes travel the same path during installation.

9. Continuous monitoring of the installation torque should be undertaken during installation to determine whether the screw pile has been damaged during installation and to monitor the consistency of the subsurface soils.

10. Screw piles should be designed on the basis of conventional static analysis using the resistance values presented above. Installation torque should be used for monitoring purposes only and not to determine pile capacity.

11. The installation of screw piles typically disturbs the upper portion of the soils, often resulting in poor to no contact with the adjacent soils in this zone. As such, additional measures may be required if screw piles are required to resist lateral loading (i.e., pre-boring and backfilling of the annular space with lean mix concrete, construction of a buried pile cap/grade beam over the screw pile, use of larger diameter pile shafts etc.). If screw piles are required to resist lateral loads, the design details should be reviewed with the Geotechnical Consultant.

12. A representative of the Geotechnical Consultant should inspect and document the installation of each screw pile on a continuous basis.

5.8.2 Pile Settlement

With regards to serviceability of pile foundations, assuming good construction practices are followed and the appropriate resistance factors are applied; the settlement of individual piles at the design load will be small and should be within tolerable limits. The estimated pile settlement at working loads should be in the order of 10 to 20 mm for screw piles.

The above is applicable to individual piles and small pile groups. Although not anticipated, foundation settlement should be evaluated where large pile groups are employed to carry the foundation load (i.e., breadth of foundation or pile cap is a similar dimension as depth of piles).

Pile foundations designed utilizing the provided SLS bearing capacities would perform similarly to pile foundations designed using the provided ULS capacities.

5.8.3 Lateral Thrust Forces

Pile deflection typically governs the design of laterally loaded piles. Subgrade reaction theory may be utilized to estimate lateral pile deflection. The estimated coefficients of horizontal subgrade reaction of the subgrade soils have been presented in Table IV.

TABLE IV ESTIMATED COEFFICIENTS OF HORIZONTAL SUBGRADE REACTION

Depth (m)	Coefficient of Horizontal Subgrade Reaction, Ks, (kN/m^3)
0 to 1.5D	0
1.5D to 2	3,500z/D
Below 2	6,000/D

Where D = pile diameter and z = depth (m). For large diameter piles (i.e. exceeding 1 m) the zone of zero horizontal subgrade reaction should not exceed 1.5 m.

For the purposes of this report, design depths have been referenced to existing grade. The structural engineer must consider finished grade elevation relative to existing grade. If existing grade is altered significantly, PMEL should be consulted to confirm the design parameters.

The response of a pile to lateral loads is highly nonlinear. Methods that assume linear behaviour, such as horizontal subgrade reaction theory, are only applicable where pile deflections are small, loading is static and pile materials are linear; these conditions do not exist in most cases and soil-pile interaction modeling (i.e., p-y method) is required to accurately model the pile behaviour. If a more detailed lateral analysis is deemed warranted, PMEL can model the interaction between the soil and the pile, in accordance with the p-y method. Specific pile details (i.e., loading, type, diameter, length, etc.) will be required in order to perform the analysis.

The installation of screw piles typically disturbs the upper portion of the soils, often resulting in poor to no contact with the adjacent soils in this zone. As such, additional measures may be required if screw piles are required to resist lateral loading (i.e., pre-boring and backfilling of the annular space with lean mix concrete, construction of a buried pile cap/grade beam over the screw pile, (use of larger diameter pile shafts) etc.). If screw piles are required to resist lateral loads, the design details should be reviewed with the Geotechnical Consultant.

5.8.4 Grade Beams and Pile Caps

Grade beams and pile caps should be reinforced at both top and bottom throughout their entire length/cross section. Grade beams and pile caps exposed to frost action should be constructed to allow for a minimum of 100 mm of net void space between the underside of the grade beam and the subgrade soil (compressible void form). The finished grade/floor finish adjacent to all pile caps and grade beams should be such that water runoff is not allowed to infiltrate and collect in the void space.

5.9 Foundation Drainage

The finished grade must be landscaped to provide for positive site drainage away from the proposed structure, and site grades should be maintained as high as feasible. A perimeter weeping tile drainage system (installed at the base of the perimeter foundation) is recommended to reduce the potential for external water infiltration below the foundation.

An internal sub-surface drainage system should be constructed below all basements and within all crawlspaces to allow for controlled collection and discharge of water that may accumulate below the basement/within the crawlspace.

Many drainage system configurations are possible, but generally consist of clean, drainage aggregate (less than 3% fines) in conjunction with grading the subgrade surface to collection points (i.e., sump pits) and/or utilizing perforated drainage pipes to transmit water to collection points. The drainage system should be positively sloped to sump pits equipped with automatic sump pumps (or drained by gravity) to discharge water a suitable location well away from the proposed structure.

Non-woven geotextiles should be utilized to separate the drainage aggregate from the subgrade soils. The drainage pipes and clean drainage aggregate should be fully encapsulated in non-woven geotextile capable of transmitting a flow of not less than 50 litres per second per square metre (ASTM D-4491). The sub-surface drainage system should incorporate provisions for mitigation of radon gas (i.e., traps in lines entering the sump, sealed sumps, etc.). A backup power supply for the sump pump(s) is recommended in the event of a power outage. Details for drainage systems should be reviewed by the geotechnical consultant prior to finalizing the design.

5.10 FOUNDATION WALLS

Foundation retaining walls should be designed to resist lateral earth pressure exerted by the soil as well as the horizontal pressure induced by any surcharge loading. The surcharge loading should be calculated on the basis of actual loads.

Backfill should be uniformly placed and compacted to minimize settlements as much as practical while limiting development of compaction induced pressures on the wall to an acceptable level.

Where the existing soils are used to backfill the foundation walls, the lateral earth pressure may be calculated on the basis of an equivalent fluid pressure distribution of 16 kN/m^3 (add hydrostatic pressure if a functional drainage system is not installed).

Where clean granular fill (i.e., less than 5 percent material finer than 0.071 mm) is used to backfill the foundation walls, the lateral earth pressure may be calculated on the basis of an equivalent fluid pressure distribution of 10 kN/m^3 (add hydrostatic pressure if a functional drainage system is not installed). In this case, the slope of the clean, granular backfill material must be no steeper than 45 degrees as measured from the base of the wall.

To prevent hydrostatic pressures from developing behind the wall, a drainage system should be incorporated into the design of the wall. A perforated drainage pipe should be installed with the invert elevation at or below the base of the foundation. The perimeter drainage system should be drained to a sump pit(s). The sump pit(s) should be equipped with an automatic sump pump. The perforated drainage pipe should be at least 100 mm in diameter and installed on non-woven geotextile capable of transmitting a flow of not less than 50 litres per second per square metre (ASTM D-4491). The geotextile should be placed on naturally deposited, undisturbed soil or free-draining sand as may be required for leveling. The geotextile should be used to encapsulate at least 300 mm of clean, granular drainage aggregate above the invert of the drainage pipe. The clean drainage aggregate should meet the aggregate gradation requirements shown in Table V.

TABLE V CLEAN, DRAINAGE AGGREGATE

Grain Size (mm)	Percent Passing
25.9	100
9.5	50 – 95
5.0	35 – 70
2.0	20 – 45
0.425	0 – 20
0.150	0 – 8
0.071	0 – 3

All water collected in the drainage system must be discharged in accordance with local regulations.

If a drainage system is not installed at the base of the wall, the wall must also be designed to withstand hydrostatic pressures.

The uppermost 500 mm of the backfill should consist of clay or other low permeability material.

5.11 FLOORS

5.11.1 GRADE-SUPPORTED CONCRETE SLABS

Provided that some slab movements and cracking can be tolerated, the following minimum provisions should be incorporated into the design of conventional, heated, grade-supported, cast-in-place, at-grade reinforced concrete slabs subject to light loading.

1. Prepare the site in accordance with Section 5.2. 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, should preferably consist of granular material or locally available soils, placed in thin lifts (maximum 150 mm loose) and uniformly compacted to 96 percent of standard Proctor density at optimum moisture content.
3. Soft subgrade areas should be excavated and replaced with suitable soil compacted to 96 percent of standard proctor density at optimum moisture content. High-strength geogrid/geotextile may be required to provide soil stabilization and separation where soft/wet soil conditions are encountered. The need for special measures (i.e., over-excavation, geotextile, geogrid, and/or additional gravel fill) in soft/wet areas must be subject to review by the Geotechnical Consultant during field construction.
4. To provide a level working surface and uniform subgrade support, provide a layer of crushed granular base course material beneath the slab (150 mm minimum).
5. All structural fill should be placed and uniformly compacted in thin lifts (maximum 150 mm, loose) to 98 percent of standard Proctor density at optimum moisture content.
6. Isolate the slab from foundation walls, columns, etc., by means of separation joints.
7. Reinforce the concrete slab and articulate the slab at regular intervals to provide for controlled cracking.
8. Provide positive site drainage away from the proposed structure.
9. Floor slabs should not be constructed on desiccated, wet, or frozen subgrade soil or base.
10. Frost should not be allowed to penetrate beneath the floor slab just prior to, during or after construction.
11. A soil gas membrane (i.e., radon gas and moisture resistant) should be installed between the underside of the floor slab and the granular fill.

5.11.2 Structural Floors

It is anticipated that structural floors over crawlspaces may be constructed for some structures. The crawlspaces should be covered with a soil gas membrane (i.e., radon gas and moisture resistant), followed by 50 mm of sand or lean mix concrete to hold it tightly to the soil surface. The crawl space should be forced-air ventilated during warm weather and heated during cold temperatures. The depth of the crawlspaces should be based at least 1 m above the current groundwater table (refer to previous discussions) and a drainage system is recommended within the crawlspace (refer to Section 5.9).

5.11.3 Slabs Exposed to Freezing Conditions

Grade-supported concrete slabs exposed to freezing conditions (i.e., exterior slabs/sidewalks, slabs within unheated building areas etc.) will be subject to differential movements associated with frost action. The potential for differential movements associated with frost action can be minimized by placing sub-horizontal extruded polystyrene insulation below the slabs/sidewalks. Where applicable, the insulation should butt-up to the grade beam to direct heat to the underside of the slab. The insulation should have a minimum thickness of 75 mm and should extend sub-horizontally to a minimum distance of 1.8 m beyond the outer edges of the slab. If differential movements cannot be tolerated, the slab should be structurally supported on piles.

5.11.4 Soil Gas (Radon) Mitigation

The following minimum provisions should be incorporated into the design of a subsurface depressurization system.

1. Provide a minimum of 150 mm of clean, crushed aggregate (permeable layer) beneath the underside of the slab. The permeable layer should be lightly compacted using light weight vibratory compaction equipment and should meet the following gradation.

Table VI Aggregate for Permeable Layer

Grain Size (mm)	Percent Passing
37.5	100
25	50 – 95
19	35 – 70
12.5	20 – 45
9.5	0 – 20
% Fracture (Minimum)	60

2. A rough-in for the potential for future soil gas mitigation is recommended (in accordance with NBCC 2015, 9.13.4.2). The rough-in consists of an inlet through the slab to allow for depressurization (venting) of a permeable layer placed below the floor slab. Encase the aggregate (i.e., top and bottom) with a non-woven geotextile (Nilex 4551 or equivalent). The geotextile will provide separation between the aggregate and underlying soils (to prevent mixing of materials). Placing geotextile between the aggregate and bottom of floor slab may aid in preventing damage to the vapour barrier. The geotextile should be placed as per the manufacturer's specifications.

3. A suction pit, measuring 1.2 m square and 200 mm deep, should be constructed beneath the floor slab in approximately the centre of the building footprint. Alternatively, perforated drainage pipe could be placed below the floor slab (minimum of three lines extending the length of the building). A 100 mm (minimum) diameter pipe should be connected to the suction pit or perforated drainage pipe, that extends through the floor slab and is stubbed off within the building interior.

4. To minimize the potential for soil gas entering the building, it is recommended that a soil gas membrane be placed below the floor slab (in direct contact with the floor slab) and that all drain pipes should be equipped with traps to prevent entry of radon and/or other soil gases through the floor drains (as per NBCC 2015).

5.12 FOUNDATION CONCRETE

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

TABLE VII WATER-SOLUBLE SULPHATE TEST RESULTS

Borehole No.	Depth (m)	Soil Type	Water Soluble Sulphate (%)	Class of Exposure	Degree of Sulphate Exposure
21-3	0.9	Sand	<0.05	--	Negligible
21-4	3.0	Sand	<0.05	--	Negligible
21-5	7.5	Clay	<0.05	--	Negligible
21-14	0.9	Sand and Silt	<0.05	--	Negligible
21-22	7.5	Clay	<0.05	--	Negligible
21-25	3.0	Clay	<0.05	--	Negligible

An examination of Table VII revealed that the measured sulphate concentration of the tested soils was less than 0.05 percent, which is considered negligible in terms of potential degree of sulphate attack. General use cement (CSA designation GU) may be used for foundation concrete at this site. All concrete at this site should be manufactured in accordance with current CSA standards.

6 LIMITATIONS

The presentation of the summary of the field drill logs and foundation design recommendations has been completed as authorized. Forty-six, 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.

Fourteen 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/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 with bentonite chips 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.

It is recommended that the piezometers should be decommissioned once they are no longer needed. PMEL will not accept any future liability associated with inadequate decommissioning of piezometers. Costs for decommissioning the piezometers can be provided by PMEL upon request.

This report has been prepared for the exclusive use of Oja Holdings Ltd. and their agents for specific application to the proposed Greenview Estates subdivision to be constructed within SE-24-35-5-W3M and NE-13-35-5-W3M, south of 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 design/construction recommendations presented in this report with respect to the foundation system 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.

This report has been digitally secured with personal passwords to lock the document. Due to the possibility of digital modification, only 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.



Kelly Pardoski, P. Eng.

CZ/KP

DRAWINGS

P.MACHIBRODA
ENGINEERING LTD.





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 ©2021, IMAGE ©2021 DIGITALGLOBE, (IMAGERY DATE: 08/23/15).
3. ELEVATION AND COORDINATES FOR EACH BOREHOLE ARE PROVIDED BY DIGITAL PLANIMETRICS.

LEGEND

–PMEL BOREHOLE

–PMEL PIEZOCONE PENETRATION TEST

OR OR –PMEL MONITORING WELL

P. MACHIBRODA ENGINEERING LTD.

CONSULTING
GEOENVIRONMENTAL
GEOTECHNICAL
ENGINEERS

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

DRAWING TITLE:
SITE PLAN
BOREHOLE AND PIEZOCONE LOCATIONS

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION
SE-24-35-05-W3M AND NE-13-35-05-W3M, SOUTH OF SASKATOON SK

APPROVED BY:	DRAWN BY:
CZ	TP
DATE: MAY, 2021	DRAWING NUMBER: 17789-1
SCALE: AS SHOWN	

P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-1

DRAWING NUMBER: 17789-2

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

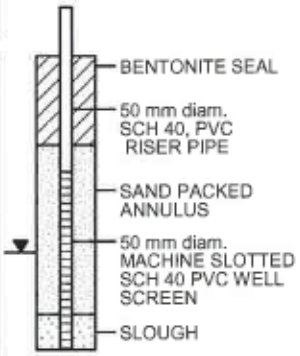
NORTHING (m): 5764329 **EASTING (m):** 391184 **ELEVATION (m):** 508.5 **DATE DRILLED:** APR 13/21

SAMPLE TYPE: ☐ CUTTINGS ☒ SPLIT SPOON ■ SHELBY TUBE

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		TOPSOIL, organic, moist, black, rootlets.			12.3					
					10.4					
1		SAND, silty, some clay, loose, poorly graded, fine grained, moist, dark brown.			12.3					
					13.6					
		brown below 0.7 m.		8	16.7					
2		silty, wet, seepage, sloughing below 2.3 m.								
3					28.4					
4		CLAY, silty, trace sand, firm, medium plastic, moist to wet, brown, oxide stained.		6	36.0					
5										
6					35.9	46	21			
7		grey below 7.0 m.			35.1					
8		highly plastic, moist below 8.3 m.								
9					35.1	50	19			0.5
10					35.1					0.5
11										
12										

WATER LEVELS
▼ After Drilling
▽ During Drilling

MONITORING WELL: BH 21-1A
ELEV.: 509.6



NOTE:
1. Borehole sloughed to 2.9 m Immediately After Drilling.
2. Monitoring Well installed in a separate shallow hole drilled adjacent to the deep Borehole.
3. Recorded Water Level on May 5, 2021.

SHEET 1 OF 1

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P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-2

DRAWING NUMBER: 17789-3

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

NORTHING (m): 5764126 **EASTING (m):** 391185 **ELEVATION (m):** 508.5 **DATE DRILLED:** APR 13/21

SAMPLE TYPE: ☒ CUTTINGS ☒ SPLIT SPOON ■ SHELBY TUBE

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		**WATER LEVELS** ▼ After Drilling ▽ During Drilling								
0		SAND, some silt, trace clay, loose, poorly graded, fine grained, moist, dark brown.			12.1					
0.5		brown below 0.5 m.			10.2					
1					10.6					
1.5					7.9					
2					7.9					
2.3		silty, wet, seepage, sloughing below 2.3 m.								
3					25.2					

MONITORING WELL: BH 21-2
ELEV.: 509.5

- BENTONITE SEAL
- 50 mm diam. SCH 40, PVC RISER PIPE
- SAND PACKED ANNULUS
- 50 mm diam. MACHINE SLOTTED SCH 40 PVC WELL SCREEN
- SLOUGH

DEPTH (m): 0 1 2 3 4 5 6 7 8 9 10 11 12

NOTE:
1. Borehole sloughed to 2.4 m Immediately After Drilling.
3. Recorded Water Level on May 5, 2021.

SHEET 1 OF 1

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P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-3

DRAWING NUMBER: 17789-4

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

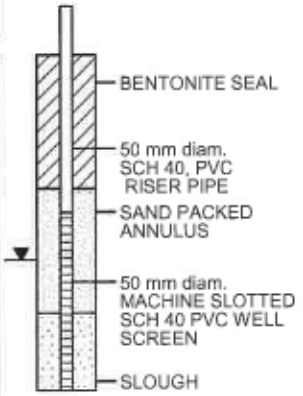
NORTHING (m): 5764133 **EASTING (m):** 391383 **ELEVATION (m):** 508.5 **DATE DRILLED:** APR 13/21

SAMPLE TYPE: ☒ CUTTINGS ☒ SPLIT SPOON ■ SHELBY TUBE

WATER LEVELS
▼ After Drilling
▽ During Drilling

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		TOPSOIL, organic, moist, black, rootlets.			19.2					
		SAND, silty, trace clay, loose, poorly graded, fine grained, moist, brown.			21.0					
1					21.4					
					23.1					
					27.6	36	18			
2		SILT, clayey, some sand, firm to stiff, medium plastic, moist, brown, oxide stained.								
3		SAND AND SILT, trace clay, loose, poorly graded, fine grained, wet, brown, seepage, sloughing.		5	36.1					
4					31.3					
5										
6					29.7					
7					28.0					
8		mottled grey and brown below 8.0 m.								
9					29.6					
10					27.8					
11										
12										

MONITORING WELL: BH 21-3A
ELEV.: 509.5



NOTE:
1. Borehole sloughed to 2.7 m Immediately After Drilling.
2. Monitoring Well installed in a separate shallow hole drilled adjacent to the deep Borehole.
3. Recorded Water Level on May 5, 2021.

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P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-4

DRAWING NUMBER: 17789-5

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

NORTHING (m): 5764103 **EASTING (m):** 391585 **ELEVATION (m):** 507.9 **DATE DRILLED:** APR 13/21

SAMPLE TYPE: ☒ CUTTINGS ☒ SPLIT SPOON ■ SHELBY TUBE

WATER LEVELS
▼ After Drilling
▽ During Drilling

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		TOPSOIL, organic, moist, black, rootlets.			20.0					
1		SAND, silty, some clay, loose, poorly graded, fine grained, moist, brown.			20.5 17.5 13.0 13.1					
2		wet, seepage, sloughing below 2.3 m.								
3					29.2					

MONITORING WELL: BH 21-4
ELEV.: 508.9

- BENTONITE SEAL
- 50 mm diam. SCH 40, PVC RISER PIPE
- SAND PACKED ANNULUS
- 50 mm diam. MACHINE SLOTTED SCH 40 PVC WELL SCREEN
- SLOUGH

DEPTH (m)

NOTE:
1. Borehole sloughed to 2.3 m Immediately After Drilling.
3. Recorded Water Level on May 5, 2021.

SHEET 1 OF 1

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P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-5

DRAWING NUMBER: 17789-6

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

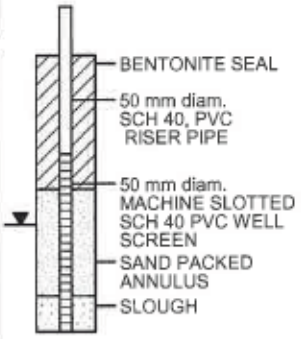
NORTHING (m): 5764070 **EASTING (m):** 391772 **ELEVATION (m):** 507.9 **DATE DRILLED:** APR 13/21

SAMPLE TYPE: ☒ CUTTINGS ☒ SPLIT SPOON ■ SHELBY TUBE

WATER LEVELS
▼ After Drilling
▽ During Drilling

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		TOPSOIL, organic, moist, black, rootlets.			15.5					
1		SAND, some silt, trace clay, loose, poorly graded, fine grained, moist, dark brown.			12.8					
		brown below 0.7 m.			11.2					
		wet, seepage, sloughing below 1.7 m.		2	10.9 25.1					
3				8	25.9					
4		SILT, clayey, sandy, firm, medium plastic, moist, brown.			32.6					
5										
6					33.5					
7		CLAY, silty, firm to stiff, highly plastic, moist, grey.			34.4					0.5
8										
9					35.3					1
		firm below 9.5 m.								
10					35.7					0.5
11										
12					34.7					0.5

MONITORING WELL: BH 21-5A
ELEV.: 509.0



NOTE:
1. Borehole sloughed to 2.9 m Immediately After Drilling.
2. Monitoring Well installed in a separate shallow hole drilled adjacent to the deep Borehole.
3. Recorded Water Level on May 5, 2021.

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P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-6

DRAWING NUMBER: 17789-7

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

NORTHING (m): 5763925 **EASTING (m):** 391772 **ELEVATION (m):** 509.4 **DATE DRILLED:** APR 13/21

SAMPLE TYPE: ☒ CUTTINGS ☒ SPLIT SPOON ■ SHELBY TUBE

WATER LEVELS
▼ After Drilling
▽ During Drilling

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		SAND, some silt, trace clay, loose, poorly graded, fine grained, moist, brown.			12.2					
1					10.3					
					9.1					
					9.9					
2					10.7					
3					8.9					
4		wet, seepage, sloughing below 3.8 m.			25.7					
5										
6										
7										
8										
9										
10										
11										
12										

MONITORING WELL: BH 21-6
ELEV.: 510.4

- BENTONITE SEAL
- 50 mm diam. SCH 40, PVC RISER PIPE
- CUTTINGS
- SAND PACKED ANNULUS
- 50 mm diam. MACHINE SLOTTED SCH 40 PVC WELL SCREEN
- SLOUGH

NOTE:
1. Borehole sloughed to 4.0 m Immediately After Drilling.
3. Recorded Water Level on May 5, 2021.

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P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-7

DRAWING NUMBER: 17789-8

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

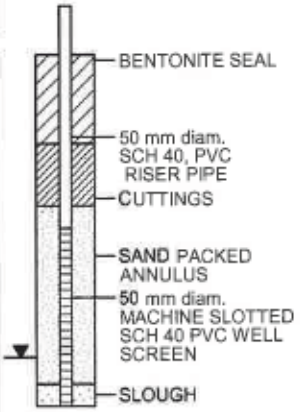
NORTHING (m): 5763924 **EASTING (m):** 391593 **ELEVATION (m):** 509.4 **DATE DRILLED:** APR 13/21

SAMPLE TYPE: ☒ CUTTINGS ☒ SPLIT SPOON ■ SHELBY TUBE

WATER LEVELS
▼ After Drilling
▽ During Drilling

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		SAND, trace to some silt, trace to some clay, loose, poorly graded, fine grained, moist, dark brown.			12.4					
1		brown below 0.4 m.			10.5					
					8.7					
					5.4					
2		dark brown 2.1 to 2.5 m.			5.0					
3		dark brown 3.0 to 3.3 m. silty, trace clay, wet, seepage, sloughing below 3.1 m.	☒	4	25.7					
4		CLAY, some silt, stiff, highly plastic, moist, brown, oxide stained.			29.2					1.5
5		very stiff below 5.0 m								
6			☒	13	35.6			18.3		1.5
7		grey below 7.0 m.			35.6					1.5
8										
9		silty, firm below 9.2 m.			35.5					1.25
10					33.5					0.5
11										
12										

MONITORING WELL: BH 21-7A
ELEV.: 510.4



NOTE:
1. Borehole sloughed to 2.9 m Immediately After Drilling.
2. Monitoring Well installed in a separate shallow hole drilled adjacent to the deep Borehole.
3. Recorded Water Level on May 5, 2021.

SHEET 1 OF 1

05-18-2021 Z:\2021 Projects\NEWLOG\17789-GEO-SOUTH OF SASKTOON,SK\DWG\TH7-17789.bor

P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-8

DRAWING NUMBER: 17789-9

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

NORTHING (m): 5763926 **EASTING (m):** 391389 **ELEVATION (m):** 509.0 **DATE DRILLED:** APR 13/21

SAMPLE TYPE: ☒ CUTTINGS ☒ SPLIT SPOON ■ SHELBY TUBE

WATER LEVELS
▼ After Drilling
▽ During Drilling

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		TOPSOIL, organic, moist, black, rootlets.			16.5					
1		SAND, silty, trace to some clay, loose, poorly graded, fine grained, moist, brown.			13.1 8.1 9.1 8.4					
2		wet, seepage, sloughing below 2.0 m.			20.4					
3		SILT, some clay, firm, medium plastic, moist, brown, oxide stained.			32.5					
4										
5										
6										
7										
8										
9										
10										
11										
12										

MONITORING WELL: BH 21-8
ELEV.: 510.1

- BENTONITE SEAL
- 50 mm diam. SCH 40, PVC RISER PIPE
- SAND PACKED ANNULUS
- 50 mm diam. MACHINE SLOTTED SCH 40 PVC WELL SCREEN

NOTE:
1. Borehole open Immediately After Drilling with trace water.
3. Recorded Water Level on May 5, 2021.

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P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-9

DRAWING NUMBER: 17789-10

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

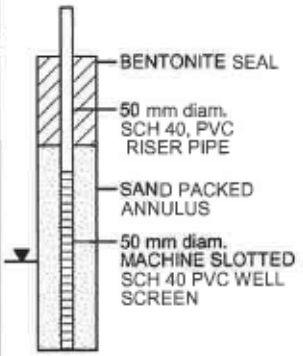
NORTHING (m): 5763693 **EASTING (m):** 391097 **ELEVATION (m):** 508.8 **DATE DRILLED:** APR 12/21

SAMPLE TYPE: ☒ CUTTINGS ☒ SPLIT SPOON ■ SHELBY TUBE

WATER LEVELS
▼ After Drilling
▽ During Drilling

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		SAND, silty, trace clay, loose to compact, poorly graded, fine grained, moist, mottled black and brown, trace organics.			15.4					
0.5					14.5					
1					9.1					
1.5					7.1					
		some silt to silty, brown below 0.5 m		12	14.9					
2		wet, seepage, sloughing below 2.0 m. silt seam 2.6 to 3.0 m.								
3				9	23.6					
4		some silt, compact, mottled grey and brown below 4.0 m.								
5				21	26.1					
6		SILT, some clay, trace sand, firm, medium plastic, moist, grey.			29.3					
		clay lense at 6.4 m.								
7		some sand, trace clay below 6.5 m.			31.4					
8		SAND, silty, compact, poorly graded, fine grained, wet, grey, seepage, sloughing.								
9					28.0					
10		SILT, sandy, firm, medium plastic, moist, grey.			29.0					0.5
11										
12					28.9					0.5

MONITORING WELL: BH 21-9A
ELEV.: 509.8



NOTE:
1. Borehole sloughed to 2.1 m Immediately After Drilling.
2. Monitoring Well installed in a separate shallow hole drilled adjacent to the deep Borehole.
3. Recorded Water Level on May 5, 2021.

SHEET 1 OF 1

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P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-10

DRAWING NUMBER: 17789-11

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

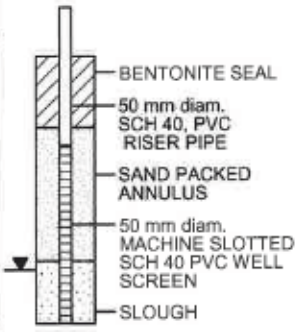
NORTHING (m): 5763693 **EASTING (m):** 391097 **ELEVATION (m):** 508.9 **DATE DRILLED:** APR 13/21

SAMPLE TYPE: ☒ CUTTINGS ☒ SPLIT SPOON ■ SHELBY TUBE

WATER LEVELS
▼ After Drilling
▽ During Drilling

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		TOPSOIL, organic, moist, black, rootlets.			13.5					
		SAND, some silt, trace clay, loose, poorly graded, fine grained, moist, brown.			11.5					
1					12.6					
					12.9					
2		wet, seepage, sloughing below 2.3 m.			13.1					
3					22.7					

MONITORING WELL: BH 21-10
ELEV.: 510.0



DEPTH (m)

NOTE:
1. Borehole sloughed to 2.3 m Immediately After Drilling.
3. Recorded Water Level on May 5, 2021.

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P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-11

DRAWING NUMBER: 17789-12

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

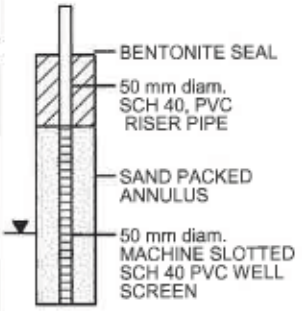
NORTHING (m): 5763726 **EASTING (m):** 391390 **ELEVATION (m):** 508.3 **DATE DRILLED:** APR 12/21

SAMPLE TYPE: ☒ CUTTINGS ☒ SPLIT SPOON ■ SHELBY TUBE

WATER LEVELS
▼ After Drilling
▽ During Drilling

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		TOPSOIL, organic, moist, black, rootlets.			21.0					
		SAND, some silt, loose, trace clay, poorly graded, fine grained, moist, mottled black and brown.			13.3					
1		brown below 0.7 m.			10.9					
		wet, seepage, sloughing below 2.0 m.			14.1					
2					12.3					
		compact below 3.0 m.								
3			☒	13	24.0					
4										
			☒	13	28.6					
5		CLAY, some silt, stiff to very stiff, highly plastic, moist, grey.								
6			☒	15	30.5					
7					30.2					2.0
8										
9					31.4					2.0
10										
					36.3					
11										
12					34.4					

MONITORING WELL: BH 21-11A
ELEV.: 509.3



NOTE:
1. Borehole sloughed to 2.0 m Immediately After Drilling.
2. Monitoring Well installed in a separate shallow hole drilled adjacent to the deep Borehole.
3. Recorded Water Level on May 5, 2021.

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P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-12

DRAWING NUMBER: 17789-13

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

NORTHING (m): 5763735 **EASTING (m):** 391611 **ELEVATION (m):** 507.5 **DATE DRILLED:** APR 13/21

SAMPLE TYPE: ☒ CUTTINGS ☒ SPLIT SPOON ■ SHELBY TUBE

WATER LEVELS
▼ After Drilling
▽ During Drilling

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		TOPSOIL, organic, moist, black, rootlets.			31.3					
		SAND, silty, trace clay, loose, poorly graded, fine grained, moist, brown.			18.5					
1					13.3					
					14.4					
					25.6					
2		wet, seepage, sloughing below 2.4 m.								
					28.6					
3										

MONITORING WELL: BH 21-12
ELEV.: 508.6

- BENTONITE SEAL
- 50 mm diam. SCH 40, PVC RISER PIPE
- SAND PACKED ANNULUS
- 50 mm diam. MACHINE SLOTTED SCH 40 PVC WELL SCREEN
- SLOUGH

DEPTH (m)

0 1 2 3 4 5 6 7 8 9 10 11 12

NOTE:
1. Borehole sloughed to 2.4 m Immediately After Drilling.
3. Recorded Water Level on May 5, 2021.

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P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-13

DRAWING NUMBER: 17789-14

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

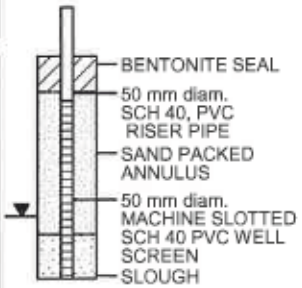
NORTHING (m): 5763807 **EASTING (m):** 391811 **ELEVATION (m):** 507.1 **DATE DRILLED:** APR 13/21

SAMPLE TYPE: ☒ CUTTINGS ☒ SPLIT SPOON ■ SHELBY TUBE

WATER LEVELS
▼ After Drilling
▽ During Drilling

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		TOPSOIL, organic, moist, black, rootlets.			21.0					
					22.2					
1		SAND, silty, trace clay, loose, poorly graded, fine grained, moist, dark brown.			19.8					
		brown below 1.0 m.			17.7					
2		wet, seepage, sloughing below 1.7 m.	☒	7	27.5					
3		SILT AND SAND, trace clay, loose, non-plastic, wet, brown, seepage, sloughing.			24.9					
4										
					29.6					
5										
6		SILT, sandy, firm, low plastic, wet, grey, seepage, sloughing.			30.4					
7					29.7					
8		SAND, silty, loose, poorly graded, fine grained, wet, grey, seepage, sloughing.								
9					30.7					
10					29.8					
11										
12										

MONITORING WELL: BH 21-13A
ELEV.: 508.1



NOTE:
1. Borehole sloughed to 2.0 m Immediately After Drilling.
2. Monitoring Well installed in a separate shallow hole drilled adjacent to the deep Borehole.
3. Recorded Water Level on May 5, 2021.

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P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-14

DRAWING NUMBER: 17789-15

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

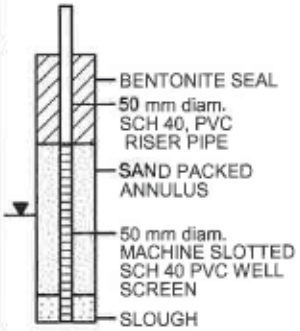
NORTHING (m): 5763574 **EASTING (m):** 391185 **ELEVATION (m):** 506.9 **DATE DRILLED:** APR 16/21

SAMPLE TYPE: ☒ CUTTINGS ☒ SPLIT SPOON ■ SHELBY TUBE

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		SAND, silty, trace clay, loose to compact, poorly graded, fine grained, moist, brown.			17.0					
					19.9					
					24.0					
1		SAND AND SILT, some clay, loose, poorly graded, fine grained, moist, brown.			25.3	27	17			
					26.6					
2		wet, seepage, sloughing below 1.4 m.								
3		SAND, some silt, compact, poorly graded, fine to medium grained, wet, grey, seepage, sloughing.			26.5					
4										
5										
6										
7										
8										
9										
10										
11										
12										

WATER LEVELS
▼ After Drilling
▽ During Drilling

MONITORING WELL: BH 21-14
ELEV.: 507.9



NOTE:
1. Borehole sloughed to 2.7 m Immediately After Drilling.
3. Recorded Water Level on May 5, 2021.

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P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-15

DRAWING NUMBER: 17789-16

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

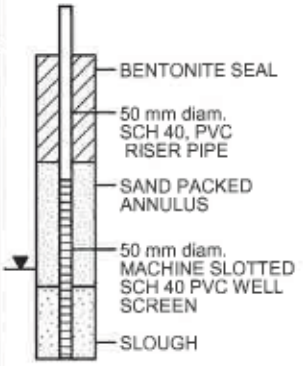
NORTHING (m): 5763520 **EASTING (m):** 391594 **ELEVATION (m):** 508.6 **DATE DRILLED:** APR 9/21

SAMPLE TYPE: ☒ CUTTINGS ☒ SPLIT SPOON ■ SHELBY TUBE

WATER LEVELS
▼ After Drilling
▽ During Drilling

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		SAND, some silt, trace to some clay, loose, poorly graded, fine grained, moist, dark brown.			19.6					
1		trace organics to 0.1 m.			16.2					
		brown below 0.5 m.			13.8					
					9.0					
				10	18.0					
2		moist to wet below 1.9 m.								
		wet, seepage, sloughing below 2.4 m.								
3		SILT AND SAND, trace clay, loose, non-plastic, wet, brown, seepage, sloughing.			28.8					
4		CLAY, silty, firm, medium to highly plastic, moist, brown.								
		moist to wet below 4.7 m.		7	35.7			17.9		
5										
6					34.7					0.5
7					35.1					0.75
8		SILT, some clay, firm, medium plastic, moist to wet, grey.								
9					32.2	40	15			0.5
10					30.4					0.5
11		some sand, trace clay, low plastic, moist to wet below 10.7 m.								
12					28.7					0.5

MONITORING WELL: BH 21-15A
ELEV.: 509.7



NOTE:
1. Borehole sloughed to 2.5 m immediately After Drilling.
2. Monitoring Well installed in a separate shallow hole drilled adjacent to the deep Borehole.
3. Recorded Water Level on May 5, 2021.

SHEET 1 OF 1

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P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-16

DRAWING NUMBER: 17789-17

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

NORTHING (m): 5763522 **EASTING (m):** 391389 **ELEVATION (m):** 509.7 **DATE DRILLED:** APR 13/21

SAMPLE TYPE: ☒ CUTTINGS ☒ SPLIT SPOON ■ SHELBY TUBE

WATER LEVELS
▼ After Drilling
▽ During Drilling

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		SAND, some silt, trace clay, oose to compact, poorly graded, fine grained, moist, brown.			10.5					
1					7.8					
					5.2					
2					4.0					
					4.4					
3		wet, seepage, sloughing below 2.9 m.			18.9					
		CLAY, some silt, stiff, medium to highly plastic, moist, mottled grey brown.								
4					30.4					1.5
5										
6										
7										
8										
9										
10										
11										
12										

MONITORING WELL: BH 21-16
ELEV.: 510.7

- BENTONITE SEAL
- 50 mm diam. SCH 40, PVC RISER PIPE
- SAND PACKED ANNULUS
- 50 mm diam. MACHINE SLOTTED SCH 40 PVC WELL SCREEN
- SLOUGH

NOTE:
1. Borehole sloughed to 4.4 m Immediately After Drilling.
3. Recorded Water Level on May 5, 2021.

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P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-17

DRAWING NUMBER: 17789-18

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

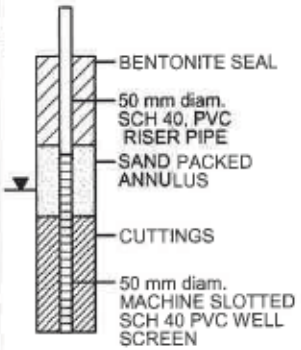
NORTHING (m): 5763524 **EASTING (m):** 391182 **ELEVATION (m):** 508.1 **DATE DRILLED:** APR 12/21

SAMPLE TYPE: ☒ CUTTINGS ☒ SPLIT SPOON ■ SHELBY TUBE

WATER LEVELS
▼ After Drilling
▽ During Drilling

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		SAND, some silt, trace clay, loose, poorly graded, fine to medium grained, moist, mottled brown and black, sloughing.			20.5					
1		brown below 0.4 m			19.2					
					14.9					
					16.2					
		wet, seepage, sloughing below 1.8 m.		4	29.9					
2										
3					25.4					
4		grey below 4.1 m.								
		loose to compact below 4.5		8	25.9					
5		silty, fine below 5.3								
6					29.4					
		clay lense at 6.5 m.								
7										
8		SILT, sandy, firm, low plastic, moist, grey. trace black staining 7.7 to 8.3 m.								
9					26.2					0.5
10					31.5					1.0
11										
12										

MONITORING WELL: BH 21-17A
ELEV.: 509.1



NOTE:
1. Borehole sloughed to 1.4 m Immediately After Drilling.
2. Monitoring Well installed in a separate shallow hole drilled adjacent to the deep Borehole.
3. Recorded Water Level on May 5, 2021.

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P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-18

DRAWING NUMBER: 17789-19

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

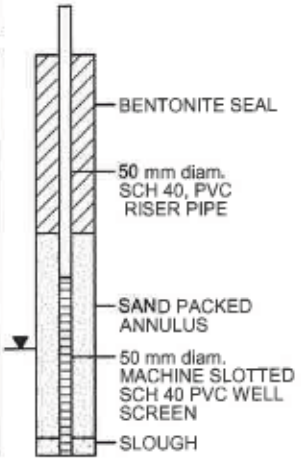
NORTHING (m): 5763326 **EASTING (m):** 391087 **ELEVATION (m):** 509.8 **DATE DRILLED:** APR 16/21

SAMPLE TYPE: ☒ CUTTINGS ☒ SPLIT SPOON ■ SHELBY TUBE

WATER LEVELS
▼ After Drilling
▽ During Drilling

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		SAND, some silt, trace clay, loose to compact, poorly graded, fine to medium grained, moist, brown.			14.6					
1					14.2					
					11.5					
					9.9					
2					5.2					
3		wet, seepage, sloughing below 3.0 m.			16.3					
4					24.0					
5										
6										
7										
8										
9										
10										
11										
12										

MONITORING WELL: BH 21-18
ELEV.: 510.9



NOTE:
1. Borehole sloughed to 4.3 m Immediately After Drilling.
3. Recorded Water Level on May 5, 2021.

SHEET 1 OF 1

05-18-2021 Z:\2021 Projects\NEWLOG\17789-GEO-SOUTH OF SASKTOON.SK\DWG\TH18-17789.bor

P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-19

DRAWING NUMBER: 17789-20

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

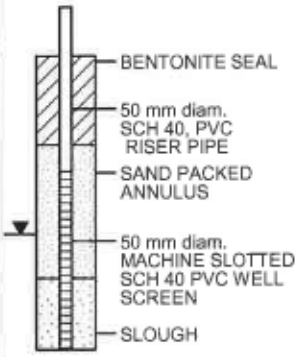
LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

NORTHING (m): 5763320 **EASTING (m):** 391390 **ELEVATION (m):** 508.7 **DATE DRILLED:** APR 9/21

SAMPLE TYPE: ☐ CUTTINGS ☒ SPLIT SPOON ■ SHELBY TUBE

WATER LEVELS
▼ After Drilling
▽ During Drilling

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		SAND, some silt, trace clay, loose, poorly graded, fine grained, moist, dark brown.			13.0					
1		trace organics to 0.15			10.9					
		brown below 0.4 m.			10.2					
					9.1					
2		wet, seepage, sloughing below 2.3 m.			8.4					
3			☒	9	25.6					
4					26.4					
5		CLAY, some silt, stiff, highly plastic, moist, brown.								
6					33.5					1.75
		grey below 6.4 m.								
7					35.1					1.25
8		firm to stiff, medium to highly plastic below 7.7 m.								
9					32.2					1.0
10					33.1					
11										
12										



NOTE:
1. Borehole sloughed to 2.5 m Immediately After Drilling.
2. Monitoring Well installed in a separate shallow hole drilled adjacent to the deep Borehole.
3. Recorded Water Level on May 5, 2021.

SHEET 1 OF 1

05-18-2021 Z:\2021 Projects\NEW LOG\17789-GEO-SOUTH OF SASKTOON,SK\DWG\TH19-17789.bor

P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-20

DRAWING NUMBER: 17789-21

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

NORTHING (m): 5763320 **EASTING (m):** 391622 **ELEVATION (m):** 508.0 **DATE DRILLED:** APR 16/21

SAMPLE TYPE: ☐ CUTTINGS ☒ SPLIT SPOON ■ SHELBY TUBE

WATER LEVELS
▼ After Drilling
▽ During Drilling

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		SAND, some silt, trace to some clay, loose to compact, poorly graded, fine grained, moist, brown.			17.7					
1					15.1					
					13.6					
		wet, seepage, sloughing below 1.3 m.			15.7					
2					23.6					
3					27.1					

MONITORING WELL: BH 21-20
ELEV.: 509.0

- BENTONITE SEAL
- 50 mm diam. SCH 40, PVC RISER PIPE
- SAND PACKED ANNULUS
- 50 mm diam. MACHINE SLOTTED SCH 40 PVC WELL SCREEN
- SLOUGH

DEPTH (m)

NOTE:
1. Borehole sloughed to 1.2 m Immediately After Drilling.
3. Recorded Water Level on May 5, 2021

SHEET 1 OF 1

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P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-21

DRAWING NUMBER: 17789-22

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

NORTHING (m): 5763323 **EASTING (m):** 391798 **ELEVATION (m):** 509.3 **DATE DRILLED:** APR 9/21

SAMPLE TYPE: CUTTINGS SPLIT SPOON SHELBY TUBE

WATER LEVELS
After Drilling
During Drilling

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		SAND, some silt, loose, poorly graded, fine grained, moist, brown.			10.1					
1					9.9					
					10.1					
					11.2					
					9.2					
2		clay seam 1.7 to 1.9 m.			24.0					
3		CLAY, some silt, firm to stiff, highly plastic, moist, brown, oxide stained.		6	36.7			18.3		
4					36.0					1.0
5		grey below 5.4 m.								
6		silty, firm, medium to highly below 5.9 m.		8	36.0			18.4		1.0
7					34.6					0.5
8		SAND, silty, loose, poorly graded, fine grained, wet, grey, seepage, sloughing.								
9		SILT, clayey, firm, medium plastic, moist, grey.		5	29.6					
10					31.1					
11		SAND, silty, loose, poorly graded, fine grained, wet, grey, seepage, sloughing.								
12										

MONITORING WELL: BH21-21A
ELEV.: 510.1

BENTONITE SEAL
CUTTINGS
50 mm diam. SCH 40, PVC RISER PIPE
BENTONITE SEAL
SAND PACKED ANNULUS
50 mm diam. MACHINE SLOTTED SCH 40 PVC WELL SCREEN
SLOUGH

DEPTH (m)

NOTE:
1. Borehole sloughed to 6.0 m Immediately After Drilling.
2. Monitoring Wells installed in separate shallow holes drilled adjacent to the deep Borehole.
3. Recorded Water Level on May 5, 2021

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P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-21B

DRAWING NUMBER: 17789-22A

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

NORTHING (m): 5763323 **EASTING (m):** 391796 **ELEVATION (m):** 509.3 **DATE DRILLED:** APR 9/21

SAMPLE TYPE: ☒ CUTTINGS ☒ SPLIT SPOON ■ SHELBY TUBE

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		SAND, some silt, loose, poorly graded, fine grained, moist, brown.								
1										
2		clay seam 1.7 to 1.9 m								
3		CLAY, some silt, firm to stiff, highly plastic, moist, brown, oxide stained.								
4										
5		grey below 5.4 m.								
6		silty, firm, medium to highly below 5.9 m.								
7										
8		SAND, silty, loose, poorly graded, fine grained, wet, grey, seepage, sloughing.								
9		SILT, clayey, firm, medium plastic, moist, grey.								
10		SAND, silty, loose, poorly graded, fine grained, wet, grey, seepage, sloughing.								
11										
12										

WATER LEVELS
▼ After Drilling
▽ During Drilling

MONITORING WELL: BH 21-21B
ELEV.: 510.4

BENTONITE SEAL
50 mm diam. SCH 40, PVC RISER PIPE
CUTTINGS
50 mm diam. MACHINE SLOTTED SCH 40 PVC WELL SCREEN
SLOUGH

NOTE:
1. Borehole sloughed to 6.0 m Immediately After Drilling.
2. Monitoring Wells installed in separate shallow holes drilled adjacent to the deep Borehole.
3. Recorded Water Level on May 5, 2021

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P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-22

DRAWING NUMBER: 17789-23

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

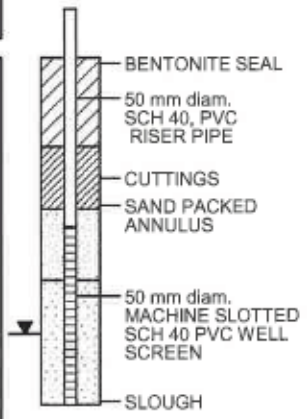
LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

NORTHING (m): 5763127 **EASTING (m):** 391084 **ELEVATION (m):** 509.4 **DATE DRILLED:** APR 13/21

SAMPLE TYPE: ☒ CUTTINGS ☒ SPLIT SPOON ■ SHELBY TUBE

WATER LEVELS
▼ After Drilling
▽ During Drilling

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		TOPSOIL, organic, moist, black, rootlets.			14.9					
		SAND, some silt, trace to some clay, loose, poorly graded, fine grained, moist, dark brown.			9.9					
1		brown below 0.8 m.			5.3					
					8.1					
2					6.8					
3		wet, seepage, sloughing below 3.0 m.		10	24.2					
4					31.1					1.5
		CLAY, some silt, stiff, highly plastic, moist, brown.								
5										
6					33.0					1.25
7		grey below 7.2 m.			35.2					1.5
8										
9					36.9					1.25
10					35.9					1.0
11										
12					34.8					1.25



NOTE:
1. Borehole sloughed to 3.0 m Immediately After Drilling.
2. Monitoring Well installed in a separate shallow hole drilled adjacent to the deep Borehole.
3. Recorded Water Level on May 5, 2021

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P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-24

DRAWING NUMBER: 16874-24

PROJECT: PROPOSED INLAND GRAIN TERMINAL

LOCATION: SE-7-13-19-W3M, NEAR GULL LAKE, SK

NORTHING (m): 5549183 **EASTING (m):** 673011 **ELEVATION (m):** 795.9 **DATE DRILLED:** APR 26/21

SAMPLE TYPE: ☒ CUTTINGS ☒ SPLIT SPOON ■ SHELBY TUBE

WATER LEVELS
▼ After Drilling
▽ During Drilling

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		TOPSOIL, moist, dark brown, rootlets.			12.2					
		SAND, some silt, loose, poorly graded, fine grained, moist, brown.			5.6	non -	plastic			
1										
				5	7.6					
2					8.0					
		wet, seepage, sloughing below 3.1 m.		9	17.5					
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										

NOTE:
1. Borehole open and dry Immediately After Drilling.
2. % fines = 16.1 at 0.75 m.

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P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-24

DRAWING NUMBER: 17789-25

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

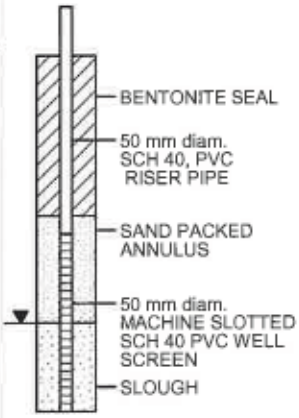
NORTHING (m): 5763124 **EASTING (m):** 391631 **ELEVATION (m):** 508.9 **DATE DRILLED:** APR 14/21

SAMPLE TYPE: ⊘ CUTTINGS ⊠ SPLIT SPOON ■ SHELBY TUBE

WATER LEVELS
▼ After Drilling
▽ During Drilling

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		TOPSOIL, organic, moist, black, rootlets.			11.7					
		SAND, trace silt, trace clay, compact, poorly graded, fine grained, moist, brown.			8.7					
1					9.1					
					11.4					
					15.8					
2		some silt to silty below 2.0 m.								
		loose, wet, seepage, sloughing below 2.7 m.								
3			⊠	7	29.4					
		compact below 4.0 m.								
4										
			⊠	14	26.4					
5		silty below 5.0 m.								
					27.2					
6										
7					25.1					
8										
9		CLAY, silty, firm, medium plastic, moist, grey.			36.8					
10					34.0					
11										
12										

MONITORING WELL: BH 21-24A
ELEV.: 509.9



NOTE:
1. Borehole sloughed to 3.0 m Immediately After Drilling.
2. Monitoring Well installed in a separate shallow hole drilled adjacent to the deep Borehole.
3. Recorded Water Level on May 5, 2021.

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P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-25

DRAWING NUMBER: 17789-26

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

NORTHING (m): 5763134 **EASTING (m):** 391813 **ELEVATION (m):** 506.9 **DATE DRILLED:** APR 16/21

SAMPLE TYPE: ☒ CUTTINGS ☒ SPLIT SPOON ■ SHELBY TUBE

WATER LEVELS
▼ After Drilling
▽ During Drilling

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		SAND, silty, trace clay, loose to compact, poorly graded, fine grained, moist, brown.			20.5					
1		organics, black to 0.4 m.			18.5					
		some silt, wet, seepage, sloughing below 1.4 m.			19.0					
2					19.5					
					23.9					
3		CLAY, silty, stiff, medium to highly plastic, moist, mottled grey and brown, oxide stained.			29.5					

MONITORING WELL: BH 21-25
ELEV.: 508.0

- BENTONITE SEAL
- 50 mm diam. SCH 40, PVC RISER PIPE
- SAND PACKED ANNULUS
- 50 mm diam. MACHINE SLOTTED SCH 40 PVC WELL SCREEN

DEPTH (m)

NOTE:
1. Borehole open with trace water Immediately After Drilling.
3. Recorded Water Level on May 5, 2021.

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P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-26

DRAWING NUMBER: 17789-27

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

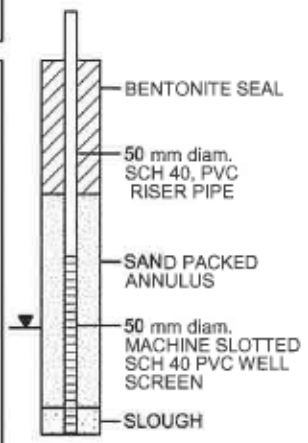
NORTHING (m): 5762943 **EASTING (m):** 391789 **ELEVATION (m):** 508.3 **DATE DRILLED:** APR 14/21

SAMPLE TYPE: ☒ CUTTINGS ☒ SPLIT SPOON ■ SHELBY TUBE

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		TOPSOIL, organic, moist, black, rootlets.			14.1					
1		SAND, trace to some silt, trace clay, compact, poorly graded, fine grained, moist, brown.			8.9					
					8.3					
					10.9					
					10.8					
2		loose, wet, seepage, sloughing below 2.5 m.								
3		clay lense at 2.7 m.	☒	6	27.9					
		clay lense at 3.4 m.								
4		mottled brown and grey below 3.5 m.								
		clay lense at 3.9 m.								
		compact below 4.0 m.	☒	15	24.8					
5		brown below 5.2 m.								
6					24.9					
7					25.5					
8		grey below 8.5 m.								
9					28.3					
10					28.0					
11										
12										

WATER LEVELS
▼ After Drilling
▽ During Drilling

MONITORING WELL: BH 21-26A
ELEV.: 509.4



NOTE:
1. Borehole sloughed to 3.9 m Immediately After Drilling.
2. Monitoring Well Installed in a separate shallow hole drilled adjacent to the deep Borehole.
3. Recorded Water Level on May 5, 2021.

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P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-27

DRAWING NUMBER: 17789-28

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

NORTHING (m): 5762922 **EASTING (m):** 391597 **ELEVATION (m):** 510.9 **DATE DRILLED:** APR 14/21

SAMPLE TYPE: ☒ CUTTINGS ☒ SPLIT SPOON ■ SHELBY TUBE

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		TOPSOIL, organic, moist, black, rootlets.			5.7					
1		SAND, silty, trace clay, compact, poorly graded, fine grained, moist, brown.			4.8 5.9 8.5 11.3					
2										
3					7.2					
4					14.7					
5		wet, seepage, sloughing below 5.1 m. trace clay below 5.7 m								
6					22.7					
7										
8										
9										
10										
11										
12										

WATER LEVELS
▼ After Drilling
▽ During Drilling

MONITORING WELL: BH 21-27
ELEV.: 511.9

BENTONITE SEAL
50 mm diam. SCH 40, PVC RISER PIPE
SAND PACKED ANNULUS
50 mm diam. MACHINE SLOTTED SCH 40 PVC WELL SCREEN
SLOUGH

NOTE:
1. Borehole sloughed to 5.6 m Immediately After Drilling.
2. Recorded Water Level on May 5, 2021.

SHEET 1 OF 1

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P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-28

DRAWING NUMBER: 17789-29

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

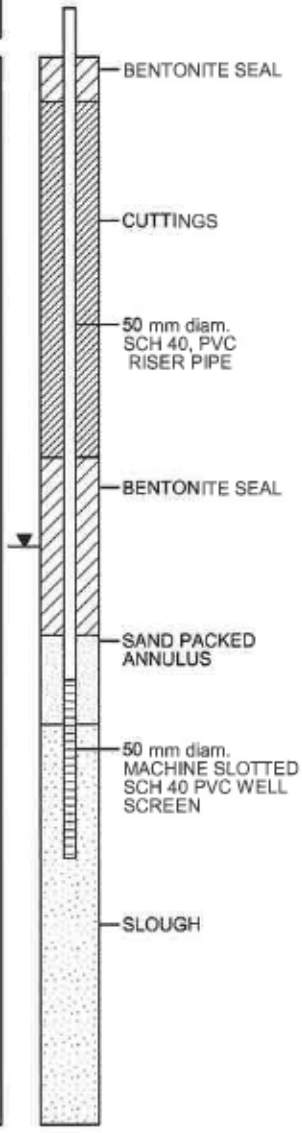
NORTHING (m): 5762907 **EASTING (m):** 391385 **ELEVATION (m):** 511.9 **DATE DRILLED:** APR 14/21

SAMPLE TYPE: CUTTINGS SPLIT SPOON SHELBY TUBE

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		TOPSOIL, organic, moist, black, rootlets.			17.9					
1		SAND, silty, trace clay, compact, poorly graded, fine grained, moist, brown. some silt, looes below 1.5 m.			13.1					
					5.3					
					4.7					
2				10	8.2					
3					4.9					
4										
5		CLAY, silty, firm, medium plastic, moist, mottled brown. stiff below 5.0 m.		6	33.2			18.0		0.75
6				10	32.7			18.5		1.0
7		some silt, highly plastic, mottled grey and brown below 6.9 m.			35.2	54	18			1.5
8										
9		SAND, some silt, trace clay, loose, poorly graded, fine grained, wet, olive brown, seepage, sloughing. grey below 9.3 m.		5	27.4					
10					30.2					
11										
12					28.2					

WATER LEVELS
- After Drilling
- During Drilling

MONITORING WELL: BH 21-28
ELEV.: 513.1



NOTE:
1. Borehole sloughed to 7.5 m Immediately After Drilling.
2. Monitoring Wells installed in separate shallow holes drilled adjacent to the deep Borehole.
3. Recorded Water Level on May 5, 2021.

SHEET 1 OF 1

05-18-2021 Z:\2021 Projects\NEW LOG\17789-GEO-SOUTH OF SASKTOON.SK\DWG\TH28-17789.bor

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BOREHOLE 21-28A

DRAWING NUMBER: 17789-29A

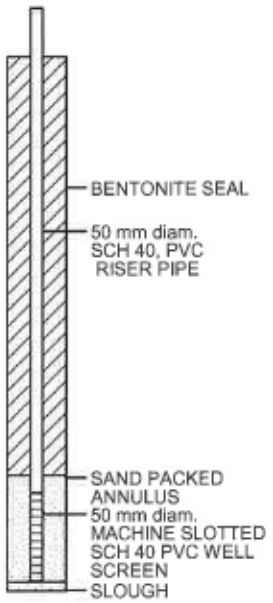
PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

NORTHING (m): 5762906 **EASTING (m):** 391384 **ELEVATION (m):** 512.2 **DATE DRILLED:** APR 14/21

SAMPLE TYPE: ☒ CUTTINGS ☒ SPLIT SPOON ■ SHELBY TUBE

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		**WATER LEVELS** ▼ After Drilling ▽ During Drilling								
0		TOPSOIL, organic, moist, black, rootlets.								
1		SAND, silty, trace clay, compact, poorly graded, fine grained, moist, brown. some silt, looes below 1.5 m.								
2										
3										
4										
5		CLAY, silty, firm, medium plastic, moist, mottled brown. stiff below 5.0 m.								
6										
7										
8										
9										
10										
11										
12										



DEPTH (m) 0 1 2 3 4 5 6 7 8 9 10 11 12

NOTE:
1. Borehole sloughed and dry Immediately After Drilling.
2. Monitoring Wells installed in separate shallow holes drilled adjacent to the deep Borehole.
3. Recorded Dry on May 5, 2021.

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BOREHOLE 21-28B

DRAWING NUMBER: 17789-29B

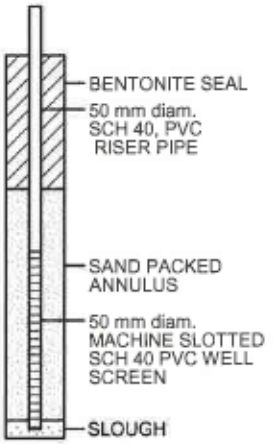
PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

NORTHING (m): 5762908 **EASTING (m):** 391384 **ELEVATION (m):** 512.1 **DATE DRILLED:** APR 14/21

SAMPLE TYPE: ☐ CUTTINGS ☒ SPLIT SPOON ■ SHELBY TUBE

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		**WATER LEVELS** ▼ After Drilling ▽ During Drilling								
0		TOPSOIL, organic, moist, black, rootlets.								
1		SAND, silty, trace clay, compact, poorly graded, fine grained, moist, brown. some silt, looes below 1.5 m.								
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										



DEPTH (m) 0 1 2 3 4 5 6 7 8 9 10 11 12

NOTE:
1. Borehole sloughed to 4.1 m and dry Immediately After Drilling.
2. Monitoring Wells installed in separate shallow holes drilled adjacent to the deep Borehole.
3. Recorded Dry on May 5, 2021.

05-18-2021 Z:\2021 Projects\NEWLOG\17789-GEO-SOUTH OF SASKTOON,SK\DWG\TH28B-17789.bor

P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-29

DRAWING NUMBER: 17789-30

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

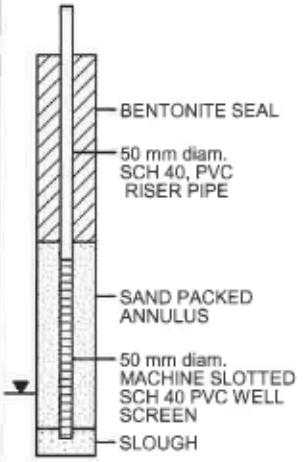
NORTHING (m): 5762919 **EASTING (m):** 391083 **ELEVATION (m):** 509.7 **DATE DRILLED:** APR 14/21

SAMPLE TYPE: ☒ CUTTINGS ☒ SPLIT SPOON ■ SHELBY TUBE

WATER LEVELS
▼ After Drilling
▽ During Drilling

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		TOPSOIL, organic, moist, black, rootlets.			12.9					
0.4		SAND, some silt, trace clay, loose, poorly graded, fine grained, moist, dark brown.			10.1					
0.7		brown below 0.7 m.			8.3					
1					9.7					
1.5					8.0					
3					19.8					
3.6		wet, seepage, sloughing below 3.6 m.			22.6					
4.2		SILT, some clay, trace sand, firm, medium plastic, moist, brown, oxide stained.			33.2					0.25

MONITORING WELL: BH 21-29
ELEV.: 510.7



NOTE:
1. Borehole sloughed to 4.2 m Immediately After Drilling.
2. Recorded Water Level on May 5, 2021.

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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 ©2021, IMAGE ©2021 DIGITALGLOBE, (IMAGERY DATE: 08/23/15).
3. ELEVATION AND COORDINATES FOR EACH BOREHOLE ARE PROVIDED BY DIGITAL PLANIMETRICS.

LEGEND

506.5 - GROUNDWATER ELEVATIONS (m) (MAY 5, 2021)

P. MACHIBRODA ENGINEERING LTD.

CONSULTING
GEOENVIRONMENTAL
GEOTECHNICAL
ENGINEERS

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

DRAWING TITLE:
GROUNDWATER CONTOUR MAP

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION SE-24-35-05-W3M AND NE-13-35-05-W3M, SOUTH OF SASKATOON SK

APPROVED BY:	DRAWN BY:
CZ	TP
DATE: MAY, 2021	DRAWING NUMBER: 17789-31
SCALE: 1:7500	

APPENDIX A

Explanation of Terms on
Borehole 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.

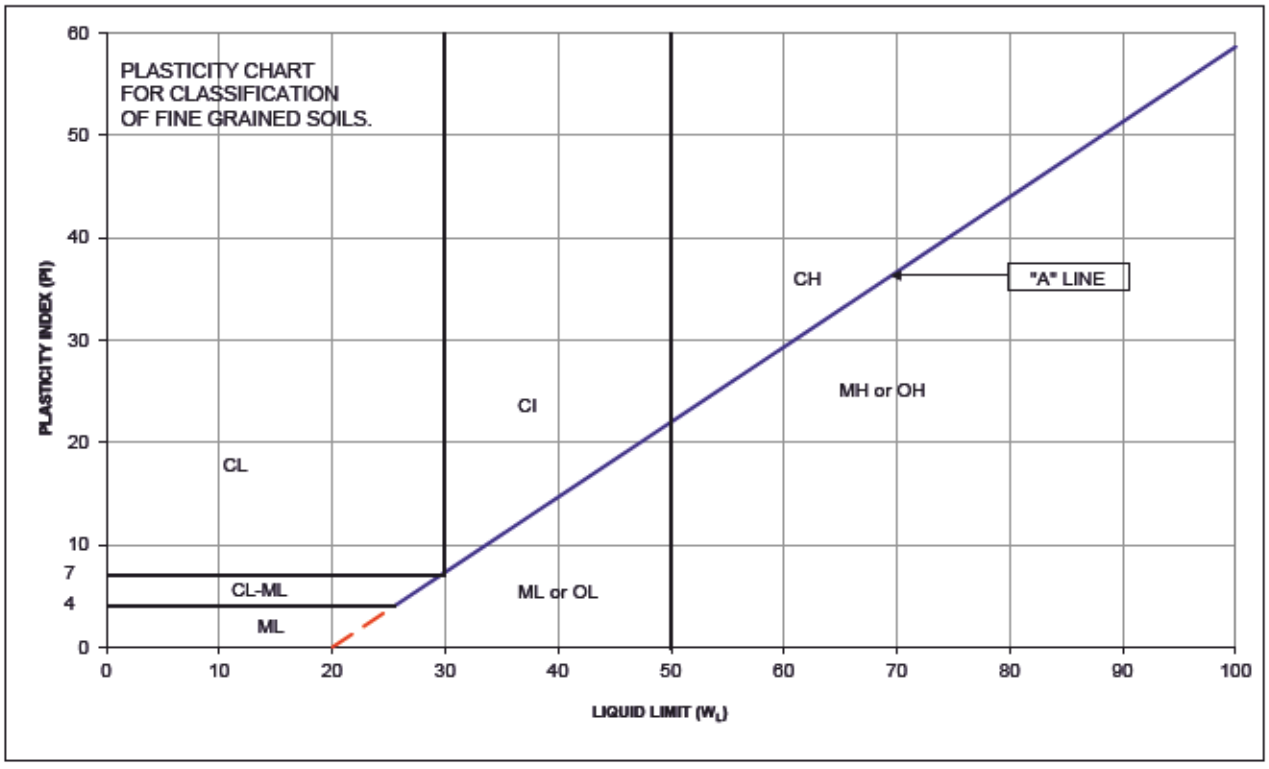
Organic Soils: Readily identified by colour, odour, spongy feel and frequently by fibrous texture.

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 More than half coarse fraction larger than No. 4 sieve size	CLEAN GRAVELS	GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES <5% FINES	$C_u = \frac{D_{60}}{D_{10}} > 4 \quad C_c = \frac{(D_{30})^2}{D_{60} \times D_{10}} = 1 \text{ to } 3$
			GP	POORLY-GRADED GRAVELS AND GRAVEL-SAND MIXTURES <5% FINES	NOT MEETING ALL ABOVE REQUIREMENTS FOR GW
		DIRTY GRAVELS	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES >12% FINES	ATTERBERG LIMITS BELOW "A" LINE OR PI < 4
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES >12% FINES	ATTERBERG LIMITS ABOVE "A" LINE WITH PI > 7
	SANDS More than half coarse fraction smaller than No. 4 sieve size	CLEAN SANDS	SW	WELL-GRADED SANDS, GRAVELLY SANDS MIXTURES <5% FINES	$C_u = \frac{D_{60}}{D_{10}} > 6 \quad C_c = \frac{(D_{30})^2}{D_{60} \times D_{10}} = 1 \text{ to } 3$
			SP	POORLY-GRADED SANDS OR GRAVELLY SANDS <5% FINES	NOT MEETING ALL GRADATION REQUIREMENTS FOR SW
		DIRTY SANDS	SM	SILTY SANDS, SAND-SILT MIXTURES >12% FINES	ATTERBERG LIMITS BELOW "A" LINE OR PI < 4
			SC	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 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 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 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	$W_L > 50$



recpt\PMEL\repref\SoilClassChart

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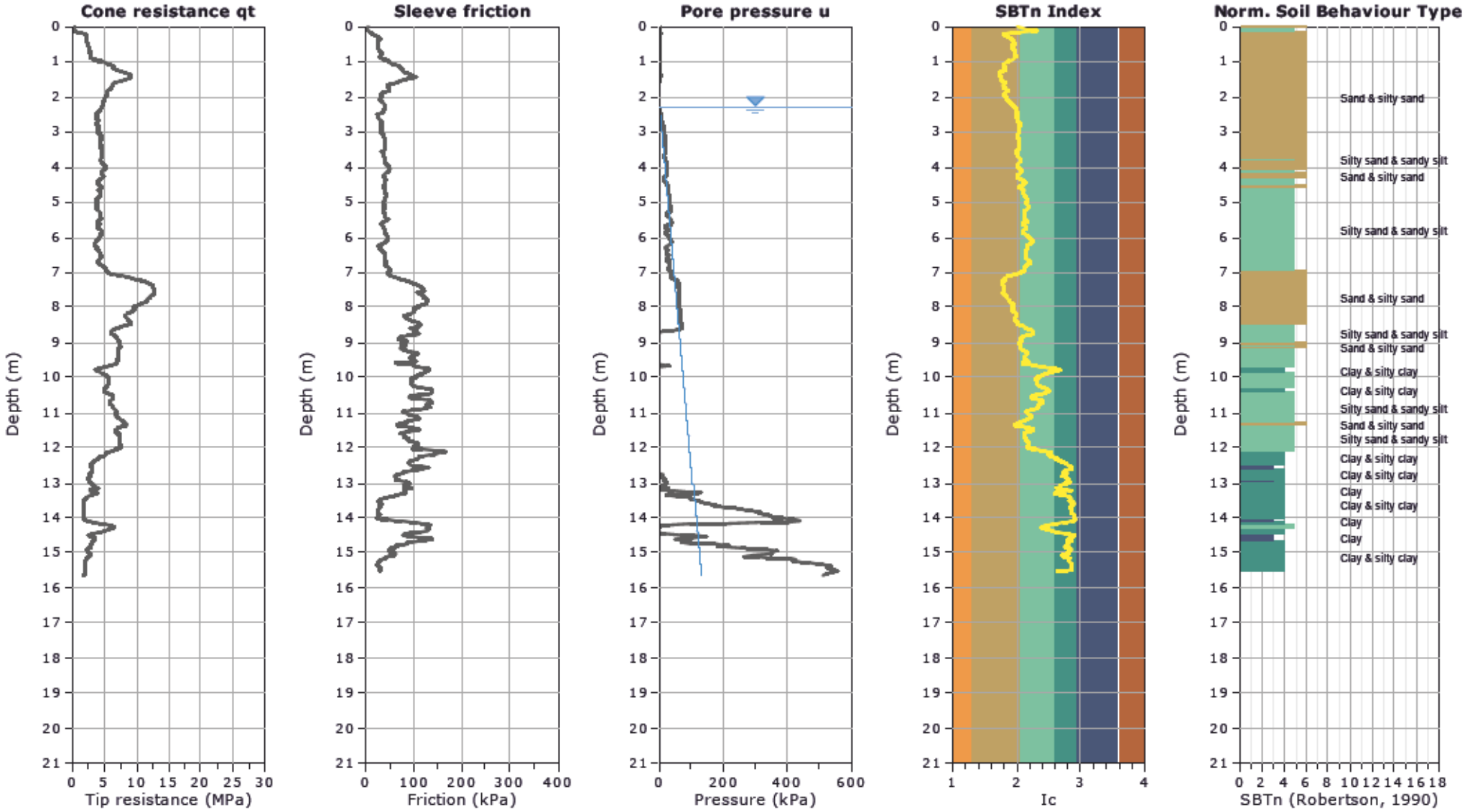
APPENDIX B

CPTu Plots

P. Machibroda Engineering Ltd.
806-48th Street East
Saskatoon, Saskatchewan S7K 3Y4
www.machibroda.com

Project: **Greenview Estates Subdivision**
Location: **South of Saskatoon, SK**

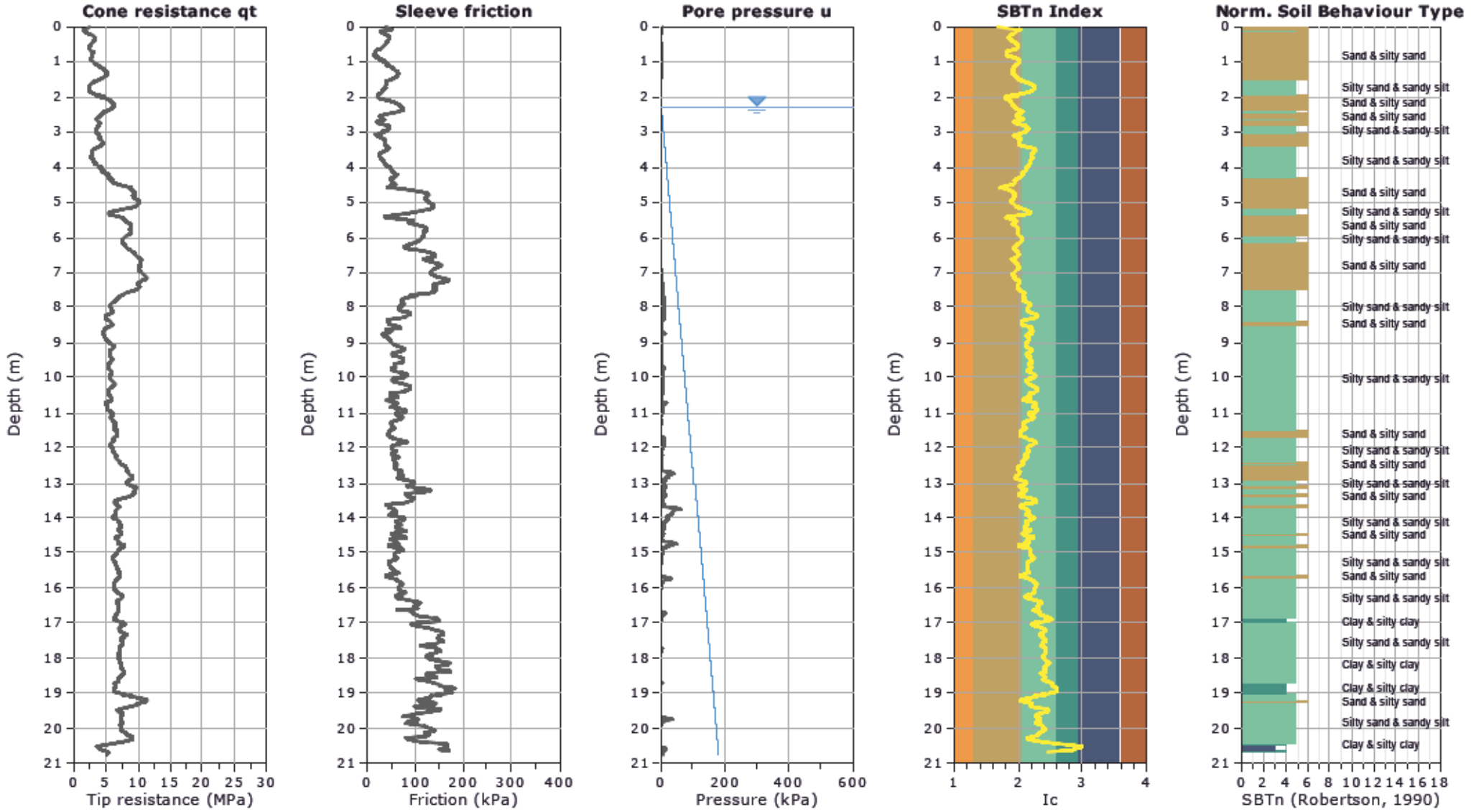
CPT: 21-2
Total depth: 15.62 m, Date: 4/22/2021
Surface Elevation: 0.00 m
Cone Type: Vertek 15 cm^2
Cone Operator: PMEL



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Location: **South of Saskatoon, SK**

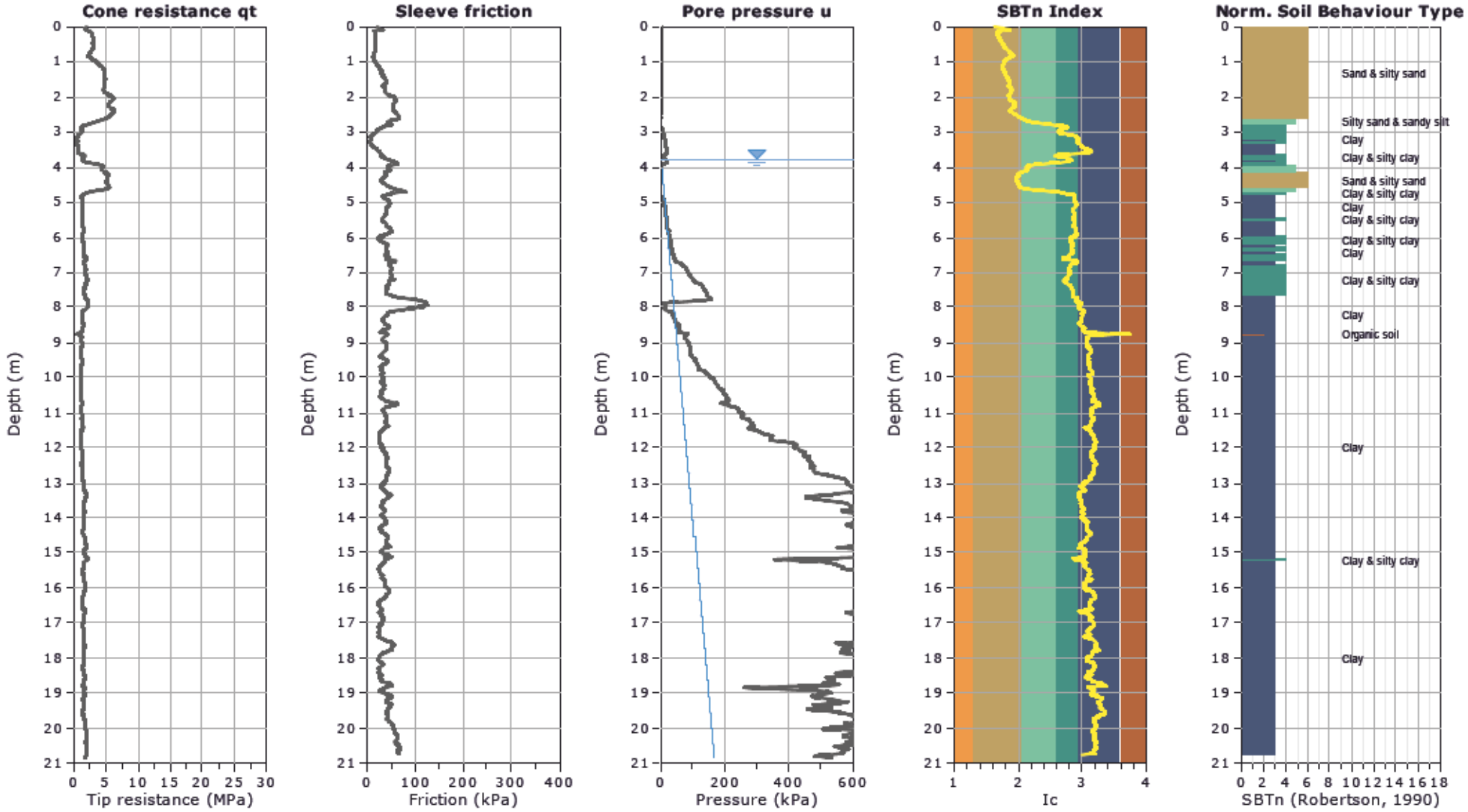
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Surface Elevation: 0.00 m
Cone Type: Vertek 15 cm^2
Cone Operator: PMEL



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Location: **South of Saskatoon, SK**

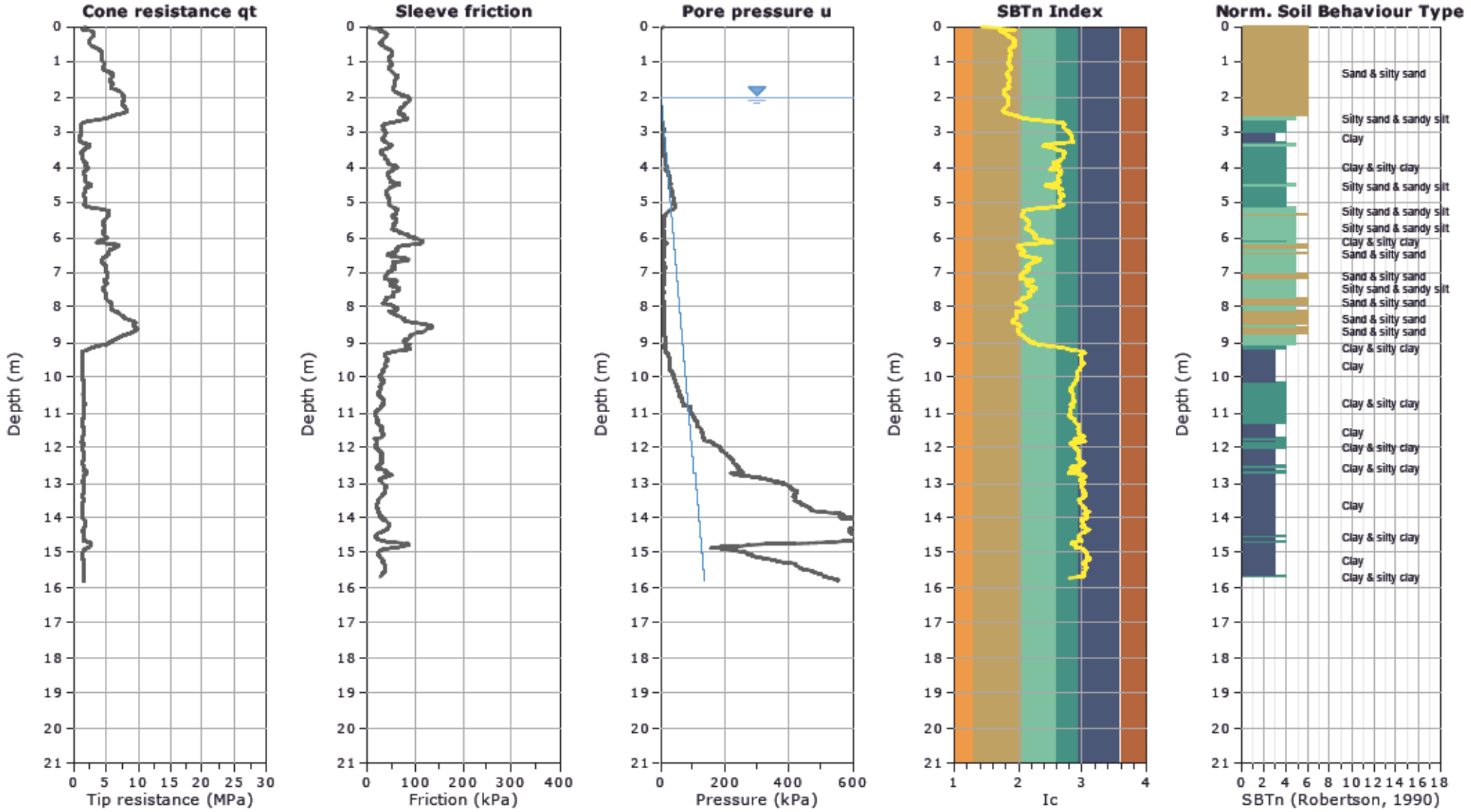
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Cone Type: Vertek 15 cm^2
Cone Operator: PMEL



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Location: **South of Saskatoon, SK**

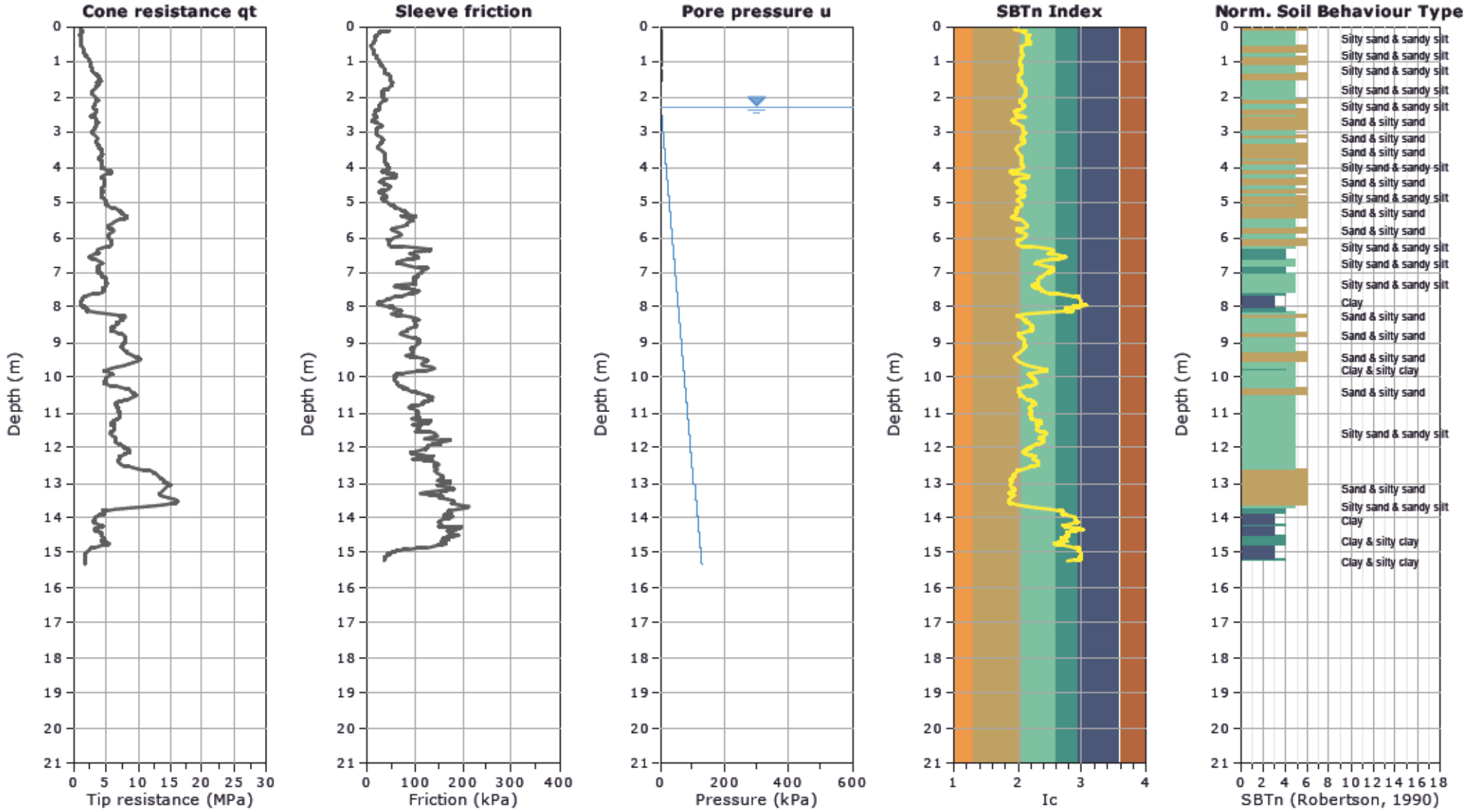
CPT: 21-8
Total depth: 15.80 m, Date: 4/22/2021
Surface Elevation: 0.00 m
Cone Type: Vertek 15 cm^2
Cone Operator: PMEL



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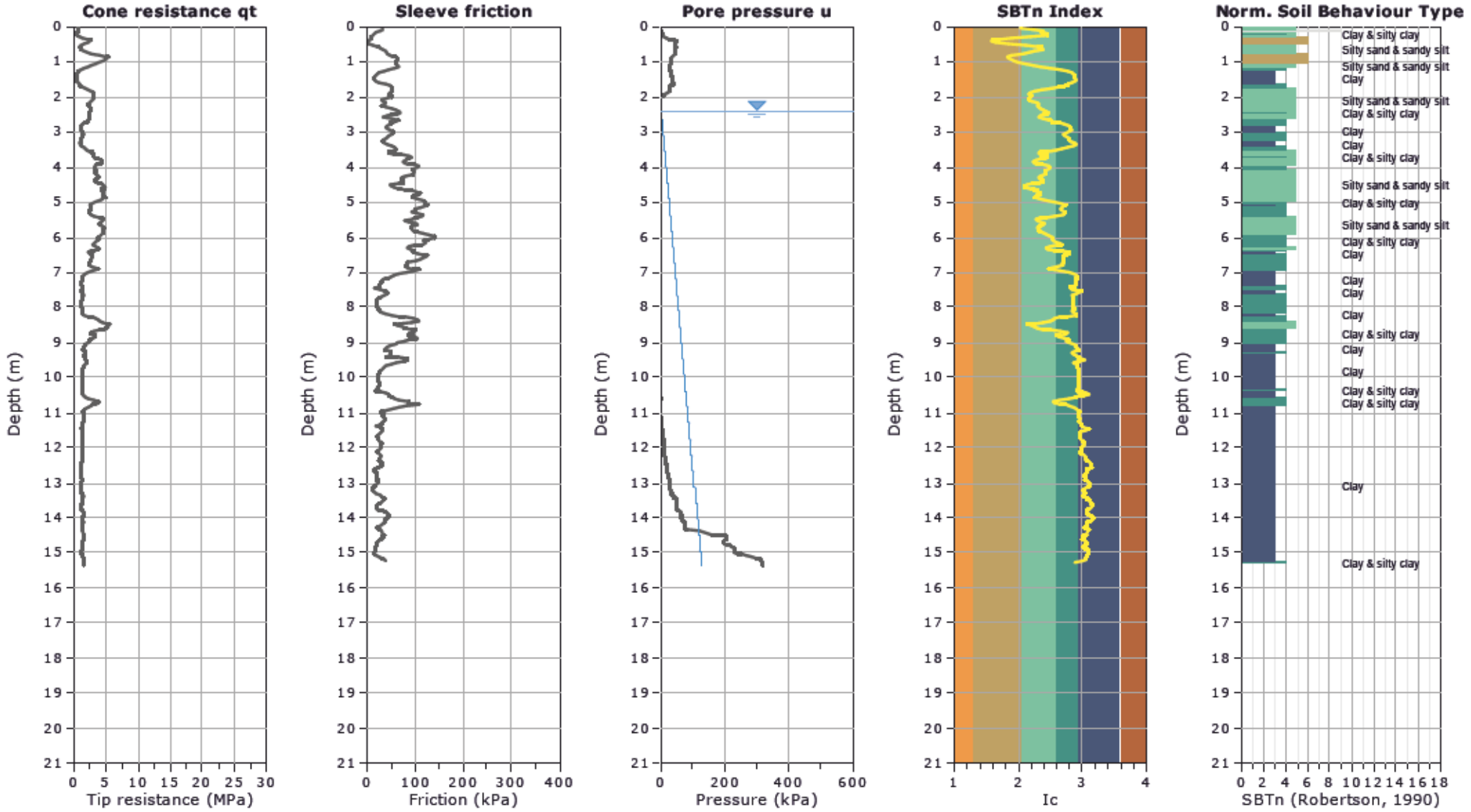
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Surface Elevation: 0.00 m
Cone Type: Vertek 15 cm^2
Cone Operator: PMEL



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Project: **Greenview Estates Subdivision**
Location: **South of Saskatoon, SK**

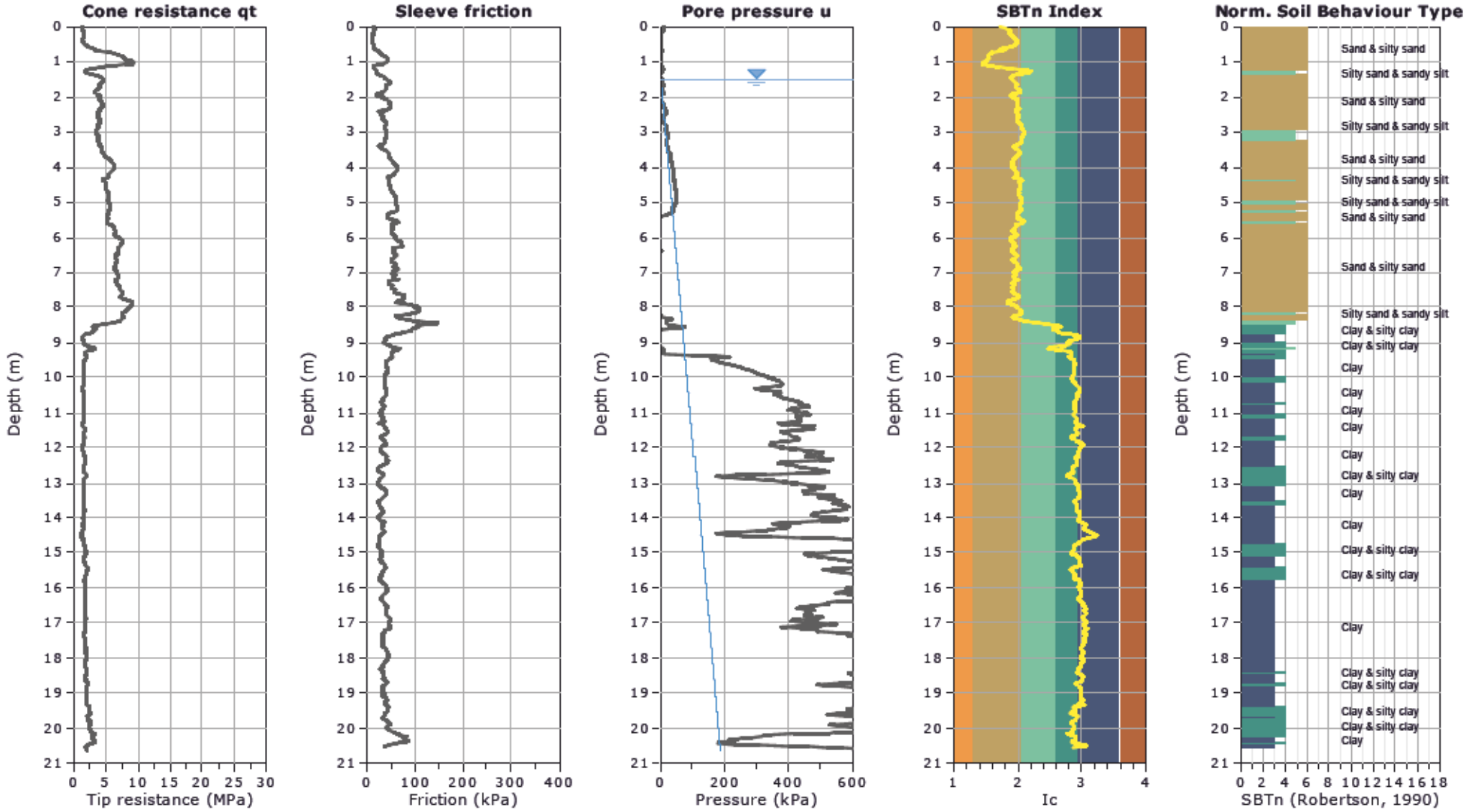
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Surface Elevation: 0.00 m
Cone Type: Vertek 15 cm^2
Cone Operator: PMEL



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Project: **Greenview Estates Subdivision**
Location: **South of Saskatoon, SK**

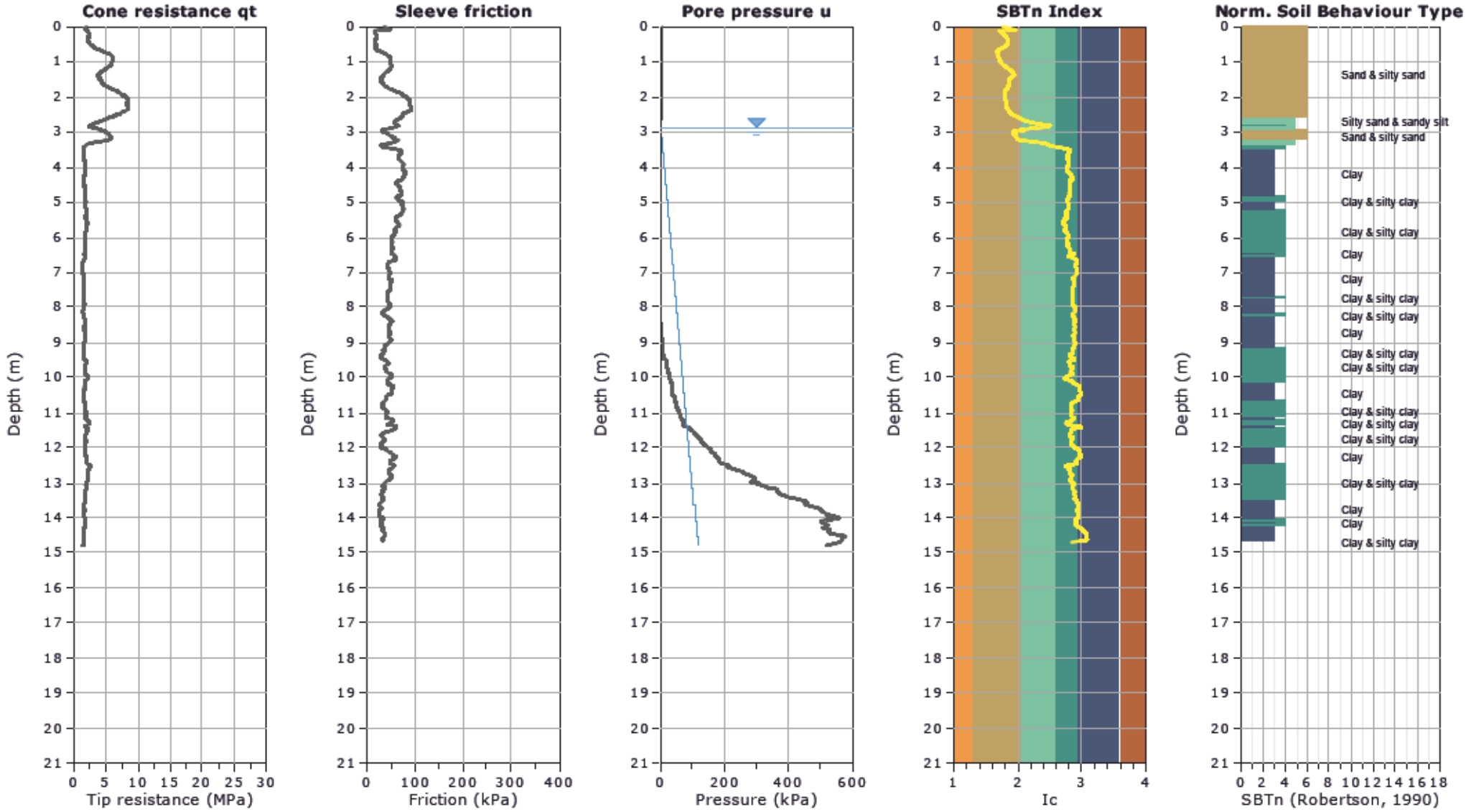
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Surface Elevation: 0.00 m
Cone Type: Vertek 15 cm^2
Cone Operator: PMEL



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Project: **Greenview Estates Subdivision**
Location: **South of Saskatoon, SK**

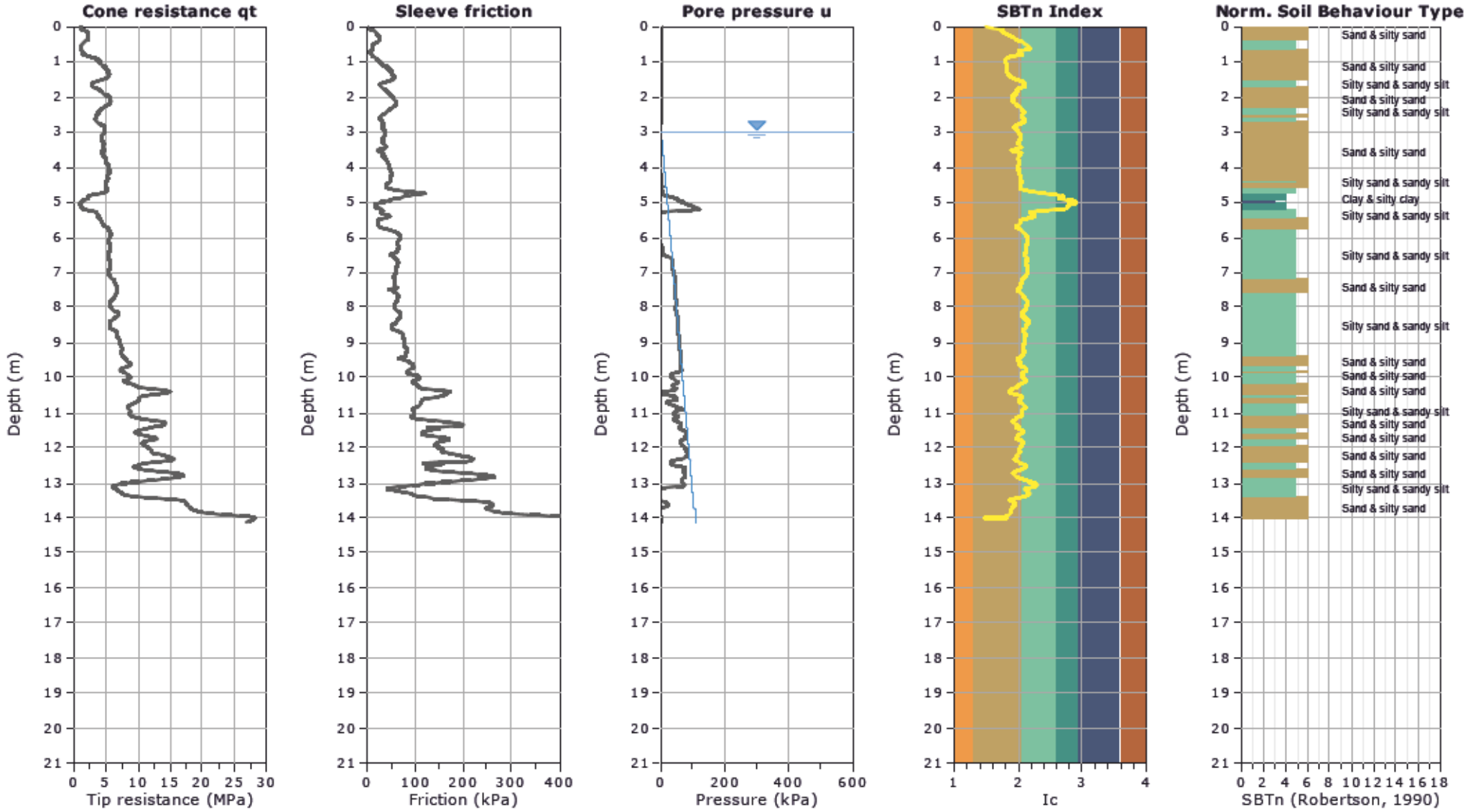
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Surface Elevation: 0.00 m
Cone Type: Vertek 15 cm^2
Cone Operator: PMEL



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Project: **Greenview Estates Subdivision**
Location: **South of Saskatoon, SK**

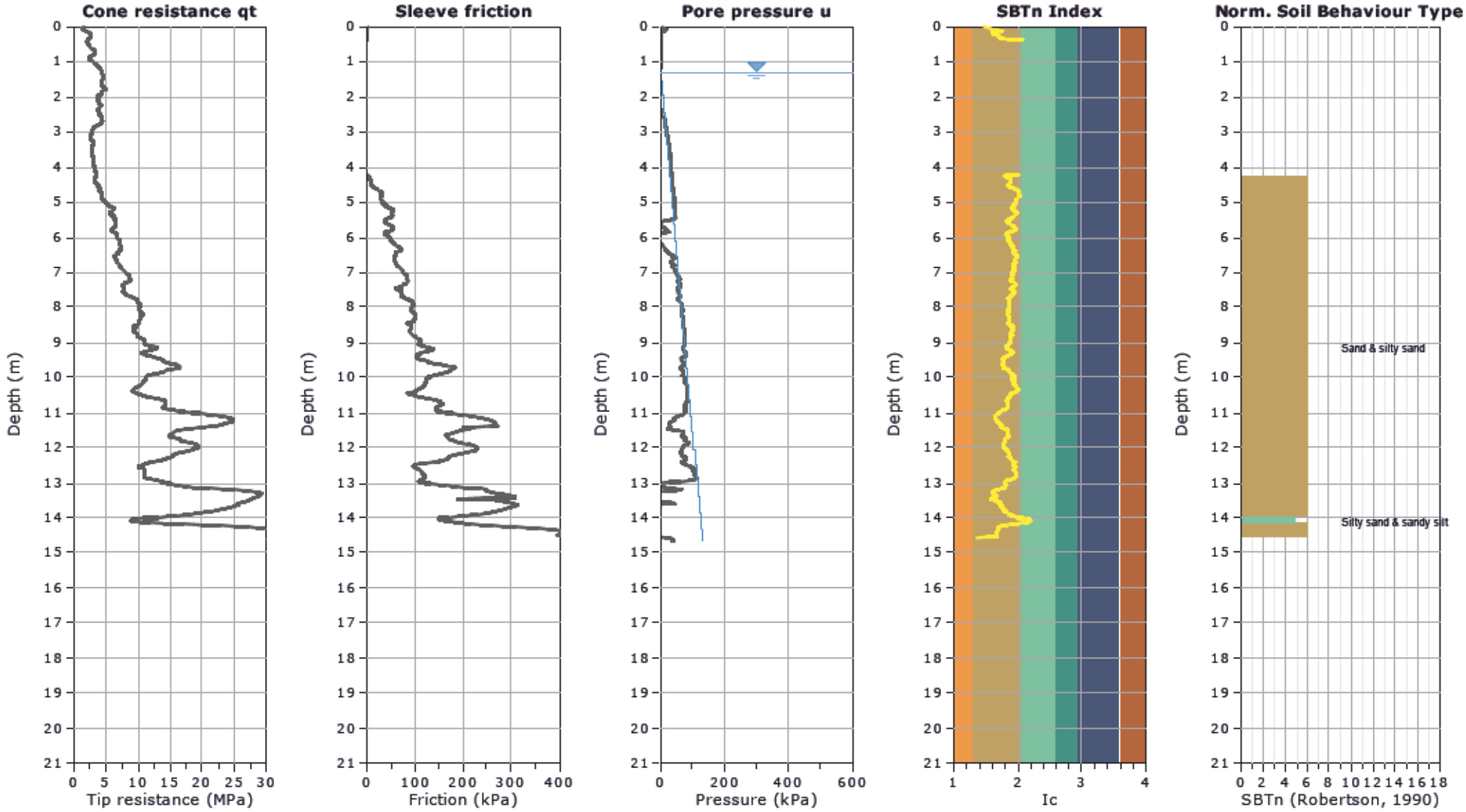
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Surface Elevation: 0.00 m
Cone Type: Vertek 15 cm^2
Cone Operator: PMEL



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Project: **Greenview Estates Subdivision**
Location: **South of Saskatoon, SK**

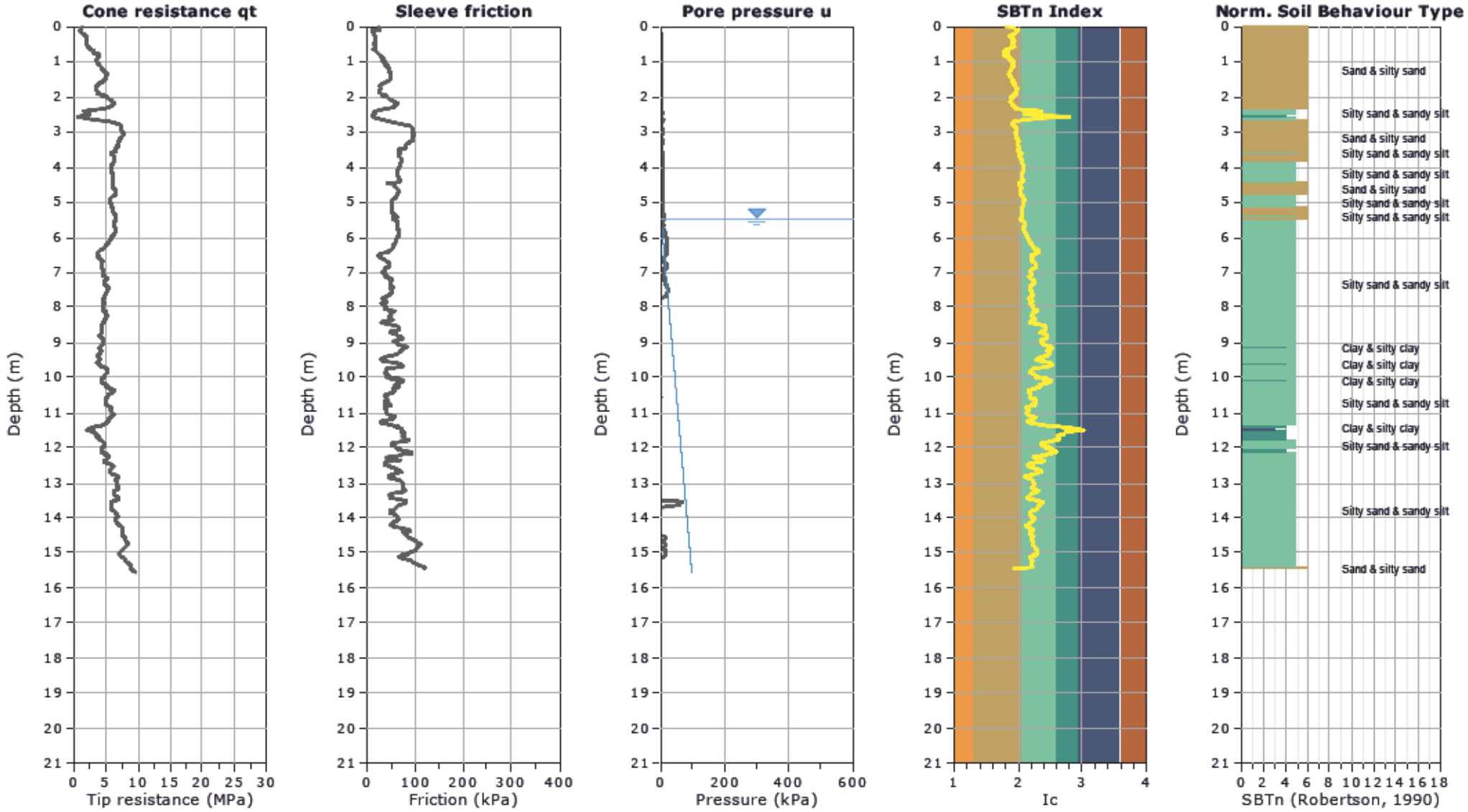
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Cone Type: Vertek 15 cm^2
Cone Operator: PMEL



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Project: **Greenview Estates Subdivision**
Location: **South of Saskatoon, SK**

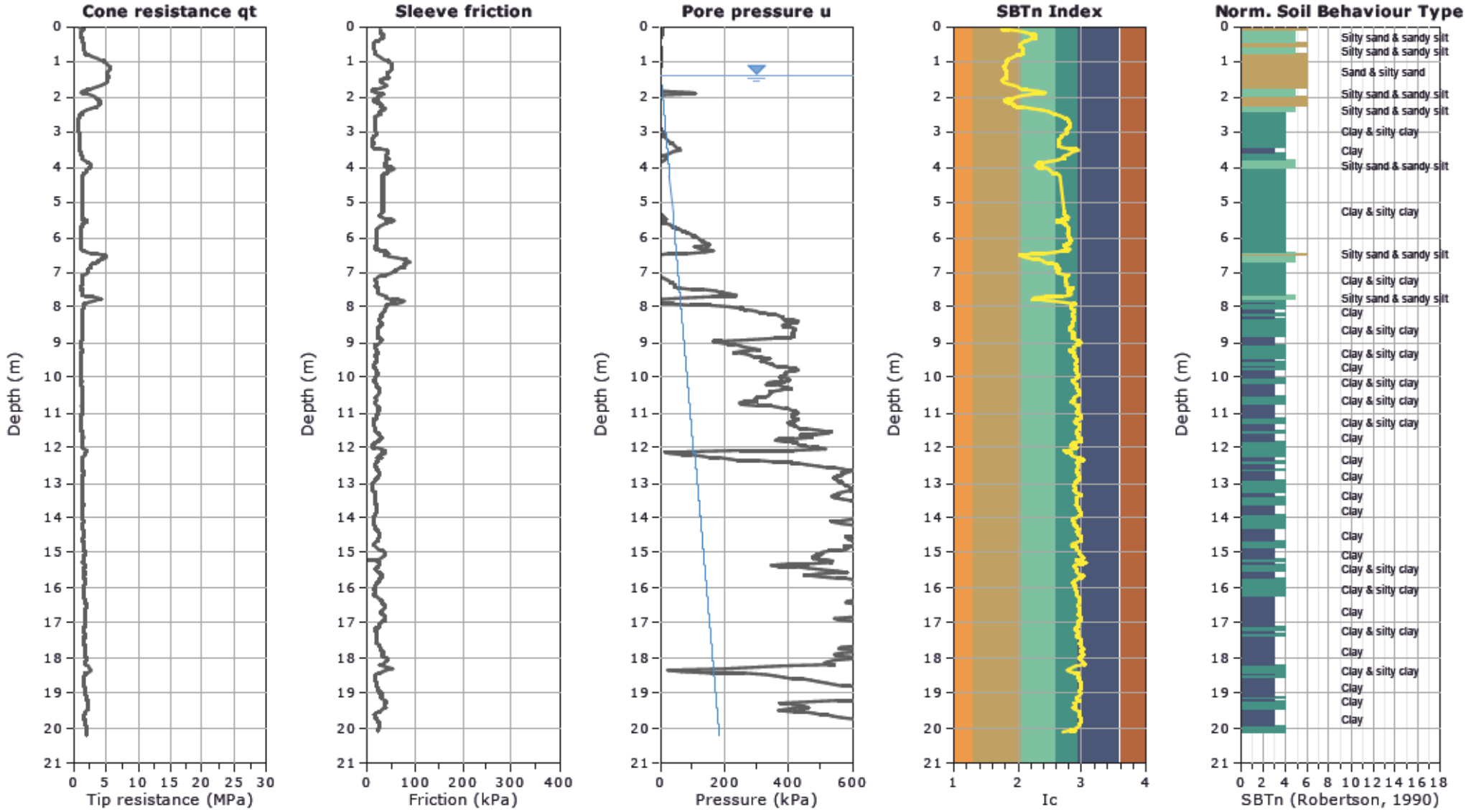
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Surface Elevation: 0.00 m
Cone Type: Vertek 15 cm^2
Cone Operator: PMEL



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Project: **Greenview Estates Subdivision**
Location: **South of Saskatoon, SK**

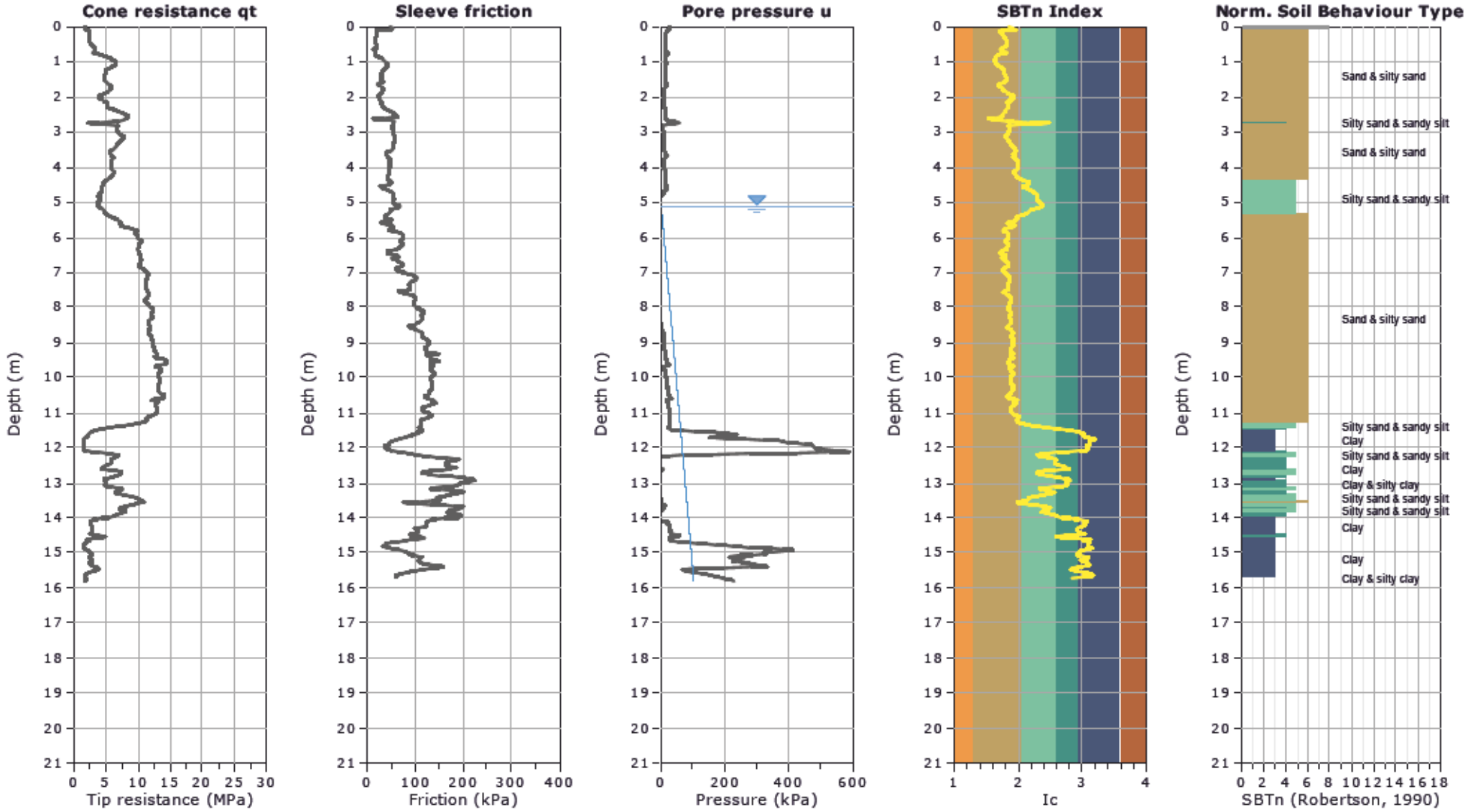
CPT: 21-25
Total depth: 20.18 m, Date: 4/16/2021
Surface Elevation: 0.00 m
Cone Type: Vertek 15 cm^2
Cone Operator: PMEL



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Project: **Greenview Estates Subdivision**
Location: **South of Saskatoon, SK**

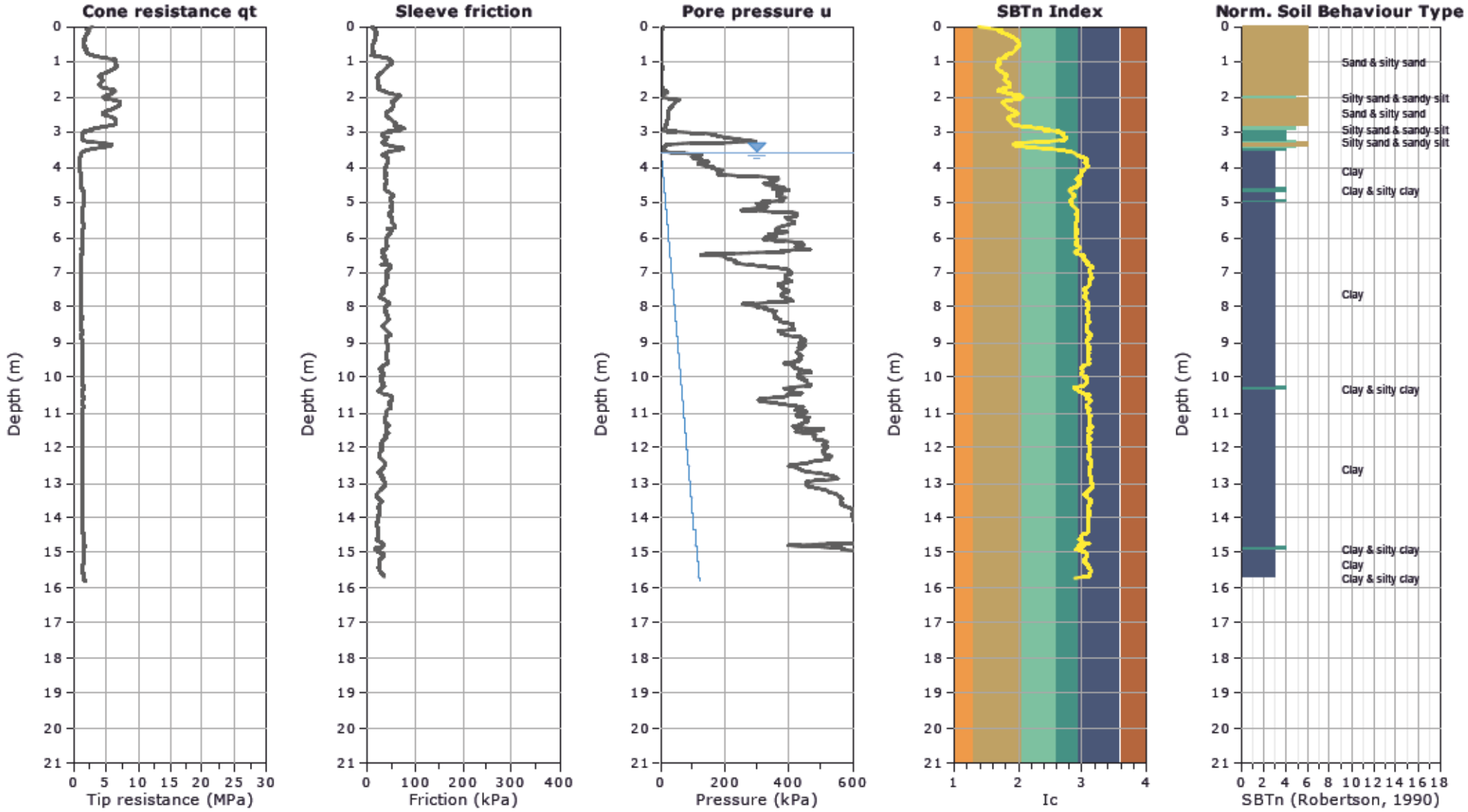
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Surface Elevation: 0.00 m
Cone Type: Vertek 15 cm^2
Cone Operator: PMEL



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Project: Greenview Estates Subdivision
Location: South of Saskatoon, SK

CPT: 21-29
Total depth: 15.80 m, Date: 4/16/2021
Surface Elevation: 0.00 m
Cone Type: Vertek 15 cm^2
Cone Operator: PMEL



APPENDIX C

Grain Size Distribution Analysis
Test Results

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: April 27, 2021

Test Hole No.: 21-1

Sample No.: 76

Depth (m): 1.2

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	99.9
#60	0.25	99.6
# 100	0.15	87.3
# 200	0.075	36.4

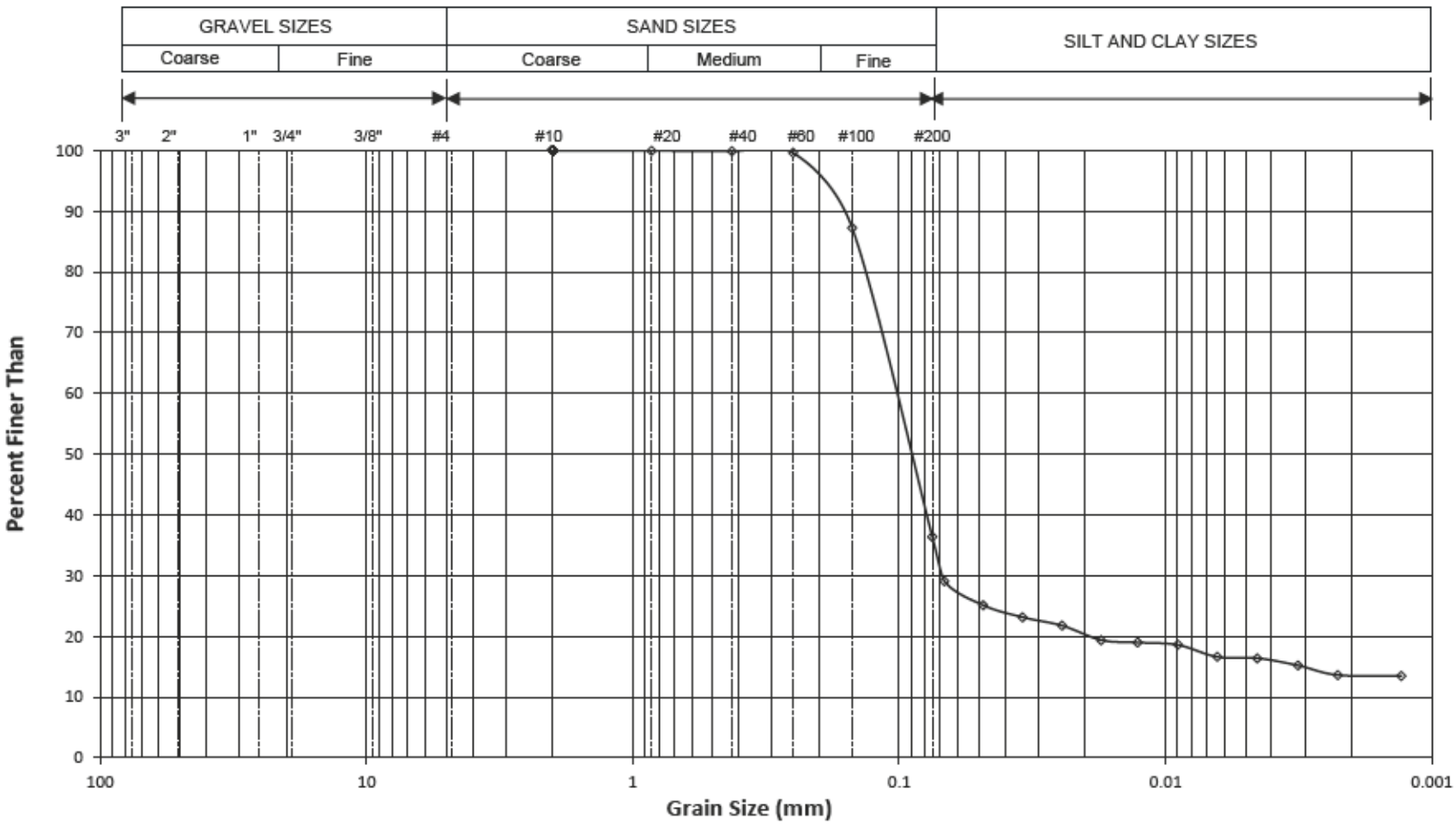
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0675	29.1
Sodium Hexametaphosphate	0.0483	25.1
	0.0344	23.2
	0.0244	21.8
	0.0174	19.4
	0.0127	19.0
	0.0090	18.6
	0.0064	16.6
	0.0045	16.4
	0.0032	15.2
	0.0022	13.6
	0.0013	13.5

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	64	22	14

Remarks:



CERTIFIED BY CCIL Canadian Council of Independent Laboratories For specific tests as listed on www.ccil.com

Drawing No.

APPENDIX C-1

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD
P. MACHIBRODA ENGINEERING LTD.

PER

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: April 27, 2021

Test Hole No.: 21-2

Sample No.: 85

Depth (m): 0.6

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	99.9
#60	0.25	99.1
# 100	0.15	76.1
# 200	0.075	22.3

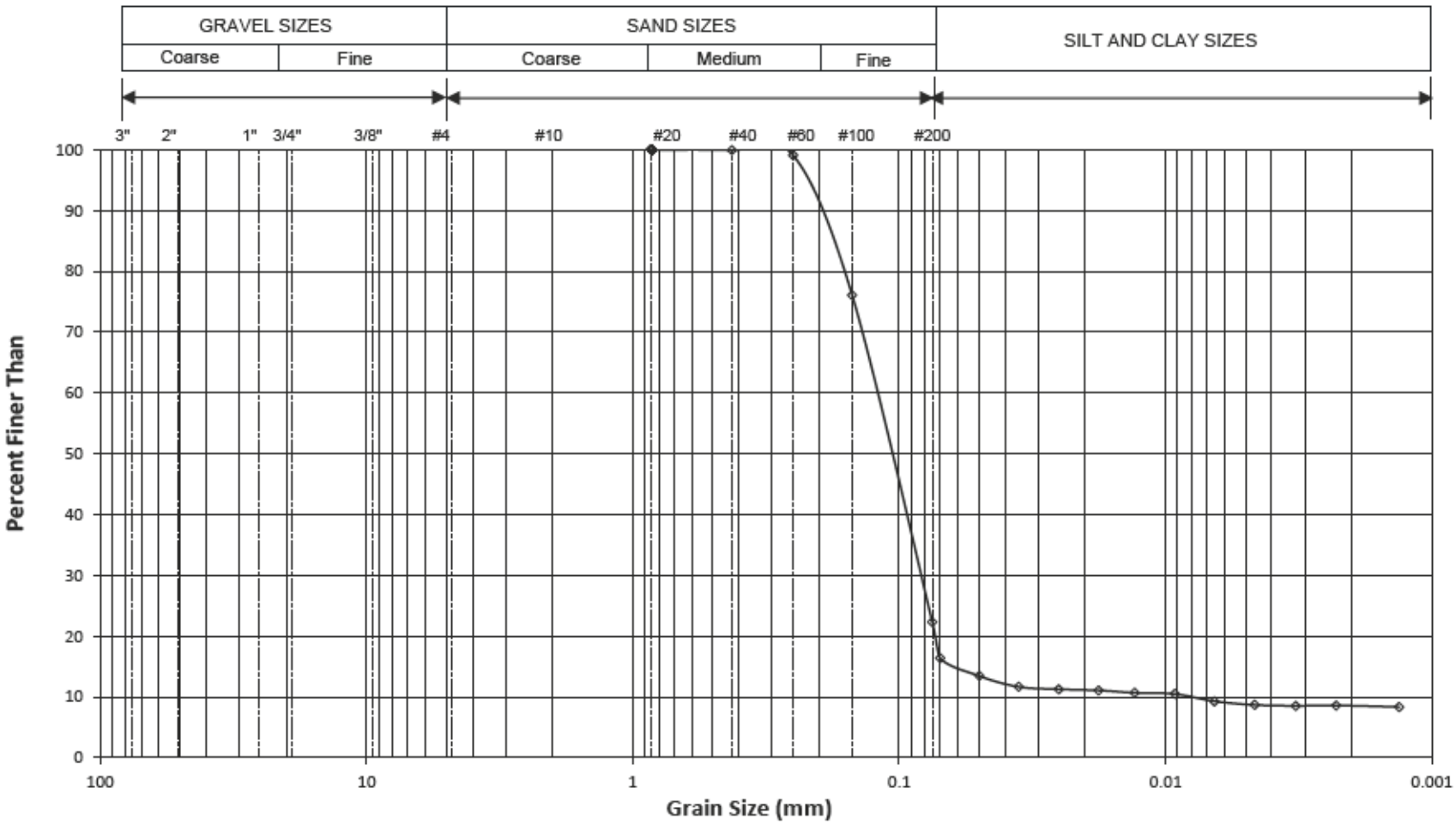
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0702	16.4
Sodium Hexametaphosphate	0.0500	13.5
	0.0356	11.7
	0.0252	11.3
	0.0178	11.1
	0.0130	10.7
	0.0092	10.5
	0.0065	9.3
	0.0046	8.7
	0.0032	8.6
	0.0023	8.6
	0.0013	8.4

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	78	13	9

Remarks:



CERTIFIED BY CCIL Canadian Council of Independent Laboratories For specific tests as listed on www.ccil.com

Drawing No.

APPENDIX C-2

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD
P. MACHIBRODA ENGINEERING LTD.

PER Preston Schergevitch

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: April 27, 2021

Test Hole No.: 21-3

Sample No.: 93

Depth (m): 1.2

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	99.9
#60	0.25	99.8
# 100	0.15	97.5
# 200	0.075	82.4

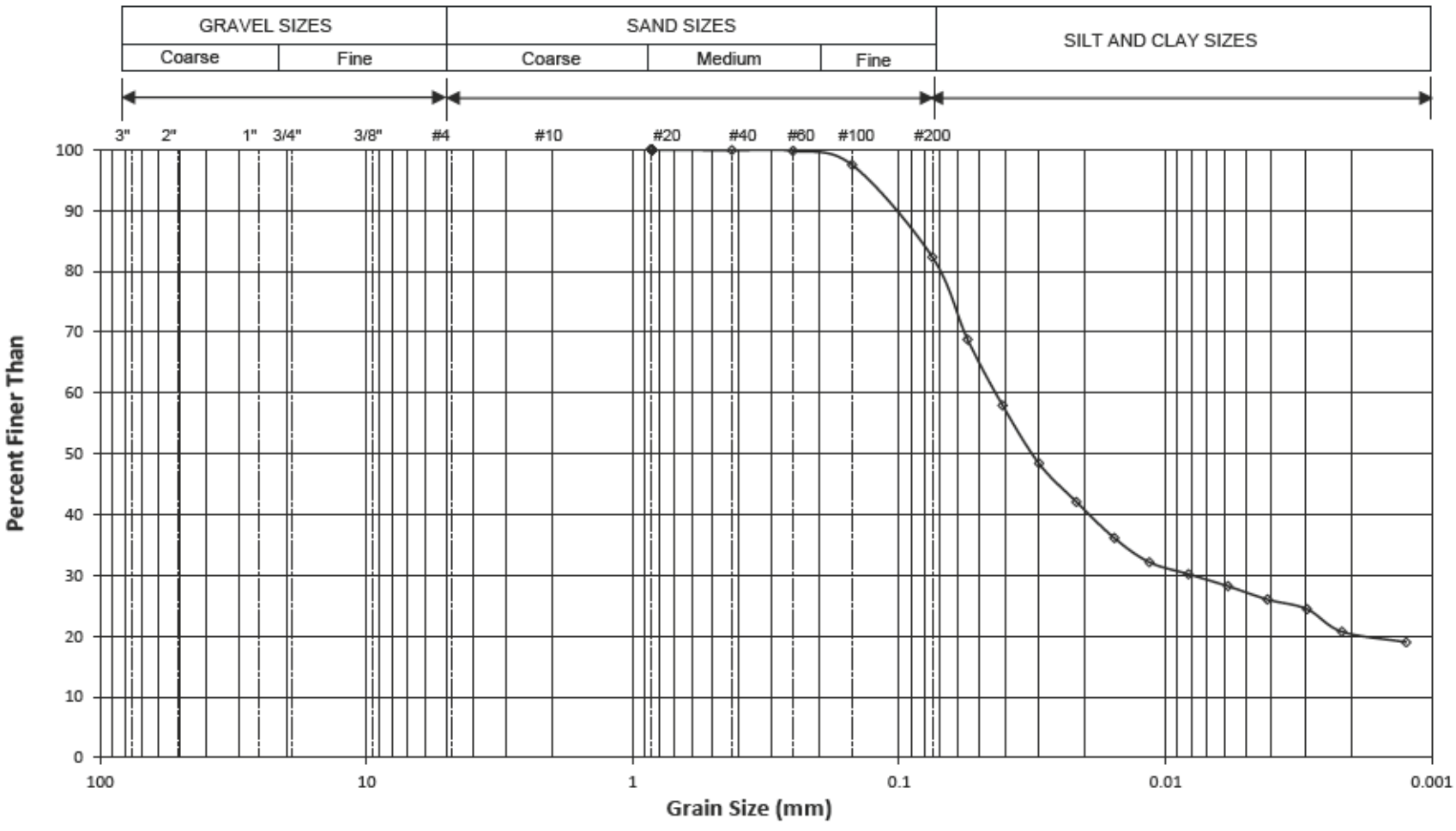
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0553	68.8
Sodium Hexametaphosphate	0.0408	57.9
	0.0298	48.4
	0.0216	42.1
	0.0155	36.2
	0.0115	32.2
	0.0082	30.2
	0.0058	28.2
	0.0041	26.1
	0.0029	24.5
	0.0022	20.7
	0.0012	19.0

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	18	61	21

Remarks:



CERTIFIED BY CCIL Canadian Council of Independent Laboratories For specific tests as listed on www.ccil.com

Drawing No.

APPENDIX C-3

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD
P. MACHIBRODA ENGINEERING LTD.

PER

P.MACHIBRODA ENGINEERING LTD.

ASTM C136: GRAIN SIZE ANALYSIS

Project: Greenview Estates Subdivision

Location: South of Saskatoon

Project No.: 17789

Date Tested: April 22, 2021

Test Hole No: 21-3

Sample No.: 97

Depth: 6.0

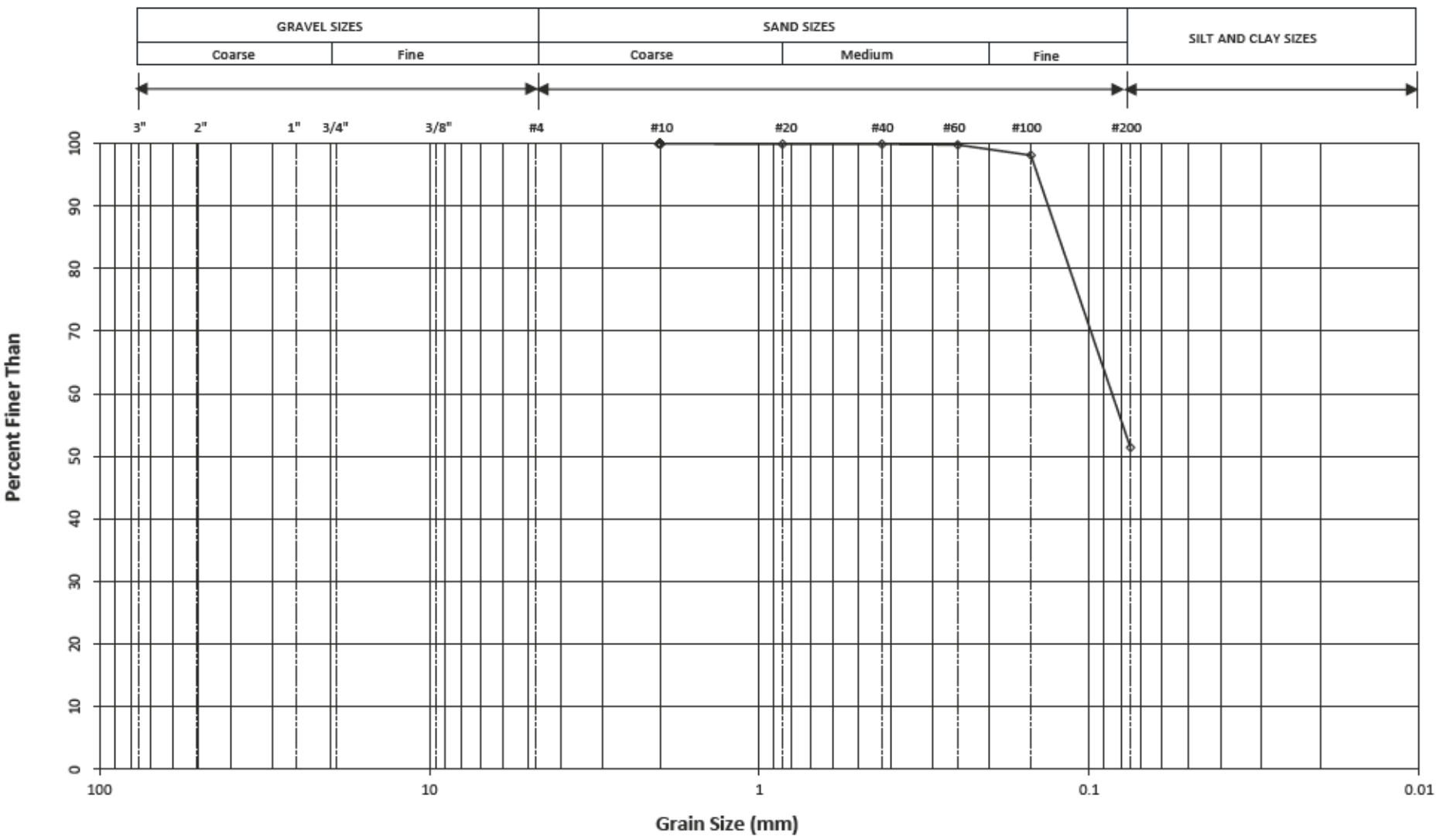
Sieve Analysis:

Sieve	Diameter mm	% 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	98
	0.075	51

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt and Clay Sizes
0	49	51

Remarks:



CERTIFIED BY CCIL Canadian Council of Independent Laboratories For specific tests as listed on www.ccil.com

DRAWING NO.

APPENDIX C-4

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH ASTM C136 AND C117 CSTANDARDS
P. MACHIBRODA ENGINEERING LTD.

PER Preston Schergevitch

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: April 27, 2021

Test Hole No.: 21-4

Sample No.: 102

Depth (m): 0.6

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	99.8
#60	0.25	99.5
# 100	0.15	84.8
# 200	0.075	38.2

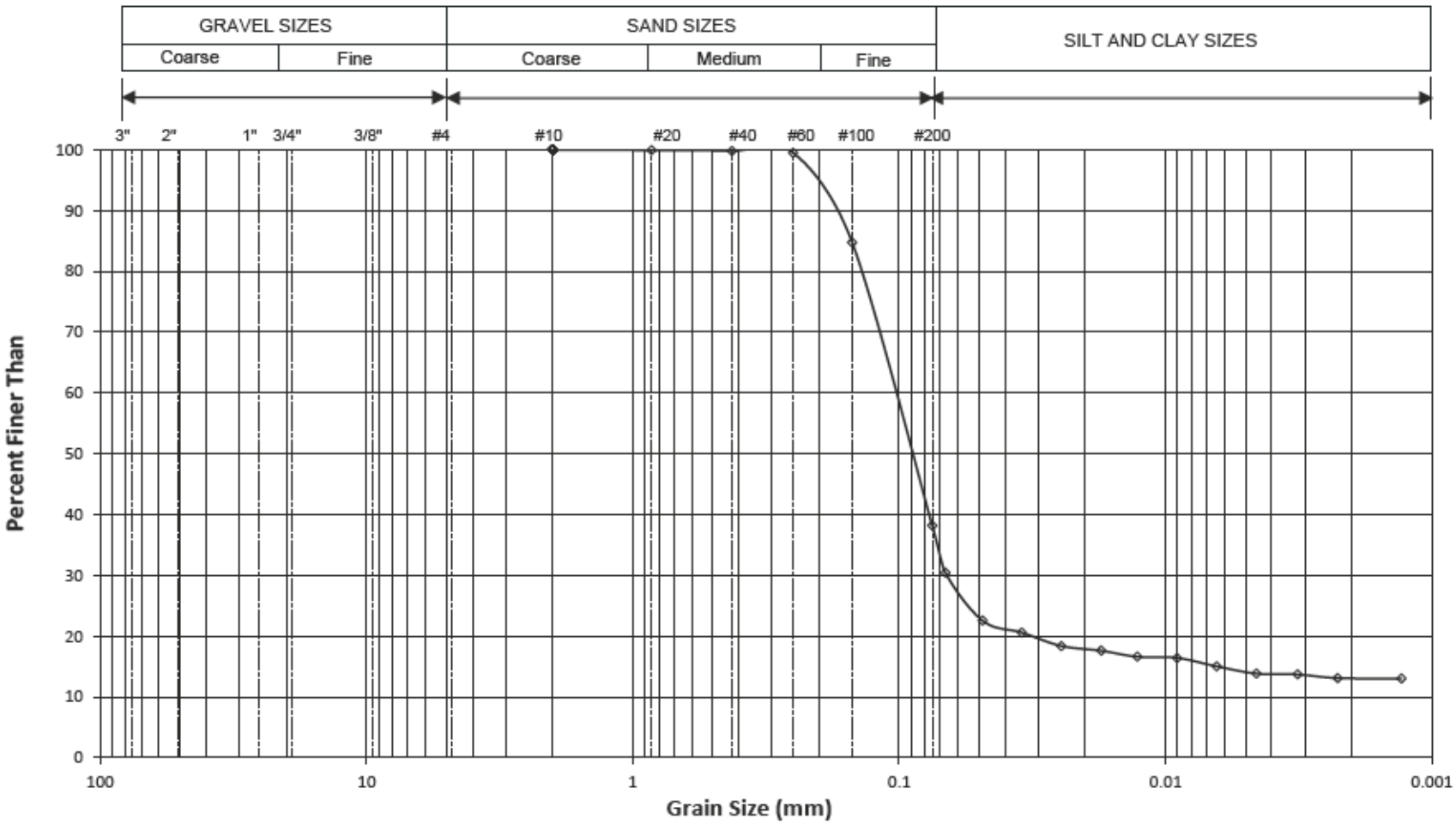
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0670	30.5
Sodium Hexametaphosphate	0.0486	22.6
	0.0346	20.6
	0.0246	18.4
	0.0174	17.6
	0.0128	16.6
	0.0090	16.4
	0.0064	15.0
	0.0045	13.9
	0.0032	13.7
	0.0023	13.1
	0.0013	13.0

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	62	25	13

Remarks:



CERTIFIED BY CCIL Canadian Council of Independent Laboratories For specific tests as listed on www.ccil.com

Drawing No.

APPENDIX C-5

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD
P. MACHIBRODA ENGINEERING LTD.

PER Preston Schergevitch

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: April 27, 2021

Test Hole No.: 21-5

Sample No.: 109

Depth (m): 0.9

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	99.9
#60	0.25	99.2
# 100	0.15	75.9
# 200	0.075	23.5

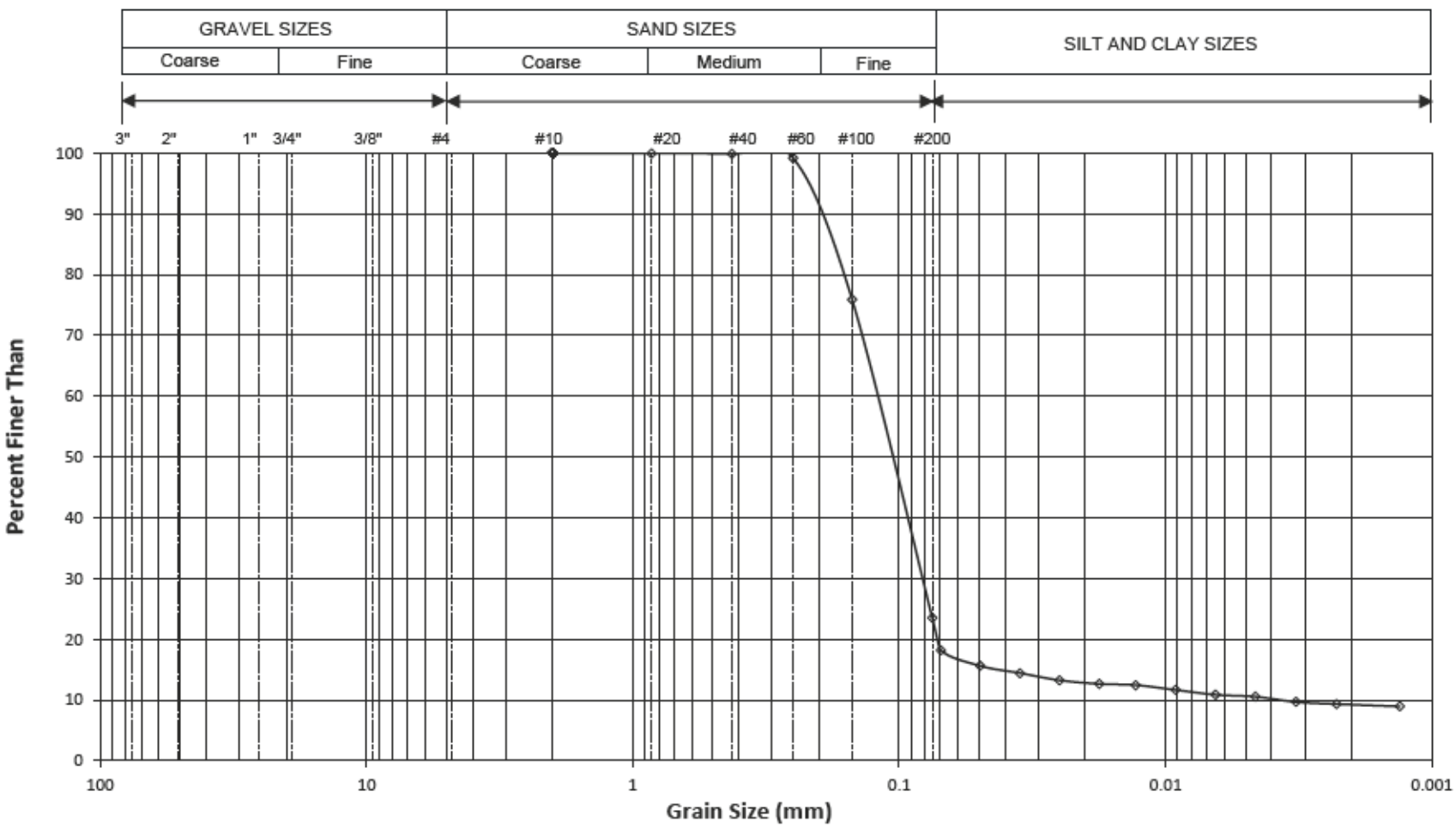
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0696	18.2
Sodium Hexametaphosphate	0.0496	15.6
	0.0352	14.5
	0.0250	13.3
	0.0177	12.7
	0.0129	12.5
	0.0092	11.7
	0.0065	10.9
	0.0046	10.6
	0.0032	9.7
	0.0023	9.4
	0.0013	9.0

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	76	15	9

Remarks:



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Drawing No.

APPENDIX C-6

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD
P. MACHIBRODA ENGINEERING LTD.

PER Preston Schergevitch

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: April 29, 2021

Test Hole No.: 21-5

Sample No.: 113

Depth (m): 4.5

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	99.9
#60	0.25	99.7
# 100	0.15	94.7
# 200	0.075	77.8

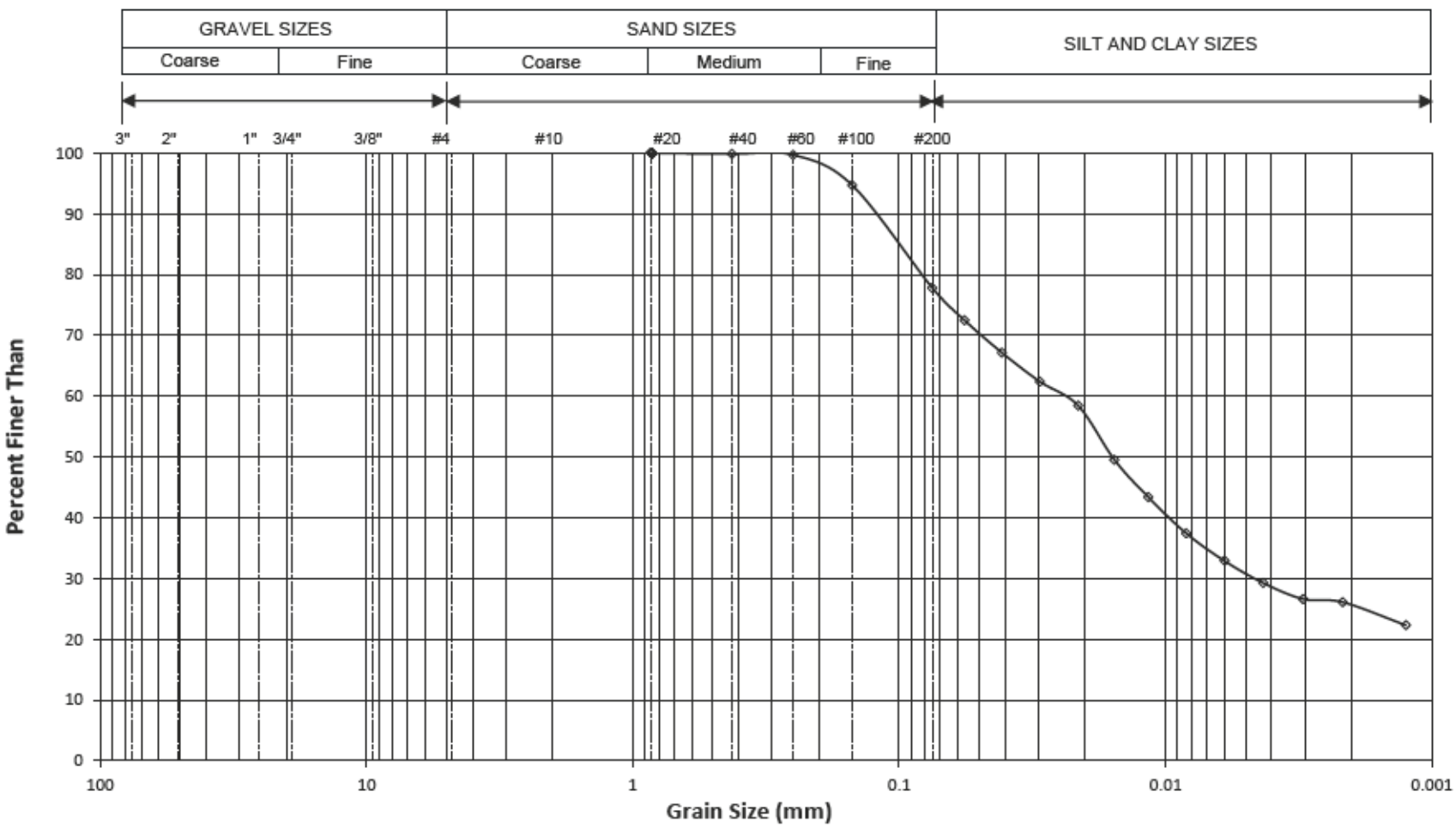
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0568	72.5
Sodium Hexametaphosphate	0.0411	67.2
	0.0296	62.4
	0.0212	58.5
	0.0155	49.5
	0.0116	43.4
	0.0084	37.5
	0.0060	32.9
	0.0043	29.3
	0.0030	26.6
	0.0022	26.1
	0.0013	22.3

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	22	52	26

Remarks:



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Drawing No.

APPENDIX C-7

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD
P. MACHIBRODA ENGINEERING LTD.

PER Preston Schergevitch

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: April 27, 2021

Test Hole No.: 21-6

Sample No.: 123

Depth (m): 1.5

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	99.8
#60	0.25	99.0
# 100	0.15	76.2
# 200	0.075	22.8

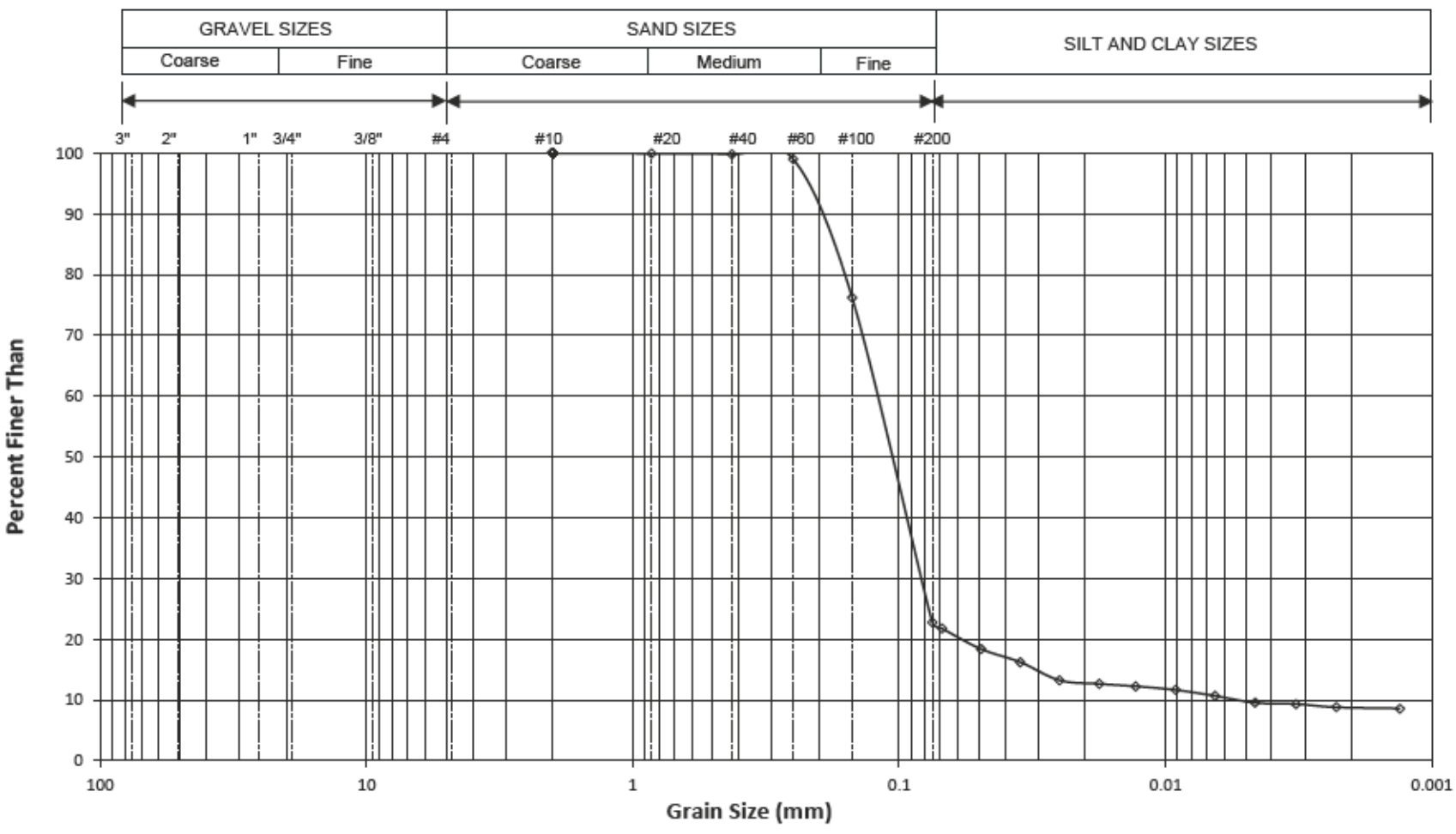
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0689	21.8
Sodium Hexametaphosphate	0.0492	18.4
	0.0350	16.2
	0.0250	13.3
	0.0177	12.7
	0.0129	12.3
	0.0092	11.7
	0.0065	10.7
	0.0046	9.6
	0.0032	9.4
	0.0023	8.8
	0.0013	8.6

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	77	14	9

Remarks:



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Drawing No.

APPENDIX C-8

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD
P. MACHIBRODA ENGINEERING LTD.

PER Preston Schergevitch

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: April 27, 2021

Test Hole No.: 21-7

Sample No.: 128

Depth (m): 0.9

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	99.8
#60	0.25	99.3
# 100	0.15	78.5
# 200	0.075	21.9

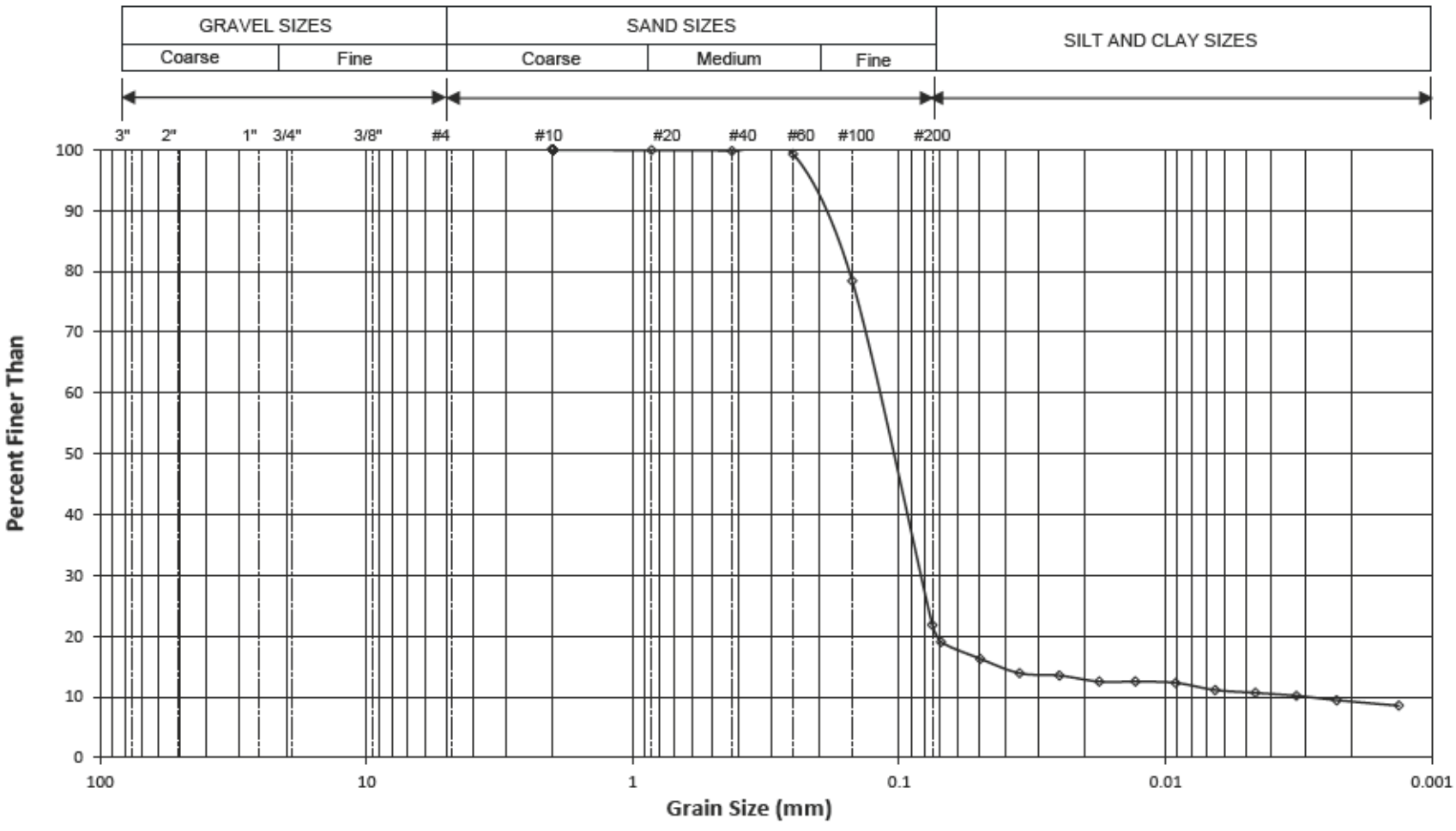
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0696	19.1
Sodium Hexametaphosphate	0.0496	16.3
	0.0353	13.9
	0.0250	13.5
	0.0177	12.5
	0.0129	12.5
	0.0092	12.3
	0.0065	11.2
	0.0046	10.7
	0.0032	10.2
	0.0023	9.5
	0.0013	8.6

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	78	12	10

Remarks:



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Drawing No.

APPENDIX C-9

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD
P. MACHIBRODA ENGINEERING LTD.

PER Preston Schergevitch

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: April 27, 2021

Test Hole No.: 21-8

Sample No.: 138

Depth (m): 0.6

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	100.0
#60	0.25	99.5
# 100	0.15	86.8
# 200	0.075	46.1

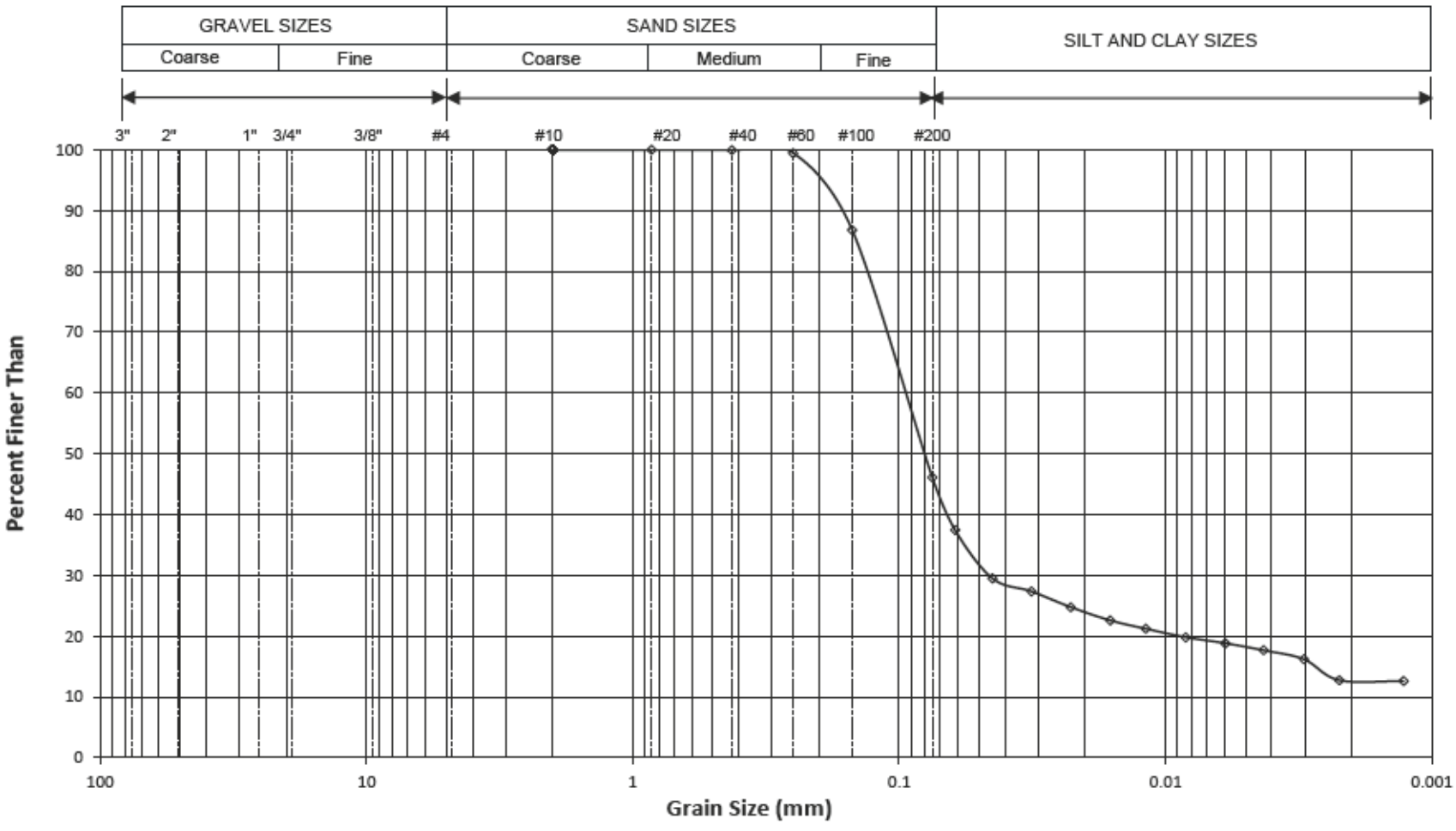
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0616	37.5
Sodium Hexametaphosphate	0.0446	29.5
	0.0318	27.4
	0.0226	24.8
	0.0161	22.6
	0.0118	21.2
	0.0084	19.8
	0.0059	18.9
	0.0043	17.7
	0.0030	16.2
	0.0022	12.8
	0.0013	12.6

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	54	33	13

Remarks:



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Drawing No.

APPENDIX C-10

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD
P. MACHIBRODA ENGINEERING LTD.

PER Preston Schergevitch

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: April 28, 2021

Test Hole No.: 21-9

Sample No.: 62

Depth (m): 0.6

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	99.8
#60	0.25	98.8
# 100	0.15	72.5
# 200	0.075	27.1

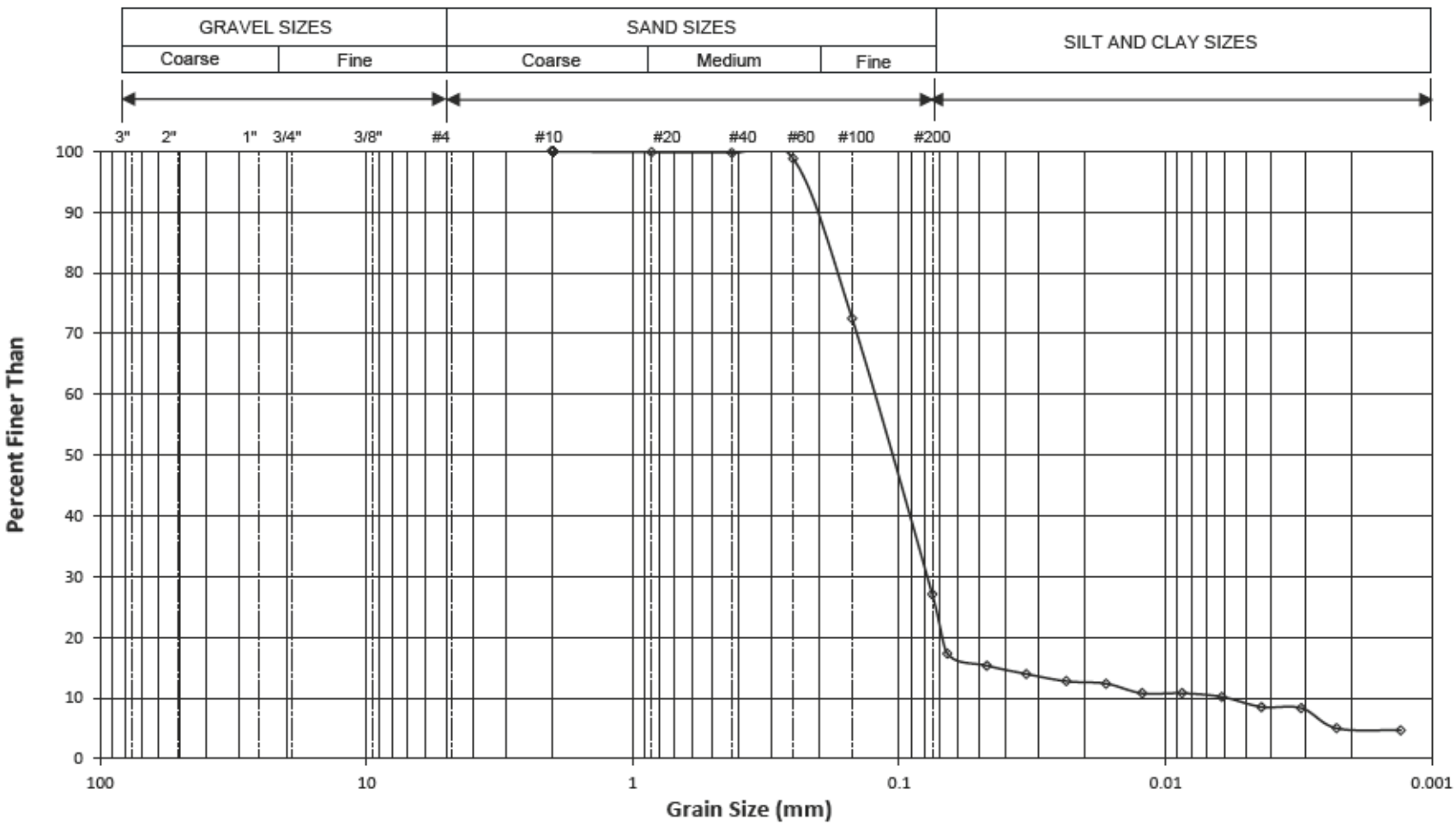
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0658	17.3
Sodium Hexametaphosphate	0.0468	15.4
	0.0332	14.0
	0.0236	12.8
	0.0167	12.4
	0.0122	10.8
	0.0087	10.8
	0.0061	10.2
	0.0044	8.6
	0.0031	8.4
	0.0023	5.0
	0.0013	4.7

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	73	22	5

Remarks:



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Drawing No.

APPENDIX C-11

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD
P. MACHIBRODA ENGINEERING LTD.

PER Preston Schergevitch

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: May 3, 2021

Test Hole No.: 21-10

Sample No.: 146

Depth (m): 0.9

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	100.0
#60	0.25	99.2
# 100	0.15	79.3
# 200	0.075	30.0

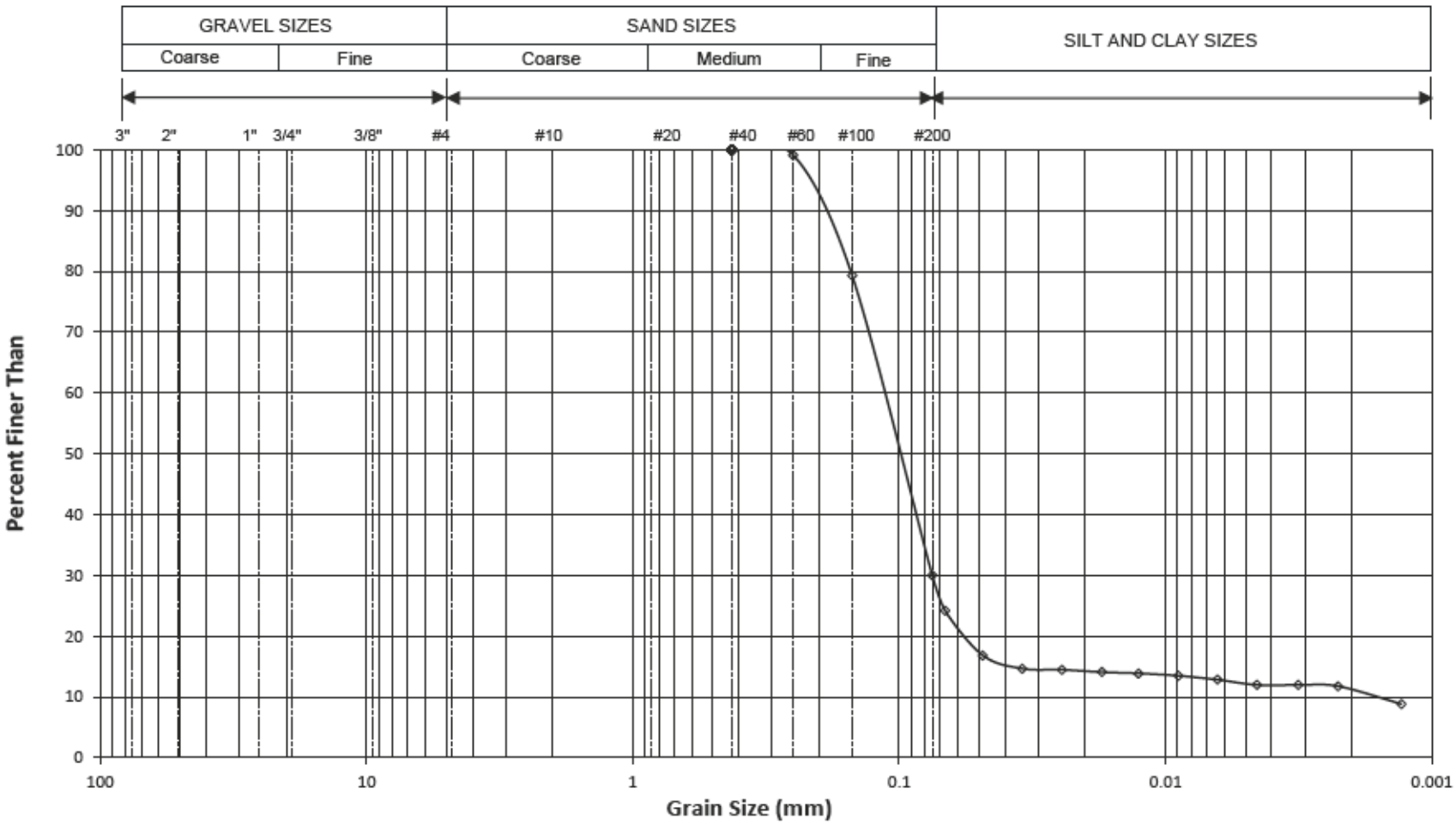
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0671	24.2
Sodium Hexametaphosphate	0.0485	16.9
	0.0345	14.7
	0.0244	14.5
	0.0173	14.1
	0.0126	13.9
	0.0089	13.5
	0.0064	12.9
	0.0045	12.0
	0.0032	12.0
	0.0022	11.8
	0.0013	8.9

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	70	18	12

Remarks:



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Drawing No.

APPENDIX C-12

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD
P. MACHIBRODA ENGINEERING LTD.

PER Preston Schergevitch

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: May 3, 2021

Test Hole No.: 21-11

Sample No.: 53

Depth (m): 1.5

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	99.8
#60	0.25	99.2
# 100	0.15	80.0
# 200	0.075	26.0

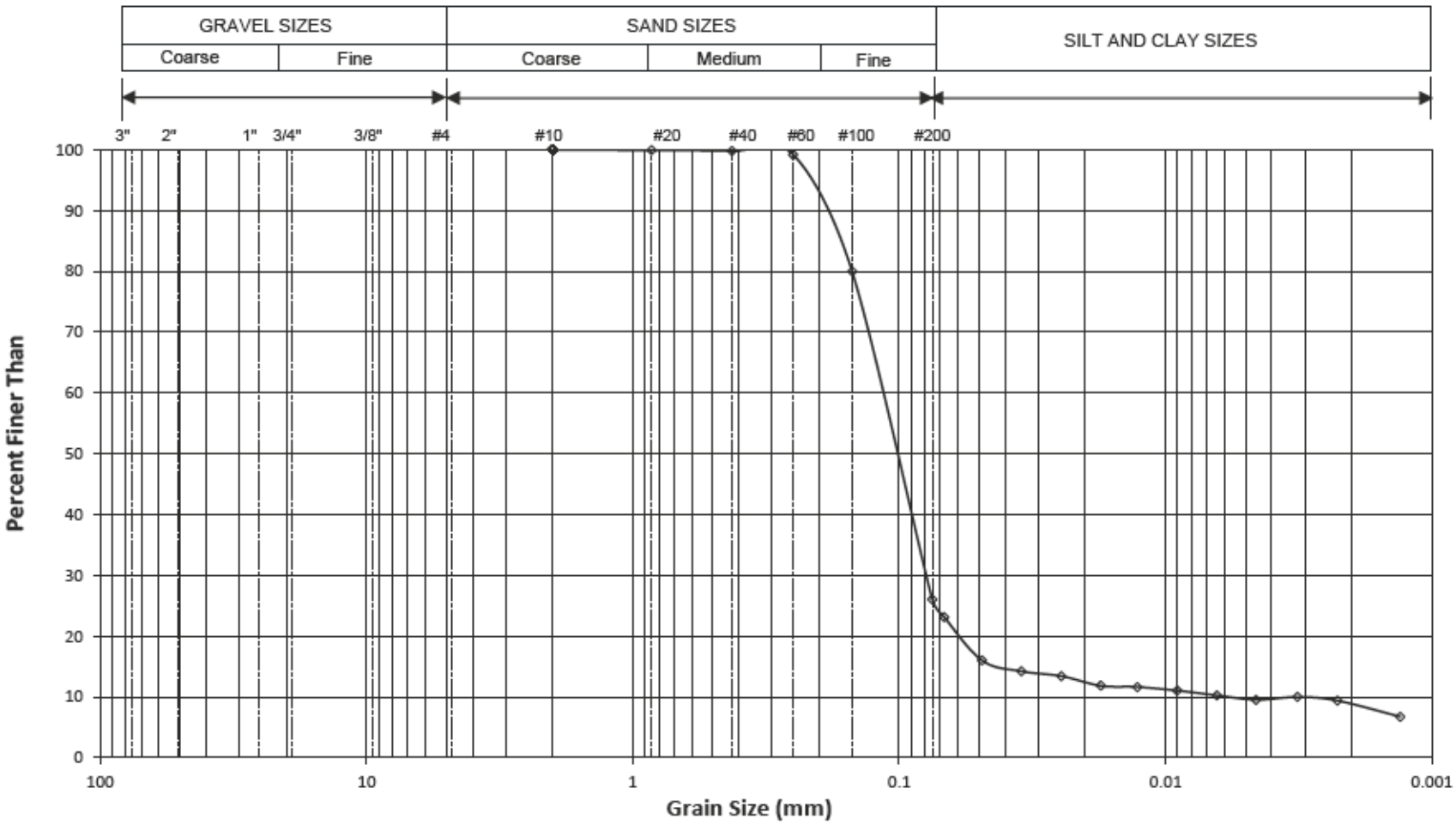
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0676	23.1
Sodium Hexametaphosphate	0.0488	16.0
	0.0347	14.2
	0.0246	13.4
	0.0175	11.9
	0.0128	11.7
	0.0090	11.1
	0.0064	10.3
	0.0046	9.6
	0.0032	10.0
	0.0023	9.4
	0.0013	6.8

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	74	17	9

Remarks:



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Drawing No.

APPENDIX C-13

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD
P. MACHIBRODA ENGINEERING LTD.

PER

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: April 29, 2021

Test Hole No.: 21-12

Sample No.: 162

Depth (m): 0.6

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	100.0
#60	0.25	99.3
# 100	0.15	81.9
# 200	0.075	37.4

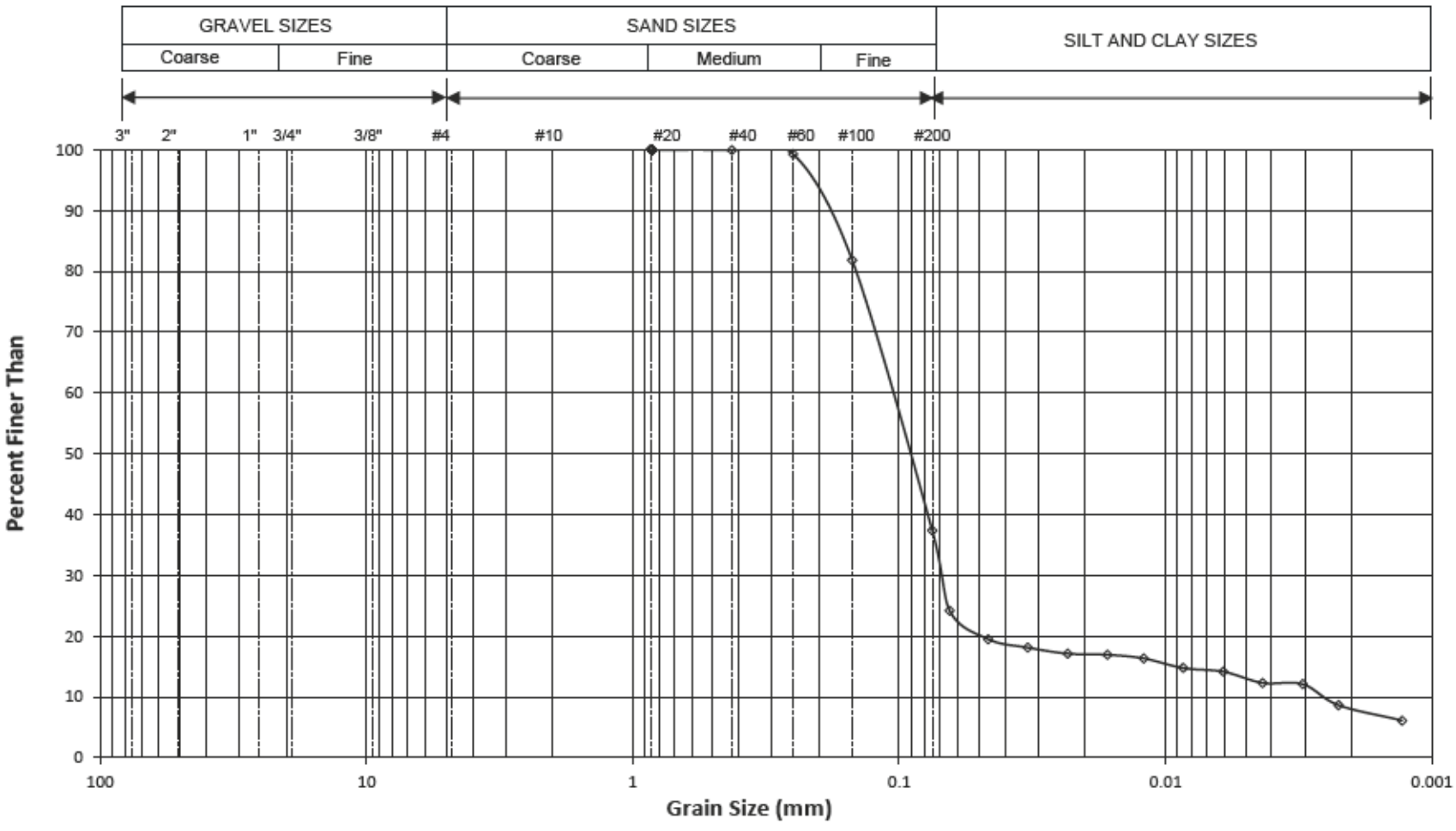
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0646	24.2
Sodium Hexametaphosphate	0.0462	19.5
	0.0328	18.1
	0.0233	17.1
	0.0165	16.9
	0.0120	16.4
	0.0086	14.8
	0.0061	14.2
	0.0043	12.3
	0.0031	12.1
	0.0022	8.7
	0.0013	6.1

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	63	28	9

Remarks:



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Drawing No.

APPENDIX C-14

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD
P. MACHIBRODA ENGINEERING LTD.

PER Preston Schergevitch

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: May 3, 2021

Test Hole No.: 21-13

Sample No.: 150

Depth (m): 0.3

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	99.9
#60	0.25	99.4
# 100	0.15	81.6
# 200	0.075	36.4

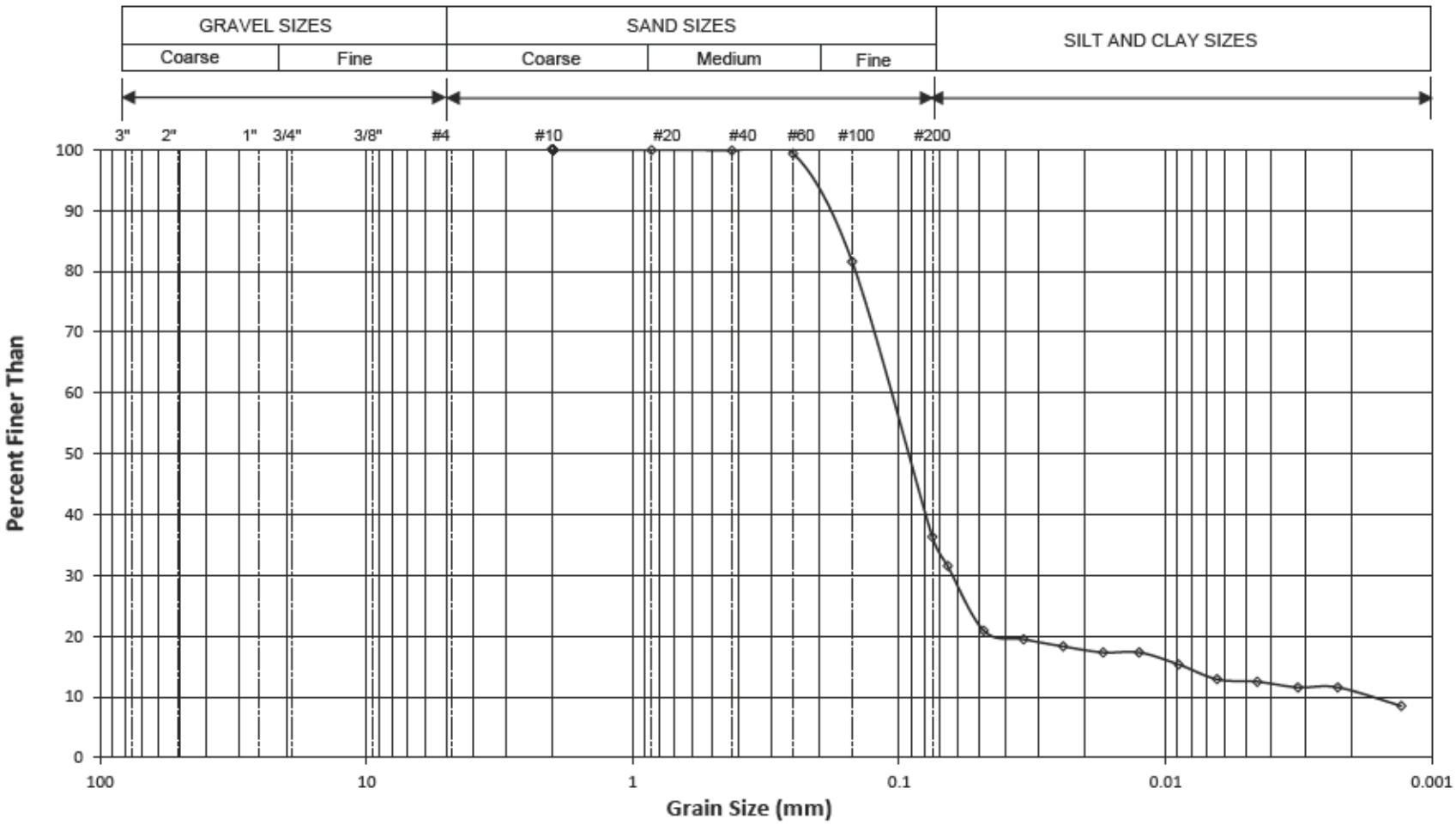
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0657	31.6
Sodium Hexametaphosphate	0.0480	20.9
	0.0341	19.5
	0.0242	18.3
	0.0172	17.3
	0.0125	17.3
	0.0089	15.4
	0.0064	12.9
	0.0045	12.5
	0.0032	11.6
	0.0023	11.6
	0.0013	8.5

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	64	24	12

Remarks:



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Drawing No.

APPENDIX C-15

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD
P. MACHIBRODA ENGINEERING LTD.

PER Preston Schergevitch

P.MACHIBRODA ENGINEERING LTD.

ASTM C136: GRAIN SIZE ANALYSIS

Project: Greenview Estates Subdivision

Location: South of Saskatoon

Project No.: 17789

Date Tested: April 22, 2021

Test Hole No: 21-13

Sample No.: 156

Depth: 4.5

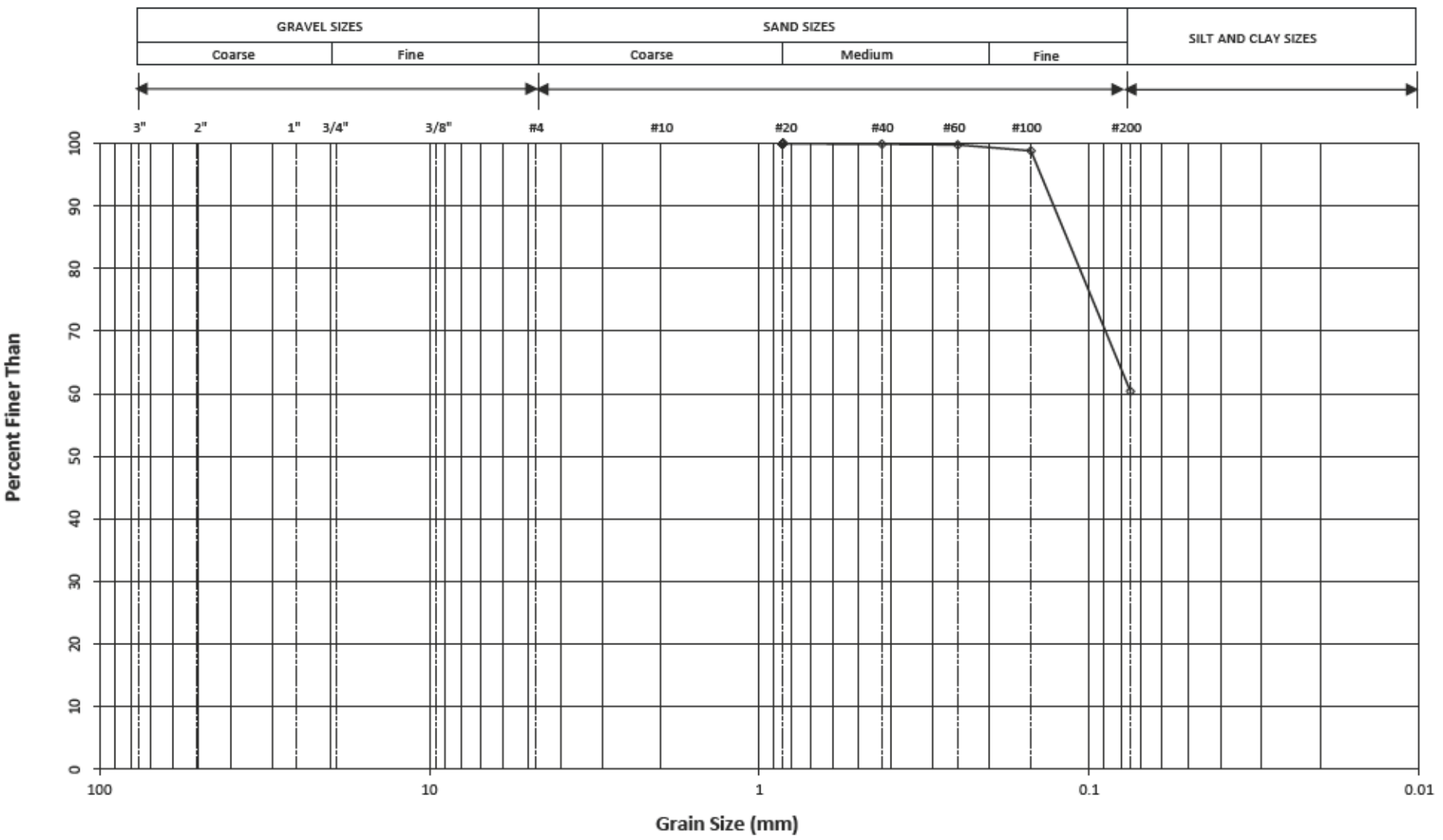
Sieve Analysis:

Sieve	Diameter mm	% 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	60

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt and Clay Sizes
0	40	60

Remarks:



CERTIFIED BY CCIL Canadian Council of Independent Laboratories For specific tests as listed on www.ccil.com

DRAWING NO.

APPENDIX C-16

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH ASTM C136 AND C117 CSTANDARDS
P. MACHIBRODA ENGINEERING LTD.

PER Preston Schergevitch

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: April 29, 2021

Test Hole No.: 21-14

Sample No.: 197

Depth (m): 1.2

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	99.8
#60	0.25	99.5
# 100	0.15	97.4
# 200	0.075	53.8

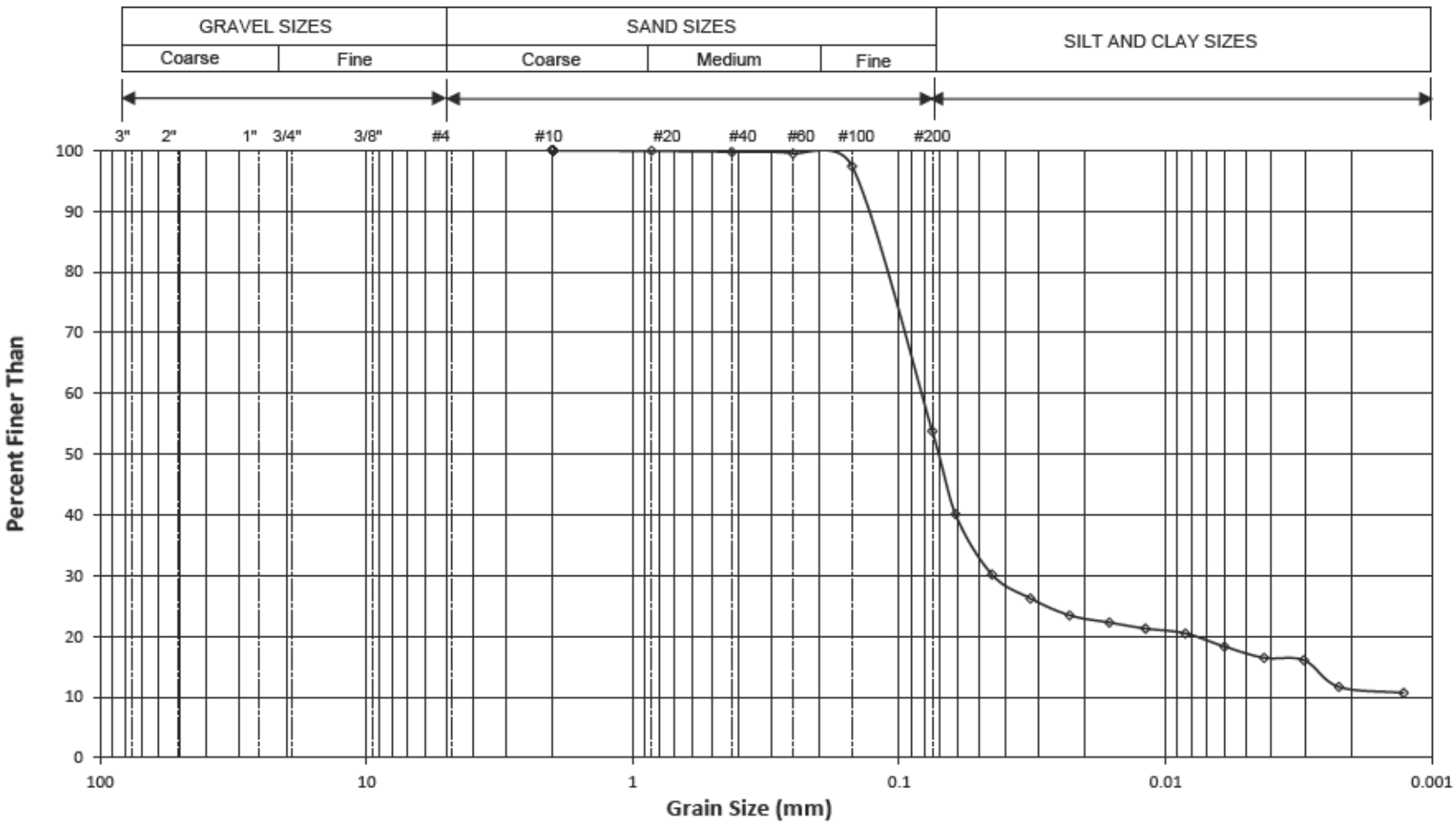
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0614	40.1
Sodium Hexametaphosphate	0.0448	30.2
	0.0321	26.3
	0.0229	23.5
	0.0162	22.3
	0.0119	21.3
	0.0084	20.5
	0.0060	18.3
	0.0043	16.5
	0.0030	16.1
	0.0022	11.7
	0.0013	10.7

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	46	42	12

Remarks:



CERTIFIED BY CCIL Canadian Council of Independent Laboratories For specific tests as listed on www.ccil.com

Drawing No.

APPENDIX C-17

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD
P. MACHIBRODA ENGINEERING LTD.

PER Preston Schergevitch

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: May 3, 2021

Test Hole No.: 21-15

Sample No.: 15

Depth (m): 0.6

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	99.5
#60	0.25	98.7
# 100	0.15	78.2
# 200	0.075	29.9

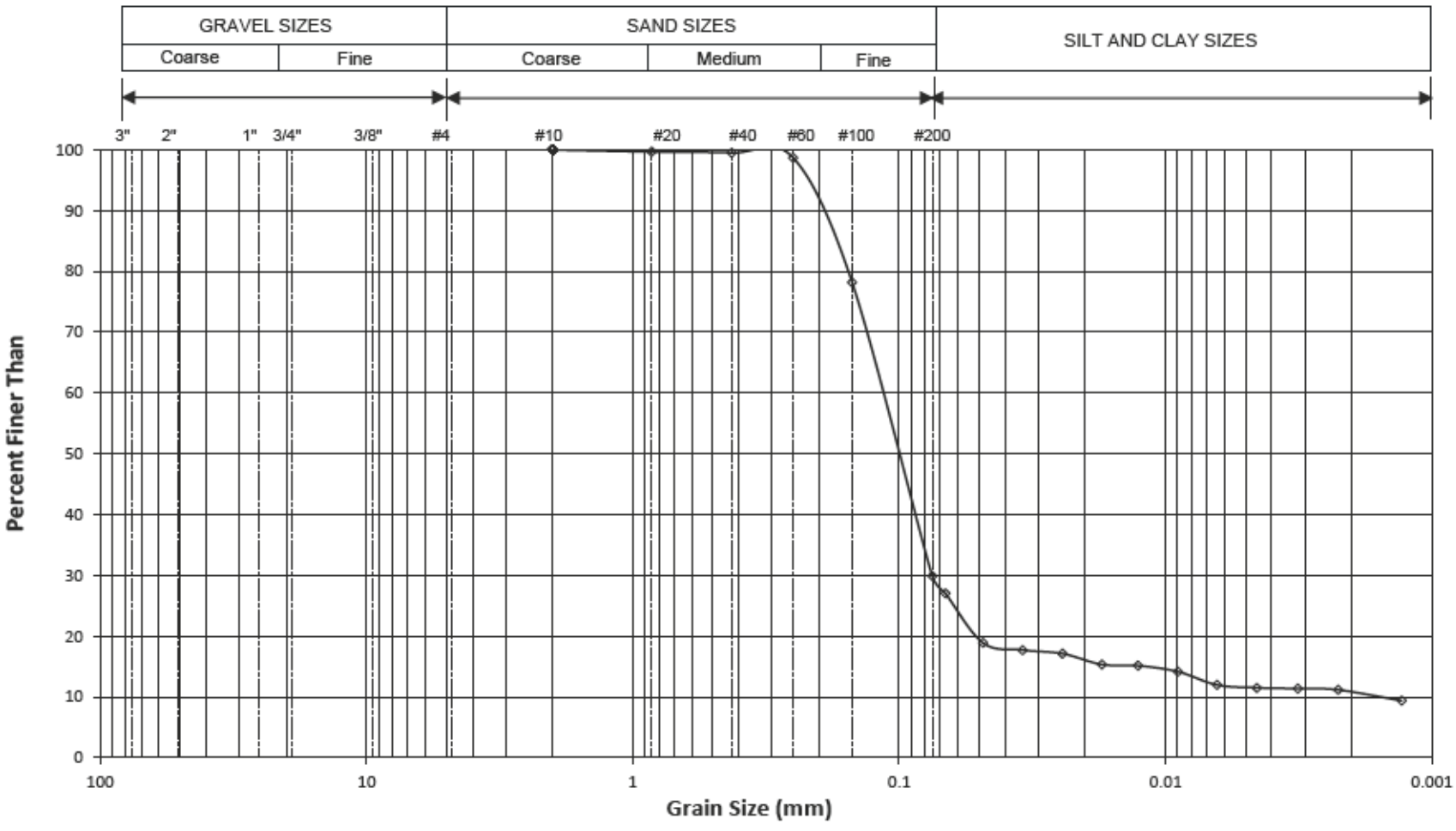
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0668	27.0
Sodium Hexametaphosphate	0.0484	18.9
	0.0344	17.7
	0.0243	17.1
	0.0173	15.4
	0.0126	15.2
	0.0090	14.2
	0.0064	12.0
	0.0045	11.5
	0.0032	11.4
	0.0022	11.2
	0.0013	9.4

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	70	19	11

Remarks:



CERTIFIED BY CCIL Canadian Council of Independent Laboratories For specific tests as listed on www.ccil.com

Drawing No.

APPENDIX C-18

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD
P. MACHIBRODA ENGINEERING LTD.

PER Preston Schergevitch

P.MACHIBRODA ENGINEERING LTD.

ASTM C136: GRAIN SIZE ANALYSIS

Project: Greenview Estates Subdivision

Location: South of Saskatoon

Project No.: 17789

Date Tested: April 19, 2021

Test Hole No: 21-15

Sample No.: 19

Depth: 3.0

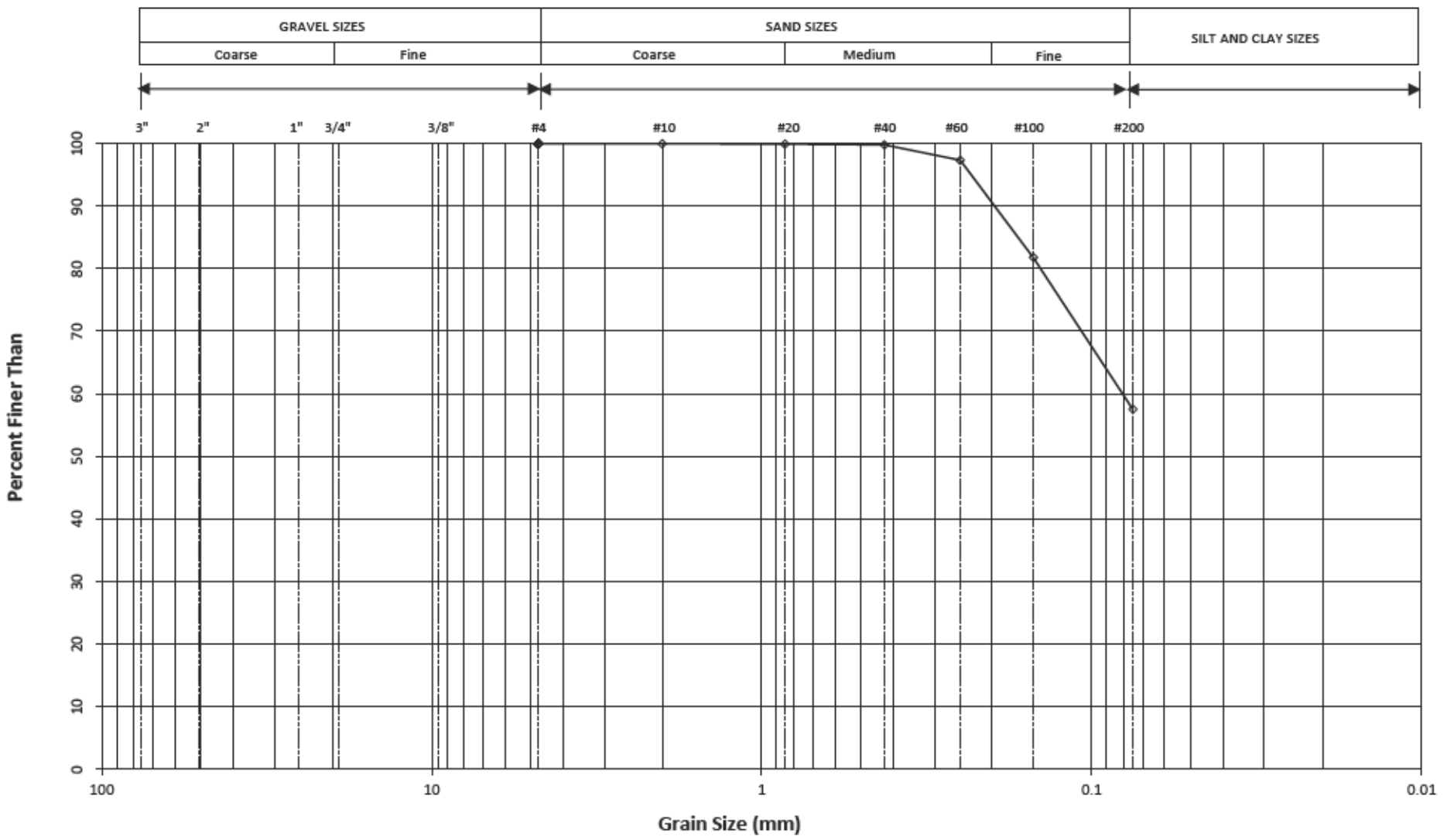
Sieve Analysis:

Sieve	Diameter mm	% 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	97
	0.150	82
	0.075	57

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt and Clay Sizes
0	43	57

Remarks:



CERTIFIED BY CCIL Canadian Council of Independent Laboratories For specific tests as listed on www.ccil.com

DRAWING NO.

APPENDIX C-19

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH ASTM C136 AND C117 CSTANDARDS
P. MACHIBRODA ENGINEERING LTD.

PER Preston Schergevitch

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: April 29, 2021

Test Hole No.: 21-16

Sample No.: 191

Depth (m): 1.5

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	99.9
#60	0.25	98.8
# 100	0.15	72.0
# 200	0.075	20.6

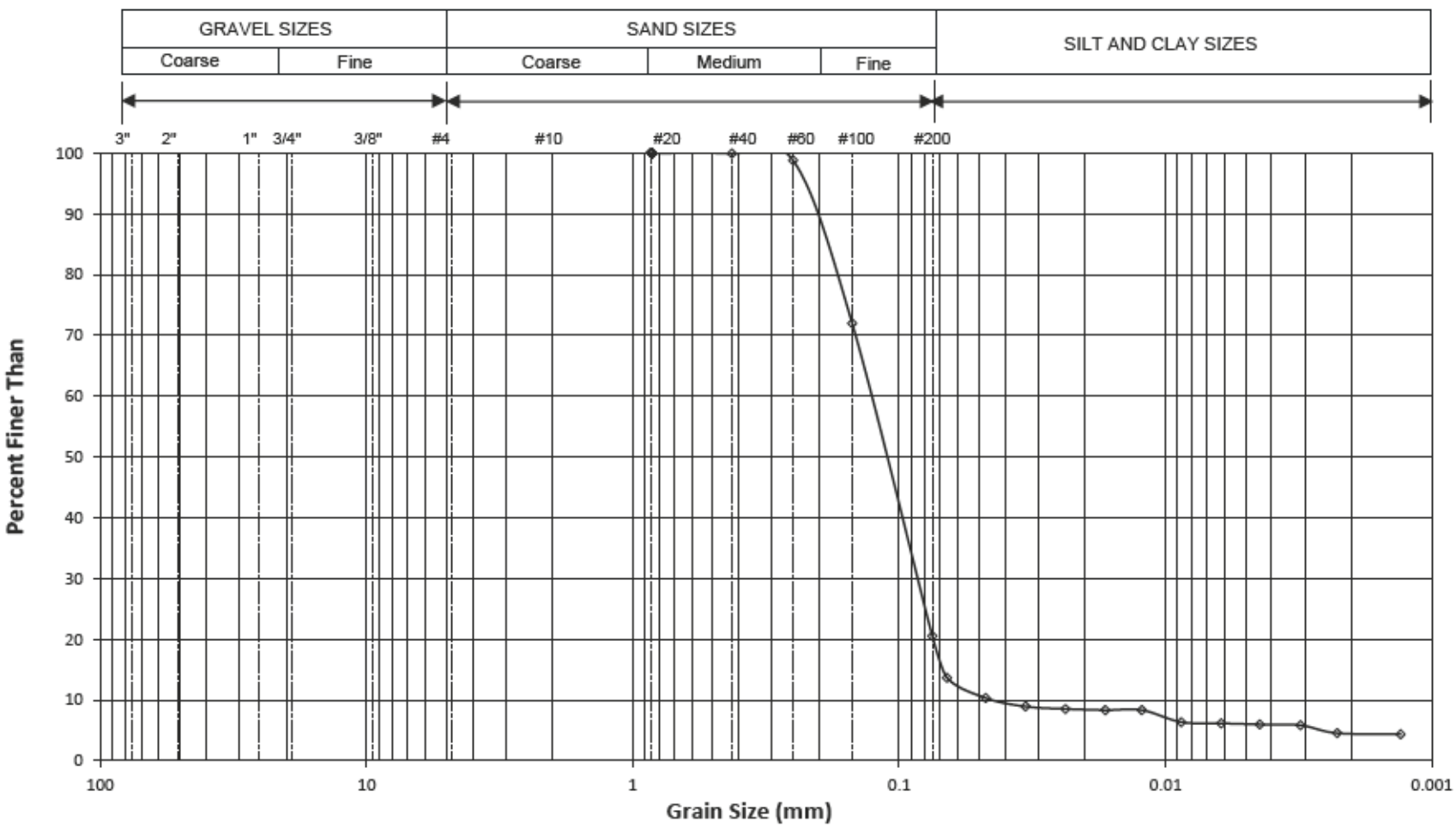
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0661	13.7
Sodium Hexametaphosphate	0.0472	10.3
	0.0335	9.0
	0.0237	8.6
	0.0168	8.4
	0.0123	8.4
	0.0087	6.4
	0.0062	6.2
	0.0044	6.0
	0.0031	5.9
	0.0023	4.6
	0.0013	4.4

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	79	16	5

Remarks:



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Drawing No.

APPENDIX C-20

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD
P. MACHIBRODA ENGINEERING LTD.

PER Preston Schergevitch

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: May 3, 2021

Test Hole No.: 21-17

Sample No.: 38

Depth (m): 0.6

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	99.8
#60	0.25	98.7
# 100	0.15	76.0
# 200	0.075	31.0

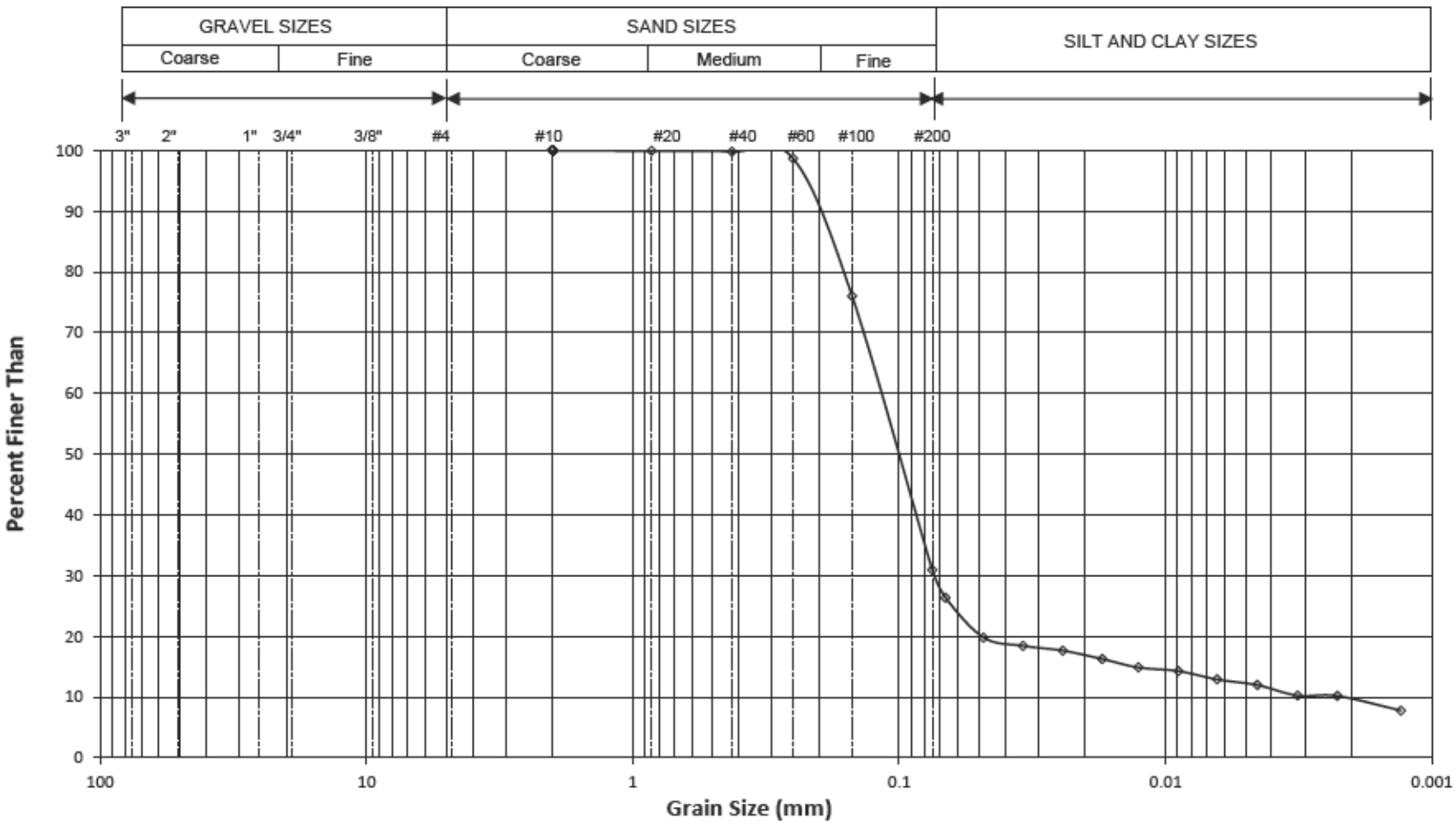
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0669	26.4
Sodium Hexametaphosphate	0.0482	19.8
	0.0342	18.5
	0.0243	17.7
	0.0172	16.3
	0.0126	14.9
	0.0089	14.3
	0.0064	12.9
	0.0045	12.0
	0.0032	10.3
	0.0023	10.2
	0.0013	7.8

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	69	21	10

Remarks:



CERTIFIED BY CCIL Canadian Council of Independent Laboratories For specific tests as listed on www.ccil.com

Drawing No.

APPENDIX C-21

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD
P. MACHIBRODA ENGINEERING LTD.

PER Preston Schergevitch

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: April 29, 2021

Test Hole No.: 21-18

Sample No.: 209

Depth (m): 1.2

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	99.1
#60	0.25	97.6
# 100	0.15	67.3
# 200	0.075	21.0

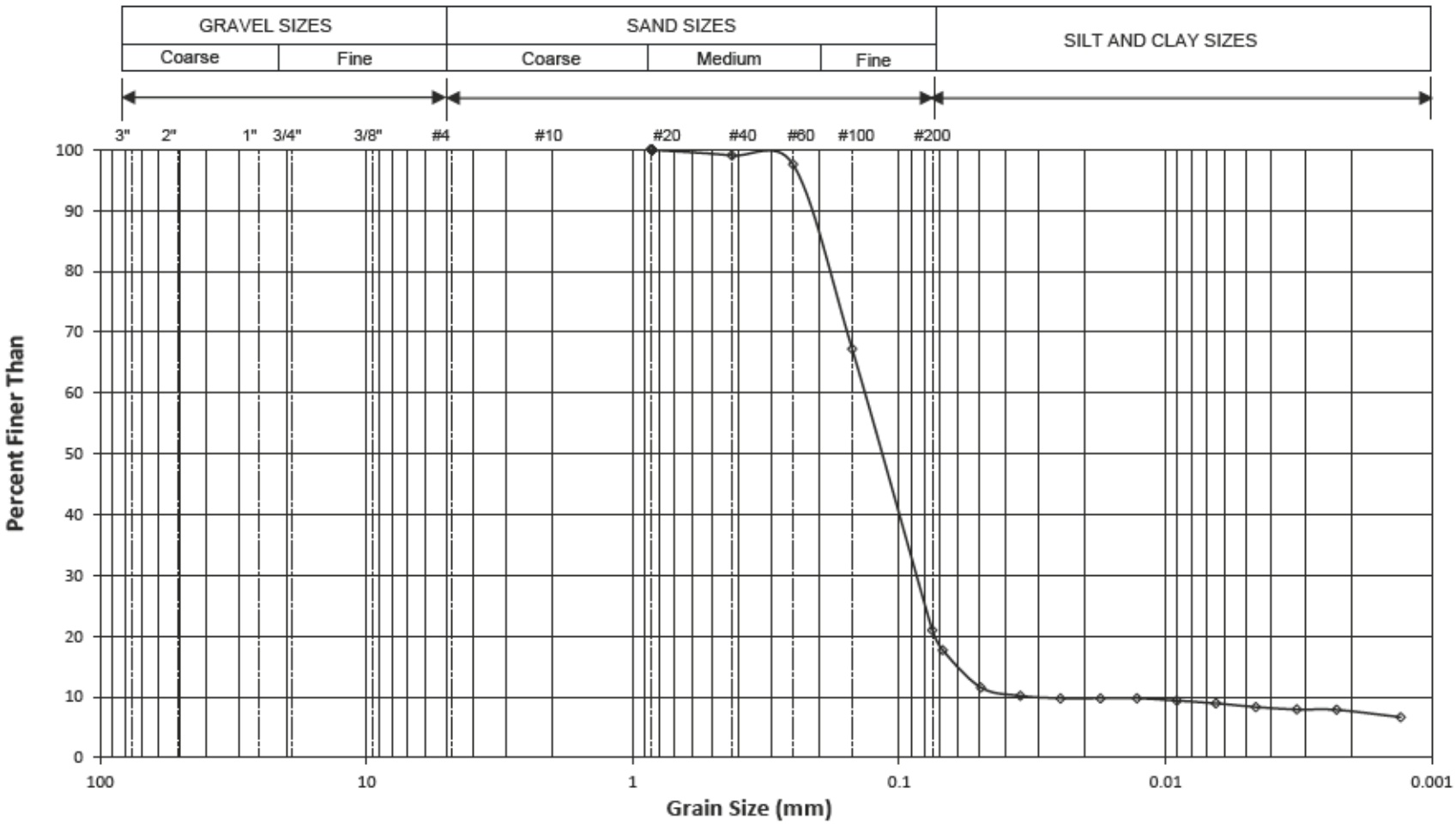
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0685	17.7
Sodium Hexametaphosphate	0.0493	11.6
	0.0350	10.2
	0.0248	9.8
	0.0175	9.8
	0.0128	9.8
	0.0091	9.4
	0.0065	9.0
	0.0046	8.4
	0.0032	8.0
	0.0023	7.9
	0.0013	6.7

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	79	13	8

Remarks:



CERTIFIED BY CCIL Canadian Council of Independent Laboratories For specific tests as listed on www.ccil.com

Drawing No.

APPENDIX C-22

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD
P. MACHIBRODA ENGINEERING LTD.

PER Preston Schergevitch

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: April 29, 2021

Test Hole No.: 21-19

Sample No.: 29

Depth (m): 1.2

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	99.9
#60	0.25	99.1
# 100	0.15	76.6
# 200	0.075	22.5

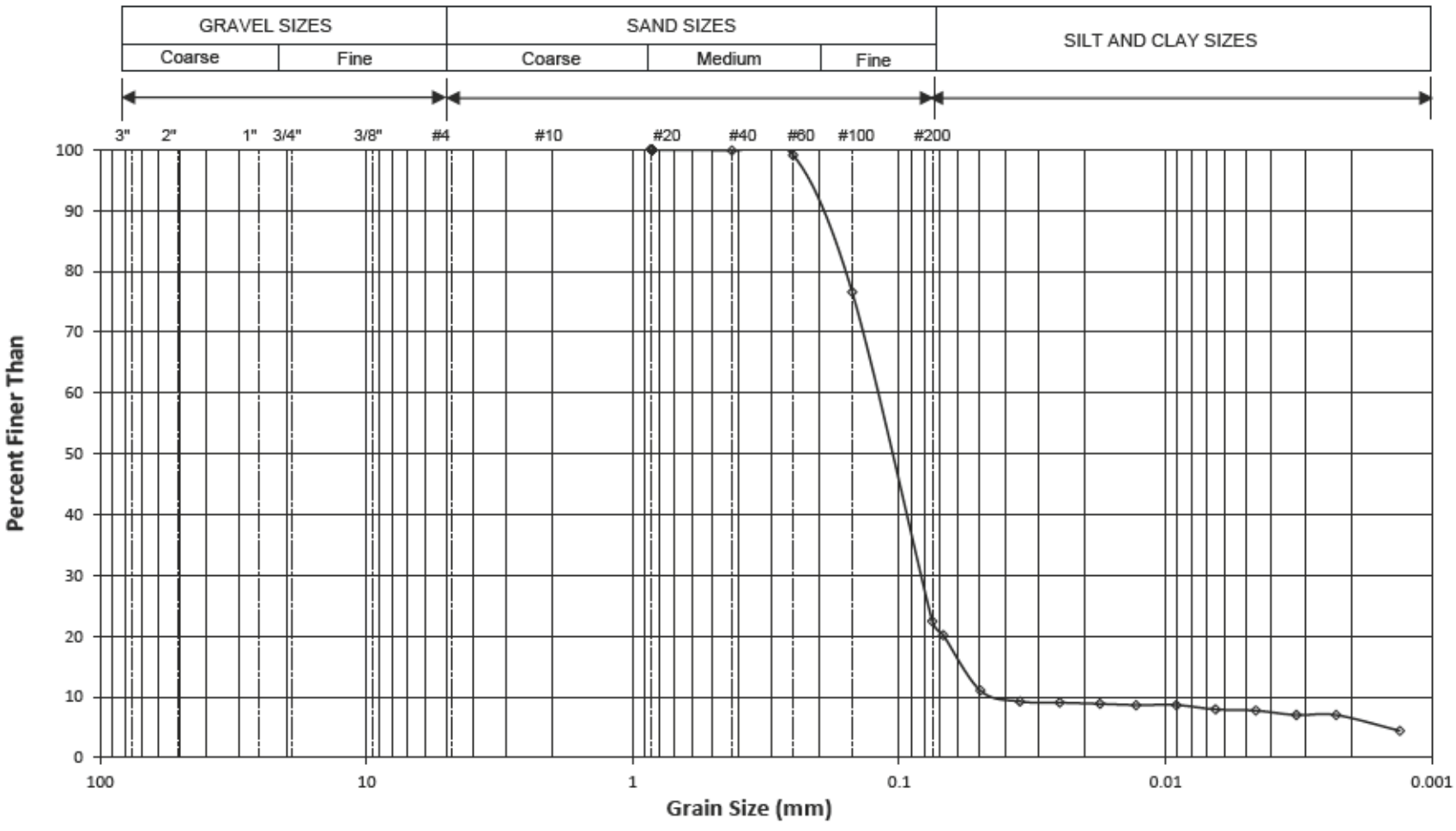
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0682	20.2
Sodium Hexametaphosphate	0.0495	11.1
	0.0352	9.3
	0.0249	9.1
	0.0176	8.9
	0.0129	8.7
	0.0091	8.7
	0.0065	8.0
	0.0046	7.8
	0.0032	7.0
	0.0023	7.0
	0.0013	4.5

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	77	16	7

Remarks:



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Drawing No.

APPENDIX C-23

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD
P. MACHIBRODA ENGINEERING LTD.

PER

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: May 3, 2021

Test Hole No.: 21-20

Sample No.: 201

Depth (m): 0.6

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	100.0
#60	0.25	99.0
# 100	0.15	75.3
# 200	0.075	25.9

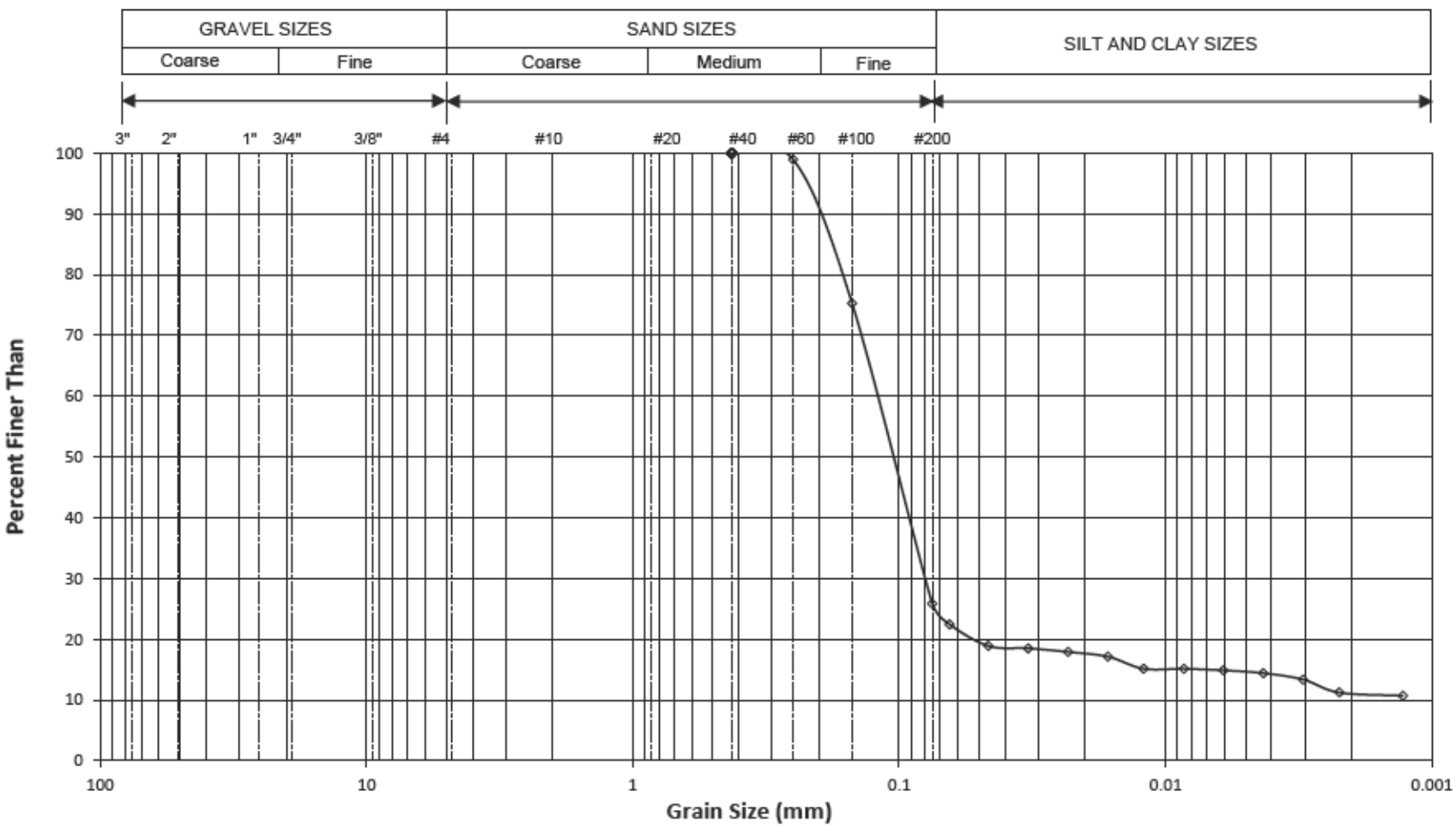
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0646	22.5
Sodium Hexametaphosphate	0.0462	18.9
	0.0327	18.5
	0.0232	17.9
	0.0164	17.1
	0.0121	15.2
	0.0085	15.2
	0.0061	14.9
	0.0043	14.4
	0.0030	13.4
	0.0022	11.2
	0.0013	10.7

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	74	15	11

Remarks:



CERTIFIED BY CCIL Canadian Council of Independent Laboratories For specific tests as listed on www.ccil.com

Drawing No.

APPENDIX C-24

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD
P. MACHIBRODA ENGINEERING LTD.

PER

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: April 29, 2021

Test Hole No.: 21-21

Sample No.: 3

Depth (m): 0.9

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	99.8
#60	0.25	99.0
# 100	0.15	72.6
# 200	0.075	19.5

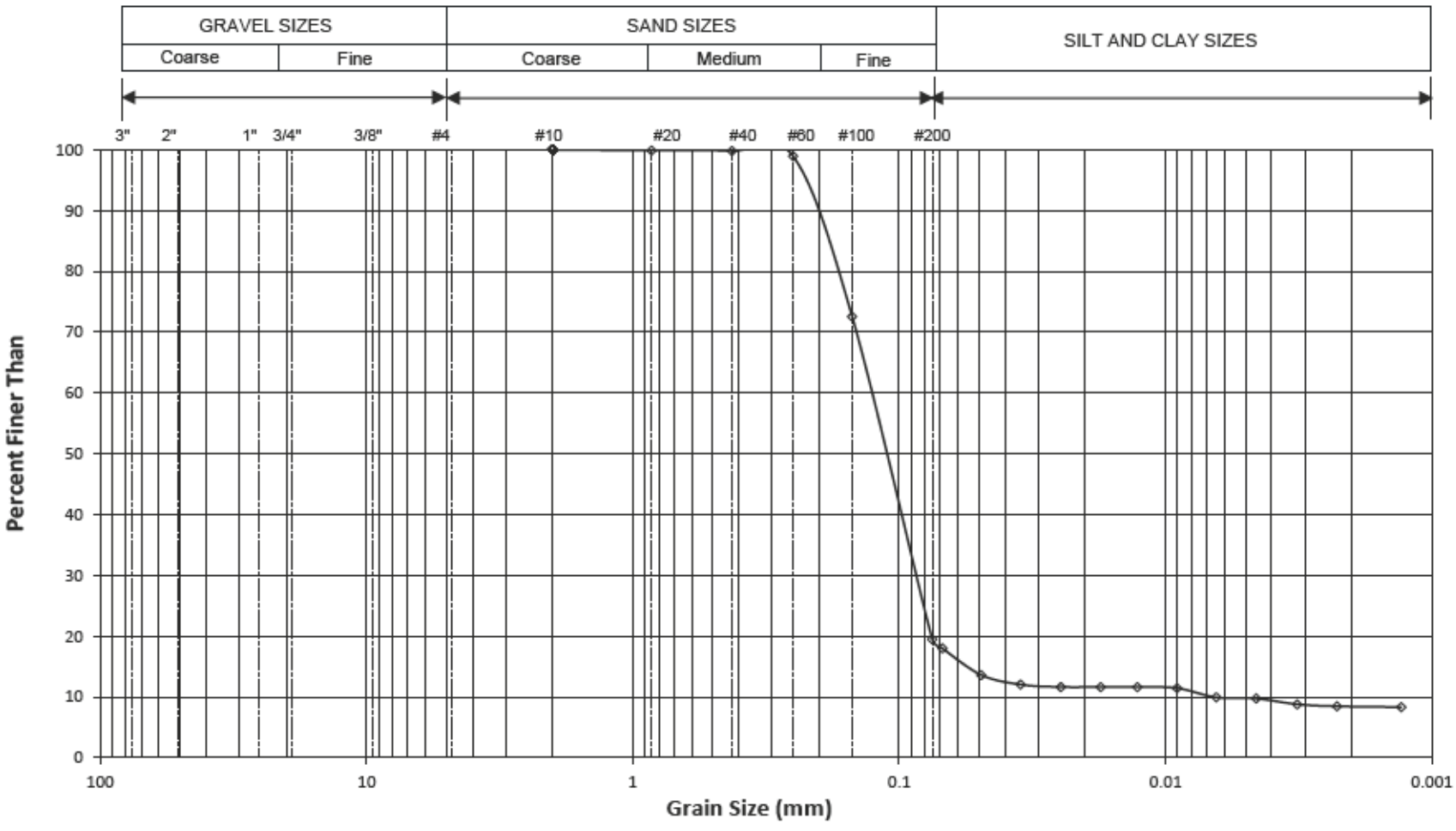
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0686	18.0
Sodium Hexametaphosphate	0.0491	13.6
	0.0349	12.1
	0.0247	11.7
	0.0175	11.7
	0.0128	11.7
	0.0090	11.5
	0.0064	10.0
	0.0046	9.8
	0.0032	8.8
	0.0023	8.5
	0.0013	8.3

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	80	11	9

Remarks:



CERTIFIED BY CCIL Canadian Council of Independent Laboratories For specific tests as listed on www.ccil.com

Drawing No.

APPENDIX C-25

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD
P. MACHIBRODA ENGINEERING LTD.

PER

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: April 29, 2021

Test Hole No.: 21-21

Sample No.: 11

Depth (m): 9.0-9.4

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	100.0
#60	0.25	99.9
# 100	0.15	95.8
# 200	0.075	66.4

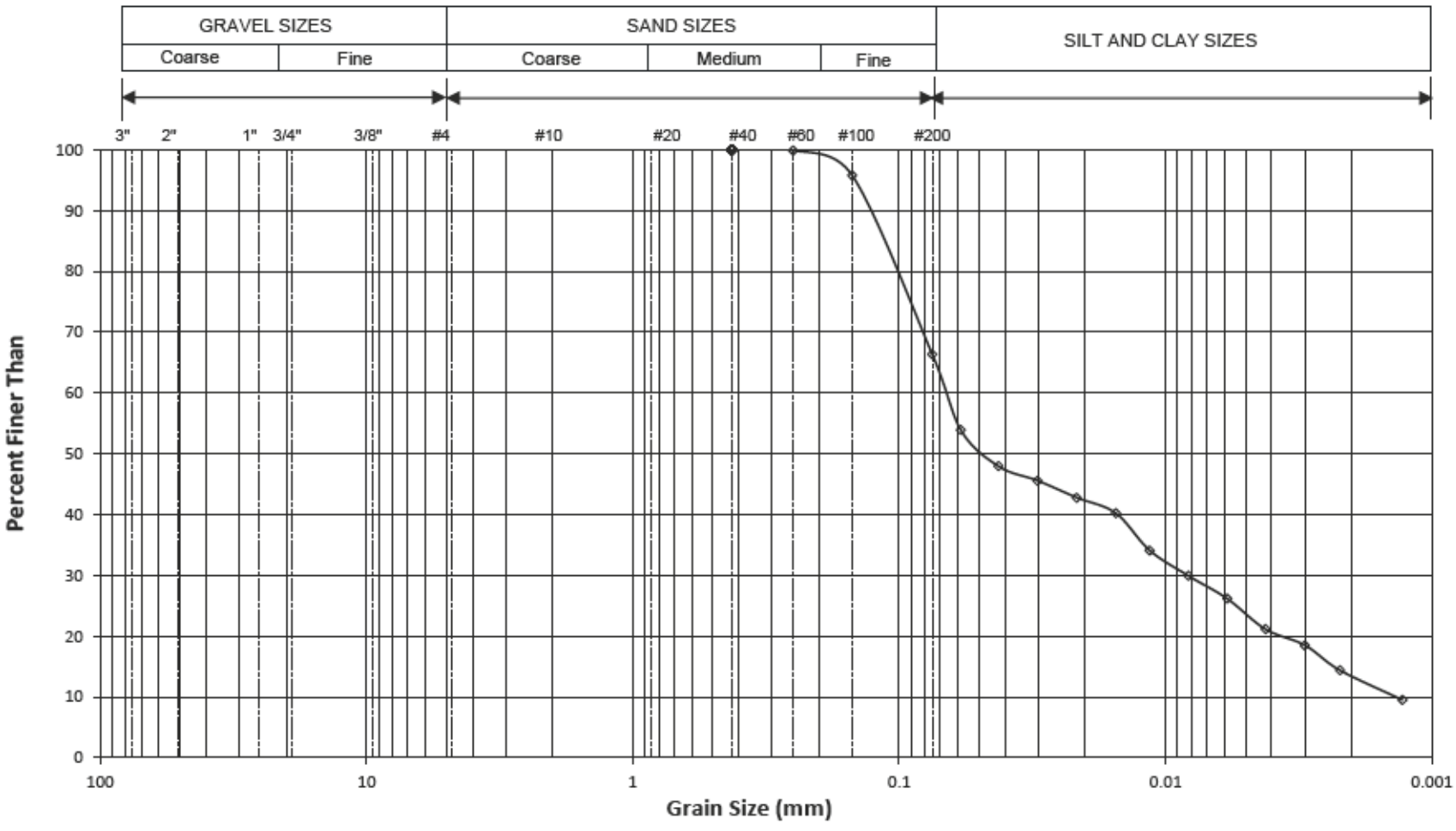
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0586	53.9
Sodium Hexametaphosphate	0.0423	48.0
	0.0302	45.6
	0.0215	42.8
	0.0154	40.2
	0.0114	34.1
	0.0082	29.9
	0.0059	26.2
	0.0042	21.2
	0.0030	18.5
	0.0022	14.4
	0.0013	9.5

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	34	52	14

Remarks:



CERTIFIED BY CCIL Canadian Council of Independent Laboratories For specific tests as listed on www.ccil.com

Drawing No.

APPENDIX C-26

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD
P. MACHIBRODA ENGINEERING LTD.

PER

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: April 27, 2021

Test Hole No.: 21-22

Sample No.: 168

Depth (m): 0.6

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	99.9
#60	0.25	98.6
# 100	0.15	69.6
# 200	0.075	29.7

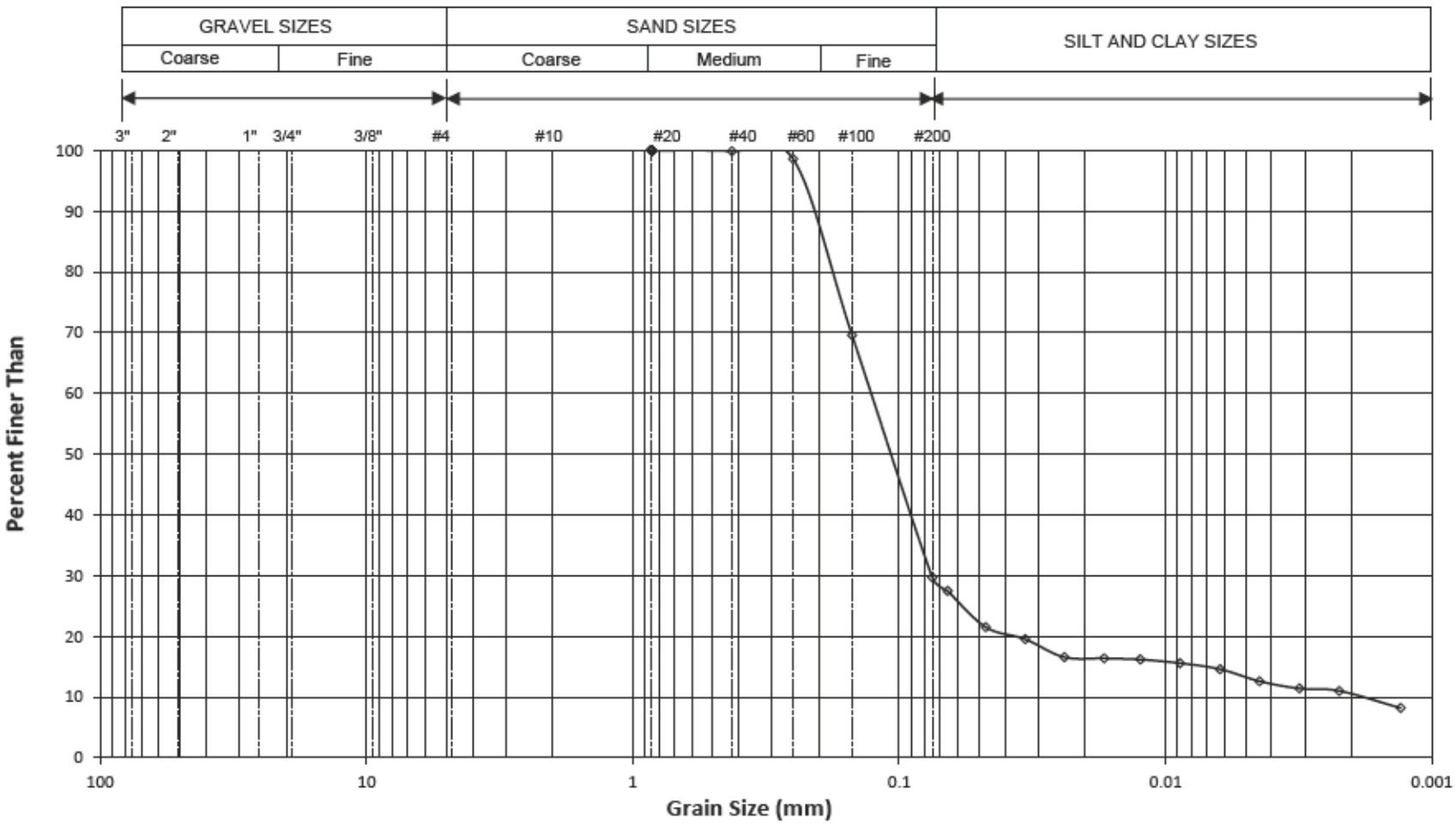
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0657	27.5
Sodium Hexametaphosphate	0.0473	21.5
	0.0336	19.6
	0.0240	16.6
	0.0170	16.4
	0.0124	16.2
	0.0088	15.6
	0.0062	14.6
	0.0044	12.6
	0.0031	11.4
	0.0022	11.0
	0.0013	8.2

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	70	19	11

Remarks:



CERTIFIED BY CCIL Canadian Council of Independent Laboratories For specific tests as listed on www.ccil.com

Drawing No.

APPENDIX C-27

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD
P. MACHIBRODA ENGINEERING LTD.

PER Preston Schergevitch

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: April 29, 2021

Test Hole No.: 21-23

Sample No.: 235

Depth (m): 1.5

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	99.9
#60	0.25	99.2
# 100	0.15	74.5
# 200	0.075	31.5

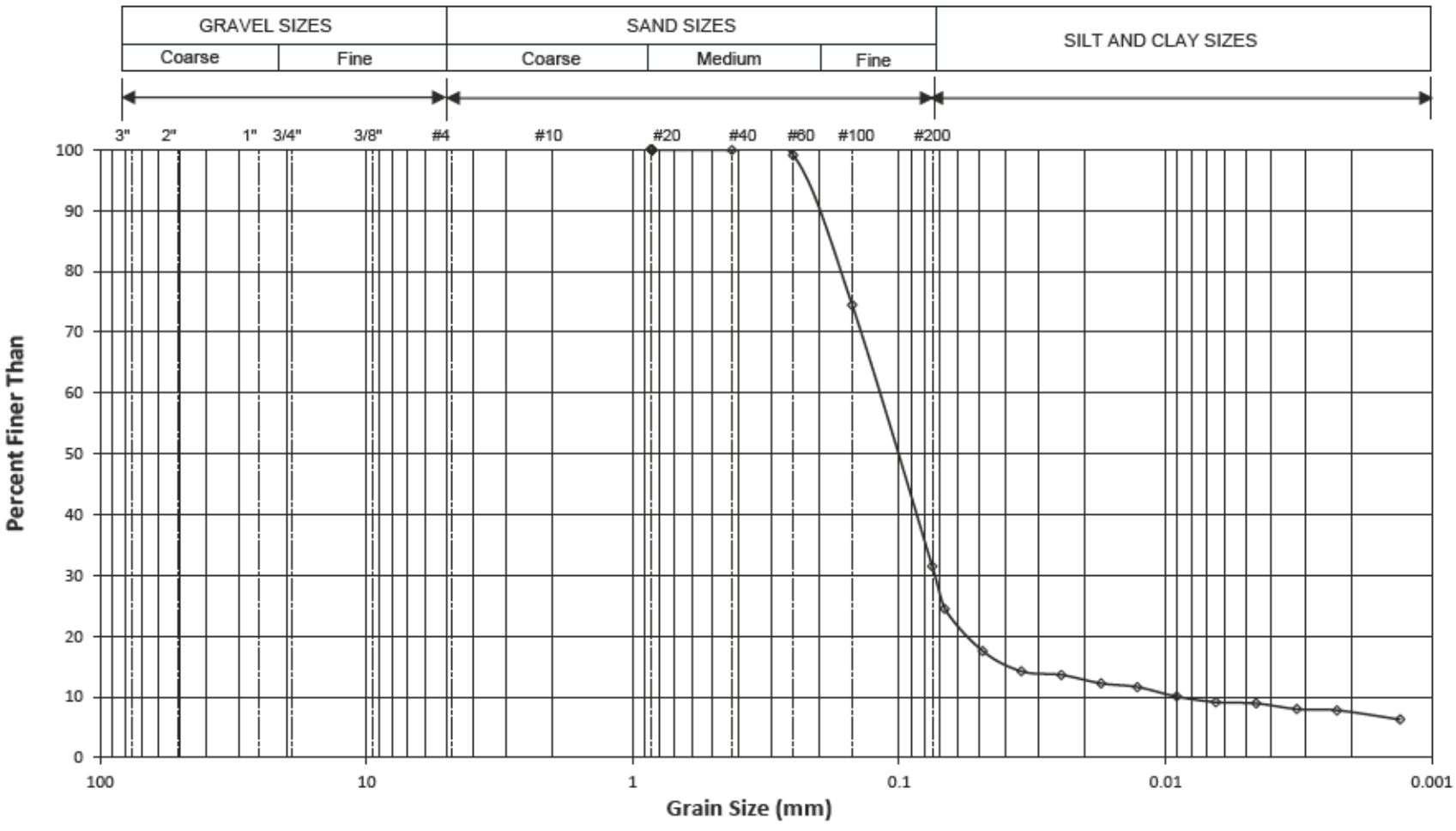
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0673	24.5
Sodium Hexametaphosphate	0.0486	17.6
	0.0347	14.2
	0.0246	13.6
	0.0174	12.3
	0.0128	11.7
	0.0091	10.1
	0.0065	9.2
	0.0046	9.0
	0.0032	8.0
	0.0023	7.8
	0.0013	6.3

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	68	24	8

Remarks:



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Drawing No.

APPENDIX C-28

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD
P. MACHIBRODA ENGINEERING LTD.

PER

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: April 28, 2021

Test Hole No.: 21-24

Sample No.: 243

Depth (m): 1.2

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	99.6
#60	0.25	96.7
# 100	0.15	35.0
# 200	0.075	14.5

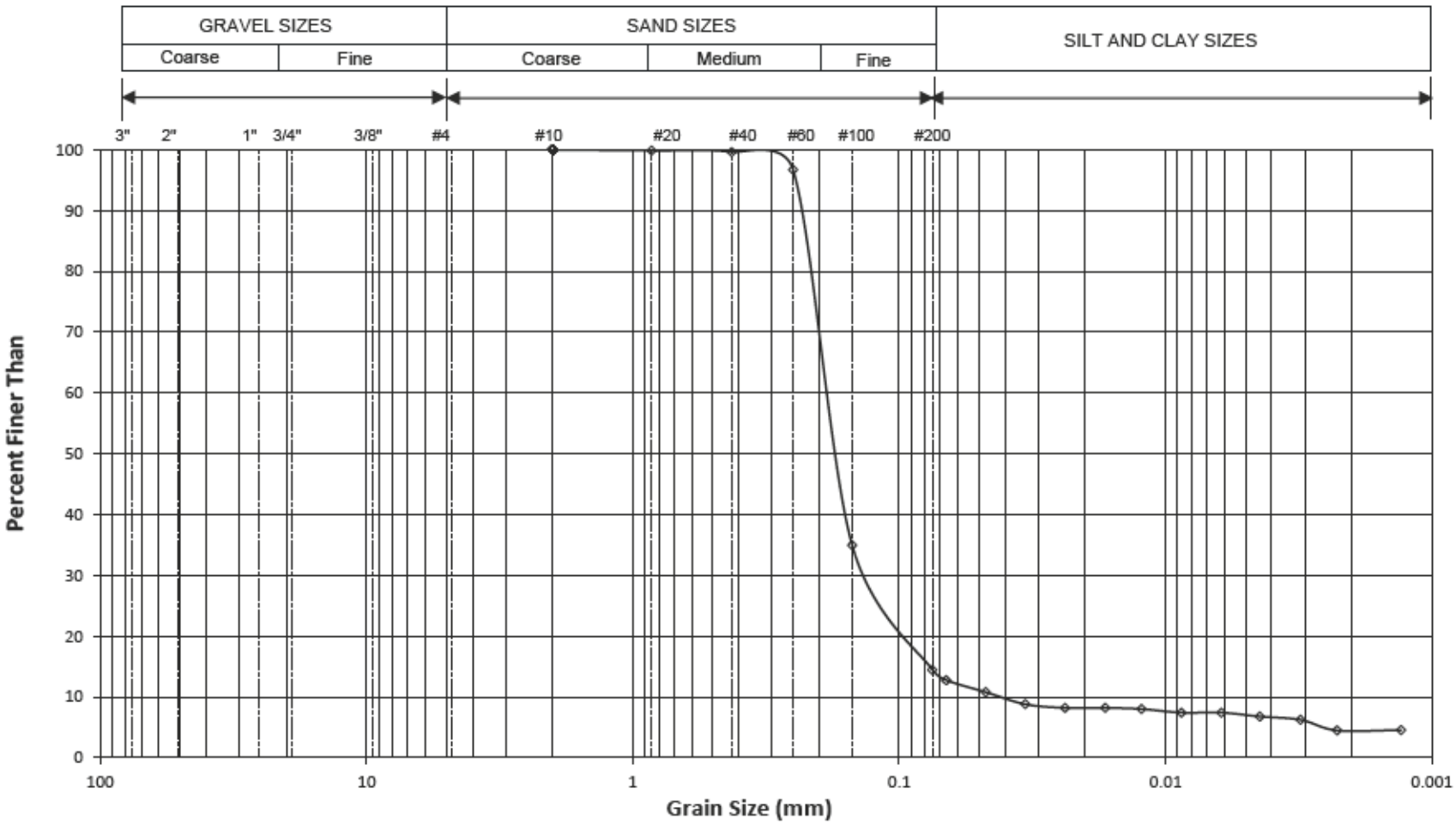
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0665	12.8
Sodium Hexametaphosphate	0.0472	10.8
	0.0336	8.8
	0.0238	8.2
	0.0168	8.2
	0.0123	8.0
	0.0087	7.4
	0.0062	7.4
	0.0044	6.8
	0.0031	6.3
	0.0023	4.5
	0.0013	4.6

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	85	10	5

Remarks:



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Drawing No.

APPENDIX C-29

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD
P. MACHIBRODA ENGINEERING LTD.

PER Preston Schergevitch

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: April 28, 2021

Test Hole No.: 21-25

Sample No.: 214

Depth (m): 0.6

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	99.9
#60	0.25	99.2
# 100	0.15	80.9
# 200	0.075	34.1

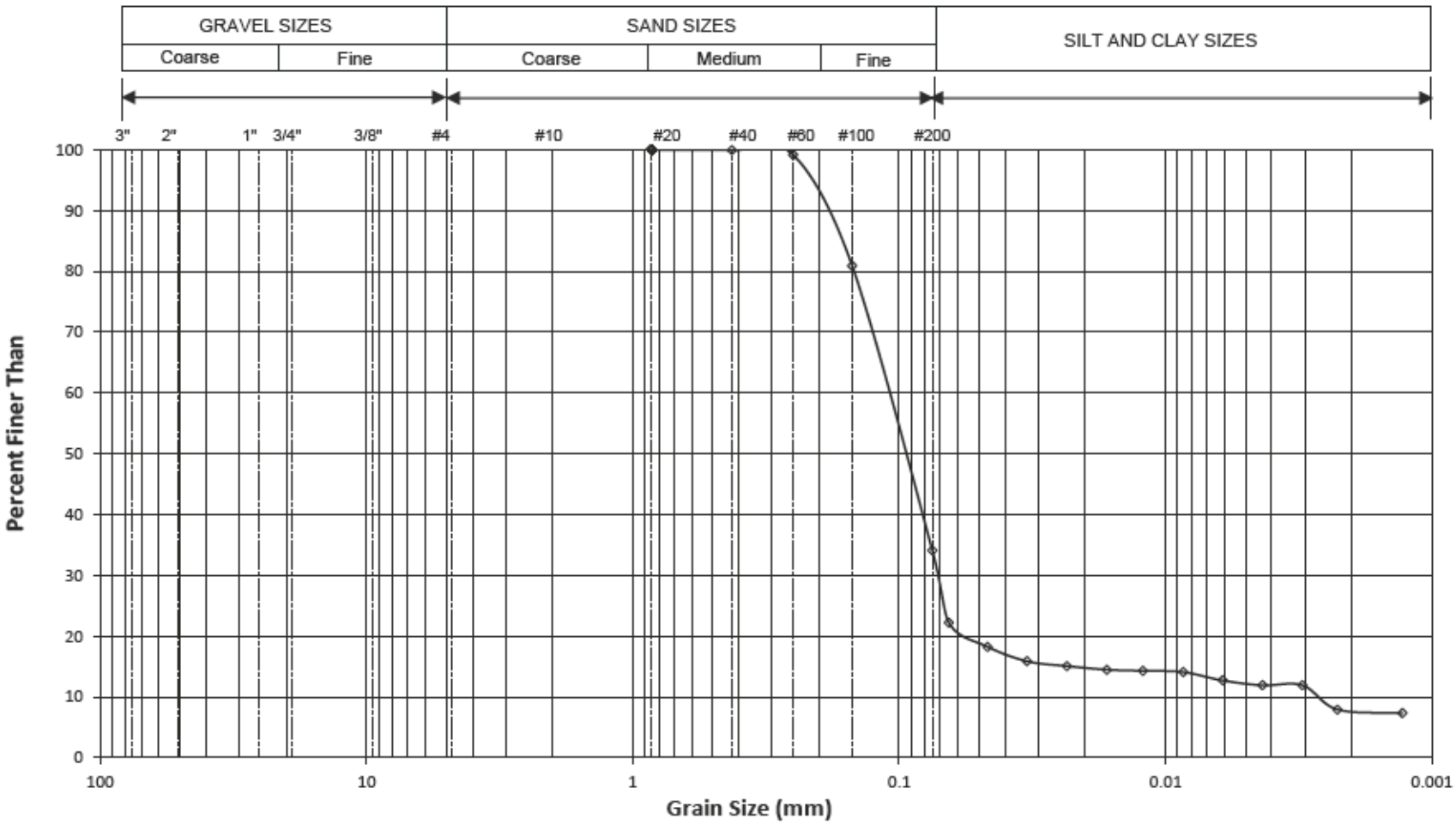
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0650	22.2
Sodium Hexametaphosphate	0.0465	18.3
	0.0331	15.9
	0.0234	15.1
	0.0166	14.5
	0.0121	14.3
	0.0086	14.1
	0.0061	12.7
	0.0043	11.9
	0.0031	11.9
	0.0023	7.9
	0.0013	7.3

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	66	26	8

Remarks:



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Drawing No.

APPENDIX C-30

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD
P. MACHIBRODA ENGINEERING LTD.

PER Preston Schergevitch

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: April 28, 2021

Test Hole No.: 21-25

Sample No.: 217

Depth (m): 3.0

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	99.8
#60	0.25	98.8
# 100	0.15	76.3
# 200	0.075	22.9

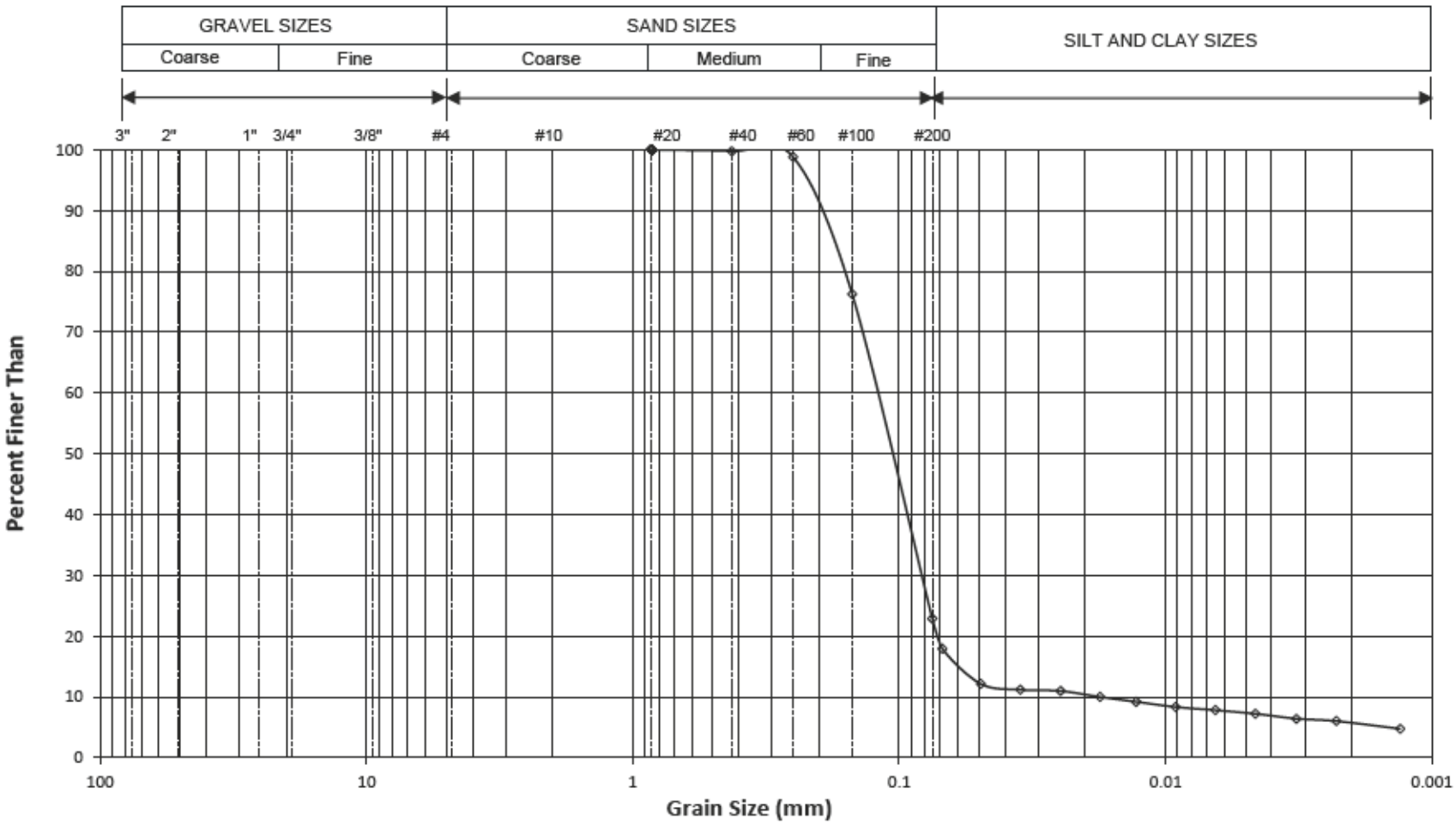
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0687	17.9
Sodium Hexametaphosphate	0.0494	12.2
	0.0350	11.2
	0.0248	11.0
	0.0176	10.0
	0.0129	9.2
	0.0091	8.4
	0.0065	7.8
	0.0046	7.2
	0.0032	6.4
	0.0023	6.0
	0.0013	4.8

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	77	17	6

Remarks:



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Drawing No.

APPENDIX C-31

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD
P. MACHIBRODA ENGINEERING LTD.

PER

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: April 28, 2021

Test Hole No.: 21-26

Sample No.: 210

Depth (m): 0.9

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	99.9
#60	0.25	98.9
# 100	0.15	71.5
# 200	0.075	16.4

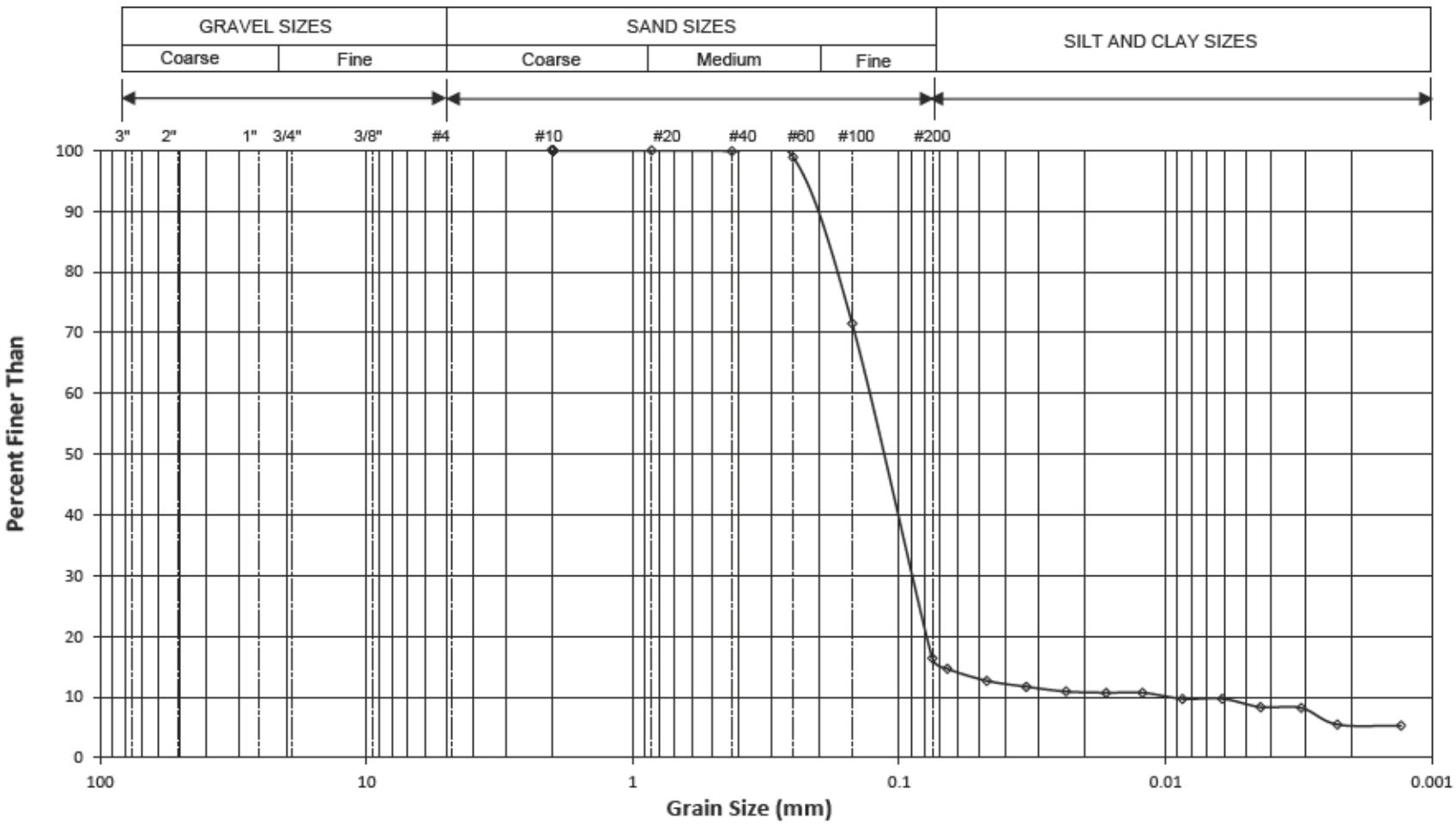
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0660	14.7
Sodium Hexametaphosphate	0.0469	12.7
	0.0333	11.7
	0.0236	10.9
	0.0167	10.7
	0.0122	10.7
	0.0086	9.7
	0.0061	9.7
	0.0044	8.4
	0.0031	8.2
	0.0023	5.5
	0.0013	5.3

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	84	11	5

Remarks:



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Drawing No.

APPENDIX C-32

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD
P. MACHIBRODA ENGINEERING LTD.

PER

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: April 29, 2021

Test Hole No.: 21-27

Sample No.: 201

Depth (m): 0.6

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	100.0
#60	0.25	99.6
# 100	0.15	83.4
# 200	0.075	28.5

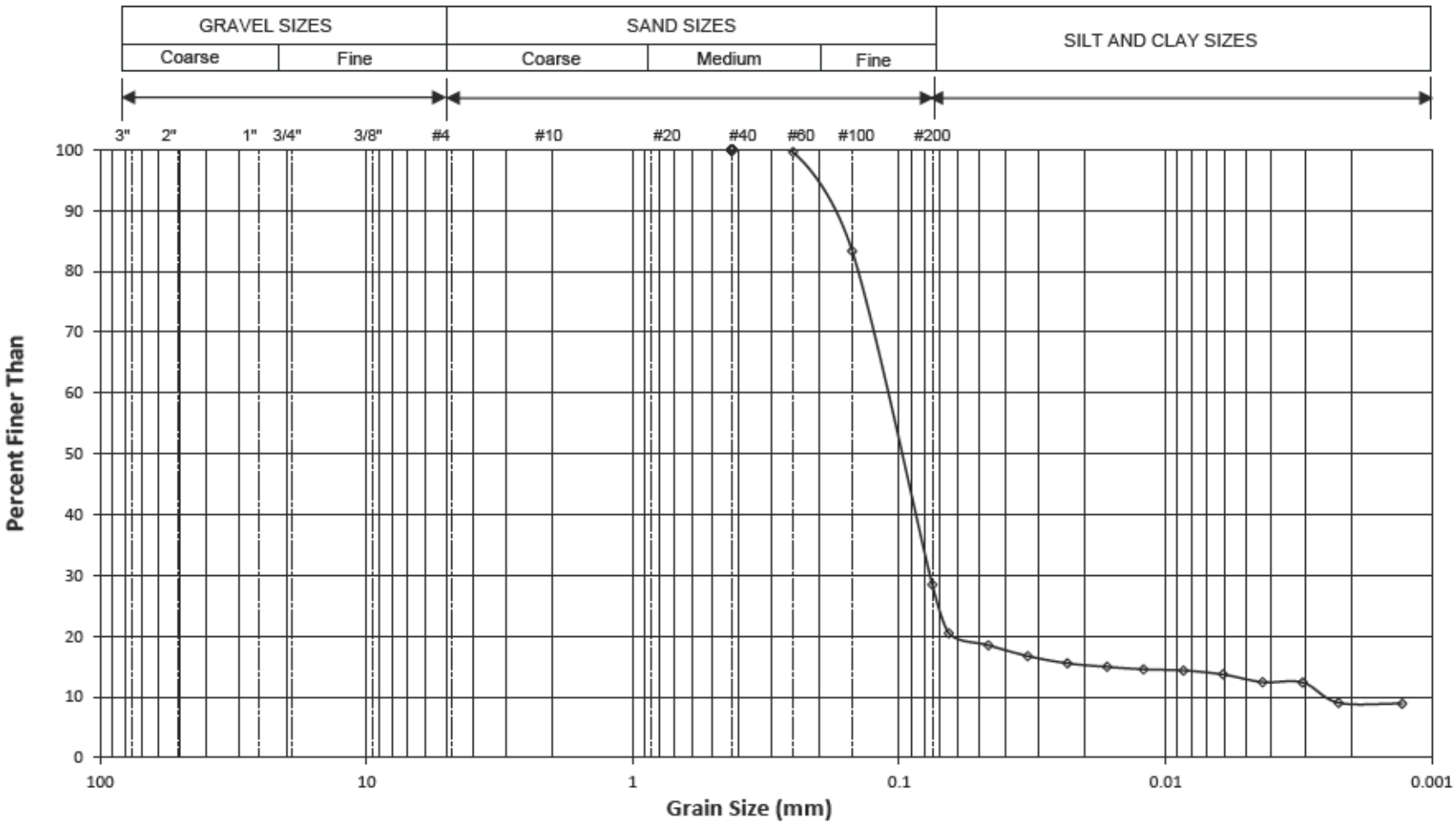
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0650	20.5
Sodium Hexametaphosphate	0.0462	18.5
	0.0329	16.7
	0.0233	15.6
	0.0165	15.0
	0.0121	14.6
	0.0085	14.4
	0.0061	13.7
	0.0043	12.5
	0.0030	12.4
	0.0022	9.1
	0.0013	8.9

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	71	20	9

Remarks:



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Drawing No.

APPENDIX C-33

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD
P. MACHIBRODA ENGINEERING LTD.

PER Preston Schergevitch

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: April 29, 2021

Test Hole No.: 21-28

Sample No.: 222

Depth (m): 1.2

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	99.9
#60	0.25	99.5
# 100	0.15	82.0
# 200	0.075	30.9

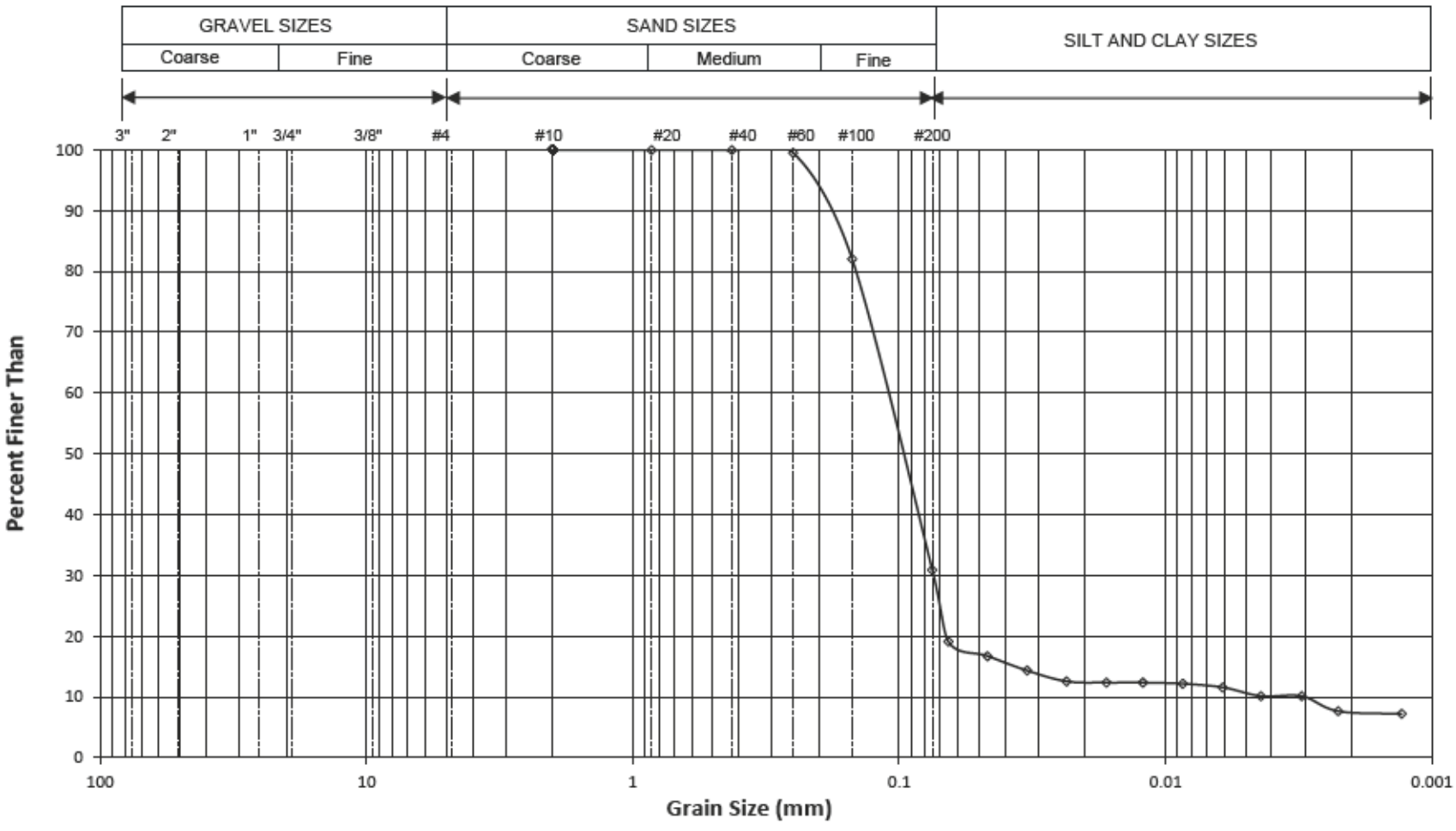
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0653	19.1
Sodium Hexametaphosphate	0.0465	16.7
	0.0331	14.4
	0.0235	12.6
	0.0166	12.4
	0.0121	12.4
	0.0086	12.2
	0.0061	11.6
	0.0044	10.2
	0.0031	10.2
	0.0022	7.7
	0.0013	7.2

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	69	23	8

Remarks:



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Drawing No.

APPENDIX C-34

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD
P. MACHIBRODA ENGINEERING LTD.

PER Preston Schergevitch

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: April 29, 2021

Test Hole No.: 21-28

Sample No.: 228

Depth (m): 9.0-9.4

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	99.6
#60	0.25	98.6
# 100	0.15	70.8
# 200	0.075	18.0

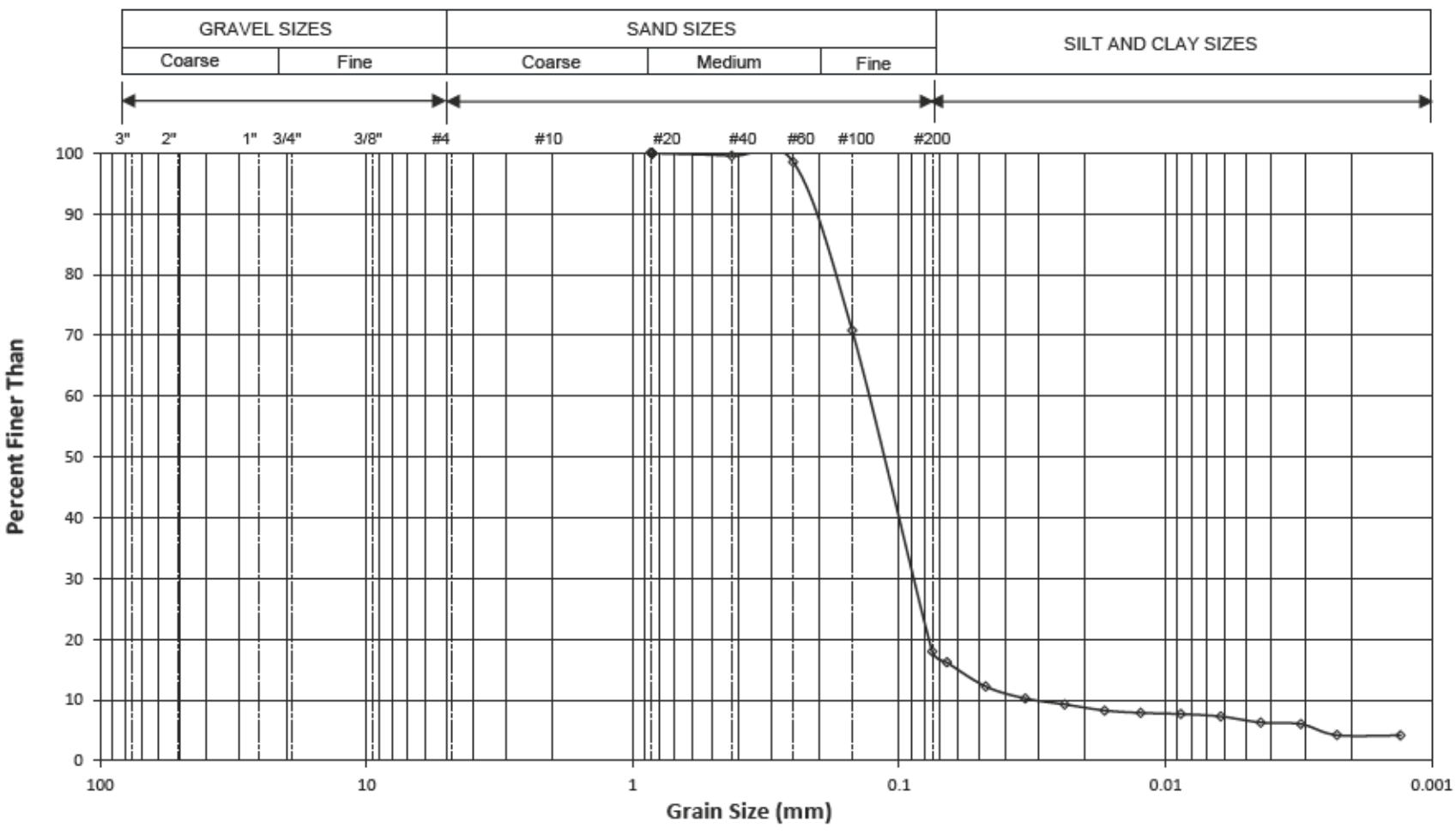
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0662	16.2
Sodium Hexametaphosphate	0.0473	12.3
	0.0336	10.3
	0.0238	9.3
	0.0169	8.3
	0.0124	7.9
	0.0087	7.7
	0.0062	7.3
	0.0044	6.3
	0.0031	6.1
	0.0023	4.2
	0.0013	4.2

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	82	14	4

Remarks:



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Drawing No.

APPENDIX C-35

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD
P. MACHIBRODA ENGINEERING LTD.

PER Preston Schergevitch

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: April 29, 2021

Test Hole No.: 21-29

Sample No.: 183

Depth (m): 1.5

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	99.9
#60	0.25	99.2
# 100	0.15	71.7
# 200	0.075	24.6

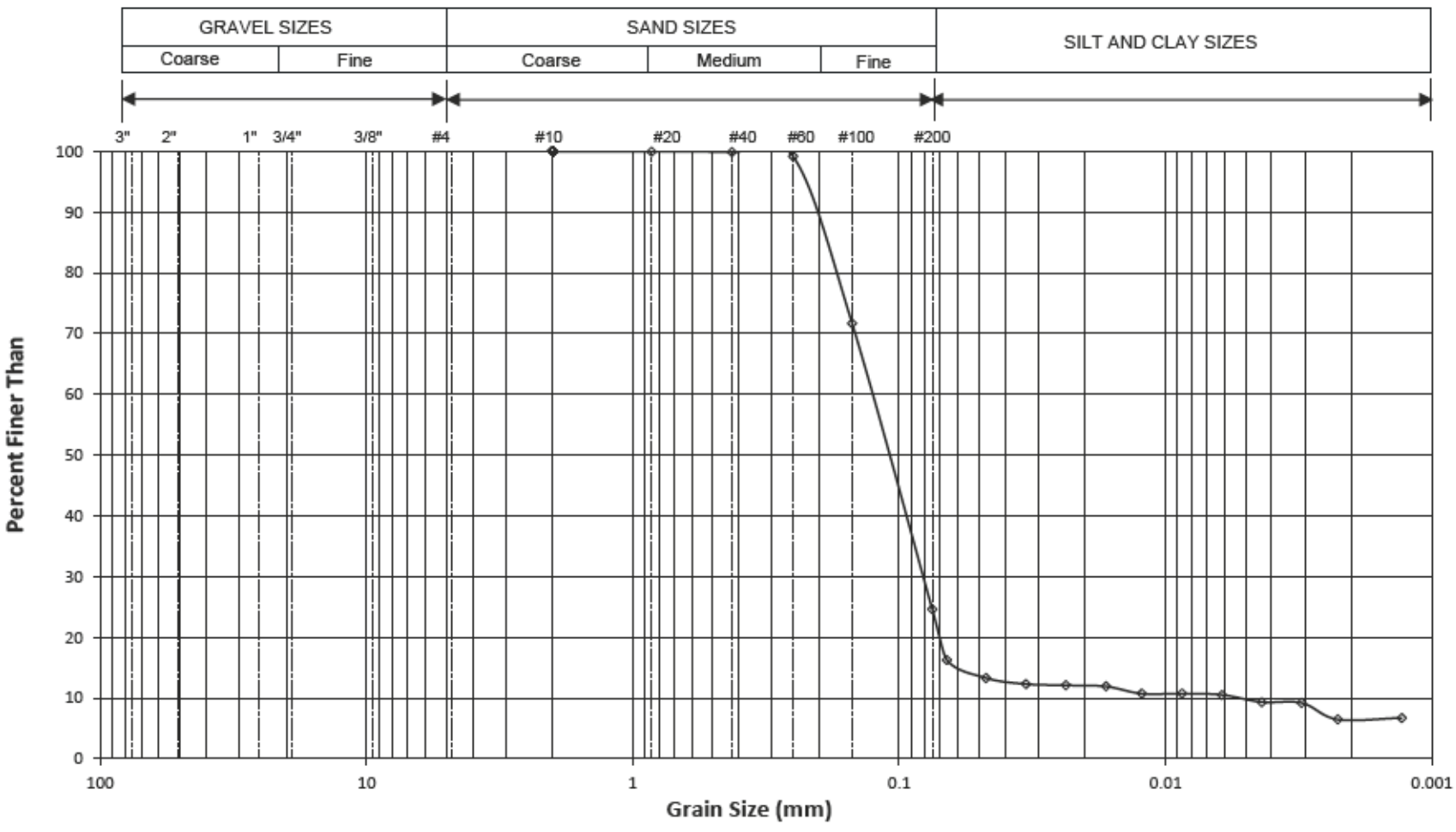
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0661	16.3
Sodium Hexametaphosphate	0.0471	13.3
	0.0334	12.3
	0.0236	12.1
	0.0167	11.9
	0.0123	10.7
	0.0087	10.7
	0.0061	10.5
	0.0043	9.4
	0.0031	9.2
	0.0023	6.5
	0.0013	6.7

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	75	18	7

Remarks:



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Drawing No.

APPENDIX C-36

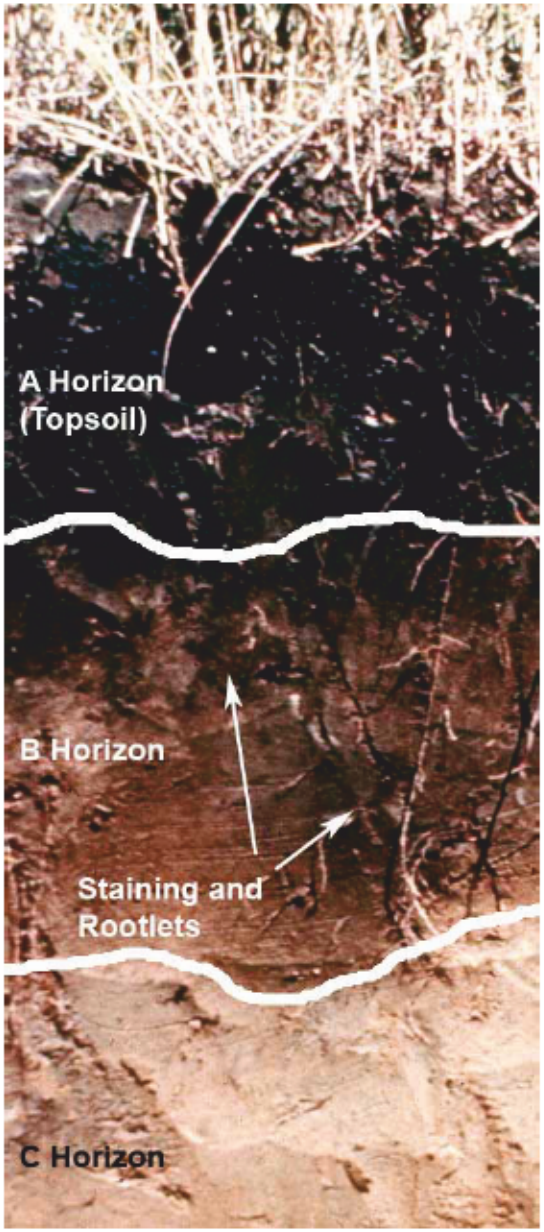
WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD
P. MACHIBRODA ENGINEERING LTD.

PER

APPENDIX D

Topsoil, Organic Matter
and Organics

P.MACHIBRODA
ENGINEERING LTD.



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 B - Correspondence

DUNDURN RURAL WATER UTILITY
PO BOX 442
DUNDURN SK S0K 1K0
Phone: 306-492-2566
Fax: 306-492-2564
E-mail: drwu@sasktel.net

February 17, 2022

Associated Engineering (Sask.) Ltd. *sent via e-mail*
1 – 2225 Northridge Drive
Saskatoon, SK S7L 6X6

Attn.: Mike Pawluski, Project Planner

RE: Development in the NE 13 – 35 – 5 – W3 and SE 24 – 35 – 05 – W3 (Greenview Estates)

The Dundurn Rural Water Utility would like to confirm the availability of treated potable water in principle for your new project. Details will need to be discussed prior to making any final commitment on water to be delivered. If we can supply water to this quarter section, we could supply 50 igpm.

The Developer (or representative) agrees to provide a Request for Service Form and the City of Saskatoon – Letter for Special Consideration Form as soon as possible.

The Utility will need to confirm that SaskWater will be able to provide the Dundurn Rural Water with the additional flow rate. The project also needs to be reviewed with our Engineering firm.

Thank you.

Yours truly,

DUNDURN RURAL WATER UTILITY

Rosalind Arndt (via e-mail)

Rosalind L. Arndt
Administrator

/rla

Mike Pawluski

From: Corman Park Police Service <police.service@rmcormanpark.ca>
Sent: Tuesday, December 14, 2021 9:10 AM
To: Mike Pawluski
Subject: RE: 2021-4570-00 - Greenview Estates CDR

Good morning,

The RM of Corman Park is enforced by a 2 tiered policing model. Corman Park Police enforce provincial statues and RM Bylaws and assist the RCMP. The RCMP hold the jurisdiction for all property / personal / and criminal enforcement with Corman Park Police assisting where required.

Saskatoon Detachment enforce the area south of the South Saskatchewan River and Warman Detachment enforce the area north of the South Saskatchewan River.

For confirmation of your question, you will need to get in touch with the Saskatoon Detachment.

Thank you,

Michelle

Michelle Graff
Executive Administraive Assistant
Corman Park Police Service
Phone: (306) 242-8808
Fax: (306) 975-1662
mgraff@rmcormanpark.ca

From: Mike Pawluski <pawluskim@ae.ca>
Sent: December 14, 2021 7:25 AM
To: Corman Park Police Service <police.service@rmcormanpark.ca>
Subject: 2021-4570-00 - Greenview Estates CDR

Good morning John,

My name is Mike Pawluski and I work for Associated Engineering.

We represent a client who has asked us to complete a Comprehensive Development Review (CDR) for the RM of Corman Park. One of the requirements for the CDR is consultation with protective service agencies to confirm they have the capability/capacity to service the proposed development. Our development is located on the NE 13-35-05-W3M and the SE 24-35-05-W3M along Highway 11, within the RM of Corman Park.

Would you please confirm if the RM of Corman Park Police Service has the capability/capacity to service our clients proposed development within this location?

Attached is a draft concept plan design for the proposed development.

If you have any questions or comments, please feel free to contact us.

Regards,

Mike Pawluski, RPP, MCIP
Project Planner
Associated Engineering (Sask.) Ltd.
1 - 2225 Northridge Drive, Saskatoon, SK S7L 6X6
Tel: 306.808.3102

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You may unsubscribe from Associated's electronic communications at any time.

Mike Pawluski

From: Mike Pawluski <pawluskim@ae.ca>
Sent: Wednesday, February 2, 2022 3:20 PM
To: Beattie, Tori
Subject: RE: 2021-4570-00 - Greenview Estates CDR
Attachments: de0d17d7-8c3f-4837-9431-6574b16b0974.png

Good afternoon Tori,

Let's do Monday, February 7th at 1.

Thank you.

Mike Pawluski

From: Beattie, Tori [mailto:Tori.Beattie@Saskatoon.ca]
Sent: Wednesday, February 2, 2022 3:15 PM
To: Mike Pawluski <pawluskim@ae.ca>
Subject: RE: 2021-4570-00 - Greenview Estates CDR

Good afternoon Mike,

Thank you for reaching out with the draft layout of Greenview Estates.
Our Deputy Fire Chief Rob Hogan would like to setup a quick meeting with you to discuss this further.

Would Monday Feb 7th work at either 1:00pm or 2:00pm?

Let me know and I will send out a teams invite.

Thank you!

Tori Beattie | 306-975-2722
Secretary III
Saskatoon Fire Department
125 Idylwyld Drive South | Saskatoon, SK S7M 1L4
Treaty 6 Territory and Homeland of the Metis
tori.beattie@saskatoon.ca
www.saskatoon.ca

From: Mike Pawluski <pawluskim@ae.ca>
Sent: Wednesday, February 2, 2022 09:03
To: Web E-mail - Saskatoon Fire Department <Saskatoon.Fire@Saskatoon.ca>
Subject: 2021-4570-00 - Greenview Estates CDR

[Warning: This email originated outside our email system. Do not click links or open attachments unless you recognize the sender and know the content is safe.]

Hello,

My name is Mike Pawluski, I work for Associated Engineering.

We represent a client who has asked us to complete a Comprehensive Development Review (CDR) for the RM of Corman Park. One of the requirements for the CDR is consultation with fire protection services to confirm they have the capability/capacity to service the proposed development. Our development is located on the NE 13-35-05-W3M and the SE 24-35-05-W3M along Highway 11, within the RM of Corman Park. We understand the RM and City of Saskatoon Fire Department have an agreement in place for fire services in this area. The development includes 95 country residential lots and 4 commercial properties (see attached draft lot layout).

As a part of our due diligence, we are contacting the Saskatoon Fire Department to determine how you would respond to an emergency event at the proposed development site? Which Fire Hall would provide the service? What equipment would attend the emergency event? Any other details you can share would be helpful.

If you have any questions, kindly contact me.

Regards,

Mike Pawluski, RPP, MCIP
Project Planner
Associated Engineering (Sask.) Ltd.
1 - 2225 Northridge Drive, Saskatoon, SK S7L 6X6
Tel: 306.808.3102

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Financial and Consumer Affairs Authority of Saskatchewan
Consumer Protection Division
601-1919 Saskatchewan Drive
Regina, Saskatchewan S4P 4H2

March 31, 2022

Associated Engineering
2225 Northridge Drive #1
Saskatoon, Saskatchewan S7L 6X6
ATTN: Mike Pawluski

Dear Mike Pawluski,

SUBJECT: Your Inquiry regarding a residential development near a Crematorium

I am writing with respect to your inquiry received by our office dated March 29, 2022, in which you requested information involving potential setbacks from a residential development as it pertains to Prairieview Chapel and Crematorium, located on Highway 11.

During a subsequent phone conversation on March 30, 2022, you indicated that a client was planning the development of a neighbouring property and sought guidance as to whether there would be any legislative obstacles related to the crematorium and its proximity to the planned development. I can confirm that *The Funeral and Cremation Services Act* and its regulations are silent on this aspect and there are no requirements under the Act as you described them during our phone call.

Trusting this provides the clarification you were looking for. Any follow-up questions or inquiries can be directed to the email address from which you received this correspondence.

Regards,

Shawn Cook, Director of Enforcement
Consumer Protection Division

Loraas Disposal Services Ltd.

Associated Engineering (Sask.) Ltd.
1 – 2225 Northridge Dr.
Saskatoon, Sk. S7L 6X6

May 6, 2022

Attn: Mike Pawluski

Please accept this letter stating that Loraas Disposal can offer waste and recycle service removal from a new residential development with 100 lots located at SE 24-35-5-W3M and NE 13-35-5-W3M.

Thank You,

Heather Button

Heather Button
Inside Sales Representative
Loraas Disposal Services Ltd.

Mike Pawluski

From: Cook, Shawn FCAA <shawn.cook@gov.sk.ca>
Sent: Thursday, March 31, 2022 12:20 PM
To: Mike Pawluski
Subject: Crematorium Inquiry
Attachments: Letter to Associated Engineering.pdf

Good afternoon Mike,

Please find the attached letter as requested, in relation to yesterday's phone conversation.

Regards,

Shawn Arlington Cook, Director of Enforcement
Financial and Consumer Affairs Authority of Saskatchewan
Consumer Protection Division
601 -1919 Saskatchewan Drive
Regina, Canada S4P 4H2



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May 2, 2022

To: Michelle Chuhanuik, Corman Park Planning Division

Attn: Jonathan Abrametz, Mike Pawluski, Leah Cawood

From: Brent and Stacy Bly

Re: Greenview Estates Proposal

Greetings,

After attending the Public Open House that was hosted by the Developer of this project on April 27th we were made aware of the plan to avoid Baker Road as one of two entrance/exit points to Highway 11, with the second entrance/exit being the existing Prairie View Road to Highway 11 intersection.

The new proposal which had not been discussed with me at a previous meeting with the developers has shifted the other entry/exit to Victor Road. This decision raises some concerns for our family farm. Prairie View Road along SE/SW 13-35-5 W3rd to Victor Road intersections has always been a very lightly used grid road mainly because it was established over 60 years ago to provide access to farm land. Prairie View Chapel and Crematorium also was established on this stretch of road. There has been really no reason for any non-farmers or Prairie View Chapel visitors to use this roadway. Victor Road is larger, wider and a shorter distance for everyone else with a large intersection and existing turn/ merge lanes to Highway 11.

With this situation existing and the Bly Family owning land on either side of Prairie View Road, our farm yard and dwellings were established approximately 50 meters from Prairie View Road in 1960.

Our concerns are obvious with vehicle/truck traffic from this proposed large, dense development with commercial frontage on Prairie View Road. Currently there is no speed limit signage and of course the road is a grid; noise, dust and the road type (narrow, low) would need to be addressed. A greater concern would be for safety reasons. SB Bly Farms Ltd. is a substantial farm which has very large machinery, semi-trucks/trailers, tandem trucks, etc. routinely using Prairie View Road to enter/exit our farm yard and go both North, South to access farm land in the municipalities. Increased traffic, dust and road type/size is a serious concern for our business/family and employees.

Brent Bly

Stacy Bly

To: Mike Pawluski, RPP Associated Engineering

pawluskim@ae.ca
306-808-3102
306 280-7209.

Greenview Estates
Open House Comments
April 27/2022

1. Lighting on all development sites:

- Keep all lighting "downward" to prevent light pollution - educate home owners as well Make this an architectual control.

2. Water

- Our existing yard and aquaculture operation relies on good quality ground water and must not be compromised.
- The proposed "trout pond" must not be allowed to dig down to the water table to be a source of water. as much evaporation, will only waste this resource. The loss of ~~water~~ water out weighs only trout pond.
- Also if you dredge this pond to deepen it, what safety design measures will be put in place to keep a "dug out" type of pond - a safe place to be at. Risk of drowning is a concern for your residents and visitors alike.

Continued →

Water Continued.....

· I support this development accessing the piped in Dundurn water utility to be used by residents.

· I would not support all 96 lots digging wells and sandpoints with out any assurances from the developer, or RM Corman Park that existing neighbours have there ground water compromised.

* Water conservation + use must be considered in yard development
* Ground water is not an endless supply and quality can change with over use.

3. Tree Screening and Shelter Belt (West Side of development)

*Shelter belt should be put in now by developer to protect the lots on west border to provide protection for the future yards. Benifits are immense and would enhance sales and comfort to home owners. Plus, existing residents to the east of development would not have to see the multi-parcel development to the east. This is a huge change to the country views we currently enjoy and set out to experience when we developed our yards in the country. Your development drastically changes our "Green View" when we look to the east in the future! Be considerate please.

4 Agriculture Practices

- The current farming practices + operations must not be negatively affected by the development and future residents, eg: continued use of herbicides + pesticides

- Education + transparency should be the responsibility of the developer and RM. and make future/potential buyers aware.

- Respectfully submitted.

Thank you

Plus....

5. - Keep the natural bluff directly east of the existing crematorium on Prairie Lane, as it is habitat/home for much wildlife + birds. There is a small dug out - that is used as a watering hole for this wildlife. Very essential, please do not destroy it.
The dug out watering hole - is on the west side of Prairie Lane in line with the Pet Crematorium.

3 of 3. Thank you.

Prairie View Chapel and Crematorium Family Pet Cremation Services
Saskatoon Crematorium Ltd.
Hwy. 11 South at Prairie View Road 333, 4th Ave. N. Saskatoon, SK S7K 2L8
P 306-244-5577 F 306-665-1095 E bill@saskatoonfuneralhome.com

Johathan Abrametz - Developer
C/O
Mike Pawluski
Associated Engineering
1-2225 Northridge Drive
Saskatoon, SK
S7L 6X6

Dear Sirs:

RE: Proposed Rezoning and Subdivision of Land
Rural Municipality of Corman Park #344
NE 13-35-05-W3M & SE 24-35-5-W3M Hwy 11 South.

We have received a package from Associated Engineering regarding the above reference proposed rezoning, land subdivision and development and as direct neighbours to this work are herewith registering concerns.

One concern is with the proposed access point to Hwy 11. This large and small lot residential development along with the commercial sites will generate a significant increase in the amount of vehicular traffic. The access point at Prairie View Road will create a very dangerous and predictably life threatening situation with vehicles attempting exit and access Hwy 11. Particularly north bound vehicles having to slow down and stop attempting a left turn across the south bound highway lanes as well as vehicles attempting to access the highway to head north towards Saskatoon. Has there been review and approval by the Provincial highways authority? It would appear that the proposal is to use this small highway access and the current small Prairie View grid road as the only access route. The use of the Baker Road intersection and an access service road parallel to Hwy 11 would seem much more logical and safe.

Another, very real concern is the fact that we are a long established service provider of funeral and cremation services on our property directly adjacent to the proposed rezoned land and development. We are officially Recognized and Approved by the Saskatchewan Ministry of Environment as a Source of Emissions pursuant to the Environmental Management and Protection Act 2010 Approval No. PO19-257. In this regard it is incumbent that the developer understand the implications of this and that it be made clear to and acknowledged by all potential and real property purchasers or renters regarding the nature and impact of our current established and future expanded operations. Considering this may affect perceived property value and desirability it may well have an impact on your design and the land use being proposed directly adjacent.

We would be pleased to discuss our concerns at any time.

Respectfully submitted,

Wm.A.Edwards
President

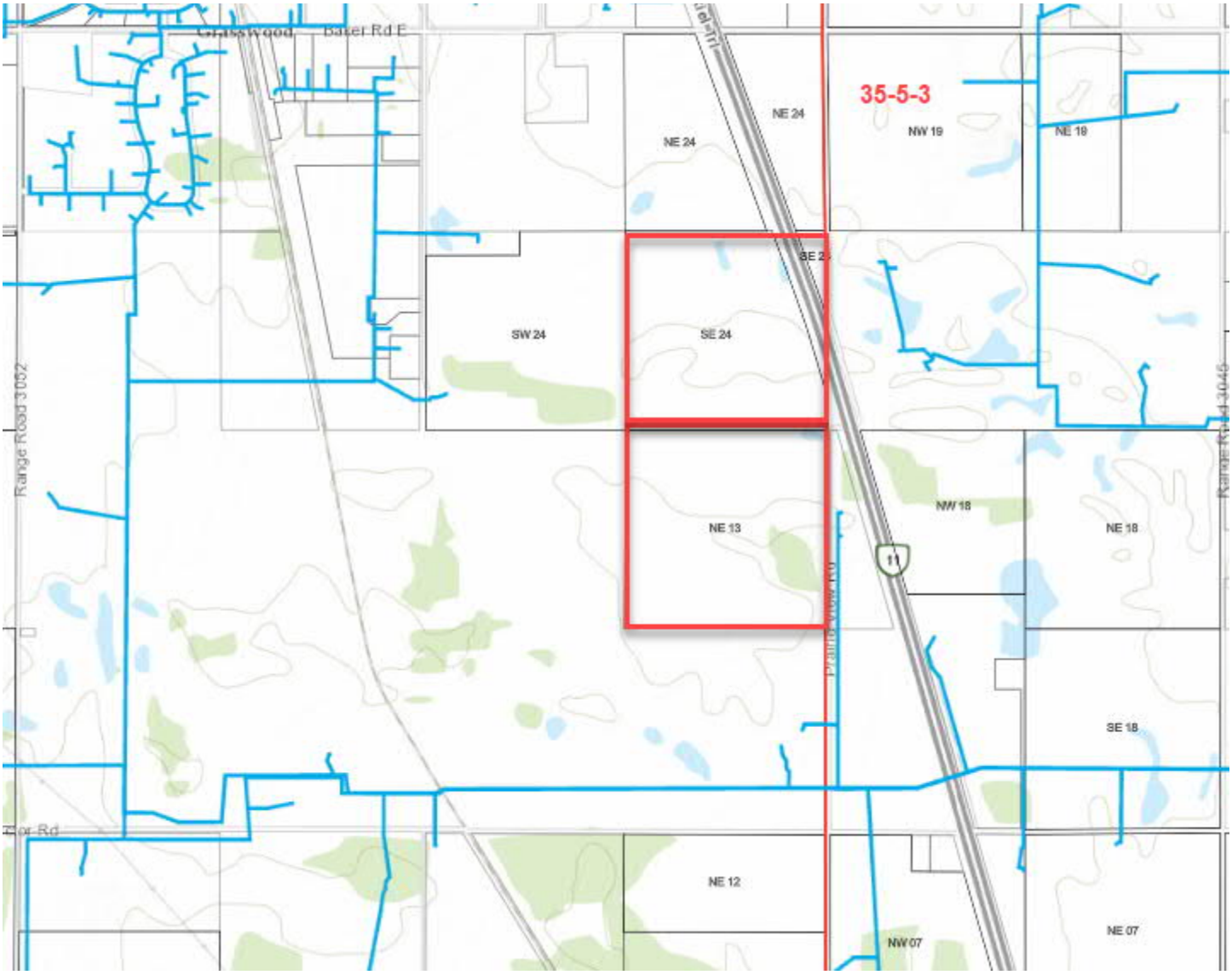
CC: Rural Municipality of Corman Park # 344
Saskatchewan Ministry of Environment, Environmental Protection Branch

Mike Pawluski

From: Brad Shotton <BShotton@saskenergy.com>
Sent: Thursday, April 21, 2022 10:24 AM
To: Mike Pawluski
Cc: Josh Inwood
Subject: RE: 2021-4570-00 - Greenview Estates CDR

Hi Mike,
I reviewed your development location and I can confirm that SaskEnergy has gas mains in the area and will be able to extend services into the proposed development. Please see attached screen shot for reference only. We would probably serve this development from the SE.
Note. Due to the number of lots (and a couple commercial lots), it is likely that we will need to do some looping in addition to the gas mains within the development. Please ensure you apply as soon as possible to make sure we can get the work done and meet your schedule.

Thanks for reaching out and let Josh or I know if you have any further questions. (Josh – business questions, me – design type questions).
Brad



Brad Shotton, P.Eng.
Senior Engineer, Distribution Engineering
SaskEnergy
408 – 36th Street East | Saskatoon, SK S7K 6K8
c. 306.281.4867
bshotton@saskenergy.com | saskenergy.com

From: Mike Pawluski <pawluskim@ae.ca>
Sent: Thursday, April 21, 2022 8:45 AM
To: Brad Shotton <BShotton@saskenergy.com>
Subject: 2021-4570-00 - Greenview Estates CDR

WARNING: This email was not sent from SaskEnergy. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Good morning Brad,

I was hoping you could help me by answering my questions below or directing them to someone else with SaskEnergy who can answer them. We represent a client preparing a comprehensive development review (CDR) report supporting a new multi-parcel country residential development approximately 6 kilometres south of Saskatoon along Highway 11 on the SE 24-35-5-W3M and the NE 13-35-5-W3M.

As part of the CDR, the RM of Corman Park requires a developer to confirm available energy services in the area. Can you confirm if SaskEnergy can extend services to this site? Are natural gas lines available in the area to offer additional services to a new multi-parcel country residential/commercial development with 100 lots? (see attached site plan)

Could you please provide an email or letter if SaskEnergy can service this residential/commercial development?

Note our client is in the early planning stages of this development and currently working towards obtaining municipal approvals to proceed with the subdivision. Construction of the project will occur at a later date following municipal approvals. If you need any additional information, please feel free to contact me.

Regards,

Mike Pawluski, RPP, MCIP
Project Planner
Associated Engineering (Sask.) Ltd.
1 - 2225 Northridge Drive, Saskatoon, SK S7L 6X6
Tel: 306.808.3102



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Mike Pawluski

From: Justin Bloor <Jbloor@saskpower.com>
Sent: Friday, April 22, 2022 2:05 PM
To: Mike Pawluski
Cc: Tina Ekert
Subject: FW: 2021-4570-00 - Greenview Estates CDR

Good afternoon Mike,

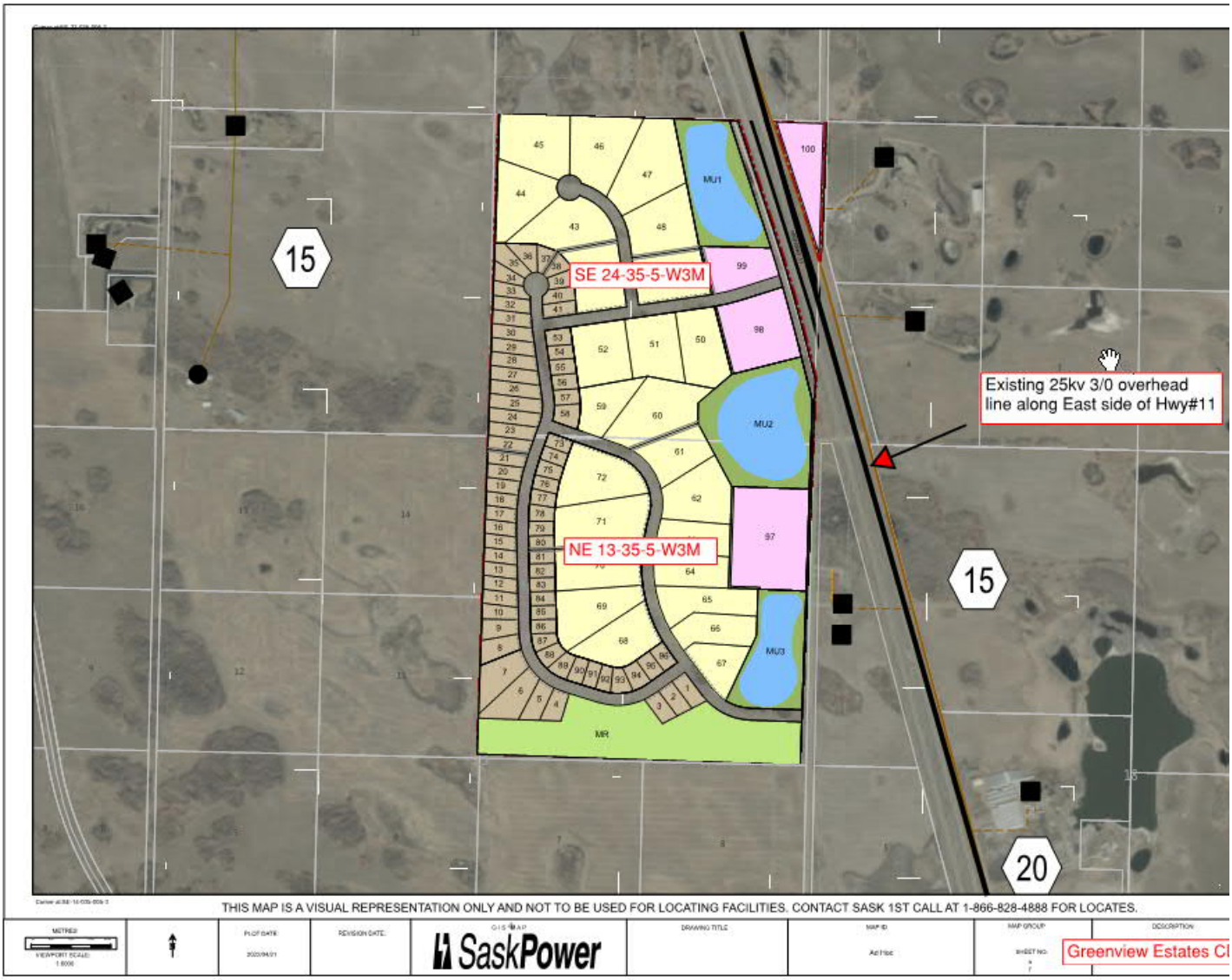
SaskPower has an existing three phase line on the east side of highway 11 that can be used to serve the proposed development.

Justin

From: Ian Waldner <iwaldner@saskpower.com>
Sent: Thursday, April 21, 2022 10:48 AM
To: Justin Bloor <Jbloor@saskpower.com>
Subject: RE: 2021-4570-00 - Greenview Estates CDR

Justin,
Existing 25kv 3/0 overhead line along east side of Hwy#11 will be able to feed this new development.

Thanks
Ian Waldner
SaskPower |Quote Expeditor
p. 306-934-7760 | email (iwaldner@saskpower.com) | saskpower.com



From: Justin Bloor <Jbloor@saskpower.com>
Sent: Thursday, April 21, 2022 9:34 AM
To: Ian Waldner <iwaldner@saskpower.com>
Subject: FW: 2021-4570-00 - Greenview Estates CDR

Please take a look the distribution in the area

From: Tina Ekert <TEkert@saskpower.com>
Sent: Thursday, April 21, 2022 8:46 AM
To: Justin Bloor <Jbloor@saskpower.com>
Subject: 2021-4570-00 - Greenview Estates CDR

Good morning!

Can you please respond to the email below?

Sent from my iPhone

Begin forwarded message:

> From: Mike Pawluski <pawluskim@ae.ca>
> Date: April 21, 2022 at 8:41:42 AM CST
> To: Tina Ekert <TEkert@saskpower.com>
> Subject: EXTERNAL EMAIL: 2021-4570-00 - Greenview Estates CDR
>
> EXTERNAL EMAIL: Take extra caution when clicking links or opening files. Report any suspected phishing.
>
> Good morning Tina,
>
> I was hoping you could help me by answering my questions below or directing my questions to someone else with SaskPower who can answer them. We represent a client preparing a comprehensive development review (CDR) report supporting a new multi-parcel country residential development approximately 6 kilometres south of Saskatoon along Highway 11 on the SE 24-35-5-W3M and the NE 13-35-5-W3M.
>
> As part of the CDR, the RM of Corman Park requires a developer to confirm available power services in the area. Can you confirm if SaskPower can extend services to this site? Is power readily available in the area to offer additional services to a new multi-parcel country residential/commercial development with 100 lots? (see attached site plan)
>
> If SaskPower can service this residential/commercial development, could you please provide an email or letter?
>
> Note our client is in the early planning stages of this development and currently working towards obtaining municipal approvals to proceed with the subdivision. Construction of the project will occur at a later date following municipal approvals. If you need any additional information, please feel free to contact me.
>
> Regards,
>
> **Mike Pawluski, RPP, MCIP**
> Project Planner
> **Associated Engineering (Sask.) Ltd.**
> 1 - 2225 Northridge Drive, Saskatoon, SK S7L 6X6
> Tel: 306.808.3102
>
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Mike Pawluski

From: Bob Bayles <bob.bayles@spiritsd.ca>
Sent: Wednesday, March 16, 2022 2:08 PM
To: Mike Pawluski
Subject: FW: 2021-4570-00 - Greenview Estates CDR

Hi Mike,

Apologies for my delayed response.

This new development would impact S. C. Park and Clavet. It is out of the transportation/attendance boundary for Dundurn. We might have to add a bus in both transportation areas depending on the speed of growth, that would be a decision to be made at that time.

South Corman Park – a Gr k-6 school is 74% utilized currently and would have the ability to absorb growth. Clavet Prek-12 continues to have enrolment pressure and, as of the fall, was over 90% utilized. We continue to work on increasing capacity.

Please let me know if this is enough information or if you would like to set up a call.

Regards,

Bob Bayles, Ph.D. ABD, MBA, CPHR
Deputy Director, Division Services, CFO, CHRO
Prairie Spirit School Division
T 306.683.2908| C 306.371.3998 Learners for life

From: Mike Pawluski <pawluskim@ae.ca>
Sent: December 14, 2021 7:08 AM
To: Bob Bayles <bob.bayles@spiritsd.ca>
Subject: 2021-4570-00 - Greenview Estates CDR

CAUTION: This email originated from outside of Prairie Spirit. Exercise caution when viewing attachments, clicking links or responding to requests.

My name is Mike Pawluski and I work for Associated Engineering. We represent a client who has asked us to draft a Comprehensive Development Review report for a country residential subdivision in the RM of Corman Park.

As part of our due diligence, it is our responsibility to contact the local school district to confirm available school capacities and busing services to accommodate the anticipated enrollment growth from the development. The reason I am contacting you is based on the location of the proposed subdivision, we anticipate the Clavet Composite, Dundurn, and South Corman Park schools to see the increased enrollment numbers. The proposed development is expected to create up to 96 new lots, and we anticipate an average of 3 persons per household. The local enrollments could likely increase by around 96 students based on these numbers. It is expected that this growth will be slow and staggered over many years.

Questions are:

- Do any of these schools have available capacity to support the anticipated growth?
- Are there busing services available to accommodate the growth?

I have attached a figure to identify where our client's land is in relation to these communities.

Kindly respond at your earliest convenience. If you require additional information, don't hesitate to contact me.

Have a safe and enjoyable holiday season.

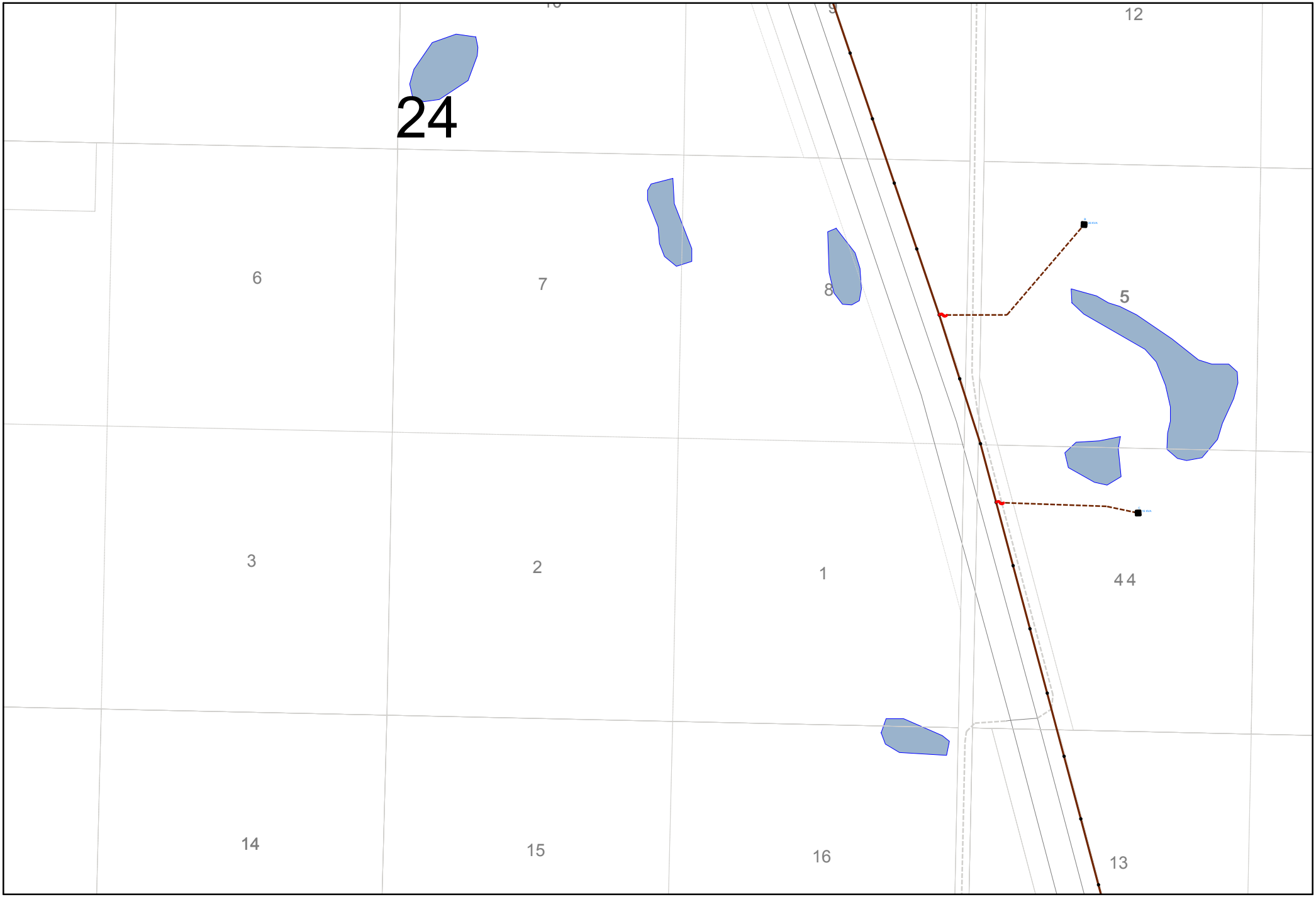
Regards,

Mike Pawluski, RPP, MCIP
Project Planner
Associated Engineering (Sask.) Ltd.
1 - 2225 Northridge Drive, Saskatoon, SK S7L 6X6
Tel: 306.808.3102



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Scale: 1 CM = 168 M

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04/26/21 16:23


LSD
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SW24
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SE24
35-05-W3
SASKATOON
CITY EXC.
LSD
14
NE13
35-05-W3
A

From: Zeremariam, Samson HI
To: Ellen McLaughlin; Bill Delainey
Cc: Gillies, Archie HI
Subject: FW: Greenview Estates Traffic Impact Assessment
Date: June 6, 2022 2:32:52 PM
Attachments: image002.png
image003.png
image001.png

Hi Ellen and Bill,

The recommendations presented by AE in the Greenview Estate TIA are acceptable to the Ministry.

The next step will be for the ministry to draft an updated partnership agreement that covers the construction of the recommended improvements.

Since the need for the southbound right turn lane (1st year of development), delineation light (2nd year of development), and area lighting (within 5 years of development as agreed) at Prairie View Road is being triggered entirely by development traffic, the cost of those improvements will fall solely on the developer. The ministry has an updated agreement template for developer delivered projects (2018 version) and the agreement will outline the ministry requirements for reviewing the design, quality control, and the ministry's responsibilities for paying the operating costs of the delineation and area intersection lights.

For your information, the cost from a similar highway location where the ministry installed area lighting on a twinned highway (2020 cost) was approx. $ 80,000. Single delineation lights have recently ranged from $12-15,000. It can be expected that costs will vary from site to site depending on local conditions, material and labour cost escalation, etc. but these examples should help understand what to expect.

Other improvements identified at Baker and Victor road that are warranted based on background traffic will not be the responsibility of the developer. The Ministry will add these to the provincial improvement list to be delivered by the Ministry based on priority and funding.

Let me know if you have any questions.

Thanks,

Samson Zeremariam, EIT (he/him)
Government of Saskatchewan
Operations Project Engineer
Traffic Engineering and Development, Ministry of Highways

18-3603 Millar Avenue
Saskatoon, Canada S7P 0B2
Office: 306-933-5340
Cell : 306-280-0724
Samson.Zeremariam@gov.sk.ca

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Samson

From: Bill Delainey <delaineyb@ae.ca>
Sent: Monday, June 6, 2022 10:11 AM
To: Zeremariam, Samson HI <samson.zeremariam@gov.sk.ca>
Cc: Gillies, Archie HI <archie.gillies@gov.sk.ca>; Ellen McLaughlin <mclaughline@ae.ca>
Subject: FW: Greenview Estates Traffic Impact Assessment

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Good morning, please see the communication from the property owner below.

Samson, could you please provide me with a letter confirming the Ministry's acceptance of the TIA report so we may include it in our submission to the RM?

Thanks,

Bill Delainey, RPP MCIP
Manager, Urban Planning
Associated Engineering (Sask.) Ltd.
1 - 2225 Northridge Drive, Saskatoon, SK S7L 6X6
Tel: 306.653.4969 | Cel: 306.261.9612 | Dir: 306.808.3047

Associated Engineering | 75 YEARS | COR | BEST MANAGED COMPANIES Platinum member

From: Jonathan Abrametz <j.abrametz@gmail.com>
Sent: June 6, 2022 9:44 AM
To: Bill Delainey <delaineyb@ae.ca>
Subject: Re: Greenview Estates Traffic Impact Assessment

Yes I will agree
Jon

On Fri, Jun 3, 2022 at 5:57 PM Bill Delainey <delaineyb@ae.ca> wrote:

> Good evening Jon, please see the email string below regarding the finalization of the TIA. It appears that the Ministry is seeking your agreement to including within a partnering agreement, the requirement to construct area lighting at the Prairie View/Highway 11 intersection within the next five-year period rather than after year 13 as estimated in our TIA.
>
> Given that the timetable for development as defined in the TIA is just an estimate combined with the fact that this is an obligation that exists regardless of timing, I believe that this is reasonable request.
>
> It is my assumption that subject to your agreement to this request, we will receive the written support from the Ministry needed to proceed with the submission of our application to Corman Park. The partnering agreement would be executed between yourself and the Ministry following approval of the subdivision.
>
> Please let me know if you need any information from us to assist in his decision.
>
> Regards,
>
> Bill Delainey, RPP
> Group Manager, Urban Planning
> Associated Engineering (Sask.) Ltd.
> 1 - 2225 Northridge Drive, Saskatoon, SK S7L 6X6
> Tel: 306.653.4969 | Cel: 306.261-.9612 | Dir: 306.653.2137 Ext. 5489
>
> ---
>
> **From:** Ellen McLaughlin <mclaughline@ae.ca>
> **Sent:** Friday, June 3, 2022 4:55 PM
> **To:** Zeremariam, Samson HI <samson.zeremariam@gov.sk.ca>; Bill Delainey <delaineyb@ae.ca>
> **Cc:** Gillies, Archie HI <archie.gillies@gov.sk.ca>
> **Subject:** RE: Greenview Estates Traffic Impact Assessment
>
> Hello Samson,
>
> The development is expected to take 15 years to reach full build out. Delineation lighting is warranted after 1 year assuming background traffic and development traffic grow at a steady rate. Area lighting is warranted after 13 years.

I'll let @Bill respond to your question advancing the timeline of the area lighting construction once we've had a chance to discuss with the developer.

Ellen McLaughlin, P.Eng. *(She/Her)*
Transportation Planning Engineer
Associated Engineering (Sask.) Ltd.
1922 Park Street, Regina, SK S4N 7M4
Tel: 306.721.2466 | Cel: 306.741.3245 | Dir: 306.271.0883



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From: Zeremariam, Samson HI <samson.zeremariam@gov.sk.ca>
Sent: Friday, June 3, 2022 4:17 PM
To: Ellen McLaughlin <mclaughline@ae.ca>
Cc: Bill Delainey <delaineyb@ae.ca>; Gillies, Archie HI <archie.gillies@gov.sk.ca>
Subject: RE: Greenview Estates Traffic Impact Assessment

Hey Ellen,

As we spoke earlier, can you please specify at what year is the delineation light and the area intersection light are warranted in the TIA?

It would make sense to build the delineation light first then once it warrants an upgrade to an area lighting, then the upgrade can be implemented.

In addition, before we proceed to the partnership agreement we would like to propose to the developer, to build the area lighting after 5 years (if it is warranted past 5 years) so it is easier to keep tabs on the agreement.

Please give me a call if you have any questions.

Thanks,

Samson Zeremariam, EIT (he/him)
Government of Saskatchewan
Operations Project Engineer
Traffic Engineering and Development, Ministry of Highways

18-3603 Millar Avenue
Saskatoon, Canada S7P 0B2
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From: Ellen McLaughlin <mclaughline@ae.ca>
Sent: Tuesday, May 10, 2022 3:37 PM
To: Zeremariam, Samson HI <samson.zeremariam@gov.sk.ca>
Cc: Bill Delainey <delaineyb@ae.ca>
Subject: Greenview Estates Traffic Impact Assessment

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Hello Samson,

Thank you for your detailed review of the Greenview TIA draft report. We've updated the report based on your comments and our subsequent phone call. Our final report is attached.

Regards,

Ellen McLaughlin, P.Eng. *(She/Her)*
Transportation Planning Engineer
Associated Engineering (Sask.) Ltd.
1922 Park Street, Regina, SK S4N 7M4
Tel: 306.721.2466 | Cel: 306.741.3245 | Dir: 306.271.0883

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From: Spencer McNie
To: Jason Forest
Cc: Bill Delainey; Mike Pawluski
Subject: RE: Greenview Estates - Conceptual Drainage
Date: April 13, 2022 10:44:22 AM
Attachments: image003.png
image004.png
image005.png

Jason,

The final report appears to address our previous comments.

WSA has no further comments at this time.

Regards,

S

Spencer McNie - A.Sc.T.
Supervisor, Rural Water Services - North
402 Royal Bank Tower 1101 - 101st Street
North Battleford, SK S9A 0Z5
Ph: 306.446.7450 | Cell: 306.490.7078 | Fax: 306.446.7461
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From: Jason Forest <forestj@ae.ca>
Sent: Thursday, March 24, 2022 8:55 AM
To: Spencer McNie <Spencer.McNie@wsask.ca>
Cc: Bill Delainey <delaineyb@ae.ca>; Mike Pawluski <pawluskim@ae.ca>
Subject: RE: Greenview Estates - Conceptual Drainage

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Hi Spencer,

The final report for Greenview Estates is attached.

Let me know if you have any questions.

Thanks

Jason Forest, A.Sc.T.

Project Technologist
Associated Engineering (Sask.) Ltd.
1 - 2225 Northridge Drive, Saskatoon, SK S7L 6X6
Tel: 306.653.4969 | Cel: 306.221.0846 | Dir: 306.808.3053

From: Spencer McNie <Spencer.McNie@wsask.ca>
Sent: Thursday, February 17, 2022 9:34 AM
To: Jason Forest <forestj@ae.ca>
Subject: RE: Greenview Estates - Conceptual Drainage

Jason,

I have reviewed the memo provided. I realize it is a relatively early draft and most of my comments will likely relate to things that will be sorted out as the design progresses.

- Concept appears solid and follows accepted practices. Reasonable assumptions surrounding the residential portions.
- Clarify operating levels (elevations) of the ponds (normal water level, high water level, spill, etc.)
- Clarify which depressions are entering Pond 3, it appears that some depressions may bypass it on the drawings.
- Ensure appropriate culverts are installed to allow natural flows off of the residential areas.
- Elaborate on the ultimate outlet for this water, the area does not benefit from a well defined positive outlet. Likely looking at a “no net downstream increase” situation.
- Provide more clarity around the MBE’s and how they were obtained.

I don’t see anything major at this time.

Regards,

S

Spencer McNie - A.Sc.T.
Senior Technologist, Rural Water Services - North
402 Royal Bank Tower 1101 - 101st Street
North Battleford, SK S9A 0Z5
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Water Security Agency

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From: Jason Forest <forestj@ae.ca>
Sent: Friday, February 4, 2022 1:48 PM
To: Spencer McNie <Spencer.McNie@wsask.ca>
Cc: Bill Delainey <delaineyb@ae.ca>; Jonathan Abrametz <j.abrametz@gmail.com>
Subject: Greenview Estates - Conceptual Drainage

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Hi Spencer,

We are working with Johnathan Abrametz (developer) in developing 2 quarter sections of land near adjacent to highway 11. The development is a mix of residential and commercial lots. Attached is our conceptual drainage plan for development. Please review and provide comment. If you have questions, feel free to call me directly.

Thanks and have a great weekend.

Jason Forest, A.Sc.T.
Project Technologist
Associated Engineering (Sask.) Ltd.
1 - 2225 Northridge Drive, Saskatoon, SK S7L 6X6
Tel: 306.653.4969 | Cel: 306.221.0846 | Dir: 306.808.3053

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Appendix C - Phase I ESA

Associated Environmental

REPORT

Jonathan Abrametz Legal Prof Corp.

Greenview Estates
SE 24-35-05 W3 and NE 13-35-05 W3
Phase I Environmental Site Assessment



JULY 2021

A Carbon Neutral Company

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EXECUTIVE SUMMARY

Associated Environmental Consultants Inc. (Associated) was retained by Jonathan Abrametz Legal Prof Corp. (the client) to complete a Phase I Environmental Site Assessment (ESA) for two quarter sections, namely SE 24-35-05 W3 and NE 13-35-05 W3. The quarter sections are located along Highway 11 and are approximately 6.0 km south of Saskatoon, Saskatchewan. The quarter sections are being utilized for farmland, as are many of the surrounding properties (Subject Site, Figure 1, Appendix A). This Phase I ESA is completed for environmental due diligence purposes and to support the application to rezone and subdivide the lands for residential development. The assessment followed the protocols defined in the Canadian Standards Association, Standard CSA Z768-01 (R2016) – Phase I Environmental Site Assessment and was conducted in consideration of the legislation and regulations relevant to contaminated sites in Saskatchewan, as stipulated in the Saskatchewan Environmental Code (Government of Saskatchewan 2015); adhering to the Saskatchewan *Environmental Management and Protection Act* (RSS 2010 c. E-10.22).

The scope of work in this Phase I ESA included reviewing relevant historical documents, interviewing persons with knowledge of current and past activities at the Subject Site and neighbouring properties, and visually inspecting the Subject Site and surrounding area for signs of contamination (i.e., staining and odours) or areas of potential environmental concern (APECs).

The findings of the Phase I ESA indicate low potential of contamination and that current or past activities have not led to significant soil, vapour, and/or groundwater contamination beneath the Subject Site. The site reconnaissance supports this conclusion.

Past and present land use of neighbouring properties, the positions of these properties relative to the Subject Site with respect to inferred groundwater flow, and their respective distances from the site indicate low potential of contamination at the Subject Site.

This executive summary is subject to the same standard limitations described in Section 9 of this report.

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LIST OF ABBREVIATIONS

Acronym	Definition
AL	Agricultural Land
APEC	Area of Potential Environmental Concern
CCME	Canadian Council of the Ministers of Environment
CSA	Canadian Standards Association
ESA	Environmental Site Assessment
ISC	Information Services Corporation
NCSCS	National Classification System for Contaminated Sites
PHC	Petroleum Hydrocarbons
WSA	Water Security Agency

Units

°C	degrees Celsius
ha	hectare (10,000 m^2)
km	kilometre
m	metre
m^2	square metre

1 INTRODUCTION

Associated Environmental Consultants (Associated) was retained by Jonathan Abrametz Legal Prof Corp. (the client) to complete a Phase I Environmental Site Assessment (ESA) for two quarter sections, namely SE 24-35-05 W3 and NE 13-35-05 W3. The quarter sections are located along Highway 11 and are roughly 6.0 km south of Saskatoon, Saskatchewan. The quarter sections are being utilized for farmland, as are many of the surrounding properties (Subject Site, Figure 1, Appendix A). This Phase I ESA s completed to support an application to rezone and subdivide the lands for residential development.

The Phase I ESA's objective was to determine the potential that soil, groundwater, or vapour at the site is contaminated relative to applicable standards under current or intended land use. This report describes the methods and results of the Phase I ESA and presents conclusions, and recommendations.

2 SCOPE

The assessment followed the protocols defined in the Canadian Standards Association Standard CSA Z768-01 (R2016) – Phase I Environmental Site Assessment (CSA 2016) and was conducted in consideration of the legislation and regulations relevant to contaminated sites in Saskatchewan, as stipulated in the Saskatchewan Environmental Code (Government of Saskatchewan 2015); adhering to the Saskatchewan *Environmental Management and Protection Act* (RSS 2010 c. E-10.22).

The Subject Site (Appendix H, Subject Site Photos 1-8) is agricultural land with the following land description:

- SE 24-35-05 W3: 58.89 hectares
- NE 13-35-05 W3: 65.64 hectares

The scope of work included the following activities:

- A records review of the Subject Site and adjacent properties.
- Interviews of persons with knowledge of current and/or historic operations at the Subject Site and neighbouring properties.
- A visual inspection of the Subject Site and adjacent properties visible from either the Subject Site or public property. Associated conducted a site inspection on June 18, 2021.
- Preparation of this Phase I ESA report, which includes a discussion of the potential risk of soil, groundwater, and vapour contamination at the Subject Site with respect to provincial guidelines for the current or intended land use.

This Phase I ESA does not include sampling or testing of soil, groundwater, surface water, sediment, vapour, or building materials. As a result, potential environmental concerns related to undocumented historical use or unknown buried debris remain as possibilities, as an extensive investigation of these materials is beyond the scope of this project. For this reason, the potential exists for adverse environmental conditions to be encountered in locations not specifically investigated.

3 RELEVANT GUIDELINES

Contaminated sites in Saskatchewan are governed by the Saskatchewan Environmental Code (Government of Saskatchewan 2015), Division B of the Code relates to environmentally impacted sites.

The Environmental Spill Control Regulations (RSS c. E-10.22 Reg 2) of *The Environmental Management and Protection Act 2010* (RSS 2010 c. E-10.22) are intended to protect the physical and biological environment in the event of a release of hazardous materials. The Regulations require that spills of hazardous material be reported immediately, be contained, and be properly cleaned up. A description of the substances and their quantities subject to a reportable spill is provided in the Regulations.

The applicable standards for soil and vapour depend on the primary land use on site. Standards for agricultural land use (AL), as defined in the Canadian Council of the Ministers of Environment (CCME) Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health, apply to the Subject Site and were used for interpretation purposes (CCME 2007).

Additional applicable CCME guidelines and standards include:

- Canada-Wide Standards for Petroleum Hydrocarbons (PHC) in Soil (CCME 2008).
- Soil Quality Guidelines for the Protection of Environmental and Human Health.

Additional standards for drinking water, aquatic life, and recreational water include:

- Guidance Document on Federal Interim Groundwater Quality Guidelines for Federal Contaminated Sites (Government of Canada 2012);
- Guidelines for Canadian Drinking Water Quality (Health Canada 2017); and
- Guidelines for Canadian Recreation Water Quality (Health Canada 2012).

The Subject Site's closest surface waterbodies are a local slough, roughly 500 m to the east/southeast as well as the South Saskatchewan River, located approximately 8 km west of the Subject Site. Therefore, the Canadian Water Quality Guidelines for the Protection of Aquatic Life are not applicable, (CCME 2003) due to the proximity.

4 METHODS

4.1 Records Review

The information reviewed for a Phase I ESA typically includes any available records, databases, maps, and reports relevant to the Subject Site and surrounding area, as summarized in Table 4-1. A selection of the historical aerial photographs reviewed by Associated is provided in Section 6.1.1. Associated obtained land titles from Information Services Corporation (ISC). Copies of the land titles are provided in Appendix C.

Table 4-1
Records Reviewed for a Phase I ESA

Record	
National Air Photo Library/Google Earth ™	Aerial photographs provide a visual history of the Subject Site and surrounding area, and typically show site features (e.g., buildings) and how the area has developed over time.
Land Titles - Information Services Corporation (ISC)	Land Titles indicate the registered owners of the Subject Site property over time.
Previous Environmental Reports	Previous reports can determine if or what environmental work has been conducted at the Subject Site and neighbouring properties.
SaskSpills and Hazardous Substance Storage Program Database	SaskSpills provides environmental records of reported spills and hazardous materials storage at the Subject Site and neighbouring properties. The database provides information on the reported type(s) of substance(s) spilled, the location and quantity of a spill, and any containment, disposal, and remediation activities relevant to the site and surrounding areas.
Water Security Agency Water Well Database	This database provides records of reported wells in the province and contains information such as spatial locations, local lithology, well completion dates, and well depths.

4.2 Interviews

Detailed interviews with knowledgeable persons were not available given the timing and deliverable expectations.

4.3 Site Inspection

On Friday, June 18, 2021, Associated conducted a site inspection of the Subject Site and surrounding area. The inspection's objective was to determine the current conditions onsite and to observe and document the current surrounding properties.

The site inspection involved a visual examination of the grounds and neighbouring properties visible from the Subject Site or public property. Surface and subsurface drainage patterns were also examined. Any evidence of contamination was noted (e.g., odours and staining), and materials and waste product handling, use, disposal methods, and storage vessels were also recorded (e.g., sumps and aboveground and underground storage tanks). These topics are explored in more detail in Section 6.

5 SITE DESCRIPTION

5.1 Location

The Subject Site (Appendix H, Subject Site Photos 1-8) is located on the quarter sections of SE 24-35-05 W3 and NE 13-35-05 W3. The quarter sections are located along Highway 11 and are roughly 6.0 km south of Saskatoon, Saskatchewan. The quarter sections are being utilized for farmland, as are many of the surrounding properties (Subject Site, Figure 1, Appendix A).

Historically, the Subject Site was vacant farmland. Currently, the Subject Site is used for agricultural purposes. The Subject Site is roughly rectangular-shaped. The Subject Site covers an approximate area two quarter sections or 125 hectares. The Subject Site is discussed further in Section 6.

5.2 Physiography

The Subject Site is in the Moist Mixed Grassland ecoregion (Prairie Ecozone), which is the northern extension of open grassland in the region and features semi-arid moisture conditions. The diverse landscapes of this ecoregion include glacial till and short, steep slopes and numerous undrained depressions or sloughs, as well as several large, level glacial lake plains (SKCDC 2019). The nearest climate station is the Saskatoon SRC Saskatchewan Weather Station (Weather Station ID: 4057180). The normal monthly annual temperature ranges from -13.9°C in January to 19.0°C in July. The mean annual precipitation is 340.4 mm, with a total of 263.8 mm falling as rain and the remainder falling as snow (Environment Canada 2021).

Surficial geology can be described as “surficial stratified deposits” occurring between the bedrock and surface (MDH 2011). The drift ranges in thickness and is comprised of an unsorted mixture of gravel, sand, silt and clay (MDH 2011). The “surficial stratified deposits” also commonly known as drift is comprised of three formations: the Empress Group, the Sutherland Group and the Saskatoon Group (MDH 2011). Bedrock geology beneath the Subject Properties and area are defined by three formations including the Lea Park Formation, Judith River Formation and Bearpaw Formation (MDH 2011).

Groundwater is a common pathway for contaminant transport. Based on regional topography and the location and flow of surface waterbodies, groundwater beneath the Subject Site is inferred to flow potentially towards the local slough (southeast), but eventually feeds into the South Saskatchewan River (which would suggest southwesterly flow). from the Subject Site. The local flat topography and lack of surface water drainage complicates the estimation direction of groundwater flow beneath the Subject Site. Determining the precise direction would require field verification because localized variations in groundwater flow direction are possible.

The inferred groundwater flow direction for the general area is a good approximation, however, localized variations in actual flow direction may exist due to yet unverified sub-surface features, temporal variation, and influence from surface waterbodies.

6 RESULTS

6.1 Records Review

6.1.1 Aerial Photographs

Historical aerial photos were obtained from the National Air Photo to determine the subject site's historical development and surrounding area. GoogleEarth imagery was also reviewed 2000s onwards. The results of the available aerial photographs are summarized in reverse chronological order in Table 6-1. A copy of all aerial photos is included in Appendix B.

Table 6-1
Aerial Photograph Analysis

Date	Subject Site	Surrounding Area
1944	A slough like feature was observed in the northwest corner of the quarter section SE 24-35-05 W3 and a farmstead with a heavy vegetated area was present in the southeast corner of the quarter section. NE 13-35-05 W3 was undeveloped land.	North: Vacant, undeveloped land. East: One structure was noted close to the center line of the quarter section on the west, south of the heavy vegetated area. The rest of the land was undeveloped. South: Vacant, undeveloped land. West: The view to the west (for 1944) is limited. Vacant, undeveloped land.
1944-1966	Highway 11 was constructed, intersecting the east side of SE 24-35-05 W3, running southeasterly. Highway 11 cut through the heavy vegetation. No visible changes were observed in the farmstead area. Prairie View Road was constructed in the northeast corner of NE 13-35-05 W3, running southeasterly and then parallel with the southeast quarter line. The Prairie View Road was constructed to connect the westbound lane of Highway 11.	North: Highway 11 was constructed. No other land development was observed. East: Highway 11 was constructed. No other land development was observed. South: Vacant, agricultural land. West: Vacant, agricultural land.
1966-1986	SE 24-35-05 W3 was developed into a farmland, including the slough area in the northwest corner and the heavy vegetated area in the south. The noted farmsteads were removed. NE 13-35-05 W3 was developed into a farmland. Some modification might apply to the Prairie View Road, which appeared to be heading	North: No visible changes observed in the quarter section straight north of the Subject Site. Farm houses were noted in the northeast corner of the quarter section northwest of the Subject Site. East: The structure found in the quarter section east of SE 24-35-05 W3, close to the center line was removed. No other visible changes were observed. There was one structure constructed in the northwest corner of the quarter section east of NE 13-35-05 W3, between Highway 11 and Prairie View Road.

Date	Subject Site	Surrounding Area
	straight, parallel with the east quarter line. Potential silos were noted on the east side, close to the east quarter line.	South: Farm houses were found against the center line of the quarter section on the east side. Some development found in the quarter section southeast of NE 13-35-05 W3, in the northeast corner, further east of Highway 11 eastbound lane. West: Farm houses were observed in the southwest corner of the quarter section west of SE 24-35-05 W3.
1986-2002	No visible changes.	North: No visible changes. East: Two group of farm houses were observed in the quarter section east of SE 24-35-05 W3. One was constructed in the northwest corner and one was in the southwest corner towards to the center of the quarter section. No visible changes to the quarter section east of NE 13-35-05 W3. South: No visible changes to the quarter section south of NE 13-35-05 W3. Additional buildings were constructed in the land development in the northeast corner of the quarter section southeast of NE 13-35-05 W3. West: Another farmstead was observed in the northwest corner of the quarter section west of SE 24-35-05 W3. No visible changes to the quarter section west of NE 13-35-05 W3.
2002-2004	No visible changes.	North: No visible changes. East: Additional structures were observed in the quarter section east of NE 13-35-05 W3. The structures were constructed in the northwest corner west of Highway 11 westbound lane, further south of the pre-existed group of structure. South: No visible changes. West: No visible changes.
2004-2016	No visible changes	North: No visible changes. East: No visible changes. South: No visible changes. West: No visible changes.

6.1.2 Land Titles

The historical land titles were obtained from Information Services Corporation (ISC). They indicate that the current registered owner for the Subject Site is OJA Holdings Ltd. as listed in Appendix C. The properties were transferred from an individual in 2021. No other individuals or businesses owned the properties prior to 2021.

6.1.3 Previous Environmental Reports

To the knowledge of Associated, no previous environmental reports have been completed for the Subject Site property. In addition, Associated submitted Freedom of Information (FOIP) Request to the Ministry of Environment (MOE) – Environmental Protection Branch for any environmental information including but not limited to tanks, spills, environmental infractions/complaints/orders/investigations/remediation, site assessments, remediation plans/reports, site plans and fire information for the Subject Site property. Responses were received on June 22, 2021 stating that there were no available records responsive to the requests. The FOIP Request record can be found in Appendix E.

6.1.4 Spills and Hazardous Materials Storage

The SaskSpills database (data available from January 1, 1988, to the present) revealed no records of spills or hazardous materials storage associated with the Subject Site or neighbouring properties (Government of Saskatchewan 2018). The spills and hazardous material storage search results are provided in Appendix D. No spills were identified on or around the Subject Site during the site inspection.

6.1.5 Groundwater Wells

A search of the Water Security Agency (WSA) Saskatchewan Ground Water Resources GIS Web Mapping application for water well drilling records (WSA 2018) identified 21 wells within a 500 m radius of the Subject Site.

The well map and all well records are included in Appendix F. Note that this database does not contain or identify all wells that have been completed in the province but rather contains only records that drillers have submitted. Some wells in the area are plotted in the centre of the respective quarter section. WSA uses this form of plotting to indicate that the well was not given an exact location within its respective quarter section. Table 6-2 lists the WSA wells that are within a 500 m radius of the Subject Site. The wells were not field verified or investigated in detail but are listed for completeness.

Table 6-2
WSA Water Wells Within a 500 m Radius of the Subject Site

Well Identification	Use	Total Depth (ft.)	Year Completed
WWDR No. 014488	Domestic – Withdrawal	27	1974
WWDR No. 014489	Domestic – Withdrawal	28	1974
WWDR No. 031757	Research Test Hole	464	1966
WWDR No. 043814	Domestic – Withdrawal	27	1975
WWDR No. 047554	Domestic – Withdrawal	57	1975
WWDR No. 048671	Domestic – Withdrawal	50	1976
WWDR No. 049257	Domestic – Withdrawal	26	1977
WWDR No. 051139	Domestic – Withdrawal	80	1977
WWDR No. 064131	Domestic – Withdrawal	95	1980
WWDR No. 077641	Domestic – Withdrawal	28	1984

Well Identification	Use	Total Depth (ft.)	Year Completed
WWDR No. 086177	Domestic – Withdrawal	50	1987
WWDR No. 099861	Domestic – Withdrawal	54	1990
WWDR No. 102459	Domestic – Withdrawal	29	1992
WWDR No. 104120	Domestic – Withdrawal	50	1994
WWDR No. 109245	Domestic – Withdrawal	55	1998
WWDR No. 109498	Domestic – Withdrawal	94	1998
WWDR No. 111078	Domestic – Withdrawal	49	1999
WWDR No. 116917	Research Test Hole	479	1991
WWDR No. 218798	Domestic – Withdrawal	33	2009
WWDR No. 219553	Unknown	479	Unknown
WWDR No. 237148	Domestic – Withdrawal	75	2017

6.1.6 National Classification System for Contaminated Sites

The National Classification System for Contaminated Sites (NCSCS) was developed by the CCME is a method for screening and prioritizing contaminated sites according to their current or potential adverse impact on human health and the environment. The NCSCS was developed to establish a rational and scientifically defensible spreadsheet-based scoring system for comparable assessment of contaminated sites and a management tool for prioritizing the investigation and remediation of contaminated sites since 1992 (CCME 2008).

It should also be noted that since there is no testing completed for a Phase I ESA, no exceedances (i.e., soil, water) can be reported to the NCSCS. As per the NCSCS review instruction, the NCSCS review does not need to be proceeded through if there are no exceedances. A copy of the complete review result is provided in Appendix G.

6.2 Interviews

Detailed interviews with knowledgeable persons were not available given the timing and deliverable expectations.

6.3 Site Inspection

Associated conducted the site inspection on Friday, June 18, 2021. At the time of the inspection, it was roughly 17°C with cloudy conditions.

6.3.1 Buildings and Structures

No buildings were found in quarter section SE 24-35-05 W3. One grain silo and an old barn (empty) were found in the quarter section NE 13-35-05 W3, along the center line of the quarter section on the east side (Appendix H – Subject Site Photos 1-4).

6.3.2 Grounds

The Subject Site is vegetated with crop(s). Storm ditches were found along the highway. No stains were found. Numerous piezometers were observed throughout the Subject Site. These piezometers were installed by P. Machibroda Engineering Ltd. (PMEL) recently as part of a hydrogeological assessment for the Subject Site in support of the future development of the site. In addition, the Subject Site had a trailer (used for advertising purposes) located onsite.

6.3.3 Hazardous Substances Use and Storage

No hazardous substances were noted onsite at the time of inspection.

6.3.4 Solid Waste Management

No solid waste management practices were noted onsite at the time of inspection.

6.3.5 Wastewater Management

No wastewater management practices were noted onsite at the time of inspection.

6.3.6 Heating and Cooling Systems

No heating and/or cooling systems were noted onsite at the time of inspection.

6.3.7 Wells

The inspection found numerous piezometers at the Subject Site. These were installed as part of a hydrogeological assessment). In addition, the WSA indicated 21 wells registered that are within a 500 m radius of the Subject Site (WSA 2018), as described in Section 6.1.5.

6.3.8 Stains and Odours

No stains or odors were noted onsite at the time of inspection.

6.3.9 Above Ground or Below Ground Storage Tanks

No above-ground or below-ground storage tanks were noted onsite at the time of inspection.

6.3.10 Mechanical Equipment

No mechanical equipment was noted onsite at the time of inspection.

6.3.11 Vegetation

The Subject Site is vegetated with crop(s).

6.3.12 Hazardous Building Materials

No buildings were present onsite as noted above.

6.3.13 Pits and Lagoons

No pits and lagoons were noted onsite at the time of inspection.

6.3.14 Neighbouring Properties

The surrounding land use is considered to be mostly agricultural (AL) land and some commercial (CL) land including:

- Farm houses/yards and their respective grounds to the south (Neighbouring Properties Photos 7 and 8) and west (Neighbouring Properties Photos 9-12);
- Vacant land and Highway 11 to the north (Neighbouring Properties Photo 13); and
- Farm/greenhouse, farm houses/yards and their respective grounds, Highway 11 and PrairieView Chapel and Crematorium (which includes Family Pet Cremation Services) to the east (Neighbouring Properties Photos 1-6).

Table 6-3 lists the neighbouring properties at the time of the site inspection, and Figure 2 shows the location of neighbouring properties (Appendix A).

Table 6-3
Neighbouring Properties

Direction Relative to Subject Site	Description
South	Farm houses/yards and their respective grounds
West	Farm houses/yards, their respective grounds and farmland
North	Farmland
East	A farm/greenhouse, farm houses/yards and their respective grounds PrairieView Chapel and Crematorium (which includes Family Pet Cremation Services)

None of these operations or businesses are involved with the production or manufacturing of product on site.

7 INDICATIONS OF ENVIRONMENTAL RISK

The potential for soil, vapour, and/or groundwater at the Subject Site to be contaminated to levels that exceed relevant provincial standards depends on current and past land use(s) at the Subject Site. Neighbouring properties can also pose environmental risk based on their current and past uses, and on their distance and relative position to the Subject Site with respect to the groundwater flow gradient. Up-gradient, sites are generally associated with higher risk because of the potential for groundwater transport of contaminants to down-gradient locations.

7.1 Subject Site

Based on the results of the Phase I ESA, there is low potential[1] that current or past land use activities at the Subject Site have resulted in contamination of soil, vapour, and/or groundwater with respect to applicable environmental standards and guidelines.

7.2 Neighbouring Properties

Based on the results of the Phase I ESAs, there is low potential[1] that current or past land use activities at properties neighbouring the Subject Site have resulted in contamination of soil, vapour and/or groundwater with respect to applicable environmental standards and guidelines.

[1] High potential means there is either physical or visual/olfactory evidence or very recent factual evidence of contamination on site. Moderate potential means there is evidence of past or current land uses or infrastructure with potential to release contaminant(s) into the environment. Low potential means there is little or no evidence of sources of contamination.

8 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Associated completed a Phase I Environmental Site Assessment (ESA) on the quarter sections of SE 24-35-05 W3 and NE 13-35-05 W3. The quarter sections are located along Highway 11 and are roughly 6.0 km south of Saskatoon, Saskatchewan. The quarter sections are being utilized for farmland, as are many of the surrounding properties (Subject Site, Figure 1, Appendix A). Associated reviewed historical records, searched provincial databases, interviewed certain knowledgeable individuals, and inspected the property to assess the potential risk of contamination.

The findings for land use at the Subject Site indicate the low potential[2] that current or past activities have led to detectable concentrations of soil, vapour, and/or groundwater contamination. The site reconnaissance, which included a site inspection and interviews, supports this conclusion.

The findings for land use at neighbouring properties/the surrounding area also indicate the low potential[2] that current or past activities have led to significant soil, vapour, and/or groundwater contamination. The site reconnaissance, which included a site inspection and interviews, supports this conclusion.

Further environmental assessment (i.e., Phase II ESA) at the Subject Site is not warranted at this time.

[2] High potential means there is either physical or visual/olfactory evidence or very recent factual evidence of contamination on site. Moderate potential means there is evidence of past or current land uses or infrastructure with potential to release contaminant(s) into the environment. Low potential means there is little or no evidence of sources of contamination.

9 DISCLAIMER

ASSOCIATED ENVIRONMENTAL CONSULTANTS INC.

STANDARD DISCLAIMER FOR CONTAMINATED SITE INVESTIGATIONS, MONITORING AND CONFIRMATION OF REMEDIATION SERVICES

Subject to the following conditions and limitations, the investigation described in this report has been conducted by Associated Environmental Consultants Inc. (Associated) for Jonathan Abrametz Legal Prof Corp. (the Client) in a manner consistent with a reasonable level of care and skill normally exercised by members of the environmental science profession currently practicing under similar conditions in the area.

1. The scope of the investigation described in this report has been limited by the budget set for the investigation in the work program. The scope of the investigation has been reasonable having regard to that budget constraint.
2. The investigation described in this report has been limited to the scope of work described in the work program.
3. The investigation described in this report has relied upon information provided by third parties concerning the history of the site. Except as stated in this report, we have not made an independent verification of such historical information. Notwithstanding the foregoing, Associated may be under a legal obligation to report the discovery of all historical impacts, whether discovered directly or through a third party or third-party historical information, to the Government of Saskatchewan, Ministry of Environment.
4. The investigation described in this report has been made in the context of existing government regulations generally promulgated at the date of this report. Except as specifically noted, the investigation did not take account of any government regulations not in effect and generally promulgated at the date of this report.
5. All documents and drawings prepared by Associated, or by others on behalf of Associated, in connection with this Project are instruments of professional service for the execution of the Project. Associated retains the property and copyright in these documents and drawings, whether the Project is executed or not.
6. The findings and conclusions are valid only for the specific site identified in the report.
7. Associated may be required pursuant to applicable laws and regulations to report the discharge or discovery of a contaminant to a regulator without notice to the Client.
8. Since site conditions may change over time, the report is intended for immediate use.
9. This report is intended for the exclusive use of the Client, including all successors and assigns. The material in it reflects Associated's best judgement, in light of the information available to it, at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Associated accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report and makes no representation of fact or opinion of any nature whatsoever to any person or entity other than the Client.

In accepting delivery of this report, the Client hereby agrees that:

1. Associated's liability for all claims of the Client, arising out of the agreement between Associated and the Client, pursuant to which this report has been prepared (the Agreement) shall absolutely cease to exist after a period of six (6) years from the date of:
   i. substantial completion of the investigation described in this report,
   ii. termination of Associated's Services under the Agreement,
   iii. commencement of the limitation period for claims prescribed by any statute of the Province or Territory for the site of the investigation described in this report,
   iv. any significant alteration of the site of the investigation described in this report, and/or neighbouring properties after the date of the final report that would change the conclusions and recommendations of the final report,

whichever shall first occur, and following the expiration of such period, the Client shall have no claim whatsoever against Associated.

2. Associated may be under a legal obligation to report certain discoveries and as such will not be able to maintain confidentiality of information but agrees to disclose only that information required by law to be disclosed.
3. Any and all claims which it may have against Associated's or any of its servants, agents, or employees arising out of or in any way connected with the investigation described in this report or the preparation of this report, whether such claims are in contract or in tort, and whether such claims are based on negligence or otherwise, shall be limited to a total amount equal to the fees payable to Associated's under the contract with the Client. Associated's shall bear no liability whatsoever for any consequential loss, injury or damage incurred by the Client including but not limited to claims for loss of profits and loss of markets.
4. Associated may be obligated to report discharges or discoveries of contaminants to a regulator or third party with or without notice to the Client or others and in such situation Associated shall not be liable for any liability, damages, injury, losses, costs, expenses (including without limitation legal fees on a solicitor and own client basis), consequential or indirect loss, lost profits or any liability whatsoever ("Damages") suffered or incurred as a result of any claims demands, actions, suits or proceedings which may be made, brought or prosecuted in any manner whatsoever by the Client or a third party and Client shall hold Associated harmless and indemnify Associated for any such Damages incurred.

CLOSURE

This report was prepared for Jonathan Abrametz Legal Prof Corp. to qualitatively assess the level of risk of soil, soil vapour, and/or groundwater contamination at the Subject Site as posed by current and past land uses at either the site or neighbouring properties.

The services provided by Associated Environmental Consultants Inc. in the preparation of this report were conducted in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practicing under similar conditions. No other warranty expressed or implied is made.

Respectfully submitted,
Associated Environmental Consultants Inc.

Prepared by:



Chelsea Cooke, B.Sc.
Environmental Scientist

Reviewed by:



Ash Starzynski, M.Sc., P, Geo.
Senior Environmental Scientist

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APPENDIX A - FIGURES

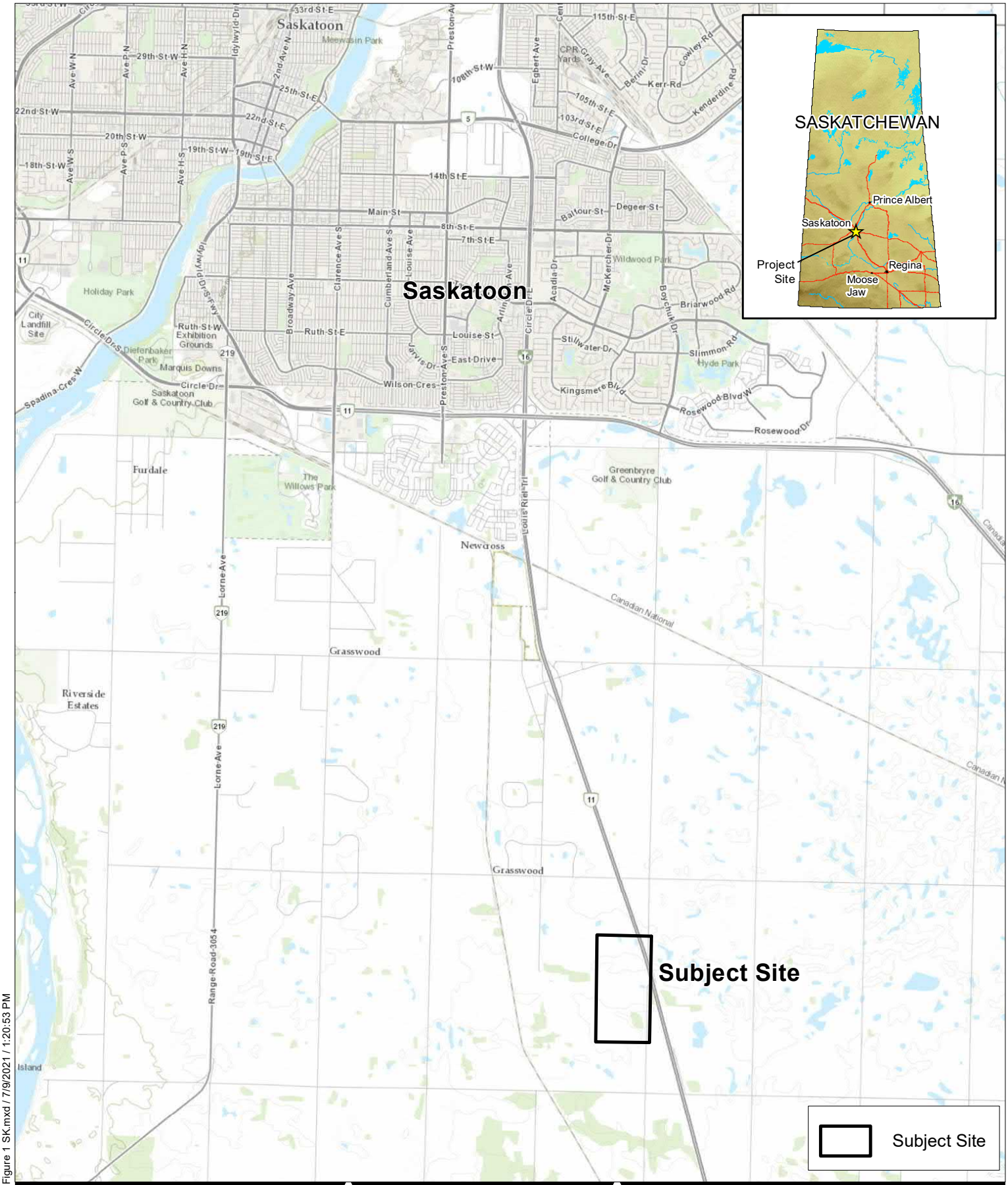


Figure 1 SK.mxd / 7/9/2021 / 1:20:53 PM

Associated Environmental

PROJECT NO.: 2021-4570.000.130
DATE: July 2021
DRAWN BY: DA

0 2 km

N

FIGURE 1: PROJECT LOCATION

Jonathon Abrametz Legal Prof Corp.

Phase I ESA at SE 24 35 05 W3 and NE 13 35 05 W3



Figure 2.mxd / 7/9/2021 / 1:21:53 PM

Associated Environmental

PROJECT NO.: 2021-4570.000.130
DATE: July 2021
DRAWN BY: DA

0 400 m

N

FIGURE 2: SUBJECT SITE AND SURROUNDING LAND USE

Jonathon Abrametz Legal Prof Corp.

Phase I ESA at SE 24 35 05 W3 and NE 13 35 05 W3

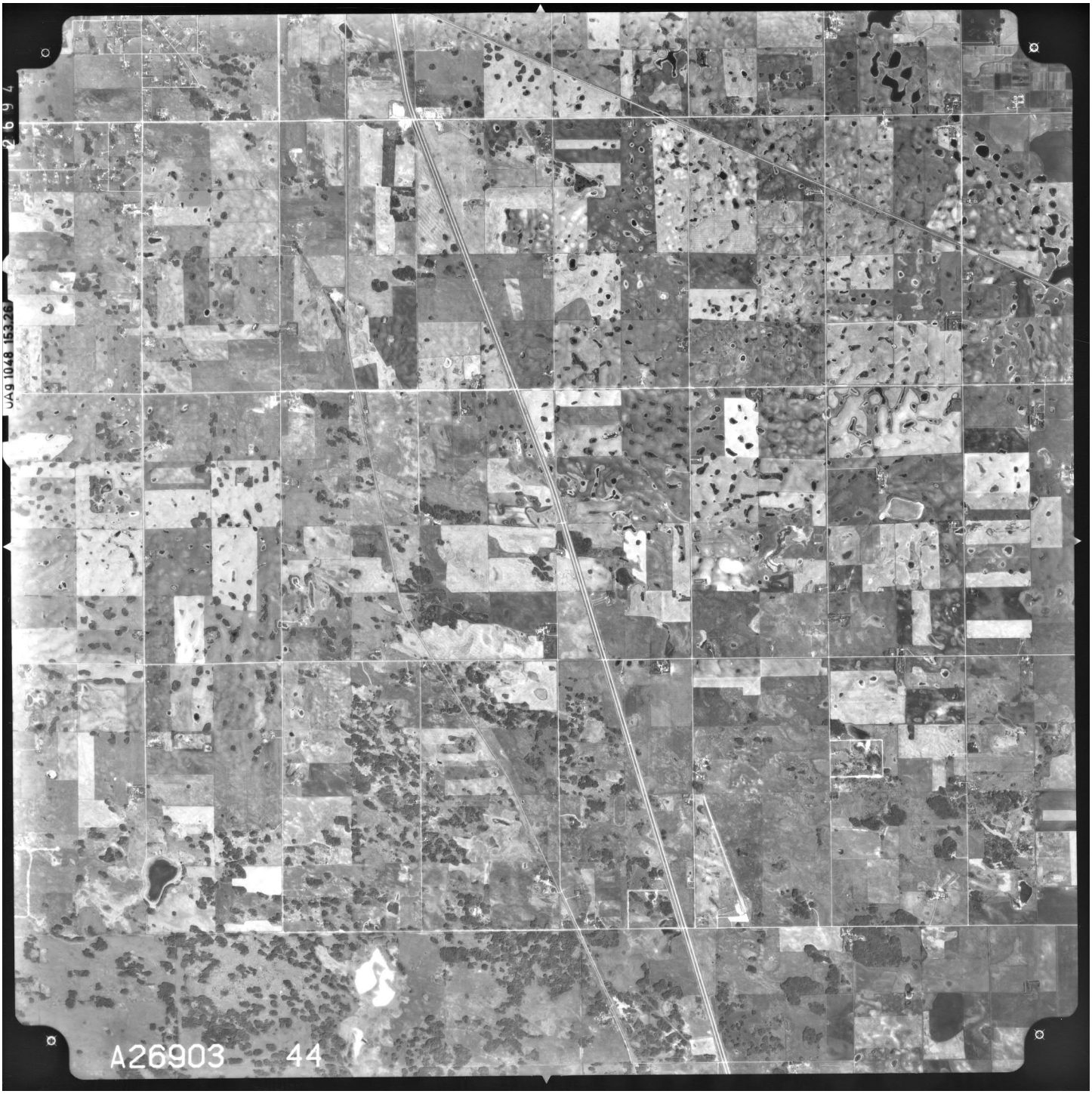
APPENDIX B - HISTORICAL AERIAL PHOTOGRAPHS



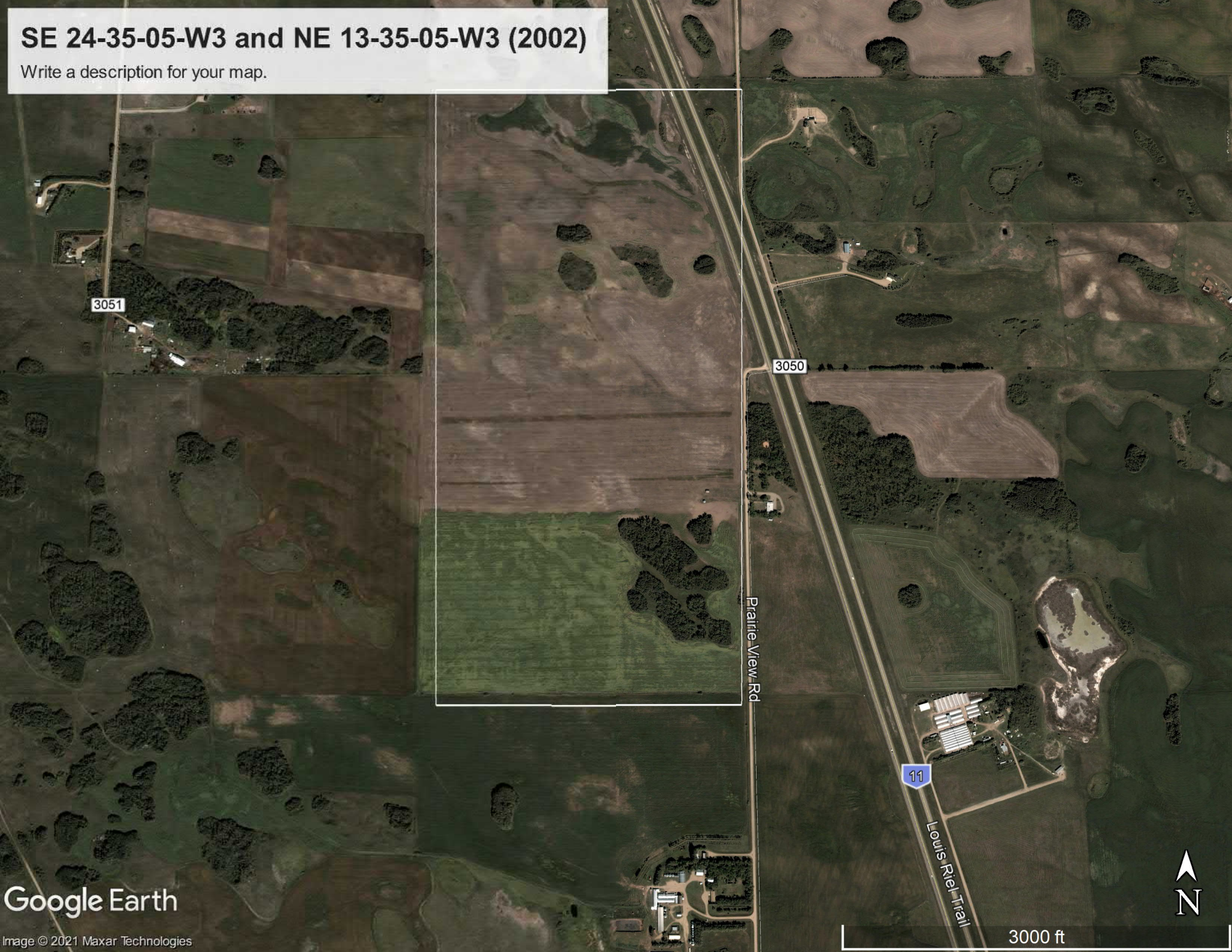
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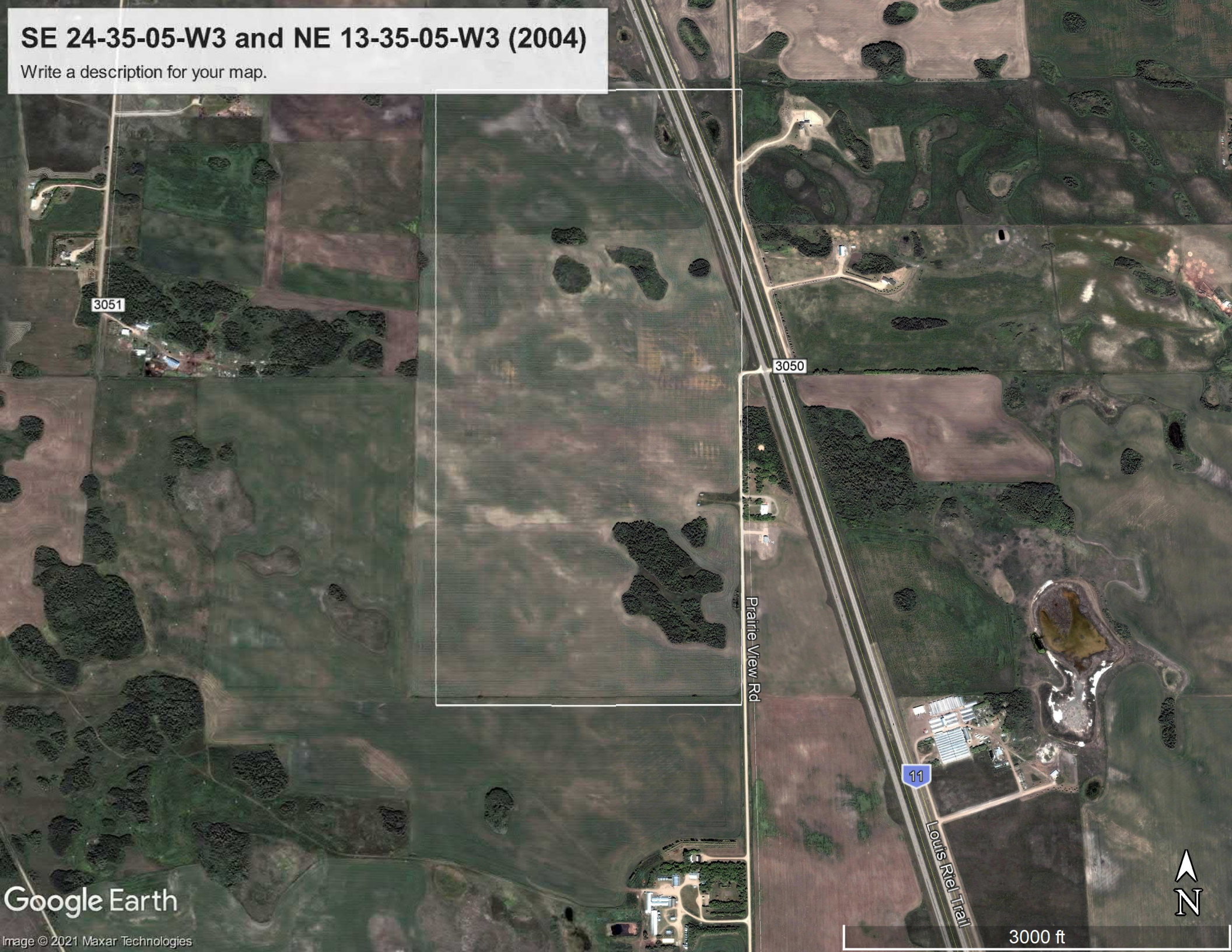


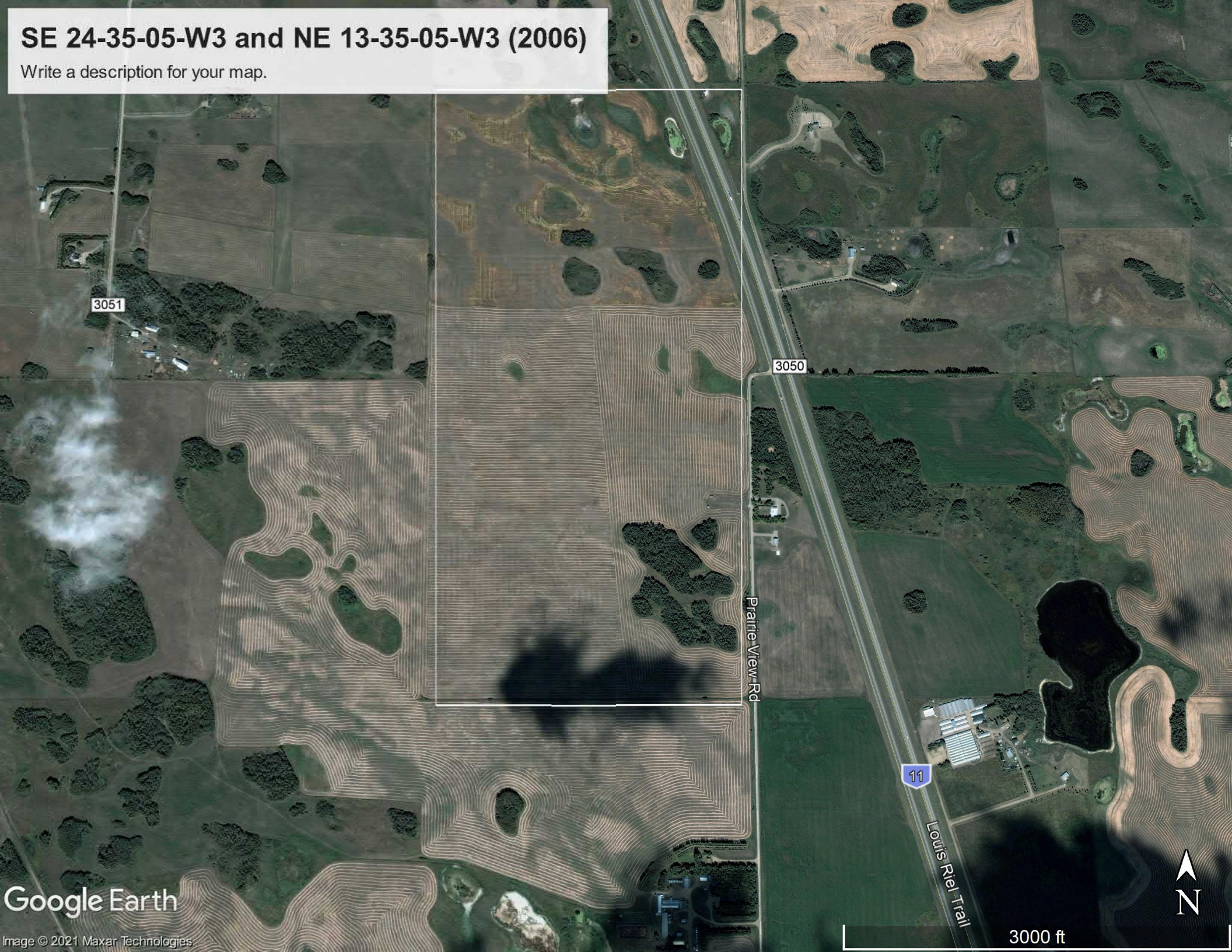
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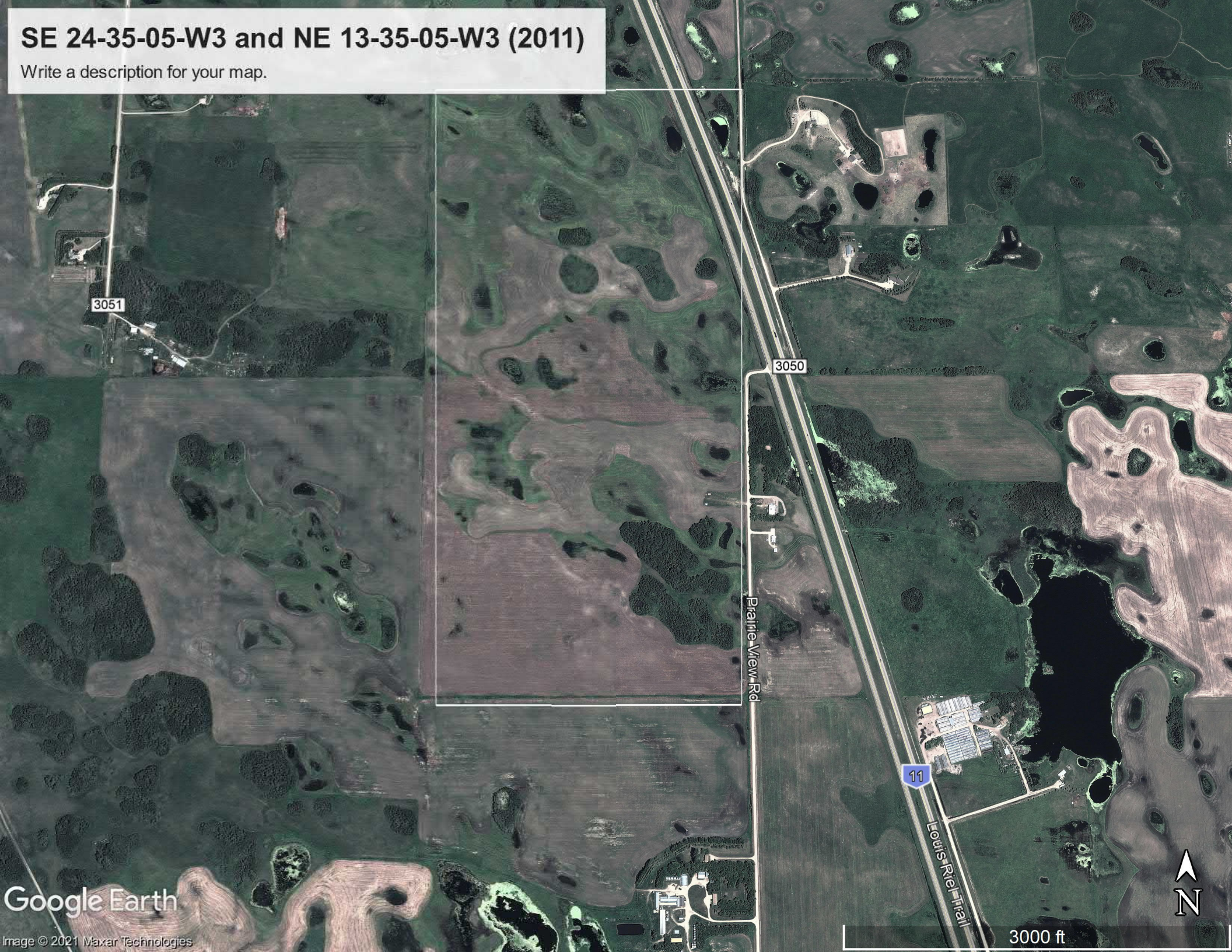


SE 24-35-05-W3 and NE 13-35-05-W3_Photo 3 - 1986


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Louis Riel Trail
N
3000 ft
Google Earth
Image © 2021 Maxar Technologies

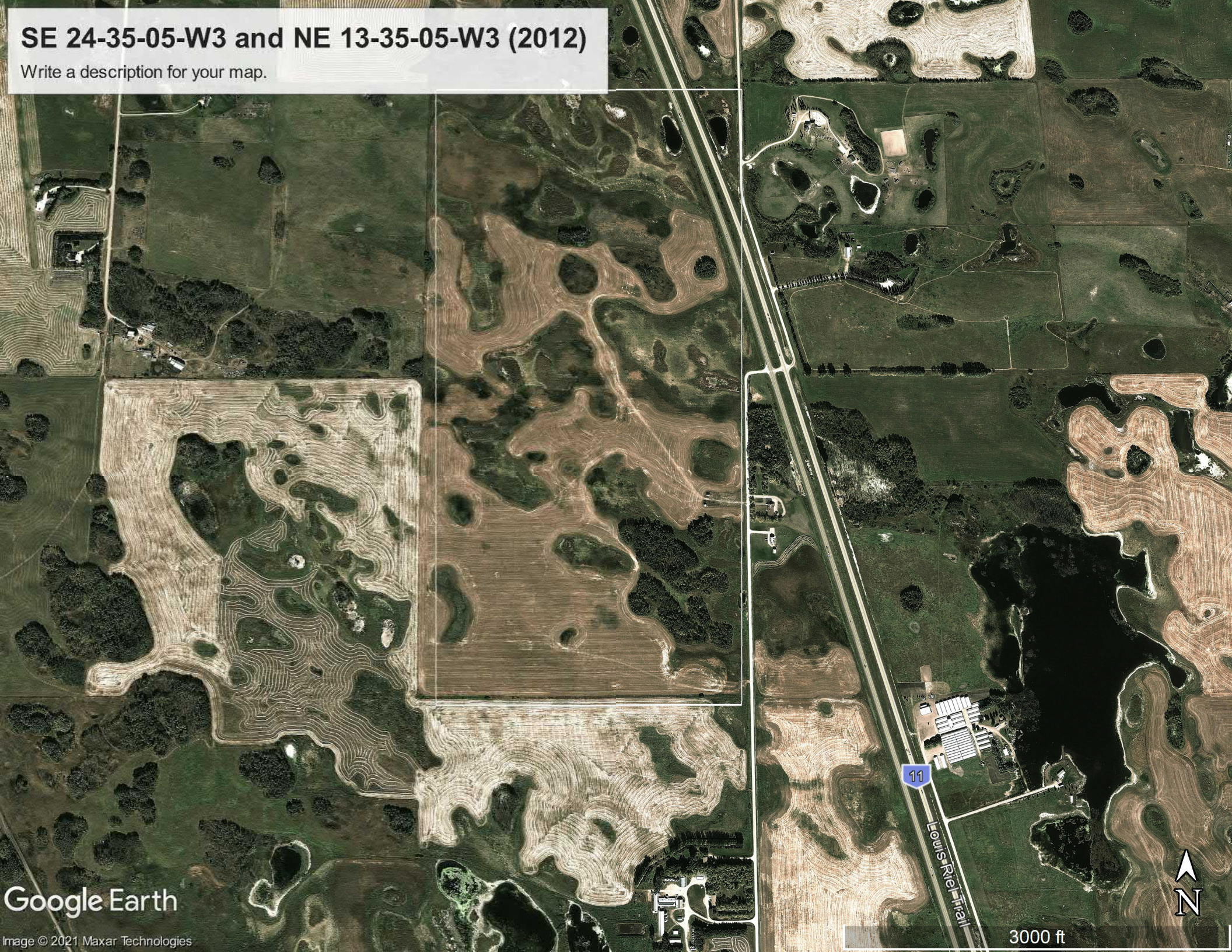

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Louis Riel Trail
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Google Earth
Image © 2021 Maxar Technologies


SE 24-35-05-W3 and NE 13-35-05-W3 (2006)
Write a description for your map.
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Louis Riel Trail
N
3000 ft
Google Earth
Image © 2021 Maxar Technologies


SE 24-35-05-W3 and NE 13-35-05-W3 (2011)
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Image © 2021 Maxar Technologies

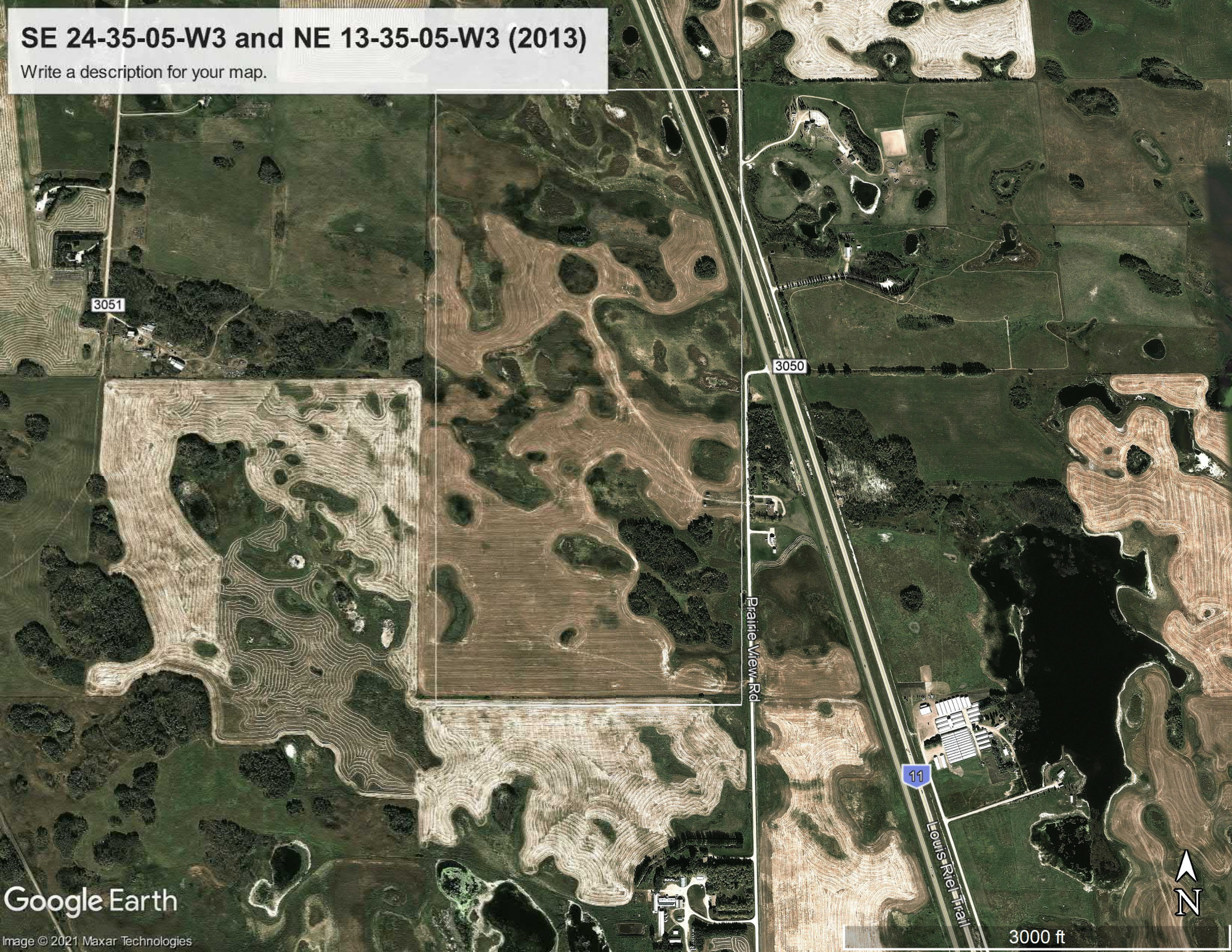
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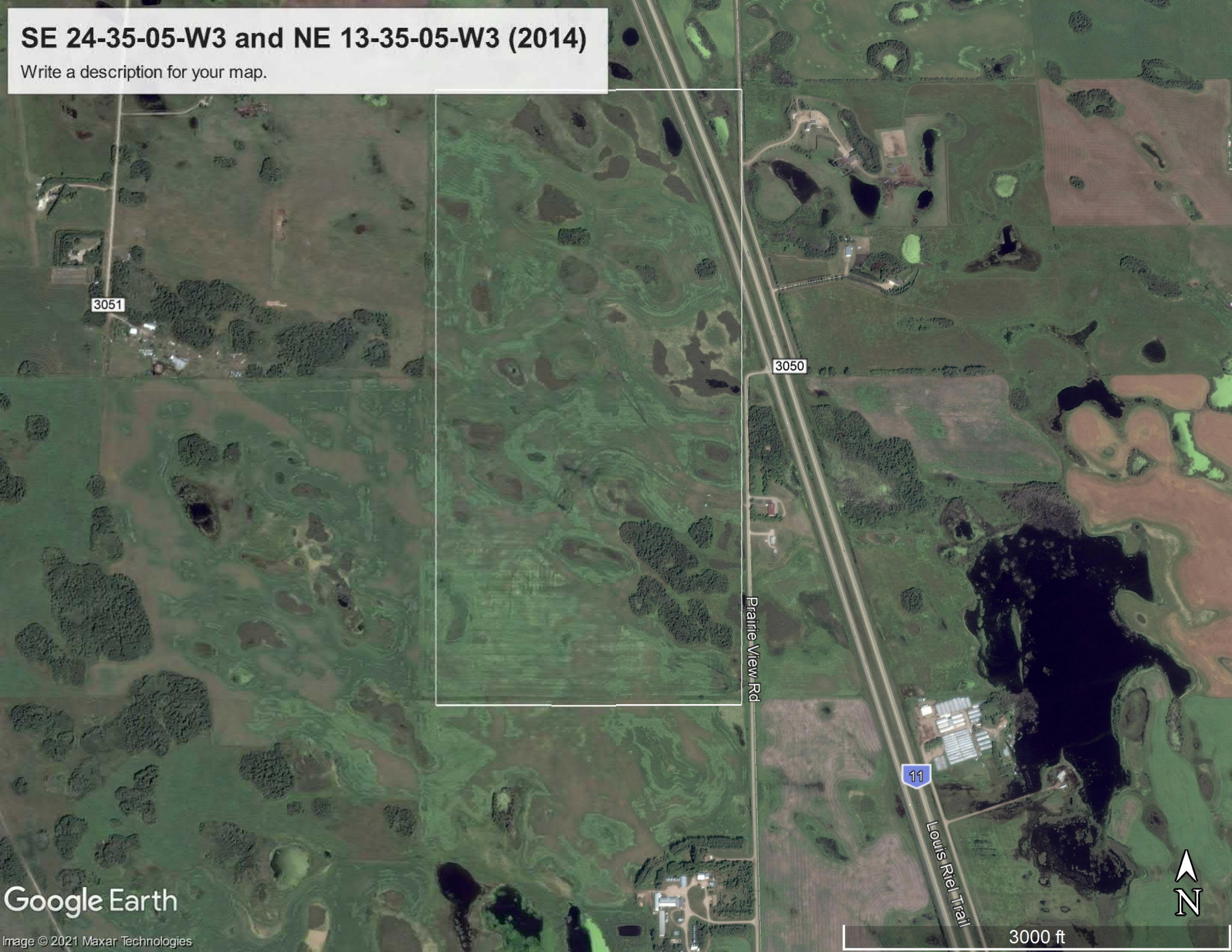
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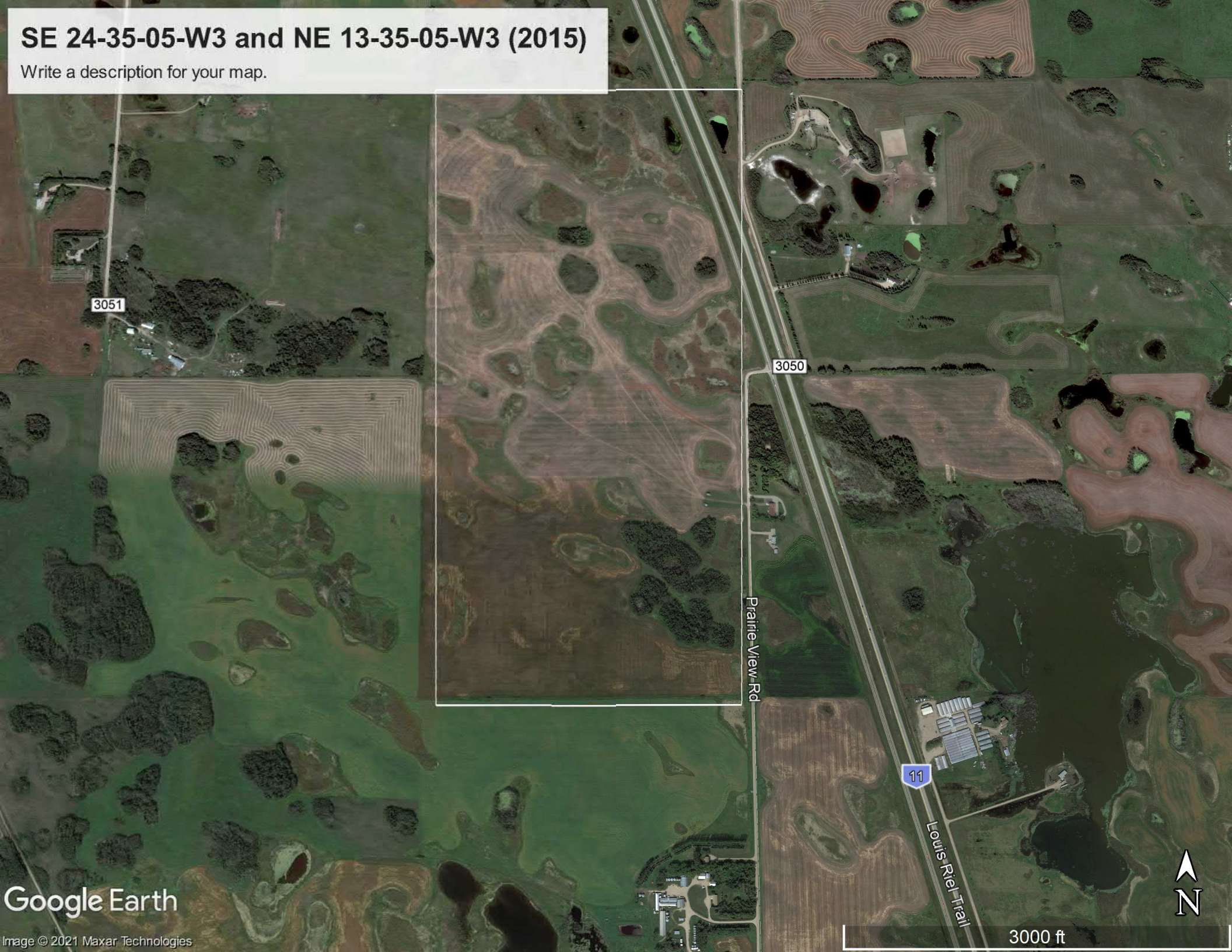


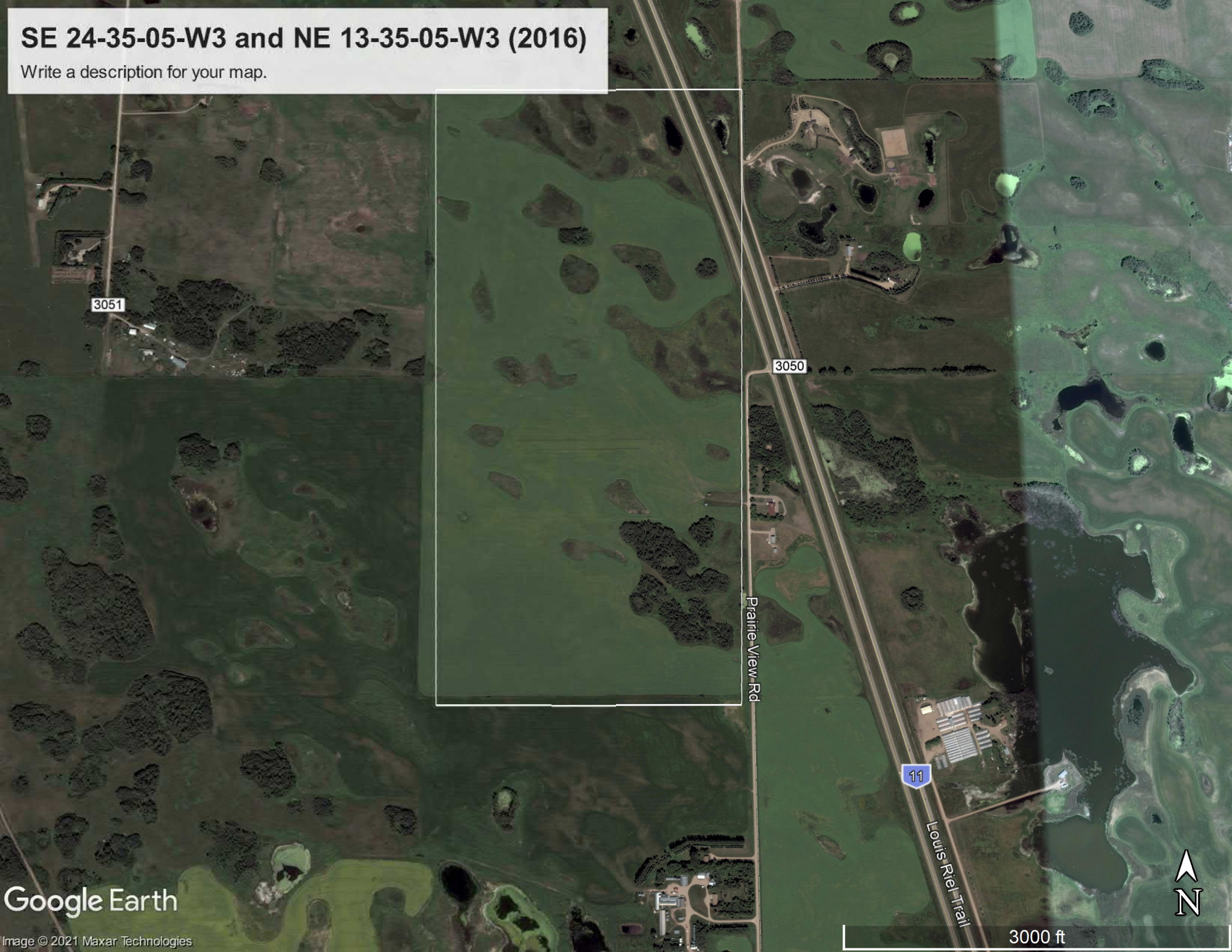
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Write a description for your map.




SE 24-35-05-W3 and NE 13-35-05-W3 (2014)
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Louis Riel Trail
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Google Earth
Image © 2021 Maxar Technologies

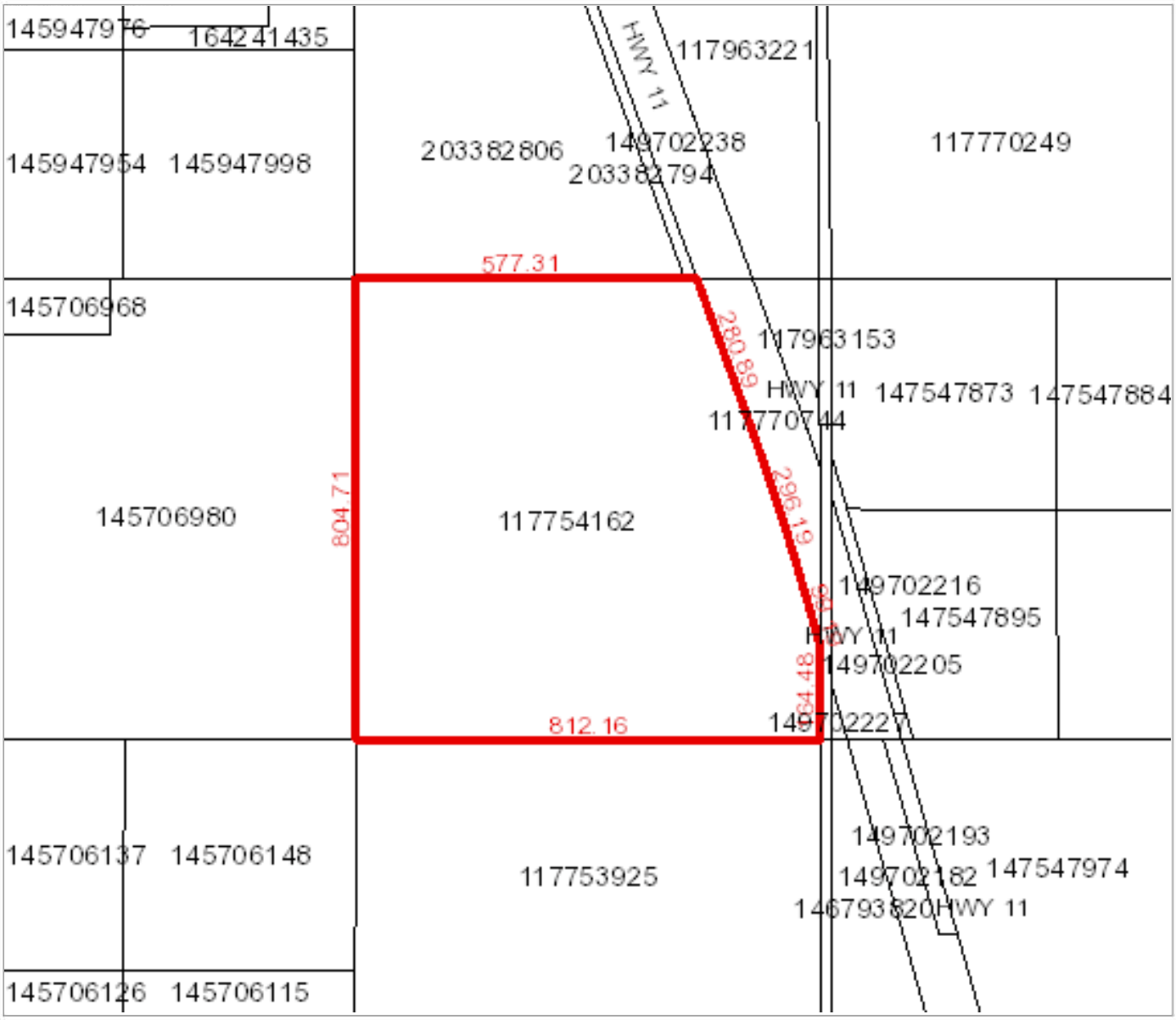

SE 24-35-05-W3 and NE 13-35-05-W3 (2015)
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Louis Riel Trail
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3000 ft
Google Earth
Image © 2021 Maxar Technologies


SE 24-35-05-W3 and NE 13-35-05-W3 (2016)
Write a description for your map.
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Prairie View Rd
11
Louis Riel Trail
N
3000 ft
Google Earth
Image © 2021 Maxar Technologies

APPENDIX C - LAND TITLES

Surface Parcel Number: 117754162

REQUEST DATE: Thu Jul 8 13:13:34 GMT-06:00 2021



Owner Name(s) : OJA HOLDINGS LTD.

Municipality : RM OF CORMAN PARK NO. 344

Area : 58.886 hectares (145.51 acres)

Title Number(s) : 154013903

Converted Title Number : 86S08303

Parcel Class : Parcel (Generic)

Ownership Share : 1:1

Land Description : SE 24-35-05-3 Ext 1

Source Quarter Section : SE-24-35-05-3

Commodity/Unit : Not Applicable

DISCLAIMER: THIS IS NOT A PLAN OF SURVEY It is a consolidation of plans to assist in identifying the location, size and shape of a parcel in relation to other parcels. Parcel boundaries and area may have been adjusted to fit with adjacent parcels. To determine actual boundaries, dimensions or area of any parcel, refer to the plan, or consult a surveyor.

Province of Saskatchewan
Land Titles Registry
Title

Title #: 154013880
Title Status: Active
Parcel Type: Surface
Parcel Value: $366,667.00 CAD
Title Value: *$366,667.00 CAD*
Converted Title: 86S08303
Previous Title and/or Abstract #: 153992571

As of: 08 Jul 2021 13:15:08
Last Amendment Date: 10 May 2021 14:46:42.550
Issued: 06 May 2021 11:05:50.200
Municipality: RM OF CORMAN PARK NO. 344

OJA HOLDINGS LTD. is the registered owner of Surface Parcel #117963153

Reference Land Description: SE Sec 24 Twp 35 Rge 05 W 3 Extension 2
As described on Certificate of Title 86S08303 which describes this parcel and other parcel(s) with the same land description tied to this one.

This title is subject to any registered interests set out below and the exceptions, reservations and interests mentioned in section 14 of *The Land Titles Act, 2000.*

Registered Interests:

Interest #:
190720065 Public Utility Easement

Value: N/A
Reg'd: 24 Oct 2012 14:41:20
Interest Register Amendment Date: N/A
Interest Assignment Date: N/A
Interest Scheduled Expiry Date: N/A
Expiry Date: N/A

Holder:
DUNDURN RURAL WATER UTILITY
BOX 442
DUNDURN, SK, Canada S0K 1K0
Client #: 118404312

Int. Register #: 118731551

Interest #:
190720076 Public Utility Easement

Value: N/A
Reg'd: 24 Oct 2012 14:43:09
Interest Register Amendment Date: N/A
Interest Assignment Date: N/A
Interest Scheduled Expiry Date: N/A
Expiry Date: N/A

Holder:
DUNDURN RURAL WATER UTILITY
BOX 442
DUNDURN, SK, Canada S0K 1K0
Client #: 118404312

Int. Register #: 118731584

Interest #:
190720100 Mortgage

Value: $825,000.00 CAD
Reg'd: 06 May 2021 11:05:51
Interest Register Amendment Date: N/A
Interest Assignment Date: N/A
Interest Scheduled Expiry Date: N/A
Expiry Date: N/A

Holder:
AFFINITY CREDIT UNION 2013
PO BOX 1330
SASKATOON, Saskatchewan, Canada S7K 3P4
Client #: 133829028

Int. Register #: 124512027

Interest #:
190748784 Assignment of Rents

Value: N/A
Reg'd: 10 May 2021 14:46:43
Interest Register Amendment Date: N/A
Interest Assignment Date: N/A
Interest Scheduled Expiry Date: N/A
Expiry Date: N/A

Holder:
AFFINITY CREDIT UNION 2013
PO BOX 1330
SASKATOON, Saskatchewan, Canada S7K 3P4
Client #: 133829028

Int. Register #: 124518225

Addresses for Service:

Name	Address
Owner:	
OJA HOLDINGS LTD.	321 - 6th AVENUE NORTH SASKATOON, SASKATCHEWAN, Canada S7K 2S3

Client #: 122205237

Notes:

Under The Planning and Development Act, 2007, the title for this parcel and parcels 117754162 may not be transferred or, in certain circumstances, mortgaged or leased separately without the approval of the appropriate planning authority.

Parcel Class Code: Parcel (Generic)

Back

Back to top

Search Results

Search By: Title History

With Criteria: Title Number = 154013880
As Of Date = 08 Jul 2021 13:15:08

Title History

Number	Type	Parcel	Owner(s)
154013880	Surface Regular	117963153	OJA HOLDINGS LTD.

Transferred From

Number	Type	Parcel	Owner(s)
153992571	Surface Regular	117963153	Richard King

Transferred To

N/A

Back to top

Search Results

Search By: Title Audit
With Criteria: Title Number = 154013880

Audit Results

Date	Action / Request	Details
06 May 2021 11:05:50.200	Application for Transfer (Form II: Setup) 116268082	Type: Surface Regular Status: Active Share: 1/1 Title Value: $366,667.00 CAD Commodity: N/A Unit: N/A Common Property: N/A
06 May 2021 11:05:50.480	Application for Transfer (Form II: Setup) 116268082	Number: 190720065 Description: PU Easement
06 May 2021 11:05:50.497	Application for Transfer (Form II: Setup) 116268082	Number: 190720076 Description: PU Easement
06 May 2021 11:05:50.513	Application for Transfer (Form II: Setup) 116268082	Number: 190720087 Description: Miscellaneous Intere
06 May 2021 11:05:50.967	Application for Interest Registration 116268084	Number: 190720100 Description: Mortgage - General
06 May 2021 11:05:51.340	Application for Interest Discharge 116268085	Number: 190720087 Description: Miscellaneous Intere
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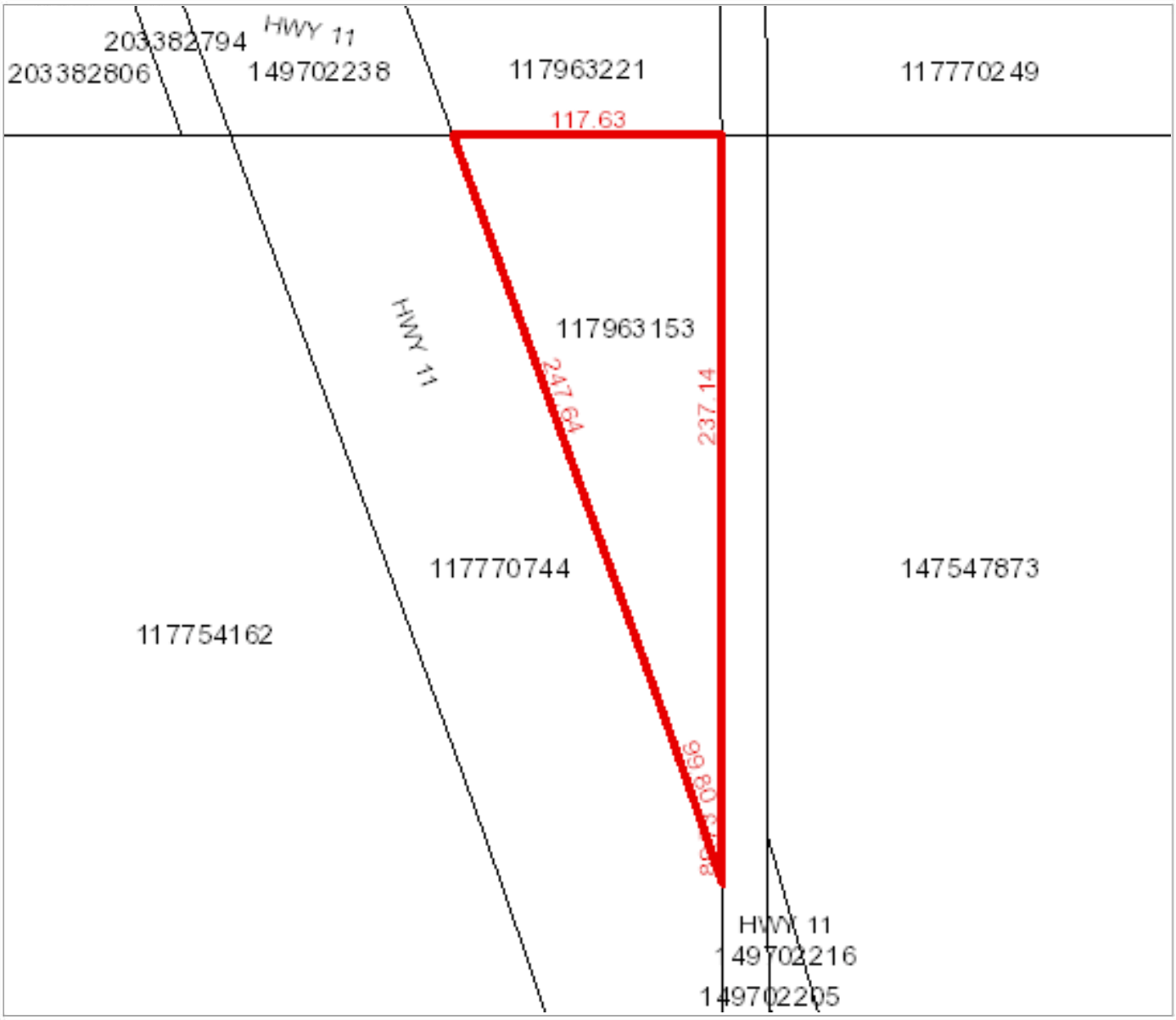
Owner Changes

Date	Name	Address
19 Feb 2020 14:35:33.377	OJA HOLDINGS LTD.	321 - 6th AVENUE NORTH, SASKATOON, SASKATCHEWAN, Canada, S7K2S3

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Surface Parcel Number: 117963153

REQUEST DATE: Thu Jul 8 13:14:09 GMT-06:00 2021



Owner Name(s) : OJA HOLDINGS LTD.

Municipality : RM OF CORMAN PARK NO. 344

Area : 1.907 hectares (4.71 acres)

Title Number(s) : 154013880

Converted Title Number : 86S08303

Parcel Class : Parcel (Generic)

Ownership Share : 1:1

Land Description : SE 24-35-05-3 Ext 2

Source Quarter Section : SE-24-35-05-3

Commodity/Unit : Not Applicable

DISCLAIMER: THIS IS NOT A PLAN OF SURVEY It is a consolidation of plans to assist in identifying the location, size and shape of a parcel in relation to other parcels. Parcel boundaries and area may have been adjusted to fit with adjacent parcels. To determine actual boundaries, dimensions or area of any parcel, refer to the plan, or consult a surveyor.

Province of Saskatchewan
Land Titles Registry
Title

Title #: 154013903
Title Status: Active
Parcel Type: Surface
Parcel Value: $366,667.00 CAD
Title Value: *$366,667.00 CAD*
Converted Title: 86S08303
Previous Title and/or Abstract #: 153992560

As of: 08 Jul 2021 13:20:03
Last Amendment Date: 10 May 2021 14:46:42.630
Issued: 06 May 2021 11:05:50.560
Municipality: RM OF CORMAN PARK NO. 344

OJA HOLDINGS LTD. is the registered owner of Surface Parcel #117754162

Reference Land Description: SE Sec 24 Twp 35 Rge 05 W 3 Extension 1
As described on Certificate of Title 86S08303 which describes this parcel and other parcel(s) with the same land description tied to this one.

This title is subject to any registered interests set out below and the exceptions, reservations and interests mentioned in section 14 of *The Land Titles Act, 2000.*

Registered Interests:

Interest #:
190720111 Mortgage

Value: $825,000.00 CAD
Reg'd: 06 May 2021 11:05:51
Interest Register Amendment Date: N/A
Interest Assignment Date: N/A
Interest Scheduled Expiry Date: N/A
Expiry Date: N/A

Holder:
AFFINITY CREDIT UNION 2013
PO BOX 1330
SASKATOON, Saskatchewan, Canada S7K 3P4
Client #: 133829028

Int. Register #: 124512027

Interest #:
190748795 Assignment of Rents

Value: N/A
Reg'd: 10 May 2021 14:46:43
Interest Register Amendment Date: N/A
Interest Assignment Date: N/A
Interest Scheduled Expiry Date: N/A
Expiry Date: N/A

Holder:
AFFINITY CREDIT UNION 2013
PO BOX 1330
SASKATOON, Saskatchewan, Canada S7K 3P4
Client #: 133829028

Int. Register #: 124518225

Addresses for Service:

Name	Address
Owner:	
OJA HOLDINGS LTD.	321 - 6th AVENUE NORTH SASKATOON, SASKATCHEWAN, Canada S7K 2S3

Client #: 122205237

Notes:

Under The Planning and Development Act, 2007, the title for this parcel and parcels 117963153 may not be transferred or, in certain circumstances, mortgaged or leased separately without the approval of the appropriate planning authority.

Parcel Class Code: Parcel (Generic)

Back

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Search Results

Search By: Title History

With Criteria: Title Number = 154013903
As Of Date = 08 Jul 2021 13:20:03

Title History

Number	Type	Parcel	Owner(s)
154013903	Surface Regular	117754162	OJA HOLDINGS LTD.

Transferred From

Number	Type	Parcel	Owner(s)
153992560	Surface Regular	117754162	Richard King

Transferred To

N/A

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Search Results

Search By: Title Audit
With Criteria: Title Number = 154013903

Audit Results

Date	Action / Request	Details
06 May 2021 11:05:50.560	Application for Transfer (Form II: Setup) 116268083	Type: Surface Regular Status: Active Share: 1/1 Title Value: $366,667.00 CAD Commodity: N/A Unit: N/A Common Property: N/A
06 May 2021 11:05:50.717	Application for Transfer (Form II: Setup) 116268083	Number: 190720098 Description: Miscellaneous Intere
06 May 2021 11:05:50.997	Application for Interest Registration 116268084	Number: 190720111 Description: Mortgage - General
06 May 2021 11:05:51.357	Application for Interest Discharge 116268085	Number: 190720098 Description: Miscellaneous Intere
10 May 2021 14:46:42.597	Application for Interest Registration 116275020	Number: 190748795 Description: Assignment of Rents

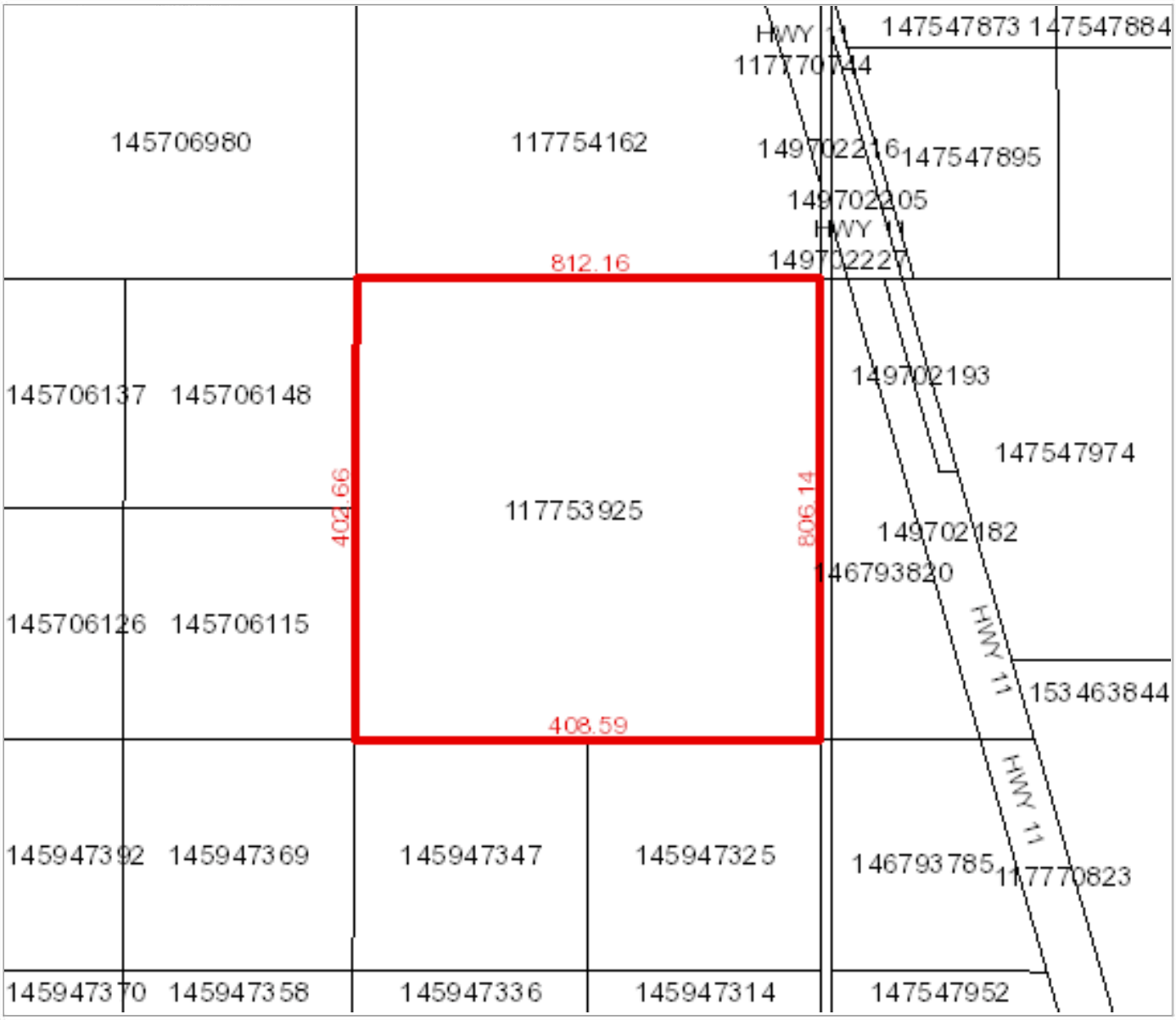
Owner Changes

Date	Name	Address
19 Feb 2020 14:35:33.377	OJA HOLDINGS LTD.	321 - 6th AVENUE NORTH, SASKATOON, SASKATCHEWAN, Canada, S7K2S3

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Surface Parcel Number: 117753925

REQUEST DATE: Thu Jul 8 13:24:39 GMT-06:00 2021



Owner Name(s) : OJA HOLDINGS LTD.

Municipality : RM OF CORMAN PARK NO. 344

Area : 65.64 hectares (162.2 acres)

Title Number(s) : 154013879

Converted Title Number : 86S08303

Parcel Class : Parcel (Generic)

Ownership Share : 1:1

Land Description : NE 13-35-05-3 Ext 0

Source Quarter Section : NE-13-35-05-3

Commodity/Unit : Not Applicable

DISCLAIMER: THIS IS NOT A PLAN OF SURVEY It is a consolidation of plans to assist in identifying the location, size and shape of a parcel in relation to other parcels. Parcel boundaries and area may have been adjusted to fit with adjacent parcels. To determine actual boundaries, dimensions or area of any parcel, refer to the plan, or consult a surveyor.

Province of Saskatchewan
Land Titles Registry
Title

Title #: 154013879
Title Status: Active
Parcel Type: Surface
Parcel Value: $366,666.00 CAD
Title Value: *$366,666.00 CAD*
Converted Title: 86S08303
Previous Title and/or Abstract #: 153992582

As of: 08 Jul 2021 13:26:09
Last Amendment Date: 10 May 2021 14:46:42.707
Issued: 06 May 2021 11:05:50.043
Municipality: RM OF CORMAN PARK NO. 344

OJA HOLDINGS LTD. is the registered owner of Surface Parcel #117753925

Reference Land Description: NE Sec 13 Twp 35 Rge 05 W 3 Extension 0
As described on Certificate of Title 86S08303.

This title is subject to any registered interests set out below and the exceptions, reservations and interests mentioned in section 14 of *The Land Titles Act, 2000.*

Registered Interests:

Interest #:
190720122 Mortgage

Value: $825,000.00 CAD
Reg'd: 06 May 2021 11:05:51
Interest Register Amendment Date: N/A
Interest Assignment Date: N/A
Interest Scheduled Expiry Date: N/A
Expiry Date: N/A

Holder:
AFFINITY CREDIT UNION 2013
PO BOX 1330
SASKATOON, Saskatchewan, Canada S7K 3P4
Client #: 133829028

Int. Register #: 124512027

Interest #:
190748773 Assignment of Rents

Value: N/A
Reg'd: 10 May 2021 14:46:42
Interest Register Amendment Date: N/A
Interest Assignment Date: N/A
Interest Scheduled Expiry Date: N/A
Expiry Date: N/A

Holder:
AFFINITY CREDIT UNION 2013
PO BOX 1330
SASKATOON, Saskatchewan, Canada S7K 3P4
Client #: 133829028

Int. Register #: 124518225

Addresses for Service:

Name Owner:	Address
OJA HOLDINGS LTD.	321 - 6th AVENUE NORTH SASKATOON, SASKATCHEWAN, Canada S7K 2S3

Client #: 122205237

Notes:

Parcel Class Code: Parcel (Generic)

Back

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Search Results

Search By: Title History

With Criteria: Title Number = 154013879
As Of Date = 08 Jul 2021 13:26:09

Title History

Number	Type	Parcel	Owner(s)
154013879	Surface Regular	117753925	OJA HOLDINGS LTD.

Transferred From

Number	Type	Parcel	Owner(s)
153992582	Surface Regular	117753925	Richard King

Transferred To

N/A

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Search Results

Search By: Title Audit
With Criteria: Title Number = 154013879

Audit Results

Date	Action / Request	Details
06 May 2021 11:05:50.043	Application for Transfer (Form II: Setup) 116268081	Type: Surface Regular Status: Active Share: 1/1 Title Value: $366,666.00 CAD Commodity: N/A Unit: N/A Common Property: N/A
06 May 2021 11:05:50.170	Application for Transfer (Form II: Setup) 116268081	Number: 190720054 Description: Miscellaneous Intere
06 May 2021 11:05:50.950	Application for Interest Registration 116268084	Number: 190720122 Description: Mortgage - General
06 May 2021 11:05:51.323	Application for Interest Discharge 116268085	Number: 190720054 Description: Miscellaneous Intere
10 May 2021 14:46:42.487	Application for Interest Registration 116275020	Number: 190748773 Description: Assignment of Rents

Owner Changes

Date	Name	Address
19 Feb 2020 14:35:33.377	OJA HOLDINGS LTD.	321 - 6th AVENUE NORTH, SASKATOON, SASKATCHEWAN, Canada, S7K2S3

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APPENDIX D – HAZARDOUS MATERIALS & SPILL SEARCHES

Hazardous Substance Storage Facility Search

Hazardous Storage Search Results

Your search for Hazardous Storage matching keyword with the Legal Land Description NE-13-35-05-3 produced *no results*

Back to Search

Spill/Incident Number Operation ID	Operation Name	Address	Legal Land Description	Operation Status

No Results were found matching your required search parameters.

Hazardous Substance Storage Facility Search

Hazardous Storage Search Results

Your search for Hazardous Storage matching keyword with the Legal Land Description NE-13-35-05-3 produced *no results*

Back to Search

Spill/Incident Number Operation ID	Operation Name	Address	Legal Land Description	Operation Status

No Results were found matching your required search parameters.

Hazardous Substance Storage Facility Search

Hazardous Storage Search Results

Your search for Hazardous Storage matching keyword with the Legal Land Description SE-24-35-05-3 produced *no results*

Back to Search

Spill/Incident Number Operation ID	Operation Name	Address	Legal Land Description	Operation Status

No Results were found matching your required search parameters.

Hazardous Substance Storage Facility Search

Hazardous Storage Search Results

Your search for Hazardous Storage matching keyword with the Legal Land Description SE-24-35-05-3 produced *no results*

Back to Search

Spill/Incident Number Operation ID	Operation Name	Address	Legal Land Description	Operation Status

No Results were found matching your required search parameters.

APPENDIX E - PREVIOUS ENVIRONMENTAL REPORTS

Ministry of Environment
Environmental Protection Branch
102 – 112 Research Drive
SASKATOON Canada S7N 3R3

June 22, 2021

Chelsea Cooke
Associated Environmental Consultants Inc.
1922 Park Street
REGINA SK S4N 7M4

Dear Chelsea Cooke:

RE: Access Request ENV 235/21

Thank you for your access to information request received in this office on June 17, 2021, requesting:

> *"All environmental information including tanks, spills, environmental infractions/complaints/orders, site assessments, remediation plans/reports, environmental investigations/remediation, site plans and fires for SE-24-35 05-W3."*

This is to advise that we do not have any records responsive to your request.

If you wish to request a review of this action, you may do so within one year of this notice. To request a review, please complete a "Request for Review" form which is available at the same location where you applied for access. Your request should be sent to:

Information and Privacy Commissioner
#503 – 1801 Hamilton Street
REGINA SK S4P 4B4

Sincerely,

Dean Hales, Freedom of Information Coordinator
Environmental Protection Branch

Ministry of Environment
Environmental Protection Branch
102 – 112 Research Drive
SASKATOON Canada S7N 3R3

June 22, 2021

Chelsea Cooke
Associated Environmental Consultants Inc.
1922 Park Street
REGINA SK S4N 7M4

Dear Chelsea Cooke:

RE: Access Request ENV 236/21

Thank you for your access to information request received in this office on June 17, 2021, requesting:

> *"All environmental information including tanks, spills, environmental infractions/complaints/orders, site assessments, remediation plans/reports, environmental investigations/remediation, site plans and fires for NE-13-35-05-W3."*

This is to advise that we do not have any records responsive to your request.

If you wish to request a review of this action, you may do so within one year of this notice. To request a review, please complete a "Request for Review" form which is available at the same location where you applied for access. Your request should be sent to:

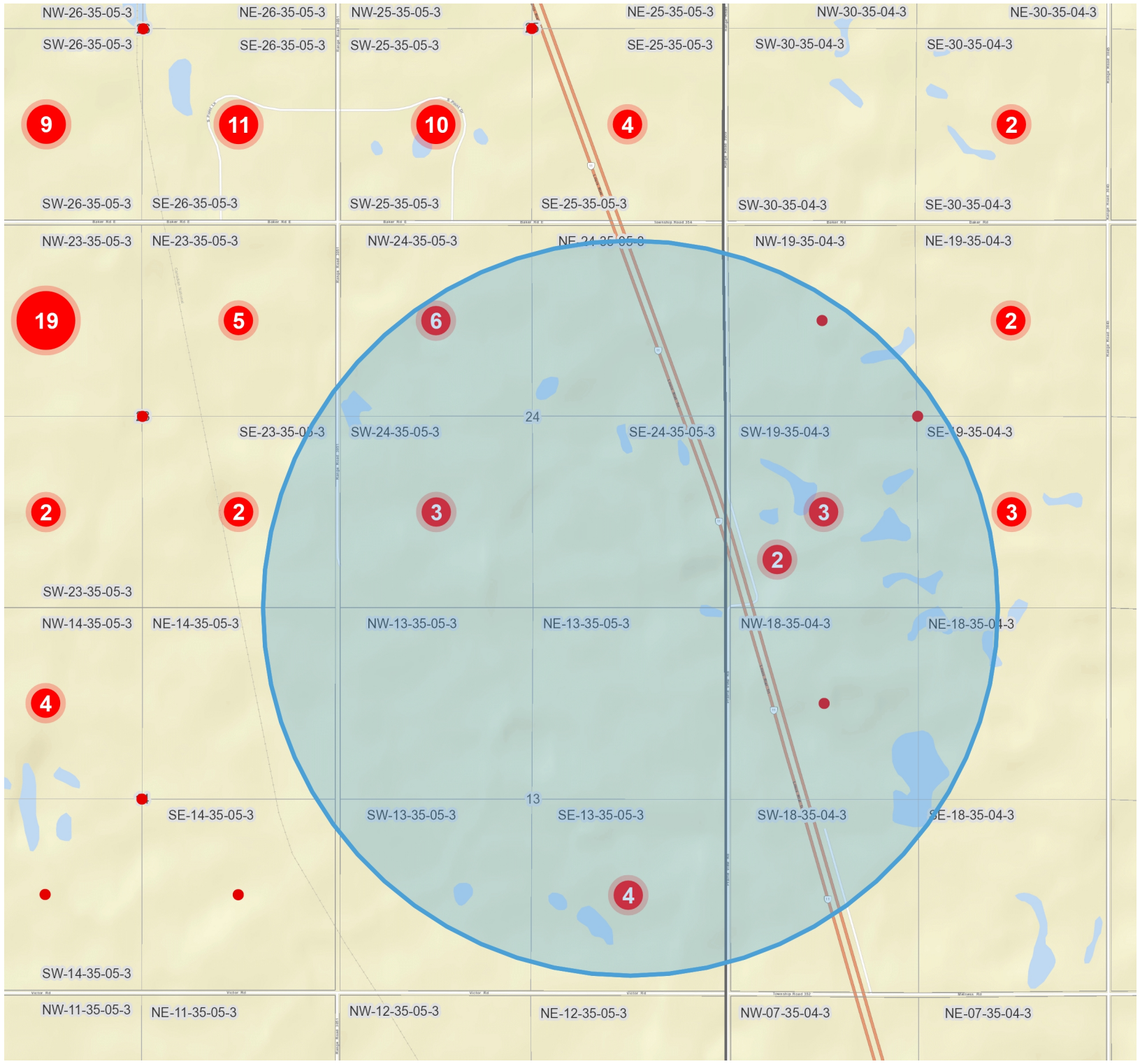
Information and Privacy Commissioner
#503 – 1801 Hamilton Street
REGINA SK S4P 4B4

Sincerely,

Dean Hales

Dean Hales, Freedom of Information Coordinator
Environmental Protection Branch

APPENDIX F - NEIGHBOURING WELLS LOGS AND MAP



Wells - Within 500 m of SE24-35-05-W3 and NE13-35-05-W3

Notes

Projection:

WGS_1984_Web_Mercator_Auxiliary_Sphere

Scale:

1: 36,112

Date

2-Jul-21

Copyright:

Map © 2021 , Government of Saskatchewan

All Datasets ©2021 , Government of Saskatchewan.

Disclaimer:

WSA prepares maps with varying degrees of accuracy and completeness dependant on the circumstances and available data. WSA makes no representation that this map will be sufficient for all uses. The user is advised to confirm the information contained herein in the event that precision and currency of data are required.

Water Security Agency

Water Well Driller's Report

2-Jul-2021

WSaskWWDR01

(c) Water Security Agency

Well Name: **BOEHMLER** WWDR #: **014488**

Well Location

Land Location	**SW-24-035 -05 -W3**	Location of Well (in Quarter)	
LSD	**00**	**0** ft from N/S Boundary	
Reserve		**0** ft from E/W Boundary	
RM:			
NTS Map:	**73B00**	Major Basin:	**06**
Elevation (ft)	**1675**	SubBasin:	**30**
Aquifer			

Well Information

Driller	**WIG'S SANDPOINT DRILLING**
Completion Date	**1974.05.09**
Hole #	**001**
Install Method	**Jetted**
Borehole Depth (ft)	**27**
Bit Dia (in)	**1.5**
Water Level	**8**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Sand Point**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
0	**24**	**1.5**	**Plastic**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

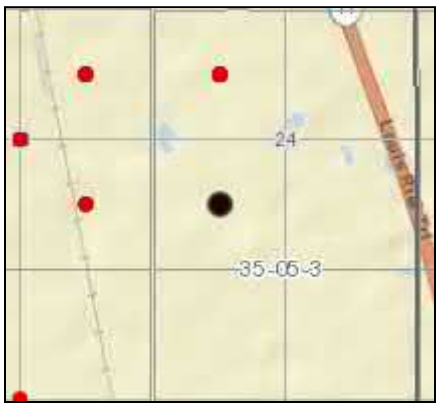
Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
3	**27**	**1.5**	**10**	**Plastic**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**0**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**10**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
8	Clay	Grey	Hard
27	Sand	Brown	Coarse



Water Well Driller's Report

2-Jul-2021

WSaskWWDR01

(c) Water Security Agency

Well Name: **KRISTIANSEN** WWDR #: **014489**

Well Location

Land Location	**NW-24-035 -05 -W3**	Location of Well (in Quarter)	
LSD	**00**	**0** ft from N/S Boundary	
Reserve		**0** ft from E/W Boundary	
RM:			
NTS Map:	**73B00**	Major Basin:	**06**
Elevation (ft)	**1675**	SubBasin:	**30**
Aquifer			

Well Information

Driller	**WIG'S SANDPOINT DRILLING**
Completion Date	**1974.05.09**
Hole #	**001**
Install Method	**Jetted**
Borehole Depth (ft)	**28**
Bit Dia (in)	**2**
Water Level	**13**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Sand Point**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
0	**26**	**1.5**	**Plastic**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

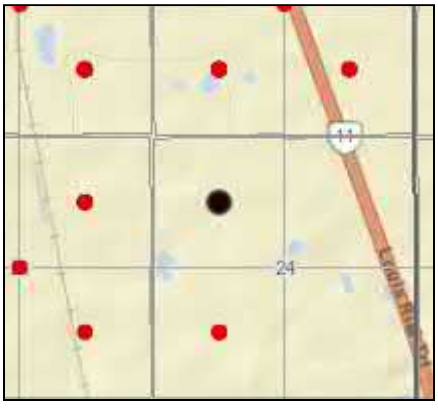
Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
3	**28**	**2**	**10**	**Plastic**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**5**	hrs
Pumping Rate	**6**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**6**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
13	Clay	Brown	Unknown
28	Sand	Grey	Medium



Water Well Driller's Report

2-Jul-2021

WSaskWWDR01

(c) Water Security Agency

Well Name: **SASK RESEARCH COUNCIL** WWDR #: **031757**

Well Location

Land Location	**SW-19-035 -04 -W3**	Location of Well (in Quarter)	
LSD	**00**	**0** ft from N/S Boundary	
Reserve		**0** ft from E/W Boundary	
RM:			
NTS Map:	**73B00**	Major Basin:	**06**
Elevation (ft)	**1680**	SubBasin:	**30**
Aquifer			

Well Information

Driller	**ELK POINT DRILLING CORP**
Completion Date	**1966.09.01**
Hole #	
Install Method	**Drilled**
Borehole Depth (ft)	**464**
Bit Dia (in)	**0**
Water Level	**0**
Flowing Head	**0**
Water Use	**Research**
Well Use	**Water Test Hole**
Completion Method	
E-Log	**SCANNED**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
0	**0**	**0**	
0	**0**	**0**	
0	**0**	**0**	

Well Screens

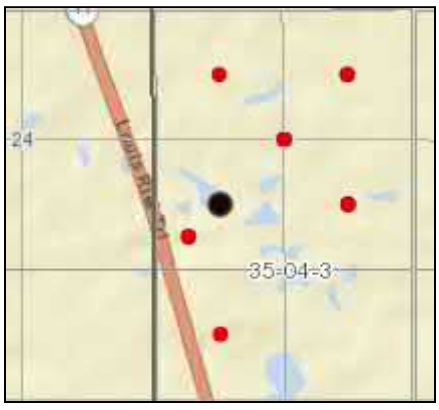
Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**0**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**0**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
4	Sand	Unknown	Oxidized
87	Silty Clay	Unknown	Unoxidized
446	Till	Unknown	Unoxidized
464	Clay	Unknown	Noncalcareous



Water Well Driller's Report

2-Jul-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **KRISTIANSEN** WWDR #: **043814**

Well Location

Land Location	**NW-24-035 -05 -W3**	Location of Well (in Quarter)	
LSD	**00**	**0** ft from N/S Boundary	
Reserve		**0** ft from E/W Boundary	
RM:			
NTS Map:	**73B00**	Major Basin:	**06**
Elevation (ft)	**1675**	SubBasin:	**30**
Aquifer			

Well Information

Driller	**WIG'S SANDPOINT DRILLING**
Completion Date	**1975.04.25**
Hole #	**001**
Install Method	**Jetted**
Borehole Depth (ft)	**27**
Bit Dia (in)	**1.5**
Water Level	**13**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Sand Point**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
0	**27**	**1.5**	**A.B.S.**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

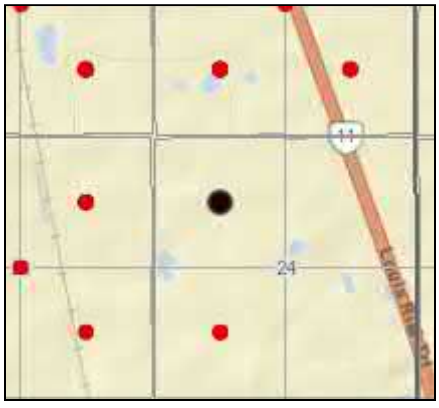
Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
0	**0**	**0**	**0**	**Plastic**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**0**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**6**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
13	Sandy Clay	Unknown	Hard
20	Sandy Clay	Brown	Unknown
27	Sand	Unknown	Unknown



Water Well Driller's Report

2-Jul-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **BOEHMER** WWDR #: **047554**

Well Location

Land Location	**NW-24-035 -05 -W3**	Location of Well (in Quarter)	
LSD	**00**	**0** ft from N/S Boundary	
Reserve		**0** ft from E/W Boundary	
RM:			
NTS Map:	**73B00**	Major Basin:	**06**
Elevation (ft)	**1675**	SubBasin:	**30**
Aquifer			

Well Information

Driller	**WIG'S SANDPOINT DRILLING**
Completion Date	**1975.05.20**
Hole #	**001**
Install Method	**Jetted**
Borehole Depth (ft)	**57**
Bit Dia (in)	**2**
Water Level	**41**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Sand Point**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
0	**54**	**2**	**A.B.S.**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

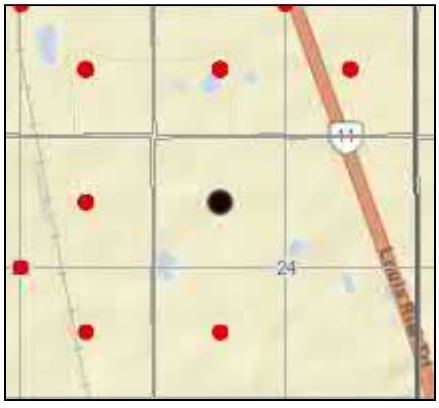
Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
3	**57**	**2**	**10**	**Plastic**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**0**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**4**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
57	Sandy Clay	Unknown	Water



Water Well Driller's Report

2-Jul-2021

WSaskWWDR01

(c) Water Security Agency

Well Name: **BLY** WWDR #: **048671**

Well Location

Land Location	**SE-13-035 -05 -W3**	Location of Well (in Quarter)		
LSD	**00**	**700**	ft from N/S Boundary	**S**
Reserve		**500**	ft from E/W Boundary	**E**
RM:				
NTS Map:	**73B00**	Major Basin:	**06**	
Elevation (ft)	**1675**	SubBasin:	**30**	
Aquifer				

Well Information

Driller	**WIG'S SANDPOINT DRILLING**
Completion Date	**1976.11.09**
Hole #	**001**
Install Method	**Bored**
Borehole Depth (ft)	**50**
Bit Dia (in)	**30**
Water Level	**16**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Curbed**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
0	**50**	**30**	**Steel Curbing**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

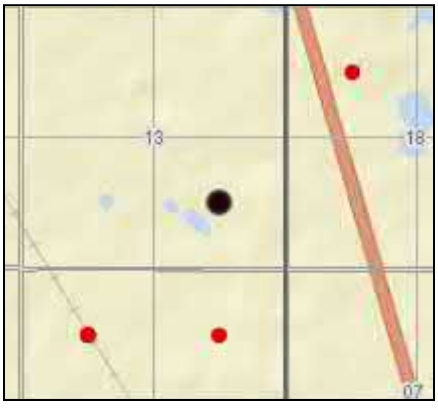
Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**29**	ft
Duration	**5**	hrs
Pumping Rate	**8**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**4**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
1	Topsoil	Unknown	Dry
26	Clay	Yellow	Dry
35	Sandy Clay	Unknown	Water
50	Clay	Unknown	Wet



Water Well Driller's Report

2-Jul-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **BOOEHMLER** WWDR #: **049257**

Well Location

Land Location	**SW-24-035 -05 -W3**	Location of Well (in Quarter)	
LSD	**00**	**0** ft from N/S Boundary	
Reserve		**0** ft from E/W Boundary	
RM:			
NTS Map:	**73B00**	Major Basin:	**06**
Elevation (ft)	**1675**	SubBasin:	**30**
Aquifer			

Well Information

Driller	**PRAIRIE WATER LTD**
Completion Date	**1977.04.14**
Hole #	
Install Method	**Bored**
Borehole Depth (ft)	**26**
Bit Dia (in)	**36**
Water Level	**0**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Curbed**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
26	**0**	**36**	**Porous Concrete**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

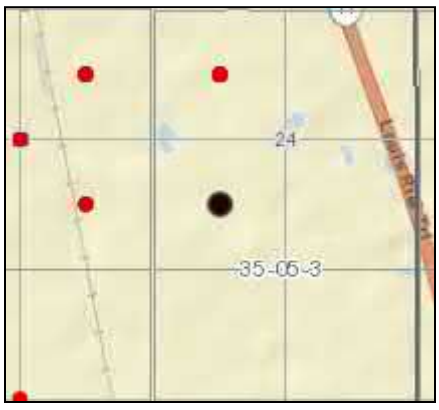
Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**0**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**0**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
8	Sandy Clay	Brown	Unknown
26	Sand	Brown	Unknown



Water Well Driller's Report

2-Jul-2021

WSaskWWDR01

(c) Water Security Agency

Well Name: **BLY** WWDR #: **051139**

Well Location

Land Location	**SE-13-035 -05 -W3**	Location of Well (in Quarter)	
LSD	**00**	**0** ft from N/S Boundary	
Reserve		**0** ft from E/W Boundary	
RM:			
NTS Map:	**73B00**	Major Basin:	**06**
Elevation (ft)	**1675**	SubBasin:	**30**
Aquifer			

Well Information

Driller	**TWEIDT WELLBORING SERVICING LTD**
Completion Date	**1977.08.10**
Hole #	
Install Method	**Bored**
Borehole Depth (ft)	**80**
Bit Dia (in)	**30**
Water Level	**0**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Curbed**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
0	**80**	**30**	**Galvanized Iron**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

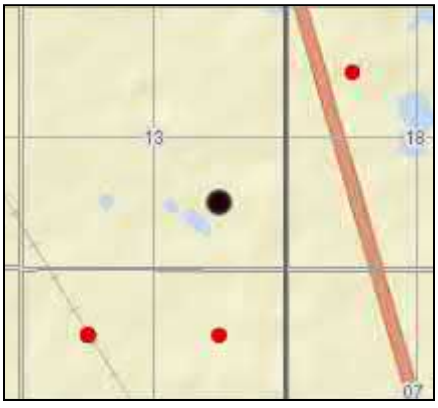
Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**4**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**0**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
2	Topsoil	Unknown	Unknown
16	Sand	Yellow	Dry
27	Sand	Yellow	Water
30	Clay	Blue	Wet
35	Sand	Black	Water
45	Clay	Blue	Wet
80	Clay	Blue	Soft



Water Well Driller's Report

2-Jul-2021

WSaskWWDR01

(c) Water Security Agency

Well Name: **BLY** WWDR #: **064131**

Well Location

Land Location	**SE-13-035 -05 -W3**	Location of Well (in Quarter)	
LSD	**00**	**0** ft from N/S Boundary	
Reserve		**0** ft from E/W Boundary	
RM:			
NTS Map:	**73B00**	Major Basin:	**06**
Elevation (ft)	**1675**	SubBasin:	**30**
Aquifer			

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**1980.11.12**
Hole #	
Install Method	**Bored**
Borehole Depth (ft)	**95**
Bit Dia (in)	**40**
Water Level	**12**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Curbed**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
97	**95**	**30**	**Galvanized Iron**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

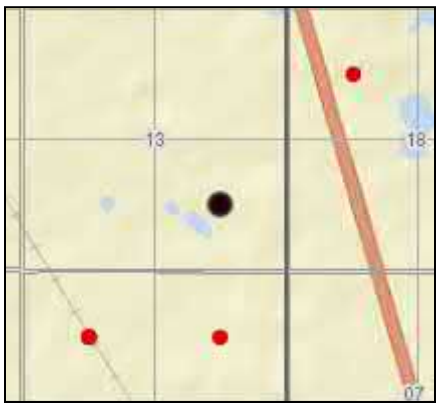
Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**0**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**0**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
12	Sand	Brown	Unknown
18	Silt	Grey	Unknown
24	Sand	Brown	Fine
35	Sand	Grey	Fine
45	Sand	Grey	Fine
55	Silt	Grey	Unknown
95	Silty Clay	Grey	Unknown



Water Well Driller's Report

2-Jul-2021

WSaskWWDR01

(c) Water Security Agency

Well Name: **KRISTIANSEN** WWDR #: **077641**

Well Location

Land Location	**NW-24-035 -05 -W3**	Location of Well (in Quarter)	
LSD	**00**	**0** ft from N/S Boundary	
Reserve		**0** ft from E/W Boundary	
RM:			
NTS Map:	**73B00**	Major Basin:	**06**
Elevation (ft)	**1675**	SubBasin:	**30**
Aquifer			

Well Information

Driller	**PRAIRIE WATER LTD**
Completion Date	**1984.04.23**
Hole #	**1**
Install Method	**Bored**
Borehole Depth (ft)	**28**
Bit Dia (in)	**36**
Water Level	**0**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Curbed**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
30	**28**	**36**	**Porous Concrete**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

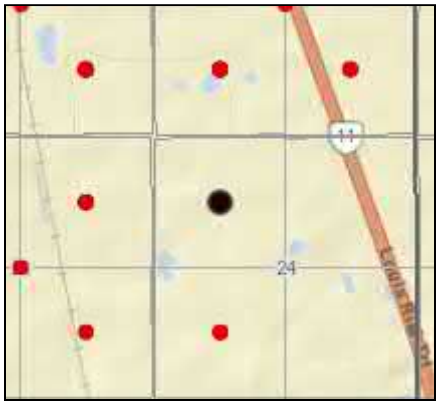
Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**0**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**0**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
1	Topsoil	Unknown	Unknown
18	Sand	Brown	Fine
28	Sand	Grey	Fine



Water Well Driller's Report

2-Jul-2021

WSaskWWDR01

(c) Water Security Agency

Well Name: **KRISTIONSEN** WWDR #: **086177**

Well Location

Land Location	**NW-24-035 -05 -W3**	Location of Well (in Quarter)	
LSD	**00**	**0** ft from N/S Boundary	
Reserve		**0** ft from E/W Boundary	
RM:			
NTS Map:	**73B00**	Major Basin:	**06**
Elevation (ft)	**1675**	SubBasin:	**30**
Aquifer			

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**1987.07.06**
Hole #	**1**
Install Method	**Bored**
Borehole Depth (ft)	**50**
Bit Dia (in)	**44**
Water Level	**15**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
52	**50**	**30**	**Steel**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

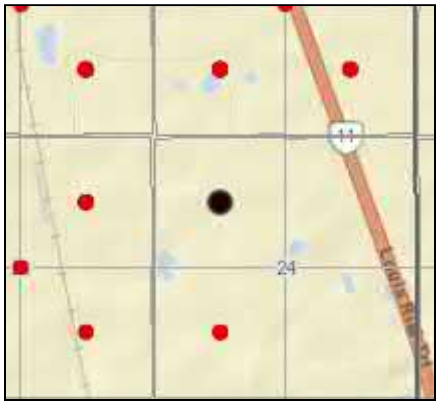
Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**0**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**0**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
1	Topsoil	Unknown	Unknown
20	Sand	Yellow	Unknown
47	Sand	Grey	Unknown
50	Clay	Unknown	Silty



Water Well Driller's Report

2-Jul-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **LAXDAL** WWDR #: **099861**

Well Location

Land Location	**-19-035 -04 -W3**	Location of Well (in Quarter)	
LSD	**00**	**0** ft from N/S Boundary	
Reserve		**0** ft from E/W Boundary	
RM:			
NTS Map:	**73B00**	Major Basin:	**06**
Elevation (ft)	**1675**	SubBasin:	**30**
Aquifer			

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**1990.11.21**
Hole #	**1**
Install Method	**Bored**
Borehole Depth (ft)	**54**
Bit Dia (in)	**42**
Water Level	**15**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
56	**54**	**30**	**Fiberglass**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

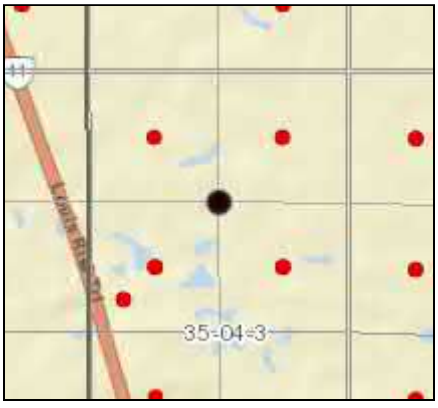
Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
26	**52**	**30**	**70**	**Fiberglass**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**15**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**0**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
20	Clay	Brown	Silty
48	Sand	Grey	Fine
49	Clay	Grey	Silty
54	Sand	Grey	Silty



Water Well Driller's Report

2-Jul-2021

WSaskWWDR01

(c) Water Security Agency

Well Name: **PRAIRIE VIEW CHAPPEL** WWDR #: **102459**

Well Location

Land Location	**NW-18-035 -04 -W3**
LSD	**00**
Reserve	
RM:	
NTS Map:	**73B02**
Elevation (ft)	**1675**
Aquifer	

Location of Well (in Quarter)

0 ft from N/S Boundary

0 ft from E/W Boundary

Major Basin: **06**

SubBasin: **30**

Well Information

Driller	**PRAIRIE WATER LTD**
Completion Date	**1992.09.15**
Hole #	**1**
Install Method	**Bored**
Borehole Depth (ft)	**29**
Bit Dia (in)	**36**
Water Level	**0**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Curbed**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
30	**29**	**36**	**Porous Concrete**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

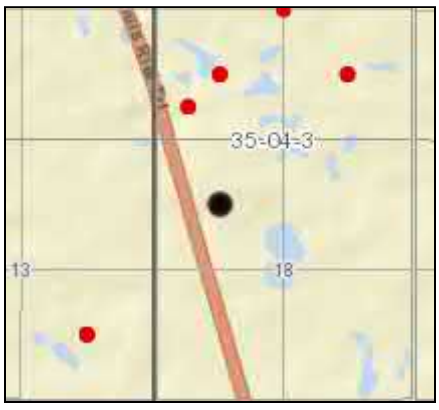
Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**5**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**0**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
1	Topsoil	Unknown	Unknown
21	Sand	Brown	Unknown
29	Sand	Grey	Unknown



Water Well Driller's Report

2-Jul-2021

WSaskWWDR01

(c) Water Security Agency

Well Name: **KRISTIANSEN** WWDR #: **104120**

Well Location

Land Location	**NW-24-035 -05 -W3**
LSD	**00**
Reserve	
RM:	**344**
NTS Map:	**73B02**
Elevation (ft)	**1675**
Aquifer	

Location of Well (in Quarter)

0 ft from N/S Boundary

0 ft from E/W Boundary

Major Basin: **06**

SubBasin: **30**

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**1994.05.10**
Hole #	
Install Method	**Bored**
Borehole Depth (ft)	**50**
Bit Dia (in)	**44**
Water Level	**16**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	**Unknown**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
52	**50**	**30**	**Fiberglass**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

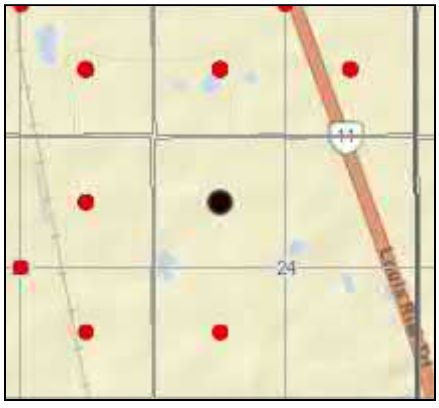
Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
30	**47**	**30**	**70**	**Fiberglass**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**12**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**0**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
21	Sand	Brown	Unknown
46	Sand	Grey	Fine
50	Sand	Grey	Silty



Water Well Driller's Report

2-Jul-2021

WSaskWWDR01

(c) Water Security Agency

Well Name: **HAGEL** WWDR #: **109245**

Well Location

Land Location	**SW-19-035 -04 -W3**
LSD	**00**
Reserve	
RM:	**344**
NTS Map:	**73B02**
Elevation (ft)	**1670**
Aquifer	

Location of Well (in Quarter)

0 ft from N/S Boundary

0 ft from E/W Boundary

Major Basin: **06**

SubBasin: **30**

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**1998.04.24**
Hole #	**001**
Install Method	**Bored**
Borehole Depth (ft)	**55**
Bit Dia (in)	**42**
Water Level	**21**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
56	**55**	**30**	**Fiberglass**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

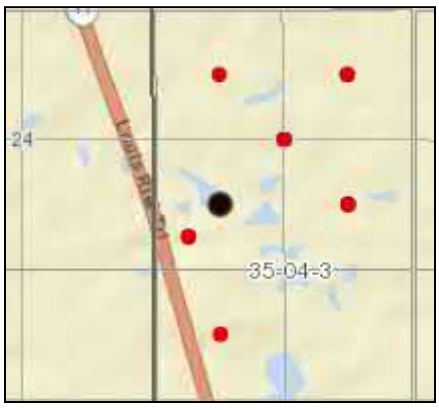
Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
28	**52**	**30**	**70**	**Fiberglass**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**0**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**0**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
26	Sand	Brown	Fine
45	Sand	Grey	Fine
55	Sand	Grey	Silty



Water Well Driller's Report

2-Jul-2021

WSaskWWDR01

(c) Water Security Agency

Well Name: **BLY** WWDR #: **109498**

Well Location

Land Location	**SE-13-035 -05 -W3**
LSD	**00**
Reserve	
RM:	**344**
NTS Map:	**72O15**
Elevation (ft)	**1675**
Aquifer	

Location of Well (in Quarter)

0 ft from N/S Boundary

0 ft from E/W Boundary

Major Basin: **06**

SubBasin: **30**

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**1998.07.30**
Hole #	**001**
Install Method	**Bored**
Borehole Depth (ft)	**94**
Bit Dia (in)	**42**
Water Level	**11**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
96	**94**	**30**	**Fiberglass**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

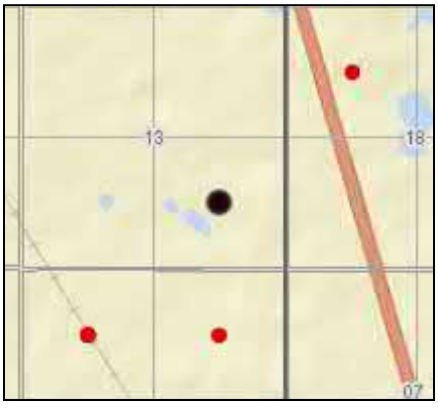
Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
80	**91**	**30**	**70**	**Fiberglass**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**20**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**0**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
22	Sand	Brown	Fine
27	Sand	Brown	Clean
30	Sand	Grey	Fine
35	Silt	Grey	Clayey
39	Sand	Grey	Fine
45	Silt	Grey	Silty
52	Clay	Grey	Silty
94	Clay	Grey	Firm



Water Well Driller's Report

2-Jul-2021

WSaskWWDR01

(c) Water Security Agency

Well Name: **LEGACY HOMES** WWDR #: **111078**

Well Location

Land Location	**SW-24-035 -05 -W3**
LSD	**00**
Reserve	
RM:	**344**
NTS Map:	**73B02**
Elevation (ft)	**1673**
Aquifer	

Location of Well (in Quarter)

0 ft from N/S Boundary

0 ft from E/W Boundary

Major Basin: **06**

SubBasin: **30**

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**1999.09.24**
Hole #	**001**
Install Method	**Bored**
Borehole Depth (ft)	**49**
Bit Dia (in)	**42**
Water Level	**11**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
51	**49**	**30**	**Fiberglass**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

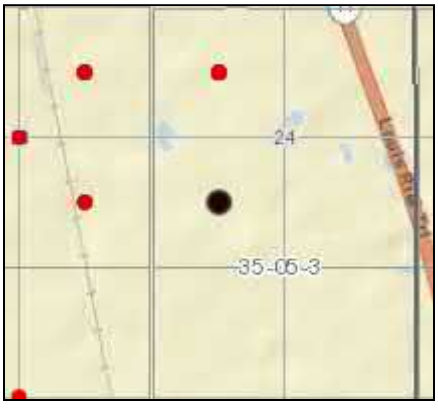
Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
33	**46**	**30**	**70**	**Fiberglass**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**15**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**0**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
20	Sand	Brown	Fine
21	Sand	Grey	Fine
28	Sand	Grey	Silty
49	Silt	Grey	Clayey



Water Well Driller's Report

2-Jul-2021

WSaskWWDR01

(c) Water Security Agency

Well Name: **SASK HIGHWAYS & TRANS - MATERIALS BRANCH** WWDR #: **116917**

Well Location

Land Location	**SW-19-035 -04 -W3**
LSD	**04**
Reserve	
RM:	**344**
NTS Map:	**73B02**
Elevation (ft)	**1670**
Aquifer	

Location of Well (in Quarter)

0 ft from N/S Boundary

0 ft from E/W Boundary

Major Basin: **06**

SubBasin: **30**

Well Information

Driller	**UNKNOWN**
Completion Date	**1991.07.03**
Hole #	**168**
Install Method	**Drilled**
Borehole Depth (ft)	**479**
Bit Dia (in)	**4.8**
Water Level	**0**
Flowing Head	**0**
Water Use	**Research**
Well Use	**Soil Test Hole**
Completion Method	
E-Log	**SCANNED**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
0	**0**	**0**	
0	**0**	**0**	
0	**0**	**0**	

Well Screens

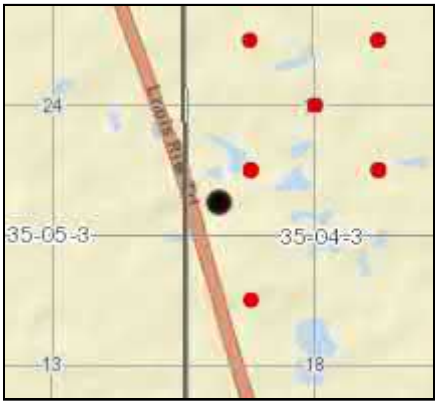
Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**0**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**0**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
3	Sand	Brown	Silty
15	Silty Clay	Grey	Calcareous
50	Clay	Grey	Calcareous
50	Silt	Grey	Sand Streaks
56	Silty Clay	Grey	Calcareous
84	Silt	Grey	Calcareous
84	Clay	Grey	Sand Streaks
92	Clay	Grey	Calcareous
103	Till	Grey	Clay Streaks
298	Till	Grey	Sandy
303	Gravel	Unknown	Unknown
453	Till	Grey	Stoney
479	Silty Clay	Grey	Noncalcareous



Water Well Driller's Report

2-Jul-2021

WSaskWWDR01

(c) Water Security Agency

Well Name: **HAGEL** WWDR #: **218798**

Well Location

Land Location	**SW-19-035 -04 -W3**
LSD	**00**
Reserve	
RM:	**344**
NTS Map:	**73B02**
Elevation (ft)	**1657**
Aquifer	

Location of Well (in Quarter)

0 ft from N/S Boundary

0 ft from E/W Boundary

Major Basin: **06**

SubBasin: **30**

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**2009.10.16**
Hole #	
Install Method	**Bored**
Borehole Depth (ft)	**33**
Bit Dia (in)	**40**
Water Level	**12**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
35	**33**	**30**	**Fiberglass**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

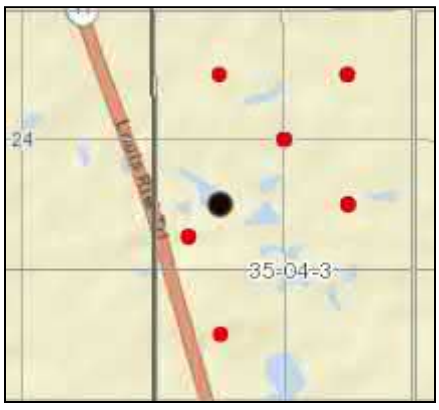
Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
20	**33**	**30**	**70**	**Fiberglass**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**2**	hrs
Pumping Rate	**12**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**10**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
1	Topsoil	Unknown	Unknown
16	Sand	Brown	Fine
33	Sand	Grey	Fine



Water Well Driller's Report

2-Jul-2021

WSaskWWDR01

(c) Water Security Agency

Well Name: **UNKNOWN** WWDR #: **219553**

Well Location

Land Location	**SW-19-035 -04 -W3**
LSD	**04**
Reserve	
RM:	**344**
NTS Map:	**73B02**
Elevation (ft)	**1653**
Aquifer	

Location of Well (in Quarter)

0 ft from N/S Boundary

0 ft from E/W Boundary

Major Basin: **06**

SubBasin: **30**

Well Information

Driller **UNKNOWN**

Completion Date

Hole #

Install Method

Borehole Depth (ft) **479**

Bit Dia (in) **0**

Water Level **0**

Flowing Head **0**

Water Use

Well Use

Completion Method

E-Log

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
0	**0**	**0**	
0	**0**	**0**	
0	**0**	**0**	

Well Screens

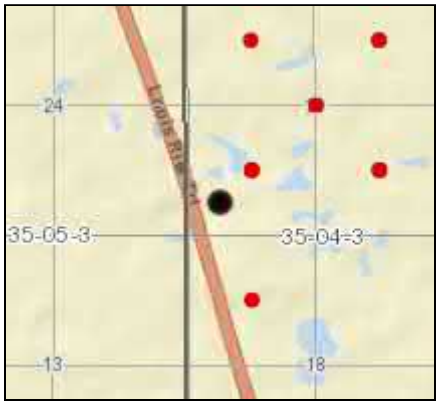
Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**0**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**0**	igpm

Lithology List

Depth (ft):	Material	Colour	Description



Water Well Driller's Report

2-Jul-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **HANBRIDGE** WWDR #: **237148**

Well Location

Land Location	**NW-19-035 -04 -W3**	Location of Well (in Quarter)	
LSD	**00**	**0** ft from N/S Boundary	
Reserve		**0** ft from E/W Boundary	
RM:	**344**		
NTS Map:	**73B02**	Major Basin:	**06**
Elevation (ft)	**1702**	SubBasin:	**30**
Aquifer			

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**2017.05.30**
Hole #	
Install Method	**Bored**
Borehole Depth (ft)	**75**
Bit Dia (in)	**72**
Water Level	**20**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
27	**25**	**30**	**Fiberglass**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

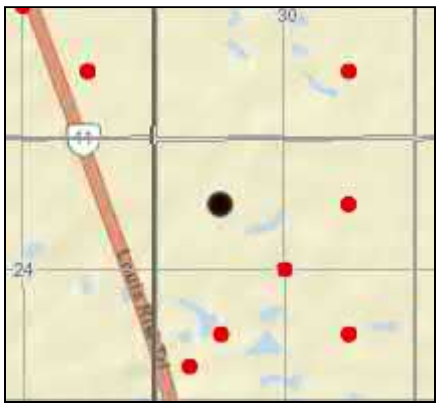
Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
50	**75**	**30**	**70**	**Fiberglass**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**1**	hrs
Pumping Rate	**30**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**20**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
30	Sand	Brown	Fine
35	Sand	Brown	Medium
38	Sand	Grey	Medium
45	Clay	Grey	Silty
75	Sand	Grey	Silty



APPENDIX G - NCSCS REPORT

CCME National Classification System for Contaminated Sites (2008) version 1.3
Summary of Site Conditions

Site:	Site will be identified by:	Site Common Name
Civic Address: *(or other description of location)*	SE 24 35 05 W3 and NE 13 35 05 W3	
Site Common Name: *(if applicable)*	Greenview Estates	
Code identifier: *(e.g., FCSI 8-digit identifier)*		
Site Owner or Custodian: *(Organization and Contact Person)*	Joanthan Abrametz Legal Prof Corp.	
Legal description *or* metes and bounds:	SE 24 35 05 W3 and NE 13 35 05 W3	
Approximate Site area:	125 ha	
Parcel Identifier(s) [PID]: *(or Parcel Identification Numbers [PIN] if untitled Crown land)*		
Centre of site: *(provide latitude/longitude or UTM coordinates)*		
Site Land Use:	Current:	Agricultural
	Proposed:	Residential
Site Plan	**To delineate the bounds of the Site a site plan MUST be attached. The plan must be drawn to scale indicating the boundaries in relation to well-defined reference points and/or legal descriptions. Delineation of the contamination should also be indicated on the site plan.**	
Provide a brief description of the Site:	Site description has been provided in the Phase I ESA report	

CCME National Classification System for Contaminated Sites (2008) version 1.3
Summary of Site Conditions

Affected media and Contaminants of Potential Concern (COPC):	N/A

Please fill in the "letter" that best describes the level of information available for the site being assessed:

Site Letter Grade **E**

If letter grade is F, do not continue, you must have a minimum of a Phase I Environmental Site Assessment or equivalent.

Scoring Completed By:	Chelsea Cooke
Date Scoring Completed:	15-Jul-21

CCME National Classification System for Contaminated Sites (2008) version 1.3
Pre-Screening Checklist

Question	Response (yes / no)	Comment
1. Are **Radioactive material**, **Bacterial contamination** or **Biological hazards** likely to be present at the site?	No	If yes, do not proceed through the NCSCS. Contact applicable regulatory agency immediately.
2. Are there **no contamination exceedances** (known or suspected)? Determination of exceedances may be based on: 1) CCME environmental quality guidelines; 2) equivalent provincial guidelines/standards if no CCME guideline exists for a specific chemical in a relevant medium; or 3) toxicity benchmarks derived from the literature for chemicals not covered by CCME or provincial guidelines/standards; or 4) background concentration.	Yes	If yes (*i.e.* , there are no exceedances), do not proceed through the NCSCS.
3. Have **partial/incompleted or no environmental site investigations** been conducted for the Site?	No	If yes, do not proceed through the NCSCS.
4. Is there direct and significant evidence of **impacts to humans** at the site, or off-site due to migration of contaminants from the site?	No	If yes, automatically rate the site as Class 1, a priority for remediation or risk management, regardless of the total score obtained should one be calculated.
5. Is there direct and significant evidence of **impacts to ecological receptors** at the site, or off-site due to migration of contaminants from the site?	No	Some low levels of impact to ecological receptors are considered acceptable, particularly on commercial and industrial land uses. However, if ecological effects are considered to be severe, the site may be categorized as Class 1, regardless of the numerical total NCSCS score. For the purpose of application of the NCSCS, effects that would be considered severe include observed effects on survival, growth or reproduction which could threaten the viability of a population of ecological receptors at the site. Other evidence that qualifies as severe adverse effects may be determined based on professional judgement and in consultation with the relevant jurisdiction.
6. Are there indicators of significant **adverse effects in the exposure zone** (*i.e* ., the zone in which receptors may come into contact with contaminants)? Some examples are as follows: -Hydrocarbon sheen or NAPL in the exposure zone -Severely stressed biota or devoid of biota; -Presence of material at ground surface or sediment with suspected high concentration of contaminants such as ore tailings, sandblasting grit, slag, and coal tar.	No	To answer "yes", two scenarios should be satisfied; (1) there has to be a high probability that receptors will be exposed to the contaminant source in the near future, and (2) the predicted impacts to ecological receptors after exposure must be significant (see question 5). A low probability of exposure resulting in significant impacts, or a high probability of exposure but with only low to moderate effects expected should not result in a Class 1 designation, neither would a low probability of exposure resulting in low-to-moderate effects. If yes, automatically rate the site as Class 1, a priority for remediation or risk management, regardless of the total score obtained should one be calculated.
7. Do measured concentrations of volatiles or unexploded	No	If yes, do not proceed through the NCSCS. Do not

ordnances represent an **explosion hazard**?	continue until the safety risks have been addressed. Consult your jurisdiction's occupational health and safety guidance or legislation on exposive hazards and measurement of lower explosive limits.

Rationale for not proceeding with NCSCS
(document any assumptions, reports, or site-specific information to support selection of "Yes" in Pre-Screening checklist)

If none of the above applies, proceed with the NCSCS scoring.

APPENDIX H - SITE PHOTOGRAPHS



20210618_Subject Site Photo_1 - Grain Silo



20210618_Subject Site Photo_2 - Old Barn



20210618_Subject Site Photo_3 - Old Barn - Interior A



20210618_Subject Site Photo_4 - Old Barn - Interior B



20210618_Subject Site Photo_5 - General Overview of Site



20210618_Subject Site Photo_6 - Trailer - Used for Advertising Purposes



20210618_Subject Site Photo_7 - One of Numerous Piezometers Onsite



20210618_Subject Site Photo_8 - One of Numerous Piezometers Onsite



20210618_Neighbouring Properties Photo_1 - Clement Farm and Greenhouse



20210618_Neighbouring Properties Photo_2 - Clement Farm and Greenhouse



20210618_Neighbouring Properties Photo_3 - Farm - East of Highway 11 and Subject Site



20210618_Neighbouring Properties Photo_4 - Farm - East of Highway 11 and Subject Site



20210618_Neighbouring Properties Photo_5 - PrairieView Chapel & Crematorium



20210618_Neighbouring Properties Photo_6 - Family Pet Cremation Services



20210618_Neighbouring Properties Photo_7 - Farm - South of Subject Site



20210618_Neighbouring Properties Photo_8 - Farm - South of Subject Site



20210618_Neighbouring Properties Photo_9 - Agricultural Land - West of Subject Site



20210618_Neighbouring Properties Photo_10 - Agricultural Land and Farm - West of Subject Site



20210618_Neighbouring Properties Photo_11 - Farm - West of Subject Site



20210618_Neighbouring Properties Photo_12 - Farm - West of Subject Site



20210618_Neighbouring Properties Photo_13 - Agricultural Land - North of Subject Site

Appendix D - Heritage & Biophysical Screening

Project Screening Report

Notes:

Report Generated
07/04/2023

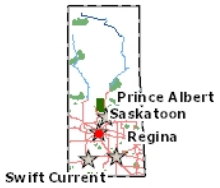
Map Information

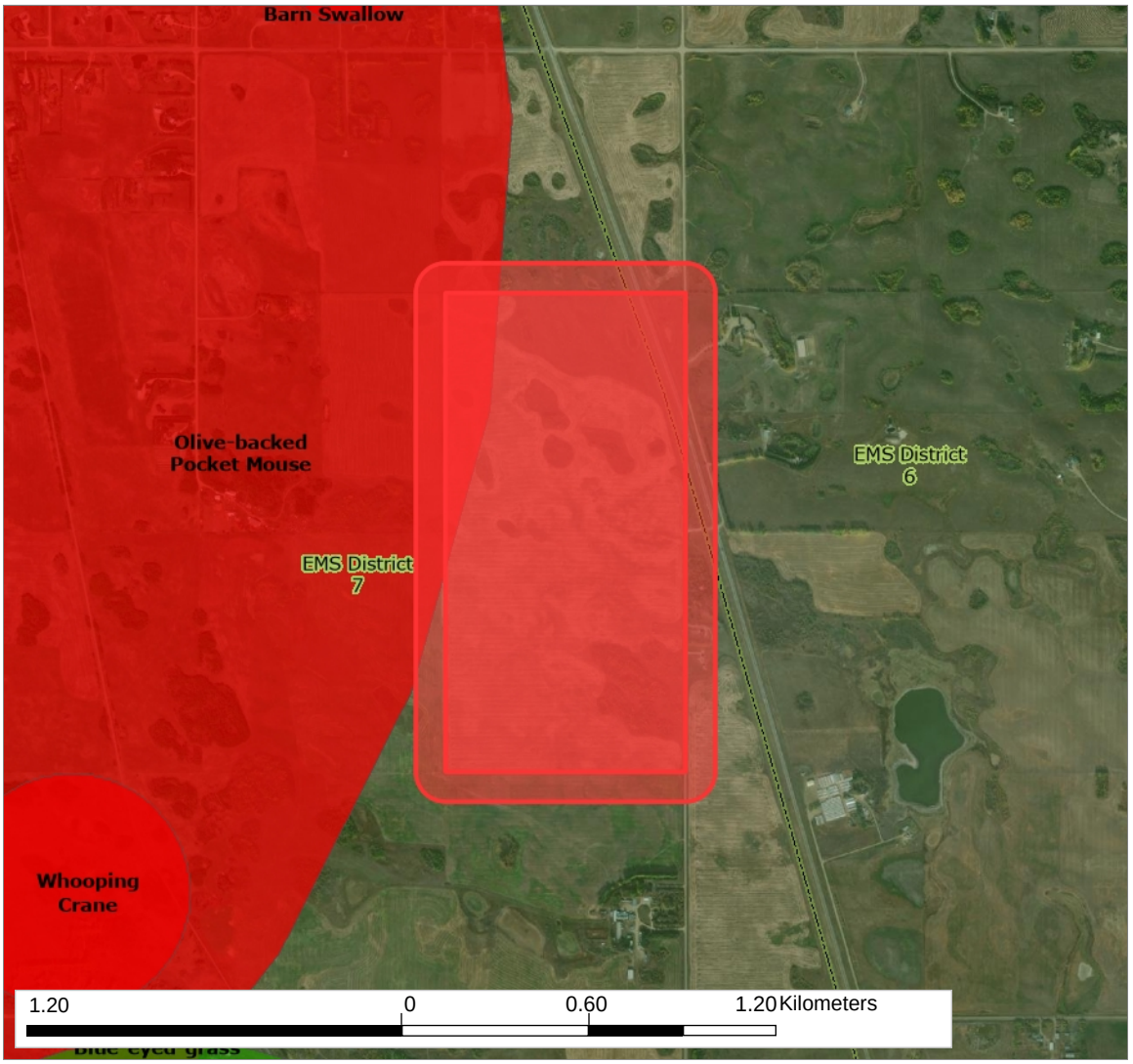
Buffer Size:

100 Meters

Coordinates:
Lat: 52.01274° N
Lon: -106.58083° W

Area of Interest





Screened Areas:

- Ecological Management Specialists (EMS) District
- Compliance & Field Service (CFS) Area
- Compliance & Field Service (CFS) Region
- Area Fisheries Ecologists Area(s)
- Area Wildlife Ecologist(s)
- Rural Municipality
- First Nation Reserve
- AG Crown Land Management Specialist Districts
- Rare and Endangered Species
- Fish Species
- Woodland Caribou Range
- Species Predictive Models
- Whooping Crane Corridor
- Federal Critical Habitat
- Proposed Critical Habitat
- Wind Energy Avoidance Zones
- Important Natural Areas
- Provincial Parks
- Recreation Sites
- Game Preserves
- National Wildlife Areas
- Federal Pastures
- Wildlife Habitat Protection Act Lands
- Fish & Wildlife Development Fund Lands
- Migratory Bird Sanctuary
- Wildlife Refuge
- Conservation Easements
- Crown Conservation Easements
- Ecological Reserves
- Ramsar Wetlands
- Reservoir Development Areas
- Representative Areas

Project Screening Report

Species Likely to be Present

Known Species

"Known" species are species that have known occurrences in the area from the Saskatchewan Conservation Data Centre's Rare and Endangered Species map layer. However, absence of species observation records does not preclude the existence of species in the area of interest. Observations may simply not have been recorded for the given area or may not have yet been entered into the ministry data holdings – new observation records are continuously being discovered. Information accessible through HABISask is not intended to be a definitive statement on the presence, absence or status of a species within a given area, nor as a substitute for onsite surveys.

Rare and Endangered Species

Category: Vertebrate Animal

Common Name	Scientific Name:	G Rank	N Rank	S Rank	COSEWIC	SARA Status	Wild Species at Risk Regulations
Olive-backed Pocket Mouse	*Perognathus fasciatus*	G5	N3N4	S3			

Expected Species

"Expected" is based on a modelled prediction if a species might occur in areas based upon developed statistical relationships between local and landscape characteristics and species presence. Models utilized by this report have only been created in the prairie ecozone for a selection of species. The boreal plain, boreal shield and taiga shield will not return any expected species results. Models are not a substitute for on the ground surveys to determine species presence.

Species Predictive Models

Category: Invertebrate Animal

Common Name	Scientific Name:	G Rank	N Rank	S Rank	COSEWIC	SARA Status	Wild Species at Risk Regulations
Monarch	*Danaus plexippus plexippus*	G4T3	N3B,NNRM	S2B,SNRM	Endangered	Special Concern	

Category: Vascular Plant

Common Name	Scientific Name:	G Rank	N Rank	S Rank	COSEWIC	SARA Status	Wild Species at Risk Regulations
Hairy Prairie Clover	*Dalea villosa var. villosa*	G5T5	N2N3	S2	Special Concern	Special Concern	Endangered
Slender Mouse-ear-cress	*Crucihimalaya virgata*	G3	N2	S1	Threatened	Threatened	Threatened
Smooth Goosefoot	*Chenopodium subglabrum*	G3G4	N3	S3	Threatened	Threatened	

Category: Vertebrate Animal

Common Name	Scientific Name:	G Rank	N Rank	S Rank	COSEWIC	SARA Status	Wild Species at Risk Regulations
American Badger	*Taxidea taxus taxus*	G5T5	N4	S3	Special Concern	Special Concern	
Baird's Sparrow	*Centronyx bairdii*	G4	N4B,N4M	S4B	Special Concern	Special Concern	
Bobolink	*Dolichonyx oryzivorus*	G5	N5B, N4N5M	S5B	Special Concern	Threatened	
Burrowing Owl	*Athene cunicularia*	G4	N1N2B, N1N2M	S2B	Endangered	Endangered	Endangered
Common Nighthawk	*Chordeiles minor*	G5	N4B,N3M	S4B	Special Concern	Special Concern	
Horned Grebe	*Podiceps auritus*	G5	N5B,N5N, N5M	S5B	Special Concern	Special Concern	
Loggerhead Shrike	*Lanius ludovicianus excubitorides*	G4T4	N3B	S3B	Threatened	Threatened	
Northern Harrier	*Circus hudsonius*	G5	N5B,N4N	S4B	Not at Risk		
Northern Leopard Frog	*Lithobates pipiens*	G5	N5	S3	Special Concern	Special Concern	
Short-eared Owl	*Asio flammeus*	G5	N4B,N3N, N4M	S3B,S2N	Threatened	Special Concern	
Sprague's Pipit	*Anthus spragueii*	G3G4	N3N4B, N3N4M	S3B	Threatened	Threatened	

Fish Species by Watershed

All fish species expected to be in any watershed that intersects the area searched are provided and their presence in the direct project area will depend on habitat.

Watershed: South Saskatchewan River

Common Name	Scientific Name:	G Rank	N Rank	S Rank	COSEWIC	SARA Status	Wild Species at Risk Regulations
Blacknose Dace	*Rhinichthys obtusus*	G5	N5	S3			
Brook Stickleback	*Culaea inconstans*	G5	N5	S5			
Brook Trout	*Salvelinus fontinalis*	G5	N5B,N5N,	SNA			
Burbot	*Lota lota*	G5	N5	S5			
Cisco	*Coregonus artedi*	G5	N5B,N5N,	S5			
Common Shiner	*Luxilus cornutus*	G5	N5	S3			
Emerald Shiner	*Notropis atherinoides*	G5	N5	S5			
Fathead Minnow	*Pimephales promelas*	G5	N5	S5			
Finescale Dace	*Chrosomus neogaeus*	G5	N5	S4			
Flathead Chub	*Platygobio gracilis*	G5	N5	S3			
Goldeye	*Hiodon alosoides*	G5	N5	S4			
Iowa Darter	*Etheostoma exile*	G5	N5	S5			
Johnny Darter	*Etheostoma nigrum*	G5	N5	S5			
Lake Chub	*Couesius plumbeus*	G5	N5	S5			
Lake Sturgeon	*Acipenser fulvescens*	G3G4	N3	S2	Endangered		
Lake Trout	*Salvelinus namaycush*	G5	N5	S5			
Lake Whitefish	*Coregonus clupeaformis*	G5	N5B,N5N,	S5	Not at Risk		
Logperch	*Percina caprodes*	G5	N5	S5			
Longnose Dace	*Rhinichthys cataractae*	G5	N5	S5			
Longnose Sucker	*Catostomus catostomus*	G5	N5	S5			
Mooneye	*Hiodon tergisus*	G5	N5	S3			
Ninespine Stickleback	*Pungitius pungitius*	G5	N5B,N5N,	S5			
Northern Pike	*Esox lucius*	G5	N5	S5			
Pearl Dace	*Margariscus nachtriebi*	G5	N5	S5			
Quillback	*Carpiodes cyprinus*	G5	N5	S4			
Rainbow Trout	*Oncorhynchus mykiss*	G5	N5B,N5N,	SNA			
River Shiner	*Notropis blennius*	G5	N5	S3			
Sauger	*Sander canadensis*	G5	N5	S5			
Shorthead Redhorse	*Moxostoma macrolepidotum*	G5	N5	S4			
Silver Redhorse	*Moxostoma anisurum*	G5	N5	S4			
Slimy Sculpin	*Cottus cognatus*	G5	N5	S4			
Spoonhead Sculpin	*Cottus ricei*	G5	N5	S5	Not at Risk		
Spottail Shiner	*Notropis hudsonius*	G5	N5	S5			
Trout-perch	*Percopsis omiscomaycus*	G5	N5	S5			
Walleye	*Sander vitreus*	G5	N5	S5			
White Sucker	*Catostomus commersonii*	G5	N5	S4			
Yellow Perch	*Perca flavescens*	G5	N5	S5			

Whooping Crane Corridor	50% Core Area
Whooping Crane Corridor	95% Core Area
Whooping Crane Corridor	75% Core Area

Species with Critical Habitat Present

This dataset displays the geographic areas within which federal Critical Habitat for species at risk listed on Schedule 1 of the federal Species at Risk Act (SARA) occurs in Saskatchewan. Please be aware that not all of the area within these boundaries is necessarily Critical Habitat. To determine if a specific area is Critical Habitat and if your activity might be considered “destruction” of Critical Habitat, other information available in each individual species’ Recovery documents (http://www.sararegistry.gc.ca) need to be considered, including biophysical attributes and activities likely to result in destruction of Critical Habitat.

Note that recovery documents (and therefore Critical Habitat) may be amended from time to time. Species are added as the data becomes ready, which may occur after the recovery document has been posted on the SAR Public Registry. Although HABISask will try to provide the latest data, the SAR Public Registry should always be considered as the official source for Critical Habitat information.

Common Name	Scientific Name:	G Rank	N Rank	S Rank	COSEWIC	SARA Status	Wild Species at Risk Regulations
No Critical Habitat found							

Proposed Critical Habitat Present

This section identifies federally proposed critical habitat that is up for consultation as per the information contained within the federal recovery strategies developed under the federal Species at Risk Act (SARA). This information on location of critical habitat is intended for reference by landowners and/or lease holders. Shapefiles or additional maps of critical habitat can be obtained by contacting Environment and Climate Change Canada at ec.leprpn-sarapnr.ec@canada.ca.

Common Name	Scientific Name:	G Rank	N Rank	S Rank	COSEWIC	SARA Status	Wild Species at Risk Regulations
No Critical Habitat found							

Managed Areas

Managed areas are a diverse collection of lands and waters on which the conservation of biodiversity and ecosystem function are among the goals of the land management programs. Each of the unique or sensitive landscapes, within the network of managed areas, have some level of protection or activity restrictions placed on them by legislation, agreement or policy. These lands include provincial and national parks, ecological reserves, wildlife lands, game preserves, conservation easements and other privately held stewardship lands.

Provincial Park

Nothing Found

Representative Area Ecological Reserve

Nothing Found

Recreation Site

Nothing Found

Game Preserve

Nothing Found

National Wildlife Area

Nothing Found

Pasture Boundary

Nothing Found

Wildlife Habitat Protection Act (WHPA)

Nothing Found

Fish & Wildlife Development Fund (FWDF)

Nothing Found

Migratory Bird Sanctuary

Nothing Found

Wildlife Refuge

Nothing Found

Conservation Easement

Nothing Found

Crown Conservation Easement

Nothing Found

Ecological Reserve

Nothing Found

Ramsar Wetland

Nothing Found

Reservoir Development Area

Nothing Found

Project Screening Report

Rare and Endangered Species Occurrences

The absence of information provided by the Saskatchewan Conservation Data Centre (SKCDC) does not categorically mean the absence of sensitive species or features. The quantity and quality for data collected by the SKCDC are dependent on the research and observations of many individuals and organizations. SKCDC reports summarize the existing natural heritage information, known to the SKCDC, at the time of the request.

SKCDC data should never be regarded as final statements on the elements or areas being considered, nor should they be substituted for on-site surveys required for environmental assessments. The user therefore acknowledges that the absence of data may indicate that the project area has not been surveyed, rather than confirm that the area lacks natural heritage resources.

Occurrence ID: 2746
First Observation: 1955
Occurrence Class: Vertebrate Animal
Last Observation: 1955
Scientific Name: Perognathus fasciatus
Common Name: Olive-backed Pocket Mouse
Occurrence Rank: H - Historical
General Description:
Occurrence Data: 1955: Alexander Bakerspigel trapped pocket mice while doing a survey of Saskatchewan rodents (A65NER01SKCA and A65NER02SKCA).
Directions: "Saskatoon, a few miles south."

Project Screening Report

Wild Species Research Permitting

A Research Permit is required to detect or observe plants or wildlife for commercial purposes, such as pre-screening surveys to collect baseline data or other activities, or to conduct academic research. Research Permits are not required if you are doing surveys for personal, recreational, educational or other non-commercial purposes. Revisions were made to Section 21 of The Wildlife Act in 2015 and to Section 6.2 of The Wildlife Regulations in 2016.

See the Government of Saskatchewan Wild Species Research Permitting page for more information.

All forms and related information pertaining to Research Permits can be found in the Publications Centre. Be sure to check out the Conservation Standards Terms and Conditions for Research Permits for general, wildlife and research-specific and information submission conditions that pertain to all research permits.

Subscribe to our Mail-out List Subscriptions for updates regarding Species Detection Permits, SKCDC Lists and Ranks, Legislation and Policy and HABISask.

Species Detection Survey Protocols

The Species Detection Survey Protocols are used to detect rare and sensitive species so Activity Restriction Guidelines can be applied. Their use is required by industry/ environmental consultants for proposed or existing commercial activities.

Activity Restriction Guidelines for Sensitive Species

The Activity Restriction Guidelines for Sensitive Species outline restricted activity periods and distance setbacks for rare and sensitive species to assist proponents in minimizing impacts to rare and sensitive species and habitats.

Administrative Areas

District 6	Ecological Management Specialist (EMS) District(s)
District 7	Ecological Management Specialist (EMS) District(s)
Saskatoon	Compliance and Field Services Area(s)
Saskatoon	Compliance and Field Services Region(s)
Saskatoon	Area Fisheries Ecologist Area(s)
PARKLAND REGION	Area Wildlife Ecologist(s)
344 - CORMAN PARK	Rural Municipality
Nothing Found	First Nation Reserve
District 9	AG Crown Land Management Specialist District

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Saskatchewan

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Inquiry was made on April 14, 2021 at 6:42 AM
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Quarter-section:	NE
Section:	13
Township:	35
Range:	05
Meridian:	3

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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 Energy and Resources). Please email arms@gov.sk.ca if you have any questions.

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Appendix E - Traffic Impact Assessment

Associated Engineering | 75 YEARS

REPORT

Jonathon Abrametz

Greenview Estates
Traffic Impact Assessment



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EXECUTIVE SUMMARY

Associated Engineering (AE) has been retained by Jonathon Abrametz to determine the traffic impacts of the proposed Greenview Estates country residential and highway commercial development south of Saskatoon, on Highway No. 11. Greenview Estates is a proposed mixed-use development expected to include a combination of residential and highway commercial uses. Preliminary site plans include 11.85 ha gross area of highway commercial development and 96 country residential units of varying lot size. The following summarizes the findings and recommendations described in this report:

Overall, the proposed Greenview Estates development is expected to generate 117 two-way trips in the AM peak and 176 two-way trips in the PM peak.

Short-term access to the proposed Greenview Estates development is planned at the temporary intersection of Highway No. 11 and Prairie View Road. Long-term access to Greenview Estates will be provided via a new service road from Baker Road to Prairie View Road and the existing Prairie View Road to Victor Road.

Level of Service (LOS) for all movements in all horizons are within acceptable limits. Any noticeable queueing is unlikely. These results indicate Prairie View Road is capable of supporting development traffic and the construction of a service road is not required until additional development occurs in the area.

Development Related Recommendations include:

1. Maintain development access at Prairie View Road until intersection operation falls below LOS D or until additional area development is planned to support a service road to Baker Road;
2. Construct a southbound right turn lane at Prairie View Road before the first year of development; and
3. Install intersection area lighting at Prairie View Road before full build-out.

Should additional area development traffic drive the need for a service road:

1. Close the west leg of Prairie View Road and construct a two-lane service road from Baker Road to Prairie View Road parallel to Highway No. 11;
2. Install a yield sign at the T-intersection created by the service road connection with Baker Road; and
3. Install area lighting at Victor Road before full build-out.

Planned Improvements by MoH include:

1. Installing a southbound left turn lane at Baker Road before 2037. This improvement is warranted based on background traffic volumes.
2. Installing a northbound right turn lane at Victor Road before 2037. This improvement is warranted based on background traffic volumes.
3. Installing area lighting at Baker Road before full build-out.

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1 INTRODUCTION

Associated Engineering (AE) has been retained by Jonathon Abrametz to determine the traffic impacts of the proposed Greenview Estates country residential and highway commercial development south of Saskatoon, on Highway No. 11, within the Rural Municipality of Corman Park No. 344. The development is intended to be built out in phases over the course of approximately 15 years. This traffic impact assessment evaluates the impacts of full build out of development traffic on the surrounding road network and includes a sensitivity analysis to determine a staged approach to access management. The study location is shown in **Figure 1-1**.

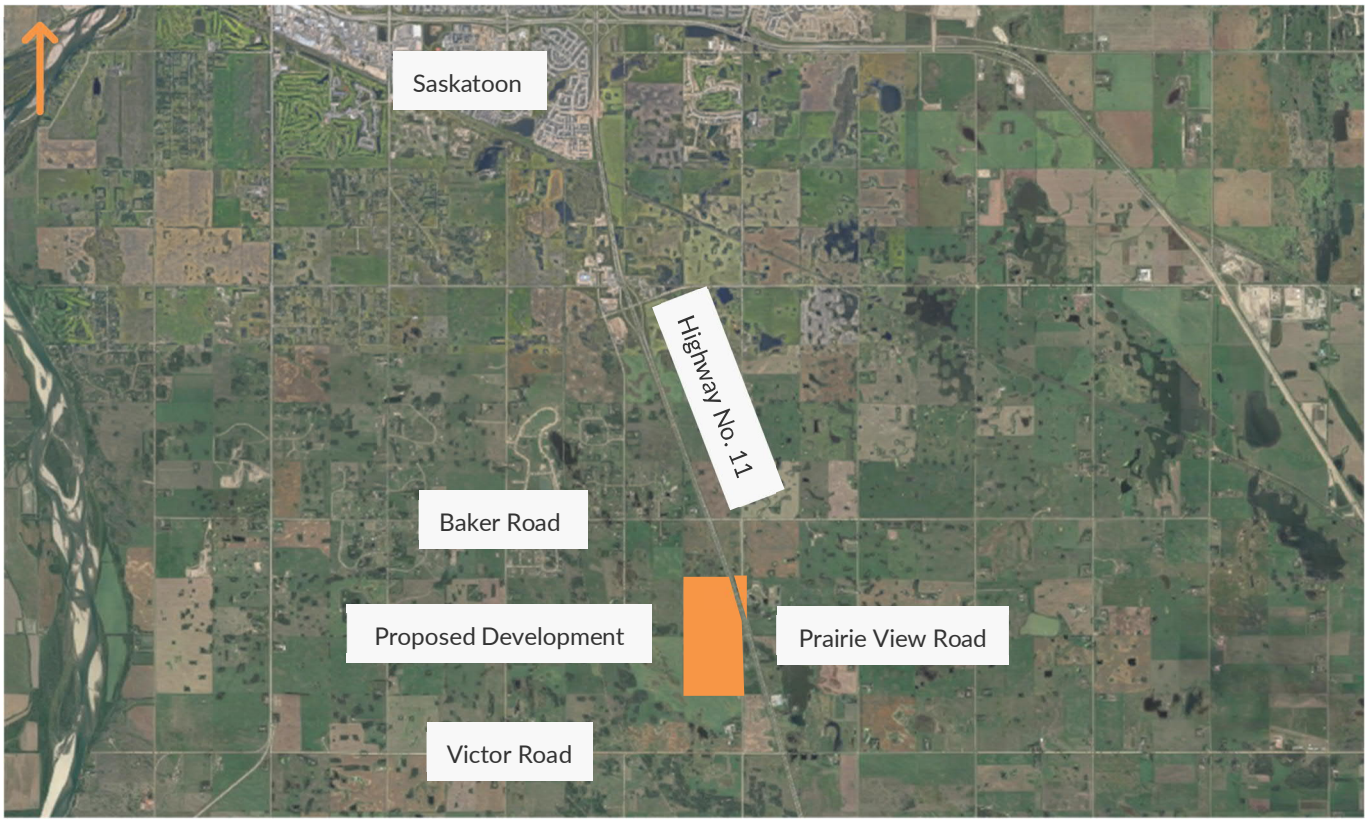


Figure 1-1
Study Location

Greenview Estates is a proposed mixed-use development expected to include a combination of residential and highway commercial uses. Preliminary site plans include 11.85 ha gross area of highway commercial development and 96 country residential units of varying lot size. The proposed land use plan is illustrated in **Figure 1-2**.

Since the proposed development is located near a Provincial Highway, Ministry of Highways (MoH) standards apply to this report. This report is intended to meet MoH traffic impact study requirements and focuses on motor vehicle traffic. As a rural location, the site is not expected to generate significant pedestrian or cyclist traffic and there will be no transit service, therefore these modes are not considered in this report.



Figure 1-2
Proposed Land Use Plan

2 BACKGROUND

2.1 Existing Roadways

Highway No. 11 is a four-lane divided highway and is part of the National Highway System connecting Saskatoon to Regina and the regional transportation system beyond.

Baker Road (Township Road 354) is a two-lane paved road within the jurisdiction of the RM of Corman Park. Its weight limit is posted at 10 tonnes.

Victor Road (Township Road 352) is a two-lane gravel road within the jurisdiction of the RM of Corman Park.

Prairie View Road (Range Road 3050) is a two-lane gravel road within the jurisdiction of the RM of Corman Park. The northeast leg is posted as a summer road and not maintained during the winter. Prairie View Road has been realigned to intersect with Highway No. 11 at a 90° angle.

The three study intersections have been constructed with varying levels of safety improvements. The study intersections and safety improvements are illustrated in **Figure 2-1**.



Figure 2-1
Highway No. 11 and Intersecting Roads

2.2 Proposed Access

Highway No. 11 is classified as Access Management Level R-3. According to the Roadside Management Manual (RSMM 430-30), permanent at-grade intersections are allowed at a minimum spacing of 3.2 km; temporary direct access points are allowed at most public highway intersections. No exceptions to access management policies are proposed by this report.

Short-term access to the proposed Greenview Estates development is planned at the temporary intersection of Highway No. 11 and Prairie View Road. Long-term access to Greenview Estates will be provided via a new service road from Baker Road to Prairie View Road and the existing Prairie View Road to Victor Road. Victor Road and Baker Road are separated by approximately 3.4 km. A staged approach to access management is illustrated in **Figure 2-2** and proposed as follows:

Stage 1 – Prairie View Road operates as a full-turns intersection. Install a southbound right turn lane when warranted.

Stage 2 – Close Prairie View Road. Construct a service road from Baker Road to the existing Prairie View Road when additional area development generates demand for the internal road.



Figure 2-2
Short- and Long-Term Access Plans

This staged approach spreads out concentrated traffic demand on Baker Road generated by numerous country residential developments. Dispersing existing and planned country residential development across numerous locations may reduce collision risk at Baker Road stemming from a high volume of minor road left-hand turns.

2.3 Speed Limit

The posted speed limit of Highway No. 11 is 110 km/hr. The design speed is assumed to be 130 km/hr based on Standard Plan 20020. The posted speed limit of the RM roads is 80 km/hr. The design speed of these roads is assumed to be 10 km/hr above the posted limit.

2.4 Geometrics

The terrain appears to be flat with no noticeable sight distance limitations. No survey was conducted along the highway right-of-way. Highway No. 11 has limited horizontal curves within the study area. A slight westward deflection is noted approximately 390 m north of Prairie View Road with no impact to sight distance.

2.5 Surrounding Land Use

Surrounding land uses are predominantly agricultural with some country residential, institutional, and commercial developments. Baker Road acts as a primary access road to a significant amount of country residential development northwest of the subject property. The Prairie View Chapel & Crematorium is located immediately east of the site on Prairie View Road.

3 TRAFFIC VOLUMES

3.1 Design Hour and Horizon Year

Associated Engineering completed a manual traffic count on Thursday, February 3, 2022, at the Prairie View and Victor Road intersections. The counts were conducted in the morning from 7:45 am to 9:45 am and in the afternoon from 4:00 pm to 6:00 pm. The peak hour within each count period was 8:00 am to 9:00 am and 4:15 pm to 5:15 pm. The MoH provided traffic counts at the intersection of Highway No. 11 and Baker Road. This data was collected on Thursday, November 5, 2020.

Construction is expected to begin in 2022 and is expected to take 15 years to complete. The horizon year for full build-out is therefore 2037.

3.2 Background Traffic

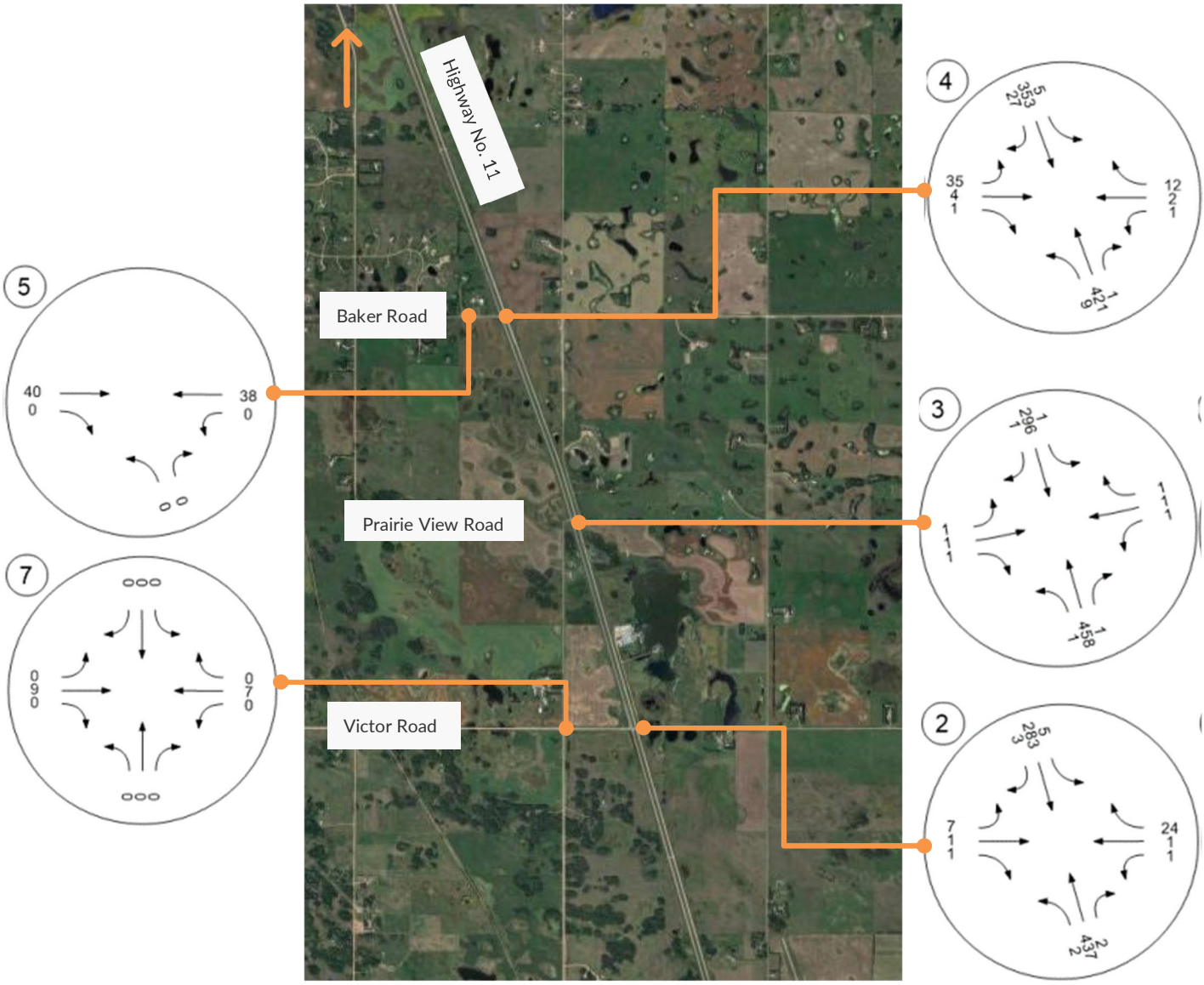
Background traffic volumes for 2022 were determined by adjusting the manual traffic counts using factors obtained by the MoH document Travel on Saskatchewan Highways (2016). All factors are summarized in **Table 3-1** and described as follows:

- The volumes were adjusted to annual averages for a Rural Commuter Highway based on day and month of the count: for a Thursday in February, a seasonal adjustment factor of 1.04 was used; for a Thursday in November, a seasonal adjustment factor of 0.92 was used.
- MoH supplied volumes were converted from 2020 to 2022 volumes using a 15-year growth factor of 1.40 provided by MoH for Highway No. 11. A 2-year factor was obtained using MoH equation SKS 2.3.1-C-Eq.10.
- The traffic volumes were converted to background traffic volume for the 2037 design horizon year using a 15-year growth factor of 1.40 provided by MoH for Highway No. 11.
- Traffic volumes along Highway No. 11 have been affected by the ongoing Covid-19 pandemic. Covid-19 adjustment factors were provided by MOH Traffic Services Branch. The factor was applied to all turning movements to account for changes to traffic volumes due to the Covid-19 pandemic.

Table 3-1
Traffic Factors

Intersection	Counted	Annual Average Factor	2022 Growth Factor	2037 Growth Factor	Covid-19 Factor
Baker Road	November 5, 2020	0.92	1.05	1.45	1.22
Prairie View Road	February 3, 2022	1.04	-	1.40	1.13
Victor Road	February 3, 2022	1.04	-	1.40	1.13

Figures 3-1 through **3-4** illustrate the 2022 and 2037 background traffic volumes for the AM and PM peak hours. Raw traffic count data and communication regarding Covid-19 factors are included in **Appendix A**.


Highway No. 11
Baker Road
Prairie View Road
Victor Road
4
5
3
7
2
40
0
38
0
0
0

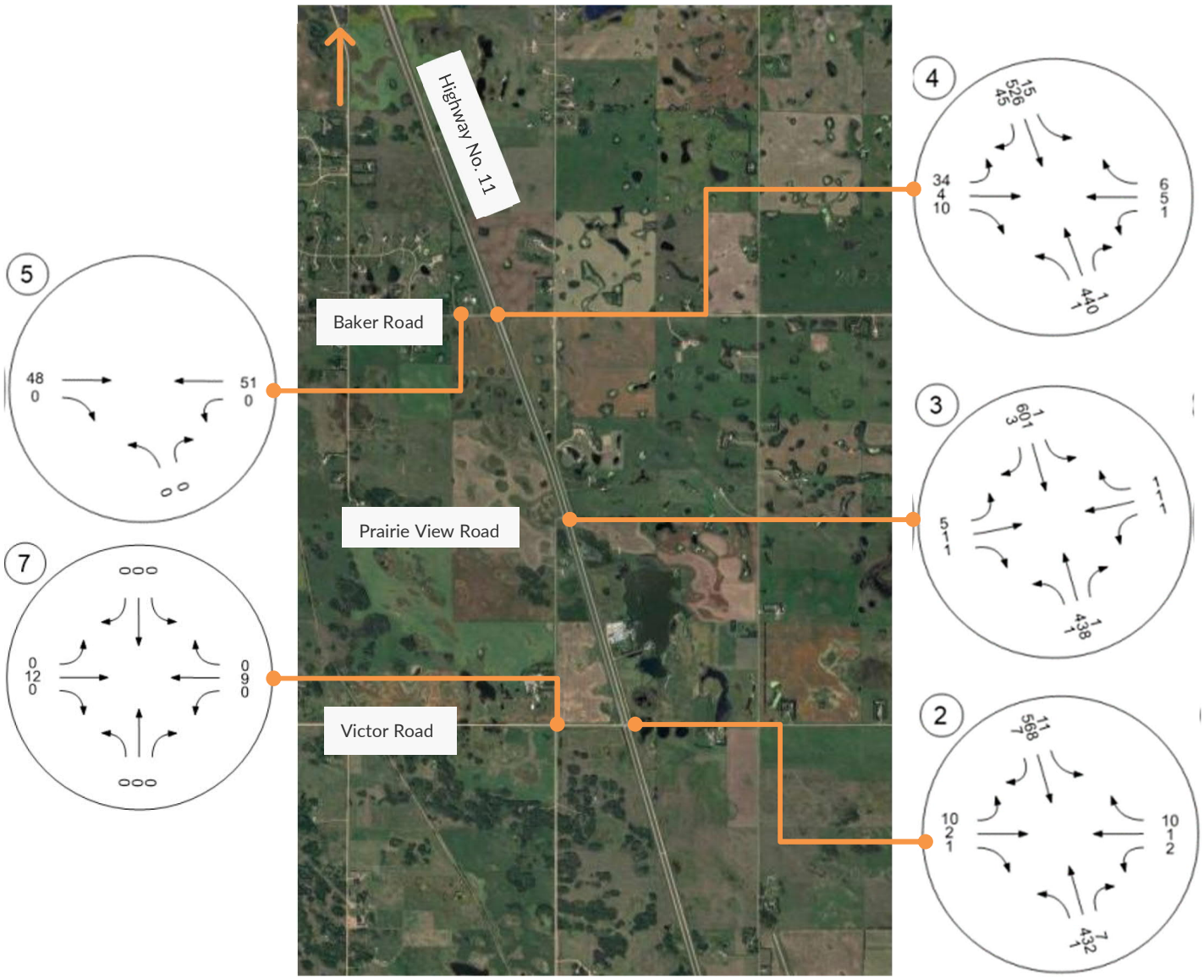


Figure 3-2
Existing Conditions Traffic Volumes – 2022 PM Peak

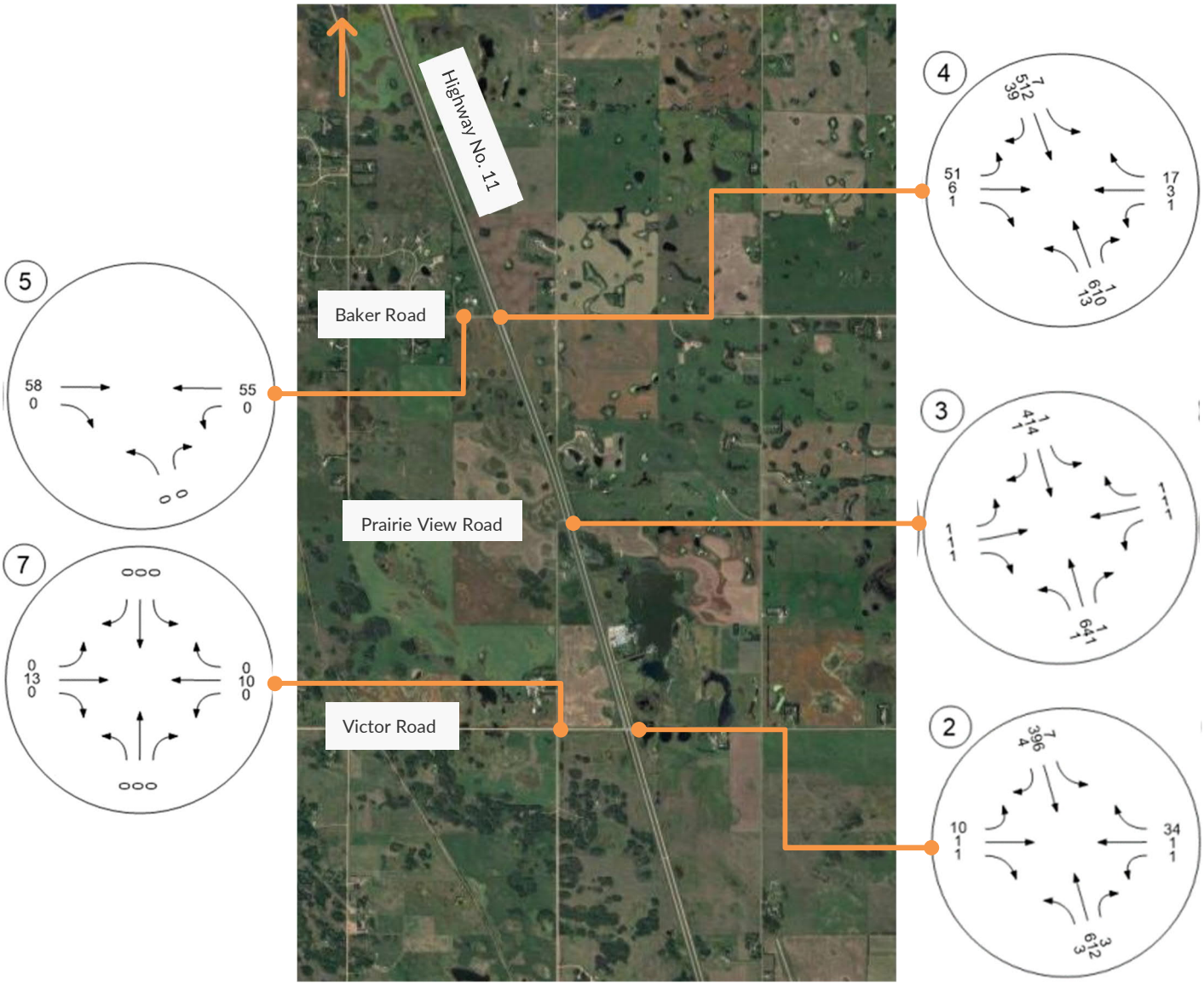


Figure 3-3
Background Traffic Volumes – 2037 AM Peak

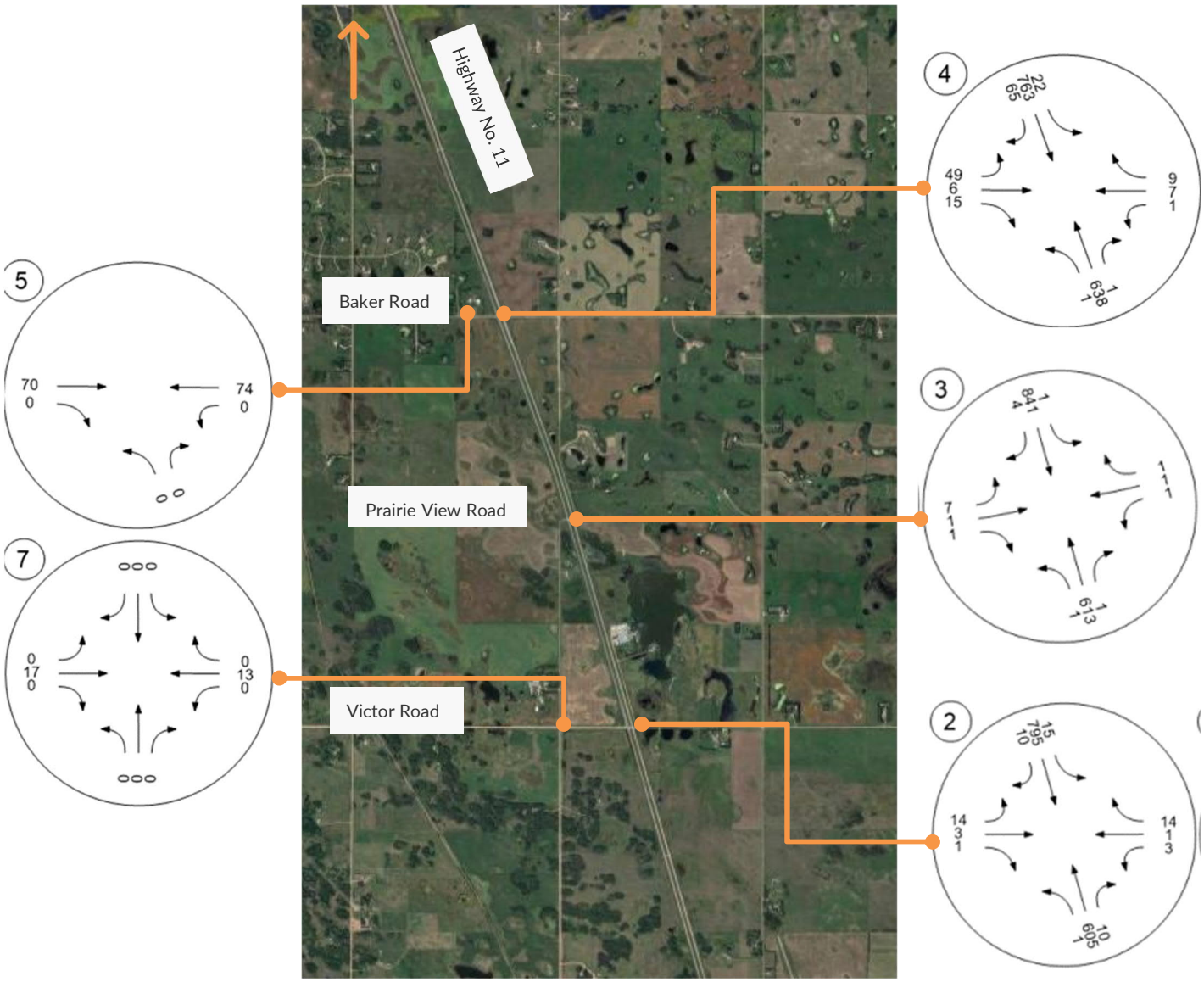


Figure 3-4
Background Traffic Volumes – 2037 PM Peak

3.3 Daily Traffic Volumes

AADT on Highway No. 11 was estimated by converting the manual four-hour counts to daily traffic based on the MoH distribution graphs for the specific hour of the day. The four-hour manual count represents an estimated 28.5% of daily traffic. A conversion factor of 3.51 was used to convert the four-hour count to a daily traffic estimate. **Figures 3-5** and **3-6** illustrate AADT estimates in 2022 and 2037.



Figure 3-5
2022 AADT

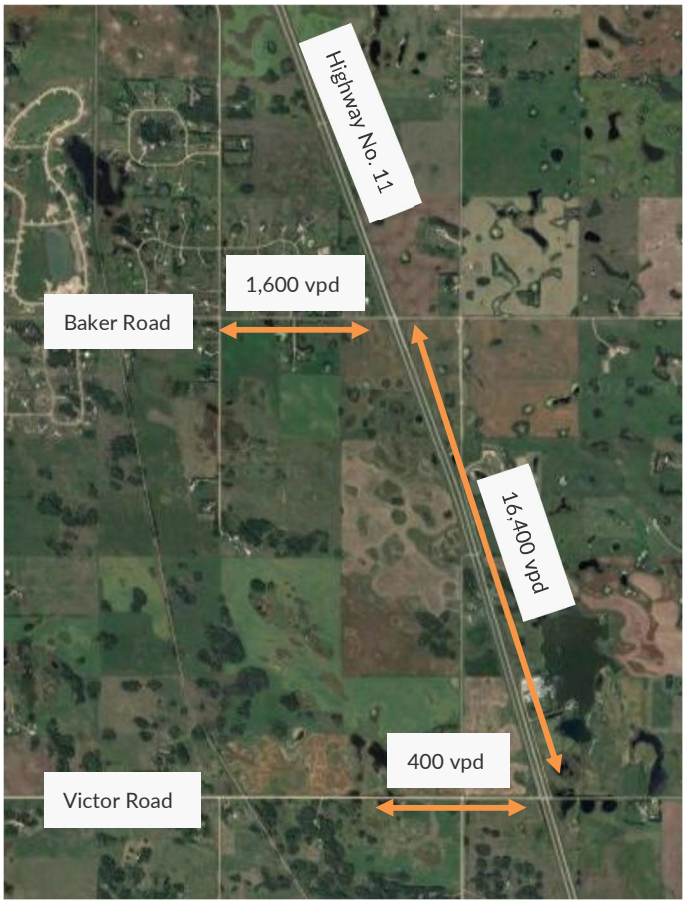


Figure 3-6
2037 AADT

3.4 Truck Volumes

Based on traffic counts, trucks represent between 11% and 23% of vehicle traffic on Highway No. 11 depending on the direction of travel and time of day. Detailed heavy truck volumes are supplied with traffic count summaries in **Appendix A**.

Ministry of Highways intersection improvement warrants uses a Passenger Car Equivalent (PCE) to translate truck presence to an equivalent number of passenger cars. The MoH default value of 1.7 was applied to all turning movements for intersection improvement warrant calculations. The PCE standard is not applied to lighting warrant calculations.

3.5 Development Traffic

3.5.1 Trip Generation

Preliminary site plans include 11.85 ha gross area of highway commercial development and 96 country residential units of varying lot size.

Trip generation rates for the proposed development were estimated using the Institute of Transportation Engineers' Trip Generation Manual, 10th Edition (ITE TGM). The ITE TGM is a resource that was developed for dense urban environments which generate much more traffic than rural Saskatchewan. Based on the remote location of this development and the longer commuting distance relative to similar urban destinations, we have adjusted trip generation rates to reflect rural travel patterns.

The proposed country residential development is expected to generate traffic similar to Single Family Detached Housing, Land Use Code 210 in the TGM. Peak hour trip generation was reduced by 20% and daily trip generation was reduced by 50% to represent the expected lower trip generation of a country residential unit relative to the published case of a typical U.S. suburb.

The exact land uses within the highway commercial area are currently undefined but may contain a combination of:

- Automotive sales,
- Food services,
- Warehousing and wholesaling, or
- Various retail uses.

Recreational Vehicle Sales (ITE code 842) was selected to represent the commercial component of development. Trip generation was reduced by 50% in the Peak hour and for daily travel to represent the remote location of this development and the longer commuting distance relative to similar urban destinations. We have assumed that the Floor Area Ratio (FAR) for the commercial area is approximately 0.2 based on our work with similar jurisdictions and projects. The Gross Floor Area (GFA) is estimated to be 255,105 square feet (2.37 ha).

Trip generation rates for the AM and PM hours of adjacent street traffic are summarized in **Table 3-2**.

Table 3-2
Trip Generation

			AM Peak						PM Peak						Daily
Land Use	Units		Trip Rate	% In	Trips In	% Out	Trips Out	Total Trips	Trip Rate	% In	Trips In	% Out	Trips Out	Total Trips	Total Trips
Highway Commercial LUC 842	255	1000 SF GFA	0.23	85%	50	15%	9	**59**	0.39	31%	30	69%	68	**98**	**638**
Country Residential LUC 210	96	Dwellings	0.61	25%	14	75%	44	**58**	0.81	63%	49	37%	29	**78**	**453**
TOTAL					**64**		**53**	**117**			**79**		**97**	**176**	**1,091**

Overall, the proposed Greenview Estates development is expected to generate 117 two-way trips in the AM peak and 176 two-way trips in the PM peak.

3.5.2 Pass-by Trips

Properties adjacent to highways typically have a small local customer base and are often attract pass-by trips. Based on the type of expected development and accessibility of the site, we have assumed that up to 5% of commercial traffic will be diverted from Highway No. 11 as a pass-by trip.

The commercial development is expected to divert 3 trips in the AM peak and 5 trips in the PM peak.

3.5.3 Trip Distribution

We have estimated trip distribution based on the surrounding population and employment centres. We expect the majority of traffic will travel between the site and the City of Saskatoon. As such, we have allocated 80% of site trips to Highway No. 11 north and 10% of the trips to the rural grid systems to the west. The remaining 10% of trips are expected to travel south on Highway No. 11. **Table 3-3** summarizes trip distribution.

Table 3-3
Trip Distribution

Origin / Destination	Share (%)	Total Trips (AM Peak)	Total Trips (PM Peak)	Total Trips (Daily)
North of Development via Highway No. 11	80%	93 veh	140 veh	873 veh
North of Development via Grid Roads	10%	12 veh	18 veh	109 veh
South of Development via Highway No. 11	10%	12 veh	18 veh	109 veh

3.5.4 Trip Assignment

Stage 1 – Prairie View Road

Before the construction of a service road, 100% of trips will access the site via Prairie View Road or by backtracking from Victor Road. Full buildout traffic during Stage 1 access management is illustrated in **Figure 3-7**.



Figure 3-7
Net Development Traffic Volumes – Stage 1

Stage 2 – Service Road

Following the construction of a service road, vehicles may access the site from either Victor Road or Baker Road. We have assumed that commuters travelling between the development and the City of Saskatoon will take the shortest travel time path. The majority of residents may take Baker Road to the north while a portion of the southern-most residents may take Victor Road. **Table 3-4** summarizes the trip assignment for Stage 2 access management.

Table 3-4
Trip Assignment with Service Roads

Origin / Destination	Route	Share (%)	Total Trips (AM Peak)	Total Trips (PM Peak)	Total Trips (Daily)
North of Development via Highway No. 11	Baker Road	80%	73 veh	111 veh	698 veh
	Victor Road	20%	18 veh	28 veh	175 veh
North of Development via Grid Roads	Baker Road	100%	12 veh	17 veh	109 veh
South of Development via Highway No. 11	Victor Road	100%	12 veh	17 veh	109 veh

Figures 3-8 and **3-9** illustrate full buildout development traffic following Stage 2 access management – the construction of a service road – for the AM and PM peak hour.

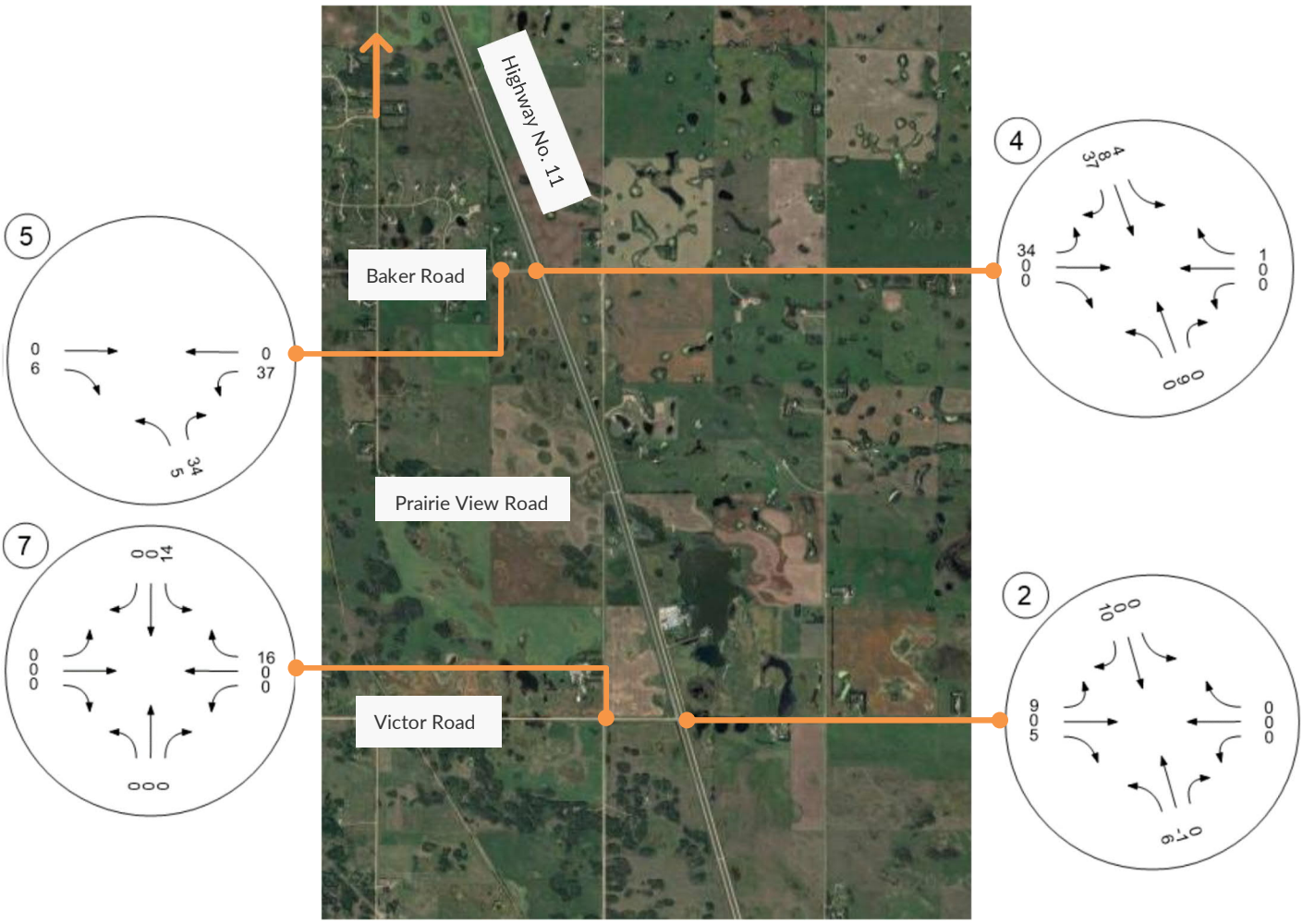


Figure 3-8
Net Development Traffic Volumes – Stage 2 AM Peak

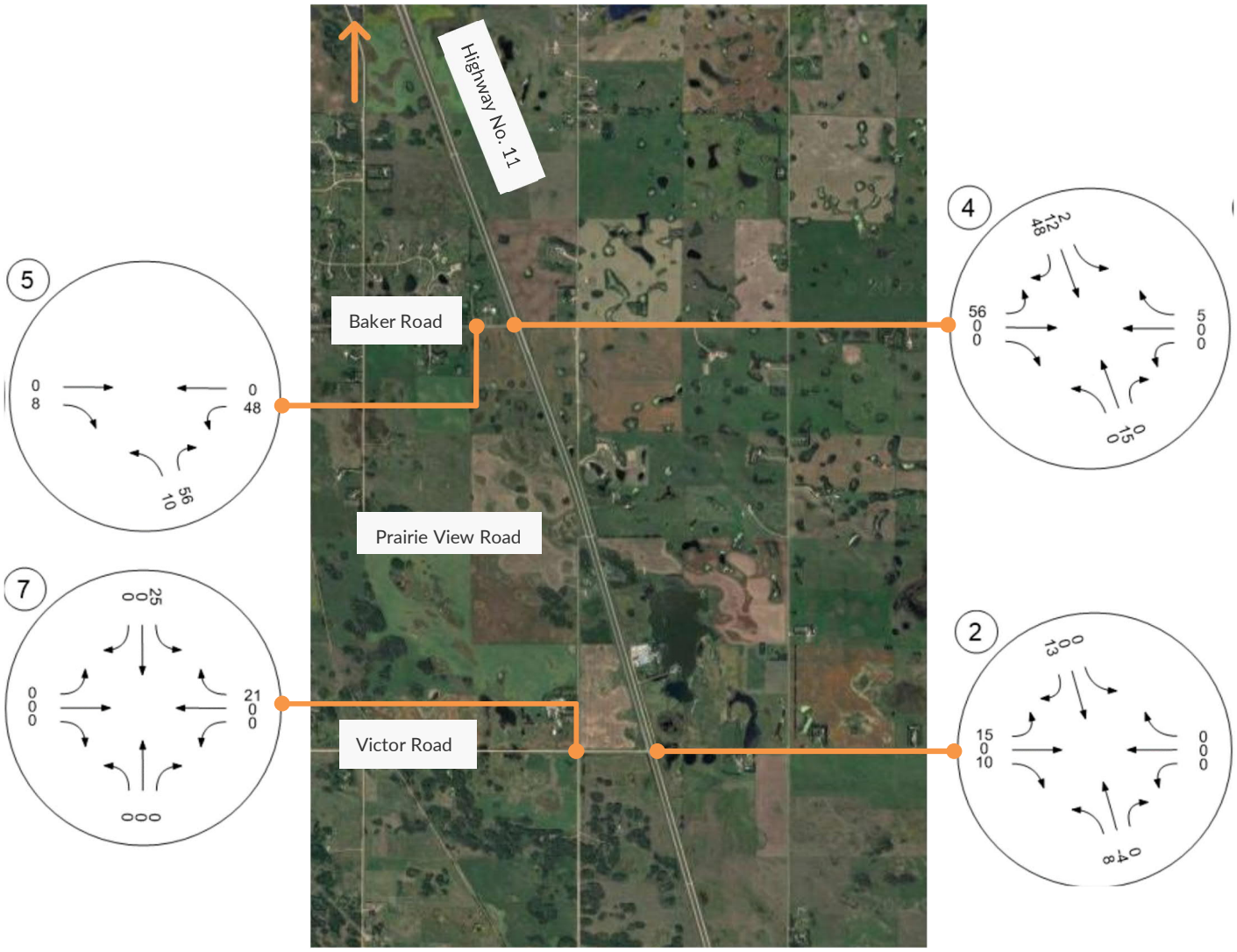


Figure 3-9
Net Development Traffic Volumes – Stage 2 PM Peak

3.6 Total Traffic

The combined traffic volumes for 2037 were calculated by adding the future background and development traffic volumes together.

Stage 1 – Prairie View Road

Figure 3-10 illustrates the total volumes for the AM and PM peak hours in 2037.



Figure 3-10
Full Build Out Traffic Volumes – Stage 1

Stage 2 – Service Road

Figures 3-11 and **3-12** illustrate the total volumes for the AM peak hour and PM peak hour.

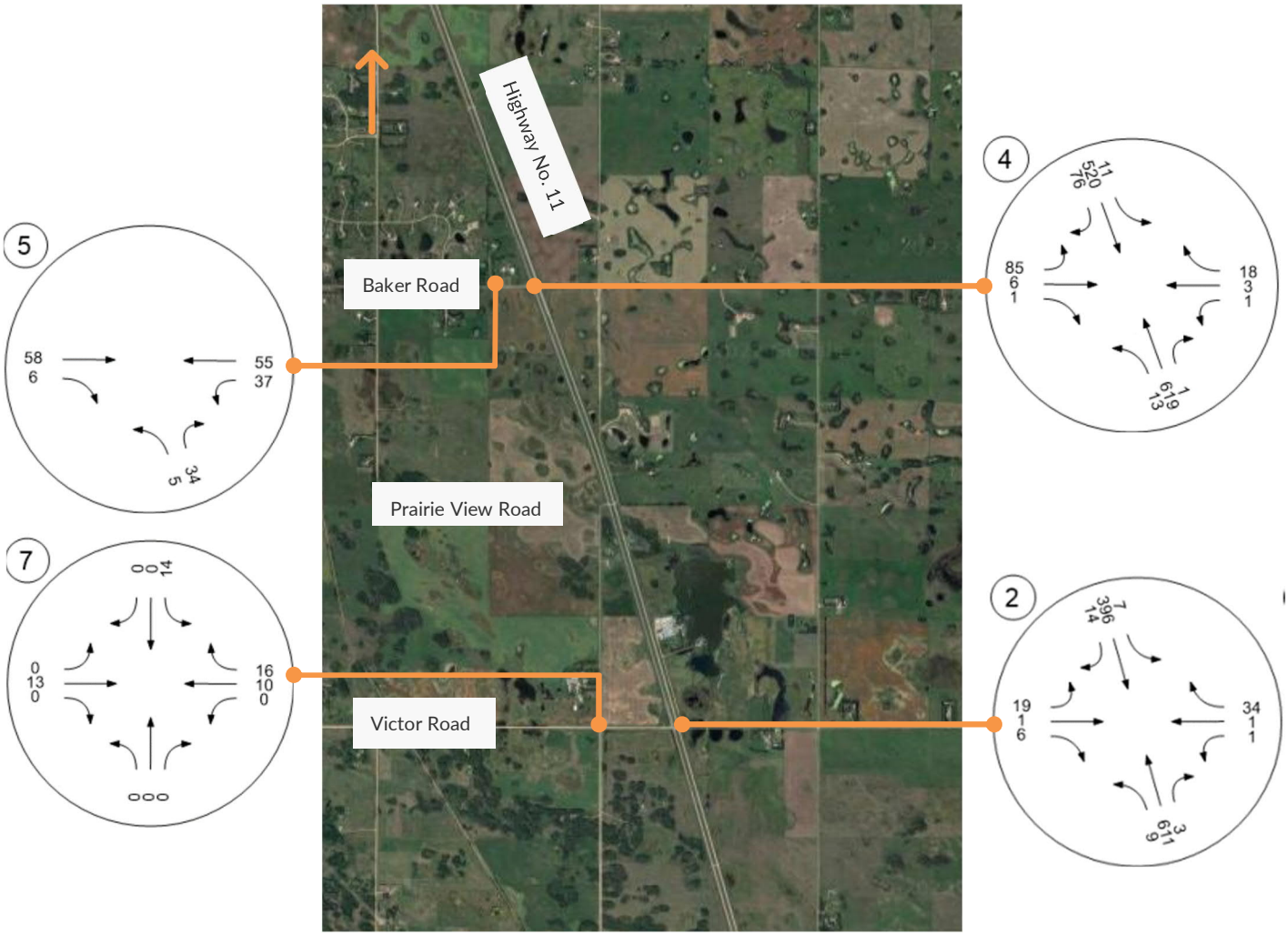


Figure 3-11
Full Build Out Traffic Volumes – 2037 AM Peak

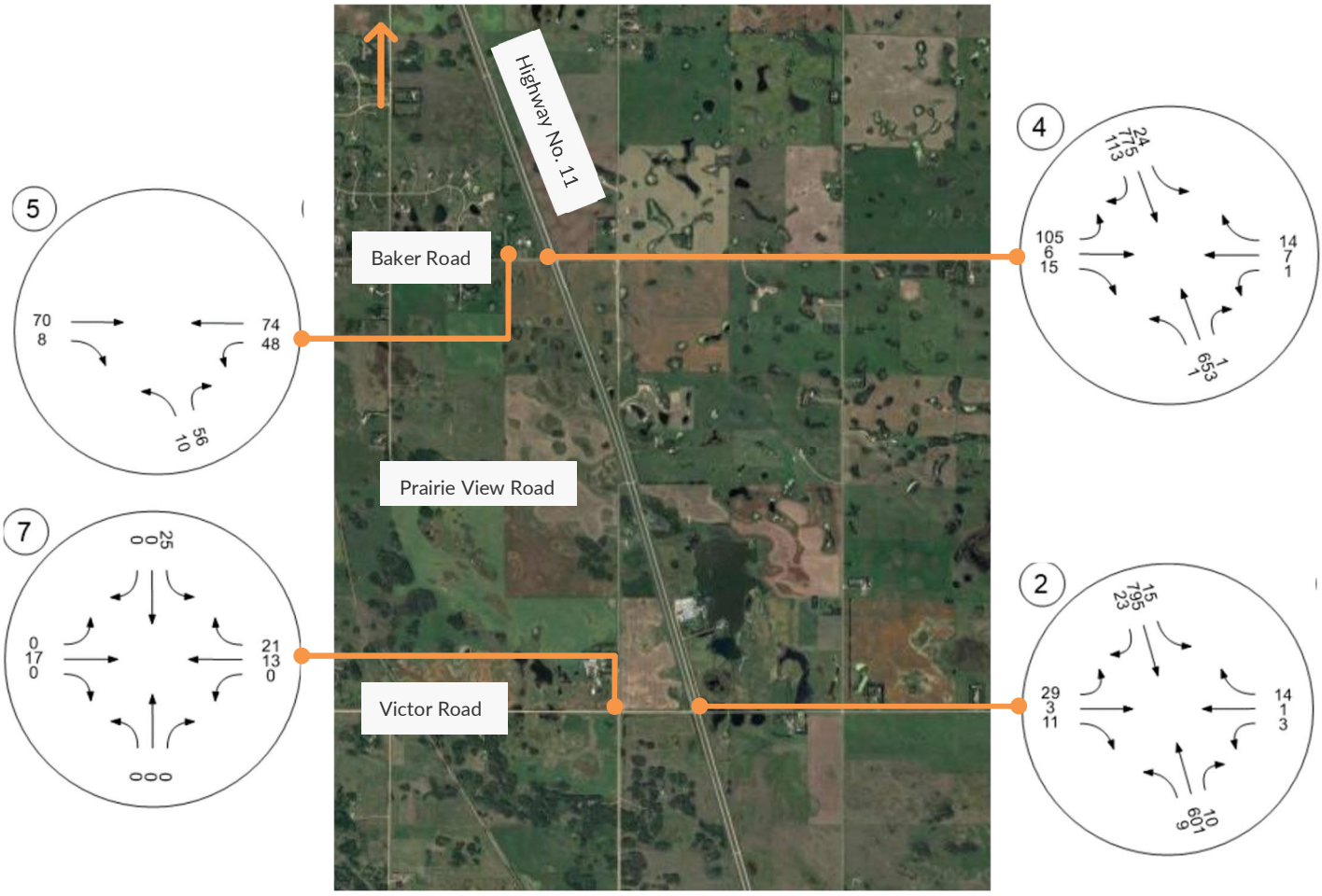


Figure 3-12
Full Build Out Traffic Volumes – PM Peak

Figure 3-13 illustrates the expected 2037 AADT at full build out.

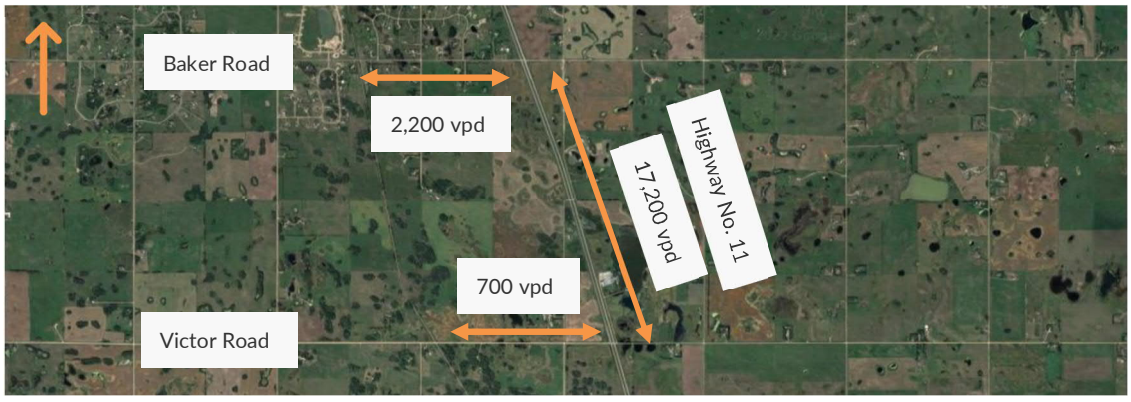


Figure 3-13
2037 AADT – Full Build Out

4 STAGE 1 TRAFFIC ANALYSIS

4.1 Analysis Method

The study intersections were analyzed using PTV Vistro™ software and the methods described in the Highway Capacity Manual, 6th Edition (2016) to determine delays and associated level of service (LOS) for the background and full build-out traffic conditions. **Section 4** assumes that all traffic may continue to access the development at Prairie View Road as a full-turns intersection. It is assumed that traffic is evenly distributed throughout the design hour.

4.2 Level of Service

The Level of Service is summarized in **Tables 4-1** and **4-2**. LOS for all movements in all horizons are within acceptable limits. At full buildout, the intersection LOS is C or better for both peak periods. The expected 95th percentile queue length at Prairie View Road is less than two vehicles in both peak periods; indicating that any noticeable queueing is unlikely. These results indicate Prairie View Road is capable of supporting development traffic and the construction of a service road is not required until additional development occurs in the area. **Appendix B** includes a detailed Level of Service report for this scenario.

Table 4-1
Intersection Operations –Prairie View Road AM Peak

2022 Existing Conditions														
	Overall Intersection		Performance	Northbound			Southbound			Eastbound			Westbound		
				Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Highway No. 11 and Prairie View Road			Volume (vph)	1	458	1	1	296	1	1	1	1	1	1	1
	LOS =	B	Approach LOS		A			A			B			B	
	V/C =	0.00	Movement LOS	A	A	A	A	A	A	B	B	A	B	B	A
	Delay =	0.1	V/C	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			95th queue(m)	0	0	0	0	0	0	0	0	0	0	0	0
2037 Background Conditions															
	Overall Intersection		Performance	Northbound			Southbound			Eastbound			Westbound		
				Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Highway No. 11 and Prairie View Road			Volume (vph)	1	641	1	1	414	1	1	1	1	1	1	1
	LOS =	C	Approach LOS		A			A			B			A	
	V/C =	0.00	Movement LOS	A	A	A	A	A	A	B	C	A	C	C	B
	Delay =	0.1	V/C	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			95th queue(m)	0	0	0	0	0	0	0	0	0	0	0	0
2037 Full Build Out															
	Overall Intersection		Performance	Northbound			Southbound			Eastbound			Westbound		
				Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Highway No. 11 and Prairie View Road			Volume (vph)	7	641	1	5	414	54	48	1	6	1	1	2
	LOS =	C	Approach LOS		A			A			B			B	
	V/C =	0.00	Movement LOS	A	A	A	A	A	A	B	C	B	C	C	B
	Delay =	0.8	V/C	0.01	0.01	0.01	0.01	0.01	0.01	0.12	0.00	0.01	0.00	0.00	0.00
			95th queue(m)	0	0	0	0	0	0	3	3	3	0	0	0

Table 4-2
Intersection Operations – Prairie View Road PM Peak

2022 Existing Conditions														
	Overall Intersection		Performance	Northbound			Southbound			Eastbound			Westbound		
				Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Highway No. 11 and Prairie View Road			Volume (vph)	1	438	1	1	601	3	5	1	1	1	1	1
	LOS =	B	Approach LOS		A			A			B			B	
	V/C =	0.00	Movement LOS	A	A	A	A	A	A	B	B	B	B	B	A
	Delay =	0.2	V/C	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
			95th queue(m)	0	0	0	0	0	0	0	0	0	0	0	0
2037 Background Conditions															
	Overall Intersection		Performance	Northbound			Southbound			Eastbound			Westbound		
				Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Highway No. 11 and Prairie View Road			Volume (vph)	1	613	1	1	841	4	7	1	1	1	1	1
	LOS =	C	Approach LOS		A			A			C			B	
	V/C =	0.02	Movement LOS	A	A	A	A	A	A	C	C	B	B	C	B
	Delay =	0.2	V/C	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00
			95th queue(m)	0	0	0	0	0	0	1	1	1	0	0	0
2037 Full Build Out															
	Overall Intersection		Performance	Northbound			Southbound			Eastbound			Westbound		
				Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Highway No. 11 and Prairie View Road			Volume (vph)	9	613	1	3	841	73	89	1	11	1	1	6
	LOS =	C	Approach LOS		A			A			C			B	
	V/C =	0.31	Movement LOS	A	A	A	A	A	A	C	C	C	C	C	B
	Delay =	1.5	V/C	0.01	0.01	0.01	0.00	0.00	0.00	0.31	0.00	0.02	0.00	0.00	0.01
			95th queue(m)	0	0	0	0	0	0	10	10	10	0	0	0

4.3 MOH Warrants

4.3.1 Intersection Treatment

An MoH system warrant analysis was carried out at the intersection of Highway No. 11 with Prairie View Road for right and left-turn lanes, Standard Plans 20614 and 20610 respectively, to determine when development traffic is expected to trigger intersection improvements.

Based on a conversation with the developer, we have assumed that 6 – 10 lots (7% of the development) will be constructed per year over approximately 15 years. The warrants were completed for the 2022 background traffic scenario and in 7% increments of total site traffic to represent the annual growth of the development. Results are summarized in **Table 4-3** and MoH warrants are provided in **Appendix C**.

Table 4-3
Prairie View Road – Intersection Treatment

Turning Lane Warrant Type	AM Peak	PM Peak
2022 Background Traffic		
NB Left Turn Lane	Not Warranted	Not Warranted
SB Right Turn Lane	Not Warranted	Not Warranted
2023 Background Traffic		
NB Left Turn Lane	Not Warranted	Not Warranted
SB Right Turn Lane	Not Warranted	Not Warranted
2023 (7%) Development Traffic		
NB Left Turn Lane	Not Warranted	Not Warranted
SB Right Turn Lane	Not Warranted	**Warranted**

A southbound right turn lane is warranted at Prairie View Road as a result of development traffic following the first year of development as part of Stage 1 access management.

4.3.2 Intersection Lighting

Intersection delineation lighting refers to the placement of a single streetlight over the approach road, often directly above the stop sign. The MoH standard DM 2621-1 states that intersection delineation lighting is warranted at public highway intersections with an AADT of 150 vpd. Intersection delineation lighting is warranted at public highway intersections with an AADT of 150 vpd. Intersection delineation lighting is warranted as a result of development.

Intersection area lighting is more extensive than delineation lighting and includes several streetlights on the highway to illuminate the entire intersection area. According to DM 2621-2, intersection area lighting is warranted if the through highway AADT exceeds or is equal to 1,500 vpd and the intersecting roadway traffic volume exceeds or is equal to 1,000 vpd. Intersection area lighting is warranted at Prairie View Road as a result of development. Lighting warrants are available in **Appendix C**.

5 STAGE 2 TRAFFIC ANALYSIS

5.1 Analysis Method

Section 5 assumes Prairie View Road has been removed and a service road has been constructed parallel to Highway No. 11 from Baker Road to Prairie View Road. We have assumed that the service road will be constructed as a two-lane roadway, creating a yield-controlled T-intersection at its terminus with Baker Road.

Vistro is designed to evaluate interrupted flow conditions and does not evaluate the capacity of receiving lanes or free-flow conditions. This method cannot quantify the operational benefit of the existing median acceleration lane at Baker Road or the possible effect of a new acceleration lane at Victor Road. Additional analysis using a micro simulation would be required to quantify the impact of this type of intersection improvement.

5.2 Level of Service

5.2.1 2022 Existing Conditions

The Level of Service is summarized in **Tables 5-1** and **5-2**. LOS for all movements in the 2022 AM and PM peak is well within acceptable limits. The intersection LOS is C or better for both peak periods. The expected 95th percentile queue length at Baker Road and Victor Road is less than one vehicle in both peak periods; indicating that any noticeable queueing is unlikely. **Appendix D** includes a detailed Level of Service report for this scenario.

Table 5-1
Intersection Operations – 2022 Existing Conditions AM Peak

AM PEAK														
	Overall Intersection		Performance	Northbound			Southbound			Eastbound			Westbound		
				Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Highway No. 11 and Baker Road			Volume (vph)	9	421	1	5	353	27	35	4	1	1	2	12
	LOS =	C	Approach LOS		A			A			B			B	
	V/C =	0.01	Movement LOS	A	A	A	A	A	A	B	B	A	B	C	A
	Delay =	0.9	V/C	0.01	0.00	0.00	0.00	0.00	0.00	0.06	0.01	0.00	0.00	0.01	0.02
			95th queue(m)	0	0	0	0	0	0	2	2	2	0	0	0
	Overall Intersection		Performance	Northbound			Southbound			Eastbound			Westbound		
				Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Highway No. 11 and Victor Road			Volume (vph)	2	436	2	5	283	3	7	1	1	1	1	24
	LOS =	B	Approach LOS		A			A			B			A	
	V/C =	0.00	Movement LOS	A	A	A	A	A	A	B	B	A	B	B	A
	Delay =	0.6	V/C	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.03
			95th queue(m)	0	0	0	0	0	0	0	0	0	1	1	1

Table 5-2
Intersection Operations – 2022 Existing Conditions PM Peak

PM PEAK														
	Overall Intersection		Performance	Northbound			Southbound			Eastbound			Westbound		
				Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Highway No. 11 and Baker Road			Volume (vph)	1	462	1	16	552	47	36	4	11	1	5	6
	LOS =	C	Approach LOS		A			A			B			B	
	V/C =	0.02	Movement LOS	A	A	A	A	A	A	C	C	B	B	C	A
	Delay =	0.9	V/C	0.00	0.00	0.00	0.01	0.01	0.00	0.10	0.01	0.02	0.00	0.02	0.01
			95th queue(m)	0	0	0	0	0	0	3	3	3	0	0	0
	Overall Intersection		Performance	Northbound			Southbound			Eastbound			Westbound		
				Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Highway No. 11 and Victor Road			Volume (vph)	1	432	7	11	568	7	10	2	1	2	1	10
	LOS =	C	Approach LOS		A			A			B			B	
	V/C =	0.01	Movement LOS	A	A	A	A	A	A	C	C	B	B	C	A
	Delay =	0.4	V/C	0.00	0.00	0.00	0.01	0.01	0.00	0.03	0.01	0.00	0.00	0.00	0.01
			95th queue(m)	0	0	0	0	0	0	1	1	1	0	0	0

5.2.2 2037 Background Conditions

The Level of Service is summarized in **Tables 5-3** and **5-4**. LOS for all movements in the 2037 Background AM and PM peak is well within acceptable limits. The LOS is C or better for both peak periods in the horizon year. The expected 95th percentile queue length at Baker Road and Victor Road is less than one vehicle in both peak periods; indicating that any noticeable queueing is unlikely. A detailed Level of Service report for this scenario is included in **Appendix D**.

Table 5-3
Intersection Operations – 2037 Background Conditions AM Peak

AM PEAK														
	Overall Intersection		Performance	Northbound			Southbound			Eastbound			Westbound		
				Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Highway No. 11 and Baker Road			Volume (vph)	13	610	1	7	512	39	51	6	1	1	3	17
	LOS =	C	Approach LOS		A			A			C			B	
	V/C =	0.01	Movement LOS	A	A	A	A	A	A	B	C	B	C	C	B
	Delay =	1.0	V/C	0.01	0.01	0.00	0.01	0.01	0.00	0.12	0.02	0.00	0.00	0.01	0.02
			95th queue(m)	0	0	0	0	0	0	4	4	4	1	1	1
	Overall Intersection		Performance	Northbound			Southbound			Eastbound			Westbound		
				Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Highway No. 11 and Victor Road			Volume (vph)	3	611	3	7	396	4	10	1	1	1	1	34
	LOS =	C	Approach LOS		A			A			B			B	
	V/C =	0.00	Movement LOS	A	A	A	A	A	A	B	C	A	C	C	B
	Delay =	0.6	V/C	0.00	0.01	0.00	0.01	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.05
			95th queue(m)	0	0	0	0	0	0	1	1	1	1	1	1

Table 5-4
Intersection Operations – 2037 Background Conditions PM Peak

PM PEAK														
	Overall Intersection		Performance	Northbound			Southbound			Eastbound			Westbound		
				Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Highway No. 11 and Baker Road			Volume (vph)	1	638	1	22	763	65	49	6	15	1	7	9
	LOS =	C	Approach LOS		A			A			C			C	
	V/C =	0.04	Movement LOS	A	A	A	A	A	A	C	C	B	C	C	B
	Delay =	1.1	V/C	0.00	0.01	0.00	0.02	0.01	0.00	0.17	0.02	0.03	0.00	0.04	0.01
			95th queue(m)	0	0	0	1	0	0	5	5	5	1	1	1
	Overall Intersection		Performance	Northbound			Southbound			Eastbound			Westbound		
				Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Highway No. 11 and Victor Road			Volume (vph)	1	605	10	15	795	10	14	3	1	3	1	14
	LOS =	C	Approach LOS		A			A			C			B	
	V/C =	0.01	Movement LOS	A	A	A	A	A	A	C	C	B	C	C	B
	Delay =	0.5	V/C	0.00	0.01	0.00	0.02	0.01	0.00	0.05	0.01	0.00	0.01	0.00	0.02
			95th queue(m)	0	0	0	0	0	0	2	2	2	0	0	0

5.2.3 2037 Full Build Out

The Level of Service is summarized in **Tables 5-5** and **5-6**. LOS for all movements in the 2037 Full Build Out AM and PM peak is well within acceptable limits. The LOS is D or better for both peak periods in the horizon year. The expected 95th percentile queue length at Baker Road and Victor Road does not exceed 2 vehicles in both peak periods; indicating that any noticeable queueing is unlikely.

According to the Ministry document SKS 2.3.5-F, there is currently no ministry standard warrant for acceleration lanes. The decision about their use is based on the forecast level of service for entering vehicles at the intersection. A low level of service, D or worse, can lead to drivers attempting to enter the highway when there is an insufficient gap in approaching traffic or attempting to use a paved shoulder as an acceleration lane. As such, a median acceleration lane is not recommended at Victor Road for the full build-out scenario.

Appendix D includes a detailed Level of Service report for this scenario.

Table 5-5
Intersection Operations – 2037 Full Build Out AM Peak

AM PEAK														
	Overall Intersection		Performance	Northbound			Southbound			Eastbound			Westbound		
				Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Highway No. 11 and Baker Road			Volume (vph)	13	619	1	11	520	76	85	6	1	1	3	18
	LOS =	C	Approach LOS		A			A			C			B	
	V/C =	0.01	Movement LOS	A	A	A	A	A	A	C	C	B	C	C	B
	Delay =	1.5	V/C	0.01	0.01	0.00	0.01	0.01	0.00	0.21	0.02	0.00	0.00	0.01	0.03
			95th queue(m)	0	0	0	0	0	0	7	7	7	1	1	1
	Overall Intersection		Performance	Northbound			Southbound			Eastbound			Westbound		
				Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Highway No. 11 and Victor Road			Volume (vph)	9	611	3	7	396	14	19	1	6	1	1	34
	LOS =	C	Approach LOS		A			A			B			B	
	V/C =	0.00	Movement LOS	A	A	A	A	A	A	B	C	A	C	C	B
	Delay =	0.8	V/C	0.01	0.01	0.00	0.01	0.00	0.00	0.05	0.00	0.01	0.00	0.00	0.05
			95th queue(m)	0	0	0	0	0	0	1	1	1	1	1	1
	Overall Intersection		Performance	Northbound			Southbound			Eastbound			Westbound		
				Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Baker Road and Future Service Road			Volume (vph)	5		34					58	6	37	55	
	LOS =	A	Approach LOS		A						A			A	
	V/C =	0.01	Movement LOS	A		A					A	A	A	A	
	Delay =	3.2	V/C	0.01		0.03					0.00	0.00	0.02	0.00	
			95th queue(m)	1		1					0	0	1	1	
	Overall Intersection		Performance	Northbound			Southbound			Eastbound			Westbound		
				Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Victor Road and Prairie View Road			Volume (vph)				14		0	0	13			10	16
	LOS =	A	Approach LOS					A			A			A	
	V/C =	0.01	Movement LOS				A		A	A	A			A	A
	Delay =	2.3	V/C				0.01		0.00	0.00	0.00			0.00	0.00
			95th queue(m)				0		0	0	0			0	0

Table 5-6
Intersection Operations – 2037 Full Build Out PM Peak

PM PEAK														
	Overall Intersection		Performance	Northbound			Southbound			Eastbound			Westbound		
				Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Highway No. 11 and Baker Road	LOS =	D	Volume (vph)	1	653	1	24	775	113	105	6	15	1	7	14
	V/C =	0.02	Approach LOS		A			A			C			C	
	Delay =	2.1	Movement LOS	B	A	A	A	A	A	C	D	C	C	C	B
			V/C	0.00	0.01	0.00	0.03	0.01	0.00	0.36	0.02	0.03	0.00	0.04	0.02
			95th queue(m)	0	0	0	1	0	0	14	14	14	1	1	1
	Overall Intersection		Performance	Northbound			Southbound			Eastbound			Westbound		
				Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Highway No. 11 and Victor Road	LOS =	C	Volume (vph)	9	601	10	15	795	23	29	3	11	3	1	14
	V/C =	0.01	Approach LOS		A			A			C			B	
	Delay =	0.8	Movement LOS	A	A	A	A	A	A	C	C	B	C	C	B
			V/C	0.01	0.01	0.00	0.02	0.01	0.00	0.11	0.01	0.02	0.01	0.00	0.02
			95th queue(m)	0	0	0	0	0	0	3	3	3	0	0	0
	Overall Intersection		Performance	Northbound			Southbound			Eastbound			Westbound		
				Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Baker Road and Future Service Road	LOS =	B	Volume (vph)	10		56					70	8	48	74	
	V/C =	0.01	Approach LOS		A						A			A	
	Delay =	3.6	Movement LOS	B		A					A	A	A	A	
			V/C	0.01		0.06					0.00	0.00	0.03	0.00	
			95th queue(m)	2		2					0	0	1	1	
	Overall Intersection		Performance	Northbound			Southbound			Eastbound			Westbound		
				Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Victor Road and Prairie View Road	LOS =	A	Volume (vph)				25		0	0	17			13	21
	V/C =	0.03	Approach LOS					A			A			A	
	Delay =	2.9	Movement LOS				A		A	A	A			A	A
			V/C				0.03		0.00	0.00	0.00			0.00	0.00
			95th queue(m)				1		1	0	0			0	0

5.3 MoH Warrants

5.3.1 Intersection Treatment

An MoH system warrant analysis was carried out at the intersection of Highway No. 11 with Baker Road and Victor Road for right and left-turn lanes, Standard Plans 20614 and 20610 respectively.

Baker Road has several safety improvements installed to date including a southbound right turn lane, northbound left turn lane and northbound median acceleration lane. The results of the intersection treatment warrants at Baker Road for the 2037 background and full build out conditions are summarized in **Table 5-7**.

Table 5-7
Baker Road – Intersection Treatment

Turning Lane Warrant Type		AM Peak		PM Peak	
		Background	Development	Background	Development
NB	Right Turn Lane	Not Warranted	Not Warranted	Not Warranted	Not Warranted
	Left Turn Lane	Installed	Installed	Installed	Installed
SB	Right Turn Lane	Installed	Installed	Installed	Installed
	Left Turn Lane	Not Warranted	Not Warranted	**Warranted**	**Warranted**

A southbound left-turn lane is warranted at Baker Road as a result of background traffic volumes.

Victor Road has several safety improvements installed to date including southbound right and left-turn lanes. The results of the intersection treatment warrants at Victor Road for the 2037 background and full build out conditions are summarized in **Table 4-8**. Full intersection warrants are available in **Appendix E**.

Table 5-8
Victor Road – Intersection Treatment

Turning Lane Warrant Type		AM Peak		PM Peak	
		Background	Development	Background	Development
NB	Right Turn Lane	Not Warranted	Not Warranted	**Warranted**	**Warranted**
	Left Turn Lane	Not Warranted	Not Warranted	Not Warranted	Not Warranted
SB	Right Turn Lane	Installed	Installed	Installed	Installed
	Left Turn Lane	Installed	Installed	Installed	Installed

A northbound right turn lane is warranted at Victor Road based on background traffic volumes.

5.3.2 Intersection Lighting

Intersection delineation lighting refers to the placement of a single streetlight over the approach road, often directly above the stop sign. Intersection delineation lighting has already been installed at both Baker Road and Victor Road.

Intersection area lighting is more extensive than delineation lighting and includes several streetlights on the highway to illuminate the entire intersection area. According to DM 2621-2, intersection area lighting is warranted if the through highway AADT exceeds or is equal to 1,500 vpd and the intersecting roadway traffic volume exceeds or is equal to 1,000 vpd.

The AADT on Baker Road currently exceeds 1,000 vpd, MoH has indicated intersection area lighting is already warranted at this location and registered with the Safety Improvement Program (SIP). The AADT on Victor Road in 2037 is nearing the threshold prior to development. Development traffic is expected to raise the AADT above 1,000 vpd at full build-out, therefore intersection area lighting is warranted. Lighting warrants are available in **Appendix E**.

6 RECOMMENDATIONS

The following summarizes the findings and recommendations described in this report:

Development Related Recommendations include:

1. Maintain development access at Prairie View Road until intersection operation falls below LOS D or until additional area development is planned to support a service road to Baker Road;
2. Construct a southbound right turn lane at Prairie View Road before the first year of development; and
3. Install intersection area lighting at Prairie View Road before full build-out.

Should additional area development traffic drive the need for a service road:

1. Close the west leg of Prairie View Road and construct a two-lane service road from Baker Road to Prairie View Road parallel to Highway No. 11;
2. Install a yield sign at the T-intersection created by the service road connection with Baker Road; and
3. Install area lighting at Victor Road before full build-out.

Planned Improvements by MoH include:

1. Installing a southbound left turn lane at Baker Road before 2037. This improvement is warranted based on background traffic volumes.
2. Installing a northbound right turn lane at Victor Road before 2037. This improvement is warranted based on background traffic volumes.
3. Installing area lighting at Baker Road before full build-out.

CLOSURE

This report was prepared for the proposed Jonathon Abrametz Greenview Estates Development to quantify the traffic impact the development is expected to have on the surrounding transportation network.

The services provided by Associated Engineering (Sask.) Ltd. in the preparation of this report were conducted in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practicing under similar conditions. No other warranty expressed or implied is made.

Respectfully submitted,
Associated Engineering (Sask.) Ltd.

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APPENDIX A - TRAFFIC COUNTS

Traffic Count Data Summary

Highway 11 and Baker Road		Northbound						Southbound						Eastbound						Westbound						Total	Pedestrians *(Crossing in front of vehicles facing)*				Departure Leg Vehicle Totals			
Date: Nov 5, 2020		Left		Through		Right		Left		Through		Right		Left		Through		Right		Left		Through		Right			E/W	E/W	N/S	N/S	NB	SB	EB	WB
Time Interval		Car	Truck	Car	Truck	Car	Truck	Car	Truck	Car	Truck	Car	Truck	Car	Truck	Car	Truck	Car	Truck	Car	Truck	Car	Truck	Car	Truck		*(NB)*	*(SB)*	*(EB)*	*(WB)*				
6:00	6:15																									0					0	0	0	0
6:15	6:30																									0					0	0	0	0
6:30	6:45																									0					0	0	0	0
6:45	7:00																									0					0	0	0	0
7:00	7:15																									0					0	0	0	0
7:15	7:30																									0					0	0	0	0
7:30	7:45																									0					0	0	0	0
7:45	8:00																									0					0	0	0	0
8:00	8:15	8	1	396	73	0	0	5	0	324	69	29	1	39	1	3	1	1	0	0	0	3	0	13	0	967					522	394	9	42
8:15	8:30																									0					0	0	0	0
8:30	8:45																									0					0	0	0	0
8:45	9:00																									0					0	0	0	0
9:00	9:15																									0					0	0	0	0
9:15	9:30																									0					0	0	0	0
9:30	9:45																									0					0	0	0	0
9:45	10:00																									0					0	0	0	0
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AM Peak Total (non-PCE)		**9**		**469**		**0**		**5**		**393**		**30**		**40**		**4**		**1**		**0**		**3**		**13**										
AM Peak %Truck		11%		16%		0%		0%		18%		3%		3%		25%		0%		0%		0%		0%										
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16:15	16:30																									0					0	0	0	0
16:30	16:45	1	0	324	69	0	0	13	0	396	73	39	1	29	1	3	0	8	1	0	0	3	1	5	0	967					428	478	16	45
16:45	17:00																									0					0	0	0	0
17:00	17:15																									0					0	0	0	0
17:15	17:30																									0					0	0	0	0
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PM Peak Subtotal		1	0	324	69	0	0	13	0	396	73	39	1	29	1	3	0	8	1	0	0	3	1	5	0		0	0	0	0	428	478	16	45
PM Peak Total (non-PCE)		**1**		**393**		**0**		**13**		**469**		**40**		**30**		**3**		**9**		**0**		**4**		**5**										
PM Peak %Truck		0%		18%		0%		0%		16%		3%		3%		0%		11%		0%		25%		0%										

Traffic Count Data Summary

Highway 11 and Prairie View Road		Northbound						Southbound						Eastbound						Westbound						Total	Pedestrians *(Crossing in front of vehicles facing)*				Departure Leg Vehicle Totals			
Date: February 3, 2022		Left		Through		Right		Left		Through		Right		Left		Through		Right		Left		Through		Right			E/W *(NB)*	E/W *(SB)*	N/S *(EB)*	N/S *(WB)*	NB	SB	EB	WB
Time Interval		Car	Truck	Car	Truck	Car	Truck	Car	Truck	Car	Truck	Car	Truck	Car	Truck	Car	Truck	Car	Truck	Car	Truck	Car	Truck	Car	Truck									
6:00	6:15																									0					0	0	0	0
6:15	6:30																									0					0	0	0	0
6:30	6:45																									0					0	0	0	0
6:45	7:00																									0					0	0	0	0
7:00	7:15																									0					0	0	0	0
7:15	7:30																									0					0	0	0	0
7:30	7:45																									0					0	0	0	0
7:45	8:00	0	0	69	10	0	0	0	0	40	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	136	0	0	0	0	79	57	0	0
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8:15	8:30	0	0	93	15	0	0	0	0	49	9	0	0	0	0	0	0	1	0	0	0	0	0	0	0	167	0	0	0	0	108	59	0	0
8:30	8:45	0	0	86	18	0	0	0	0	41	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	161	0	0	0	0	104	57	0	0
8:45	9:00	0	0	62	15	0	0	0	0	51	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	139	0	0	0	0	77	62	0	0
9:00	9:15	0	0	44	12	0	0	0	0	55	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	136	0	0	0	0	56	80	0	0
9:15	9:30	0	0	50	21	0	0	0	0	45	26	0	0	1	0	0	0	0	0	0	0	0	0	0	0	143	0	0	0	0	72	71	0	0
9:30	9:45	0	0	57	19	0	0	0	0	46	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	141	0	0	0	0	76	65	0	0
9:45	10:00																									0					0	0	0	0
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AM Peak Total (non-PCE)		**0**		**391**		**0**		**0**		**253**		**1**		**1**		**0**		**1**		**0**		**0**		**0**										
AM Peak %Truck		0%		15%		0%		0%		23%		0%		0%		0%		0%		0%		0%		0%										
15:00	15:15																									0					0	0	0	0
15:15	15:30																									0					0	0	0	0
15:30	15:45																									0					0	0	0	0
15:45	16:00																									0					0	0	0	0
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17:15	17:30	0	0	63	18	0	0	0	0	104	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	199	0	0	0	0	81	118	0	0
17:30	17:45	0	0	61	20	0	0	0	0	114	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	212	0	0	0	0	81	131	0	0
17:45	18:00	0	0	51	10	0	0	0	0	85	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	156	0	0	0	0	61	95	0	0
18:00	18:15																									0					0	0	0	0
18:15	18:30																									0					0	0	0	0
18:30	18:45																									0					0	0	0	0
18:45	19:00																									0					0	0	0	0
PM Peak Subtotal		0	0	321	54	0	0	0	0	458	56	3	0	4	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	379	514	0	3
PM Peak Total (non-PCE)		**0**		**375**		**0**		**0**		**514**		**3**		**4**		**0**		**0**		**0**		**0**		**0**										
PM Peak %Truck		0%		14%		0%		0%		11%		0%		0%		0%		0%		0%		0%		0%										

Traffic Count Data Summary

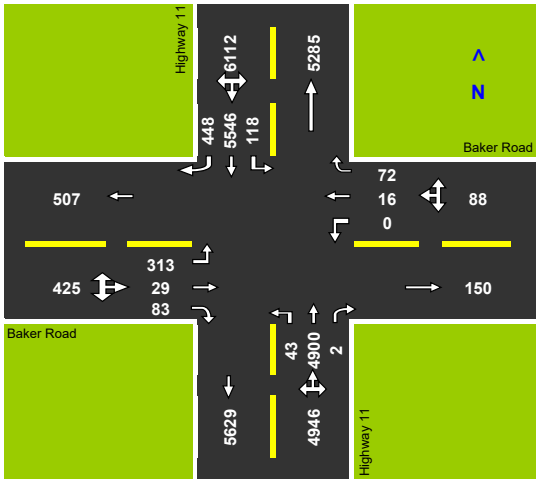
Associated Engineering

Highway 11 and Victor Road		Northbound						Southbound						Eastbound						Westbound						Total	Pedestrians *(Crossing in front of vehicles facing)*				Departure Leg Vehicle Totals			
Date: February 3, 2022		Left		Through		Right		Left		Through		Right		Left		Through		Right		Left		Through		Right			E/W *(NB)*	E/W *(SB)*	N/S *(EB)*	N/S *(WB)*	NB	SB	EB	WB
Time Interval		Car	Truck	Car	Truck	Car	Truck	Car	Truck	Car	Truck	Car	Truck	Car	Truck	Car	Truck	Car	Truck	Car	Truck	Car	Truck	Car	Truck									
6:00	6:15																									0					0	0	0	0
6:15	6:30																									0					0	0	0	0
6:30	6:45																									0					0	0	0	0
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7:15	7:30																									0					0	0	0	0
7:30	7:45																									0					0	0	0	0
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8:30	8:45	1	0	87	18	2	0	0	0	39	12	0	0	2	0	0	0	0	0	0	0	1	0	2	1	165	0	0	0	0	110	51	2	2
8:45	9:00	0	0	55	12	0	0	4	0	46	13	1	0	1	0	1	0	0	1	0	0	0	0	2	0	136	0	0	0	0	70	60	5	1
9:00	9:15	1	0	44	10	1	0	1	0	56	23	1	0	1	0	0	0	0	0	0	0	0	0	2	0	140	0	0	0	0	57	79	2	2
9:15	9:30	0	1	46	20	0	0	1	0	34	26	2	0	0	0	0	0	0	0	0	0	1	0	2	0	133	0	0	0	0	68	60	1	4
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9:45	10:00																									0					0	0	0	0
AM Peak Subtotal		2	0	320	54	2	0	3	1	177	64	3	0	6	0	0	0	0	0	1	0	1	0	19	1		0	0	0	0	400	242	6	6
AM Peak Total (non-PCE)		**2**		**374**		**2**		**4**		**241**		**3**		**6**		**0**		**0**		**1**		**1**		**20**										
AM Peak %Truck			0%		14%		0%		25%		27%		0%		0%		0%		0%		0%		0%		5%									
15:00	15:15																									0					0	0	0	0
15:15	15:30																									0					0	0	0	0
15:30	15:45																									0					0	0	0	0
15:45	16:00																									0					0	0	0	0
16:00	16:15	0	0	58	24	0	0	2	0	88	16	3	2	0	0	0	0	0	0	0	0	0	0	1	0	194	0	0	0	0	83	104	2	5
16:15	16:30	0	0	95	11	1	0	4	0	111	10	1	0	1	1	0	0	0	0	1	0	0	0	0	0	236	0	0	0	0	108	122	5	1
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17:15	17:30	0	0	65	16	0	0	3	0	106	15	3	0	0	0	0	0	0	0	0	0	2	0	0	0	210	0	0	0	0	81	121	3	5
17:30	17:45	0	0	57	22	0	0	5	0	107	15	2	0	1	0	0	0	3	0	1	0	0	0	1	0	214	0	0	0	0	81	126	5	2
17:45	18:00	0	0	40	10	0	0	4	0	69	12	3	0	3	0	0	0	1	0	0	0	1	0	3	0	146	0	0	0	0	56	82	4	4
18:00	18:15																									0					0	0	0	0
18:15	18:30																									0					0	0	0	0
18:30	18:45																									0					0	0	0	0
18:45	19:00																									0					0	0	0	0
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PM Peak Total (non-PCE)		**1**		**369**		**6**		**10**		**486**		**6**		**9**		**2**		**1**		**2**		**1**		**9**										
PM Peak %Truck			0%		14%		0%		0%		11%		0%		11%		0%		0%		0%		0%		0%									

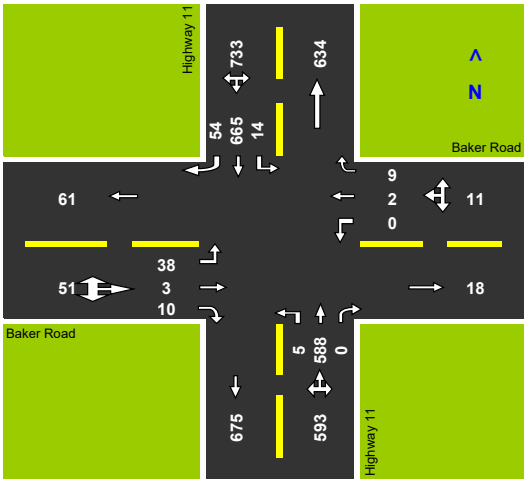
Baker Road Traffic Count Results

C.S: CS 11-08 Date: 11/5/2020 Start: 13:00:00
Km: 0 End: 19:00:00

2020 AADT

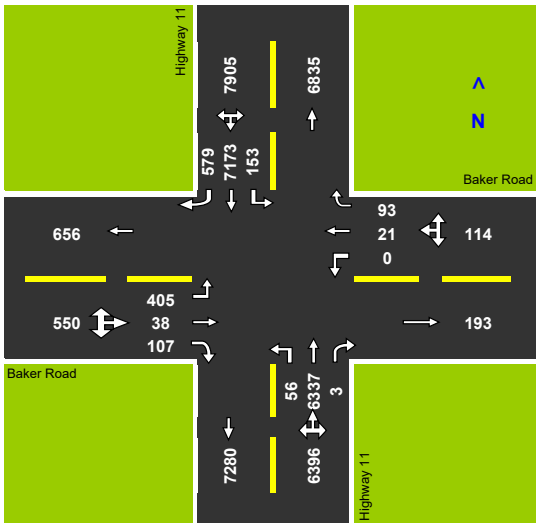


2020 Design Hourly Volume

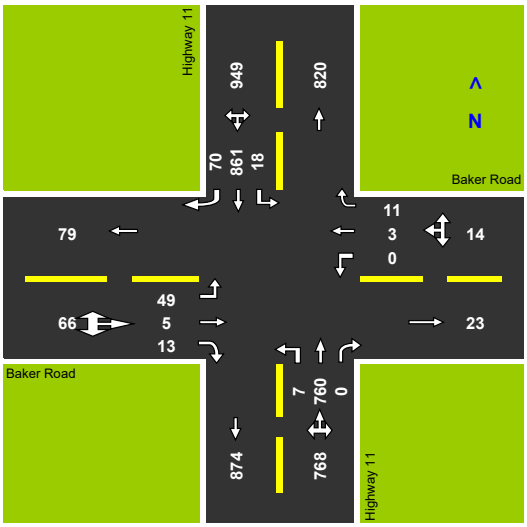


Leg	Current Leg AADT
Northbound	10574
Southbound	11397
Eastbound	933
Westbound	237

2031 Projected AADT



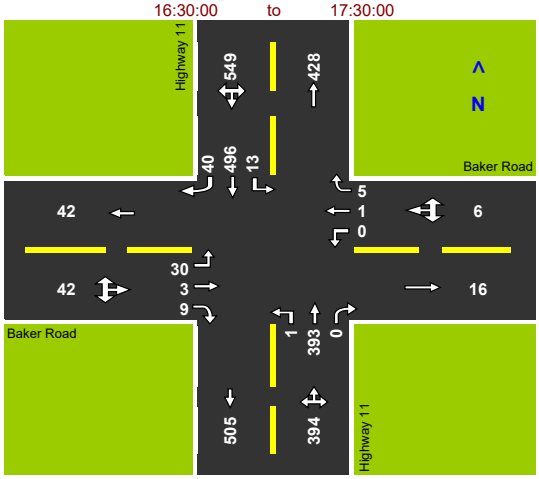
2031 Projected Design Hourly Volume



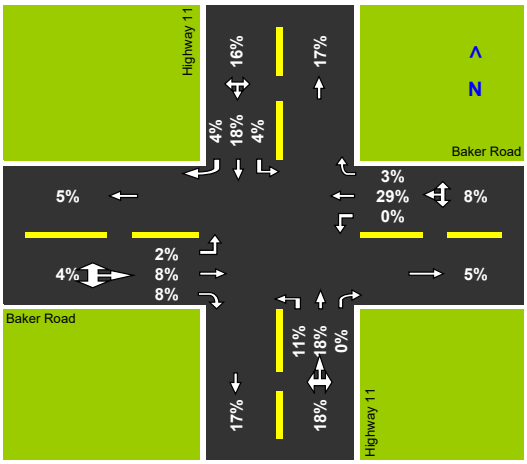
Leg	2031 Leg AADT
Northbound	13676
Southbound	14740
Eastbound	1206
Westbound	307

Peak Counted Hour

16:30:00 to 17:30:00



Truck Percentage During Traffic Count



Ellen McLaughlin

From: Jaworski, Derek HI <Derek.Jaworski@gov.sk.ca>
Sent: Thursday, February 10, 2022 4:57 PM
To: Ellen McLaughlin
Subject: RE: Greenview Estates TIA

Ellen:

The daily vehicle count from the Dundurn permanent count station was 5904 on February 3, all lanes combined. In 2020 (still before pandemic) the nearest Thursdays were January 30 and February 6, so I looked at the daily vehicle counts from both Thursdays and averaged them. The average was 6650, resulting in a COVID adjustment factor of 1.13.

Thanks,
-Derek J.

From: Jaworski, Derek HI
Sent: Monday, February 7, 2022 11:08 AM
To: Ellen McLaughlin <mclaughline@ae.ca>
Subject: RE: Greenview Estates TIA

Ellen:

At this point I don't think so. Sometime this week the data from last week at the Dundurn permanent count station should come in for the COVID analysis.

Thanks,
-Derek J.

From: Ellen McLaughlin <mclaughline@ae.ca>
Sent: Monday, February 7, 2022 10:48 AM
To: Jaworski, Derek HI <Derek.Jaworski@gov.sk.ca>
Cc: Zeremariam, Samson HI <samson.zeremariam@gov.sk.ca>
Subject: RE: Greenview Estates TIA

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Hello Derek!

We completed our traffic counts on Highway 11 at Prairie View Road and Victor Road on Thursday, February 3. Do you need any additional information to develop a covid factor for this corridor?

Thanks,

Ellen McLaughlin, P.Eng. *(She/Her)*
Transportation Planning Engineer
Associated Engineering (Sask.) Ltd.
1922 Park Street, Regina, SK S4N 7M4
Tel: 306.721.2466 | Cel: 306.741.3245 | Dir: 306.271.0883

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From: Zeremariam, Samson HI <samson.zeremariam@gov.sk.ca>
Sent: Monday, January 24, 2022 1:37 PM
To: Ellen McLaughlin <mclaughline@ae.ca>
Cc: Jaworski, Derek HI <Derek.Jaworski@gov.sk.ca>; Andersen, Laura HI <laura.andersen@gov.sk.ca>
Subject: RE: Greenview Estates TIA

Afternoon Ellen,

I have attached TED's traffic count at the intersection of Baker Road and Highway 11 in 2020 (fall/winter).

Let me know if you have any questions.

Thanks,

Samson Zeremariam, EIT (he/him)
Government of Saskatchewan
Operations Project Engineer
Traffic Engineering and Development, Ministry of Highways

18-3603 Millar Avenue
Saskatoon, Canada S7P 0B2
Office: 306-933-5340
Cell : 306-280-0724
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Saskatchewan

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From: Jaworski, Derek HI <Derek.Jaworski@gov.sk.ca>
Sent: Monday, January 24, 2022 1:14 PM
To: Ellen McLaughlin <mclaughline@ae.ca>; Andersen, Laura HI <laura.andersen@gov.sk.ca>
Cc: Zeremariam, Samson HI <samson.zeremariam@gov.sk.ca>
Subject: RE: Greenview Estates TIA

Ellen:

In the response I included Laura Andersen in Central Region TED to find if they had done any turning movement counts at Highway 11 and Baker Road. Otherwise, there is just the 48-hour data sent earlier on all legs except the east leg.

Thanks,
-Derek J.

From: Ellen McLaughlin <mclaughline@ae.ca>
Sent: Monday, January 24, 2022 12:20 PM
To: Jaworski, Derek HI <Derek.Jaworski@gov.sk.ca>
Cc: Zeremariam, Samson HI <samson.zeremariam@gov.sk.ca>
Subject: RE: Greenview Estates TIA

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Thank you so much for this information Derek!

I would just like to confirm that there is no intersection turning movement count at Highway No. 11 and Baker Road? If not, I will need to find another traffic counter ASAP.

Regards,

Ellen McLaughlin, P.Eng. *(She/Her)*
Transportation Planning Engineer
Associated Engineering (Sask.) Ltd.
1922 Park Street, Regina, SK S4N 7M4
Tel: 306.721.2466 | Cel: 306.741.3245 | Dir: 306.271.0883

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From: Jaworski, Derek HI <Derek.Jaworski@gov.sk.ca>
Sent: Thursday, January 20, 2022 4:11 PM
To: Ellen McLaughlin <mclaughline@ae.ca>
Subject: RE: Greenview Estates TIA

Ellen:

Below and attached is traffic information at the requested locations.

Baker Rd/Twp Rd 354 – Regional Commuter west of Highway 11 (K factor 0.120, growth factor 1.60) and Rural < 600 east of Highway 11 (K factor 0.140, growth factor 1.40). Count file name Daily Class 71 N.24-35-05-W3.xlsx for hourly traffic west of Highway 11. East of Highway 11, only daily counter readings were recorded.

Prairie View Road – no data files collected, but growth factor of 1.00, K factor of 0.140 and Rural < 600 traffic can be assumed.

Victor Road – Rural < 600, K factor 0.120, growth factor 1.35, count file name Daily Class 74 N.12-35-05-W3.xlsx
Melness Road – Rural < 600, K factor 0.120, growth factor 1.35, count file name Daily Class 29 N.08-35-04-W3.xlsx

On Highway 11, the hourly data files are separated by inner (I) and outer (O) lane designation.

Within a couple of weeks after January 26, we'll look at data from a permanent count station near Dundurn and compare it to data from 2019 to determine if a COVID factor is needed.

Thanks,
Derek Jaworski, P.Eng.
Government of Saskatchewan
Manager of Traffic Services
Operation and Maintenance, Ministry of Highways

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From: Ellen McLaughlin <mclaughline@ae.ca>
Sent: Wednesday, January 19, 2022 12:01 PM
To: Jaworski, Derek HI <Derek.Jaworski@gov.sk.ca>
Subject: Greenview Estates TIA

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Hello Derek!

Hope all is well and the new year finds you safe! We are completing a TIA south of Saskatoon on Highway 11 and I was hoping to gather some background information. Our study includes three intersections with Highway 11 – Baker Road, Prairie View Road, and Victor Road. Can the Ministry provide:

- The 15 year Growth Factor for the corridor,
- Existing traffic counts at the intersection of Highway 11 and Baker Road (Samson Z indicated a 2020 count was available) + covid factor is applicable,
- Highway classification (for time of day and monthly distribution graphs)
- Covid factors for our upcoming counts. I will confirm our counts dates, but I am hoping to mobilize staff Wednesday January 26.

Regards,

Ellen McLaughlin, P.Eng. *(She/Her)*
Transportation Planning Engineer
Associated Engineering (Sask.) Ltd.
1922 Park Street, Regina, SK S4N 7M4
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APPENDIX B – STAGE 1 VISTRO REPORTS

Greenview Estates

Vistro File: \...\Greenview_20220422.vistro
Report File: \...\Appendix B.1.pdf

Scenario 3 Am Peak Stage 1
4/22/2022

Intersection Analysis Summary

ID	Intersection Name	Control Type	Method	Worst Mvmt	V/C	Delay (s/veh)	LOS
2	Highway 11 and Victor Road	Two-way stop	HCM 6th Edition	EB Thru	0.003	15.8	C
3	Highway 11 and Prairie View Road	Two-way stop	HCM 6th Edition	WB Thru	0.003	15.7	C
4	Highway 11 and Baker Road	Two-way stop	HCM 6th Edition	WB Thru	0.012	19.2	C
5	Baker Road and Service Road	Two-way stop	HCM 6th Edition	EB Thru	0.001	0.0	A
7	Victor Road and Service Road	Two-way stop	HCM 6th Edition	EB Thru	0.000	0.0	A

V/C, Delay, LOS: For two-way stop, these values are taken from the movement with the worst (highest) delay value. For all other control types, they are taken for the whole intersection.

Intersection Level Of Service Report
Intersection 2: Highway 11 and Victor Road

Control Type:	Two-way stop	Delay (sec / veh):	15.8
Analysis Method:	HCM 6th Edition	Level Of Service:	C
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.003

Intersection Setup

Name	Highway 11			Highway 11			Victor Road			Victor Road		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70
No. of Lanes in Entry Pocket	0	0	0	1	0	1	0	0	0	0	0	0
Entry Pocket Length [m]	30.48	30.48	30.48	180.00	30.48	180.00	30.48	30.48	30.48	30.48	30.48	30.48
No. of Lanes in Exit Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Speed [km/h]	110.00			110.00			70.00			70.00		
Grade [%]	0.00			0.00			0.00			0.00		
Crosswalk	No			No			No			No		

Volumes

Name	Highway 11			Highway 11			Victor Road			Victor Road		
Base Volume Input [veh/h]	2	387	2	4	250	3	6	1	1	1	1	21
Base Volume Adjustment Factor	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300
Heavy Vehicles Percentage [%]	2.00	14.00	2.00	2.00	19.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Growth Factor	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Total Hourly Volume [veh/h]	3	612	3	7	396	4	10	1	1	1	1	34
Peak Hour Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Other Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Total 15-Minute Volume [veh/h]	1	153	1	2	99	1	3	0	0	0	0	9
Total Analysis Volume [veh/h]	3	612	3	7	396	4	10	1	1	1	1	34
Pedestrian Volume [ped/h]	0			0			0			0		

Intersection Settings

Priority Scheme	Free	Free	Stop	Stop
Flared Lane			Yes	Yes
Storage Area [veh]	0	0	1	1
Two-Stage Gap Acceptance			Yes	Yes
Number of Storage Spaces in Median	0	0	1	1

Movement, Approach, & Intersection Results

V/C, Movement V/C Ratio	0.00	0.01	0.00	0.01	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.05
d_M, Delay for Movement [s/veh]	8.12	0.00	0.00	8.78	0.00	0.00	13.98	15.80	9.67	15.31	15.78	10.49
Movement LOS	A	A	A	A	A	A	B	C	A	C	C	B
95th-Percentile Queue Length [veh/ln]	0.01	0.00	0.00	0.02	0.00	0.00	0.08	0.08	0.08	0.16	0.16	0.16
95th-Percentile Queue Length [m/ln]	0.06	0.03	0.00	0.17	0.00	0.00	0.64	0.64	0.64	1.19	1.19	1.19
d_A, Approach Delay [s/veh]	0.04			0.15			13.77			10.77		
Approach LOS	A			A			B			B		
d_I, Intersection Delay [s/veh]	0.60											
Intersection LOS	C											

Intersection Level Of Service Report
Intersection 3: Highway 11 and Prairie View Road

Control Type:	Two-way stop	Delay (sec / veh):	15.7
Analysis Method:	HCM 6th Edition	Level Of Service:	C
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.003

Intersection Setup

Name	Highway 11			Highway 11			Prairie View Road			Prairie View Road		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70
No. of Lanes in Entry Pocket	0	0	0	0	0	1	0	0	0	0	0	0
Entry Pocket Length [m]	30.48	30.48	30.48	30.48	30.48	150.00	30.48	30.48	30.48	30.48	30.48	30.48
No. of Lanes in Exit Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Speed [km/h]	110.00			110.00			70.00			70.00		
Grade [%]	0.00			0.00			0.00			0.00		
Crosswalk	No			No			No			No		

Volumes

Name	Highway 11			Highway 11			Prairie View Road			Prairie View Road		
Base Volume Input [veh/h]	1	405	1	1	262	1	1	1	1	1	1	1
Base Volume Adjustment Factor	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300
Heavy Vehicles Percentage [%]	2.00	14.00	2.00	2.00	15.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Growth Factor	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Total Hourly Volume [veh/h]	1	641	1	1	414	1	1	1	1	1	1	1
Peak Hour Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Other Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Total 15-Minute Volume [veh/h]	0	160	0	0	104	0	0	0	0	0	0	0
Total Analysis Volume [veh/h]	1	641	1	1	414	1	1	1	1	1	1	1
Pedestrian Volume [ped/h]	0			0			0			0		

Intersection Settings

Priority Scheme	Free	Free	Stop	Stop
Flared Lane			Yes	Yes
Storage Area [veh]	0	0	1	1
Two-Stage Gap Acceptance			Yes	Yes
Number of Storage Spaces in Median	0	0	1	1

Movement, Approach, & Intersection Results

V/C, Movement V/C Ratio	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
d_M, Delay for Movement [s/veh]	8.16	0.00	0.00	8.84	0.00	0.00	13.60	15.74	9.54	15.34	15.75	10.38
Movement LOS	A	A	A	A	A	A	B	C	A	C	C	B
95th-Percentile Queue Length [veh/ln]	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02	0.02	0.02	0.02	0.02
95th-Percentile Queue Length [m/ln]	0.02	0.01	0.00	0.02	0.01	0.00	0.12	0.12	0.12	0.13	0.13	0.13
d_A, Approach Delay [s/veh]	0.01			0.02			12.96			13.82		
Approach LOS	A			A			B			B		
d_I, Intersection Delay [s/veh]	0.09											
Intersection LOS	C											

Intersection Level Of Service Report
Intersection 4: Highway 11 and Baker Road

Control Type:	Two-way stop	Delay (sec / veh):	19.2
Analysis Method:	HCM 6th Edition	Level Of Service:	C
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.012

Intersection Setup

Name	Highway 11			Highway 11						Baker Road		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70
No. of Lanes in Entry Pocket	1	0	0	0	0	1	0	0	0	0	0	0
Entry Pocket Length [m]	180.00	30.48	30.48	30.48	30.48	180.00	30.48	30.48	30.48	30.48	30.48	30.48
No. of Lanes in Exit Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Speed [km/h]	110.00			110.00			110.00			70.00		
Grade [%]	0.00			0.00			0.00			0.00		
Crosswalk	No			No			No			No		

Volumes

Name	Highway 11			Highway 11						Baker Road		
Base Volume Input [veh/h]	7	345	1	4	289	22	29	3	1	1	2	10
Base Volume Adjustment Factor	1.2200	1.2200	1.2200	1.2200	1.2200	1.2200	1.2200	1.2200	1.2200	1.2200	1.2200	1.2200
Heavy Vehicles Percentage [%]	11.00	18.00	2.00	4.00	18.00	4.00	2.00	8.00	8.00	2.00	29.00	3.00
Growth Factor	1.4500	1.4500	1.4500	1.4500	1.4500	1.4500	1.4500	1.4500	1.4500	1.4500	1.4500	1.4500
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Total Hourly Volume [veh/h]	13	610	1	7	512	39	51	6	1	1	3	17
Peak Hour Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Other Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Total 15-Minute Volume [veh/h]	3	153	0	2	128	10	13	2	0	0	1	4
Total Analysis Volume [veh/h]	13	610	1	7	512	39	51	6	1	1	3	17
Pedestrian Volume [ped/h]	0			0			0			0		

Intersection Settings

Priority Scheme	Free	Free	Stop	Stop
Flared Lane			Yes	Yes
Storage Area [veh]	0	0	1	1
Two-Stage Gap Acceptance			Yes	Yes
Number of Storage Spaces in Median	0	0	1	1

Movement, Approach, & Intersection Results

V/C, Movement V/C Ratio	0.01	0.01	0.00	0.01	0.01	0.00	0.14	0.02	0.00	0.00	0.01	0.02
d_M, Delay for Movement [s/veh]	8.82	0.00	0.00	8.82	0.00	0.00	16.98	19.05	11.91	15.96	19.19	10.34
Movement LOS	A	A	A	A	A	A	C	C	B	C	C	B
95th-Percentile Queue Length [veh/ln]	0.04	0.00	0.00	0.02	0.01	0.00	0.57	0.57	0.57	0.08	0.08	0.08
95th-Percentile Queue Length [m/ln]	0.32	0.00	0.00	0.17	0.08	0.00	4.37	4.37	4.37	0.58	0.58	0.58
d_A, Approach Delay [s/veh]	0.18			0.11			17.11			11.88		
Approach LOS	A			A			C			B		
d_I, Intersection Delay [s/veh]	1.12											
Intersection LOS	C											

Intersection Level Of Service Report
Intersection 5: Baker Road and Service Road

Control Type:	Two-way stop	Delay (sec / veh):	0.0
Analysis Method:	HCM 6th Edition	Level Of Service:	A
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.001

Intersection Setup

Name						
Approach	Northbound		Eastbound		Westbound	
Lane Configuration						
Turning Movement	Left	Right	Thru	Right	Left	Thru
Lane Width [m]	3.66	3.66	3.66	3.66	3.66	3.66
No. of Lanes in Entry Pocket	0	0	0	0	0	0
Entry Pocket Length [m]	30.48	30.48	30.48	30.48	30.48	30.48
No. of Lanes in Exit Pocket	0	0	0	0	0	0
Exit Pocket Length [m]	0.00	0.00	0.00	0.00	0.00	0.00
Speed [km/h]	70.00		70.00		70.00	
Grade [%]	0.00		0.00		0.00	
Crosswalk	No		No		No	

Volumes

Name						
Base Volume Input [veh/h]	0	0	33	0	0	31
Base Volume Adjustment Factor	1.2200	1.2200	1.2200	1.2200	1.2200	1.2200
Heavy Vehicles Percentage [%]	2.00	2.00	2.00	2.00	2.00	2.00
Growth Factor	1.4500	1.4500	1.4500	1.4500	1.4500	1.4500
In-Process Volume [veh/h]	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	0	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0
Total Hourly Volume [veh/h]	0	0	58	0	0	55
Peak Hour Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Other Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Total 15-Minute Volume [veh/h]	0	0	15	0	0	14
Total Analysis Volume [veh/h]	0	0	58	0	0	55
Pedestrian Volume [ped/h]	0		0		0	

Intersection Settings

Priority Scheme	Stop	Free	Free
Flared Lane	No		
Storage Area [veh]	0	0	0
Two-Stage Gap Acceptance	No		
Number of Storage Spaces in Median	0	0	0

Movement, Approach, & Intersection Results

V/C, Movement V/C Ratio	0.00	0.00	0.00	0.00	0.00	0.00
d_M, Delay for Movement [s/veh]	9.07	8.57	0.00	0.00	7.33	0.00
Movement LOS	A	A	A	A	A	A
95th-Percentile Queue Length [veh/ln]	0.00	0.00	0.00	0.00	0.00	0.00
95th-Percentile Queue Length [m/ln]	0.00	0.00	0.00	0.00	0.00	0.00
d_A, Approach Delay [s/veh]	8.82		0.00		0.00	
Approach LOS	A		A		A	
d_I, Intersection Delay [s/veh]	0.00					
Intersection LOS	A					

Intersection Level Of Service Report
Intersection 7: Victor Road and Service Road

Control Type:	Two-way stop	Delay (sec / veh):	0.0
Analysis Method:	HCM 6th Edition	Level Of Service:	A
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.000

Intersection Setup

Name	Service Road			Service Road			Victor Road			Victor Road		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3.66	3.66	3.66	3.66	3.66	3.66	3.66	3.66	3.66	3.66	3.66	3.66
No. of Lanes in Entry Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Entry Pocket Length [m]	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48
No. of Lanes in Exit Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Speed [km/h]	110.00			110.00			70.00			110.00		
Grade [%]	0.00			0.00			0.00			0.00		
Crosswalk	Yes			Yes			Yes			Yes		

Volumes

Name	Service Road			Service Road			Victor Road			Victor Road		
Base Volume Input [veh/h]	0	0	0	0	0	0	0	8	0	0	6	0
Base Volume Adjustment Factor	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300
Heavy Vehicles Percentage [%]	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Growth Factor	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Total Hourly Volume [veh/h]	0	0	0	0	0	0	0	13	0	0	10	0
Peak Hour Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Other Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Total 15-Minute Volume [veh/h]	0	0	0	0	0	0	0	3	0	0	3	0
Total Analysis Volume [veh/h]	0	0	0	0	0	0	0	13	0	0	10	0
Pedestrian Volume [ped/h]	0			0			0			0		

Intersection Settings

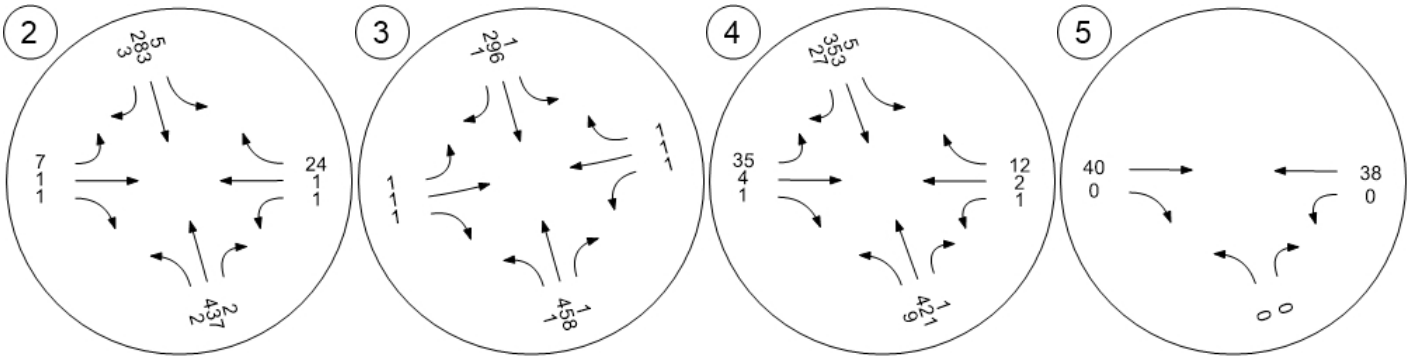
Priority Scheme	Stop	Stop	Free	Free
Flared Lane	No	No		
Storage Area [veh]	0	0	0	0
Two-Stage Gap Acceptance	No	No		
Number of Storage Spaces in Median	0	0	0	0

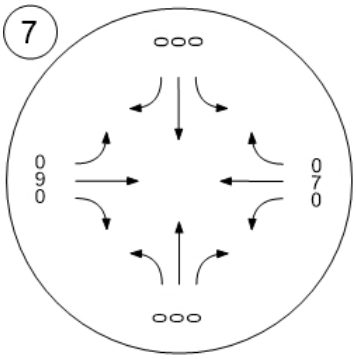
Movement, Approach, & Intersection Results

V/C, Movement V/C Ratio	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
d_M, Delay for Movement [s/veh]	8.64	9.14	8.37	8.64	9.14	8.36	7.24	0.00	0.00	7.24	0.00	0.00
Movement LOS	A	A	A	A	A	A	A	A	A	A	A	A
95th-Percentile Queue Length [veh/ln]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
95th-Percentile Queue Length [m/ln]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
d_A, Approach Delay [s/veh]	8.72			8.71			0.00			0.00		
Approach LOS	A			A			A			A		
d_I, Intersection Delay [s/veh]	0.00											
Intersection LOS	A											

Report Figure 1a: Traffic Volume - Base Volume

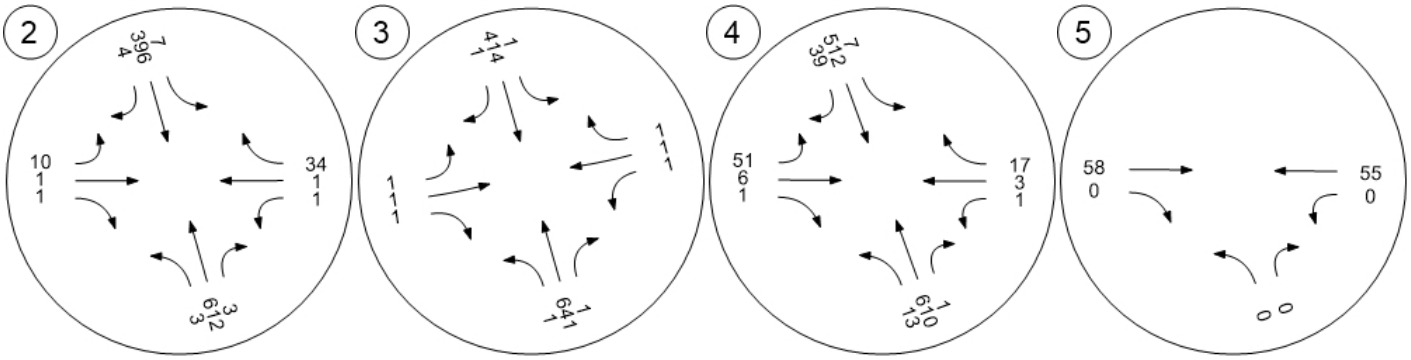


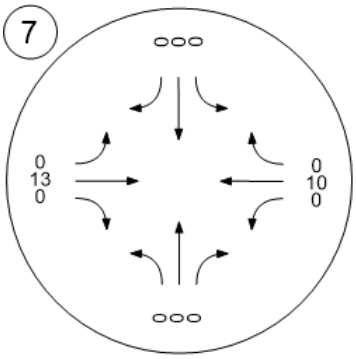




Report Figure 1c: Traffic Volume - Future Background Volume







Greenview Estates

Vistro File: \...\Greenview_20220202.vistro
Report File: \...\Appendix B.2.pdf

Scenario 4 Pm Peak Stage 1
4/22/2022

Intersection Analysis Summary

ID	Intersection Name	Control Type	Method	Worst Mvmt	V/C	Delay (s/veh)	LOS
2	Highway 11 and Victor Road	Two-way stop	HCM 6th Edition	EB Thru	0.012	20.4	C
3	Highway 11 and Prairie View Road	Two-way stop	HCM 6th Edition	EB Thru	0.004	19.8	C
4	Highway 11 and Baker Road	Two-way stop	HCM 6th Edition	WB Thru	0.036	23.6	C
5	Baker Road and Service Road	Two-way stop	HCM 6th Edition	WB Thru	0.001	0.0	A
7	Victor Road and Service Road	Two-way stop	HCM 6th Edition	EB Thru	0.000	0.0	A

V/C, Delay, LOS: For two-way stop, these values are taken from the movement with the worst (highest) delay value. For all other control types, they are taken for the whole intersection.

Intersection Level Of Service Report
Intersection 2: Highway 11 and Victor Road

Control Type:	Two-way stop	Delay (sec / veh):	20.4
Analysis Method:	HCM 6th Edition	Level Of Service:	C
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.012

Intersection Setup

Name	Highway 11			Highway 11			Victor Road			Victor Road		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70
No. of Lanes in Entry Pocket	0	0	0	1	0	1	0	0	0	0	0	0
Entry Pocket Length [m]	30.48	30.48	30.48	180.00	30.48	180.00	30.48	30.48	30.48	30.48	30.48	30.48
No. of Lanes in Exit Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Speed [km/h]	110.00			110.00			70.00			70.00		
Grade [%]	0.00			0.00			0.00			0.00		
Crosswalk	No			No			No			No		

Volumes

Name	Highway 11			Highway 11			Victor Road			Victor Road		
Base Volume Input [veh/h]	1	382	6	10	503	6	9	2	1	2	1	9
Base Volume Adjustment Factor	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300
Heavy Vehicles Percentage [%]	2.00	14.00	2.00	2.00	19.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Growth Factor	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Total Hourly Volume [veh/h]	1	605	10	15	795	10	14	3	1	3	1	14
Peak Hour Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Other Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Total 15-Minute Volume [veh/h]	0	151	3	4	199	3	4	1	0	1	0	4
Total Analysis Volume [veh/h]	1	605	10	15	795	10	14	3	1	3	1	14
Pedestrian Volume [ped/h]	0			0			0			0		

Intersection Settings

Priority Scheme	Free	Free	Stop	Stop
Flared Lane			Yes	Yes
Storage Area [veh]	0	0	1	1
Two-Stage Gap Acceptance			Yes	Yes
Number of Storage Spaces in Median	0	0	1	1

Movement, Approach, & Intersection Results

V/C, Movement V/C Ratio	0.00	0.01	0.00	0.02	0.01	0.00	0.05	0.01	0.00	0.01	0.00	0.02
d_M, Delay for Movement [s/veh]	9.42	0.00	0.00	8.81	0.00	0.00	19.93	20.44	11.92	16.80	19.53	10.31
Movement LOS	A	A	A	A	A	A	C	C	B	C	C	B
95th-Percentile Queue Length [veh/ln]	0.00	0.00	0.00	0.05	0.00	0.00	0.21	0.21	0.21	0.06	0.06	0.06
95th-Percentile Queue Length [m/ln]	0.03	0.01	0.00	0.36	0.00	0.00	1.62	1.62	1.62	0.47	0.47	0.47
d_A, Approach Delay [s/veh]	0.02			0.16			19.57			11.91		
Approach LOS	A			A			C			B		
d_I, Intersection Delay [s/veh]	0.48											
Intersection LOS	C											

Intersection Level Of Service Report
Intersection 3: Highway 11 and Prairie View Road

Control Type:	Two-way stop	Delay (sec / veh):	19.8
Analysis Method:	HCM 6th Edition	Level Of Service:	C
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.004

Intersection Setup

Name	Highway 11			Highway 11			Prairie View Road			Prairie View Road		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70
No. of Lanes in Entry Pocket	0	0	0	0	0	1	0	0	0	0	0	0
Entry Pocket Length [m]	30.48	30.48	30.48	30.48	30.48	150.00	30.48	30.48	30.48	30.48	30.48	30.48
No. of Lanes in Exit Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Speed [km/h]	110.00			110.00			70.00			70.00		
Grade [%]	0.00			0.00			0.00			0.00		
Crosswalk	No			No			No			No		

Volumes

Name	Highway 11			Highway 11			Prairie View Road			Prairie View Road		
Base Volume Input [veh/h]	1	388	1	1	532	3	4	1	1	1	1	1
Base Volume Adjustment Factor	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300
Heavy Vehicles Percentage [%]	2.00	14.00	2.00	2.00	15.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Growth Factor	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Total Hourly Volume [veh/h]	1	613	1	1	841	4	7	1	1	1	1	1
Peak Hour Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Other Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Total 15-Minute Volume [veh/h]	0	153	0	0	210	1	2	0	0	0	0	0
Total Analysis Volume [veh/h]	1	613	1	1	841	4	7	1	1	1	1	1
Pedestrian Volume [ped/h]	0			0			0			0		

Intersection Settings

Priority Scheme	Free	Free	Stop	Stop
Flared Lane			Yes	Yes
Storage Area [veh]	0	0	1	1
Two-Stage Gap Acceptance			Yes	Yes
Number of Storage Spaces in Median	0	0	1	1

Movement, Approach, & Intersection Results

V/C, Movement V/C Ratio	0.00	0.01	0.00	0.00	0.01	0.00	0.03	0.00	0.00	0.00	0.00	0.00
d_M, Delay for Movement [s/veh]	9.58	0.00	0.00	8.75	0.00	0.00	19.43	19.82	11.59	16.66	19.54	10.29
Movement LOS	A	A	A	A	A	A	C	C	B	C	C	B
95th-Percentile Queue Length [veh/ln]	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.10	0.10	0.02	0.02	0.02
95th-Percentile Queue Length [m/ln]	0.03	0.01	0.00	0.02	0.01	0.00	0.74	0.74	0.74	0.17	0.17	0.17
d_A, Approach Delay [s/veh]	0.02			0.01			18.60			15.50		
Approach LOS	A			A			C			C		
d_I, Intersection Delay [s/veh]	0.16											
Intersection LOS	C											

Intersection Level Of Service Report
Intersection 4: Highway 11 and Baker Road

Control Type:	Two-way stop	Delay (sec / veh):	23.6
Analysis Method:	HCM 6th Edition	Level Of Service:	C
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.036

Intersection Setup

Name	Highway 11			Highway 11						Baker Road		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70
No. of Lanes in Entry Pocket	1	0	0	0	0	1	0	0	0	0	0	0
Entry Pocket Length [m]	180.00	30.48	30.48	30.48	30.48	180.00	30.48	30.48	30.48	30.48	30.48	30.48
No. of Lanes in Exit Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Speed [km/h]	110.00			110.00			110.00			70.00		
Grade [%]	0.00			0.00			0.00			0.00		
Crosswalk	No			No			No			No		

Volumes

Name	Highway 11			Highway 11						Baker Road		
Base Volume Input [veh/h]	1	361	1	12	431	37	28	3	8	1	4	5
Base Volume Adjustment Factor	1.2200	1.2200	1.2200	1.2200	1.2200	1.2200	1.2200	1.2200	1.2200	1.2200	1.2200	1.2200
Heavy Vehicles Percentage [%]	11.00	18.00	2.00	4.00	18.00	4.00	2.00	8.00	8.00	2.00	29.00	3.00
Growth Factor	1.4500	1.4500	1.4500	1.4500	1.4500	1.4500	1.4500	1.4500	1.4500	1.4500	1.4500	1.4500
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Total Hourly Volume [veh/h]	1	638	1	22	763	65	49	6	15	1	7	9
Peak Hour Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Other Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Total 15-Minute Volume [veh/h]	0	160	0	6	191	16	12	2	4	0	2	2
Total Analysis Volume [veh/h]	1	638	1	22	763	65	49	6	15	1	7	9
Pedestrian Volume [ped/h]	0			0			0			0		

Intersection Settings

Priority Scheme	Free	Free	Stop	Stop
Flared Lane			Yes	Yes
Storage Area [veh]	0	0	1	1
Two-Stage Gap Acceptance			Yes	Yes
Number of Storage Spaces in Median	0	0	1	1

Movement, Approach, & Intersection Results

V/C, Movement V/C Ratio	0.00	0.01	0.00	0.02	0.01	0.00	0.19	0.03	0.03	0.00	0.04	0.01
d_M, Delay for Movement [s/veh]	9.85	0.00	0.00	8.98	0.00	0.00	22.21	23.41	14.09	17.71	23.62	10.68
Movement LOS	A	A	A	A	A	A	C	C	B	C	C	B
95th-Percentile Queue Length [veh/ln]	0.00	0.00	0.00	0.07	0.04	0.00	0.81	0.81	0.81	0.12	0.12	0.12
95th-Percentile Queue Length [m/ln]	0.03	0.00	0.00	0.56	0.28	0.00	6.20	6.20	6.20	0.93	0.93	0.93
d_A, Approach Delay [s/veh]	0.02			0.23			20.57			16.42		
Approach LOS	A			A			C			C		
d_I, Intersection Delay [s/veh]	1.22											
Intersection LOS	C											

Intersection Level Of Service Report
Intersection 5: Baker Road and Service Road

Control Type:	Two-way stop	Delay (sec / veh):	0.0
Analysis Method:	HCM 6th Edition	Level Of Service:	A
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.001

Intersection Setup

Name						
Approach	Northbound		Eastbound		Westbound	
Lane Configuration						
Turning Movement	Left	Right	Thru	Right	Left	Thru
Lane Width [m]	3.66	3.66	3.66	3.66	3.66	3.66
No. of Lanes in Entry Pocket	0	0	0	0	0	0
Entry Pocket Length [m]	30.48	30.48	30.48	30.48	30.48	30.48
No. of Lanes in Exit Pocket	0	0	0	0	0	0
Exit Pocket Length [m]	0.00	0.00	0.00	0.00	0.00	0.00
Speed [km/h]	70.00		70.00		70.00	
Grade [%]	0.00		0.00		0.00	
Crosswalk	No		No		No	

Volumes

Name						
Base Volume Input [veh/h]	0	0	39	0	0	42
Base Volume Adjustment Factor	1.2200	1.2200	1.2200	1.2200	1.2200	1.2200
Heavy Vehicles Percentage [%]	2.00	2.00	2.00	2.00	2.00	2.00
Growth Factor	1.4500	1.4500	1.4500	1.4500	1.4500	1.4500
In-Process Volume [veh/h]	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	0	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0
Total Hourly Volume [veh/h]	0	0	70	0	0	74
Peak Hour Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Other Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Total 15-Minute Volume [veh/h]	0	0	18	0	0	19
Total Analysis Volume [veh/h]	0	0	70	0	0	74
Pedestrian Volume [ped/h]	0		0		0	

Intersection Settings

Priority Scheme	Stop	Free	Free
Flared Lane	No		
Storage Area [veh]	0	0	0
Two-Stage Gap Acceptance	No		
Number of Storage Spaces in Median	0	0	0

Movement, Approach, & Intersection Results

V/C, Movement V/C Ratio	0.00	0.00	0.00	0.00	0.00	0.00
d_M, Delay for Movement [s/veh]	9.24	8.63	0.00	0.00	7.35	0.00
Movement LOS	A	A	A	A	A	A
95th-Percentile Queue Length [veh/ln]	0.00	0.00	0.00	0.00	0.00	0.00
95th-Percentile Queue Length [m/ln]	0.00	0.00	0.00	0.00	0.00	0.00
d_A, Approach Delay [s/veh]	8.93		0.00		0.00	
Approach LOS	A		A		A	
d_I, Intersection Delay [s/veh]	0.00					
Intersection LOS	A					

Intersection Level Of Service Report
Intersection 7: Victor Road and Service Road

Control Type:	Two-way stop	Delay (sec / veh):	0.0
Analysis Method:	HCM 6th Edition	Level Of Service:	A
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.000

Intersection Setup

Name	Service Road			Service Road			Victor Road			Victor Road		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3.66	3.66	3.66	3.66	3.66	3.66	3.66	3.66	3.66	3.66	3.66	3.66
No. of Lanes in Entry Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Entry Pocket Length [m]	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48
No. of Lanes in Exit Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Speed [km/h]	110.00			110.00			70.00			110.00		
Grade [%]	0.00			0.00			0.00			0.00		
Crosswalk	Yes			Yes			Yes			Yes		

Volumes

Name	Service Road			Service Road			Victor Road			Victor Road		
Base Volume Input [veh/h]	0	0	0	0	0	0	0	11	0	0	8	0
Base Volume Adjustment Factor	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300
Heavy Vehicles Percentage [%]	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Growth Factor	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Total Hourly Volume [veh/h]	0	0	0	0	0	0	0	17	0	0	13	0
Peak Hour Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Other Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Total 15-Minute Volume [veh/h]	0	0	0	0	0	0	0	4	0	0	3	0
Total Analysis Volume [veh/h]	0	0	0	0	0	0	0	17	0	0	13	0
Pedestrian Volume [ped/h]	0			0			0			0		

Intersection Settings

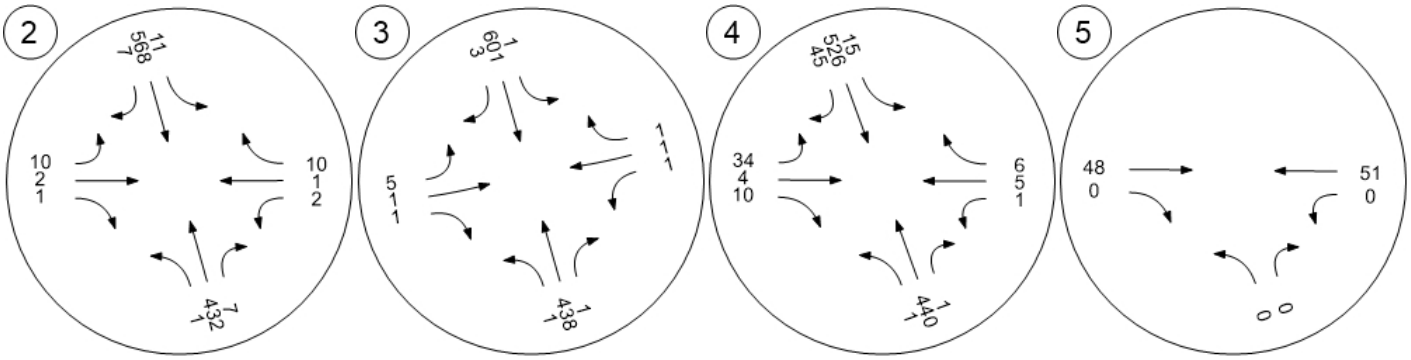
Priority Scheme	Stop	Stop	Free	Free
Flared Lane	No	No		
Storage Area [veh]	0	0	0	0
Two-Stage Gap Acceptance	No	No		
Number of Storage Spaces in Median	0	0	0	0

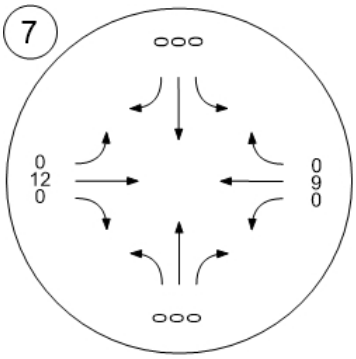
Movement, Approach, & Intersection Results

V/C, Movement V/C Ratio	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
d_M, Delay for Movement [s/veh]	8.68	9.17	8.39	8.68	9.17	8.37	7.24	0.00	0.00	7.25	0.00	0.00
Movement LOS	A	A	A	A	A	A	A	A	A	A	A	A
95th-Percentile Queue Length [veh/ln]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
95th-Percentile Queue Length [m/ln]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
d_A, Approach Delay [s/veh]	8.75			8.74			0.00			0.00		
Approach LOS	A			A			A			A		
d_I, Intersection Delay [s/veh]	0.00											
Intersection LOS	A											

Report Figure 1a: Traffic Volume - Base Volume

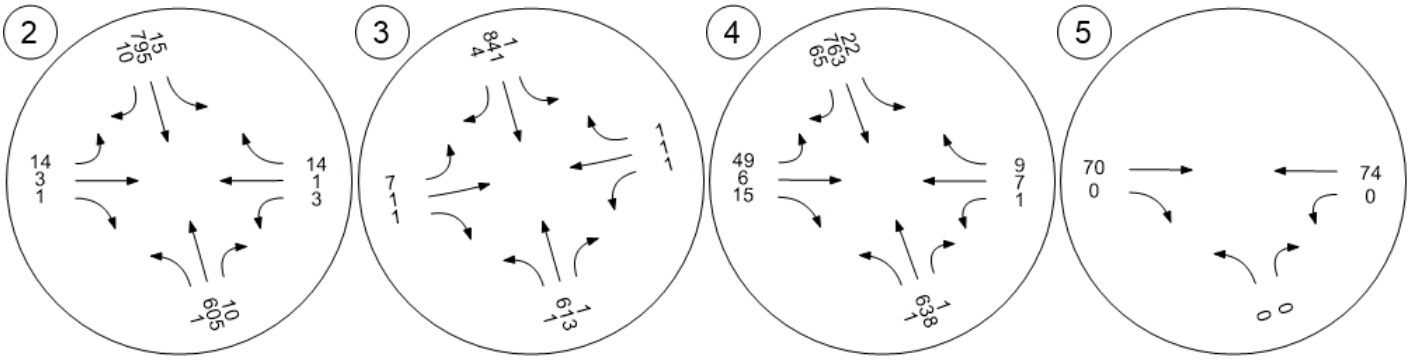






Report Figure 1c: Traffic Volume - Future Background Volume





Greenview Estates

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Report File: \...\Appendix B.3.pdf

Scenario 3 Am Peak Stage 1
4/22/2022

Intersection Analysis Summary

ID	Intersection Name	Control Type	Method	Worst Mvmt	V/C	Delay (s/veh)	LOS
3	Highway 11 and Prairie View Road	Two-way stop	HCM 6th Edition	EB Thru	0.003	17.1	C

V/C, Delay, LOS: For two-way stop, these values are taken from the movement with the worst (highest) delay value. For all other control types, they are taken for the whole intersection.

Intersection Level Of Service Report
Intersection 3: Highway 11 and Prairie View Road

Control Type:	Two-way stop	Delay (sec / veh):	17.1
Analysis Method:	HCM 6th Edition	Level Of Service:	C
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.003

Intersection Setup

Name	Highway 11			Highway 11			Prairie View Road			Prairie View Road		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70
No. of Lanes in Entry Pocket	0	0	0	0	0	1	0	0	0	0	0	0
Entry Pocket Length [m]	30.48	30.48	30.48	30.48	30.48	150.00	30.48	30.48	30.48	30.48	30.48	30.48
No. of Lanes in Exit Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Speed [km/h]	110.00			110.00			70.00			70.00		
Grade [%]	0.00			0.00			0.00			0.00		
Crosswalk	No			No			No			No		

Volumes

Name	Highway 11			Highway 11			Prairie View Road			Prairie View Road		
Base Volume Input [veh/h]	1	405	1	1	262	1	1	1	1	1	1	1
Base Volume Adjustment Factor	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300
Heavy Vehicles Percentage [%]	2.00	14.00	2.00	2.00	15.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Growth Factor	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	6	0	0	4	0	53	47	0	5	0	0	1
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Total Hourly Volume [veh/h]	7	641	1	5	414	54	48	1	6	1	1	2
Peak Hour Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Other Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Total 15-Minute Volume [veh/h]	2	160	0	1	104	14	12	0	2	0	0	1
Total Analysis Volume [veh/h]	7	641	1	5	414	54	48	1	6	1	1	2
Pedestrian Volume [ped/h]	0			0			0			0		

Intersection Settings

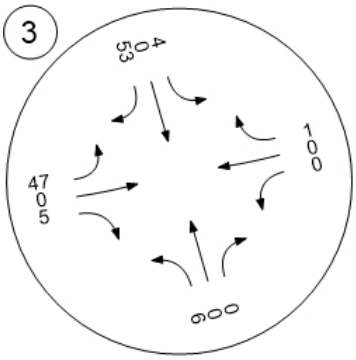
Priority Scheme	Free	Free	Stop	Stop
Flared Lane			Yes	Yes
Storage Area [veh]	0	0	1	1
Two-Stage Gap Acceptance			Yes	Yes
Number of Storage Spaces in Median	0	0	1	1

Movement, Approach, & Intersection Results

V/C, Movement V/C Ratio	0.01	0.01	0.00	0.01	0.00	0.00	0.12	0.00	0.01	0.00	0.00	0.00
d_M, Delay for Movement [s/veh]	8.32	0.00	0.00	8.86	0.00	0.00	14.89	17.09	10.58	15.65	16.42	10.37
Movement LOS	A	A	A	A	A	A	B	C	B	C	C	B
95th-Percentile Queue Length [veh/ln]	0.02	0.01	0.00	0.02	0.01	0.00	0.41	0.41	0.41	0.02	0.02	0.02
95th-Percentile Queue Length [m/ln]	0.15	0.07	0.00	0.12	0.06	0.00	3.11	3.11	3.11	0.14	0.14	0.14
d_A, Approach Delay [s/veh]	0.09			0.09			14.46			13.20		
Approach LOS	A			A			B			B		
d_I, Intersection Delay [s/veh]	0.81											
Intersection LOS	C											

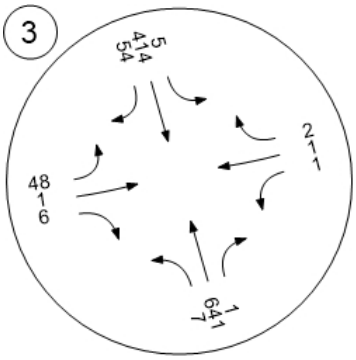
Report Figure 1d: Traffic Volume - Net New Site Trips





Report Figure 1f: Traffic Volume - Future Total Volume





Greenview Estates

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Report File: \...\Appendix B.4.pdf

Scenario 4 Pm Peak Stage 1
4/22/2022

Intersection Analysis Summary

ID	Intersection Name	Control Type	Method	Worst Mvmt	V/C	Delay (s/veh)	LOS
3	Highway 11 and Prairie View Road	Two-way stop	HCM 6th Edition	EB Thru	0.004	27.2	D

V/C, Delay, LOS: For two-way stop, these values are taken from the movement with the worst (highest) delay value. For all other control types, they are taken for the whole intersection.

Intersection Level Of Service Report
Intersection 3: Highway 11 and Prairie View Road

Control Type:	Two-way stop	Delay (sec / veh):	27.2
Analysis Method:	HCM 6th Edition	Level Of Service:	D
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.004

Intersection Setup

Name	Highway 11			Highway 11			Prairie View Road			Prairie View Road		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70
No. of Lanes in Entry Pocket	0	0	0	0	0	1	0	0	0	0	0	0
Entry Pocket Length [m]	30.48	30.48	30.48	30.48	30.48	150.00	30.48	30.48	30.48	30.48	30.48	30.48
No. of Lanes in Exit Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Speed [km/h]	110.00			110.00			70.00			70.00		
Grade [%]	0.00			0.00			0.00			0.00		
Crosswalk	No			No			No			No		

Volumes

Name	Highway 11			Highway 11			Prairie View Road			Prairie View Road		
Base Volume Input [veh/h]	1	388	1	1	532	3	4	1	1	1	1	1
Base Volume Adjustment Factor	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300
Heavy Vehicles Percentage [%]	2.00	14.00	2.00	2.00	15.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Growth Factor	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	8	0	0	2	0	69	82	0	10	0	0	5
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Total Hourly Volume [veh/h]	9	613	1	3	841	73	89	1	11	1	1	6
Peak Hour Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Other Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Total 15-Minute Volume [veh/h]	2	153	0	1	210	18	22	0	3	0	0	2
Total Analysis Volume [veh/h]	9	613	1	3	841	73	89	1	11	1	1	6
Pedestrian Volume [ped/h]	0			0			0			0		

Intersection Settings

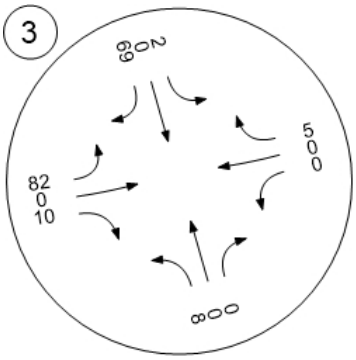
Priority Scheme	Free	Free	Stop	Stop
Flared Lane			Yes	Yes
Storage Area [veh]	0	0	1	1
Two-Stage Gap Acceptance			Yes	Yes
Number of Storage Spaces in Median	0	0	1	1

Movement, Approach, & Intersection Results

V/C, Movement V/C Ratio	0.01	0.01	0.00	0.00	0.01	0.00	0.35	0.00	0.02	0.00	0.00	0.01
d_M, Delay for Movement [s/veh]	9.91	0.00	0.00	8.76	0.00	0.00	26.79	27.21	18.64	17.15	20.88	10.26
Movement LOS	A	A	A	A	A	A	D	D	C	C	C	B
95th-Percentile Queue Length [veh/ln]	0.04	0.02	0.00	0.01	0.00	0.00	1.63	1.63	1.63	0.03	0.03	0.03
95th-Percentile Queue Length [m/ln]	0.28	0.14	0.00	0.07	0.04	0.00	12.39	12.39	12.39	0.20	0.20	0.20
d_A, Approach Delay [s/veh]	0.14			0.03			25.91			12.45		
Approach LOS	A			A			D			B		
d_I, Intersection Delay [s/veh]	1.72											
Intersection LOS	D											

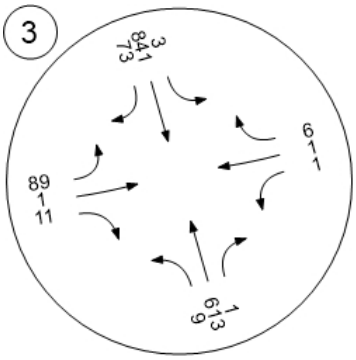
Report Figure 1d: Traffic Volume - Net New Site Trips





Report Figure 1f: Traffic Volume - Future Total Volume





APPENDIX C – STAGE 1 MOH WARRANTS

Turning Lane Warrants
Worksheet for Four Lane Rural Highways

Highway:	**Highway 11**
Crossroad:	**PrairieView Road**
Scenario:	**2022 Background PM Peak**

Highway Direction A:	**NB**	Usually WB or NB
Highway Direction B:	**SB**	Usually EB or SB
Truck Equivalency (E_T)	**1.7**	MHI Standard: 1.7

NB Data	NBL	NBT	NBR	NB Total
Hourly Vol (veh/h)	**1**	**438**	**1**	440
Truck %	**2.0%**	**14.0%**	**2.0%**	14%
Equiv Vol (pce/h)	1	481	1	483
Growth Factor	**1.27**	**1.27**	**1.27**	
Future Equiv Vol (pce/h)	1	611	1	613
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

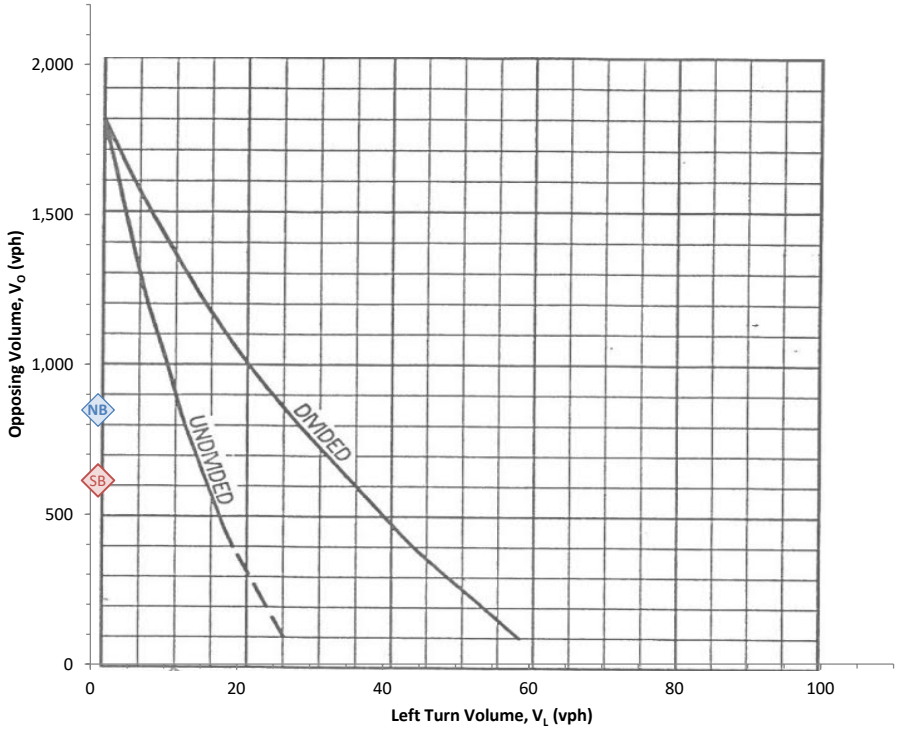
SB Data	SBL	SBT	SBR	SB Total
Hourly Vol. (veh/h)	**1**	**601**	**3**	605
Truck %	**2.0%**	**15.0%**	**2.0%**	15%
Equiv Vol (pce/h)	1	664	3	668
Growth Factor	**1.27**	**1.27**	**1.27**	
Future Equiv Vol (pce/h)	1	843	4	848
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

Notes:

- No warrant if the plotted point falls to the left of the applicable line
- Right and left turn lanes are warranted at:
  -Intersections with other Provincial Highways
  -Industrial Access Roads
  -Provincial Campgrounds and Picnic Sites
- Length of turning lane is related to speed. See SP 20618.
- For right turn lane on four-lane highways, advancing volume should be half of the directional volume with no further reduction for left turning vehicles.
- Use the corrected peak hour volumes (vph) projected to the 10th year after construction. See SKS 2.3.1-C (formerly DM 502-3) for correction factors.

Saskatchewan Ministry of Highways and Infrastructure
Warrants for Left Turn Lanes - 4 Lane Rural Highways
Standard Plan STP 20610

Associated Engineering



	Calculated		Plotted	
	NB	SB	NB	SB
Left Turn Volume, V_L	1	1	1	1
Opposing Volume, V_O	848	613	848	613

Turning Lane Warrants
Worksheet for Four Lane Rural Highways

Highway:	**Highway 11**
Crossroad:	**PrairieView Road**
Scenario:	**2022 Background PM Peak**

Highway Direction A:	**NB**	Usually WB or NB
Highway Direction B:	**SB**	Usually EB or SB
Truck Equivalency (E_T)	**1.7**	MHI Standard: 1.7

NB Data	NBL	NBT	NBR	NB Total
Hourly Vol (veh/h)	**1**	**438**	**1**	440
Truck %	**2.0%**	**14.0%**	**2.0%**	14%
Equiv Vol (pce/h)	1	481	1	483
Growth Factor	**1.27**	**1.27**	**1.27**	
Future Equiv Vol (pce/h)	1	611	1	613
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

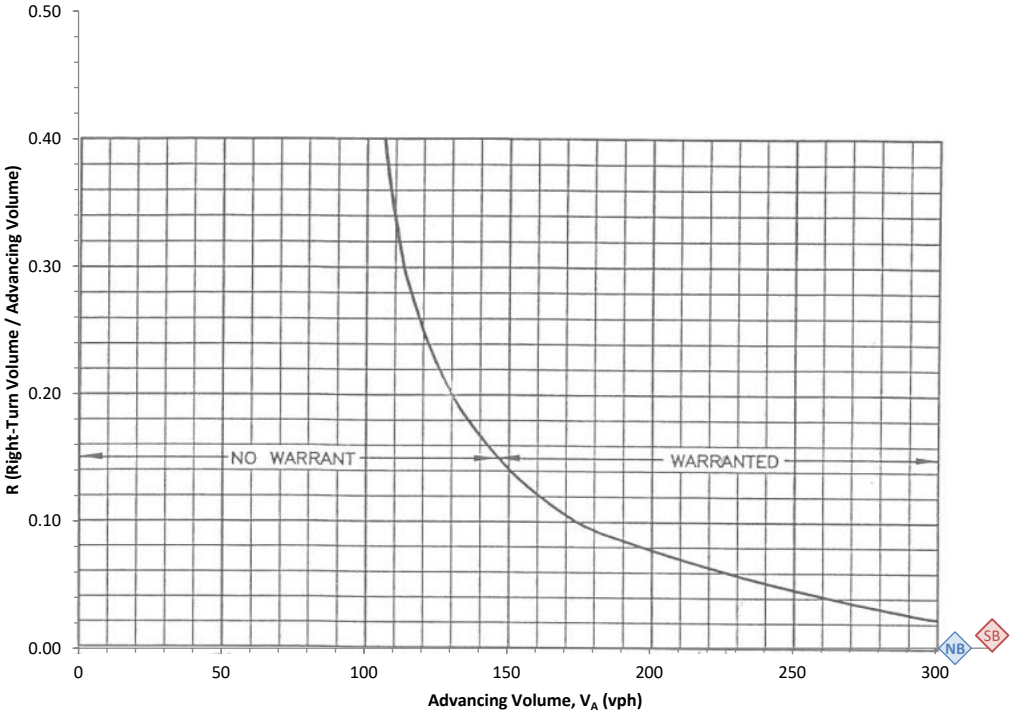
SB Data	SBL	SBT	SBR	SB Total
Hourly Vol. (veh/h)	**1**	**601**	**3**	605
Truck %	**2.0%**	**15.0%**	**2.0%**	15%
Equiv Vol (pce/h)	1	664	3	668
Growth Factor	**1.27**	**1.27**	**1.27**	
Future Equiv Vol (pce/h)	1	843	4	848
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

Notes:

- No warrant if the plotted point falls to the left of the applicable line
- Right and left turn lanes are warranted at:
  -Intersections with other Provincial Highways
  -Industrial Access Roads
  -Provincial Campgrounds and Picnic Sites
- Length of turning lane is related to speed. See SP 20618.
- For right turn lane on four-lane highways, advancing volume should be half of the directional volume with no further reduction for left turning vehicles.
- Use the corrected peak hour volumes (vph) projected to the 10th year after construction. See SKS 2.3.1-C (formerly DM 502-3) for correction factors.

Saskatchewan Ministry of Highways and Infrastructure
Warrants for Right Turn Lanes - Rural Highways
Standard Plan 20614

Associated Engineering



	Calculated		Plotted	
	NB	SB	NB	SB
Advancing Volume, V_A	307	424	307	320
R (V_R / V_A)	0	0.01	0.00	0.01

Turning Lane Warrants
Worksheet for Four Lane Rural Highways

Highway:	**Highway 11**
Crossroad:	**PrairieView Road**
Scenario:	**2023 Background PM Peak**

Highway Direction A:	**NB**	Usually WB or NB
Highway Direction B:	**SB**	Usually EB or SB
Truck Equivalency (E_T)	**1.7**	MHI Standard: 1.7

NB Data	NBL	NBT	NBR	NB Total
Hourly Vol (veh/h)	**1**	**450**	**1**	452
Truck %	**2.0%**	**14.0%**	**2.0%**	14%
Equiv Vol (pce/h)	1	494	1	496
Growth Factor	**1.27**	**1.27**	**1.27**	
Future Equiv Vol (pce/h)	1	627	1	629
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

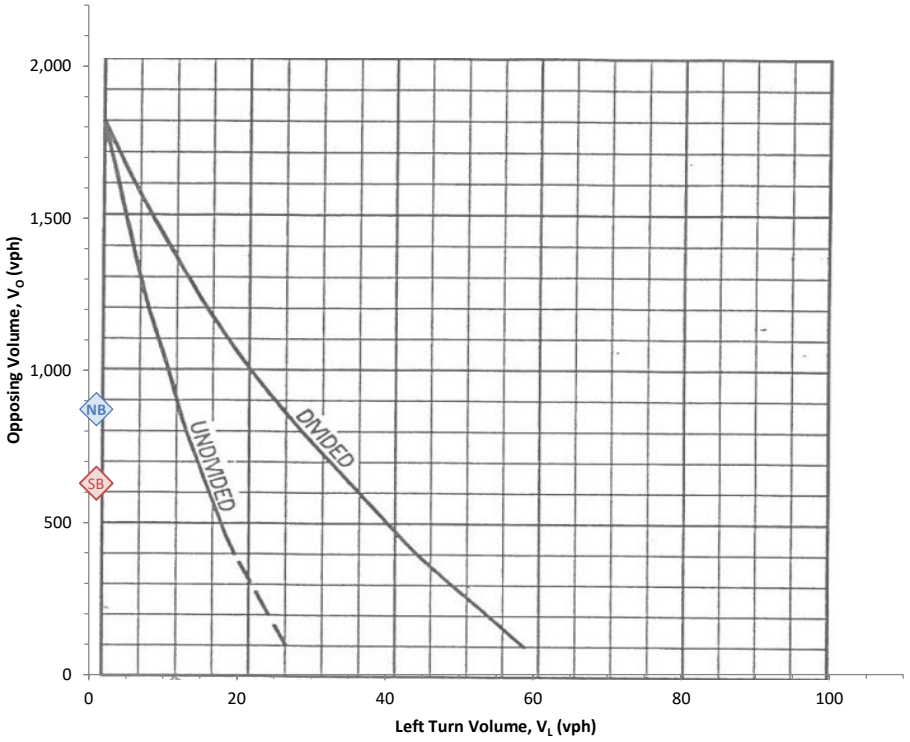
SB Data	SBL	SBT	SBR	SB Total
Hourly Vol. (veh/h)	**1**	**618**	**3**	622
Truck %	**2.0%**	**15.0%**	**2.0%**	15%
Equiv Vol (pce/h)	1	683	3	687
Growth Factor	**1.27**	**1.27**	**1.27**	
Future Equiv Vol (pce/h)	1	867	4	872
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

Notes:

- No warrant if the plotted point falls to the left of the applicable line
- Right and left turn lanes are warranted at:
  - -Intersections with other Provincial Highways
  - -Industrial Access Roads
  - -Provincial Campgrounds and Picnic Sites
- Length of turning lane is related to speed. See SP 20618.
- For right turn lane on four-lane highways, advancing volume should be half of the directional volume with no further reduction for left turning vehicles.
- Use the corrected peak hour volumes (vph) projected to the 10th year after construction. See SKS 2.3.1-C (formerly DM 502-3) for correction factors.

Saskatchewan Ministry of Highways and Infrastructure
Warrants for Left Turn Lanes - 4 Lane Rural Highways
Standard Plan STP 20610

Associated Engineering



	Calculated		Plotted	
	NB	SB	NB	SB
Left Turn Volume, V_L	1	1	1	1
Opposing Volume, V_O	872	629	872	629

Turning Lane Warrants
Worksheet for Four Lane Rural Highways

Highway:	**Highway 11**
Crossroad:	**PrairieView Road**
Scenario:	**2023 Background PM Peak**

Highway Direction A:	**NB**	Usually WB or NB
Highway Direction B:	**SB**	Usually EB or SB
Truck Equivalency (E_T)	**1.7**	MHI Standard: 1.7

NB Data	NBL	NBT	NBR	NB Total
Hourly Vol (veh/h)	**1**	**450**	**1**	452
Truck %	**2.0%**	**14.0%**	**2.0%**	14%
Equiv Vol (pce/h)	1	494	1	496
Growth Factor	**1.27**	**1.27**	**1.27**	
Future Equiv Vol (pce/h)	1	627	1	629
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

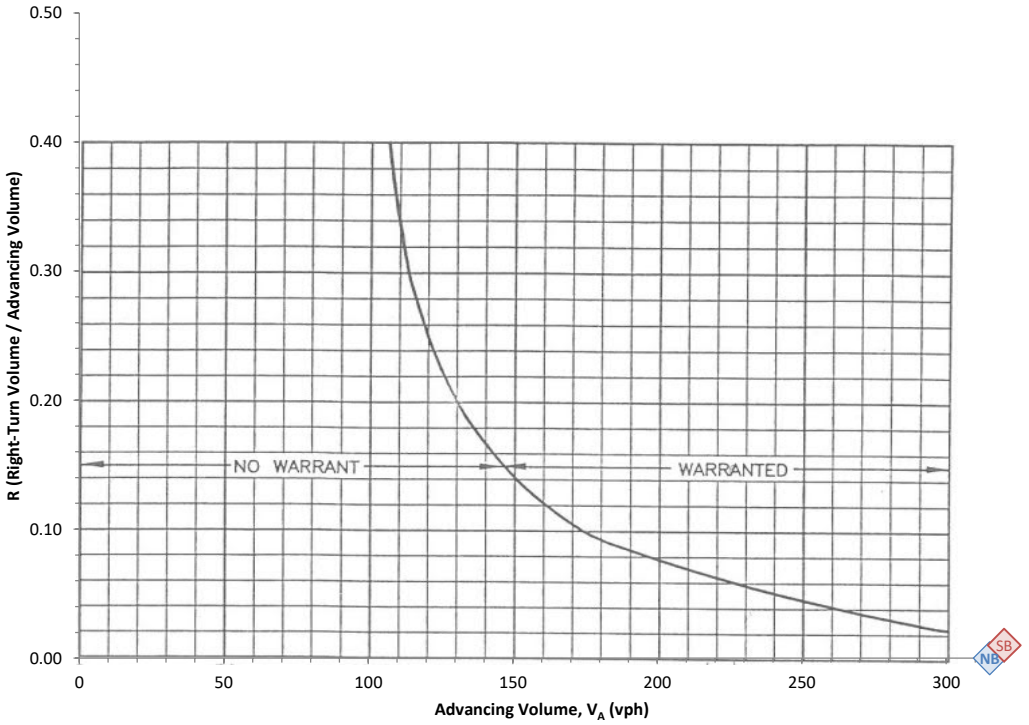
SB Data	SBL	SBT	SBR	SB Total
Hourly Vol. (veh/h)	**1**	**618**	**3**	622
Truck %	**2.0%**	**15.0%**	**2.0%**	15%
Equiv Vol (pce/h)	1	683	3	687
Growth Factor	**1.27**	**1.27**	**1.27**	
Future Equiv Vol (pce/h)	1	867	4	872
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

Notes:

- No warrant if the plotted point falls to the left of the applicable line
- Right and left turn lanes are warranted at:
  - -Intersections with other Provincial Highways
  - -Industrial Access Roads
  - -Provincial Campgrounds and Picnic Sites
- Length of turning lane is related to speed. See SP 20618.
- For right turn lane on four-lane highways, advancing volume should be half of the directional volume with no further reduction for left turning vehicles.
- Use the corrected peak hour volumes (vph) projected to the 10th year after construction. See SKS 2.3.1-C (formerly DM 502-3) for correction factors.

Saskatchewan Ministry of Highways and Infrastructure
Warrants for Right Turn Lanes - Rural Highways
Standard Plan 20614

Associated Engineering



	Calculated		Plotted	
	NB	SB	NB	SB
Advancing Volume, V_A	315	436	315	320
R (V_R / V_A)	0	0.01	0.00	0.01

Turning Lane Warrants
Worksheet for Four Lane Rural Highways

Highway:	**Highway 11**
Crossroad:	**PrairieView Road**
Scenario:	**2023 (7% Buildout) PM Peak**

Highway Direction A:	**NB**	Usually WB or NB
Highway Direction B:	**SB**	Usually EB or SB
Truck Equivalency (E_T)	**1.7**	MHI Standard: 1.7

NB Data	NBL	NBT	NBR	NB Total
Hourly Vol (veh/h)	**2**	**450**	**1**	453
Truck %	**2.0%**	**14.0%**	**2.0%**	14%
Equiv Vol (pce/h)	2	494	1	497
Growth Factor	**1.27**	**1.27**	**1.27**	
Future Equiv Vol (pce/h)	3	627	1	631
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

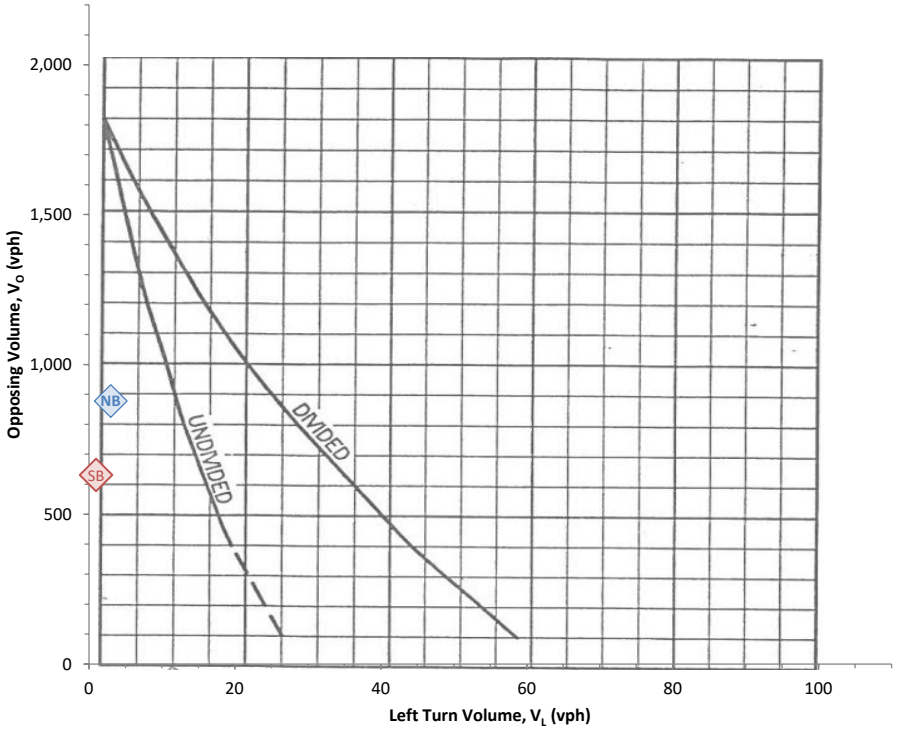
SB Data	SBL	SBT	SBR	SB Total
Hourly Vol. (veh/h)	**1**	**618**	**8**	627
Truck %	**2.0%**	**15.0%**	**2.0%**	15%
Equiv Vol (pce/h)	1	683	8	692
Growth Factor	**1.27**	**1.27**	**1.27**	
Future Equiv Vol (pce/h)	1	867	10	878
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

Notes:

- No warrant if the plotted point falls to the left of the applicable line
- Right and left turn lanes are warranted at:
  -Intersections with other Provincial Highways
  -Industrial Access Roads
  -Provincial Campgrounds and Picnic Sites
- Length of turning lane is related to speed. See SP 20618.
- For right turn lane on four-lane highways, advancing volume should be half of the directional volume with no further reduction for left turning vehicles.
- Use the corrected peak hour volumes (vph) projected to the 10th year after construction. See SKS 2.3.1-C (formerly DM 502-3) for correction factors.

Saskatchewan Ministry of Highways and Infrastructure
Warrants for Left Turn Lanes - 4 Lane Rural Highways
Standard Plan STP 20610

Associated Engineering



	Calculated		Plotted	
	NB	SB	NB	SB
Left Turn Volume, V_L	3	1	3	1
Opposing Volume, V_O	878	631	878	631

Turning Lane Warrants
Worksheet for Four Lane Rural Highways

Highway:	**Highway 11**
Crossroad:	**PrairieView Road**
Scenario:	**2023 (7% Buildout) PM Peak**

Highway Direction A:	**NB**	Usually WB or NB
Highway Direction B:	**SB**	Usually EB or SB
Truck Equivalency (E_T)	**1.7**	MHI Standard: 1.7

NB Data	NBL	NBT	NBR	NB Total
Hourly Vol (veh/h)	**2**	**450**	**1**	453
Truck %	**2.0%**	**14.0%**	**2.0%**	14%
Equiv Vol (pce/h)	2	494	1	497
Growth Factor	**1.27**	**1.27**	**1.27**	
Future Equiv Vol (pce/h)	3	627	1	631
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

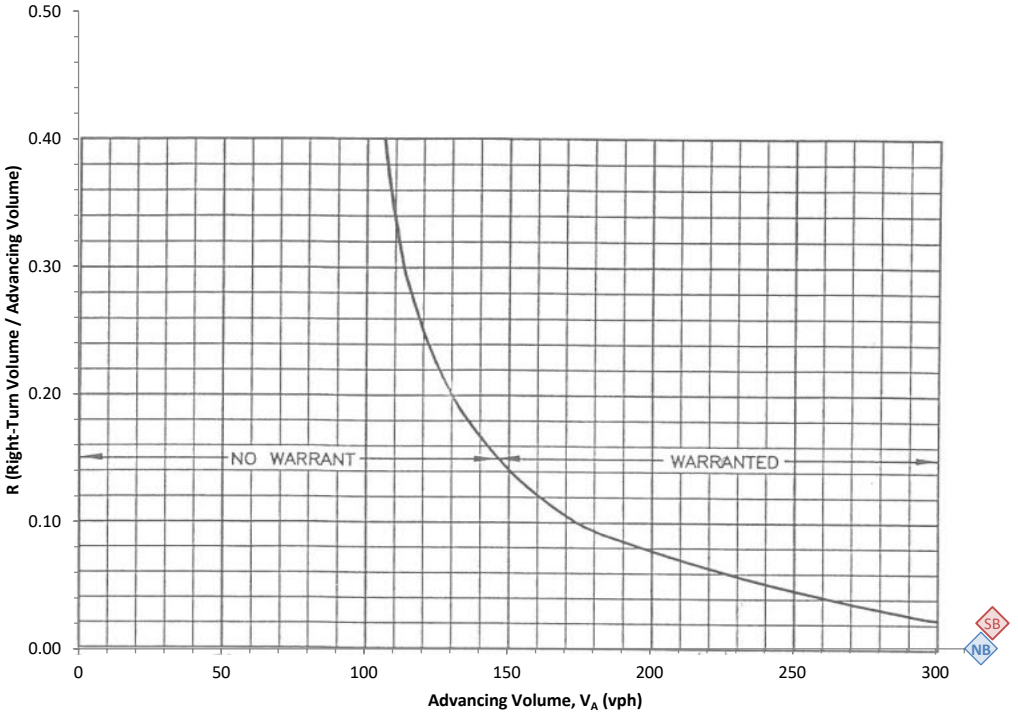
SB Data	SBL	SBT	SBR	SB Total
Hourly Vol. (veh/h)	**1**	**618**	**8**	627
Truck %	**2.0%**	**15.0%**	**2.0%**	15%
Equiv Vol (pce/h)	1	683	8	692
Growth Factor	**1.27**	**1.27**	**1.27**	
Future Equiv Vol (pce/h)	1	867	10	878
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

Notes:

- No warrant if the plotted point falls to the left of the applicable line
- Right and left turn lanes are warranted at:
  - -Intersections with other Provincial Highways
  - -Industrial Access Roads
  - -Provincial Campgrounds and Picnic Sites
- Length of turning lane is related to speed. See SP 20618.
- For right turn lane on four-lane highways, advancing volume should be half of the directional volume with no further reduction for left turning vehicles.
- Use the corrected peak hour volumes (vph) projected to the 10th year after construction. See SKS 2.3.1-C (formerly DM 502-3) for correction factors.

Saskatchewan Ministry of Highways and Infrastructure
Warrants for Right Turn Lanes - Rural Highways
Standard Plan 20614

Associated Engineering



	Calculated		Plotted	
	NB	SB	NB	SB
Advancing Volume, V_A	316	439	316	320
R (V_R / V_A)	0	0.02	0.00	0.02

Warrants for Intersection Lighting

MHI Design Manual 2621-01

Intersection Description	**Highway No. 11 and Prairie View Road - 2037 Full Build Out**			
Through Highway	**Highway No. 11**	Highway Class	Major Arterial	5
Minor Leg 1	**Prairie View Road**	Road Type	Other All-Season Road (AADT >150)	OK
Minor Leg 2	**Prairie View Road**	Road Type	Other All-Season Road (AADT <150)	NO

☐ Intersection is skewed (<70° or >110°)	0	Night Collision Rate	**0.0** crash/year	0

Other Nearby Lighting		Traffic Volumes		
None	0	On Through Highway	**17200** AADT	25
☐ Urban street light within 25 m of Minor Leg 1	OK	On Minor Leg 1	**1100** AADT	55
☐ Urban street light within 25 m of Minor Leg 2	OK	On Minor Leg 2	**100** AADT	5

Existing Intersection Channelization		Intersection Road Surface Visible from…		
☐ On Through Highway	0	On Through Highway	> 370 m	0
☐ On Minor Leg 1	0	On Minor Leg 1	> 180 m	0
☐ On Minor Leg 2	0	On Minor Leg 2	> 180 m	0

Divided Roadway		Proximity to Horizontal Curves		
☑ On Through Highway	5	On Through Highway	> 100 m	0
☐ On Minor Leg 1	0	On Minor Leg 1	> 60 m	0
☐ On Minor Leg 2	0	On Minor Leg 2	> 60 m	0

Hospital Access Routes		Obstructed Sight Triangles		
☐ Minor Leg 1	0	On Minor Leg 1	None	0
☐ Minor Leg 2	0	On Minor Leg 2	None	0

Notes:

1. Delineation lighting has no minimum warrant score. Lights are warranted for the following cases:
   - All Provincial Highway intersections
   - All designated Community Access roads (Control Section 40-series)
   - All roads where AADT>150
   - All seasonal/recreational roads where SADT>250
   - Never when an urban streetlight is within 25m
2. For Night Collision Rate use the average annual night time intersection collisions over the last 3 years
3. For sight distances use eye height of 1.15m and object height at the road surface

	Result	Score
Leg 1 Delineation	**Warranted**	**90**
Leg 2 Delineation	**Not Warranted**	**40**
Intersection Area	**Warranted**	**N/A**

APPENDIX D – STAGE 2 VISTRO REPORTS

Greenview Estates

Vistro File: \...\Greenview_20220422.vistro
Report File: \...\Appendix D.1.pdf

Scenario 1 Am Peak Stage 2
4/22/2022

Intersection Analysis Summary

ID	Intersection Name	Control Type	Method	Worst Mvmt	V/C	Delay (s/veh)	LOS
2	Highway 11 and Victor Road	Two-way stop	HCM 6th Edition	EB Thru	0.003	16.1	C
4	Highway 11 and Baker Road	Two-way stop	HCM 6th Edition	WB Thru	0.012	20.0	C
5	Baker Road and Service Road	Two-way stop	HCM 6th Edition	NB Left	0.006	9.8	A
7	Victor Road and Service Road	Two-way stop	HCM 6th Edition	SB Left	0.014	8.7	A

V/C, Delay, LOS: For two-way stop, these values are taken from the movement with the worst (highest) delay value. For all other control types, they are taken for the whole intersection.

Intersection Level Of Service Report
Intersection 2: Highway 11 and Victor Road

Control Type:	Two-way stop	Delay (sec / veh):	16.1
Analysis Method:	HCM 6th Edition	Level Of Service:	C
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.003

Intersection Setup

Name	Highway 11			Highway 11			Victor Road			Victor Road		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70
No. of Lanes in Entry Pocket	0	0	0	1	0	1	0	0	0	0	0	0
Entry Pocket Length [m]	30.48	30.48	30.48	180.00	30.48	180.00	30.48	30.48	30.48	30.48	30.48	30.48
No. of Lanes in Exit Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Speed [km/h]	110.00			110.00			70.00			70.00		
Grade [%]	0.00			0.00			0.00			0.00		
Crosswalk	No			No			No			No		

Volumes

Name	Highway 11			Highway 11			Victor Road			Victor Road		
Base Volume Input [veh/h]	2	387	2	4	250	3	6	1	1	1	1	21
Base Volume Adjustment Factor	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300
Heavy Vehicles Percentage [%]	2.00	14.00	2.00	2.00	19.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Growth Factor	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	6	0	0	0	0	10	9	0	5	0	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	-1	0	0	0	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Total Hourly Volume [veh/h]	9	611	3	7	396	14	19	1	6	1	1	34
Peak Hour Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Other Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Total 15-Minute Volume [veh/h]	2	153	1	2	99	4	5	0	2	0	0	9
Total Analysis Volume [veh/h]	9	611	3	7	396	14	19	1	6	1	1	34
Pedestrian Volume [ped/h]	0			0			0			0		

Intersection Settings

Priority Scheme	Free	Free	Stop	Stop
Flared Lane			Yes	Yes
Storage Area [veh]	0	0	1	1
Two-Stage Gap Acceptance			Yes	Yes
Number of Storage Spaces in Median	0	0	1	1

Movement, Approach, & Intersection Results

V/C, Movement V/C Ratio	0.01	0.01	0.00	0.01	0.00	0.00	0.05	0.00	0.01	0.00	0.00	0.05
d_M, Delay for Movement [s/veh]	8.17	0.00	0.00	8.77	0.00	0.00	14.24	16.08	9.81	15.54	16.03	10.48
Movement LOS	A	A	A	A	A	A	B	C	A	C	C	B
95th-Percentile Queue Length [veh/ln]	0.02	0.01	0.00	0.02	0.00	0.00	0.16	0.16	0.16	0.16	0.16	0.16
95th-Percentile Queue Length [m/ln]	0.18	0.09	0.00	0.17	0.00	0.00	1.20	1.20	1.20	1.18	1.18	1.18
d_A, Approach Delay [s/veh]	0.12			0.15			13.29			10.78		
Approach LOS	A			A			B			B		
d_I, Intersection Delay [s/veh]	0.79											
Intersection LOS	C											

Intersection Level Of Service Report
Intersection 4: Highway 11 and Baker Road

Control Type:	Two-way stop	Delay (sec / veh):	20.0
Analysis Method:	HCM 6th Edition	Level Of Service:	C
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.012

Intersection Setup

Name	Highway 11			Highway 11						Baker Road		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70
No. of Lanes in Entry Pocket	1	0	0	0	0	1	0	0	0	0	0	0
Entry Pocket Length [m]	180.00	30.48	30.48	30.48	30.48	180.00	30.48	30.48	30.48	30.48	30.48	30.48
No. of Lanes in Exit Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Speed [km/h]	110.00			110.00			110.00			70.00		
Grade [%]	0.00			0.00			0.00			0.00		
Crosswalk	No			No			No			No		

Volumes

Name	Highway 11			Highway 11						Baker Road		
Base Volume Input [veh/h]	7	345	1	4	289	22	29	3	1	1	2	10
Base Volume Adjustment Factor	1.2200	1.2200	1.2200	1.2200	1.2200	1.2200	1.2200	1.2200	1.2200	1.2200	1.2200	1.2200
Heavy Vehicles Percentage [%]	11.00	18.00	2.00	4.00	18.00	4.00	2.00	8.00	8.00	2.00	29.00	3.00
Growth Factor	1.4500	1.4500	1.4500	1.4500	1.4500	1.4500	1.4500	1.4500	1.4500	1.4500	1.4500	1.4500
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	9	0	4	10	37	34	0	0	0	0	1
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	-2	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Total Hourly Volume [veh/h]	13	619	1	11	520	76	85	6	1	1	3	18
Peak Hour Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Other Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Total 15-Minute Volume [veh/h]	3	155	0	3	130	19	21	2	0	0	1	5
Total Analysis Volume [veh/h]	13	619	1	11	520	76	85	6	1	1	3	18
Pedestrian Volume [ped/h]	0			0			0			0		

Intersection Settings

Priority Scheme	Free	Free	Stop	Stop
Flared Lane			Yes	Yes
Storage Area [veh]	0	0	1	1
Two-Stage Gap Acceptance			Yes	Yes
Number of Storage Spaces in Median	0	0	2	1

Movement, Approach, & Intersection Results

V/C, Movement V/C Ratio	0.01	0.01	0.00	0.01	0.01	0.00	0.21	0.02	0.00	0.00	0.01	0.03
d_M, Delay for Movement [s/veh]	8.98	0.00	0.00	8.86	0.00	0.00	16.35	17.94	12.54	16.19	19.99	10.39
Movement LOS	A	A	A	A	A	A	C	C	B	C	C	B
95th-Percentile Queue Length [veh/ln]	0.04	0.00	0.00	0.04	0.02	0.00	0.85	0.85	0.85	0.08	0.08	0.08
95th-Percentile Queue Length [m/ln]	0.33	0.00	0.00	0.27	0.13	0.00	6.51	6.51	6.51	0.62	0.62	0.62
d_A, Approach Delay [s/veh]	0.18			0.16			16.42			11.96		
Approach LOS	A			A			C			B		
d_I, Intersection Delay [s/veh]	1.47											
Intersection LOS	C											

Intersection Level Of Service Report
Intersection 5: Baker Road and Service Road

Control Type:	Two-way stop	Delay (sec / veh):	9.8
Analysis Method:	HCM 6th Edition	Level Of Service:	A
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.006

Intersection Setup

Name						
Approach	Northbound		Eastbound		Westbound	
Lane Configuration						
Turning Movement	Left	Right	Thru	Right	Left	Thru
Lane Width [m]	3.66	3.66	3.66	3.66	3.66	3.66
No. of Lanes in Entry Pocket	0	0	0	0	0	0
Entry Pocket Length [m]	30.48	30.48	30.48	30.48	30.48	30.48
No. of Lanes in Exit Pocket	0	0	0	0	0	0
Exit Pocket Length [m]	0.00	0.00	0.00	0.00	0.00	0.00
Speed [km/h]	70.00		70.00		70.00	
Grade [%]	0.00		0.00		0.00	
Crosswalk	No		No		No	

Volumes

Name						
Base Volume Input [veh/h]	0	0	33	0	0	31
Base Volume Adjustment Factor	1.2200	1.2200	1.2200	1.2200	1.2200	1.2200
Heavy Vehicles Percentage [%]	2.00	2.00	2.00	2.00	2.00	2.00
Growth Factor	1.4500	1.4500	1.4500	1.4500	1.4500	1.4500
In-Process Volume [veh/h]	0	0	0	0	0	0
Site-Generated Trips [veh/h]	5	34	0	6	37	0
Diverted Trips [veh/h]	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0
Total Hourly Volume [veh/h]	5	34	58	6	37	55
Peak Hour Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Other Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Total 15-Minute Volume [veh/h]	1	9	15	2	9	14
Total Analysis Volume [veh/h]	5	34	58	6	37	55
Pedestrian Volume [ped/h]	0		0		0	

Intersection Settings

Priority Scheme	Stop	Free	Free
Flared Lane	No		
Storage Area [veh]	0	0	0
Two-Stage Gap Acceptance	No		
Number of Storage Spaces in Median	0	0	0

Movement, Approach, & Intersection Results

V/C, Movement V/C Ratio	0.01	0.03	0.00	0.00	0.02	0.00
d_M, Delay for Movement [s/veh]	9.78	8.74	0.00	0.00	7.40	0.00
Movement LOS	A	A	A	A	A	A
95th-Percentile Queue Length [veh/ln]	0.13	0.13	0.00	0.00	0.07	0.07
95th-Percentile Queue Length [m/ln]	0.96	0.96	0.00	0.00	0.56	0.56
d_A, Approach Delay [s/veh]	8.87		0.00		2.98	
Approach LOS	A		A		A	
d_I, Intersection Delay [s/veh]	3.18					
Intersection LOS	A					

Intersection Level Of Service Report
Intersection 7: Victor Road and Service Road

Control Type:	Two-way stop	Delay (sec / veh):	8.7
Analysis Method:	HCM 6th Edition	Level Of Service:	A
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.014

Intersection Setup

Name	Service Road			Service Road			Victor Road			Victor Road		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3.66	3.66	3.66	3.66	3.66	3.66	3.66	3.66	3.66	3.66	3.66	3.66
No. of Lanes in Entry Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Entry Pocket Length [m]	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48
No. of Lanes in Exit Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Speed [km/h]	110.00			110.00			70.00			110.00		
Grade [%]	0.00			0.00			0.00			0.00		
Crosswalk	Yes			Yes			Yes			Yes		

Volumes

Name	Service Road			Service Road			Victor Road			Victor Road		
Base Volume Input [veh/h]	0	0	0	0	0	0	0	8	0	0	6	0
Base Volume Adjustment Factor	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300
Heavy Vehicles Percentage [%]	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Growth Factor	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	14	0	0	0	0	0	0	0	16
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Total Hourly Volume [veh/h]	0	0	0	14	0	0	0	13	0	0	10	16
Peak Hour Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Other Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Total 15-Minute Volume [veh/h]	0	0	0	4	0	0	0	3	0	0	3	4
Total Analysis Volume [veh/h]	0	0	0	14	0	0	0	13	0	0	10	16
Pedestrian Volume [ped/h]	0			0			0			0		

Intersection Settings

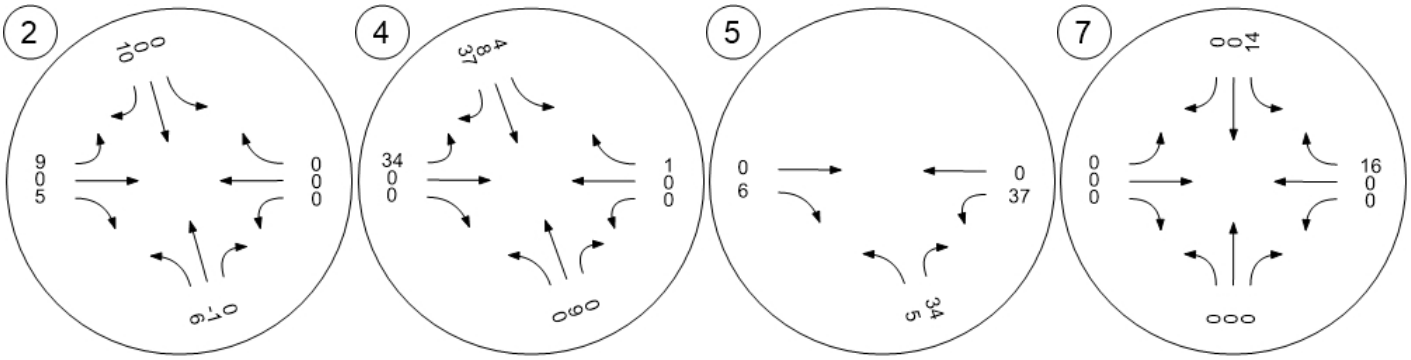
Priority Scheme	Stop	Stop	Free	Free
Flared Lane	No	No		
Storage Area [veh]	0	0	0	0
Two-Stage Gap Acceptance	No	No		
Number of Storage Spaces in Median	0	0	0	0

Movement, Approach, & Intersection Results

V/C, Movement V/C Ratio	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
d_M, Delay for Movement [s/veh]	8.68	9.22	8.37	8.74	9.23	8.45	7.27	0.00	0.00	7.24	0.00	0.00
Movement LOS	A	A	A	A	A	A	A	A	A	A	A	A
95th-Percentile Queue Length [veh/ln]	0.00	0.00	0.00	0.04	0.04	0.04	0.00	0.00	0.00	0.00	0.00	0.00
95th-Percentile Queue Length [m/ln]	0.00	0.00	0.00	0.33	0.33	0.33	0.00	0.00	0.00	0.00	0.00	0.00
d_A, Approach Delay [s/veh]	8.76			8.74			0.00			0.00		
Approach LOS	A			A			A			A		
d_I, Intersection Delay [s/veh]	2.31											
Intersection LOS	A											

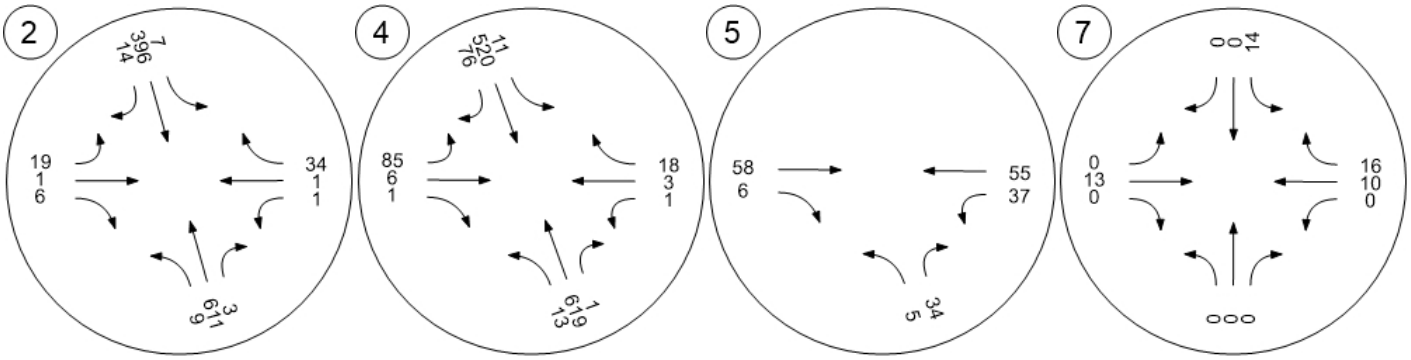
Report Figure 1d: Traffic Volume - Net New Site Trips





Report Figure 1f: Traffic Volume - Future Total Volume





Greenview Estates

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Report File: \...\Appendix D.2.pdf

Scenario 2 Pm Peak Stage 2
4/22/2022

Intersection Analysis Summary

ID	Intersection Name	Control Type	Method	Worst Mvmt	V/C	Delay (s/veh)	LOS
2	Highway 11 and Victor Road	Two-way stop	HCM 6th Edition	EB Thru	0.012	21.2	C
4	Highway 11 and Baker Road	Two-way stop	HCM 6th Edition	EB Thru	0.021	25.1	D
5	Baker Road and Service Road	Two-way stop	HCM 6th Edition	NB Left	0.014	10.3	B
7	Victor Road and Service Road	Two-way stop	HCM 6th Edition	SB Left	0.026	8.8	A

V/C, Delay, LOS: For two-way stop, these values are taken from the movement with the worst (highest) delay value. For all other control types, they are taken for the whole intersection.

Intersection Level Of Service Report
Intersection 2: Highway 11 and Victor Road

Control Type:	Two-way stop	Delay (sec / veh):	21.2
Analysis Method:	HCM 6th Edition	Level Of Service:	C
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.012

Intersection Setup

Name	Highway 11			Highway 11			Victor Road			Victor Road		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70
No. of Lanes in Entry Pocket	0	0	0	1	0	1	0	0	0	0	0	0
Entry Pocket Length [m]	30.48	30.48	30.48	180.00	30.48	180.00	30.48	30.48	30.48	30.48	30.48	30.48
No. of Lanes in Exit Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Speed [km/h]	110.00			110.00			70.00			70.00		
Grade [%]	0.00			0.00			0.00			0.00		
Crosswalk	No			No			No			No		

Volumes

Name	Highway 11			Highway 11			Victor Road			Victor Road		
Base Volume Input [veh/h]	1	382	6	10	503	6	9	2	1	2	1	9
Base Volume Adjustment Factor	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300
Heavy Vehicles Percentage [%]	2.00	14.00	2.00	2.00	19.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Growth Factor	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	8	0	0	0	0	13	15	0	10	0	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	-4	0	0	0	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Total Hourly Volume [veh/h]	9	601	10	15	795	23	29	3	11	3	1	14
Peak Hour Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Other Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Total 15-Minute Volume [veh/h]	2	150	3	4	199	6	7	1	3	1	0	4
Total Analysis Volume [veh/h]	9	601	10	15	795	23	29	3	11	3	1	14
Pedestrian Volume [ped/h]	0			0			0			0		

Intersection Settings

Priority Scheme	Free	Free	Stop	Stop
Flared Lane			Yes	Yes
Storage Area [veh]	0	0	1	1
Two-Stage Gap Acceptance			Yes	Yes
Number of Storage Spaces in Median	0	0	1	1

Movement, Approach, & Intersection Results

V/C, Movement V/C Ratio	0.01	0.01	0.00	0.02	0.01	0.00	0.11	0.01	0.02	0.01	0.00	0.02
d_M, Delay for Movement [s/veh]	9.52	0.00	0.00	8.79	0.00	0.00	20.67	21.23	12.50	17.21	20.04	10.30
Movement LOS	A	A	A	A	A	A	C	C	B	C	C	B
95th-Percentile Queue Length [veh/ln]	0.03	0.02	0.00	0.05	0.00	0.00	0.43	0.43	0.43	0.06	0.06	0.06
95th-Percentile Queue Length [m/ln]	0.26	0.13	0.00	0.36	0.00	0.00	3.26	3.26	3.26	0.47	0.47	0.47
d_A, Approach Delay [s/veh]	0.14			0.16			18.62			11.99		
Approach LOS	A			A			C			B		
d_I, Intersection Delay [s/veh]	0.81											
Intersection LOS	C											

Intersection Level Of Service Report
Intersection 4: Highway 11 and Baker Road

Control Type:	Two-way stop	Delay (sec / veh):	25.1
Analysis Method:	HCM 6th Edition	Level Of Service:	D
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.021

Intersection Setup

Name	Highway 11			Highway 11						Baker Road		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70
No. of Lanes in Entry Pocket	1	0	0	0	0	1	0	0	0	0	0	0
Entry Pocket Length [m]	180.00	30.48	30.48	30.48	30.48	180.00	30.48	30.48	30.48	30.48	30.48	30.48
No. of Lanes in Exit Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Speed [km/h]	110.00			110.00			110.00			70.00		
Grade [%]	0.00			0.00			0.00			0.00		
Crosswalk	No			No			No			No		

Volumes

Name	Highway 11			Highway 11						Baker Road		
Base Volume Input [veh/h]	1	361	1	12	431	37	28	3	8	1	4	5
Base Volume Adjustment Factor	1.2200	1.2200	1.2200	1.2200	1.2200	1.2200	1.2200	1.2200	1.2200	1.2200	1.2200	1.2200
Heavy Vehicles Percentage [%]	11.00	18.00	2.00	4.00	18.00	4.00	2.00	8.00	8.00	2.00	29.00	3.00
Growth Factor	1.4500	1.4500	1.4500	1.4500	1.4500	1.4500	1.4500	1.4500	1.4500	1.4500	1.4500	1.4500
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	15	0	2	13	48	56	0	0	0	0	5
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	-1	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Total Hourly Volume [veh/h]	1	653	1	24	775	113	105	6	15	1	7	14
Peak Hour Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Other Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Total 15-Minute Volume [veh/h]	0	163	0	6	194	28	26	2	4	0	2	4
Total Analysis Volume [veh/h]	1	653	1	24	775	113	105	6	15	1	7	14
Pedestrian Volume [ped/h]	0			0			0			0		

Intersection Settings

Priority Scheme	Free	Free	Stop	Stop
Flared Lane			Yes	Yes
Storage Area [veh]	0	0	1	1
Two-Stage Gap Acceptance			Yes	Yes
Number of Storage Spaces in Median	0	0	2	1

Movement, Approach, & Intersection Results

V/C, Movement V/C Ratio	0.00	0.01	0.00	0.03	0.01	0.00	0.36	0.02	0.03	0.00	0.04	0.02
d_M, Delay for Movement [s/veh]	10.12	0.00	0.00	9.04	0.00	0.00	24.76	25.14	18.35	17.97	24.92	10.70
Movement LOS	B	A	A	A	A	A	C	D	C	C	C	B
95th-Percentile Queue Length [veh/ln]	0.00	0.00	0.00	0.08	0.04	0.00	1.84	1.84	1.84	0.13	0.13	0.13
95th-Percentile Queue Length [m/ln]	0.03	0.00	0.00	0.61	0.31	0.00	14.00	14.00	14.00	0.99	0.99	0.99
d_A, Approach Delay [s/veh]	0.02			0.24			24.02			15.56		
Approach LOS	A			A			C			C		
d_I, Intersection Delay [s/veh]	2.10											
Intersection LOS	D											

Intersection Level Of Service Report
Intersection 5: Baker Road and Service Road

Control Type:	Two-way stop	Delay (sec / veh):	10.3
Analysis Method:	HCM 6th Edition	Level Of Service:	B
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.014

Intersection Setup

Name						
Approach	Northbound		Eastbound		Westbound	
Lane Configuration						
Turning Movement	Left	Right	Thru	Right	Left	Thru
Lane Width [m]	3.66	3.66	3.66	3.66	3.66	3.66
No. of Lanes in Entry Pocket	0	0	0	0	0	0
Entry Pocket Length [m]	30.48	30.48	30.48	30.48	30.48	30.48
No. of Lanes in Exit Pocket	0	0	0	0	0	0
Exit Pocket Length [m]	0.00	0.00	0.00	0.00	0.00	0.00
Speed [km/h]	70.00		70.00		70.00	
Grade [%]	0.00		0.00		0.00	
Crosswalk	No		No		No	

Volumes

Name						
Base Volume Input [veh/h]	0	0	39	0	0	42
Base Volume Adjustment Factor	1.2200	1.2200	1.2200	1.2200	1.2200	1.2200
Heavy Vehicles Percentage [%]	2.00	2.00	2.00	2.00	2.00	2.00
Growth Factor	1.4500	1.4500	1.4500	1.4500	1.4500	1.4500
In-Process Volume [veh/h]	0	0	0	0	0	0
Site-Generated Trips [veh/h]	10	56	0	8	48	0
Diverted Trips [veh/h]	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0
Total Hourly Volume [veh/h]	10	56	70	8	48	74
Peak Hour Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Other Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Total 15-Minute Volume [veh/h]	3	14	18	2	12	19
Total Analysis Volume [veh/h]	10	56	70	8	48	74
Pedestrian Volume [ped/h]	0		0		0	

Intersection Settings

Priority Scheme	Stop	Free	Free
Flared Lane	No		
Storage Area [veh]	0	0	0
Two-Stage Gap Acceptance	No		
Number of Storage Spaces in Median	0	0	0

Movement, Approach, & Intersection Results

V/C, Movement V/C Ratio	0.01	0.06	0.00	0.00	0.03	0.00
d_M, Delay for Movement [s/veh]	10.29	8.94	0.00	0.00	7.44	0.00
Movement LOS	B	A	A	A	A	A
95th-Percentile Queue Length [veh/ln]	0.23	0.23	0.00	0.00	0.10	0.10
95th-Percentile Queue Length [m/ln]	1.73	1.73	0.00	0.00	0.74	0.74
d_A, Approach Delay [s/veh]	9.14		0.00		2.93	
Approach LOS	A		A		A	
d_I, Intersection Delay [s/veh]	3.61					
Intersection LOS	B					

Intersection Level Of Service Report
Intersection 7: Victor Road and Service Road

Control Type:	Two-way stop	Delay (sec / veh):	8.8
Analysis Method:	HCM 6th Edition	Level Of Service:	A
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.026

Intersection Setup

Name	Service Road			Service Road			Victor Road			Victor Road		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3.66	3.66	3.66	3.66	3.66	3.66	3.66	3.66	3.66	3.66	3.66	3.66
No. of Lanes in Entry Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Entry Pocket Length [m]	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48
No. of Lanes in Exit Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Speed [km/h]	110.00			110.00			70.00			110.00		
Grade [%]	0.00			0.00			0.00			0.00		
Crosswalk	Yes			Yes			Yes			Yes		

Volumes

Name	Service Road			Service Road			Victor Road			Victor Road		
Base Volume Input [veh/h]	0	0	0	0	0	0	0	11	0	0	8	0
Base Volume Adjustment Factor	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300	1.1300
Heavy Vehicles Percentage [%]	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Growth Factor	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000	1.4000
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	25	0	0	0	0	0	0	0	21
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Total Hourly Volume [veh/h]	0	0	0	25	0	0	0	17	0	0	13	21
Peak Hour Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Other Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Total 15-Minute Volume [veh/h]	0	0	0	6	0	0	0	4	0	0	3	5
Total Analysis Volume [veh/h]	0	0	0	25	0	0	0	17	0	0	13	21
Pedestrian Volume [ped/h]	0			0			0			0		

Intersection Settings

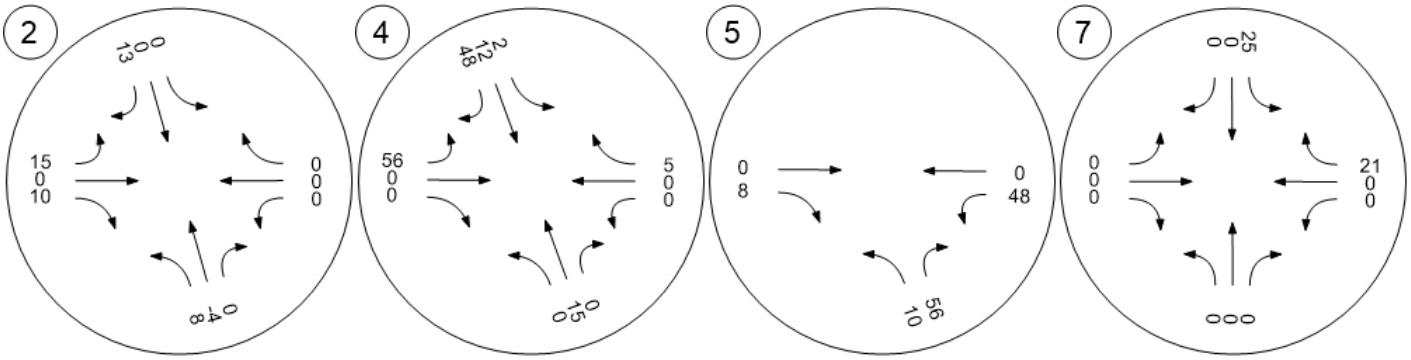
Priority Scheme	Stop	Stop	Free	Free
Flared Lane	No	No		
Storage Area [veh]	0	0	0	0
Two-Stage Gap Acceptance	No	No		
Number of Storage Spaces in Median	0	0	0	0

Movement, Approach, & Intersection Results

V/C, Movement V/C Ratio	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
d_M, Delay for Movement [s/veh]	8.74	9.28	8.39	8.84	9.33	8.52	7.28	0.00	0.00	7.25	0.00	0.00
Movement LOS	A	A	A	A	A	A	A	A	A	A	A	A
95th-Percentile Queue Length [veh/ln]	0.00	0.00	0.00	0.08	0.08	0.08	0.00	0.00	0.00	0.00	0.00	0.00
95th-Percentile Queue Length [m/ln]	0.00	0.00	0.00	0.61	0.61	0.61	0.00	0.00	0.00	0.00	0.00	0.00
d_A, Approach Delay [s/veh]	8.80			8.84			0.00			0.00		
Approach LOS	A			A			A			A		
d_I, Intersection Delay [s/veh]	2.91											
Intersection LOS	A											

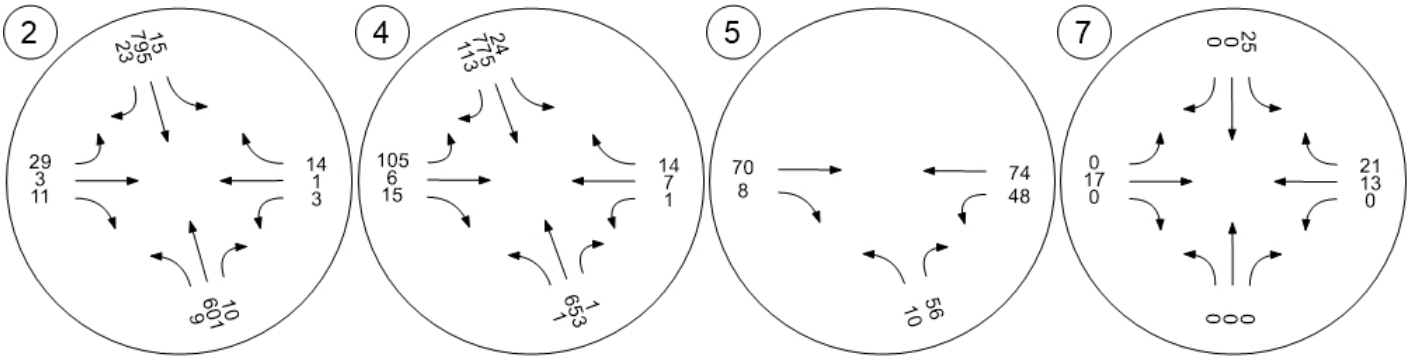
Report Figure 1d: Traffic Volume - Net New Site Trips





Report Figure 1f: Traffic Volume - Future Total Volume





APPENDIX E – STAGE 2 MOH WARRANTS

Turning Lane Warrants
Worksheet for Four Lane Rural Highways

Highway:	**Highway 11**
Crossroad:	**Baker Road**
Scenario:	**2037 Background - AM Peak**

Highway Direction A:	**NB**	Usually WB or NB
Highway Direction B:	**SB**	Usually EB or SB
Truck Equivalency (E_T)	**1.7**	MHI Standard: 1.7

NB Data	NBL	NBT	NBR	NB Total
Hourly Vol (veh/h)	**13**	**610**	**1**	624
Truck %	**11.0%**	**18.0%**	**2.0%**	18%
Equiv Vol (pce/h)	14	687	1	702
Growth Factor	**1.27**	**1.27**	**1.27**	
Future Equiv Vol (pce/h)	18	872	1	891
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

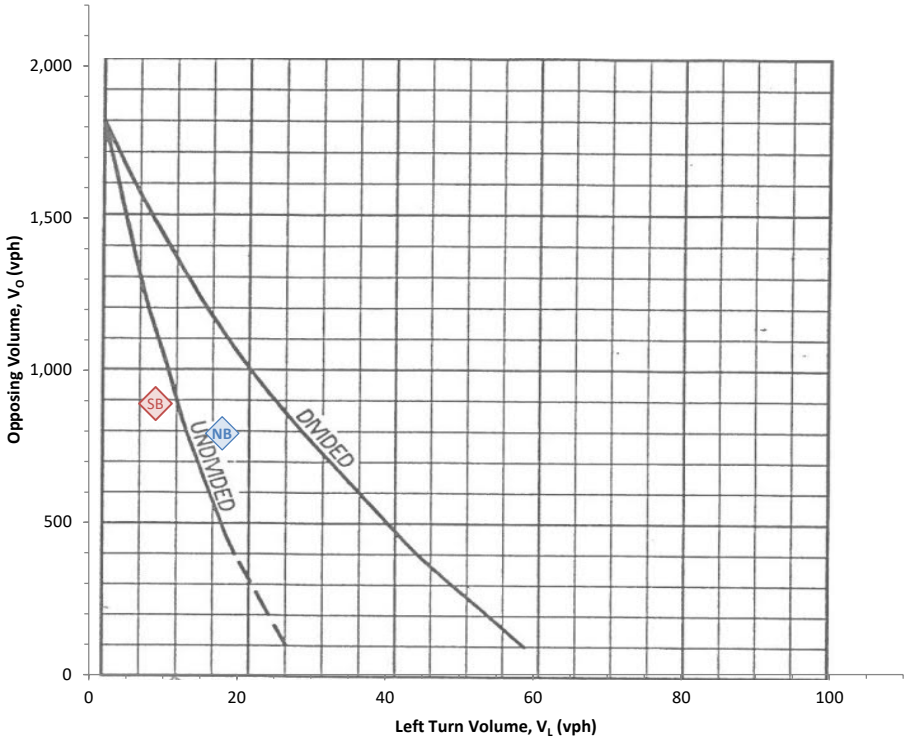
SB Data	SBL	SBT	SBR	SB Total
Hourly Vol. (veh/h)	**7**	**512**	**39**	558
Truck %	**4.0%**	**18.0%**	**4.0%**	17%
Equiv Vol (pce/h)	7	577	40	624
Growth Factor	**1.27**	**1.27**	**1.27**	
Future Equiv Vol (pce/h)	9	733	51	793
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

Notes:

- No warrant if the plotted point falls to the left of the applicable line
- Right and left turn lanes are warranted at:
  - -Intersections with other Provincial Highways
  - -Industrial Access Roads
  - -Provincial Campgrounds and Picnic Sites
- Length of turning lane is related to speed. See SP 20618.
- For right turn lane on four-lane highways, advancing volume should be half of the directional volume with no further reduction for left turning vehicles.
- Use the corrected peak hour volumes (vph) projected to the 10th year after construction. See SKS 2.3.1-C (formerly DM 502-3) for correction factors.

Saskatchewan Ministry of Highways and Infrastructure
Warrants for Left Turn Lanes - 4 Lane Rural Highways
Standard Plan STP 20610

Associated Engineering



	Calculated		Plotted	
	NB	SB	NB	SB
Left Turn Volume, V_L	18	9	18	9
Opposing Volume, V_O	793	891	793	891

Turning Lane Warrants
Worksheet for Four Lane Rural Highways

Highway:	**Highway 11**
Crossroad:	**Baker Road**
Scenario:	**2037 Background - AM Peak**

Highway Direction A:	**NB**	Usually WB or NB
Highway Direction B:	**SB**	Usually EB or SB
Truck Equivalency (E_T)	**1.7**	MHI Standard: 1.7

NB Data	NBL	NBT	NBR	NB Total
Hourly Vol (veh/h)	**13**	**610**	**1**	624
Truck %	**11.0%**	**18.0%**	**2.0%**	18%
Equiv Vol (pce/h)	14	687	1	702
Growth Factor	**1.27**	**1.27**	**1.27**	
Future Equiv Vol (pce/h)	18	872	1	891
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

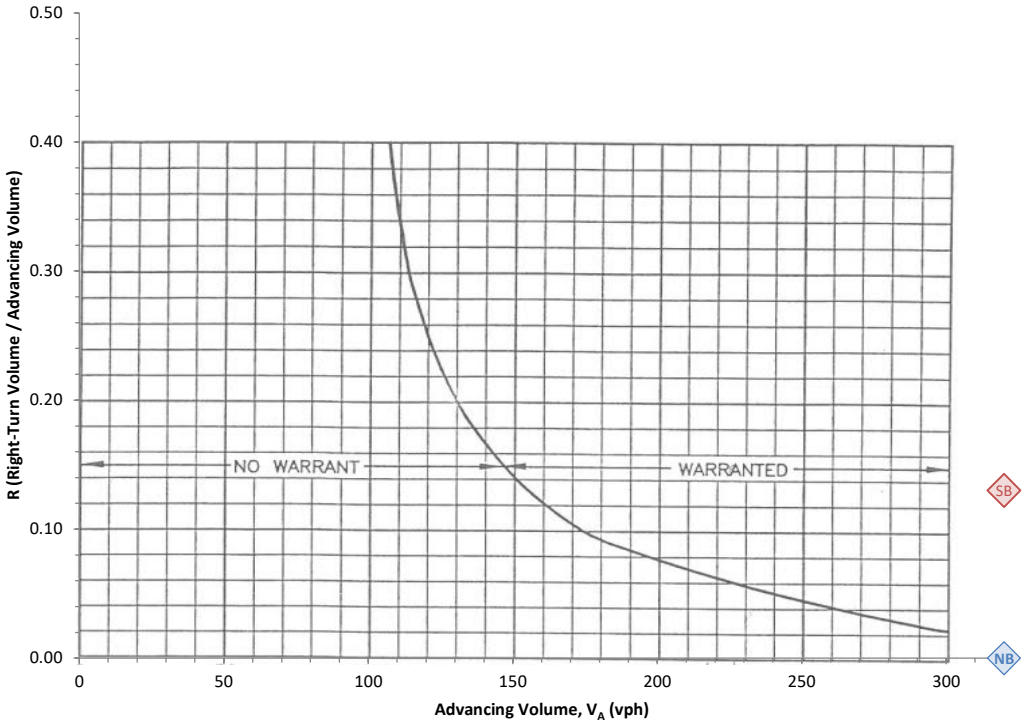
SB Data	SBL	SBT	SBR	SB Total
Hourly Vol. (veh/h)	**7**	**512**	**39**	558
Truck %	**4.0%**	**18.0%**	**4.0%**	17%
Equiv Vol (pce/h)	7	577	40	624
Growth Factor	**1.27**	**1.27**	**1.27**	
Future Equiv Vol (pce/h)	9	733	51	793
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

Notes:

- No warrant if the plotted point falls to the left of the applicable line
- Right and left turn lanes are warranted at:
  - -Intersections with other Provincial Highways
  - -Industrial Access Roads
  - -Provincial Campgrounds and Picnic Sites
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- Use the corrected peak hour volumes (vph) projected to the 10th year after construction. See SKS 2.3.1-C (formerly DM 502-3) for correction factors.

Saskatchewan Ministry of Highways and Infrastructure
Warrants for Right Turn Lanes - Rural Highways
Standard Plan 20614

Associated Engineering



	Calculated		Plotted	
	NB	SB	NB	SB
Advancing Volume, V_A	446	397	320	320
R (V_R / V_A)	0	0.13	0.00	0.13

Turning Lane Warrants
Worksheet for Four Lane Rural Highways

Highway:	**Highway 11**
Crossroad:	**Baker Road**
Scenario:	**2037 Background - PM Peak**

Highway Direction A:	**NB**	Usually WB or NB
Highway Direction B:	**SB**	Usually EB or SB
Truck Equivalency (E_T)	**1.7**	MHI Standard: 1.7

NB Data	NBL	NBT	NBR	NB Total
Hourly Vol (veh/h)	**1**	**638**	**1**	640
Truck %	**11.0%**	**18.0%**	**2.0%**	18%
Equiv Vol (pce/h)	1	718	1	720
Growth Factor	**1.27**	**1.27**	**1.27**	
Future Equiv Vol (pce/h)	1	912	1	914
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

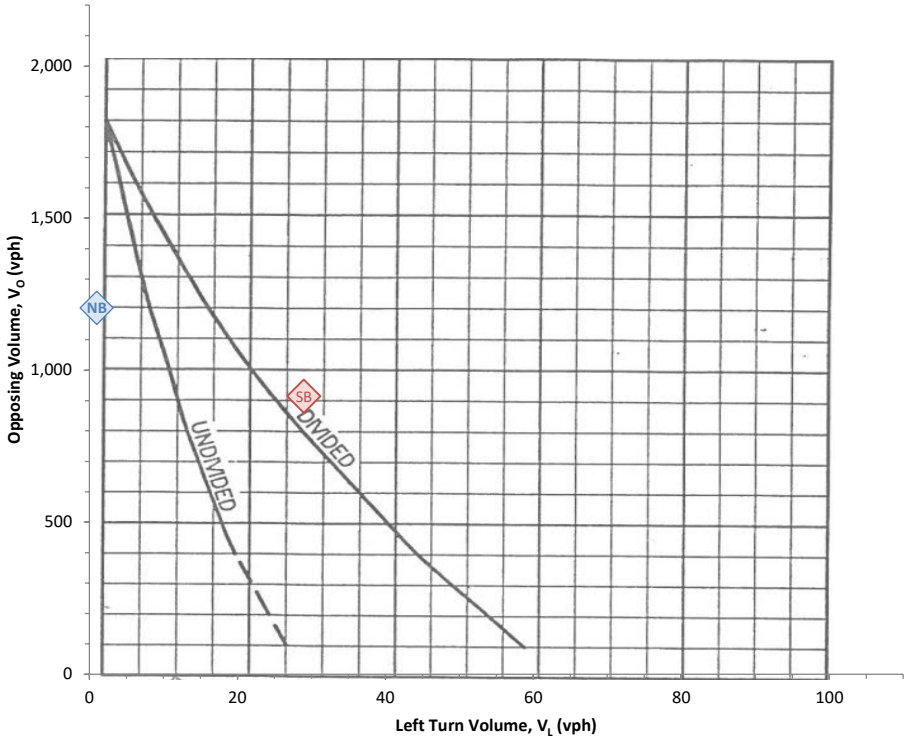
SB Data	SBL	SBT	SBR	SB Total
Hourly Vol. (veh/h)	**22**	**763**	**65**	850
Truck %	**4.0%**	**18.0%**	**4.0%**	17%
Equiv Vol (pce/h)	23	859	67	949
Growth Factor	**1.27**	**1.27**	**1.27**	
Future Equiv Vol (pce/h)	29	1091	85	1205
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

Notes:

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  - -Provincial Campgrounds and Picnic Sites
- Length of turning lane is related to speed. See SP 20618.
- For right turn lane on four-lane highways, advancing volume should be half of the directional volume with no further reduction for left turning vehicles.
- Use the corrected peak hour volumes (vph) projected to the 10th year after construction. See SKS 2.3.1-C (formerly DM 502-3) for correction factors.

Saskatchewan Ministry of Highways and Infrastructure
Warrants for Left Turn Lanes - 4 Lane Rural Highways
Standard Plan STP 20610

Associated Engineering



	Calculated		Plotted	
	NB	SB	NB	SB
Left Turn Volume, V_L	1	29	1	29
Opposing Volume, V_O	1205	914	1205	914

Turning Lane Warrants
Worksheet for Four Lane Rural Highways

Highway:	**Highway 11**
Crossroad:	**Baker Road**
Scenario:	**2037 Background - PM Peak**

Highway Direction A:	**NB**	Usually WB or NB
Highway Direction B:	**SB**	Usually EB or SB
Truck Equivalency (E_T)	**1.7**	MHI Standard: 1.7

NB Data	NBL	NBT	NBR	NB Total
Hourly Vol (veh/h)	**1**	**638**	**1**	640
Truck %	**11.0%**	**18.0%**	**2.0%**	18%
Equiv Vol (pce/h)	1	718	1	720
Growth Factor	**1.27**	**1.27**	**1.27**	
Future Equiv Vol (pce/h)	1	912	1	914
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

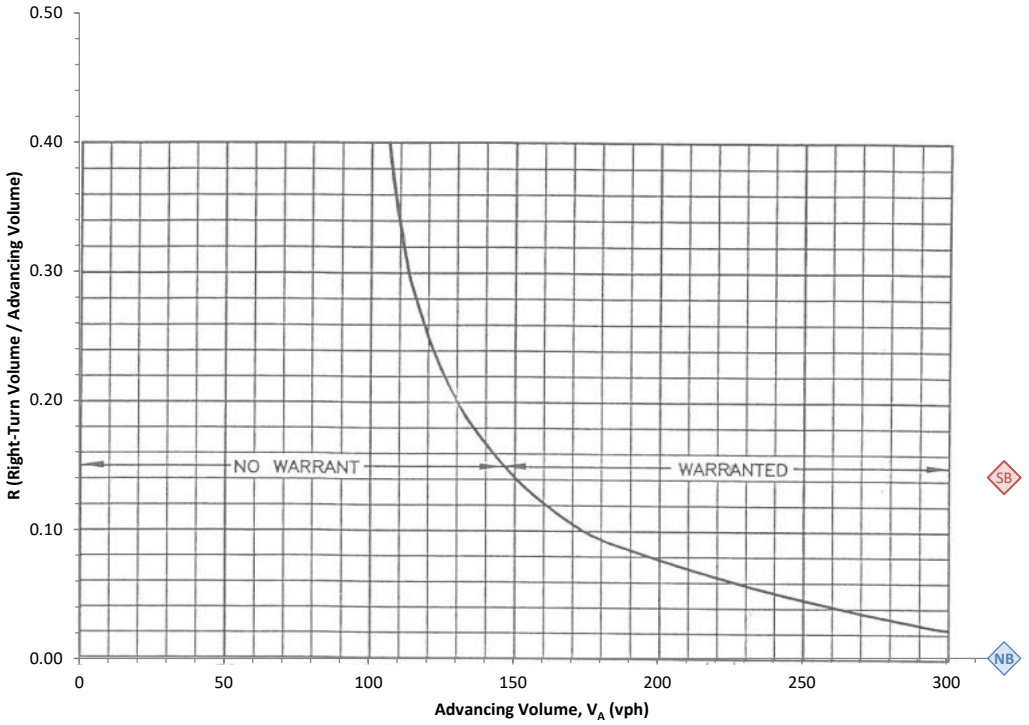
SB Data	SBL	SBT	SBR	SB Total
Hourly Vol. (veh/h)	**22**	**763**	**65**	850
Truck %	**4.0%**	**18.0%**	**4.0%**	17%
Equiv Vol (pce/h)	23	859	67	949
Growth Factor	**1.27**	**1.27**	**1.27**	
Future Equiv Vol (pce/h)	29	1091	85	1205
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

Notes:

- No warrant if the plotted point falls to the left of the applicable line
- Right and left turn lanes are warranted at:
  - -Intersections with other Provincial Highways
  - -Industrial Access Roads
  - -Provincial Campgrounds and Picnic Sites
- Length of turning lane is related to speed. See SP 20618.
- For right turn lane on four-lane highways, advancing volume should be half of the directional volume with no further reduction for left turning vehicles.
- Use the corrected peak hour volumes (vph) projected to the 10th year after construction. See SKS 2.3.1-C (formerly DM 502-3) for correction factors.

Saskatchewan Ministry of Highways and Infrastructure
Warrants for Right Turn Lanes - Rural Highways
Standard Plan 20614

Associated Engineering



	Calculated		Plotted	
	NB	SB	NB	SB
Advancing Volume, V_A	457	603	320	320
R (V_R / V_A)	0	0.14	0.00	0.14

Turning Lane Warrants
Worksheet for Four Lane Rural Highways

Highway:	**Highway 11**
Crossroad:	**Baker Road**
Scenario:	**Full Buildout - AM Peak**

Highway Direction A:	**NB**	Usually WB or NB
Highway Direction B:	**SB**	Usually EB or SB
Truck Equivalency (E_T)	**1.7**	MHI Standard: 1.7

NB Data	NBL	NBT	NBR	NB Total
Hourly Vol (veh/h)	**13**	**619**	**1**	633
Truck %	**11.0%**	**18.0%**	**2.0%**	18%
Equiv Vol (pce/h)	14	697	1	712
Growth Factor	**1.27**	**1.27**	**1.27**	
Future Equiv Vol (pce/h)	18	885	1	904
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

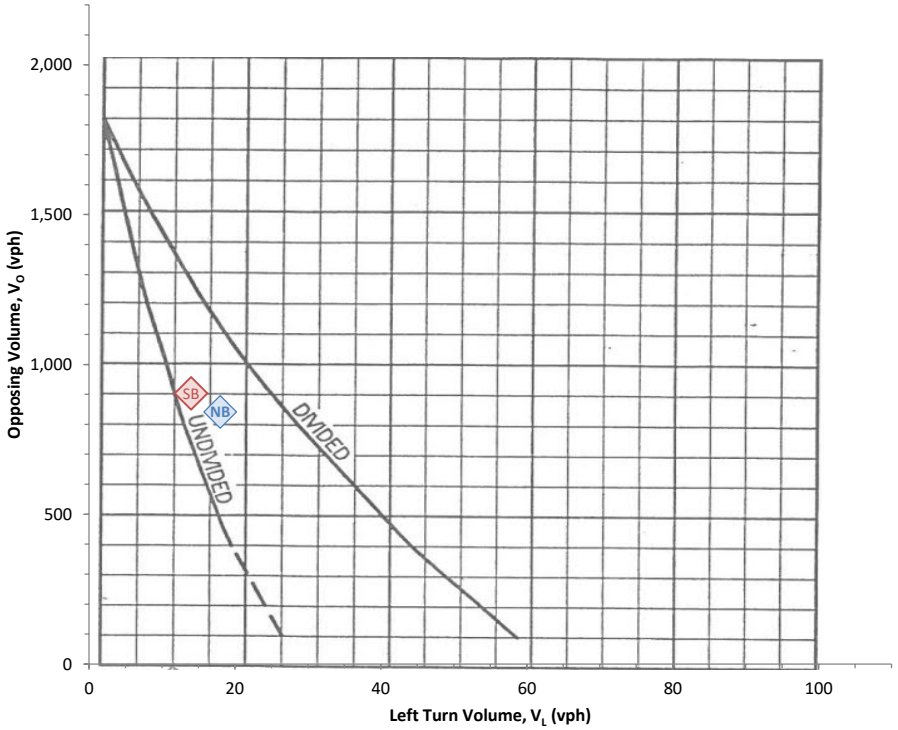
SB Data	SBL	SBT	SBR	SB Total
Hourly Vol. (veh/h)	**11**	**510**	**76**	597
Truck %	**4.0%**	**18.0%**	**4.0%**	16%
Equiv Vol (pce/h)	11	574	78	663
Growth Factor	**1.27**	**1.27**	**1.27**	
Future Equiv Vol (pce/h)	14	729	99	842
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

Notes:

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  -Intersections with other Provincial Highways
  -Industrial Access Roads
  -Provincial Campgrounds and Picnic Sites
- Length of turning lane is related to speed. See SP 20618.
- For right turn lane on four-lane highways, advancing volume should be half of the directional volume with no further reduction for left turning vehicles.
- Use the corrected peak hour volumes (vph) projected to the 10th year after construction. See SKS 2.3.1-C (formerly DM 502-3) for correction factors.

Saskatchewan Ministry of Highways and Infrastructure
Warrants for Left Turn Lanes - 4 Lane Rural Highways
Standard Plan STP 20610

Associated Engineering



	Calculated		Plotted	
	NB	SB	NB	SB
Left Turn Volume, V_L	18	14	18	14
Opposing Volume, V_O	842	904	842	904

Turning Lane Warrants
Worksheet for Four Lane Rural Highways

Highway:	**Highway 11**
Crossroad:	**Baker Road**
Scenario:	**Full Buildout - AM Peak**

Highway Direction A:	**NB**	Usually WB or NB
Highway Direction B:	**SB**	Usually EB or SB
Truck Equivalency (E_T)	**1.7**	MHI Standard: 1.7

NB Data	NBL	NBT	NBR	NB Total
Hourly Vol (veh/h)	**13**	**619**	**1**	633
Truck %	**11.0%**	**18.0%**	**2.0%**	18%
Equiv Vol (pce/h)	14	697	1	712
Growth Factor	**1.27**	**1.27**	**1.27**	
Future Equiv Vol (pce/h)	18	885	1	904
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

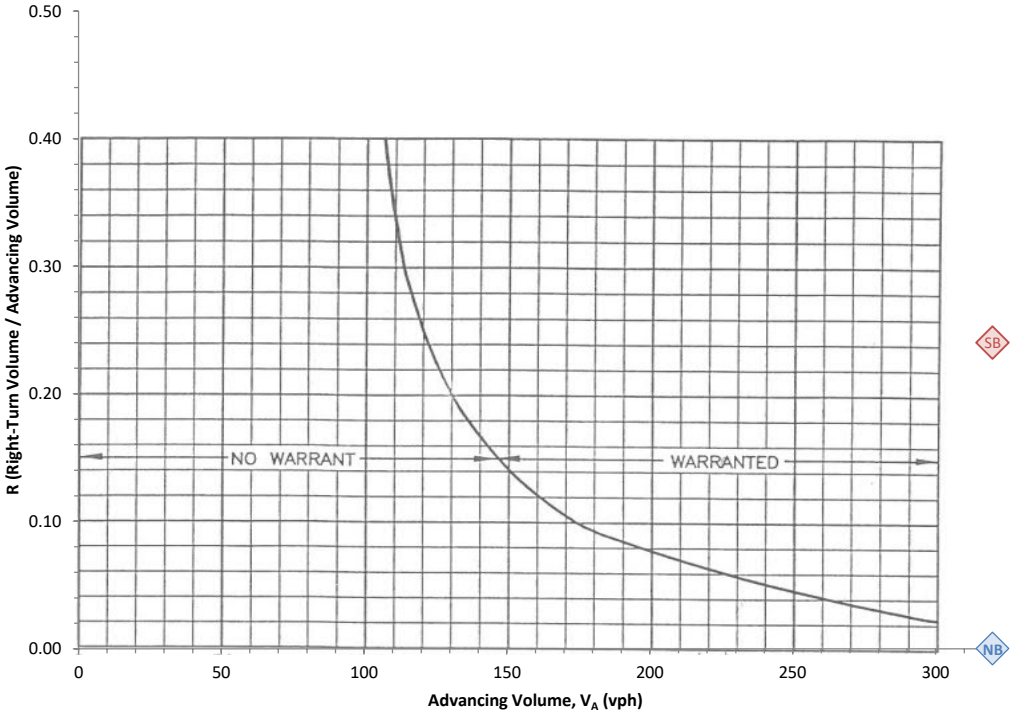
SB Data	SBL	SBT	SBR	SB Total
Hourly Vol. (veh/h)	**11**	**510**	**76**	597
Truck %	**4.0%**	**18.0%**	**4.0%**	16%
Equiv Vol (pce/h)	11	574	78	663
Growth Factor	**1.27**	**1.27**	**1.27**	
Future Equiv Vol (pce/h)	14	729	99	842
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

Notes:

- No warrant if the plotted point falls to the left of the applicable line
- Right and left turn lanes are warranted at:
  - -Intersections with other Provincial Highways
  - -Industrial Access Roads
  - -Provincial Campgrounds and Picnic Sites
- Length of turning lane is related to speed. See SP 20618.
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Saskatchewan Ministry of Highways and Infrastructure
Warrants for Right Turn Lanes - Rural Highways
Standard Plan 20614

Associated Engineering



	Calculated		Plotted	
	NB	SB	NB	SB
Advancing Volume, V_A	452	421	320	320
R (V_R / V_A)	0	0.24	0.00	0.24

Turning Lane Warrants
Worksheet for Four Lane Rural Highways

Highway:	**Highway 11**
Crossroad:	**Baker Road**
Scenario:	**Full Buildout - PM Peak**

Highway Direction A:	**NB**	Usually WB or NB
Highway Direction B:	**SB**	Usually EB or SB
Truck Equivalency (E_T)	**1.7**	MHI Standard: 1.7

NB Data	NBL	NBT	NBR	NB Total
Hourly Vol (veh/h)	**1**	**653**	**1**	655
Truck %	**11.0%**	**18.0%**	**2.0%**	18%
Equiv Vol (pce/h)	1	735	1	737
Growth Factor	**1.27**	**1.27**	**1.27**	
Future Equiv Vol (pce/h)	1	933	1	935
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

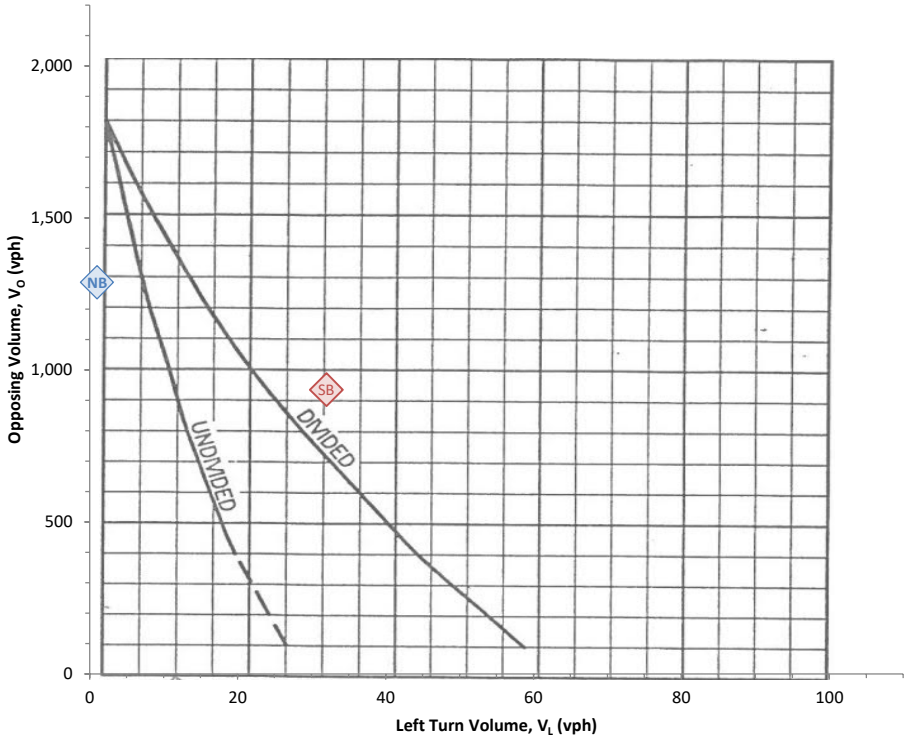
SB Data	SBL	SBT	SBR	SB Total
Hourly Vol. (veh/h)	**24**	**775**	**113**	912
Truck %	**4.0%**	**18.0%**	**4.0%**	16%
Equiv Vol (pce/h)	25	873	116	1014
Growth Factor	**1.27**	**1.27**	**1.27**	
Future Equiv Vol (pce/h)	32	1109	147	1288
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

Notes:

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  - -Industrial Access Roads
  - -Provincial Campgrounds and Picnic Sites
- Length of turning lane is related to speed. See SP 20618.
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- Use the corrected peak hour volumes (vph) projected to the 10th year after construction. See SKS 2.3.1-C (formerly DM 502-3) for correction factors.

Saskatchewan Ministry of Highways and Infrastructure
Warrants for Left Turn Lanes - 4 Lane Rural Highways
Standard Plan STP 20610

Associated Engineering



	Calculated		Plotted	
	NB	SB	NB	SB
Left Turn Volume, V_L	1	32	1	32
Opposing Volume, V_O	1288	935	1288	935

Turning Lane Warrants
Worksheet for Four Lane Rural Highways

Highway:	**Highway 11**
Crossroad:	**Baker Road**
Scenario:	**Full Buildout - PM Peak**

Highway Direction A:	**NB**	Usually WB or NB
Highway Direction B:	**SB**	Usually EB or SB
Truck Equivalency (E_T)	**1.7**	MHI Standard: 1.7

NB Data	NBL	NBT	NBR	NB Total
Hourly Vol (veh/h)	**1**	**653**	**1**	655
Truck %	**11.0%**	**18.0%**	**2.0%**	18%
Equiv Vol (pce/h)	1	735	1	737
Growth Factor	**1.27**	**1.27**	**1.27**	
Future Equiv Vol (pce/h)	1	933	1	935
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

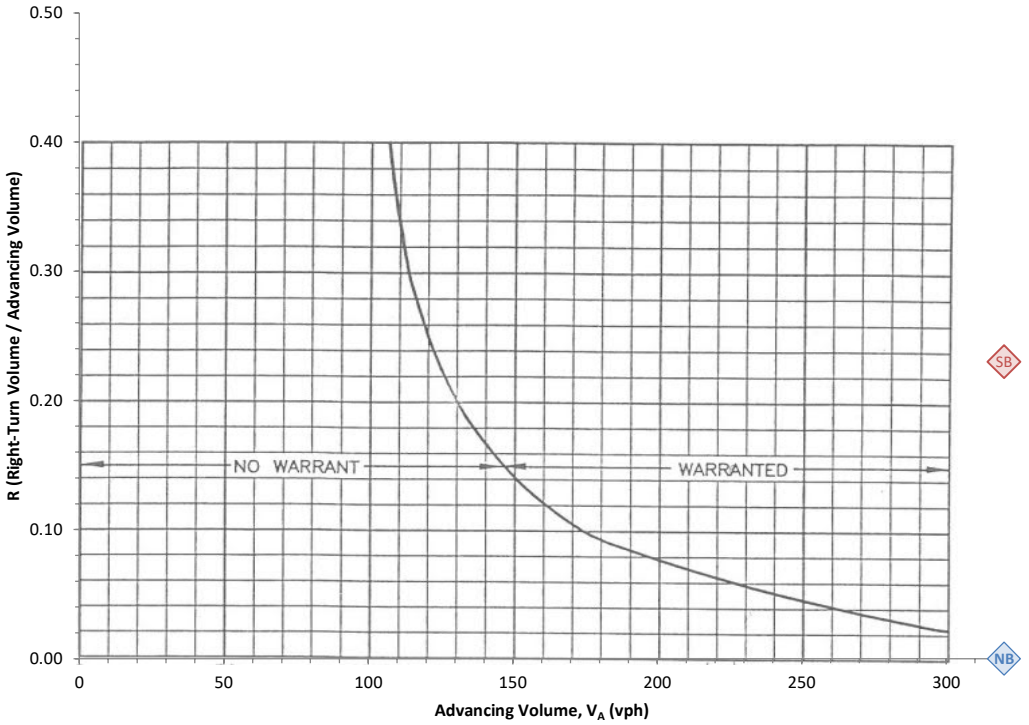
SB Data	SBL	SBT	SBR	SB Total
Hourly Vol. (veh/h)	**24**	**775**	**113**	912
Truck %	**4.0%**	**18.0%**	**4.0%**	16%
Equiv Vol (pce/h)	25	873	116	1014
Growth Factor	**1.27**	**1.27**	**1.27**	
Future Equiv Vol (pce/h)	32	1109	147	1288
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

Notes:

- No warrant if the plotted point falls to the left of the applicable line
- Right and left turn lanes are warranted at:
  - -Intersections with other Provincial Highways
  - -Industrial Access Roads
  - -Provincial Campgrounds and Picnic Sites
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Saskatchewan Ministry of Highways and Infrastructure
Warrants for Right Turn Lanes - Rural Highways
Standard Plan 20614

Associated Engineering



	Calculated		Plotted	
	NB	SB	NB	SB
Advancing Volume, V_A	468	644	320	320
R (V_R / V_A)	0	0.23	0.00	0.23

Turning Lane Warrants
Worksheet for Four Lane Rural Highways

Highway:	**Highway 11**
Crossroad:	**Victor Road**
Scenario:	**2037 Background - AM Peak**

Highway Direction A:	**NB**	Usually WB or NB
Highway Direction B:	**SB**	Usually EB or SB
Truck Equivalency (E_T)	**1.7**	MHI Standard: 1.7

NB Data	NBL	NBT	NBR	NB Total
Hourly Vol (veh/h)	**3**	**612**	**3**	618
Truck %	**2.0%**	**14.0%**	**2.0%**	14%
Equiv Vol (pce/h)	3	672	3	678
Growth Factor	**1.27**	**1.27**	**1.27**	
Future Equiv Vol (pce/h)	4	853	4	861
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

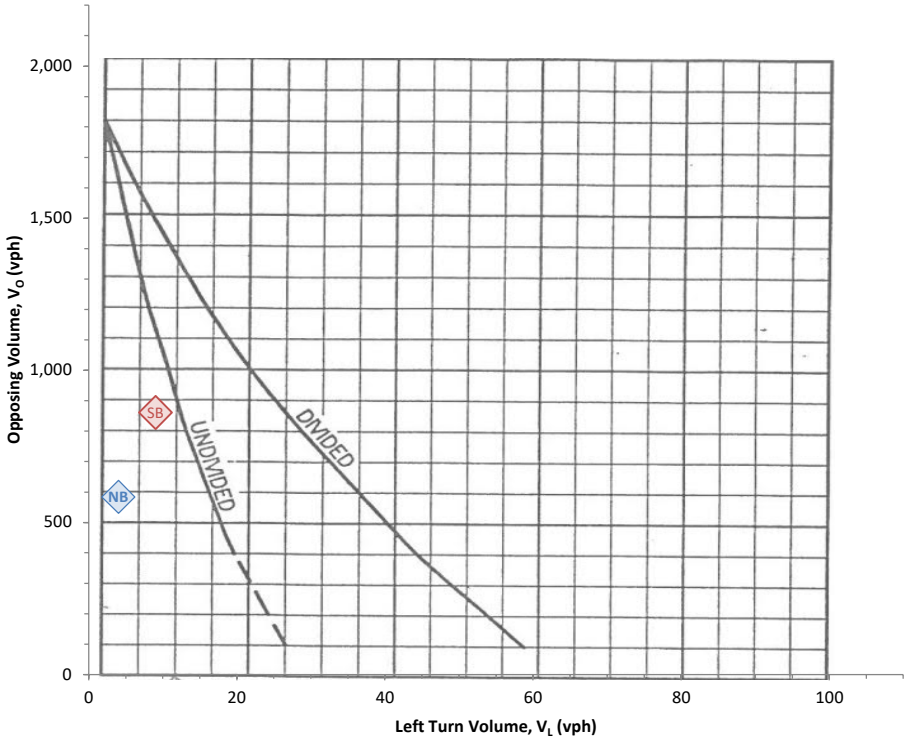
SB Data	SBL	SBT	SBR	SB Total
Hourly Vol. (veh/h)	**7**	**396**	**4**	407
Truck %	**2.0%**	**19.0%**	**2.0%**	19%
Equiv Vol (pce/h)	7	449	4	460
Growth Factor	**1.27**	**1.27**	**1.27**	
Future Equiv Vol (pce/h)	9	570	5	584
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

Notes:

- No warrant if the plotted point falls to the left of the applicable line
- Right and left turn lanes are warranted at:
  - -Intersections with other Provincial Highways
  - -Industrial Access Roads
  - -Provincial Campgrounds and Picnic Sites
- Length of turning lane is related to speed. See SP 20618.
- For right turn lane on four-lane highways, advancing volume should be half of the directional volume with no further reduction for left turning vehicles.
- Use the corrected peak hour volumes (vph) projected to the 10th year after construction. See SKS 2.3.1-C (formerly DM 502-3) for correction factors.

Saskatchewan Ministry of Highways and Infrastructure
Warrants for Left Turn Lanes - 4 Lane Rural Highways
Standard Plan STP 20610

Associated Engineering



	Calculated		Plotted	
	NB	SB	NB	SB
Left Turn Volume, V_L	4	9	4	9
Opposing Volume, V_O	584	861	584	861

Turning Lane Warrants
Worksheet for Four Lane Rural Highways

Highway:	**Highway 11**
Crossroad:	**Victor Road**
Scenario:	**2037 Background - AM Peak**

Highway Direction A:	**NB**	Usually WB or NB
Highway Direction B:	**SB**	Usually EB or SB
Truck Equivalency (E_T)	**1.7**	MHI Standard: 1.7

NB Data	NBL	NBT	NBR	NB Total
Hourly Vol (veh/h)	**3**	**612**	**3**	618
Truck %	**2.0%**	**14.0%**	**2.0%**	14%
Equiv Vol (pce/h)	3	672	3	678
Growth Factor	**1.27**	**1.27**	**1.27**	
Future Equiv Vol (pce/h)	4	853	4	861
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

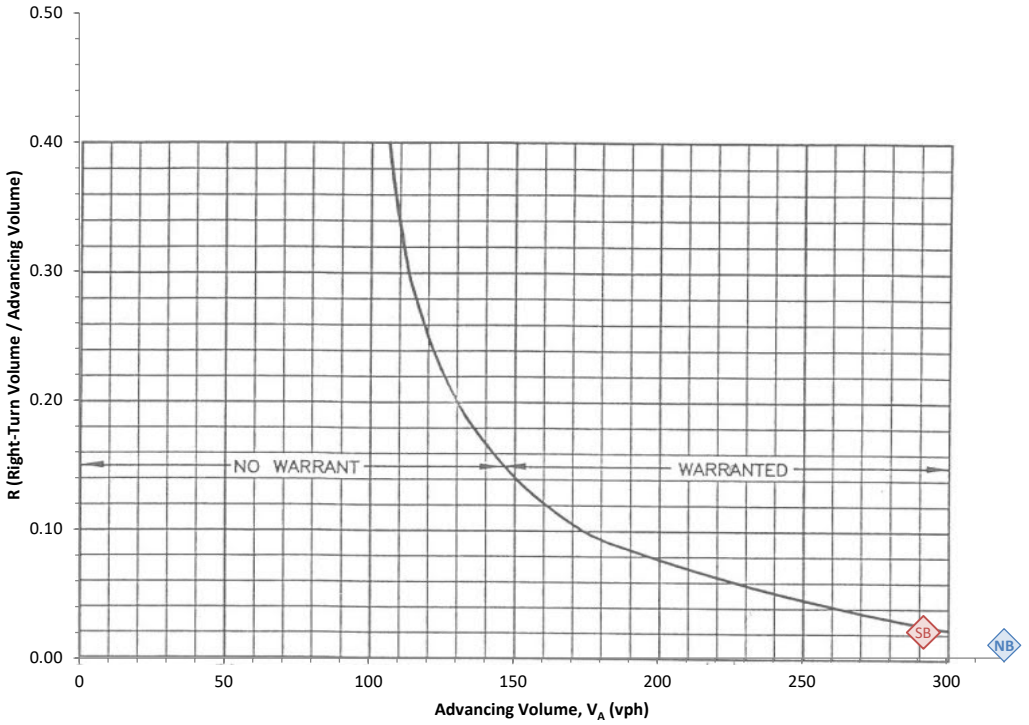
SB Data	SBL	SBT	SBR	SB Total
Hourly Vol. (veh/h)	**7**	**396**	**4**	407
Truck %	**2.0%**	**19.0%**	**2.0%**	19%
Equiv Vol (pce/h)	7	449	4	460
Growth Factor	**1.27**	**1.27**	**1.27**	
Future Equiv Vol (pce/h)	9	570	5	584
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

Notes:

- No warrant if the plotted point falls to the left of the applicable line
- Right and left turn lanes are warranted at:
  - -Intersections with other Provincial Highways
  - -Industrial Access Roads
  - -Provincial Campgrounds and Picnic Sites
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Saskatchewan Ministry of Highways and Infrastructure
Warrants for Right Turn Lanes - Rural Highways
Standard Plan 20614

Associated Engineering



	Calculated		Plotted	
	NB	SB	NB	SB
Advancing Volume, V_A	431	292	320	292
R (V_R / V_A)	0.01	0.02	0.01	0.02

Turning Lane Warrants
Worksheet for Four Lane Rural Highways

Highway:	**Highway 11**
Crossroad:	**Victor Road**
Scenario:	**2037 Background - PM Peak**

Highway Direction A:	**NB**	Usually WB or NB
Highway Direction B:	**SB**	Usually EB or SB
Truck Equivalency (E_T)	**1.7**	MHI Standard: 1.7

NB Data	NBL	NBT	NBR	NB Total
Hourly Vol (veh/h)	**1**	**605**	**10**	616
Truck %	**2.0%**	**14.0%**	**2.0%**	14%
Equiv Vol (pce/h)	1	664	10	675
Growth Factor	**1.27**	**1.27**	**1.27**	
Future Equiv Vol (pce/h)	1	843	13	857
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

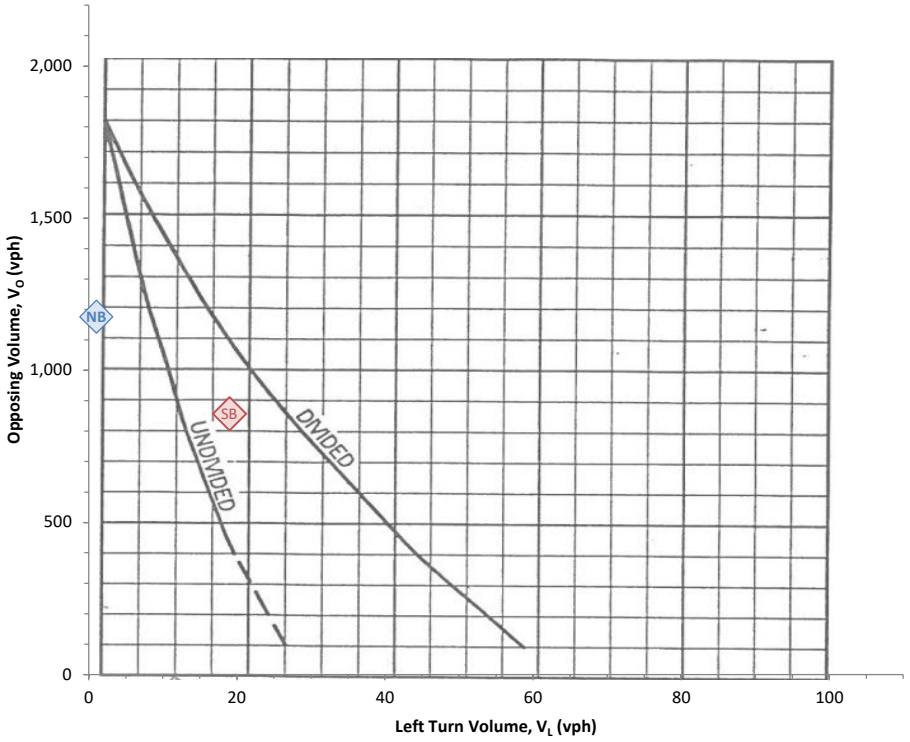
SB Data	SBL	SBT	SBR	SB Total
Hourly Vol. (veh/h)	**15**	**795**	**10**	820
Truck %	**2.0%**	**19.0%**	**2.0%**	18%
Equiv Vol (pce/h)	15	901	10	926
Growth Factor	**1.27**	**1.27**	**1.27**	
Future Equiv Vol (pce/h)	19	1144	13	1176
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

Notes:

- No warrant if the plotted point falls to the left of the applicable line
- Right and left turn lanes are warranted at:
  - -Intersections with other Provincial Highways
  - -Industrial Access Roads
  - -Provincial Campgrounds and Picnic Sites
- Length of turning lane is related to speed. See SP 20618.
- For right turn lane on four-lane highways, advancing volume should be half of the directional volume with no further reduction for left turning vehicles.
- Use the corrected peak hour volumes (vph) projected to the 10th year after construction. See SKS 2.3.1-C (formerly DM 502-3) for correction factors.

Saskatchewan Ministry of Highways and Infrastructure
Warrants for Left Turn Lanes - 4 Lane Rural Highways
Standard Plan STP 20610

Associated Engineering



	Calculated		Plotted	
	NB	SB	NB	SB
Left Turn Volume, V_L	1	19	1	19
Opposing Volume, V_O	1176	857	1176	857

Turning Lane Warrants
Worksheet for Four Lane Rural Highways

Highway:	**Highway 11**
Crossroad:	**Victor Road**
Scenario:	**2037 Background - PM Peak**

Highway Direction A:	**NB**	Usually WB or NB
Highway Direction B:	**SB**	Usually EB or SB
Truck Equivalency (E_T)	**1.7**	MHI Standard: 1.7

NB Data	NBL	NBT	NBR	NB Total
Hourly Vol (veh/h)	**1**	**605**	**10**	616
Truck %	**2.0%**	**14.0%**	**2.0%**	14%
Equiv Vol (pce/h)	1	664	10	675
Growth Factor	**1.27**	**1.27**	**1.27**	
Future Equiv Vol (pce/h)	1	843	13	857
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

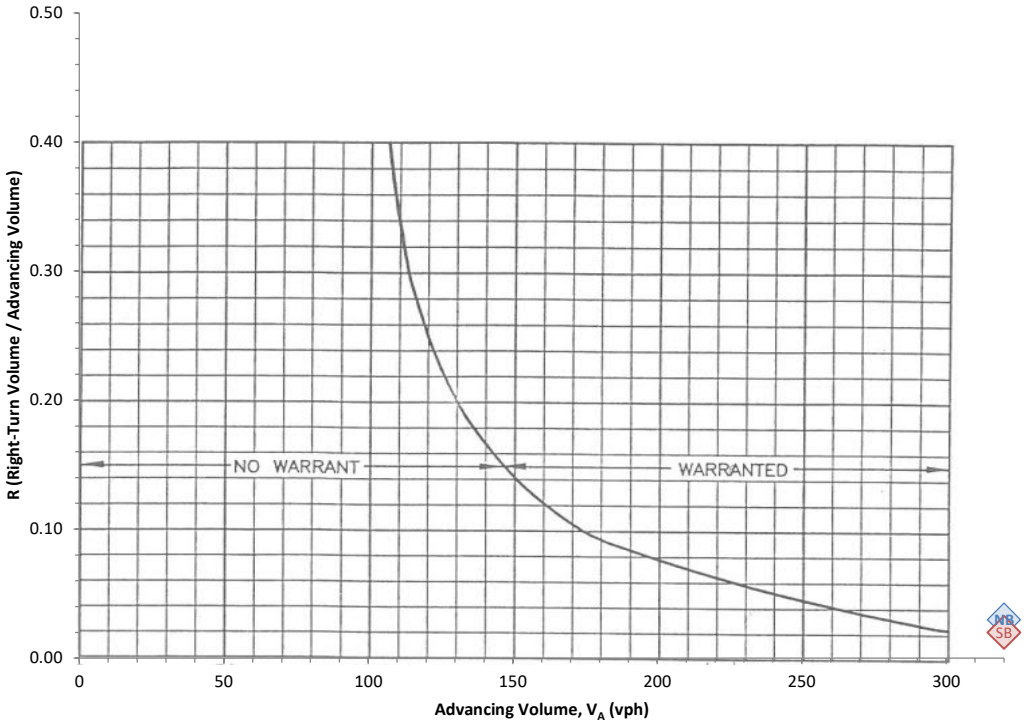
SB Data	SBL	SBT	SBR	SB Total
Hourly Vol. (veh/h)	**15**	**795**	**10**	820
Truck %	**2.0%**	**19.0%**	**2.0%**	18%
Equiv Vol (pce/h)	15	901	10	926
Growth Factor	**1.27**	**1.27**	**1.27**	
Future Equiv Vol (pce/h)	19	1144	13	1176
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

Notes:

- No warrant if the plotted point falls to the left of the applicable line
- Right and left turn lanes are warranted at:
  - -Intersections with other Provincial Highways
  - -Industrial Access Roads
  - -Provincial Campgrounds and Picnic Sites
- Length of turning lane is related to speed. See SP 20618.
- For right turn lane on four-lane highways, advancing volume should be half of the directional volume with no further reduction for left turning vehicles.
- Use the corrected peak hour volumes (vph) projected to the 10th year after construction. See SKS 2.3.1-C (formerly DM 502-3) for correction factors.

Saskatchewan Ministry of Highways and Infrastructure
Warrants for Right Turn Lanes - Rural Highways
Standard Plan 20614

Associated Engineering



	Calculated		Plotted	
	NB	SB	NB	SB
Advancing Volume, V_A	429	588	320	320
R (V_R / V_A)	0.03	0.02	0.03	0.02

Turning Lane Warrants
Worksheet for Four Lane Rural Highways

Highway:	**Highway 11**
Crossroad:	**Victor Road**
Scenario:	**Full Buildout - AM Peak**

Highway Direction A:	**NB**	Usually WB or NB
Highway Direction B:	**SB**	Usually EB or SB
Truck Equivalency (E_T)	**1.7**	MHI Standard: 1.7

NB Data	NBL	NBT	NBR	NB Total
Hourly Vol (veh/h)	**9**	**611**	**3**	623
Truck %	**2.0%**	**14.0%**	**2.0%**	14%
Equiv Vol (pce/h)	9	671	3	683
Growth Factor	**1.27**	**1.27**	**1.27**	
Future Equiv Vol (pce/h)	11	852	4	867
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

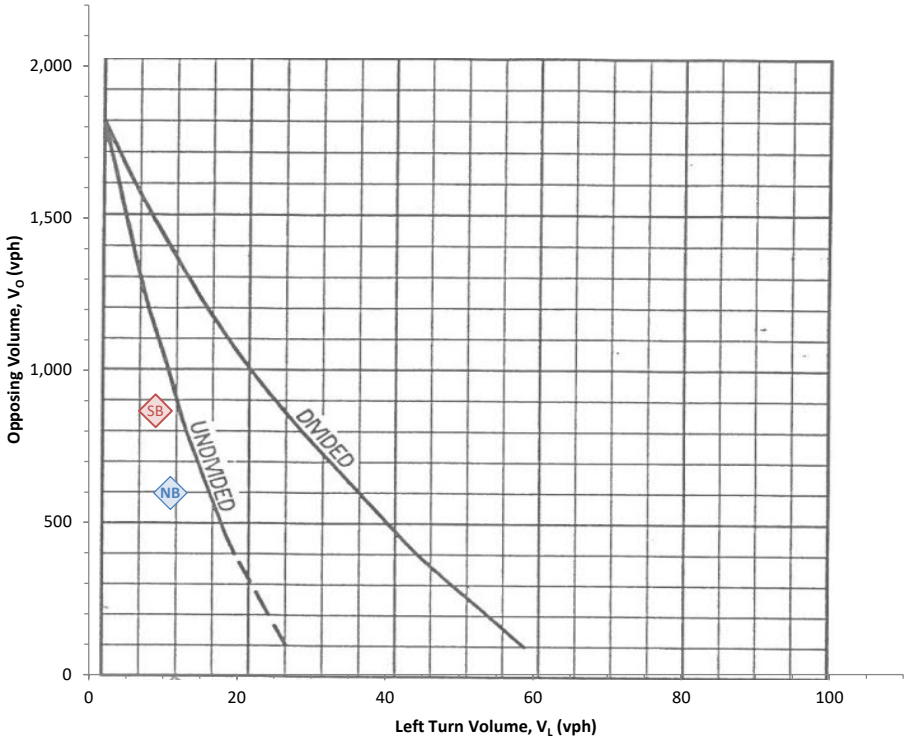
SB Data	SBL	SBT	SBR	SB Total
Hourly Vol. (veh/h)	**7**	**396**	**14**	417
Truck %	**2.0%**	**19.0%**	**2.0%**	18%
Equiv Vol (pce/h)	7	449	14	470
Growth Factor	**1.27**	**1.27**	**1.27**	
Future Equiv Vol (pce/h)	9	570	18	597
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

Notes:

- No warrant if the plotted point falls to the left of the applicable line
- Right and left turn lanes are warranted at:
  - -Intersections with other Provincial Highways
  - -Industrial Access Roads
  - -Provincial Campgrounds and Picnic Sites
- Length of turning lane is related to speed. See SP 20618.
- For right turn lane on four-lane highways, advancing volume should be half of the directional volume with no further reduction for left turning vehicles.
- Use the corrected peak hour volumes (vph) projected to the 10th year after construction. See SKS 2.3.1-C (formerly DM 502-3) for correction factors.

Saskatchewan Ministry of Highways and Infrastructure
Warrants for Left Turn Lanes - 4 Lane Rural Highways
Standard Plan STP 20610

Associated Engineering



	Calculated		Plotted	
	NB	SB	NB	SB
Left Turn Volume, V_L	11	9	11	9
Opposing Volume, V_O	597	867	597	867

Turning Lane Warrants
Worksheet for Four Lane Rural Highways

Highway:	**Highway 11**
Crossroad:	**Victor Road**
Scenario:	**Full Buildout - AM Peak**

Highway Direction A:	**NB**	Usually WB or NB
Highway Direction B:	**SB**	Usually EB or SB
Truck Equivalency (E_T)	**1.7**	MHI Standard: 1.7

NB Data	NBL	NBT	NBR	NB Total
Hourly Vol (veh/h)	**9**	**611**	**3**	623
Truck %	**2.0%**	**14.0%**	**2.0%**	14%
Equiv Vol (pce/h)	9	671	3	683
Growth Factor	**1.27**	**1.27**	**1.27**	
Future Equiv Vol (pce/h)	11	852	4	867
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

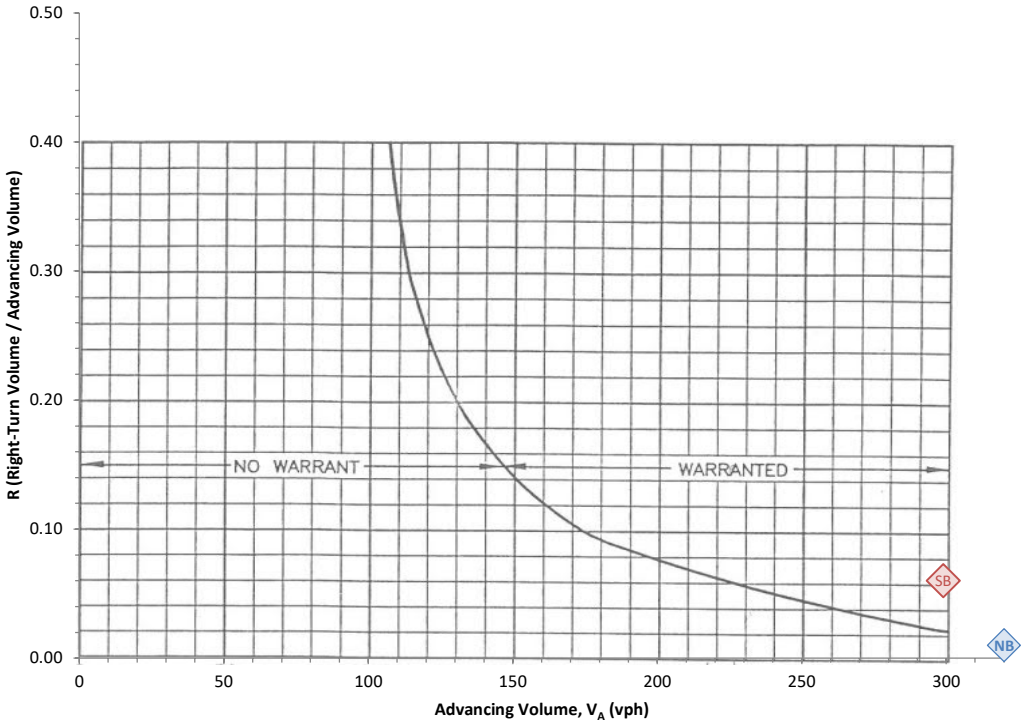
SB Data	SBL	SBT	SBR	SB Total
Hourly Vol. (veh/h)	**7**	**396**	**14**	417
Truck %	**2.0%**	**19.0%**	**2.0%**	18%
Equiv Vol (pce/h)	7	449	14	470
Growth Factor	**1.27**	**1.27**	**1.27**	
Future Equiv Vol (pce/h)	9	570	18	597
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

Notes:

- No warrant if the plotted point falls to the left of the applicable line
- Right and left turn lanes are warranted at:
  - -Intersections with other Provincial Highways
  - -Industrial Access Roads
  - -Provincial Campgrounds and Picnic Sites
- Length of turning lane is related to speed. See SP 20618.
- For right turn lane on four-lane highways, advancing volume should be half of the directional volume with no further reduction for left turning vehicles.
- Use the corrected peak hour volumes (vph) projected to the 10th year after construction. See SKS 2.3.1-C (formerly DM 502-3) for correction factors.

Saskatchewan Ministry of Highways and Infrastructure
Warrants for Right Turn Lanes - Rural Highways
Standard Plan 20614

Associated Engineering



	Calculated		Plotted	
	NB	SB	NB	SB
Advancing Volume, V_A	434	299	320	299
R (V_R / V_A)	0.01	0.06	0.01	0.06

Turning Lane Warrants
Worksheet for Four Lane Rural Highways

Highway:	**Highway 11**
Crossroad:	**Victor Road**
Scenario:	**Full Buildout - PM Peak**

Highway Direction A:	**NB**	Usually WB or NB
Highway Direction B:	**SB**	Usually EB or SB
Truck Equivalency (E_T)	**1.7**	MHI Standard: 1.7

NB Data	NBL	NBT	NBR	NB Total
Hourly Vol (veh/h)	**1**	**601**	**10**	612
Truck %	**2.0%**	**14.0%**	**2.0%**	14%
Equiv Vol (pce/h)	1	660	10	671
Growth Factor	**1.27**	**1.27**	**1.27**	
Future Equiv Vol (pce/h)	1	838	13	852
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

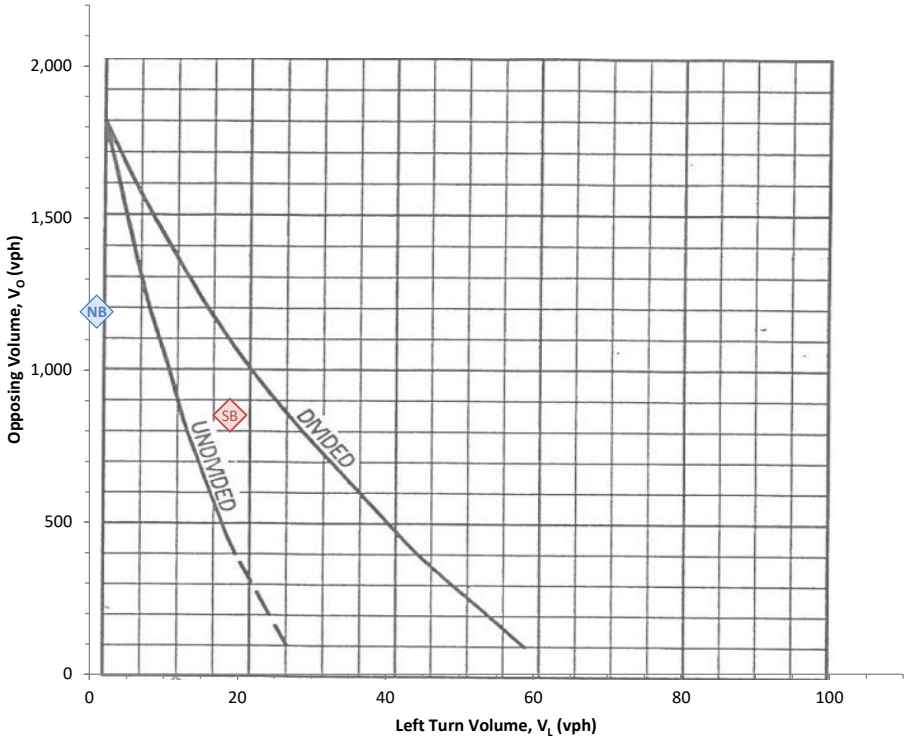
SB Data	SBL	SBT	SBR	SB Total
Hourly Vol. (veh/h)	**15**	**795**	**23**	833
Truck %	**2.0%**	**19.0%**	**2.0%**	18%
Equiv Vol (pce/h)	15	901	23	939
Growth Factor	**1.27**	**1.27**	**1.27**	
Future Equiv Vol (pce/h)	19	1144	29	1192
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

Notes:

- No warrant if the plotted point falls to the left of the applicable line
- Right and left turn lanes are warranted at:
  - -Intersections with other Provincial Highways
  - -Industrial Access Roads
  - -Provincial Campgrounds and Picnic Sites
- Length of turning lane is related to speed. See SP 20618.
- For right turn lane on four-lane highways, advancing volume should be half of the directional volume with no further reduction for left turning vehicles.
- Use the corrected peak hour volumes (vph) projected to the 10th year after construction. See SKS 2.3.1-C (formerly DM 502-3) for correction factors.

Saskatchewan Ministry of Highways and Infrastructure
Warrants for Left Turn Lanes - 4 Lane Rural Highways
Standard Plan STP 20610

Associated Engineering



	Calculated		Plotted	
	NB	SB	NB	SB
Left Turn Volume, V_L	1	19	1	19
Opposing Volume, V_O	1192	852	1192	852

Turning Lane Warrants
Worksheet for Four Lane Rural Highways

Highway:	**Highway 11**
Crossroad:	**Victor Road**
Scenario:	**Full Buildout - PM Peak**

Highway Direction A:	**NB**	Usually WB or NB
Highway Direction B:	**SB**	Usually EB or SB
Truck Equivalency (E_T)	**1.7**	MHI Standard: 1.7

NB Data	NBL	NBT	NBR	NB Total
Hourly Vol (veh/h)	**1**	**601**	**10**	612
Truck %	**2.0%**	**14.0%**	**2.0%**	14%
Equiv Vol (pce/h)	1	660	10	671
Growth Factor	**1.27**	**1.27**	**1.27**	
Future Equiv Vol (pce/h)	1	838	13	852
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

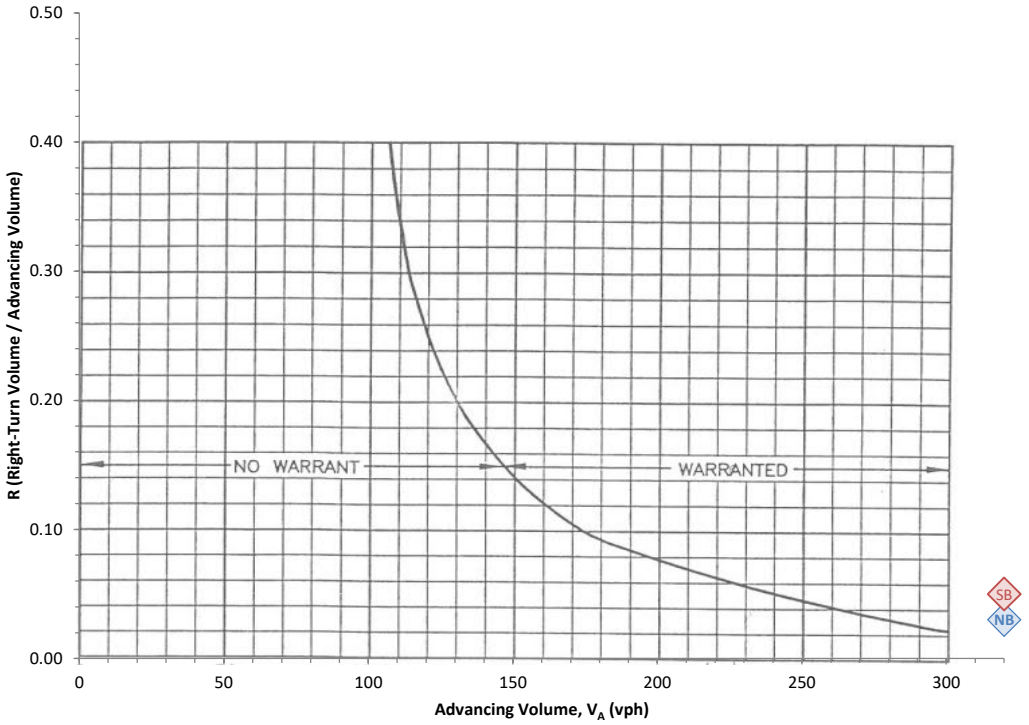
SB Data	SBL	SBT	SBR	SB Total
Hourly Vol. (veh/h)	**15**	**795**	**23**	833
Truck %	**2.0%**	**19.0%**	**2.0%**	18%
Equiv Vol (pce/h)	15	901	23	939
Growth Factor	**1.27**	**1.27**	**1.27**	
Future Equiv Vol (pce/h)	19	1144	29	1192
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

Notes:

- No warrant if the plotted point falls to the left of the applicable line
- Right and left turn lanes are warranted at:
  - -Intersections with other Provincial Highways
  - -Industrial Access Roads
  - -Provincial Campgrounds and Picnic Sites
- Length of turning lane is related to speed. See SP 20618.
- For right turn lane on four-lane highways, advancing volume should be half of the directional volume with no further reduction for left turning vehicles.
- Use the corrected peak hour volumes (vph) projected to the 10th year after construction. See SKS 2.3.1-C (formerly DM 502-3) for correction factors.

Saskatchewan Ministry of Highways and Infrastructure
Warrants for Right Turn Lanes - Rural Highways
Standard Plan 20614

Associated Engineering



	Calculated		Plotted	
	NB	SB	NB	SB
Advancing Volume, V_A	426	596	320	320
R (V_R / V_A)	0.03	0.05	0.03	0.05

Warrants for Intersection Lighting

MHI Design Manual 2621-01

Intersection Description	**Highway 11 and Baker Road - 2037 Background Traffic**			
Through Highway	**Highway No. 11**	Highway Class	Major Arterial	5
Minor Leg 1	**Baker Road**	Road Type	Other All-Season Road (AADT >150)	OK
Minor Leg 2	**Baker Road**	Road Type	Other All-Season Road (AADT >150)	OK

☐ Intersection is skewed (<70° or >110°)	0	Night Collision Rate	**0.0** crash/year	0

Other Nearby Lighting		Traffic Volumes		
None	0	On Through Highway	**17200** AADT	25
☐ Urban street light within 25 m of Minor Leg 1	OK	On Minor Leg 1	**1600** AADT	80
☐ Urban street light within 25 m of Minor Leg 2	OK	On Minor Leg 2	**450** AADT	23

Existing Intersection Channelization		Intersection Road Surface Visible from…		
☑ On Through Highway	5	On Through Highway	> 370 m	0
☐ On Minor Leg 1	0	On Minor Leg 1	> 180 m	0
☐ On Minor Leg 2	0	On Minor Leg 2	> 180 m	0

Divided Roadway		Proximity to Horizontal Curves		
☑ On Through Highway	5	On Through Highway	> 100 m	0
☐ On Minor Leg 1	0	On Minor Leg 1	> 60 m	0
☐ On Minor Leg 2	0	On Minor Leg 2	> 60 m	0

Hospital Access Routes		Obstructed Sight Triangles		
☐ Minor Leg 1	0	On Minor Leg 1	None	0
☐ Minor Leg 2	0	On Minor Leg 2	None	0

Notes:

1. Delineation lighting has no minimum warrant score. Lights are warranted for the following cases:
   - All Provincial Highway intersections
   - All designated Community Access roads (Control Section 40-series)
   - All roads where AADT>150
   - All seasonal/recreational roads where SADT>250
   - Never when an urban streetlight is within 25m
2. For Night Collision Rate use the average annual night time intersection collisions over the last 3 years
3. For sight distances use eye height of 1.15m and object height at the road surface

	Result	Score
Leg 1 Delineation	**Warranted**	**120**
Leg 2 Delineation	**Warranted**	**63**
Intersection Area	**Warranted**	**N/A**

Warrants for Intersection Lighting

MHI Design Manual 2621-01

Intersection Description	**Highway 11 and Baker Road - 2037 Full Build Out**

Through Highway	**Highway No. 11**	Highway Class	Major Arterial	5
Minor Leg 1	**Baker Road**	Road Type	Other All-Season Road (AADT >150)	OK
Minor Leg 2	**Baker Road**	Road Type	Other All-Season Road (AADT >150)	OK

☐ Intersection is skewed (<70° or >110°)	0	Night Collision Rate	**0.0** crash/year	0

Other Nearby Lighting		Traffic Volumes		
None	0	On Through Highway	**17200** AADT	25
☐ Urban street light within 25 m of Minor Leg 1	OK	On Minor Leg 1	**2200** AADT	110
☐ Urban street light within 25 m of Minor Leg 2	OK	On Minor Leg 2	**450** AADT	23

Existing Intersection Channelization		Intersection Road Surface Visible from…		
☑ On Through Highway	5	On Through Highway	> 370 m	0
☐ On Minor Leg 1	0	On Minor Leg 1	> 180 m	0
☐ On Minor Leg 2	0	On Minor Leg 2	> 180 m	0

Divided Roadway		Proximity to Horizontal Curves		
☑ On Through Highway	5	On Through Highway	> 100 m	0
☐ On Minor Leg 1	0	On Minor Leg 1	> 60 m	0
☐ On Minor Leg 2	0	On Minor Leg 2	> 60 m	0

Hospital Access Routes		Obstructed Sight Triangles		
☐ Minor Leg 1	0	On Minor Leg 1	None	0
☐ Minor Leg 2	0	On Minor Leg 2	None	0

Notes:

1. Delineation lighting has no minimum warrant score. Lights are warranted for the following cases:
   - All Provincial Highway intersections
   - All designated Community Access roads (Control Section 40-series)
   - All roads where AADT>150
   - All seasonal/recreational roads where SADT>250
   - Never when an urban streetlight is within 25m
2. For Night Collision Rate use the average annual night time intersection collisions over the last 3 years
3. For sight distances use eye height of 1.15m and object height at the road surface

	Result	Score
Leg 1 Delineation	**Warranted**	**150**
Leg 2 Delineation	**Warranted**	**63**
Intersection Area	**Warranted**	**N/A**

Warrants for Intersection Lighting

MHI Design Manual 2621-01

Intersection Description	**Highway No. 11 and Victor Road - 2037 Background Traffic**			
Through Highway	**Highway No. 11**	Highway Class	Major Arterial	5
Minor Leg 1	**Victor Road**	Road Type	Other All-Season Road (AADT >150)	OK
Minor Leg 2	**Victor Road**	Road Type	Other All-Season Road (AADT >150)	OK

☐ Intersection is skewed (<70° or >110°)	0	Night Collision Rate	**0.0** crash/year	0

Other Nearby Lighting		Traffic Volumes		
None	0	On Through Highway	**16400** AADT	25
☐ Urban street light within 25 m of Minor Leg 1	OK	On Minor Leg 1	**400** AADT	20
☐ Urban street light within 25 m of Minor Leg 2	OK	On Minor Leg 2	**550** AADT	28

Existing Intersection Channelization		Intersection Road Surface Visible from…		
☑ On Through Highway	5	On Through Highway	> 370 m	0
☐ On Minor Leg 1	0	On Minor Leg 1	> 180 m	0
☐ On Minor Leg 2	0	On Minor Leg 2	> 180 m	0

Divided Roadway		Proximity to Horizontal Curves		
☑ On Through Highway	5	On Through Highway	> 100 m	0
☐ On Minor Leg 1	0	On Minor Leg 1	> 60 m	0
☐ On Minor Leg 2	0	On Minor Leg 2	> 60 m	0

Hospital Access Routes		Obstructed Sight Triangles		
☐ Minor Leg 1	0	On Minor Leg 1	None	0
☐ Minor Leg 2	0	On Minor Leg 2	None	0

Notes:

1. Delineation lighting has no minimum warrant score. Lights are warranted for the following cases:
   - All Provincial Highway intersections
   - All designated Community Access roads (Control Section 40-series)
   - All roads where AADT>150
   - All seasonal/recreational roads where SADT>250
   - Never when an urban streetlight is within 25m
2. For Night Collision Rate use the average annual night time intersection collisions over the last 3 years
3. For sight distances use eye height of 1.15m and object height at the road surface

	Result	Score
Leg 1 Delineation	**Warranted**	**60**
Leg 2 Delineation	**Warranted**	**68**
Intersection Area	**Not Warranted**	**N/A**

Appendix F - Hydrogeological Report

HYDROGEOLOGICAL INVESTIGATION

PROPOSED GREENVIEW ESTATES SUBDIVISION
SE-24-35-5-W3M AND NE-13-35-5-W3M
NEAR SASKATOON, SASKATCHEWAN
PMEL FILE NO. 17788
MAY 4, 2022



PREPARED FOR:
Oja Holdings Ltd.

ATTENTION: Mr. Jonathon Abrametz, President

PRIVILEGED AND CONFIDENTIAL

P.MACHIBRODA ENGINEERING LTD.
DOWN TO EARTH SOLUTIONS

P.MACHIBRODA ENGINEERING LTD.

PROJECT: Hydrogeological Investigation
Proposed Greenview Estates Subdivision
SE-24-35-5-W3M and NE-13-35-5-W3M
Near Saskatoon, Saskatchewan
PMEL File No. 17788
May 4, 2022

PREPARED FOR: Oja Holdings Ltd.
321 – 6th Avenue North
Saskatoon, Saskatchewan
S7K 2S3

ATTENTION: Mr. Jonathon Abrametz, President

DISTRIBUTION: Oja Holdings Ltd. – Digital Copy
P. Machibroda Engineering Ltd. – One Copy

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www.machibroda.com

EXECUTIVE SUMMARY

The following report presents the results of a hydrogeological investigation conducted by P. Machibroda Engineering Ltd. (PMEL) for a proposed Greenview Estates rural subdivision (i.e., study site) to be located in the Rural Municipality (RM) of Corman Park No. 344, Saskatchewan, on the properties legally described as:

- The southeast quarter of Section 24, Township 35, Range 05, West of the 3rd Meridian (SE-24-35-05-W3M).
- The northeast quarter of Section 13, Township 35, Range 05, West of the 3rd Meridian (NE-13-35-05-W3M).

The terms of reference for this investigation were presented in PMEL Proposal No. 17789, dated March 9, 2021. Written authorization to proceed with this investigation was provided in the signed Consulting Agreement between Oja Holdings Ltd. and PMEL, dated March 26, 2021.

This report was completed to assist with the application for the proposed Greenview Estates rural subdivision which includes residential and commercial development. It is reported that:

- The proposed subdivision will use onsite wastewater treatment systems (OWTS) to manage and treat sewage; and
- Potable water will be supplied to the study site using a piped distribution network.

The results of a geotechnical investigation, conducted concurrently by PMEL at the site with this hydrogeological investigation are presented in the following report:

- Geotechnical Investigation, Proposed Greenview Estates Rural Subdivision, SE-24-35-5-W3M and NE-13-35-5-W3M, South of Saskatoon, Saskatchewan, PMEL File No. 17789, May 17, 2021. Prepared for Oja Holdings Ltd. (PMEL, 2021).

Where applicable, information presented in the geotechnical report will be included in this report.

The objectives of this hydrogeological investigation were to determine:

- If aquifers (if any), proximate the proposed subdivision, are considered hydrogeologically isolated from sewage effluent;
- The sensitivity of the proposed subdivision in accordance with the Saskatchewan Onsite Wastewater Disposal Guide (GOS, 2018);
- If sewage effluent will degrade the groundwater quality of shallow aquifers proximate the proposed subdivision to an unacceptable level; and
- If the proposed subdivision is suitable for successful long-term utilization of OWTS.

SUMMARY OF RESULTS

OWTS SUITABILITY

Based on the results of this assessment the study site is amenable to the use of OWTS's for management/treatment of sanitary waste generated at the site. However, based on the results of the cumulative nitrate assessment, conducted as part of this hydrogeological investigation, advanced package treatment systems (i.e., treatment plant coupled with a standard soil treatment system) will be required to ensure that the effluent quality entering the receiving environment will not adversely impact downstream groundwater users and/or the environment.

DRAINFIELD/OWTS TYPES

Based on the results of this investigation, one or more of the following soil treatment systems/OWTS types were determined to be suitable based on the soil and hydrogeological conditions at the site:

- Holding Tanks
- Type II Mounds
- Chamber Systems
- Absorption Field System

In accordance with the Government of Saskatchewan Onsite Wastewater Disposal Guide (GOS, 2018), the following OWTS are not considered to be suitable for use at the site:

- Lagoons are not acceptable as all the lots are smaller than 4 hectares.
- Jets and Type 1 mounds are not acceptable as the proposed subdivision is high density and is considered a sensitive area.

Two (2) types of advanced package treatment systems will be required at the site to ensure protection of downgradient groundwater users and/or the environment:

- **Lots where the OWTS would be constructed within 220 m of the property boundary:** an advanced package treatment system meeting or exceeding NSF-40, NSF245, and NSF-350 standards (i.e., Bio-Microbics BioBarrier-N MBR or equivalent) with an average effluent nitrate concentration of less than or equal to 9 mg/L.
- **Lots where the OWTS would be constructed greater than 220 m from the property boundary:** an advanced package treatment system meeting or exceeding NSF-40 and NSF-245 standards (i.e., Ecoflo Coco Filter ECDn Model or equivalent) with an average effluent nitrate concentration of less than or equal to 19 mg/L.

The type of drainfield selected for any individual lot will be based on the soil and hydrogeological conditions encountered at the location where the system is to be installed.

Based on the results of this assessment there appears to be adequate area (including reserve area) with suitable soil and hydrogeological conditions for the construction of an OWTS on each of the proposed lots. Therefore, specific locations for OWTS placement, or reserve areas, were not specified as part of this investigation. This is preferable as it provides the future landowner with some degree of design and architectural flexibility.

Soil Consistency

Based on the results of this assessment, the surficial soils (i.e., upper 2.0 m) at the site were generally classified as silt loam, loam, sandy loam and/or loamy sand. As such there are sufficient areas across the site where the soil consistency is suitable for one or more of the soil treatment systems specified above.

Vertical Separation Distance (Vadose Zone)

GOS (2018) recommends that a minimum vadose zone, from the bottom of the infiltrative surfaces (i.e., bottom of dispersal trench) to the surface of the water table or restrictive layer be a depth of 1.5 m for primary effluent and 0.9 m for secondary treated effluent.

The depth to groundwater on May 5, 2021, ranged from approximately 1.4 to 5.7 m (average of 2.8 m) below existing grade (elevation of 505.1 to 506.6 m). A review of the required vadose zone depth results for the soil samples collected at the site is provided below:

- The required vadose zone depths for the soils at the site range from 0.2 to 10.4 m based on the range of hydraulic conductivity values.
- Out of 9 calculated required vadose zone depths, 3 calculated values were less than the minimum separation distance of 1.5 m and would provide sufficient vadose zone retention time to effectively remove pathogens from OTWS effluent.

The areas where the required vadose zone depth exceeded the minimum recommended values were areas with a higher content of sand. Most of the calculated vadose zone depths, that would be required to achieve the recommended pathogen removal rate (60 day retention time) based on the measured hydraulic conductivity values, were less than the minimum vadose zone depth (1.5 m) required by GOS (2018). Since each OWTS will require some level of advanced treatment the OWTS effluent is classified as secondary treated effluent. As such, the required vertical separation can be reduced from 1.5 to 0.9 m below the infiltration surface. Type II Mounts should be used for drainfield located in higher groundwater table areas.

Topographic Constraints

From field observations and a review of information provided in the Conceptual Drainage Summary Report (AE, 2022), there are no topographic features (i.e., cuts, banks, slopes, landscaping, etc.) that would make any lot unsuitable for the construction of an OWTS.

As the site is naturally rolling and is not intended to have any significant cuts, slopes, or banks there does not appear to be any slope stability concerns related to the construction of an OWTS anywhere on the site. OWTS systems should not be constructed within natural surface water drainage pathways and/or in close proximity to natural or manmade stormwater catchment ponds.

INDICATIONS OF WET/POOR SOIL CONDITIONS

Based on observations made during the field investigation, low lying areas or several wetlands/sloughs are present onsite. Those areas where wet/poor soils conditions exist are not suitable for use as OWTS. It is recommended that if OWTS are required to be constructed on those areas, further soil testing and site development will be required prior to constructing the OWTS.

RECOMMENDATIONS

- It is recommended that the type of advanced treatment system required for each lot be specified in each purchase agreement.
- Prior to receiving approval of the building permit, a detailed soils assessment should be conducted for each individual lot to confirm the soil and groundwater conditions for selection and design of an appropriate soil treatment system. The detailed soils assessment and system installation should be conducted by a certified septic system contractor or qualified professional. As outlined by GOS (2018), details regarding system operation and maintenance must be supplied to the homeowner by the permit applicant.
- System maintenance should be conducted by a certified septic system contractor and conducted at the frequency recommend by the system manufacturer.

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1 INTRODUCTION

The following report presents the results of a hydrogeological investigation conducted by P. Machibroda Engineering Ltd. (PMEL) for a proposed Greenview Estates rural subdivision (i.e., study site) to be located in the Rural Municipality (RM) of Corman Park No. 344, Saskatchewan, on the properties legally described as:

- The southeast quarter of Section 24, Township 35, Range 05, West of the 3rd Meridian (SE-24-35-05-W3M).
- The northeast quarter of Section 13, Township 35, Range 05, West of the 3rd Meridian (NE-13-35-05-W3M).

The terms of reference for this investigation were presented in PMEL Proposal No. 17789, dated March 9, 2021. Written authorization to proceed with this investigation was provided in the signed Consulting Agreement between Oja Holdings Ltd. and PMEL, dated March 26, 2021.

This report was completed to assist with the application for the proposed Greenview Estates rural subdivision which includes residential and commercial development. It is reported that:

- The proposed subdivision will use onsite wastewater treatment systems (OWTS) to manage and treat sewage; and
- Potable water will be supplied to the study site using a piped distribution network.

The results of a geotechnical investigation, conducted concurrently by PMEL at the site with this hydrogeological investigation are presented in the following report:

- Geotechnical Investigation, Proposed Greenview Estates Rural Subdivision, SE-24-35-5-W3M and NE-13-35-5-W3M, South of Saskatoon, Saskatchewan, PMEL File No. 17789, May 17, 2021. Prepared for Oja Holdings Ltd. (PMEL, 2021).

Where applicable, information presented in the geotechnical report will be included in this report.

1.1 OBJECTIVES

The objectives of this hydrogeological investigation were to determine:

- If aquifers (if any), proximate the proposed subdivision, are considered hydrogeologically isolated from sewage effluent;
- The sensitivity of the proposed subdivision in accordance with the Saskatchewan Onsite Wastewater Disposal Guide (GOS, 2018);
- If sewage effluent will degrade the groundwater quality of shallow aquifers proximate the proposed subdivision to an unacceptable level; and
- If the proposed subdivision is suitable for successful long-term utilization of OWTS.

The Government of Saskatchewan (GOS, 2012) risk-based framework for subdivision OWTS assessment was utilized as a preliminary evaluation tool to determine the type of assessment (i.e., desktop and/or field study, etc.) and the level of assessment (Level 1 or Level 2) that would be required as part of the hydrogeological investigation for the proposed subdivision. The steps and outcome of this preliminary evaluation are provided in Section 2 of this report.

1.2 SCOPE OF WORK

The scope of work for the hydrogeological investigation was completed in general accordance with the following guidance documents:

- Government of Saskatchewan - Guidance document for developments and subdivision where onsite wastewater treatment systems are proposed (GOS, 2012).
- Government of Saskatchewan - Saskatchewan Onsite Wastewater Disposal Guide (GOS 2018).

The scope of work for this investigation included a desktop study, multiple field investigations, an OWTS feasibility assessment, and preparation of a summary report. The general scope of work that was conducted for each component of this investigation is outlined below.

Desktop Study

The following information was reviewed as part of the desktop study component of this investigation:

- Information provided by the client regarding the proposed subdivision. It is understood that the proposed subdivision will include both residential and commercial lots.
- Applicable regulations and guidelines provided by the RM of Corman Park no. 344, GOS, Saskatchewan Health Authority (SHA), or any other pertinent information.
- Regional geological and hydrogeological information for the site and surrounding area.
- Available information regarding groundwater use (private or municipal wells), surface water use, and other wastewater treatment systems (private or communal systems) in the vicinity of the site.
- Any other relevant background information that is applicable to this hydrogeological investigation or the proposed subdivision application.

Field Investigation

- Drilling of multiple boreholes for the purpose of characterizing the geological and hydrogeological conditions.
- Collection of representative soil samples for soil classification and index testing from boreholes drilled at the study site.

- Installation monitoring wells in each of the boreholes drilled at the study site for the purposes of groundwater monitoring and sampling.
- Measurement of the depth to the groundwater level in each of the monitoring wells at the site on multiple occasions.
- Conducting field hydraulic conductivity tests in select monitoring wells at the site to characterize the bulk hydraulic conductivity of the soils to determine:
    - The types of OWTS that are applicable based on the hydrogeological conditions at site; and
    - The flow and transport properties required for a nitrate assessment.
- Collection of representative groundwater samples from select monitoring wells at the site for laboratory analysis of select constituents that are indicative of water quality impacts resulting from typical OWTS. These samples were considered to represent baseline (background) concentrations of these indicator parameters.

Assessment and Reporting

- Evaluation of the overall suitability of the study site for the use of OWTS to manage sanitary septic waste generated at the study site considering soil and hydrogeological conditions.
- Completion of a cumulative nitrate assessment, using the information obtained from the desktop study and field investigations, to evaluate potential nitrate migration from OWTS to nearby receptors (i.e., water wells, surface water bodies, etc.).
- Preparation of a comprehensive report compiling the results of the desktop study, field investigations (conducted by PMEL), geotechnical investigation report (i.e., PMEL, 2021) and the study sites suitability for the using OWTS to manage and treat sewage generated at the study site.
- Provided recommendations regarding the overall suitability of the study site for using various types of OWTS, as well as general design and construction considerations for the proposed OWTS.

2 SUBDIVISION ASSESSMENT SCREENING

2.1 PROPOSED SUBDIVISION

The proposed subdivision is located on SE-24-35-5-W3M and NE-13-35-5-W3M along the west side of Highway 11 (except one commercial lot which is located east side of the highway). Once complete the proposed subdivision would consist of 96 residential lots and 4 commercial lots. The layout of the proposed subdivision is shown on the site Plan, Drawing No. 17788-1. Pertinent details of the proposed subdivision, that pertain to the hydrogeological investigation, are summarized in Table I.

It is understood that the proposed subdivision, which has an area of approximately 87.25 hectares (215.59 acres), will be subdivided into 100 lots on two quarter sections. As per GOS (2012), a subdivision is considered a high density area if:

- It contains 40 existing or proposed residential units or more on a quarter section; or
- The average land size associated with each or potential residential units is less than 1 hectare (2.5 acres).

As the proposed subdivision will consist of 100 lots in two quarter sections, the proposed subdivision is considered a high density area.

TABLE I SUMMARY OF SUBDIVISION DETAILS

Item	Notes
Subdivision Locations	Portion of SE-24-35-5-W3M and NE-13-35-5-W3M
Total Parcel Areas	87.25 hectares (215.59 acres)
Number of Proposed Residential Lots	96
Number of Proposed Commercial Lots	4
Current Landuse	Agricultural land
Surrounding Land Use	Residential houses and agricultural land
Minimum Residential Lot Size	0.22 hectare (0.53 acres)
Maximum Residential Lot Size	2.96 hectares (7.31 acres)
Average Residential Lot Size	0.79 hectares (1.94 acres)
Minimum Commercial Lot Size	1.77 hectares (4.37 acres)
Maximum Commercial Lot Size	4.99 hectares (12.32 acres)
Average Commercial Lot Size	2.96 hectares (7.32 acres)

2.2 ASSESSMENT INCLUSION SCREENING

In accordance with GOS (2012), the study site falls under Scenario A and a hydrogeological assessment is required based on the following:

- The average lot size per residential unit within the proposed subdivision (not including reserve area) will be less than 4 hectares (9.9 acres).
- After development is complete there will be more than nine (9) residential lots on the quarter section where the proposed development will be located or within 0.4 km of the proposed subdivisions.
- The proposed development does not meet the exemption criteria due to the following reasons:
    - The proposed subdivision will contain more than 16 residential lots on a quarter section;
    - The minimum size of the proposed lots will be less than 1 hectare (2.5 acres); and
    - The site is underlain by a surficial aquifer and as such is classified as a sensitive area and not hydrogeologically isolated from potential potable groundwater resources.

2.3 RISK BASED FRAMEWORK ASSESSMENT SCREENING

GOS (2012) risk-based framework was used to assist in determining the level of hydrogeological assessment required for the proposed subdivision. The response and justification for each step of the risk-based assessment framework is outlined in Table II. The relevant report sections are also outlined in Table II.

Based on the results of the screening process, it was determined that a Level 2 Assessment would be required. It was also recommended that a cumulative nitrate assessment be conducted based on the estimated probability of an OWTS system intercepting a potential downgradient water well and that the site is considered to be located in a sensitive area.

3 DESKTOP REVIEW – SITE CHARACTERIZATION

3.1 CURRENT SITE SETTING

The study site is located along the west side of Highway 11 (Louis Riel Trail), Prairie View Road and Range Road 3050. The site is currently being utilized as farmland (cultivated and/or pasture) with several treed areas and sloughs (wetlands). A shed and grain bin are located along the east side of the quarter section (i.e., NE-13-35-05-W3M). Intensive livestock operations (ILO) were formerly conducted along the south side of the study site.

3.2 SURROUNDING LAND USE

Surrounding land use in the vicinity of the site includes predominantly sparse residential (acreage), cultivated agricultural land, and individual farms/farmyards. The land use within 1.6 km of the proposed subdivision is summarized in Table III.

TABLE II SUMMARY OF RISK BASED FRAMEWORK DECISION PROCESS AND JUSTIFICATION

Item	Repsonse/Next Step	Justification	Report Section
Step 1 - Screen for inclusion criteria	Yes/Step 2	Proposed subdivision falls into Scenario A	2.2
Step 2 - Desktop review and field program	Yes/Step 3	Desktop review and field program was conducted for the site.	3.0
Step 3 - Isolate from supply aquifer	No/Step 4	Based on the information reviewed, the site is underlain by a large surficial aquifer and therefore is not hydrogeologically isolated from a potable groundwater resource.	3.3.4 and 3.8.7
Step 4 - Sufficient (vadose zone) retention time	Yes/Step 5	There appears to be an area of each lot where there would be sufficient vadose zone retention time.	6.4
Step 5 - Prepare assessment report	Yes/Step 6	Based on the proposed number of lots, the site is classified as high density and a Level 2 Assessment is required.	2.1
Step 6 - >90% chance of intersecting a plume	Yes/Step 6a	The probability of an OWTS plume intersecting a potable groundwater well revealed that the probaility of this occuring is over 90%, considering the groundwater flow direction towards the southeast.	5.1.2
Step 6a - Complete a Cumulative Nitrate Assessment	Yes/Step 7a	A cumulative nitrate assessment was completed.	5.4 and 5.5
Step 7a - Predict nitrate concentrations in downgradient wells	Yes/Step 7b	The predicted nitrate concentration generated from the proposed OWTS, was determined to be approximately 16.7 mg/L at the property boundary if conventional OWTS would be constructed on each lot. This assessment was redone assuming that advanced package treatment systems would be installed on each lot. Nitrate concentrations at the property boundary were determined to be less than potable drinking water limits (10 mg/L).	5.4.7 and 5.4.8
Step 7b - Determine if nitrate concentrations >10 mg/L in downgradient wells	No/Seek Subdivision Approval	Advanced package treatment systems would be required for each lot and the average nitrate concentration across the site was less than 10 mg/L.	5.4.8

TABLE III SUMMARY OF LAND USE ADJACENT TO PROPOSED SUBDIVISION

Direction	Land Use	Distance From Proposed Subdivision Property Boundary (m)
North	Cultivated agricultural land Cultivated agricultural land and individual farmyards	Adjacent 0.8 to >1.6 km
Northeast	Cultivated agricultural land Cultivated agricultural land and individual farmyards	Adjacent 0.8 to >1.6 km
East	Cultivated agricultural land and individual farmyards	Adjacent to >1.6 km
Southeast	Cultivated agricultural land and individual farmyards	Adjacent to >1.6 km
South	Cultivated agricultural land Cultivated agricultural land and individual farmyards	Adjacent 0.8 to >1.6 km
Southwest	Cultivated agricultural land Cultivated agricultural land and individual farmyards	Adjacent 0.8 to >1.6 km
West	Cultivated agricultural land Casa Rio East Subdivision, Cultivated agricultural land and sparse residential Casa Rio East Subdivision - Low density residential subdivision	Adjacent 0.8 to 1.6 km >1.6 km
Northwest	Cultivated agricultural land Casa Rio East and South Point Subdivisions, Cultivated agricultural land and sparse residential	Adjacent 0.8 to >1.6 km

3.3 REGIONAL SETTING

3.3.1 TOPOGRAPHY AND DRAINAGE

A review of satellite imagery (Google, 2022) revealed the following:

- The ground surface at the study site appears to be flat to gently undulating. Ground surface elevations range from approximately 512 metres above sea level (masl), west of the site, to approximately 507 masl, east of the site.
- Locally, the average downward ground surface slope, towards the southeast of the study site, ranges from approximately 0.005 to 0.009 m/m (0.5 to 0.9%).
- Regionally, the ground surface slopes gradually downward towards the South Saskatchewan River (approximate elevation 477 masl) located at its nearest point approximately 8 km to the west.

3.3.2 PHYSIOGRAPHY

A review of published physiography information (Acton et al., 1960) revealed the following:

1. The site lies in the physiographic region known as the Saskatchewan Rivers Plain.
2. This region is characterized as gently undulating to rolling glacial lacustrine-alluvial (glacial lake) plains, aeolian plains (dunes) and till plains.

3.3.3 GEOLOGY

A review of published physiography information (MDH, 2011 and Christiansen, 1967) revealed the following:

1. The surficial deposits above the bedrock surface are characterized as variable deposits of sand, silt, and clay deposited by glacial and/or subsequent erosional processes. These deposits are formally named the Surficial Stratified Deposits Formation and are associated with the Saskatoon Group.
2. Regionally, the surficial stratified deposits consists of approximately 3 m of silt and sand, underlain by approximately 30 m of clay.
3. The surficial stratified deposits are underlain by approximately 100 m of glacial till associated with the Battleford Formation of the Saskatoon Group.
4. The uppermost bedrock deposit in the vicinity of the site is comprised of several members of the Bearpaw formation with a combined thickness of approximately 90 m. The uppermost member of the Bearpaw formation consists of approximately 5 to 10 m of noncalcareous silty clay shale.
5. The Bearpaw formation is underlain by bedrock deposits associated with the Judith River formation followed by the Lea Park formation, which marks the base of exploration in the region.

3.3.4 HYDROGEOLOGY

An examination of hydrogeological data (MDH, 2011 and Christiansen, 1967) for this region revealed the following observations:

1. Important groundwater resources in the region are reported to be associated with variable surficial, intratill, and/or intertill deposits of coarse-grained sediments (silt, sand, and gravel).
2. The site overlies a large surficial aquifer which is up to approximately 28 m thick in the vicinity of the site.
3. There does not appear to be any intertill and/or intratill aquifers directly underlying the site.
4. No Mennon, Battleford, Warman Formation, Empress Group, Upper and Lower Floral Formation, or Upper and Lower Dundurn Formation Aquifers appear to be present within 1.5 km of the site.
5. The base of groundwater exploration, or the depth which it is considered to be uneconomic to explore for groundwater because the cost of wells is too high or the water is too mineralized, is considered to be the bedrock surface at the base of the drift.

3.4 GROUNDWATER WELLS

3.4.1 WATER WELL RECORDS

A search of the Saskatchewan Water Security Agency (WSA) Groundwater Well Database (WSA, 2022) was conducted for a radius of approximately 1.6 km from the study site boundaries. Detailed Water Well records have been included in Appendix B while a summary of the well records is presented in Table IV.

Review of the water well search summarized in Table IV revealed the following:

1. No registered water wells are located on the same quarter sections as the study site (i.e., SE-24-35-05-W3M and NE-13-35-05-W3M).
2. There are 112 registered water wells located within 1.6 km of the site.
3. All of the water wells other than two (2) research wells are registered for domestic use.
4. One of the registered wells is a soil test hole and six (6) of the registered wells are water test holes. The remaining (105) wells are registered as withdrawal wells.
5. The registered wells and/or test holes are completed at depths ranging from approximately 5 to 146 m below grade, while the diameter of the wells ranged from approximately 38 to 1295 mm.
6. The reported pumping rates of the completed wells ranged from approximately 9 to 364 litres per minute.

It is possible that the water well record search includes water wells that are located more than 1.6 km from the site. This is because the search includes all wells that are assigned to a quarter section that is completely or partially within the specified search radius. A field verification survey was not conducted to confirm the exact location of these water wells and/or if there are additional water wells not registered in the WSA database.

TABLE IV SUMMARY OF REGISTERED GROUNDWATER WELLS

WWDR #	Land Location	Depth		Diameter		Pumping Rate		Water Use	Well Use
		(m)	(feet)	(mm)	(inches)	Litres/Minute	Gallons/Minute		
108668	SE-26-35-05-W3M	14	47	1067	42	91	20	Domestic	Withdrawal
201950	SE-26-35-05-W3M	12	41	762	30	227	50	Domestic	Withdrawal
108004	SE-26-35-05-W3M	15	48	762	30	91	20	Domestic	Withdrawal
109359	SE-26-35-05-W3M	15	50	762	30	27	6	Domestic	Withdrawal
031901	SE-26-35-05-W3M	10	34	914	36	9	2	Domestic	Withdrawal
109360	SE-26-35-05-W3M	16	52	762	30	27	6	Domestic	Withdrawal
108328	SE-26-35-05-W3M	15	48	762	30	91	20	Domestic	Withdrawal
113599	SE-26-35-05-W3M	14	45	762	30	91	20	Domestic	Withdrawal
109358	SE-26-35-05-W3M	15	48	762	30	91	20	Domestic	Withdrawal
110027	SE-26-35-05-W3M	15	50	762	30	91	20	Domestic	Withdrawal
108329	SE-26-35-05-W3M	15	48	762	30	182	40	Domestic	Withdrawal
228859	NW-23-35-05-W3M	22	73	762	30	318	70	Domestic	Withdrawal
217625	NW-23-35-05-W3M	15	50	762	30	55	12	Domestic	Withdrawal
231903	NW-23-35-05-W3M	24	80	762	30	136	30	Domestic	Withdrawal
224407	NW-23-35-05-W3M	21	70	152	6	--	--	Domestic	Water Test Hole
009539	NW-23-35-05-W3M	5	18	38	1.5	45	10	Domestic	Withdrawal
239781	NW-23-35-05-W3M	18	60	762	30	182	40	Domestic	Withdrawal
219185	NW-23-35-05-W3M	20	65	762	30	136	30	Domestic	Withdrawal
234054	NW-23-35-05-W3M	20	66	762	30	182	40	Domestic	Withdrawal
233940	NW-23-35-05-W3M	20	65	762	30	273	60	Domestic	Withdrawal
241260	NW-23-35-05-W3M	27	90	127	5	68	15	Domestic	Withdrawal
224421	NW-23-35-05-W3M	21	70	152	6	--	--	Domestic	Water Test Hole
229857	NW-23-35-05-W3M	22	73	762	30	227	50	Domestic	Withdrawal
092456	NW-23-35-05-W3M	20	64	762	30	68	15	Domestic	Withdrawal
238174	NW-23-35-05-W3M	14	46	762	30	364	80	Domestic	Withdrawal
211586	NW-23-35-05-W3M	15	49	762	30	68	15	Domestic	Withdrawal
241819	NW-23-35-05-W3M	20	65	762	30	250	55	Domestic	Withdrawal
009538	NW-23-35-05-W3M	6	21	38.1	1.5	45	10	Domestic	Withdrawal

TABLE IV: SUMMARY OF REGISTERED GROUNDWATER WELLS (CONTINUED..)

WWDR #	Land Location	Depth		Diameter		Pumping Rate		Water Use	Well Use
		(m)	(feet)	(mm)	(inches)	Litres/Minute	Gallons/Minute		
106123	NW-23-35-05-W3M	18	60	127	5	82	18	Domestic	Withdrawal
228981	NW-23-35-05-W3M	24	78	762	30	136	30	Domestic	Withdrawal
228875	SW-23-35-05-W3M	22	73	762	30	364	80	Domestic	Withdrawal
031900	SW-23-35-05-W3M	12	39	914	36	18	4	Domestic	Withdrawal
085025	NW-14-35-05-W3M	11	35	914	36	--	--	Domestic	Withdrawal
031890	NW-14-35-05-W3M	12	40	914	36	14	3	Domestic	Withdrawal
102894	NW-14-35-05-W3M	12	38	914	36	23	5	Domestic	Withdrawal
031891	NW-14-35-05-W3M	12	40	1067	42	--	--	Domestic	Water Test Hole
047128	SW-14-35-05-W3M	7	22	38	1.5	41	9	Domestic	Withdrawal
077228	NE-11-35-05-W3M	15	50	762	30	45	10	Domestic	Withdrawal
014485	NE-11-35-05-W3M	7	24	914	36	36	8	Domestic	Withdrawal
047129	SW-12-35-05-W3M	43	140	114	4.5	45	10	Domestic	Withdrawal
080634	SW-12-35-05-W3M	15	50	762	30	45	10	Domestic	Withdrawal
048798	SE-12-35-05-W3M	20	65	762	30	14	3	Domestic	Withdrawal
241009	NE-07-35-05-W3M	16	51	762	30	91	20	Domestic	Withdrawal
047150	NE-07-35-05-W3M	10	34	914	36	--	--	Domestic	Withdrawal
210791	SW-17-35-05-W3M	6	20	914	36	--	--	Domestic	Withdrawal
045303	NW-17-35-05-W3M	12	41	914	36	--	--	Domestic	Withdrawal
095633	NW-17-35-05-W3M	30	100	1295	51	45	10	Domestic	Withdrawal
114373	SW-20-35-05-W3M	15	50	762	30	45	10	Domestic	Withdrawal
104810	SW-20-35-05-W3M	34	110	127	5	73	16	Domestic	Withdrawal
060564	NW-20-35-05-W3M	12	40	762	30	45	10	Domestic	Withdrawal
058332	NW-20-35-05-W3M	12	40	762	30	23	5	Domestic	Withdrawal
045909	SE-30-35-05-W3M	15	48	914	36	--	--	Domestic	Withdrawal
079825	SE-30-35-05-W3M	9	28	508	20	--	-	Domestic	Withdrawal
213967	NW-30-35-05-W3M	16	52	762	30	45	10	Domestic	Withdrawal
099578	-25-35-5-W3M	17	56	127	5	27	6	Domestic	Withdrawal
047127	NW-25-35-05-W3M	11	36	38.1	1.5	41	9	Domestic	Withdrawal

TABLE IV: SUMMARY OF REGISTERED GROUNDWATER WELLS (CONTINUED..)

WWDR #	Land Location	Depth		Diameter		Pumping Rate		Water Use	Well Use
		(m)	(feet)	(mm)	(inches)	Litres/Minute	Gallons/Minute		
096278	NW-25-35-05-W3M	18	58	610	24	45	10	Domestic	Withdrawal
109678	SW-25-35-05-W3M	12	40	762	30	68	15	Domestic	Withdrawal
110605	SW-25-35-05-W3M	14	45	762	30	55	12	Domestic	Withdrawal
110870	SW-25-35-05-W3M	15	50	762	30	68	15	Domestic	Withdrawal
202068	SW-25-35-05-W3M	15	48	762	30	91	20	Domestic	Withdrawal
110463	SW-25-35-05-W3M	16	54	762	30	91	20	Domestic	Withdrawal
110759	SW-25-35-05-W3M	15	50	762	30	68	15	Domestic	Withdrawal
110606	SW-25-35-05-W3M	14	46	762	30	68	15	Domestic	Withdrawal
110608	SW-25-35-05-W3M	15	48	762	30	55	12	Domestic	Withdrawal
110026	SW-25-35-05-W3M	15	50	762	30	55	12	Domestic	Withdrawal
110607	SW-25-35-05-W3M	15	48	762	30	36	8	Domestic	Withdrawal
109499	SE-25-35-05-W3M	13	43	762	30	9	2	Domestic	Withdrawal
206470	SE-25-35-05-W3M	12	38	762	30	136	30	Domestic	Withdrawal
102427	SE-25-35-05-W3M	15	48	762	30	68	15	Domestic	Withdrawal
120157	SE-25-35-05-W3M	20	66	762	30	114	25	Domestic	Withdrawal
217623	NE-23-35-05-W3M	18	60	762	30	68	15	Domestic	Withdrawal
106122	NE-23-35-05-W3M	13	43	127	5	136	30	Domestic	Withdrawal
106124	NE-23-35-05-W3M	12	38	127	5	64	14	Domestic	Withdrawal
106125	NE-23-35-05-W3M	12	39	127	5	136	30	Domestic	Withdrawal
092457	NE-23-35-05-W3M	12	40	762	30	55	12	Domestic	Withdrawal
043814	NW-24-35-05-W3M	8	27	38	1.5	27	6	Domestic	Withdrawal
077641	NW-24-35-05-W3M	9	28	914	36	--	--	Domestic	Withdrawal
014489	NW-24-35-05-W3M	8	26	38	1.5	27	6	Domestic	Withdrawal
104120	NW-24-35-05-W3M	15	50	762	30	55	12	Domestic	Withdrawal
086177	NW-24-35-05-W3M	15	50	762	30	--	--	Domestic	Withdrawal
047554	NW-24-35-05-W3M	16	54	51	2	18	4	Domestic	Withdrawal
237148	NW-19-35-04-W3M	8	25	762	30	136	30	Domestic	Withdrawal
104111	NE-19-35-04-W3M	17	55	762.0	30.0	91	20	Domestic	Withdrawal

TABLE IV: SUMMARY OF REGISTERED GROUNDWATER WELLS (CONTINUED..)

WWDR #	Land Location	Depth		Diameter		Pumping Rate		Water Use	Well Use
		(m)	(feet)	(mm)	(inches)	Litres/Minute	Gallons/Minute		
104112	NE-19-35-04-W3M	15	50	762	30	45	10	Domestic	Withdrawal
239802	SE-23-35-05-W3M	9	30	152	6	--	--	--	Water Test Hole
239801	SE-23-35-05-W3M	9	30	152	6	--	--	--	Water Test Hole
049257	SW-24-35-05-W3M	8	26	914	36	--	--	Domestic	Withdrawal
014488	SW-24-35-05-W3M	7	24	38	2	45	10	Domestic	Withdrawal
111078	SW-24-35-05-W3M	15	49	762	30	68	15	Domestic	Withdrawal
219553	SW-19-35-04-W3M	146	479	--	--	--	--	--	--
116917	SW-19-35-04-W3M	146	479	122	4.8	--	--	Research	Soil Test Hole
218798	SW-19-35-04-W3M	10	33	762	30	55	12	Domestic	Withdrawal
031757	SW-19-35-04-W3M	141	464	--	--	--	--	Research	Water Test Hole
109245	SW-19-35-04-W3M	17	55	762	30	--	--	Domestic	Withdrawal
051688	SE-19-35-04-W3M	7	24	38	1.5	27	6	Domestic	Withdrawal
106555	SE-19-35-04-W3M	15	48	762	30	68	15	Domestic	Withdrawal
103321	SE-19-35-04-W3M	14	45	762	30	--	--	Domestic	Withdrawal
099861	-19-35-04-W3M	16	54	762	30	68	15	Domestic	Withdrawal
237148	NW-19-35-04-W3M	8	25	762	30	136	30	Domestic	Withdrawal
031899	-23-35-05-W3M	6	20	914	36	--	--	Domestic	Withdrawal
092864	-14-35-05-W3M	15	50	762	30	27	6	Domestic	Withdrawal
211579	SE-14-35-04-W3M	17	56	762	30	136	30	Domestic	Withdrawal
102459	NW-18-35-04-W3M	9	29	914	36	23	5	Domestic	Withdrawal
109498	SE-13-35-05-W3M	29	94	762	30	91	20	Domestic	Withdrawal
051139	SE-13-35-05-W3M	24	80	762	30	18	4	Domestic	Withdrawal
064131	SE-13-35-05-W3M	29	95	762	30	--	--	Domestic	Withdrawal
048671	SE-13-35-05-W3M	15	50	762	30	36	8	Domestic	Withdrawal
116341	NW-12-35-05-W3M	14	47	762	30	114	25	Domestic	Withdrawal
051130	NW-12-35-05-W3M	8	26	38	1.5	27	6	Domestic	Withdrawal
236233	NW-12-35-05-W3M	11	35	762	30	136	30	Domestic	Withdrawal
114380	NE-12-35-05-W3M	14	45	762.0	30.0	91	20	Domestic	Withdrawal

3.4.2 WATER WELL INVENTORY

A field inventory of water wells within 1.0 km of the proposed subdivision was not completed as part of this investigation. Although, a field inventory is required as part of a Level 2 hydrogeological assessment, it was determined not to be necessary as detailed information regarding water well users in the vicinity of the site was obtained from the review of the RM of Corman Park No. 344 website (https://www.rmcormanpark.ca/220/Water-Systems).

A desktop review of the potable water sources utilized by the RM of Corman Park No. 344, within 1 km of the site, revealed the following:

1. Potable water is treated by the City of Saskatoon and all the existing developments surrounding the study site are reported to be connected to the piped distribution network system.

2. Casa Rio East has reservoir storage and distribution system for delivery of potable water to residents.

3. It is believed that no groundwater wells are currently being used for portable water by the properties located in the vicinity of the study site.

3.5 SURFACE WATER USERS

The closest major surface waterbody to the study site is the South Saskatchewan River which is located at its closest point approximately 8 km to the west of the study site. Several sloughs are located on and/or adjacent to the study site. There does not appear to be any surface water users proximate the site.

3.6 OWTS DEVELOPMENT

An inventory of OWTS within 1 km of the proposed subdivision is required as part of a Level 2 assessment. A field inventory of OWTS surrounding the proposed subdivision was not deemed to be necessary as part of the field investigation.

A desktop review of the OWTS utilized by the RM of Corman Park No. 344, within 1 km of the site, revealed the following:

1. The advanced treatment system (MicroFAST) is being used as OWTS by the Casa Rio East Subdivision.

2. It is anticipated that septic fields and/or septic tanks may currently be used as OWTS by the existing properties located adjacent to the study site.

3.7 METHODOLOGY

3.7.1 BOREHOLE DRILLING

Field work including drilling of boreholes, soil sampling and installation of monitoring wells was conducted April 9, 12, 13, 14 and 16, 2021.

As part of the geotechnical investigation conducted at the study site (PMEL, 2021), forty-six boreholes (drilled at 29 separate locations), located as shown on the Site Plan, Drawing No. 17789-1, were dry drilled using our truck-mounted, continuous flight auger drilling rig. The boreholes were 150 mm in diameter and extended to depths of 3 to 12 m below the existing ground surface.

Borehole drill logs, as shown on the attached Borehole Logs, Drawing Nos. 17789-2 to 30, 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 were collected during test drilling and sealed in plastic bags to minimize moisture loss. Select soil samples were taken to our laboratory for grain size distribution analysis. Soils samples were classified in general accordance with the Canadian Soil Classification System. The results of the grain size distribution analysis are provided in Appendix C.

3.7.2 MONITORING WELL INSTALLATION

Monitoring wells were installed in each of the boreholes. The purpose of the monitoring wells was to allow for monitoring of groundwater levels, collection of groundwater samples, and to conduct hydraulic conductivity tests (i.e., bail response). For the remainder of this document, monitoring wells will be referenced by the number of the borehole in which they were installed. For example, the monitoring well installed in Borehole No. 21-1 will be referenced as 21-1.

Each monitoring well consisted of a 50 mm diameter, Schedule 40, PVC machine slotted screen with a solid riser pipe. Unless sloughing occurred, the annular spaces around the slotted screens were filled with silica sand. In areas of sloughing soil, the sand was allowed to collapse adjacent to the screen and if required, additional sand was added to allow the sand pack to extend above the screen. The remaining borehole annulus above the sand pack/slough interval was backfilled to groundwater surface with bentonite to isolate the well screen and prevent surface water flow into the well.

3.7.3 BOREHOLE/MONITORING WELL SURVEY

Digital Planimetrics Inc. provided the coordinates and ground surface elevation at each test location.

3.7.4 GROUNDWATER MONITORING

The groundwater levels were measured in each monitoring well at the study site using a Solinst electric water level meter on April 22 and May 5, 2021. To prevent cross contamination the water level tape was cleaned between each monitoring well using a solution of diluted detergent and distilled water.

3.7.5 FIELD HYDRAULIC CONDUCTIVITY TESTING

Field hydraulic conductivity tests (i.e., bail response) were performed on May 4 and 5, 2021 in select monitoring wells installed at the study site. The purpose the tests was to determine the bulk saturated hydraulic conductivity of the in-situ soils at the study site. Each test consisted of removing a known volume of water to produce a change in the hydraulic head within the monitoring wells. The water levels within the monitoring wells were then allowed to recover and the response was measured using a combination pressure transducer and data logger. The computer software program Aqtesolv (HydroSOLVE Inc., proprietary Software Version 4.50) was used to determine the bulk hydraulic conductivity values from the measured pressure response using the Bouwer and Rice (1976) analytical method. The hydraulic conductivity test data and results are provided in Appendix D.

3.7.6 GROUNDWATER MONITORING AND SAMPLING

Following groundwater monitoring, each monitoring well was purged dry, or the equivalent of at least three well volumes was removed from each well, using a dedicated disposable bailer to induce groundwater recharge. Following purging, groundwater samples were collected, using dedicated disposable bailers, from each monitoring well. An attempt was made to allow enough time for the well to recover to approximately 50% of the original (static) water level prior to sampling. The collected groundwater samples were placed in the appropriate laboratory supplied containers with laboratory specified preservatives and stored on ice in a cooler.

To prevent cross contamination, all groundwater samples were collected, using the same dedicated disposable bailer used to purge each well and new nitrile gloves were worn at each new monitoring well/sample location.

The collected samples were submitted to ALS Canada Ltd. (ALS) in Saskatoon, Saskatchewan for laboratory analysis of routine indicator parameters (pH; conductivity; total dissolved solids [TDS]; major ions; nitrate as nitrogen [nitrate]; nitrite as nitrogen [nitrite]; hardness; and alkalinity). Standard Chain of Custody procedures were used to track sample handling. Copies of the laboratory Certificate of Analysis Reports are provided in Appendix E.

Blind duplicate samples were also collected from the monitoring wells 21-5 and 21-21A to assess sampling procedures, to verify the precision of the laboratory results, and to provide general quality assurance/quality control (QA/QC) of the laboratory analysis.

3.8 RESULTS

3.8.1 GENERAL SOIL PROFILE

Detailed descriptions of the soil stratigraphy at the site are presented on the borehole logs, Drawing Nos. 17789-2 to 30, inclusive. Stratigraphic sections showing an interpretation of the soil profile are presented on Drawing Nos. 17788-2 and 3. The location of the stratigraphic sections is shown on Drawing No. 17788-1.

The general soil profile consisted of a surficial sand deposit (thickness ranging from 1.2 m to greater than 10 m) overlying variable deposits of clay, silt and sand, which extended to a depth of at least 20.8 m, the maximum depth investigated. The soils encountered at the site were comprised of predominantly sand and silt with intermittent clay layers.

3.8.2 HYDROGEOLOGICAL CONDITIONS

The depth to groundwater in the monitoring wells installed at the site was measured on April 22 and May 5, 2021.

A summary of the groundwater levels recorded has been presented in Table V. Review of the results presented in Table V and field observations revealed the following:

1. Not all the monitoring wells appeared to have reached equilibrium conditions on April 22, 2021 which was approximately 5 to 12 days after installation and have therefore been excluded from further discussion.

2. The depth to groundwater on May 5, 2021 ranged from approximately 1.4 to 5.7 m (average of 2.8 m) below existing grade (elevation of 505.1 to 506.6 m).

3. The apparent direction of groundwater flow on May 5, 2021 was towards the southeast (approximately 100^{o} from north) at an average gradient of 0.0009. The inferred groundwater elevation contours, excluding deeper monitoring wells 21-21B and 21-28, and the apparent groundwater flow directions for May 5, 2021 have been shown on Drawing No. 17789-31.

4. Based on the groundwater surface elevations measured on May 5, 2021 at the nested monitoring wells installed in the location of Borehole Nos. 21-21 (monitoring wells 21-21A and 21-21B) and 21-28 (i.e., monitoring wells 21-28A and 21-28B), the vertical gradient was flat (determined using midpoint of the well screens). The presence of a flat gradient suggests that these monitoring wells are located in a localized area of intermittent groundwater recharge and the groundwater at the site is flowing downward from the ground surface towards the water table.

5. Groundwater seepage and sloughing conditions were encountered during test drilling. The depths at which groundwater seepage and/or sloughing conditions were encountered are shown on the borehole drill logs.

TABLE V SUMMARY OF GROUNDWATER LEVELS

Borehole No.	Piezometer Rim Elevation (m)	Ground Surface Elevation (m)	Groundwater Depth (m) (2021)		Groundwater Elevation (m) (2021)	
			April 22	May 5	April 22	May 5
21-1A	509.6	508.5	2.3	2.2	506.2	506.3
21-2	509.5	508.5	2.3	2.3	506.3	506.2
21-3A	509.5	508.5	2.4	2.3	506.1	506.2
21-4	508.9	507.9	2.0	2.0	505.9	505.9
21-5A	509.0	507.9	2.0	1.9	505.9	506.0
21-6	510.4	509.4	3.6	3.6	505.8	505.8
21-7A	510.4	509.4	3.5	3.4	505.9	506.0
21-8	510.1	509.0	DRY	3.0	DRY	506.0
21-9A	509.8	508.8	2.3	2.3	506.5	506.5
21-10	510.0	508.9	2.4	2.4	506.5	506.5
21-11A	509.3	508.3	2.1	2.0	506.2	506.3
21-12	508.6	507.5	1.7	1.6	505.8	505.9
21-13A	508.1	507.1	1.8	1.8	505.3	505.3
21-14	507.9	506.9	1.9	1.8	505.0	505.1
21-15A	509.7	508.6	2.4	2.4	506.2	506.2
21-16	510.7	509.7	3.2	3.2	506.5	506.5
21-17A	509.1	508.1	1.5	1.5	506.6	506.6
21-18	510.9	509.8	3.3	3.3	506.5	506.5
21-19A	509.9	508.7	2.1	2.2	506.6	506.5
21-20	509.0	508.0	1.5	1.5	506.5	506.5
21-21A	510.1	509.3	3.5	3.5	505.8	505.8
21-21B	510.4	509.3	3.6	3.5	505.7	505.8
21-22A	510.4	509.4	3.1	3.1	506.3	506.3
21-23	512.9	511.8	5.5	5.4	506.3	506.4
21-24A	509.9	508.9	3.0	3.0	505.9	505.9
21-25	508.0	506.9	1.5	1.4	505.5	505.5
21-26A	509.4	508.3	3.1	3.0	505.2	505.3
21-27	511.9	510.9	5.5	5.5	505.4	505.4
21-28	513.1	511.9	5.7	5.7	506.2	506.2
21-28A	513.2	512.2	DRY	DRY	DRY	DRY
21-28B	514.0	512.9	DRY	DRY	DRY	DRY
21-29	510.7	509.7	3.8	3.8	505.9	505.9

Based on a review of the geodetic elevations, a number of the monitoring wells are located proximate natural ground surface depressions. It would be expected that the depth to the groundwater table would be shallower in these areas and be deeper in areas of higher elevation. Elevated groundwater levels are possible during and/or following spring snowmelt or periods of precipitation.

3.8.3 SOIL CLASSIFICATION AND INDEX TESTS

The soil classification and index tests consisted of a visual classification of the soil, water contents, unit weights, Atterberg limits, and grain size distribution analysis. The results of the soil classification and index tests, conducted on representative samples of soil recovered from this site, have been plotted on the test hole drill logs alongside the corresponding depths at which the samples were recovered. Grain size distribution analyses were performed on the surficial soil samples (i.e., upper 2 m) recovered from the boreholes drilled across the site.

The results of the grain size distribution analyses, described using the Canadian System of Soil Classification, have been presented in Appendix C and summarized in Table VI.

A review of the results presented in Table VI revealed that the surficial soils (i.e., upper 2.0 m) at the site were generally classified as silt loam, loam, sandy loam or loamy sand.

3.8.4 HYDRAULIC CONDUCTIVITY

The results of hydraulic conductivity tests, calculated using the Bouwer and Rice (1976) method, are summarized in Table VII, while detailed reports are presented in Appendix D.

Review of the results presented in Table VII revealed the following range of hydraulic conductivities for the soils at the site:

- **Predominantly sand soils**: approximately 2 x 10^{-6} m/s; and
- **Predominantly silt/clay soils:** approximately 4 x 10^{-8} to 2 x 10^{-7} m/s.

TABLE VI SUMMARY OF CANADIAN SYSTEM OF SOIL CLASSIFICATION

Borehole No.	Depth (m)	Grain Size Distribution Analysis			Saskatcheawn Health Soil Texture Classification
		Sand (%)	Silt (%)	Clay (%)	
21-1	1.2	64	22	14	Sandy Loam
21-2	0.6	78	13	9	Sandy Loam
21-3	1.2	18	61	21	Silt Loam
21-4	0.6	62	25	13	Sandy Loam
21-5	0.9	76	15	9	Sandy Loam
21-6	1.5	77	14	9	Sandy Loam
21-7	0.9	78	12	10	Sandy Loam
21-8	0.6	54	33	13	Loam
21-9	0.6	73	22	5	Sandy Loam
21-10	0.9	70	18	12	Sandy Loam
21-11	1.5	74	17	9	Sandy Loam
21-12	0.6	63	28	9	Sandy Loam
21-13	0.3	64	24	12	Sandy Loam
21-14	1.2	46	42	12	Loam
21-15	0.6	70	19	11	Sandy Loam
21-16	1.5	79	16	5	Loamy Sand
21-17	0.6	69	21	10	Sandy Loam
21-18	1.2	79	13	8	Loamy Sand
21-19	1.2	77	16	7	Sandy Loam/Loamy Sand
21-20	0.6	74	15	11	Sandy Loam
21-21	0.9	80	11	9	Loamy Sand
21-22	0.6	70	19	11	Sandy Loam
21-23	1.5	68	24	8	Sandy Loam
21-24	1.2	85	10	5	Loamy Sand
21-25	0.6	66	26	8	Sandy Loam
21-26	0.9	84	11	5	Loamy Sand
21-27	0.6	71	20	9	Sandy Loam
21-28	1.2	69	23	8	Sandy Loam
21-29	1.5	75	18	7	Sandy Loam

TABLE VII SUMMARY OF HYDRAULIC CONDUCTIVITY RESULTS AND VADOSE ZONE DEPTH

Borehole No.	Effective Screen Length (m)	Hydraulic Conductivity (m/s)	Hydraulic Conductivity (m/day)	Required Vadose Zone Depth (m)	Soil Type
21-1A	1.1 to 3.3	4×10^{-8}	0.0035	0.2	Silt/Sand
21-5	1.5 to 3.1	1×10^{-6}	0.0864	5.2	Sand
21-13	0.4 to 2.5	5×10^{-7}	0.0432	2.6	Silt/Sand
21-16	1.2 to 4.5	4×10^{-8}	0.003	0.2	Sand/Clay
21-21A	4.8 to 7.2	2×10^{-7}	0.017	1.0	Clay
21-22	1.7 to 3.9	2×10^{-6}	0.173	10.4	Sand
21-26	1.5 to 4.1	1×10^{-6}	0.086	5.2	Sand
21-28	6.5 to 12	2×10^{-6}	0.173	10.4	Clay/Sand

Effective screen length refers to the total length/area of the sand pack/screened interval that is assumed to be providing groundwater recharge.

The required vadose zone depth is calculated assuming that 60 days of retention time within the vadose zone is required to achieve at least a 3-log (i.e., 99%) removal of pathogens from the OWTS effluent.

3.8.5 LABORATORY CHEMICAL ANALYSIS – GROUNDWATER

The results of the laboratory chemical analysis for major ions and routine parameters are summarized in Table VIII along with the Saskatchewan Ministry of Environment (SKMoE) Saskatchewan Environmental Quality Standards (SKMoE, 2022) for the protection of the groundwater pathway for coarse-grained soils, for comparison purposes.

Detailed analytical results can be found in the laboratory Certificate of Analysis (COA) report, provided in Appendix E, which also includes a listing of the laboratory analytical methods and a summary of the laboratory quality assurance/quality control (QA/QC) results.

Review of the results presented in Table VIII revealed the following:

1. The concentration of total dissolved solids (TDS) was elevated in all the samples analyzed, and exceeded the referenced endpoints in the groundwater samples recovered from monitoring wells 21-1A, 21-8, 21-16, 21-24A and 21-26A.

2. Sulfate, at a concentration (2,220 mg/L) exceeding the referenced endpoint (500 mg/L) was measured in the groundwater sample recovered from monitoring well 21-1A.

3. The concentration of nitrate was elevated in all the samples analyzed, and exceeded the referenced endpoints in the groundwater samples recovered from monitoring wells 21-8, 21-15A, 21-16, 21-22A, 21-24A, and 21-26A.

4. The concentrations of the remaining constituents were below the referenced endpoints in all the samples analyzed.

TABLE VIII RESULTS OF LABORATORY CHEMICAL ANALYSIS

Borehole No.		21-1A	21-2	21-5A		21-8	21-10	21-13A	21-15A	21-16	21-21A		21-21B	21-22A	21-24A	21-26A	21-28	SKMoE (2021) Potable Water Coarse-Grained Soil Endpoints
Sample No.		21-1	21-2	21-5	17788-1*	21-8	21-10	21-13	21-15	21-16	21-21A	17788-2*	21-21B	21-22	21-24	21-26	21-28	
Date Sampled		05-May-21	05-May-21	05-May-21		05-May-21	05-May-21	05-May-21	05-May-21	05-May-21	05-May-21		05-May-21	05-May-21	05-May-21	05-May-21	05-May-21	
Parameter	Units																	
Conductivity	uS/cm	3640	747	558	560	728	663	592	789	722	529	531	365	637	860	1010	625	No Endpoint
pH	pH	7.68	7.81	8.08	8.13	7.79	8.11	8.05	7.98	8	8	8.05	8.1	8.05	8.02	8.1	7.92	6.5 to 8.5
Alkalinity, Total (as CaCO3)	mg/L	319	373	268	265	216	355	231	259	200	199	200	129	251	334	436	211	No Endpoint
Bicarbonate (HCO3)	mg/L	389	455	326	324	263	434	282	316	244	243	244	157	306	407	532	258	No Endpoint
Carbonate (CO3)	mg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	No Endpoint
Chloride (Cl)	mg/L	24.7	3.77	3.11	3.03	5.38	1.78	3.94	8.64	8.71	11.2	11.4	4.89	6.06	19.2	2.43	24	250
Hardness (as CaCO3)	mg/L	2200	362	215	218	335	314	280	370	321	243	246	163	309	387	498	257	No Endpoint
Hydroxide (OH)	mg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	No Endpoint
Nitrate+Nitrite-N	mg/L	7.07	0.893	0.424	0.425	38	0.168	7.7	19	38.1	1.81	1.85	0.334	14.6	13.8	24.3	0.05	No Endpoint
Nitrate-N	mg/L	7.07	0.878	0.424	0.425	**37.8**	0.168	7.68	**19**	**38**	1.8	1.83	0.334	**14.6**	**13.7**	**24.2**	0.05	10
Nitrite-N	mg/L	<0.200	0.015	<0.010	<0.010	0.173	<0.010	0.024	0.011	0.06	0.014	0.019	<0.010	0.019	0.07	0.114	<0.010	1
TDS (Calculated)	mg/L	**3400**	435	335	334	**521**	377	346	488	**511**	318	322	220	376	**523**	**625**	377	500
Calcium (Ca) Dissolved	mg/L	466	75.5	53.8	53.5	95.7	46.5	62.7	99.1	86.5	67.9	68.4	45.1	71.8	102	67.3	73.2	No Endpoint
Magnesium (Mg) Dissolved	mg/L	251	42.2	19.6	20.5	23.4	48.2	29.9	29.9	25.6	17.8	18.2	12.2	31.6	32.2	80.1	18	No Endpoint
Potassium (K) Dissolved	mg/L	16.3	30.3	2.77	2.89	9.27	3.4	2.88	1.92	3.72	2.94	3.08	2.18	3.31	6.82	9.28	3.87	No Endpoint
Sodium (Na) Dissolved	mg/L	177	14.2	37.2	37.1	6.06	25.3	9.02	16.6	10.6	7.79	7.72	5.62	8.85	25.5	35.1	24.2	200
Sulfate (as SO4)	mg/L	**2220**	30.7	40.7	41.1	72.9	25.4	53.2	77.6	69.4	60.8	61.7	52.8	26.1	58.1	47	81.9	500

- SKMoE Saskatchewan Environmental Quality Standards (SKMoE, 2021). <https://envrbrportal.crm.saskatchewan.ca/seqg-search/> [Accessed December, 2021].
- Sample No. 17788-1 is a field blind duplicate of Sample No. 21-5. Sample No. 17788-2 is a field blind duplicate of Sample No. 21-21A.
< Result is less than the laboratory detection limit.
■ - Concentration exceeds referenced endpoint.

5. No major development is present at the study site. As such, the elevated concentrations of TDS and sulfate, are likely naturally occurring. The elevated nitrate concentrations are likely related to farming operations (i.e., fertilizer application, livestock, etc.) conducted on and/or adjacent to the study site.

3.8.6 HYDRAULIC RETENTION TIME

In accordance with GOS (2012), a minimum retention time of 60 days within the vadose zone is required to achieve a 3-log (i.e., 99.9%) removal of pathogens from the OWTS effluent. GOS (2012) recommends a minimum vadose zone depth of 1.5 m for primary treated effluent and 0.9 m for secondary treated effluent.

The required vadose zone depth, from the bottom of the infiltrative surfaces (i.e., bottom of dispersal trench, etc.) to the surface of the water table and/or restrictive layer, for each type of soil was estimated using the hydraulic conductivity values measured at the site. The required vadose zone depth for the soil samples collected at the site is provided in Table VII.

A review of the results presented in Table VII revealed the following:

1. The required vadose zone depths for the soils at the site range from 0.2 to 10.4 m based on the range of hydraulic conductivity values.
2. Out of 9 calculated required vadose zone depths, 3 calculated values were less than the minimum separation distance of 1.5 m and would provide sufficient vadose zone retention time to effectively remove pathogens from OTWS effluent.
3. The areas where the required vadose zone depth exceeded the minimum recommended values were areas with a higher content of sand.

The field hydraulic conductivity values are representative of the subsurface soils immediately adjacent to the monitoring well screen, which were completed at depths ranging from approximately 0.4 to 12 m below existing grade. However, it is believed that these hydraulic conductivity values would be representative of similar soil types at shallower depths at the site.

3.8.7 SITE SENSITIVITY

In accordance with GOS (2018) a site is considered sensitive if one or more of the following conditions exist:

1. The subdivision, containing the parcel/lot, is less than 1.0 km from the boundary of any municipality (i.e., city, town, village, organized hamlet or approved subdivision containing at least two parcel/lots) that utilizes groundwater source(s) for drinking water purposes.
2. The presence of coarse soils over an unconfined aquifer, that is of sufficient quality and quantity to be used as a drinking water source. The presence of high levels of aesthetic constituents should not be used to determine drinking water suitability.
3. The presence of subsurface water (seasonal or permanent), which is less than 1.5 m below the natural ground surface elevation.

4. Historical concerns with well water quality (in particular nitrate) believed to be due to human activities.

Based on the results of the desktop study and field investigation the site is considered to be located in a sensitive area as the site is underlain by a saturated sand unit containing groundwater of apparent sufficient quality and quantity to represent an unconfined surficial aquifer.

4 CONCEPTUAL HYDROGEOLOGICAL MODEL

4.1 HYDROGEOLOGICAL SETTING

Based on a review of regional information and observations from field investigations conducted at the site, the site overlies a large surficial aquifer that includes stratified sand, silt, and clay deposits. For this assessment the geology of the shallow surficial soils has been simplified into a single and continuous sand aquifer.

All the water in the surficial aquifer originates as precipitation which has infiltrated downward from the ground surface to the water table, which forms the surface of the uppermost surficial aquifer. Recharge occurs seasonally, mainly during intensive or long duration rainstorms or following snow melt in the spring. Groundwater entering the surficial aquifer will migrate downward, recharging underlying aquifers, or laterally in a generally west direction towards the South Saskatchewan River, which is the inferred regional groundwater flow direction. Locally, the apparent direction of groundwater flow will be towards he southeast of the study site. In some areas of the site localized flow may occur towards topographic depressions.

4.2 SUBSTANCES OF POTENTIAL CONCERN

Many contaminants present in the OWTS effluent are removed during the primary treatment that occurs within the septic tank (i.e., settling, microbial digestion). The primary substances of potential concern (SOPCs) leaving the septic tank and entering the soil treatment system are pathogenic organisms and different forms of nitrogen containing compounds (i.e., ammonia, nitrite, nitrate). Household waste is typically composed of organic nitrogen that is converted to ammonia under anaerobic conditions (i.e., septic tank). As the effluent leaves the septic tank and is discharged through the drainfield, it is biochemically transformed into nitrate through aerobic processes. It is typically assumed that no further chemical transformation occurs once the effluent is discharged from the soil treatment system as site conditions (i.e., mass of organics, anaerobic conditions) are not typically favourable for denitrification to occur (i.e., conversion to nitrogen gas). As such, the composition of nitrogen within the effluent exiting the drainfield and entering the groundwater is assumed to be in the form of nitrate.

The minimum vertical separation values outlined in GOS (2012) and recommend in most wastewater treatment design manuals, are calculated to ensure almost complete removal of organics and pathogenic organisms. If insufficient vertical separation is provided the pathogens will enter the groundwater where they can be difficult to remove. As each system must be designed to provide sufficient vertical separation, it is assumed for assessment purposes that the pathogens will be effectively removed within the vadose zone.

For this assessment it is assumed that the primary SOPC within the OWTS effluent was nitrate. It is well understood that nitrate is relatively inert and does not degrade readily in the environment. As such nitrate is generally considered a useful indicator of the migration potential of other SOPCs within the OWTS effluent.

4.3 OWTS EFFLUENT FATE AND TRANSPORT

A conceptual model of an OWTS effluent plume is presented in Figure 1. Effluent released from an OWTS is expected to travel vertically through the vadose (unsaturated) zone under the influence of gravity. Vertical flow through the vadose zone is assumed to be primarily restricted to the area underneath the soil adsorption drainfield.

Once the effluent reaches the groundwater surface, it is expected to move horizontally in the direction of groundwater flow due to the lateral force applied by the aquifer's hydraulic gradient. Groundwater flow in most aquifers is generally laminar under most conditions and thus only minimal mixing between the effluent plume and the surrounding groundwater occurs. As such, a long narrow nitrate plume, which remains near the surface of the surficial aquifer and extends in the direction of groundwater flow, is expected to develop at the study site.

Based on groundwater monitoring, conducted on May 5, 2021, the overall apparent direction of groundwater flow is towards the southeast (approximately 100^{o} from north) at an average gradient of 0.0009. As such, nitrate plumes developing at the site are expected to move towards the southeast. In some areas of the site localized groundwater flow may be towards topographic depressions (i.e., sloughs).

It is well understood that nitrate is relatively inert and does not degrade readily in the environment. Reductions in nitrate concentrations occur as a result of dilution due to mixing of the nitrate with groundwater and precipitation recharge. The final nitrate concentration will depend on the recharge rates (groundwater and precipitation) and background nitrate concentration in these recharge sources.

In accordance with GOS (2012), dilution due to mixing of groundwater can only be considered in cases where the upgradient lands have been fully developed for a considerable period of time. The land use upgradient of the proposed subdivision is primarily cultivated agricultural land and sparse commercial and residential development. It is generally understood that the nitrogen load from grain farming agriculture practices can be much larger than from conventional OWTS. As such if agricultural land is converted to residential development, it would likely not alter the (existing) background nitrate concentrations at the site.

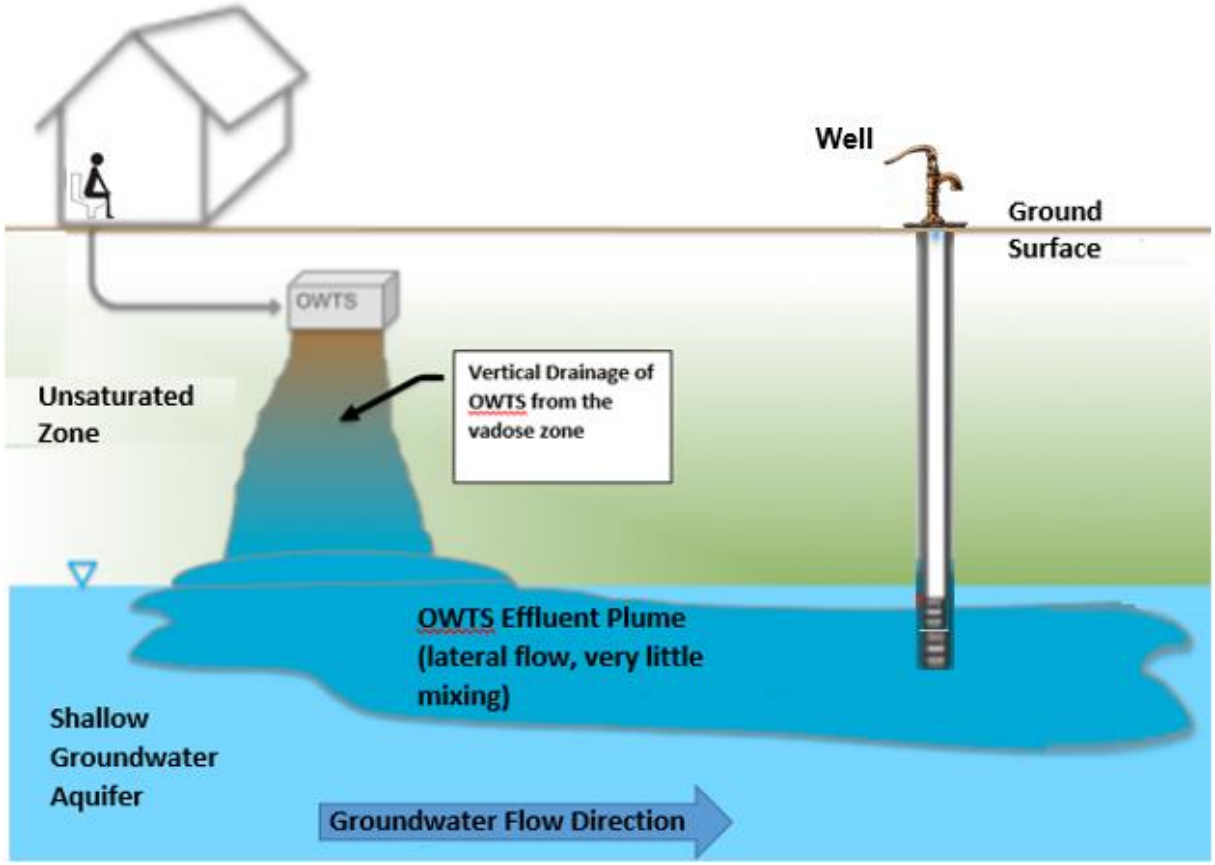


FIGURE 1 CONCEPTUAL SITE MODEL OF EFFLUENT RELEASE FROM TYPICAL OWTS

4.4 RECEPTORS

The SKMoE (2022) Saskatchewan Environmental Quality Standards (SEQS) provides end points for assessment of nitrate concentrations for the protection of the groundwater and surface water pathways. As the nitrate plume moves away from the OWTS, it is possible that it will be intercepted by wells (if any) or a surface water body located downgradient (southeast) of the proposed subdivision.

The proposed subdivision will be comprised of predominantly 96 single-family residential homes but will also include 4 commercial buildings. In accordance with the RM of Corman Park No. 344 bylaws new multiparcel residential developments require potable water to be supplied via a piped distribution network. As such there will be no new potable water wells installed at the site and thus, there will not be the possibility of a nitrate plume intercepting a potable water well on the site.

The study site is bordered by predominantly sparse residential (acreage) development, cultivated agricultural land and individual farms/farmyards. Several residential houses and farms/farmyards are located downgradient of the site (i.e., southeast of the study site). It is possible that groundwater wells could be utilized as a potable water source by single-family residential property.

Based on a review of satellite imagery (Google, 2022) the closest surface water body is a slough located in the northeast corner of the site and is cross gradient (northeast) to the apparent direction of groundwater flow (southeast). There is also a surface water body located downgradient of the study site at its closest point approximately 50 m towards the southeast. The sloughs on the study site appear to be closed end in dry years, while they appear to overflow in wet years.

As part of the Conceptual Drainage Summary Report prepared by Associated Engineering (Sask.) Ltd. (AE) for the proposed subdivision (AE, 2022), it has been proposed that both natural depressions and manmade stormwater collection ponds will be constructed at the site.

5 SITE IMPACT ASSESSMENT

The OWTS assessment included an evaluation of the potential for groundwater mounding as a result of OWTS effluent released at the site and the fate and transport of nitrate contained within the OWTS effluent.

5.1 LEVEL OF CURRENT NITRATE ASSESSMENT

In accordance with GOS (2012), a preliminary nitrate assessment is required as part of all Level 1 and 2 assessments. A cumulative nitrate assessment is only necessary where the probability of a water well intercepting an OWTS effluent plume is greater than 90%.

The probability of a water well intercepting an OWTS effluent plume is contingent on:

1. The presence of existing water wells or the potential for new water wells to be installed within 1 km downgradient of the site in the apparent groundwater flow direction; and

2. The percentage of the total flow area exiting the site that is occupied by OWTS effluent plume(s).

5.1.1 WATER WELLS

The RM of Corman Park No. 344 bylaws stipulate in their Zoning Bylaws, that all new multi parcel residential subdivision developments must be serviced by a centralized potable waterline and prohibits the installation of potable groundwater wells for multi-parcel residential developments. Therefore, all new subdivisions to be constructed downgradient of the site cannot install a water well as a potable water source. It is understood that Casa Rio East subdivision has reservoir storage and distribution system for delivery of potable water to residents.

The only water wells that could be potentially intercepted by an OWTS would be those groundwater wells that existed prior to the implementation of the new Zoning Bylaws or new water wells installed for a single-family residential development. The nearest existing or future water well downgradient of the site, would be a water well associated with the residential houses and farms/farmyards located towards the southeast of the site.

5.1.2 PERCENTAGE OF AREA OCCUPIED BY OWTS PLUMES

Another prerequisite to a theoretical OWTS nitrate plume intersecting a downgradient water well, is the width of the plume(s) relative to the overall flow width. To calculate this, potential OWTS's were superimposed onto a plan of the proposed subdivision. It was assumed that each system would have an average width of 20 m and that the groundwater nitrate plume(s), exiting each OWTS, would travel generally parallel to the overall groundwater flow direction.

It is well understood that a groundwater nitrate plume will maintain a nearly consistent width as it travels through the shallow groundwater zone with minimal lateral dispersion (will widen by approximately 5^{o} on both sides) in most geological settings (MDEQ, 2015).

To be conservative, the OWTS were arranged on each proposed lot such that the OWTS effluent plumes migrated parallel to each other, maximizing the width of the combined nitrate plume travelling across the site. The probability of the nitrate plume intersecting a well was then determined by comparison of the total flow width occupied by all the nitrate plumes to the total maximum available flow width perpendicular to the groundwater flow direction. Using this approach, it was determined that the probability of the groundwater nitrate plume intersecting a downgradient water well would be over 90%. Although, this approach does not consider widening of the effluent plumes as they migrate from an OWTS, this should be negated by the fact that the theoretical OWTS locations were purposely misaligned to obtain a maximum combined plume width relative to the total flow width.

5.1.3 SUMMARY

As per GOS (2012), a cumulative nitrate assessment is required for the property as the probability of the groundwater nitrate plume intersecting a downgradient water well is greater than 90%.

It was recommended that a cumulative nitrate assessment be conducted for the property based on the following:

1. There is the potential for an existing or future water well to be constructed within 1.0 km downgradient of the site; and
2. The probability of the groundwater nitrate plume intersecting a downgradient water well is greater than 90%.
3. It is estimated that the combined width of the OWTS effluent plumes would occupy over 90% of the total available flow width.

The site is also classified as a sensitive area due to its proximity to other approved subdivisions that could utilize potable groundwater and the presence of a surficial aquifer underlying the site.

5.2 NITRATE ASSESSMENT MODEL

The purpose of the cumulative nitrate assessment was to evaluate the combined effect of the nitrate from all the onsite OWTS and other potential sources of nitrate proximate the proposed subdivision (i.e., fertilizer application, intensive livestock operations, lagoons, landfills, etc.). A predictive based assessment, using the Wehrman (1983) mass balance nitrate dilution model, was conducted to evaluate the cumulative effects of nitrate on potential receptors.

As discussed previously, the closest surface water body is a slough located in the northeast corner of the site and is cross gradient (northeast) to the apparent direction of groundwater flow (southeast). There is also a surface water body located downgradient of the study site at its closest point approximately 50 m towards the southeast. In consideration of the above, the SKMoE referenced endpoints for protection of the potable groundwater pathway (10 mg/L) were used for assessment purposes.

The Washington State Department of Health (WDoH, 2017) nitrate dilution model was used to assess potential impacts resulting from theoretical nitrate plumes emanating from individual OWTS systems located on the site. Like the Wehrman (1983) model, the WDoH (2017) model also utilizes a mass balance approach but assumes that groundwater recharge only occurs over the area directly below the OWTS. The model also assumes that the precipitation recharge used to dilute nitrate concentrations only occurs over an area as wide as the OWTS.

5.3 CUMULATIVE NITRATE CONCEPTUAL MODEL

As discussed previously (Section 4.3) effluent released from OWTS at the study site is expected to migrate vertically downward until it reaches the upper (shallow) groundwater surface. It is then expected to travel horizontally along the top of the groundwater table in the overall direction of groundwater flow (i.e., southeast). Based on the information reviewed as part of this assessment the surficial aquifer underlying the site is also present below the adjacent properties and the geological and hydrogeologic properties are similar.

Once the nitrate enters the shallow surficial aquifer underlying the study site it may be diluted by recharge from precipitation infiltrating across the surface of the study site and groundwater entering from upgradient of the study site. The infiltrating precipitation and groundwater recharge are potential sources of nitrate.

The apparent direction of the near surface groundwater flow at the study site is expected to be towards the southeast. As such groundwater recharge entering the study site would be primarily from the northwest of the site. The concentrations of nitrate in the groundwater to the northwest would be affected by the associated land use in these areas and potential upgradient sources. It is assumed the nitrate laden groundwater recharge from the upgradient properties will provide a constant source of nitrate and will be fully mixed when it enters the site.

The properties directly to the northwest of the study site are predominantly cultivated farmland with sparse residential development. Fertilizer applied to the surface of the cultivated agricultural land contains nitrogen that will likely leach into the underlying groundwater with infiltrating precipitation. No other major sources of nitrates (i.e., municipal sewage lagoons, landfills, etc.) appear to be located near the study site.

The properties occupied by Casa Rio East and South Point subdivisions are located more than 800 m west and northwest of the site, respectively. These subdivisions utilize OWTS for management of its septic waste, which would provide a source of nitrate to the underlying groundwater.

Groundwater samples of the upgradient groundwater to the study site were not collected as part of this investigation. As the proposed subdivision has historically been used for cultivated agriculture, it was assumed that the maximum measured nitrate concentrations from groundwater samples collected on site as part of this investigation would be representative of the upgradient groundwater.

5.4 NITRATE DILUTION MODEL AND MODEL INPUTS

The Wehrman (1983) mass balance nitrate dilution model was selected to conduct the cumulative nitrate assessment for the proposed subdivision. The Wehrman (1983) nitrate dilution model takes into consideration the cumulative addition of nitrate from the entire subdivision (i.e., the combined nitrate from individual OWTS) and dilution across the entire subdivision (i.e., groundwater recharge and precipitation). Sources of nitrate considered in the Wehrman (1983) mass balance model include: nitrate within the OWTS effluent, background groundwater, and precipitation. The model considers the magnitude of the hydraulic gradient but does not consider the groundwater flow direction.

The Wehrman (1983) model assumes that the average nitrate concentration in groundwater leaving the site, C_o, is the sum of all nitrate sources in the system divided by the total volume of water in the system.

$$C_o = \frac{M_b + M_i + M_S - M_P}{(V_b + V_i + V_s - V_P)}$$

Where:

M_b = the mass of nitrate of groundwater recharge entering the site (mg/day)

M_i = the mass of nitrate in precipitation entering the site (mg/day)

M_s = the total mass of nitrate in the wastewater effluent from all the OWTS (mg/day)

M_p = the mass of nitrate removed from the system due to pumping from water wells (mg/day)

V_b = the volume of groundwater recharge across the width of the site, perpendicular to the groundwater flow direction, across the depth of the mixing zone (L/day)

V_i = the volume of groundwater recharge due to precipitation occurring across the entire surface area of the site (L/day)

V_s = the total volume of wastewater being added to the system from all the OWTS (L/day)

V_p = the volume of groundwater being removed from the system due to pumping from water wells (L/day)

An explanation of each term and the value used in the Wehrman (1983) mass balance nitrate dilution model are summarized below. Example calculations for select scenarios that illustrate the overall outcome of the nitrate assessment model results are provided in Appendix F.

5.4.1 GROUNDWATER RECHARGE

The mass of nitrate in the background groundwater recharge was calculated as follows:

$$M_b = V_b C_b$$

$$V_b = KiA(86{,}400{,}000)$$

Where:

$$A = W_P D_A$$

C_b = the concentration of nitrate in groundwater recharge entering the site (mg/L)

K = the hydraulic conductivity of the aquifer (m/s)

i = the lateral hydraulic gradient of the aquifer (m/m)

A = the cross-sectional area through which groundwater recharge is occurring (m^2)

W_P = the width of the site perpendicular to the groundwater flow direction (m)

D_A = the assumed depth of the aquifer where mixing takes place (m)

86,400,000 is a multiplier to convert from m^3/s to L/day

Groundwater nitrate Concentrations

As discussed in Section 4.3, groundwater recharge originates from the properties upgradient of the study site, The nitrate concentration of the groundwater recharge was assumed to be equal to the maximum nitrate concentration measured at the study site.

The concentration of nitrate was elevated in all the samples analyzed, and exceeded the referenced endpoints in the groundwater samples recovered from monitoring wells 21-8, 21-15A, 21-16, 21-22A, 21-24A, and 21-26A. The maximum nitrate concentration measured at the study site was 38 mg/L in groundwater samples recovered from Monitoring Well 21-16.

The nitrate concentrations in the remaining groundwater samples analyzed from the study site were below Tier 1 Agricultural Endpoint (3 mg/L). All the monitoring wells at the site are screened across the uppermost groundwater zone and should intersect groundwater nitrate plumes migrating across the site. Groundwater nitrate flumes are expected to remain close to the surface of the upper groundwater table at the study site. Based on the May 5, 2021 monitoring event, the surficial sand aquifer at the site ranged from approximately 0.4 to 12 m thick.

Groundwater Recharge and Flow Area

Based on the groundwater monitoring results, the depth to groundwater on May 5, 2021 ranged from approximately 1.4 to 5.7 m (average of 2.8 m) below existing grade (elevation of 505.1 to 506.6 m). The apparent direction of groundwater flow on May 5, 2021 was towards the southeast (approximately 100^{o} from north) at an average gradient of 0.0009.

The width of the site perpendicular to the direction of groundwater flow was determined to be approximately 1,790 m. The depth of the uppermost shallow aquifer (mixing depth) below the site was assigned a maximum value of 6.1 m as per guidance provided by WDoH (2017).

5.4.2 PRECIPITATION RECHARGE

The mass of nitrate in the precipitation recharge was calculated as follows:

$$M_i = V_i C_i$$

$$V_i = A_i R_i (1{,}000)$$

Where:

C_i = the nitrate concentration in precipitation recharge (mg/L)

A_i = the surface area contributing to precipitation recharge (m^2)

R_i = the amount of rainfall infiltrating and recharging the underlying groundwater zone (m/day)

1,000 is a multiplier to convert from m^3 to Litres (L)

Precipitation Nitrate Concentrations

A nitrate concentration of 1 mg/L was assumed for precipitation based on information provided in Wehrman (1983). This value is considered to be conservative based on a review of literature reported values and/or the default values provided by other analytical methods (WDoH, 2017).

Precipitation Recharge and Infiltration Surface

The total area of the proposed subdivision is approximately 128 hectares (316 acres). The proposed drainage plan is to utilize existing sloughs at the site as stormwater collection ponds for temporary containment of overland flow within each catchment area. It is understood that this water will not be directed offsite with the intent that it will infiltrate into the soils underlying the site. It is assumed that all rainwater collected from the eavestroughs would eventually be released and enter the groundwater zone minus any losses due to evapotranspiration. Therefore, the total area of the site was considered to provide precipitation recharge.

The total annual precipitation was assumed based on the average annual precipitation of 350 mm/year for Saskatoon, Saskatchewan (Environment Canada, 2022). It was assumed that only 15% of the total annual precipitation (approximately 53 mm/year) infiltrates into the groundwater zone due to evapotranspiration and runoff, which is close to the default infiltration rate for coarse grained soils (60 mm/year) suggested by AEP (2019) and default values provided by Wehrman (1983) and WDoH (2017).

5.4.3 WASTEWATER EFFLUENT

The mass of nitrate in the OWTS effluent was calculated as follows:

$$M_s = V_s C_s$$

$$V_S = PHQ_P\text{A}$$

Where:

C_s = the nitrate concentration in wastewater effluent from the OWTS (mg/L)

P = the number of people per household

H = the lot density

Q_P = the average per capita wastewater volume (L/day)

Wastewater Effluent Concentration

A range of nitrate concentrations were used to represent the wastewater effluent based on the types of advanced treatment systems that would potentially be specified for the site based on compatibility with site specific conditions (i.e., soil and groundwater conditions).

Wastewater Volumes

As shown on Drawing No. 17788-1, the proposed subdivision will have 100 lots, each with their own OWTS. This will include 96 single family residential homes, and 4 commercial buildings.

Information provided in GOS (2018) was used to determine the occupancy and expected sewage volume for each type of lot:

- **Single family residential home**: A value of 2 persons per bedroom was assumed for a 2-bedroom home and a value of 1.5 persons per bedroom for a 3-bedroom home. It was assumed that each home would contain at least 3 bedrooms resulting in 4.5 persons per lot.
- **Commercial Building**: It was assumed that each commercial building was 1,115 m^2 (12,000 ft^2) and had 50 employees.

In accordance with GOS (2018), the expected sewage generated by a single-family residential home was 340 L/person/day while a volume of 90 L/employee/day was assumed for each commercial building (with shower).

Information provided in GOS (2018) indicates it is acceptable to use the average per capita sewage volume when calculating the expected OWTS effluent volumes as part of a nitrate assessment. The peak per capita sewage volume is typically not sustained on a long-term basis.

As such the use of the average per capita sewage volume, rather than the peak per capita wastewater volume, is considered to provide representative estimates of the nitrate loading from an OWTS (Froese, et al., 2009). In consideration of the above an average per capita wastewater volume of 227 litres/person/day was used in this assessment.

5.4.4 WATER WELL PUMPING

As per the RM of Corman Park No. 344 bylaws, the installation of a groundwater well for potable water use is prohibited. The installation of non-potable groundwater wells is not anticipated. As such, groundwater removal due to pumping was not considered in this assessment.

5.4.5 ASSESSMENT CRITERIA

As discussed above, the existing properties and the proposed subdivision are and/or will be connected to a potable water distribution system. As such the groundwater below the study site will not be used as a potable water source.

A review of satellite imagery (Google, 2022), the closest surface water body is a slough located in the northeast corner of the site and is cross gradient (northeast) to the apparent direction of groundwater flow (southeast). There is also a surface water body located downgradient of the study site at its closest point approximately 50 m towards the southeast. The sloughs on the study site appear to be closed end in dry years, while they appear to overflow in wet years.

As part of the Conceptual Drainage Summary Report for the proposed subdivision (AE, 2022) several of the sloughs at the study site will be converted to function as stormwater collection ponds.

In consideration of the above, the SKMoE (2022) SEQS Tier 1 Agricultural Endpoint for the protection of the potable groundwater pathway (10 mg/L) was utilized to assess nitrate concentrations in the groundwater.

5.4.6 SENSITIVITY ANALYSIS

A sensitivity analysis was completed for each analytical model to evaluate the effects of the range of site measured parameters and hydrogeological conditions on the estimated nitrate concentration and groundwater mounding height. The hydraulic conductivity values (4×10^{-8} to 2×10^{-6} m/s), hydraulic gradient value (0.0009 m/m), background nitrate concentration (0.5 to 38 mg/L), specific yield (0.1 to 0.2), and OWTS effluent nitrate concentrations (9 and 50 mg/L), were used in minimum and maximum combinations within the models.

Select parameters were not included in the sensitivity analysis since their assigned values were assumed to be conservative and/or representative of site conditions (i.e., background precipitation and nitrate concentration), well documented (i.e., sewage effluent volume), and or the fixed (i.e., total parcel size).

The results of the sensitivity analysis revealed that the simulated nitrate concentrations were not sensitive to the range of hydraulic conductivity and hydraulic gradients values used in the model. The reason for this is that the volume of groundwater recharge was insignificant in comparison to the volume of OWTS effluent and the precipitation volume. Since the volume of groundwater recharge is insignificant in comparison to the volume of OWTS effluent or precipitation, for the range of measured input values, the simulated nitrate concentration was also insensitive to changes in the background nitrate concentration.

Similarly, the simulated groundwater mounding height was relatively insensitive to changes in the groundwater recharge rate (vertical hydraulic conductivity). This is likely due to the fact even where a restrictive horizontal soil is encountered there is sufficient horizontal hydraulic conductivity that effluent would be able to flow laterally away the OWTS resulting in minimal groundwater mounding.

5.4.7 NITRATE CONCENTRATION FOR CONVENTIONAL OWTS

The Wehrman (1983) mass balance nitrate dilution model was used to predict the effects of the OWTS to be constructed on the proposed subdivision. Input parameters used for the model were as follows:

Hydraulic conductivity	8.5×10^{-7} m/s – average site specific (measured)
Hydraulic Gradient	0.0009 – average site specific (measured)

Mixing zone thickness	6.1 m – assumed (model default value)
Aquifer width perpendicular to flow	1,790 m – site specific
Total Subdivision Area	316 acres – site specific
Total Number of Lots	114 – site specific (No. of equivalent residential lots for each commercial lot – 4.4)
Septic Tank Effluent (volume)	1,021.5 L/day/home (GOS, 2018) – 3 bedroom house (average daily volume – 227 L/day/person)
Natural Recharge Rate	53 mm/year (assumed to be 15 % of annual precipitation)
Upgradient Nitrate Concentration	10.5 mg/L – site specific (measured) – assumed to represent average background site concentration
Septic tank nitrate concentration	50 mg/L – assumed for standard OWTS
Denitrification Rate	0 – assumed (model default value)
Nitrate concentration in precipitation	1 mg/L – assumed (model default value)

As detailed in Appendix F, the Wehrman (1983) mass balance nitrate dilution model predicted that an average nitrate concentration of 20 mg/L would be generated at the downgradient edge (southeast) of the proposed subdivision if conventional OWTS were used for each of the proposed lots at the site. In other words, the average nitrate concentration leaving the proposed subdivision would exceed the allowable SKMoE (2022) Residential Endpoint for protection of the potable groundwater pathway (10 mg/L).

5.4.8 ADVANCED TREATMENT SYSTEM NITRATE CONCENTRATIONS

As discussed in the previous section, use of conventional OWTS at the site would result in an average nitrate concentration (20 mg/L) that exceeds the allowable potable water endpoint (10 mg/L). As such additional simulations were conducted using the Wehrman (1983) model to determine the required effluent concentration to achieve an average nitrate concentrations less than 10 mg/L at the site boundary. Example calculations for select model results are presented in Appendix F.

Results of the additional simulations revealed that if the nitrate concentration discharged from an advance treatment OWTS (i.e., Ecoflo Coco Filter ECDn Model or equivalent) was 19 mg/L, the average nitrate concentration leaving the site would be 8.0 mg/L, which is below the allowable SKMoE (2022) Endpoint for protection of the potable groundwater pathway (10 mg/L).

Based on the above, additional simulations were performed, using the Washington State Department of Health (WDoH, 2017), model to determine the setback distance required for an effluent concentration of 19 mg/L to dissipate to 10 mg/L or less. For these assessments it was assumed that each soil treatment system would be 20 m wide by 20 m long. The remaining parameters applied in the WDoH (2017) model were the same as those used in the Wehrman (1983) model as described above (Section 5.4). An iterative modeling approach was then used to determine the setback distance. Example calculations for select model results are presented in Appendix F.

Results of the simulations revealed that a setback distance of approximately 220 m would be required for a nitrate concentration of 19 mg/L, released from an advance treatment OWTS to dissipate to 10 mg/L or less. In consideration of the above, all OWTS constructed closer than 220 m from the site property line, must be capable of reducing the average effluent nitrate concentration to less than 9 mg/L.

5.5 GROUNDWATER MOUNDING

An assessment of groundwater mounding was completed using the USGS (2010) Microsoft Excel worksheet that is based on the analytical solution developed by Hantush (1967). The analytical solution requires knowledge of select site and system parameters (i.e., vertical and horizontal hydraulic conductivity, system size, hydrogeological conditions, etc.). The applicable site measured parameters and hydrogeological conditions were varied in the analytical solution to evaluate the potential range of groundwater mounding that may be experienced. Various combinations of the minimum (clay), and maximum (sand) hydraulic conductivity values were input for the horizontal hydraulic conductivity in the analytical solution.

In accordance with USGS (2010), the measured hydraulic conductivity values used for the recharge rate were divided in half as a factor of safety. Specific yields of 0.1 and 0.2 were assumed for the clay and sand/silt materials, respectively (Sanders, 1998). The septic field was assumed to be approximately 20 m long by 20 m wide and the peak daily sewage volume (340 L/person/day x 4.5 persons = 1,530 L/day) was applied to the soil treatment system to be conservative.

The simulated groundwater mounding below the OWTS, for the scenarios analyzed, ranged from 0.03 to 1.10 m. The relatively small mounding height appears to be reasonable based on the predominant soil types (sand).

5.6 GROUNDWATER MONITORING

The use of OWTS and/or advance treatment OWTS, as specified in this report, should provide adequate protection of downgradient groundwater users and/or the environment. As such it should not be necessary to monitor groundwater quality downgradient of the site.

6 OWTS FEASIBILITY

6.1 ADVANCED OWTS

As discussed previously, a cumulative nitrate assessment (Appendix F) predicted that the average cumulative nitrate concentration, generated from the 100 proposed OWTS (96 residential lots and 4 commercial lots), would be 20 mg/L at the downgradient (southeast) edge of the proposed subdivision. Therefore, advanced package treatment systems (i.e., treatment plant coupled with a standard soil treatment system) will be required to ensure that the effluent quality entering the receiving environment will not adversely impact downstream groundwater users and/or the environment.

It was determined that if advanced package treatment systems, that could reduce the effluent nitrate concentrations to less than 19 mg/L, were used on each lot, the aggregate nitrate concentration released by all the lots in the subdivision would be less than 10 mg/L. However, additional assessment revealed that the nitrate plume emanating from a system with an effluent nitrate concentration of 19 mg/L would require at least 220 m to be diluted below 10 mg/L. As such the maximum effluent nitrate concentration released from an OWTS within 220 m of a property boundary must be less than 10 mg/L.

If two (2) different advanced treatment systems are utilized (i.e., effluent nitrate concentration of less than 19 mg/L for distance exceeding 220 m from boundary and effluent nitrate concentration less than 9 mg/L for distances less than 220 m from property boundary), the resulting average nitrate concentration across the site is expected to range from 4.1 to 8.0 mg/L.

In consideration of the above, the following advanced package treatment system types/specifications are considered suitable for the proposed subdivision:

- **Lots where the OWTS would be constructed within 220 m of the property boundary:** an advanced package treatment system meeting or exceeding NSF-40, NSF245, and NSF-350 standards (i.e., Bio-Microbics BioBarrier-N MBR or equivalent) with an average effluent nitrate concentration of less than or equal to 9 mg/L.
- **Lots where the OWTS would be constructed greater than 220 m from the property boundary:** an advanced package treatment system meeting or exceeding NSF-40 and NSF-245 standards (i.e., Ecoflo Coco Filter ECDn Model or equivalent) with an average effluent nitrate concentration of less than or equal to 19 mg/L.

6.2 CONVENTIONAL SOIL TREATMENT SYSTEM/OWTS TYPES

6.2.1 HOLDING TANKS

The subject property is considered suitable for use of holding tanks to store sewage and wastewater until it can be transported to a final point of disposal.

6.2.2 LAGOONS

Lagoons are not considered an acceptable system for the site since parcel sizes at the site are less than 4 hectares.

6.2.3 TYPE I MOUNDS AND JET TYPE DISPOSAL SYSTEM

Jet type and Type I mounds are not acceptable as the proposed subdivision is high density and is considered a sensitive area.

6.2.4 TYPE II MOUNDS

Following advanced treatment, Type II Mounds are considered to be acceptable soil treatment systems (i.e., drainfield) to transmit sanitary effluent into the soil. Construction of Type II Mounds and associated works should be performed in accordance with GOS (2018). Site selection of the specific location of proposed Type II Mounds will be contingent on groundwater conditions and soil stratigraphy. Further investigation (i.e., Test Pits, Test Borings, percolation testing, etc.) should be performed at the specific site of the proposed Type II Mounds prior to installation to optimize the site selection and confirm site suitability.

6.2.5 CHAMBER SYSTEMS

Sanitary effluent collected in an adequately constructed advanced treatment system can be transmitted into the soil using a Pressure Chamber System. Construction of Chamber Systems and associated works should be performed in accordance with GOS (2018). The base of the Chamber System requires a separation distance of at least 1.5 m from the high groundwater table. As such site selection of the specific location of proposed Chamber System will be contingent on groundwater conditions and soil stratigraphy. Further investigation (i.e., Test Pits, Test Borings, percolation testing, etc.) should be performed at the specific site of the proposed Pressure Chamber System prior to installation to optimize the site selection and confirm site suitability.

6.2.6 ABSORPTION FIELD SYSTEMS

Sanitary effluent from an adequately constructed advance treatment system can be transmitted into the soil using Pressure Absorption Field Systems. Construction of Pressure Absorption Field Systems and associated works should be performed in accordance with GOS (2018). The base of Absorption Field Systems requires a separation distance of at least 1.5 m from the high groundwater table. As such site selection of the specific location of proposed Absorption Field Systems will be contingent on groundwater conditions and soil stratigraphy.

Further investigation (i.e., Test Pits, Test Borings, percolation testing, etc.) should be performed at the specific site of the proposed Pressure Absorption Field Systems prior to installation to optimize the site selection.

6.2.7 SUMMARY

The type of soil treatment system selected for any individual lot will be based on the soil and hydrogeological conditions encountered at the location where the system is to be installed. Based on the results of this assessment there is more than adequate area (including reserve area) with suitable soil and hydrogeological conditions for the construction of an OWTS on each of the proposed lots. Therefore, specific locations for OWTS placement, or reserve areas, were not specified as part of this investigation. This is preferable as it provides the future landowner with some degree of design and architectural flexibility.

In accordance with Government of Saskatchewan regulations (GOS, 2018) and/or bylaws a detailed soils assessment will be necessary for each individual lot where an OWTS system will be installed. The detailed soils assessment will be conducted where the OWTS is proposed and will need to be completed prior to obtaining a final building permit.

6.3 SOIL CONSISTENCY

Based on the results of this assessment, the surficial soils (i.e., upper 2.0 m) at the site were generally classified as silt loam, loam, sandy loam or loamy sand. As such there are sufficient areas across the site where the soil consistency is suitable for one or more of the soil treatment systems specified above.

6.4 VERTICAL SEPARATION DISTANCE (VADOSE ZONE)

GOS (2018) recommends that a minimum vadose zone, from the bottom of the infiltrative surfaces (i.e., bottom of dispersal trench) to the surface of the water table or restrictive layer be a depth of 1.5 m for primary effluent and 0.9 m for secondary treated effluent.

The depth to groundwater on May 5, 2021, ranged from approximately 1.4 to 5.7 m (average of 2.8 m) below existing grade (elevation of 505.1 to 506.6 m).

A review of the results for vertical separation distance presented in Table VII revealed the following:

1. The required vadose zone depths for the soils at the site range from 0.2 to 10.4 m based on the range of hydraulic conductivity values.
2. Out of 9 calculated required vadose zone depths, 3 calculated values were less than the minimum separation distance of 1.5 m and would provide sufficient vadose zone retention time to effectively remove pathogens from OTWS effluent.
3. The areas where the required vadose zone depth exceeded the minimum recommended values were areas with a higher content of sand.

The calculated vadose zone depths were determined using the field measured hydraulic conductivity values, which are typically more representative of the horizontal hydraulic conductivity. The vertical hydraulic conductivity is typically one (1) to two (2) orders of magnitude lower and therefore, the expected effluent infiltration rate would be slower and less vadose zone depth would be required to achieve the recommended retention time and associated pathogen removal rate. Therefore, the depth to the uppermost groundwater table at the site is expected to be sufficiently deep to provide adequate unsaturated soil (vadose zone) below the soil treatment systems. In addition, since each OWTS will require some level of advanced treatment the OWTS effluent is classified as secondary treated effluent. As such, the required vertical separation can be reduced from 1.5 to 0.9 m below the infiltration surface. Drainfield areas should bType II Mounds (i.e., raised field) should be used for drainfield located in high groundwater areas.

6.5 DRAINAGE CONSIDERATIONS

A copy of the Conceptual Drainage Summary Report, prepared by Associated Engineering (Sask.) Ltd. (AE, 2022) for the site, has been included in Appendix A of this report. In accordance with the AE (2022), the following recommendations should be followed:

1. The safe building elevation should be maintained by adding 0.5 m above the nearest downstream spill elevation at the site.

2. Ditches are proposed through several lots to minimize any downstream impacts and to reduce the runoff from the site.

6.6 SETBACKS AND RESERVE AREA

Based on the current development plan there is adequate space on each lot for the construction of an OWTS (including reserve area) whilst maintaining the required setback distances to potential site infrastructure (e.g., basement/building, walkways, etc.), property boundaries, and water courses. There will be not be any potable groundwater sources (i.e., wells) located on the site.

For illustrative purposes, the available reserve area for the smallest lot on the proposed subdivision was estimated. This calculation takes into consideration the required setback distances from the property boundaries where an OWTS is prohibited and the area occupied by a typical home, outbuilding, driveway, and the OWTS itself.

- The smallest lot (Lot 23 Block 1) within the proposed subdivision is approximately 0.22 hectares (0.53 **acres**) or 2,150 m^2 and has an approximate width of 24 m and a length of 90 m.

- Applying setback distances of 5, 8, and 2 m for the front, back, and side yards, respectively the area occupied by the setback is approximately 620 m^2. For this calculation it is assumed that an OWTS cannot be constructed within these areas. As per GOS (2018), the required setback from the property boundary is 3 m for a package treatment system. As such the applied setback area is conservative and should be sufficient to account for other site infrastructure (e.g., building, walk/driveway, etc.).
- It is assumed that a developed area of 680 m^2 was used to represent the area occupied by a typical home (500 m^2), outbuilding (80 m^2), and driveway (100 m^2).
- The OWTS was assumed to be approximately 400 m^2 (20 x 20 m).

$$\text{Reserve Area} = \text{Lot size} - \text{setback area} - \text{developed area} - \text{OWTS area}$$

$$\text{Reserve Area} = 2{,}150\text{m}^2 - 620\text{m}^2 - 680\text{m}^2 - 400\text{m}^2$$

$$\text{Reserve Area} = 450\text{m}^2$$

The calculated reserve area for the smallest lot is more than sufficient to support the construction of a replacement OWTS. As such each lot within the proposed subdivision will have more than adequate reserve area for the construction of a replacement OWTS.

6.7 TOPOGRAPHIC CONSTRAINTS

From field observations and a review of information provided in the conceptual drainage summary report (AE, 2022), there are no topographic features (i.e., cuts, banks, slopes, landscaping, etc.) that would make any lot unsuitable for the construction of an OWTS.

As the site is naturally rolling and is not intended to have any significant cuts, slopes, or banks there does not appear to be any slope stability concerns related to the construction of an OWTS anywhere on the site. OWTS systems should not be constructed within natural surface water drainage pathways and/or in close proximity to natural or manmade stormwater catchment ponds.

6.8 INDICATIONS OF WET/POOR SOIL CONDITIONS

Based on observations made during the field investigation, low lying areas or several wetlands/sloughs are present onsite. Those areas where wet/poor soils conditions exist are not suitable for use as OWTS. It is recommended that if OWTS are required to be constructed on those areas, further soil testing and site development will be required prior to constructing the OWTS.

7 RECOMMENDATIONS

The following recommendations are provided based on the results of this assessment:

- The use of onsite wastewater treatment systems (OWTS) are well suited to manage sanitary sewage generated at the site.
- Two (2) types of advanced package treatment systems will be required at the site to ensure protection of downgradient groundwater users and/or the environment:

- **Lots where the OWTS would be constructed within 220 m of the property boundary:** an advanced package treatment system meeting or exceeding NSF-40, NSF245, and NSF-350 standards (Bio-Microbics BioBarrier-N MBR or equivalent) with an average effluent nitrate concentration of less than or equal to 9 mg/L.
- **Lots where the OWTS would be constructed greater than 220 m from the property boundary:** an advanced package treatment system meeting or exceeding NSF-40 and NSF-245 standards (i.e., Ecoflo Coco Filter ECDn Model or equivalent) with an average effluent nitrate concentration of less than or equal to 19 mg/L.

- It is recommended that the type of advanced treatment system required for each lot to be specified in each purchase agreement.
- One or more of the following soil treatment systems/OWTS types were determined to be suitable based on the soil and hydrogeological conditions at the site:
  - Holding Tanks
  - Type II Mounds
  - Chamber Systems
  - Absorption Field System
- In accordance with GOS (2018), the following OWTS are not considered to be suitable for use at the site:
  - Lagoons are not acceptable as all the lots are smaller than 4 hectares.
  - Jets and Type 1 mounds are not acceptable as the proposed subdivision is high density and is considered a sensitive area.
- Prior to receiving approval of the building permit, a detailed soils assessment should be conducted for each individual lot to confirm the soil and groundwater conditions for selection and design of an appropriate soil treatment system. The detailed soils assessment and system installation should be conducted by a certified septic system contractor or qualified professional. As outlined by GOS (2018), details regarding system operation and maintenance must be supplied to the homeowner by the permit applicant.
- System maintenance should be conducted by a certified septic system contractor and conducted at the frequency recommend by the system manufacturer.

8 LIMITATIONS

The hydrogeological investigation has been completed as authorized. As part of geotechnical investigation at the site (PMEL, 2021), a total of forty-six, 150 mm diameter test holes were dry drilled using our continuous flight auger drill rig. 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.

Variations in the subsurface conditions from that shown on the drill logs at locations other than the exact Test Hole 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.

No identifiable evidence (i.e., odours, visual observations, etc.) of environmentally sensitive materials 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.

It is recommended to decommission all monitoring wells once they are no longer needed. PMEL will not accept any future liability associated with inadequate decommissioning of monitoring wells. Costs for decommissioning can be provided by PMEL upon request.

This report has been prepared for the exclusive use of Oja Holdings Ltd. and their agents for specific application to the proposed Greenview Estates subdivision to be constructed within SE-24-35-5-W3M and NE-13-35-5-W3M, south of Saskatoon, Saskatchewan. It has been prepared in accordance with generally accepted hydrogeological services and no other warranty, express or implied, is made.

The report should be referenced in its entirety, in order to properly understand the suggestions, design considerations and recommendations provided in this report. 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 design/construction recommendations presented in this report is contingent on adequate and/or full time inspection (as required, based on site conditions at the time of construction) by a representative of the Geoenvironmental 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.

If this report has been transmitted electronically, it has been 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.



Arjun Paul, M.A.Sc., P.Eng.

Ray Machibroda, M.Sc., P. Eng.

AP:RM:zz

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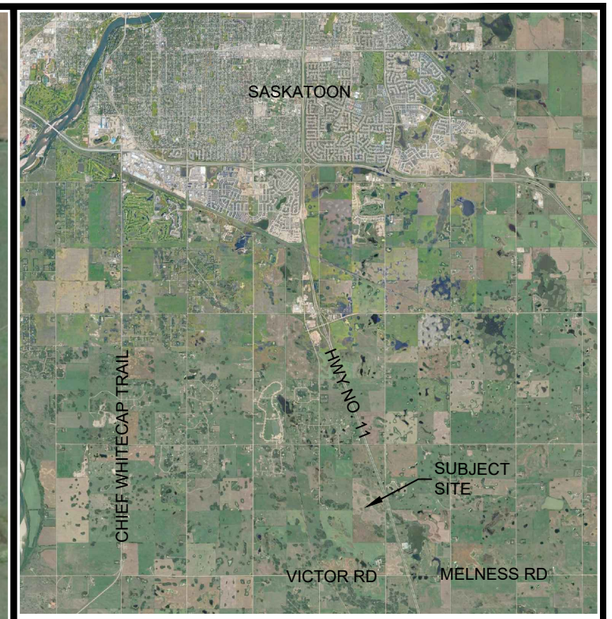
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DRAWINGS

(Prepared for Geotechnical Investigation)

P.MACHIBRODA ENGINEERING LTD.





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 ©2021, IMAGE ©2021 DIGITALGLOBE, (IMAGERY DATE: 08/23/15).
3. ELEVATION AND COORDINATES FOR EACH BOREHOLE ARE PROVIDED BY DIGITAL PLANIMETRICS.

LEGEND

–PMEL BOREHOLE

–PMEL PIEZOCONE PENETRATION TEST

–PMEL MONITORING WELL

P. MACHIBRODA ENGINEERING LTD.

CONSULTING
GEOENVIRONMENTAL
GEOTECHNICAL
ENGINEERS

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SASKATOON, SK
S7K 3Y4

DRAWING TITLE:
SITE PLAN
BOREHOLE AND PIEZOCONE LOCATIONS

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION SE-24-35-05-W3M AND NE-13-35-05-W3M, SOUTH OF SASKATOON SK

APPROVED BY: CZ	DRAWN BY: TP
DATE: MAY, 2021	DRAWING NUMBER: 17789-1
SCALE: AS SHOWN	

P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-1

DRAWING NUMBER: 17789-2

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

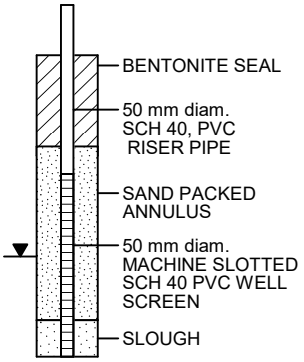
NORTHING (m): 5764329 **EASTING (m):** 391184 **ELEVATION (m):** 508.5 **DATE DRILLED:** APR 13/21

SAMPLE TYPE: CUTTINGS SPLIT SPOON SHELBY TUBE

WATER LEVELS
After Drilling
During Drilling

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		TOPSOIL, organic, moist, black, rootlets.			12.3					
					10.4					
1		SAND, silty, some clay, loose, poorly graded, fine grained, moist, dark brown.			12.3					
					13.6					
		brown below 0.7 m.		8	16.7					
2		silty, wet, seepage, sloughing below 2.3 m.								
3					28.4					
4		CLAY, silty, trace sand, firm, medium plastic, moist to wet, brown, oxide stained.								
				6	36.0					
5										
6					35.9	46	21			
7		grey below 7.0 m.			35.1					
8		highly plastic, moist below 8.3 m.								
9					35.1	50	19			0.5
10					35.1					0.5
11										
12										

MONITORING WELL: BH 21-1A
ELEV.: 509.6



NOTE:
1. Borehole sloughed to 2.9 m Immediately After Drilling.
2. Monitoring Well installed in a separate shallow hole drilled adjacent to the deep Borehole.
3. Recorded Water Level on May 5, 2021.

04-20-2022 Z:\2021 Projects\NEWLOG\17789-GEO-SOUTH OF SASKTOON,SK\DWG\TH1-17789.bor

P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-2

DRAWING NUMBER: 17789-3

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

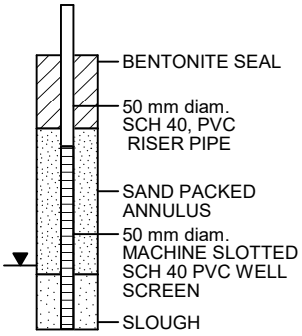
NORTHING (m): 5764126 **EASTING (m):** 391185 **ELEVATION (m):** 508.5 **DATE DRILLED:** APR 13/21

SAMPLE TYPE: ☒ CUTTINGS ☒ SPLIT SPOON ■ SHELBY TUBE

WATER LEVELS
▼ After Drilling
▽ During Drilling

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		SAND, some silt, trace clay, loose, poorly graded, fine grained, moist, dark brown.			12.1					
1		brown below 0.5 m.			10.2 10.6 7.9 7.9					
2		silty, wet, seepage, sloughing below 2.3 m.								
3					25.2					
4										
5										
6										
7										
8										
9										
10										
11										
12										

MONITORING WELL: BH 21-2
ELEV.: 509.5



DEPTH (m) 0 1 2 3 4 5 6 7 8 9 10 11 12

NOTE:
1. Borehole sloughed to 2.4 m Immediately After Drilling.
3. Recorded Water Level on May 5, 2021.

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P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-3

DRAWING NUMBER: 17789-4

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

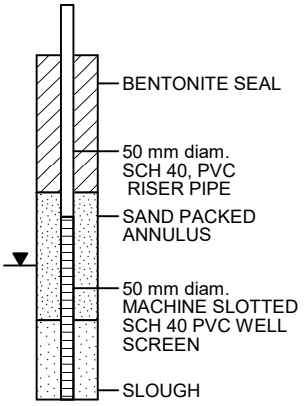
NORTHING (m): 5764133 **EASTING (m):** 391383 **ELEVATION (m):** 508.5 **DATE DRILLED:** APR 13/21

SAMPLE TYPE: CUTTINGS SPLIT SPOON SHELBY TUBE

WATER LEVELS
After Drilling
During Drilling

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		TOPSOIL, organic, moist, black, rootlets.			19.2					
		SAND, silty, trace clay, loose, poorly graded, fine grained, moist, brown.			21.0					
1					21.4					
		SILT, clayey, some sand, firm to stiff, medium plastic, moist, brown, oxide stained.			23.1					
2					27.6	36	18			
3		SAND AND SILT, trace clay, loose, poorly graded, fine grained, wet, brown, seepage, sloughing.		5	36.1					
4					31.3					
5										
6					29.7					
7					28.0					
8		mottled grey and brown below 8.0 m.								
9					29.6					
10					27.8					
11										
12										

MONITORING WELL: BH 21-3A
ELEV.: 509.5



NOTE:
1. Borehole sloughed to 2.7 m Immediately After Drilling.
2. Monitoring Well installed in a separate shallow hole drilled adjacent to the deep Borehole.
3. Recorded Water Level on May 5, 2021.

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P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-4

DRAWING NUMBER: 17789-5

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

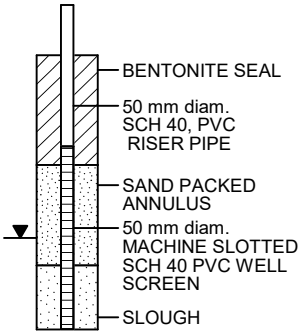
NORTHING (m): 5764103 **EASTING (m):** 391585 **ELEVATION (m):** 507.9 **DATE DRILLED:** APR 13/21

SAMPLE TYPE: ☐ CUTTINGS ☒ SPLIT SPOON ■ SHELBY TUBE

WATER LEVELS
▼ After Drilling
▽ During Drilling

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		TOPSOIL, organic, moist, black, rootlets.			20.0					
0.5					20.5					
1		SAND, silty, some clay, loose, poorly graded, fine grained, moist, brown.			17.5					
1.5					13.0					
2					13.1					
2.5		wet, seepage, sloughing below 2.3 m.								
3					29.2					

MONITORING WELL: BH 21-4
ELEV.: 508.9



DEPTH (m): 0 1 2 3 4 5 6 7 8 9 10 11 12

NOTE:
1. Borehole sloughed to 2.3 m Immediately After Drilling.
3. Recorded Water Level on May 5, 2021.

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P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-5

DRAWING NUMBER: 17789-6

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

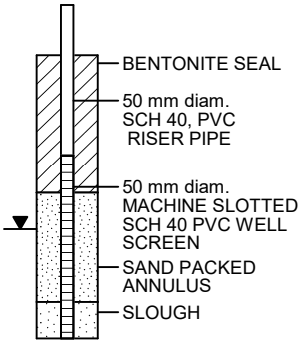
NORTHING (m): 5764070 **EASTING (m):** 391772 **ELEVATION (m):** 507.9 **DATE DRILLED:** APR 13/21

SAMPLE TYPE: CUTTINGS SPLIT SPOON SHELBY TUBE

WATER LEVELS
After Drilling
During Drilling

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		TOPSOIL, organic, moist, black, rootlets.			15.5					
					12.8					
1		SAND, some silt, trace clay, loose, poorly graded, fine grained, moist, dark brown.			11.2					
					10.9					
		brown below 0.7 m.		2	25.1					
2		wet, seepage, sloughing below 1.7 m.								
3				8	25.9					
4		SILT, clayey, sandy, firm, medium plastic, moist, brown.			32.6					
5										
6					33.5					
7		CLAY, silty, firm to stiff, highly plastic, moist, grey.			34.4					0.5
8										
9		firm below 9.5 m.			35.3					1
10					35.7					0.5
11										
12					34.7					0.5

MONITORING WELL: BH 21-5A
ELEV.: 509.0



NOTE:
1. Borehole sloughed to 2.9 m Immediately After Drilling.
2. Monitoring Well installed in a separate shallow hole drilled adjacent to the deep Borehole.
3. Recorded Water Level on May 5, 2021.

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P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-6

DRAWING NUMBER: 17789-7

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

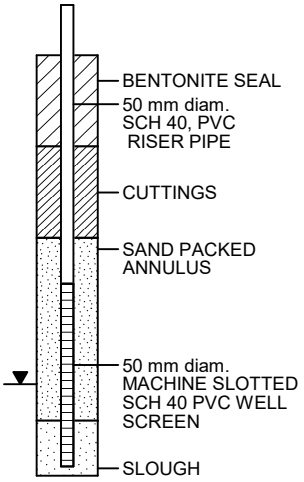
NORTHING (m): 5763925 **EASTING (m):** 391772 **ELEVATION (m):** 509.4 **DATE DRILLED:** APR 13/21

SAMPLE TYPE: ☒ CUTTINGS ☒ SPLIT SPOON ■ SHELBY TUBE

WATER LEVELS
▼ After Drilling
▽ During Drilling

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		SAND, some silt, trace clay, loose, poorly graded, fine grained, moist, brown.			12.2					
0.5					10.3					
1					9.1					
1.5					9.9					
2					10.7					
3					8.9					
4		wet, seepage, sloughing below 3.8 m.			25.7					

MONITORING WELL: BH 21-6
ELEV.: 510.4



DEPTH (m) 0 1 2 3 4 5 6 7 8 9 10 11 12

NOTE:
1. Borehole sloughed to 4.0 m Immediately After Drilling.
3. Recorded Water Level on May 5, 2021.

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P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-7

DRAWING NUMBER: 17789-8

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

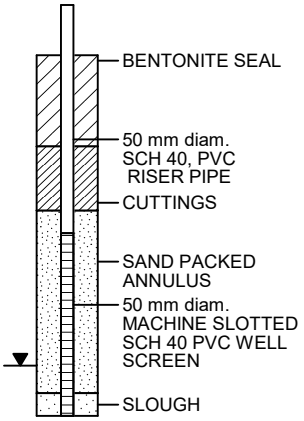
NORTHING (m): 5763924 **EASTING (m):** 391593 **ELEVATION (m):** 509.4 **DATE DRILLED:** APR 13/21

SAMPLE TYPE: ☒ CUTTINGS ☒ SPLIT SPOON ■ SHELBY TUBE

WATER LEVELS
▼ After Drilling
▽ During Drilling

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		SAND, trace to some silt, trace to some clay, loose, poorly graded, fine grained, moist, dark brown.			12.4					
0.5					10.5					
1		brown below 0.4 m.			8.7					
1.5					5.4					
2		dark brown 2.1 to 2.5 m.			5.0					
2.5										
3		dark brown 3.0 to 3.3 m.								
3.3		silty, trace clay, wet, seepage, sloughing below 3.1 m.	☒	4	25.7					
4		CLAY, some silt, stiff, highly plastic, moist, brown, oxide stained.			29.2					1.5
5		very stiff below 5.0 m								
6			☒	13	35.6			18.3		1.5
7		grey below 7.0 m.			35.6					1.5
8										
9					35.5					1.25
9.2		silty, firm below 9.2 m.								
10					33.5					0.5
11										
12										

MONITORING WELL: BH 21-7A
ELEV.: 510.4



NOTE:
1. Borehole sloughed to 2.9 m Immediately After Drilling.
2. Monitoring Well installed in a separate shallow hole drilled adjacent to the deep Borehole.
3. Recorded Water Level on May 5, 2021.

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P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-8

DRAWING NUMBER: 17789-9

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

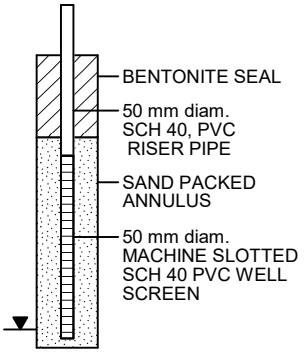
NORTHING (m): 5763926 **EASTING (m):** 391389 **ELEVATION (m):** 509.0 **DATE DRILLED:** APR 13/21

SAMPLE TYPE: CUTTINGS SPLIT SPOON SHELBY TUBE

WATER LEVELS
After Drilling
During Drilling

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		TOPSOIL, organic, moist, black, rootlets.			16.5					
		SAND, silty, trace to some clay, loose, poorly graded, fine grained, moist, brown.			13.1					
1					8.1					
					9.1					
					8.4					
2		wet, seepage, sloughing below 2.0 m.			20.4					
		SILT, some clay, firm, medium plastic, moist, brown, oxide stained.			32.5					
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										

MONITORING WELL: BH 21-8
ELEV.: 510.1



NOTE:
1. Borehole open Immediately After Drilling with trace water.
3. Recorded Water Level on May 5, 2021.

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P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-9

DRAWING NUMBER: 17789-10

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

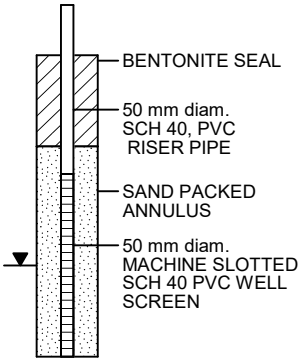
NORTHING (m): 5763693 **EASTING (m):** 391097 **ELEVATION (m):** 508.8 **DATE DRILLED:** APR 12/21

SAMPLE TYPE: CUTTINGS SPLIT SPOON SHELBY TUBE

WATER LEVELS
After Drilling
During Drilling

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		SAND, silty, trace clay, loose to compact, poorly graded, fine grained, moist, mottled black and brown, trace organics.			15.4					
0.5					14.5					
1		some silt to silty, brown below 0.5 m			9.1					
1.5					7.1					
2		wet, seepage, sloughing below 2.0 m.		12	14.9					
2.5		silt seam 2.6 to 3.0 m.								
3				9	23.6					
4		some silt, compact, mottled grey and brown below 4.0 m.								
5				21	26.1					
6		SILT, some clay, trace sand, firm, medium plastic, moist, grey.			29.3					
6.4		clay lense at 6.4 m.								
7		some sand, trace clay below 6.5 m.			31.4					
8		SAND, silty, compact, poorly graded, fine grained, wet, grey, seepage, sloughing.								
9					28.0					
10		SILT, sandy, firm, medium plastic, moist, grey.			29.0					0.5
11										
12					28.9					0.5

MONITORING WELL: BH 21-9A
ELEV.: 509.8



NOTE:
1. Borehole sloughed to 2.1 m Immediately After Drilling.
2. Monitoring Well installed in a separate shallow hole drilled adjacent to the deep Borehole.
3. Recorded Water Level on May 5, 2021.

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P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-10

DRAWING NUMBER: 17789-11

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

NORTHING (m): 5763693 **EASTING (m):** 391097 **ELEVATION (m):** 508.9 **DATE DRILLED:** APR 13/21

SAMPLE TYPE: ☐ CUTTINGS ☒ SPLIT SPOON ■ SHELBY TUBE

WATER LEVELS
▼ After Drilling
▽ During Drilling

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		TOPSOIL, organic, moist, black, rootlets.			13.5					
0.5					11.5					
1		SAND, some silt, trace clay, loose, poorly graded, fine grained, moist, brown.			12.6					
1.5					12.9					
2					13.1					
2.5		wet, seepage, sloughing below 2.3 m.								
3					22.7					

MONITORING WELL: BH 21-10
ELEV.: 510.0

BENTONITE SEAL
50 mm diam. SCH 40, PVC RISER PIPE
SAND PACKED ANNULUS
50 mm diam. MACHINE SLOTTED SCH 40 PVC WELL SCREEN
SLOUGH

DEPTH (m)

NOTE:
1. Borehole sloughed to 2.3 m Immediately After Drilling.
3. Recorded Water Level on May 5, 2021.

SHEET 1 OF 1

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P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-11

DRAWING NUMBER: 17789-12

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

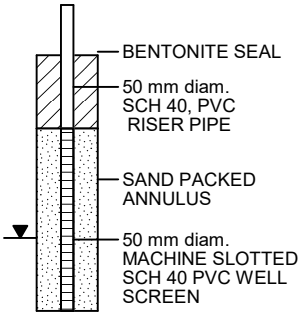
NORTHING (m): 5763726 **EASTING (m):** 391390 **ELEVATION (m):** 508.3 **DATE DRILLED:** APR 12/21

SAMPLE TYPE: CUTTINGS SPLIT SPOON SHELBY TUBE

WATER LEVELS
After Drilling
During Drilling

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		TOPSOIL, organic, moist, black, rootlets.			21.0					
		SAND, some silt, loose, trace clay, poorly graded, fine grained, moist, mottled black and brown.			13.3					
1		brown below 0.7 m.			10.9					
		wet, seepage, sloughing below 2.0 m.			14.1					
2					12.3					
		compact below 3.0 m.		13	24.0					
3										
4				13	28.6					
5		CLAY, some silt, stiff to very stiff, highly plastic, moist, grey.								
				15	30.5					
6										
7					30.2					2.0
8										
9					31.4					2.0
10					36.3					
11										
12					34.4					

MONITORING WELL: BH 21-11A
ELEV.: 509.3



NOTE:
1. Borehole sloughed to 2.0 m Immediately After Drilling.
2. Monitoring Well installed in a separate shallow hole drilled adjacent to the deep Borehole.
3. Recorded Water Level on May 5, 2021.

SHEET 1 OF 1

04-20-2022 Z:\2021 Projects\NEWLOG\17789-GEO-SOUTH OF SASKTOON,SK\DWG\TH11-17789.bor

P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-12

DRAWING NUMBER: 17789-13

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

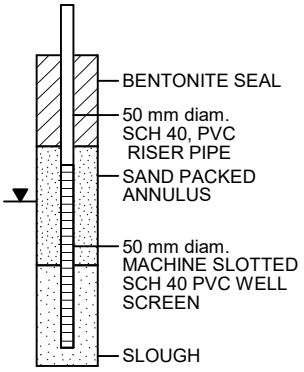
NORTHING (m): 5763735 **EASTING (m):** 391611 **ELEVATION (m):** 507.5 **DATE DRILLED:** APR 13/21

SAMPLE TYPE: CUTTINGS SPLIT SPOON SHELBY TUBE

WATER LEVELS
After Drilling
During Drilling

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		TOPSOIL, organic, moist, black, rootlets.			31.3					
		SAND, silty, trace clay, loose, poorly graded, fine grained, moist, brown.			18.5					
1					13.3					
					14.4					
2		wet, seepage, sloughing below 2.4 m.			25.6					
3					28.6					
4										
5										
6										
7										
8										
9										
10										
11										
12										

MONITORING WELL: BH 21-12
ELEV.: 508.6



NOTE:
1. Borehole sloughed to 2.4 m Immediately After Drilling.
3. Recorded Water Level on May 5, 2021.

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P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-13

DRAWING NUMBER: 17789-14

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

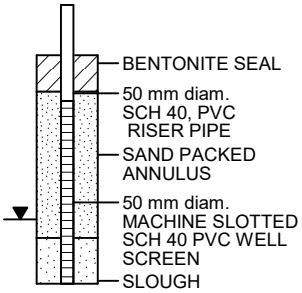
NORTHING (m): 5763807 **EASTING (m):** 391811 **ELEVATION (m):** 507.1 **DATE DRILLED:** APR 13/21

SAMPLE TYPE: CUTTINGS SPLIT SPOON SHELBY TUBE

WATER LEVELS
After Drilling
During Drilling

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		TOPSOIL, organic, moist, black, rootlets.			21.0					
					22.2					
1		SAND, silty, trace clay, loose, poorly graded, fine grained, moist, dark brown.			19.8					
					17.7					
		brown below 1.0 m.		7	27.5					
2		wet, seepage, sloughing below 1.7 m.								
3		SILT AND SAND, trace clay, loose, non-plastic, wet, brown, seepage, sloughing.			24.9					
4										
					29.6					
5										
6		SILT, sandy, firm, low plastic, wet, grey, seepage, sloughing.			30.4					
7					29.7					
8		SAND, silty, loose, poorly graded, fine grained, wet, grey, seepage, sloughing.								
9					30.7					
10					29.8					
11										
12										

MONITORING WELL: BH 21-13A
ELEV.: 508.1



NOTE:
1. Borehole sloughed to 2.0 m Immediately After Drilling.
2. Monitoring Well installed in a separate shallow hole drilled adjacent to the deep Borehole.
3. Recorded Water Level on May 5, 2021.

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P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-14

DRAWING NUMBER: 17789-15

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

NORTHING (m): 5763574 **EASTING (m):** 391185 **ELEVATION (m):** 506.9 **DATE DRILLED:** APR 16/21

SAMPLE TYPE: ☐ CUTTINGS ☒ SPLIT SPOON ■ SHELBY TUBE

WATER LEVELS
▼ After Drilling
▽ During Drilling

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		SAND, silty, trace clay, loose to compact, poorly graded, fine grained, moist, brown.			17.0					
					19.9					
					24.0					
1		SAND AND SILT, some clay, loose, poorly graded, fine grained, moist, brown.			25.3	27	17			
					26.6					
2		wet, seepage, sloughing below 1.4 m.								
3		SAND, some silt, compact, poorly graded, fine to medium grained, wet, grey, seepage, sloughing.			26.5					
4										
5										
6										
7										
8										
9										
10										
11										
12										

MONITORING WELL: BH 21-14
ELEV.: 507.9

- BENTONITE SEAL
- 50 mm diam. SCH 40, PVC RISER PIPE
- SAND PACKED ANNULUS
- 50 mm diam. MACHINE SLOTTED SCH 40 PVC WELL SCREEN
- SLOUGH

NOTE:
1. Borehole sloughed to 2.7 m Immediately After Drilling.
3. Recorded Water Level on May 5, 2021.

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P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-15

DRAWING NUMBER: 17789-16

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

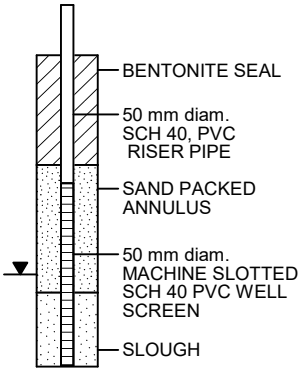
NORTHING (m): 5763520 **EASTING (m):** 391594 **ELEVATION (m):** 508.6 **DATE DRILLED:** APR 9/21

SAMPLE TYPE: ☐ CUTTINGS ☒ SPLIT SPOON ■ SHELBY TUBE

WATER LEVELS
▼ After Drilling
▽ During Drilling

DEPTH (m)	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0	SAND, some silt, trace to some clay, loose, poorly graded, fine grained, moist, dark brown.			19.6					
0.5	trace organics to 0.1 m.			16.2					
1	brown below 0.5 m.			13.8					
1.5				9.0					
1.9	moist to wet below 1.9 m.	☒	10	18.0					
2.4	wet, seepage, sloughing below 2.4 m.								
2.8	SILT AND SAND, trace clay, loose, non-plastic, wet, brown, seepage, sloughing.			28.8					
3.4	CLAY, silty, firm, medium to highly plastic, moist, brown.								
4.7	moist to wet below 4.7 m.	☒	7	35.7			17.9		
6				34.7					0.5
7				35.1					0.75
8	SILT, some clay, firm, medium plastic, moist to wet, grey.								
9				32.2	40	15			0.5
10				30.4					0.5
10.7	some sand, trace clay, low plastic, moist to wet below 10.7 m.								
12				28.7					0.5

MONITORING WELL: BH 21-15A
ELEV.: 509.7



NOTE:
1. Borehole sloughed to 2.5 m Immediately After Drilling.
2. Monitoring Well installed in a separate shallow hole drilled adjacent to the deep Borehole.
3. Recorded Water Level on May 5, 2021.

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P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-16

DRAWING NUMBER: 17789-17

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

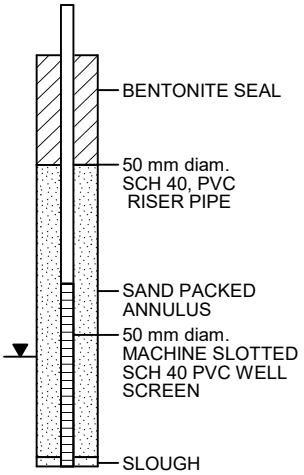
NORTHING (m): 5763522 **EASTING (m):** 391389 **ELEVATION (m):** 509.7 **DATE DRILLED:** APR 13/21

SAMPLE TYPE: ☐ CUTTINGS ☒ SPLIT SPOON ■ SHELBY TUBE

WATER LEVELS
▼ After Drilling
▽ During Drilling

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		SAND, some silt, trace clay, oose to compact, poorly graded, fine grained, moist, brown.			10.5					
1					7.8					
					5.2					
2					4.0					
					4.4					
3		wet, seepage, sloughing below 2.9 m.			18.9					
		CLAY, some silt, stiff, medium to highly plastic, moist, mottled grey brown.								
4					30.4					1.5
5										
6										
7										
8										
9										
10										
11										
12										

MONITORING WELL: BH 21-16
ELEV.: 510.7



NOTE:
1. Borehole sloughed to 4.4 m Immediately After Drilling.
3. Recorded Water Level on May 5, 2021.

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P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-17

DRAWING NUMBER: 17789-18

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

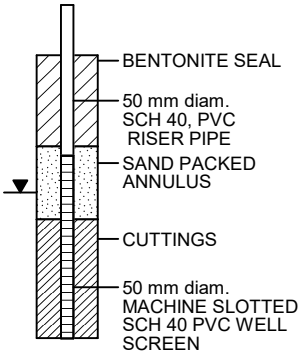
NORTHING (m): 5763524 **EASTING (m):** 391182 **ELEVATION (m):** 508.1 **DATE DRILLED:** APR 12/21

SAMPLE TYPE: CUTTINGS SPLIT SPOON SHELBY TUBE

WATER LEVELS
After Drilling
During Drilling

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		SAND, some silt, trace clay, loose, poorly graded, fine to medium grained, moist, mottled brown and black, sloughing.			20.5					
0.4		brown below 0.4 m			19.2					
1					14.9					
1.4					16.2					
1.8		wet, seepage, sloughing below 1.8 m.		4	29.9					
2										
3					25.4					
4		grey below 4.1 m.								
4.1		loose to compact below 4.5		8	25.9					
5										
5.3		silty, fine below 5.3			29.4					
6										
6.5		clay lense at 6.5 m.								
7										
7.7		SILT, sandy, firm, low plastic, moist, grey.								
8		trace black staining 7.7 to 8.3 m.								
9					26.2					0.5
10					31.5					1.0
11										
12										

MONITORING WELL: BH 21-17A
ELEV.: 509.1



NOTE:
1. Borehole sloughed to 1.4 m Immediately After Drilling.
2. Monitoring Well installed in a separate shallow hole drilled adjacent to the deep Borehole.
3. Recorded Water Level on May 5, 2021.

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P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-18

DRAWING NUMBER: 17789-19

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

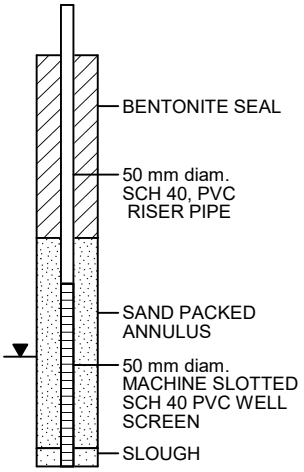
NORTHING (m): 5763326 **EASTING (m):** 391087 **ELEVATION (m):** 509.8 **DATE DRILLED:** APR 16/21

SAMPLE TYPE: ☒ CUTTINGS ☒ SPLIT SPOON ■ SHELBY TUBE

WATER LEVELS
▼ After Drilling
▽ During Drilling

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		SAND, some silt, trace clay, loose to compact, poorly graded, fine to medium grained, moist, brown.			14.6					
1					14.2					
					11.5					
					9.9					
2					5.2					
3		wet, seepage, sloughing below 3.0 m.			16.3					
4					24.0					
5										
6										
7										
8										
9										
10										
11										
12										

MONITORING WELL: BH 21-18
ELEV.: 510.9



NOTE:
1. Borehole sloughed to 4.3 m Immediately After Drilling.
3. Recorded Water Level on May 5, 2021.

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P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-19

DRAWING NUMBER: 17789-20

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

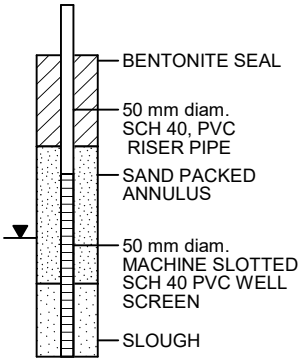
NORTHING (m): 5763320 **EASTING (m):** 391390 **ELEVATION (m):** 508.7 **DATE DRILLED:** APR 9/21

SAMPLE TYPE: CUTTINGS SPLIT SPOON SHELBY TUBE

WATER LEVELS
After Drilling
During Drilling

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		SAND, some silt, trace clay, loose, poorly graded, fine grained, moist, dark brown.			13.0					
1		trace organics to 0.15			10.9					
		brown below 0.4 m.			10.2					
					9.1					
2		wet, seepage, sloughing below 2.3 m.			8.4					
3				9	25.6					
4					26.4					
5		CLAY, some silt, stiff, highly plastic, moist, brown.								
6		grey below 6.4 m.			33.5					1.75
7					35.1					1.25
8		firm to stiff, medium to highly plastic below 7.7 m.								
9					32.2					1.0
10					33.1					
11										
12										

MONITORING WELL: BH 21-19A
ELEV.: 509.9



NOTE:
1. Borehole sloughed to 2.5 m Immediately After Drilling.
2. Monitoring Well installed in a separate shallow hole drilled adjacent to the deep Borehole.
3. Recorded Water Level on May 5, 2021.

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P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-20

DRAWING NUMBER: 17789-21

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

NORTHING (m): 5763320 **EASTING (m):** 391622 **ELEVATION (m):** 508.0 **DATE DRILLED:** APR 16/21

SAMPLE TYPE: ☒ CUTTINGS ☒ SPLIT SPOON ■ SHELBY TUBE

WATER LEVELS
▼ After Drilling
▽ During Drilling

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		SAND, some silt, trace to some clay, loose to compact, poorly graded, fine grained, moist, brown.			17.7					
1					15.1					
					13.6					
					15.7					
2		wet, seepage, sloughing below 1.3 m.			23.6					
3					27.1					

MONITORING WELL: BH 21-20
ELEV.: 509.0

- BENTONITE SEAL
- 50 mm diam. SCH 40, PVC RISER PIPE
- SAND PACKED ANNULUS
- 50 mm diam. MACHINE SLOTTED SCH 40 PVC WELL SCREEN
- SLOUGH

DEPTH (m) 0 1 2 3 4 5 6 7 8 9 10 11 12

NOTE:
1. Borehole sloughed to 1.2 m Immediately After Drilling.
3. Recorded Water Level on May 5, 2021

SHEET 1 OF 1

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P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-21

DRAWING NUMBER: 17789-22

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

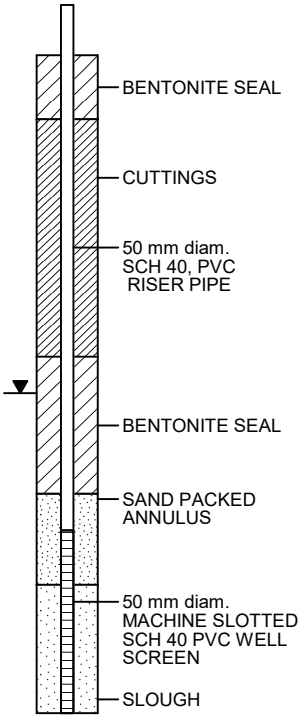
NORTHING (m): 5763323 **EASTING (m):** 391798 **ELEVATION (m):** 509.3 **DATE DRILLED:** APR 9/21

SAMPLE TYPE: CUTTINGS SPLIT SPOON SHELBY TUBE

WATER LEVELS
After Drilling
During Drilling

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		SAND, some silt, loose, poorly graded, fine grained, moist, brown.			10.1					
0.5					9.9					
1					10.1					
1.5					11.2					
					9.2					
2		clay seam 1.7 to 1.9 m.			24.0					
3		CLAY, some silt, firm to stiff, highly plastic, moist, brown, oxide stained.		6	36.7			18.3		
4					36.0					1.0
5		grey below 5.4 m.								
6		silty, firm, medium to highly below 5.9 m.		8	36.0			18.4		1.0
7					34.6					0.5
8		SAND, silty, loose, poorly graded, fine grained, wet, grey, seepage, sloughing.								
9		SILT, clayey, firm, medium plastic, moist, grey.		5	29.6					
10					31.1					
11		SAND, silty, loose, poorly graded, fine grained, wet, grey, seepage, sloughing.								
12										

MONITORING WELL: BH21-21A
ELEV.: 510.1



NOTE:
1. Borehole sloughed to 6.0 m Immediately After Drilling.
2. Monitoring Wells installed in separate shallow holes drilled adjacent to the deep Borehole.
3. Recorded Water Level on May 5, 2021

SHEET 1 OF 1

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P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-21B

DRAWING NUMBER: 17789-22A

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

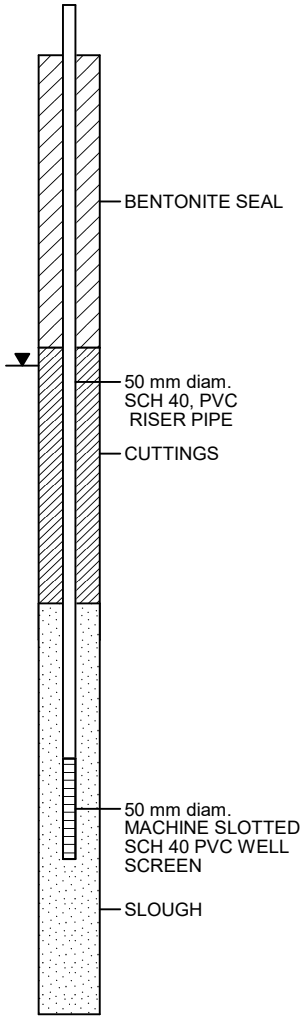
LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

NORTHING (m): 5763323 **EASTING (m):** 391796 **ELEVATION (m):** 509.3 **DATE DRILLED:** APR 9/21

SAMPLE TYPE: ☐ CUTTINGS ☒ SPLIT SPOON ■ SHELBY TUBE

WATER LEVELS
▼ After Drilling
▽ During Drilling

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		SAND, some silt, loose, poorly graded, fine grained, moist, brown.								
1		clay seam 1.7 to 1.9 m								
2										
3		CLAY, some silt, firm to stiff, highly plastic, moist, brown, oxide stained.								
4										
5		grey below 5.4 m.								
6		silty, firm, medium to highly below 5.9 m.								
7										
8		SAND, silty, loose, poorly graded, fine grained, wet, grey, seepage, sloughing.								
9		SILT, clayey, firm, medium plastic, moist, grey.								
10										
11		SAND, silty, loose, poorly graded, fine grained, wet, grey, seepage, sloughing.								
12										



NOTE:
1. Borehole sloughed to 6.0 m Immediately After Drilling.
2. Monitoring Wells installed in separate shallow holes drilled adjacent to the deep Borehole.
3. Recorded Water Level on May 5, 2021

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P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-22

DRAWING NUMBER: 17789-23

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

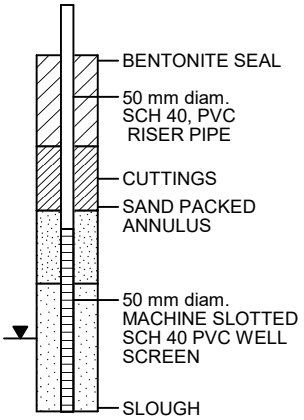
NORTHING (m): 5763127 **EASTING (m):** 391084 **ELEVATION (m):** 509.4 **DATE DRILLED:** APR 13/21

SAMPLE TYPE: CUTTINGS SPLIT SPOON SHELBY TUBE

WATER LEVELS
After Drilling
During Drilling

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		TOPSOIL, organic, moist, black, rootlets.			14.9					
		SAND, some silt, trace to some clay, loose, poorly graded, fine grained, moist, dark brown.			9.9					
1		brown below 0.8 m.			5.3					
					8.1					
2					6.8					
3		wet, seepage, sloughing below 3.0 m.		10	24.2					
4					31.1					1.5
		CLAY, some silt, stiff, highly plastic, moist, brown.								
5										
6					33.0					1.25
7		grey below 7.2 m.			35.2					1.5
8										
9					36.9					1.25
10					35.9					1.0
11										
12					34.8					1.25

MONITORING WELL: BH 21-22A
ELEV.: 510.4



NOTE:
1. Borehole sloughed to 3.0 m Immediately After Drilling.
2. Monitoring Well installed in a separate shallow hole drilled adjacent to the deep Borehole.
3. Recorded Water Level on May 5, 2021

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P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-23

DRAWING NUMBER: 17789-24

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

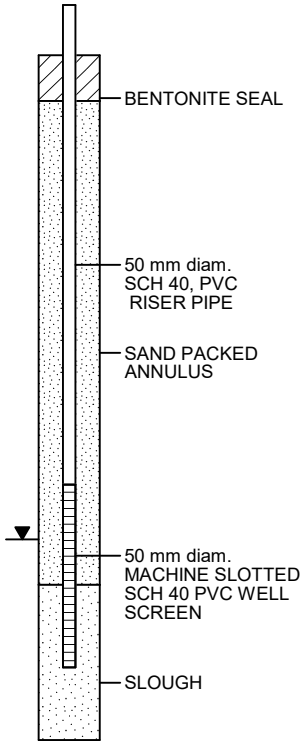
NORTHING (m): 5763122 **EASTING (m):** 391388 **ELEVATION (m):** 511.8 **DATE DRILLED:** APR 14/21

SAMPLE TYPE: CUTTINGS SPLIT SPOON SHELBY TUBE

WATER LEVELS
After Drilling
During Drilling

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		TOPSOIL, organic, moist, black, rootlets.			20.5					
0.5					11.2					
1		SAND, silty, trace clay, compact, poorly graded, fine grained, moist, brown.			6.3					
1.5					4.4					
2		some silt below 2.0 m.			5.2					
3					5.0					
4					5.6					
5		wet, seepage, sloughing below 5.5 m.								
6					25.0					
7					28.1					

MONITORING WELL: BH 21-23
ELEV.: 512.9



NOTE:
1. Borehole sloughed to 5.8 m Immediately After Drilling.
2. Monitoring Well installed in a separate shallow hole drilled adjacent to the deep Borehole.
3. Recorded Water Level on May 5, 2021.

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P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-24

DRAWING NUMBER: 17789-25

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

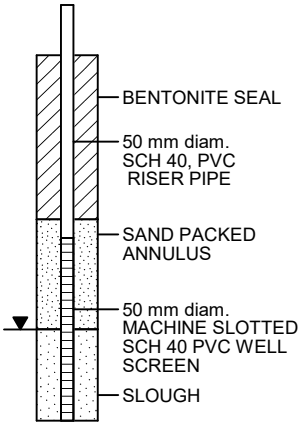
NORTHING (m): 5763124 **EASTING (m):** 391631 **ELEVATION (m):** 508.9 **DATE DRILLED:** APR 14/21

SAMPLE TYPE: CUTTINGS SPLIT SPOON SHELBY TUBE

WATER LEVELS
After Drilling
During Drilling

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		TOPSOIL, organic, moist, black, rootlets.			11.7					
					8.7					
1		SAND, trace silt, trace clay, compact, poorly graded, fine grained, moist, brown.			9.1					
					11.4					
					15.8					
2		some silt to silty below 2.0 m.								
		loose, wet, seepage, sloughing below 2.7 m.								
3				7	29.4					
4		compact below 4.0 m.								
				14	26.4					
5		silty below 5.0 m.								
6					27.2					
7					25.1					
8										
9		CLAY, silty, firm, medium plastic, moist, grey.			36.8					
10					34.0					
11										
12										

MONITORING WELL: BH 21-24A
ELEV.: 509.9



NOTE:
1. Borehole sloughed to 3.0 m Immediately After Drilling.
2. Monitoring Well installed in a separate shallow hole drilled adjacent to the deep Borehole.
3. Recorded Water Level on May 5, 2021.

04-20-2022 Z:\2021 Projects\NEWLOG\17789-GEO-SOUTH OF SASKTOON,SK\DWG\TH24-17789.bor

P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-25

DRAWING NUMBER: 17789-26

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

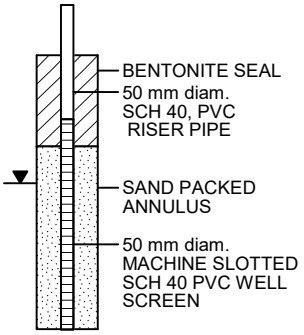
NORTHING (m): 5763134 **EASTING (m):** 391813 **ELEVATION (m):** 506.9 **DATE DRILLED:** APR 16/21

SAMPLE TYPE: ☐ CUTTINGS ☒ SPLIT SPOON ■ SHELBY TUBE

WATER LEVELS
▼ After Drilling
▽ During Drilling

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		SAND, silty, trace clay, loose to compact, poorly graded, fine grained, moist, brown.			20.5					
1		organics, black to 0.4 m.			18.5					
		some silt, wet, seepage, sloughing below 1.4 m.			19.0					
2					19.5					
					23.9					
3		CLAY, silty, stiff, medium to highly plastic, moist, mottled grey and brown, oxide stained.			29.5					
4										
5										
6										
7										
8										
9										
10										
11										
12										

MONITORING WELL: BH 21-25
ELEV.: 508.0



NOTE:
1. Borehole open with trace water Immediately After Drilling.
3. Recorded Water Level on May 5, 2021.

04-20-2022 Z:\2021 Projects\NEWLOG\17789-GEO-SOUTH OF SASKTOON,SK\DWG\TH25-17789.bor

P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-26

DRAWING NUMBER: 17789-27

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

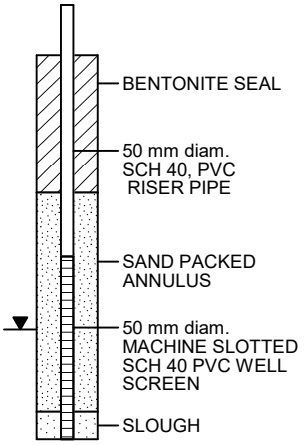
NORTHING (m): 5762943 **EASTING (m):** 391789 **ELEVATION (m):** 508.3 **DATE DRILLED:** APR 14/21

SAMPLE TYPE: CUTTINGS SPLIT SPOON SHELBY TUBE

WATER LEVELS
After Drilling
During Drilling

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		TOPSOIL, organic, moist, black, rootlets.			14.1					
					8.9					
1		SAND, trace to some silt, trace clay, compact, poorly graded, fine grained, moist, brown.			8.3					
					10.9					
					10.8					
2		loose, wet, seepage, sloughing below 2.5 m.								
3		clay lense at 2.7 m.		6	27.9					
		clay lense at 3.4 m.								
		mottled brown and grey below 3.5 m.								
4		clay lense at 3.9 m.								
		compact below 4.0 m.		15	24.8					
5		brown below 5.2 m.								
6					24.9					
7					25.5					
8		grey below 8.5 m.								
9					28.3					
10					28.0					
11										
12										

MONITORING WELL: BH 21-26A
ELEV.: 509.4



NOTE:
1. Borehole sloughed to 3.9 m Immediately After Drilling.
2. Monitoring Well installed in a separate shallow hole drilled adjacent to the deep Borehole.
3. Recorded Water Level on May 5, 2021.

04-20-2022 Z:\2021 Projects\NEWLOG\17789-GEO-SOUTH OF SASKTOON,SK\DWG\TH26-17789.bor

P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-27

DRAWING NUMBER: 17789-28

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

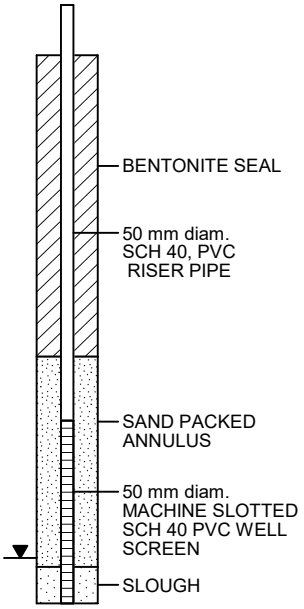
NORTHING (m): 5762922 **EASTING (m):** 391597 **ELEVATION (m):** 510.9 **DATE DRILLED:** APR 14/21

SAMPLE TYPE: ☐ CUTTINGS ☒ SPLIT SPOON ■ SHELBY TUBE

WATER LEVELS
▼ After Drilling
▽ During Drilling

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		TOPSOIL, organic, moist, black, rootlets.			5.7					
		SAND, silty, trace clay, compact, poorly graded, fine grained, moist, brown.			4.8					
1					5.9					
					8.5					
					11.3					
2										
3					7.2					
4										
					14.7					
5		wet, seepage, sloughing below 5.1 m.								
		trace clay below 5.7 m								
6					22.7					
7										
8										
9										
10										
11										
12										

MONITORING WELL: BH 21-27
ELEV.: 511.9



NOTE:
1. Borehole sloughed to 5.6 m Immediately After Drilling.
2. Recorded Water Level on May 5, 2021.

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P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-28

DRAWING NUMBER: 17789-29

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

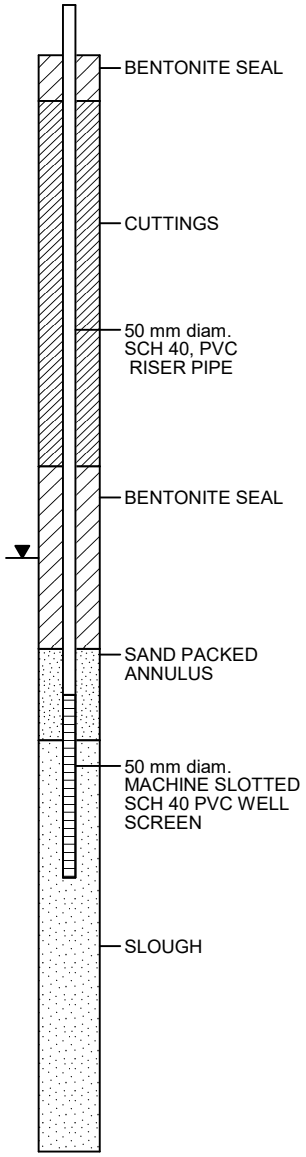
NORTHING (m): 5762907 **EASTING (m):** 391385 **ELEVATION (m):** 511.9 **DATE DRILLED:** APR 14/21

SAMPLE TYPE: CUTTINGS SPLIT SPOON SHELBY TUBE

WATER LEVELS
After Drilling
During Drilling

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		TOPSOIL, organic, moist, black, rootlets.			17.9					
					13.1					
1		SAND, silty, trace clay, compact, poorly graded, fine grained, moist, brown. some silt, looes below 1.5 m.			5.3					
					4.7					
2				10	8.2					
3					4.9					
4										
5		CLAY, silty, firm, medium plastic, moist, mottled brown. stiff below 5.0 m.		6	33.2			18.0		0.75
6				10	32.7			18.5		1.0
7		some silt, highly plastic, mottled grey and brown below 6.9 m.			35.2	54	18			1.5
8										
9		SAND, some silt, trace clay, loose, poorly graded, fine grained, wet, olive brown, seepage, sloughing. grey below 9.3 m.		5	27.4					
10					30.2					
11										
12					28.2					

MONITORING WELL: BH 21-28
ELEV.: 513.1



NOTE:
1. Borehole sloughed to 7.5 m Immediately After Drilling.
2. Monitoring Wells installed in separate shallow holes drilled adjacent to the deep Borehole.
3. Recorded Water Level on May 5, 2021.

04-20-2022 Z:\2021 Projects\NEWLOG\17789-GEO-SOUTH OF SASKTOON,SK\DWG\TH28-17789.bor

P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-28A

DRAWING NUMBER: 17789-29A

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

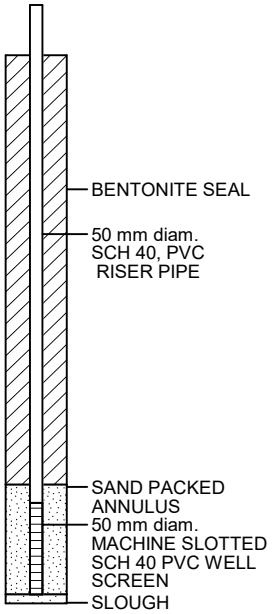
NORTHING (m): 5762906 **EASTING (m):** 391384 **ELEVATION (m):** 512.2 **DATE DRILLED:** APR 14/21

SAMPLE TYPE: ☐ CUTTINGS ☒ SPLIT SPOON ■ SHELBY TUBE

WATER LEVELS
▼ After Drilling
▽ During Drilling

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		TOPSOIL, organic, moist, black, rootlets.								
1		SAND, silty, trace clay, compact, poorly graded, fine grained, moist, brown. some silt, looes below 1.5 m.								
2										
3										
4										
5		CLAY, silty, firm, medium plastic, moist, mottled brown. stiff below 5.0 m.								
6										
7										
8										
9										
10										
11										
12										

MONITORING WELL: BH 21-28A
ELEV.: 513.2



NOTE:
1. Borehole sloughed and dry Immediately After Drilling.
2. Monitoring Wells installed in separate shallow holes drilled adjacent to the deep Borehole.
3. Recorded Dry on May 5, 2021.

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P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-28B

DRAWING NUMBER: 17789-29B

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

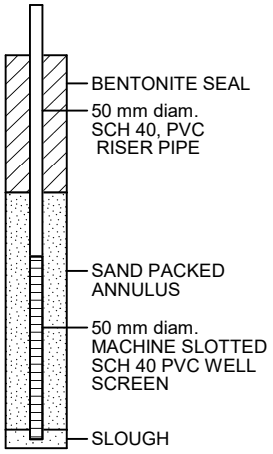
NORTHING (m): 5762908 **EASTING (m):** 391384 **ELEVATION (m):** 512.1 **DATE DRILLED:** APR 14/21

SAMPLE TYPE: ☐ CUTTINGS ☒ SPLIT SPOON ■ SHELBY TUBE

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		TOPSOIL, organic, moist, black, rootlets.								
1		SAND, silty, trace clay, compact, poorly graded, fine grained, moist, brown. some silt, looes below 1.5 m.								
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										

WATER LEVELS
▼ After Drilling
▽ During Drilling

MONITORING WELL: BH 21-28B
ELEV.: 513.2



NOTE:
1. Borehole sloughed to 4.1 m and dry Immediately After Drilling.
2. Monitoring Wells installed in separate shallow holes drilled adjacent to the deep Borehole.
3. Recorded Dry on May 5, 2021.

04-20-2022 Z:\2021 Projects\NEWLOG\17789-GEO-SOUTH OF SASKTOON,SK\DWG\TH28B-17789.bor

P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 21-29

DRAWING NUMBER: 17789-30

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION

LOCATION: SE-24-35-5-W3M AND NE-13-35-5-W3M, SOUTH OF SASKATOON, SK

NORTHING (m): 5762919 **EASTING (m):** 391083 **ELEVATION (m):** 509.7 **DATE DRILLED:** APR 14/21

SAMPLE TYPE: CUTTINGS SPLIT SPOON SHELBY TUBE

WATER LEVELS
After Drilling
During Drilling

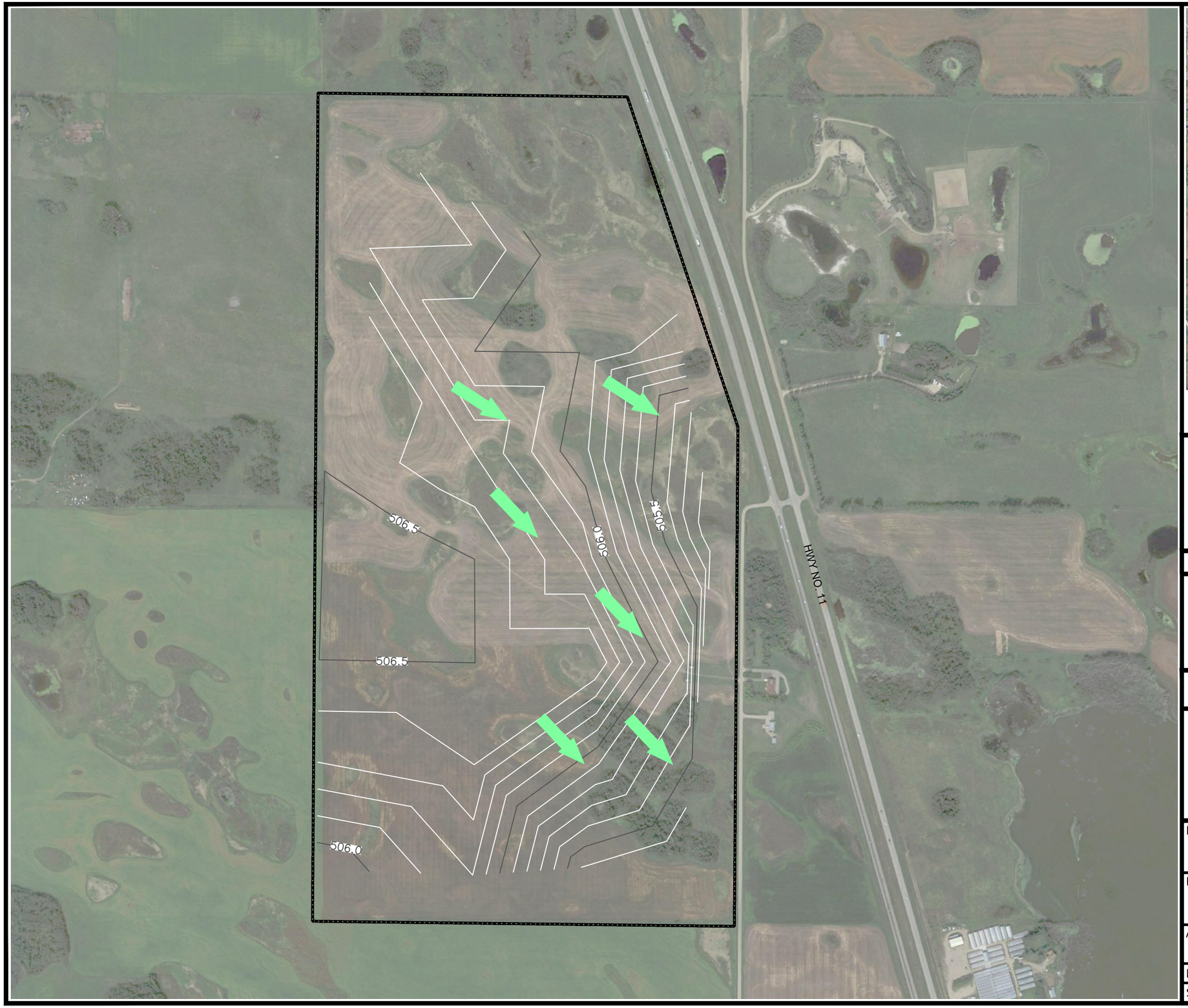
DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/m²)
0		TOPSOIL, organic, moist, black, rootlets.			12.9					
		SAND, some silt, trace clay, loose, poorly graded, fine grained, moist, dark brown.			10.1					
1		brown below 0.7 m.			8.3					
					9.7					
2					8.0					
3					19.8					
		wet, seepage, sloughing below 3.6 m.			22.6					
4		SILT, some clay, trace sand, firm, medium plastic, moist, brown, oxide stained.			33.2					0.25
5										
6										
7										
8										
9										
10										
11										
12										

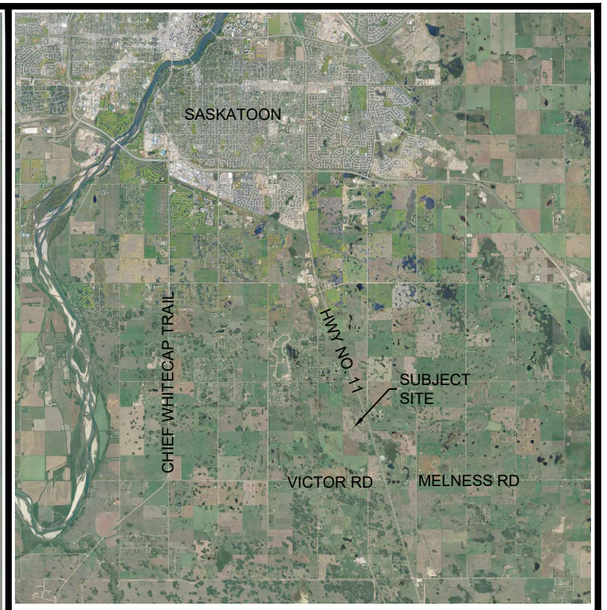
MONITORING WELL: BH 21-29
ELEV.: 510.7

BENTONITE SEAL
50 mm diam. SCH 40, PVC RISER PIPE
SAND PACKED ANNULUS
50 mm diam. MACHINE SLOTTED SCH 40 PVC WELL SCREEN
SLOUGH

NOTE:
1. Borehole sloughed to 4.2 m Immediately After Drilling.
2. Recorded Water Level on May 5, 2021.

04-20-2022 Z:\2021 Projects\NEWLOG\17789-GEO-SOUTH OF SASKTOON,SK\DWG\TH29-17789.bor





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 ©2021, IMAGE ©2021 DIGITALGLOBE, (IMAGERY DATE: 08/23/15).
3. ELEVATION AND COORDINATES FOR EACH BOREHOLE ARE PROVIDED BY DIGITAL PLANIMETRICS.

LEGEND

506.5 - GROUNDWATER ELEVATIONS (m) (MAY 5, 2021)

- APPARENT DIRECTION OF GROUNDWATER FLOW

P. MACHIBRODA ENGINEERING LTD.

CONSULTING
GEOENVIRONMENTAL
GEOTECHNICAL
ENGINEERS

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

DRAWING TITLE:

GROUNDWATER CONTOUR MAP

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION SE-24-35-05-W3M AND NE-13-35-05-W3M, SOUTH OF SASKATOON SK

APPROVED BY:	DRAWN BY:
CZ	TP
DATE: MAY, 2021	DRAWING NUMBER: 17789-31
SCALE: 1:7500	

DRAWINGS

(Prepared for Hydrogeological Investigation)

P.MACHIBRODA ENGINEERING LTD.





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 ©2021, IMAGE ©2021 DIGITALGLOBE, (IMAGERY DATE: 08/23/15).
3. ELEVATION AND COORDINATES FOR EACH BOREHOLE ARE PROVIDED BY DIGITAL PLANIMETRICS.

LEGEND

- PMEL BOREHOLE
- PMEL PIEZOCONE PENETRATION TEST
- PMEL MONITORING WELL

P. MACHIBRODA ENGINEERING LTD.

CONSULTING
GEOENVIRONMENTAL
GEOTECHNICAL
ENGINEERS

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

DRAWING TITLE:
SITE PLAN - SHOWING
CROSS-SECTIONS AND LOTS LAYOUT

PROJECT: PROPOSED GREENVIEW ESTATES SUBDIVISION
SE-24-35-05-W3M AND NE-13-35-05-W3M, NEAR
SASKATOON SK

APPROVED BY: AP	DRAWN BY: TP
DATE: MAY, 2021	DRAWING NUMBER: 17788-1
SCALE: AS SHOWN	

North

South

BH 21-3A

BH 21-8

BH 21-11A

BH 21-16

BH 21-23

BH 21-28

BH 21-28A

BH 21-28B

ELEVATION (m)

516
514
512
510
508
506
504
502
500
498
496
494
492

0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700

DISTANCE (m)

CONSULTING, GEOENVIRONMENTAL GEOTECHNICAL ENGINEERS

806 - 48th Street East,
Saskatoon, SK, S7Y 3Y4

P.MACHIBRODA ENGINEERING LTD.

DRAWING NUMBER: 17788-2

APPROVED BY: AP

DRAWN BY: TP
DATE: JUNE, 2021
SCALE: AS SHOWN

LEGEND

- TOPSOIL
- SAND
- SILT
- SAND AND SILT
- CLAY

LIMITATIONS

THIS STRATIGRAPHIC SECTION IS A SUMMARY OF SUBSURFACE FIELD CONDITIONS INFERRED FROM DATA ENCOUNTERED AT SPECIFIC BOREHOLE LOCATIONS AT THE TIME OF TEST DRILLING. SUB-SURFACE CONDITIONS MAY VARY AT OTHER LOCA-TIONS AND, IN TIME, MAY CHANGE AT THE SPECIFIC LOCATION OF ANY BOREHOLE.

DRAWING TITLE:

STRATIGRAPHIC SECTION
A-A'

PROJECT:

PROPOSED GREENVIEW ESTATES SUBDIVISION,
SE-24-35-5-W3M AND NE-13-5-W3M,
NEAR SASKATOON, SK

North

South

BH 21-18

BH 21-16

BH 21-12

BH 21-6

ELEVATION (m)

514
512
510
508
506
504
502
500
498
496
494

0 100 200 300 400 500 600 700 800 900 1000 1100 1200

DISTANCE (m)

CONSULTING, GEOENVIRONMENTAL GEOTECHNICAL ENGINEERS

806 - 48th Street East,
Saskatoon, SK, S7Y 3Y4

P.MACHIBRODA ENGINEERING LTD.

DRAWING NUMBER: 17788-3

APPROVED BY: AP

DRAWN BY: TP
DATE: JUNE, 2021
SCALE: AS SHOWN

LEGEND

- TOPSOIL
- SAND
- SILT
- SAND AND SILT
- CLAY

LIMITATIONS

THIS STRATIGRAPHIC SECTION IS A SUMMARY OF SUBSURFACE FIELD CONDITIONS INFERRED FROM DATA ENCOUNTERED AT SPECIFIC BOREHOLE LOCATIONS AT THE TIME OF TEST DRILLING. SUB-SURFACE CONDITIONS MAY VARY AT OTHER LOCATIONS AND, IN TIME, MAY CHANGE AT THE SPECIFIC LOCATION OF ANY BOREHOLE.

DRAWING TITLE:

STRATIGRAPHIC SECTION
B-B'

PROJECT:

PROPOSED GREENVIEW ESTATES SUBDIVISION,
SE-24-35-5-W3M AND NE-13-5-W3M,
NEAR SASKATOON, SK

06-29-2021 Z:\2021 Projects\NEWLOG\17788-ENV-NEAR SASKATOON, SK\DWG\CS B-B.cro

APPENDIX A

Conceptual Drainage Summary Report
(Prepared by AE)

Associated Engineering | GLOBAL PERSPECTIVE. LOCAL FOCUS.

TECHNICAL MEMORANDUM

Issue Date:	March 22, 2022	**File No.:**	AERIS
To:	Mr. Abrametz	**Previous Issue Date:**	
From:	Jason Forest, A.Sc.T.	**Project No.:**	2021-4570-00
Client:	Johnathan Abrametz		
Project Name:	Greenview Estates - Comprehensive Development Review (Draft)		
Subject:	Conceptual Drainage Summary		

1 OVERVIEW

Associated Engineering (Sask.) Ltd. (AE) was retained by Johnathan Abrametz to provide a drainage analysis of his property located approximately 7 km south of Saskatoon, Saskatchewan, within the NE 13-35-05-W3M and SE 24-35-5-W3M. This drainage analysis is intended to support the preparation of a conceptual stormwater management strategy to accompany an application to rezone and subdivide the property.

The analysis will review the existing drainage patterns and natural topography. Natural depressions will be estimated and accounted for in design considerations for stormwater management. The site will review estimated pre-development and post-development flow/volume characteristics and recommend a stormwater management strategy for the site.

2 EXISTING DRAINAGE PATTERNS AND CONDITIONS

An independent survey company provided digital contours at 10 cm intervals. The data set covers the two-quarter sections of land proposed for development. Information beyond the development was supplemented by Global Mapper, a geographic information system software.

The terrain is flat with several depressions and hummocks with very little drainage relief. Drainage generally flows from West to East at grades ranging between 0.10% to 0.30%. There are four (4) surface discharge points from the property on the East boundary and two on the Southwest (see Figure 1) for a total of six (6) main catchment areas within the site. Stormwater within the catchments eventually flows into the Highway 11 ditch system and then spills to the outlet basin on the east side of Highway 11, as illustrated in Figure 1 – Regional Drainage.

2.1 Natural Depressions

There are 19 natural depressions that have the potential to collect stormwater before spilling over into adjacent drainage paths or depressions. Table 2-1 summarizes the estimated storage volume and the nearest spill elevation associated with each depression, while Figure 2 – Existing Drainage provides the location of each depression.

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Table 2-1
Existing Depressions

Depression	Volume (m^3)	Spill Elevation	Depression	Volume (m^3)	Spill Elevation
D1	600	507.4	D11	1,500	506.6
D2	1,800	507.6	D12	4,000	509.3
D3	1,600	507.6	D13	1,200	507.2
D4	500	507.5	D14	10,800	508.8
D5	200	508.0	D15	900	507.5
D6	700	508.2	D16	7,200	509.0
D7	1,000	508.1	D17	14,300	510.3
D8	14,700	508.7	D18	1,600	509.1
D9	9,400	508.3	D19	700	506.9
D10	2,800	508.2	-	-	-

When the natural storage ponds (depressions) are consolidated due to development, the volumes associated with the depression will need to be accounted for as part of the dead storage calculation for post-development.

It is not reasonable to assume that depressions on acreage lots will be filled in by homeowners as this would be a costly endeavour and very unlikely, however, some of the depressions will be filled in partially with the construction of access roads. We estimate that 10% of the depressions within lots will be filled in. For this reason, depressions located solely on acreage lots were not included in dead storage calculations (less than 10% for roads), as were depressions that extend beyond the development boundaries. The depressions located entirely on acreage lots and are not anticipated to change from their natural state are D2, D3, D5, D6, D7, D15, and D18. The total amount of depressional storage located entirely on acreage lots is estimated at 7,000 m^3 (7,800 m^3 less 800 m^3).

All remaining depressions are located partially on small rural residential lots, commercial lots, proposed municipal utility (MU) properties, and/or road rights of ways which will be graded and developed, therefore, depressions: D1, D4, D8, D9, D10, D11, D12, D13, D14, D16, D17, and D19 are considered lost depressional storage and will need to be accounted for in the dead storage volume estimates for pond design. The total amount of depressional storage to be accounted for in the dead storage volumes for pond design is estimated at 68,500 m^3, including the 10% (800 m^3) for access roads on acreage lots.

3 STORMWATER MANAGEMENT CONCEPT

The proposed development is intended to be a mix of acreage style development, smaller rural residential, and commercial development. Drainage will be conveyed overland through roadway ditches, swales, and easements. Stormwater retention ponds will be designed per *EPB 322 – Stormwater Guidelines, January 2014* and constructed to account for dead and active storage requirements based on pre-development conditions, post-development flows and volume estimates, and lost depressional storage due to development. Roads will be a rural type of cross-section paved following the Rural Municipality of Corman Parks design standards.

The site has six (6) catchment areas and discharge points (see Figure 2). Catchments 1 and 2 will maintain the existing discharge points with proposed intercepting stormwater ponds. Catchments 3, 4, 5, and 6 will be combined through earthworks grading of the catchments and directing stormwater to the Southeast corner of the site, where stormwater will be intercepted by a pond before being released. The release rate for each of the three (3) ponds will be controlled by limiting the outflow to the estimated pre-development rate.

The Modified Rational Method was used in estimating stormwater pre-development and post-development flow/volumes. Parameters, assumptions, and data used in the calculations are summarized below:

- Intensity duration frequency data from Atmospheric Environment Service – Environment Canada using the Saskatoon U of S station, 4057200.
- 1:100-year return period 24-hour storm event.
- Coefficients of permeability (C) were used in the calculations, and where ranges of C values were given, professional judgment and experience were used in selecting an appropriate C value.
- The coefficient of permeability of 0.25 was used for estimating all pre-development flows, which are classified as undeveloped land.
- Coefficient of permeability for post-development was estimated at 0.38 by calculating a weighted average on contributing areas. as shown in the following table.

Table 3-1
Coefficient of Permeability

Land Description	Contributing Area (m^2)	Coefficient (C)
Roadways	27,000	0.95
Urban Residential	230,000	0.50
Rural Residential	641,000	0.40
Commercial	100,000	0.60
Parks – Municipal Reserve (MR)	95,000	0.25
Ponds – Municipal Utility (MU)	169,000	0.25
Undeveloped	290,000	0.25
Weighted Post Development Coefficient		0.38

3.1 Post Development Catchment 1 – Conceptual Drainage Design

3.1.1 Stormwater Storage

Catchment 1 has nine (9) depressions that spill into each other, eventually draining to the Northeast corner of the site at Highway 11's ditch system. The total volume of the nine (9) depressions before spilling is estimated at 30,500 $m^{3,}$ with the point of discharge off-site in the Highway 11 ditch at an elevation of 506.9.

Depressions D2, D3, D5, D6, and D7 are located entirely on acreage lots and are not considered lost storage except for the 10% accounted for estimated storage loss due to access road construction (800 m^3 estimated). Depressions D1, D4, D8, and D9 will be developed and are considered lost storage and will be accounted for in the design of stormwater pond 1 with a total volume estimated at 26,000 m^3 (25,200 m^3 plus 800 m^3).

The estimated permanent storage required due to the increase in runoff (post-development – pre-development) is calculated at 7,600 m^3.

Active storage within the pond is required to temporarily store runoff during a storm event and slowly release this volume over time. The runoff will be released at a controlled rate equal to pre-development conditions. The pre-development 1:100-year average flow rate was estimated at 0.169 m^3/s. Based on the estimated 1:100-year storm and an allowable outflow rate limited to 0.169 m^3/s; we estimate the active storage requirement to be 17,000 m^3. Below is a summary of the storage requirements for the pond in Municipality Utility (MU) 1.

Table 1-2
Catchment 1 - Volume Summary

Catchment 1 (MU 1)	Volume (m^3)
Depressions	26,000
Change in Land Use	7,600
Required Active Storage	17,000
Total Storage Required – Pond 1 (MU1)	**50,600**

3.2 Post Development Catchment 2 – Conceptual Drainage Design

Catchment 2 has six (6) depressions that spill into each other, eventually draining to the East side of the site at the Rural Municipality (RM) of Corman Park Road and eventually into Highway 11's ditch system. One (1) depression (D20) is outside the developable property and is not considered in the dead storage requirements; however, flow from this depression spills into the proposed development and will need to be accommodated with a drainage easement between lots. The total volume of the five (5) depressions is estimated at 10,400 $m^{3,}$ with the point of discharge off-site at the RM grid road at an elevation of 506.6 m.

Depression D15 is located entirely on an acreage lot and is not considered lost storage. Depressions D10, D11, D12, and D13 are located within small residential lot development, commercial lands, road right of ways, and MU land, therefore, will be developed and are considered lost storage. These depressions will be accounted for in the design of stormwater pond 2, with a total volume estimated at 9,500 m^3.

The estimated permanent storage required due to the increase in runoff (post-development – pre-development) is calculated at 8,500 m^3.

Similar to Pond 1, active storage within the pond is required to temporarily store runoff during a storm event. The runoff will be released at a controlled rate equal to pre-development conditions. The pre-development 1:100-year flow was estimated at an average flow rate 0.190 m^3/s. Based on the estimated 1:100-year storm and an allowable outflow rate limited to 0.190 m^3/s; we estimate the active storage requirement to be 19,800 m^3. Below is a summary of the storage requirements for the pond in Municipality Utility (MU) 2.

Table 3-3
Catchment 2 - Volume Summary

Catchment 2 (MU 2)	Volume (m^3)
Depressions	9,500
Change in Land Use	8,500
Active Storage	19,800
Total Storage Required – Pond 2 (MU2)	**37,800**

3.3 Post Development Catchment 3 – Conceptual Drainage Design

Catchment 3 was combined from four (4) separate sub-catchments. Two (2) are naturally discharged to the East site boundary and two (2) discharge to the West site boundary. The combining of four (4) catchments into one (1) is recommended for controlling outflow from the property and the feasibility of collecting stormwater due to the low-lying area in the Southeast. Ultimately, the stormwater drainage pattern from the surrounding area flows from Northwest to Southeast.

There are four (4) depressions (D14, D16, D17, and D19) within catchment 3 that are located within either: small residential lot development, commercial lands, road right of ways, or MU/MR land, therefore, will be developed and are considered lost storage. Depression D18 is located on MR land and will not be developed, therefore, is not considered lost storage and will not be included in the design of stormwater pond 3.

The stormwater flow will be temporarily collected by stormwater pond 3 and discharged into the Southeast RM ditch. The RM ditch eventually connects to Highway 11's ditch system in the Southeast. The total volume of all five (5) depressions is estimated at 34,600 $m^{3,}$ with the point of discharge off-site into the RM ditch at an elevation of 506.9 m.

Depressions (D14, D16, D17, and D19) will be included in the design of pond 3, with a total estimated volume of 33,000 m^3.

The estimated permanent storage required due to the increase in runoff (post-development – pre-development) is calculated at 4,100 m^3.

Similar to Pond 1 and 2, active storage within the pond is required to temporarily store runoff during a storm event. The runoff will be released at a controlled rate equal to pre-development conditions. Due to the combining of catchments (four into one), the existing discharge at catchment 5 would not see a cumulative flow from the other pre-development catchments (Catchments 3, 4, and 6), therefore, the allowable release rate of stormwater pond 3 must be equal to or lower than the pre-development rate of sub-catchment 5 (see Figure 1 for pre-development catchment boundaries). The pre-development rate of a 1:100-year flow at catchment 5 was estimated at an average flow rate 0.015 m^3/s. Based on the estimated 1:100-year storm and an allowable outflow rate limited to 0.015 m^3/s; we estimate the active storage requirement to be 16,100 m^3. Below is a summary of the storage requirements for the pond in Municipality Utility (MU) 3.

Table 3-4
Catchment 3 - Volume Summary

Catchment 3 (MU 3)	Volume (m^3)
Depressions	33,000
Change in Land Use	4,100
Active Storage	16,100
Total Storage Required – Pond 3 (MU3)	**53,200**

4 DRAINAGE PLAN

4.1 Grading

Grading of the site will be limited to Municipal Utility parcels for the creation of stormwater ponds, road right of ways (for the creation of roads), drainage easements (where applicable), Municipal Reserves (where required to encourage drainage relief), small residential lots (located on the West and South of the property), and the development of access and a building pad (~20 m x 25 m) to provide a site that meets the minimum building elevation requirements for each lot. Material excavated from the construction of ponds will be used for fill were required to facilitate drainage and to create suitable building sites.

4.2 Minimum Building Elevation

The minimum building elevation for building construction is calculated by adding 0.5 m above the nearest downstream spill elevation. This reduces the likelihood that buildings will be impacted by potential flooding.

Ditches are proposed through several lots to lower the spill elevations and promote positive drainage through the site. The lower spill elevations provide reduced minimum building elevations that allows for more buildable areas on lots. It reduces the need to import fill on the larger contury residential acreage lots for building sites.

4.3 Stormwater Pond Design

Stormwater pond locations were strategically placed in the low-lying areas. The areas were sized based on maintaining depths within the range of 0.5 m to 2.0 m. Stormwater ponds will be designed per EPB 322 for recommended depths of active and dead storage requirements. Controls will be designed with ease of maintenance and erosion control considerations.

5 CLOSURE

This technical memorandum serves to inform design intent concerning stormwater management for the proposed Greenview Estates development and was prepared for the RM of Corman Park, Water Security Agency, and the land developer (Johnathan Abrametz).

Should you have any questions or comments, please feel free to contact our office.

Prepared by:

Jason Forest, A.Sc.T.
Project Technologist

Reviewed by:

Ryan Karsgaard, P. Eng.
Project Engineer

ASSOCIATION OF PROFESSIONAL ENGINEERS AND GEOSCIENTISTS OF SASKATCHEWAN
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ASSOCIATED ENGINEERING (SASK.) LTD.
NUMBER
C116
Permission to Consult Held By:

Discipline	Sask. Reg. No.	Signature
Civil	09763	

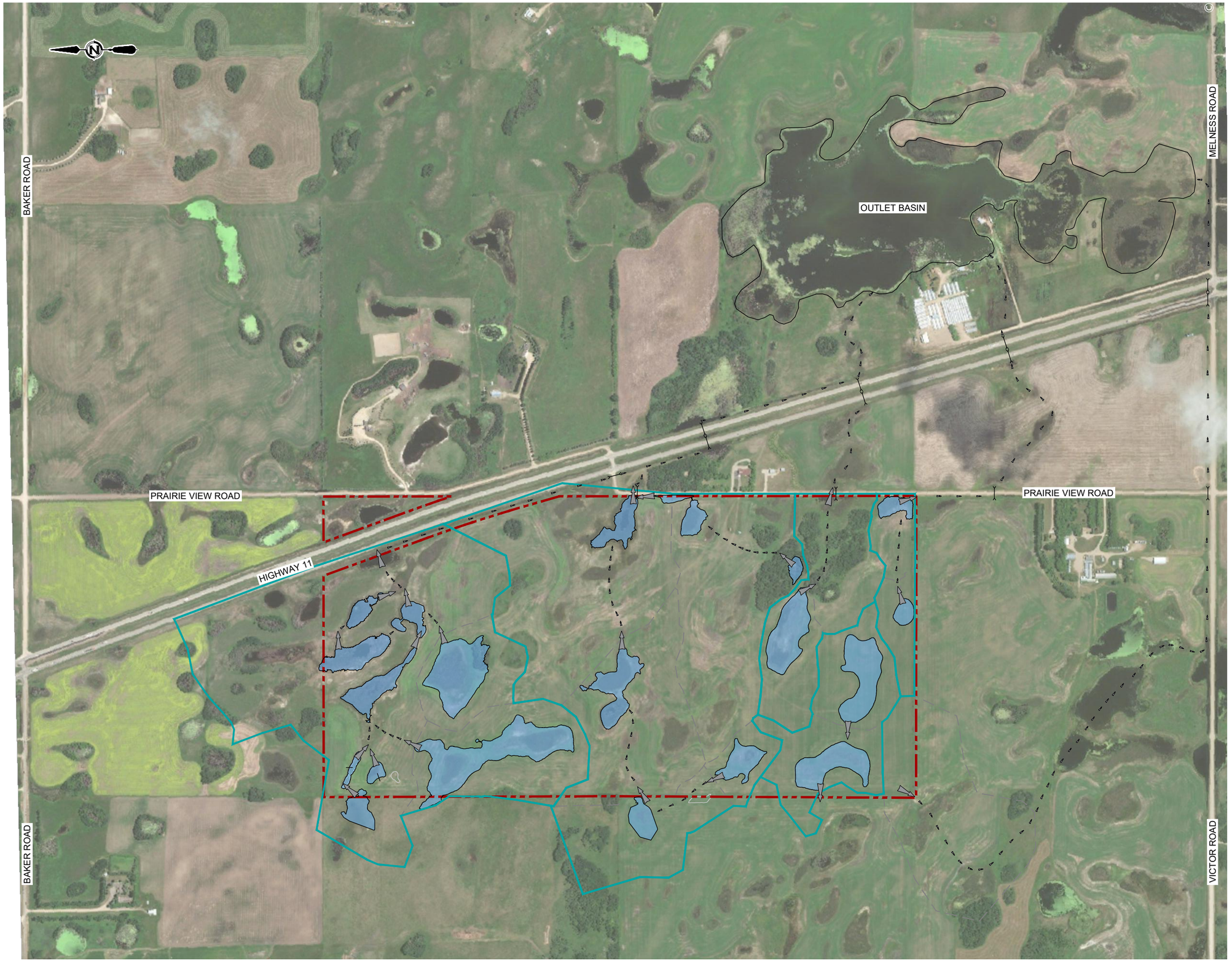
ASSOCIATED ENGINEERING
QUALITY MANAGEMENT SIGN-OFF

Signature: _____

Date: March 22, 2022

IF NOT 25 mm ADJUST SCALES
25 mm

SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE



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CANADA
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LEGEND

- PROJECT AREA
- PONDING AREAS
- WATER AT NATURAL TIPPING ELEVATION
- CATCHMENT BOUNDARY
- SUB-CATCHMENT BOUNDARY
- PONDING AREA SPILL ELEVATION
- DRAINAGE RUN
- CULVERT

NOTES:

1. DRAINAGE RUNS AND FLOWS ARE BASED ON PROVIDED CONTOURS AND WILL BE VERIFIED DURING DETAIL DESIGN.

2. CULVERT LOCATIONS ARE ASSUMED AND WILL BE VERIFIED DURING DETAIL DESIGN.

3. CULVERTS ARE ASSUMED TO BE A MINIMUM 600 mm CSP AND WILL BE CONFIRMED DURING DETAIL DESIGN.

FIGURE 1

GREENVIEW ESTATES

CIVIL
PLAN
REGIONAL DRAINAGE

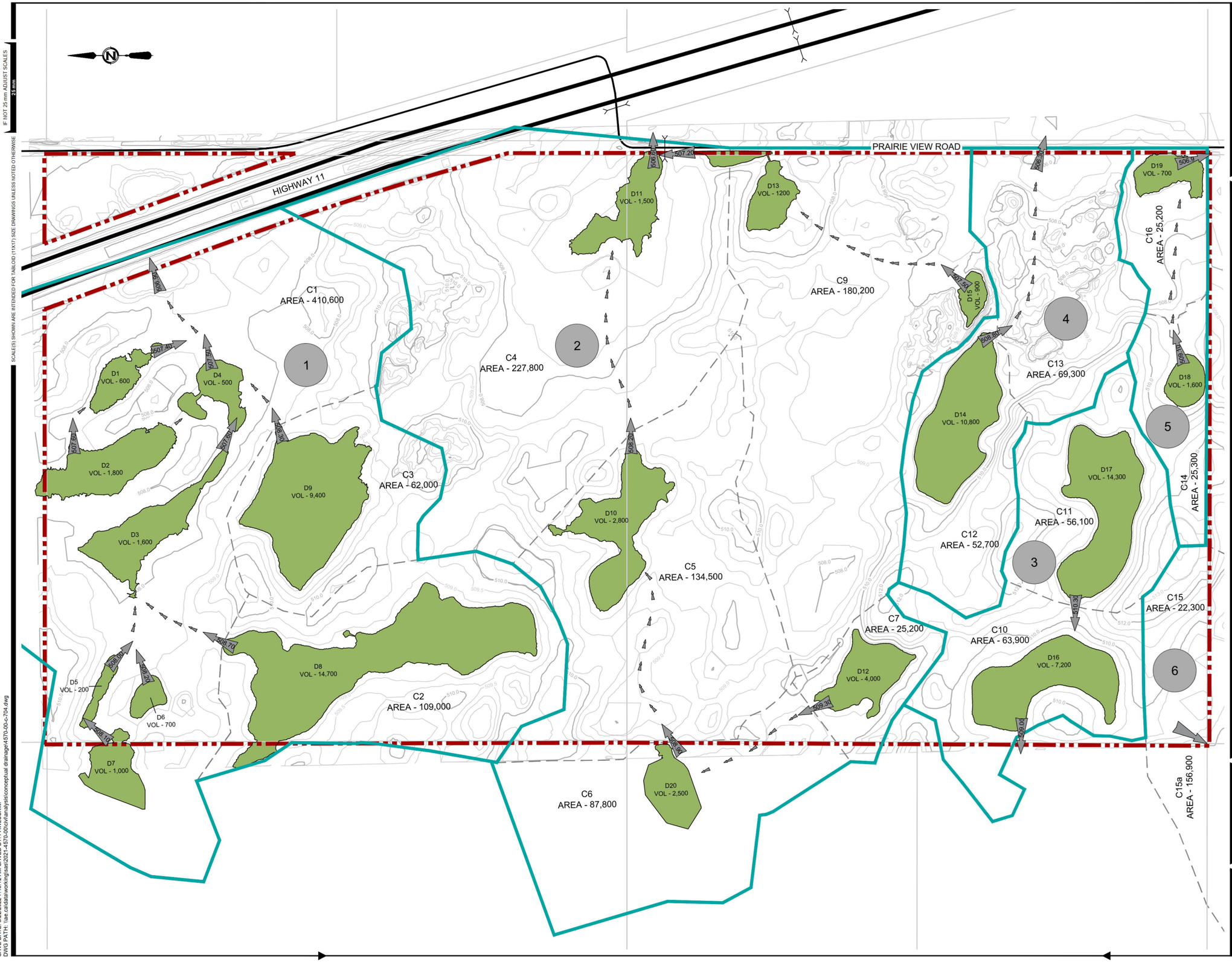
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APPROVED	J. FOREST
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REV	0
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LEGEND

- PROJECT AREA
- PONDING AREAS
- WATER AT NATURAL TIPPING ELEVATION
- CATCHMENT BOUNDARY
- SUB-CATCHMENT BOUNDARY
- PONDING AREA SPILL ELEVATION (507.50)
- DRAINAGE RUN
- 1 CATCHMENT
- CULVERT

NOTES:

1. DRAINAGE RUNS AND FLOWS ARE BASED ON PROVIDED CONTOURS AND WILL BE VERIFIED DURING DETAIL DESIGN.

2. CULVERT LOCATIONS ARE ASSUMED AND WILL BE VERIFIED DURING DETAIL DESIGN.

3. CULVERTS ARE ASSUMED TO BE A MINIMUM 600 mm CSP AND WILL BE CONFIRMED DURING DETAIL DESIGN.

FIGURE 2

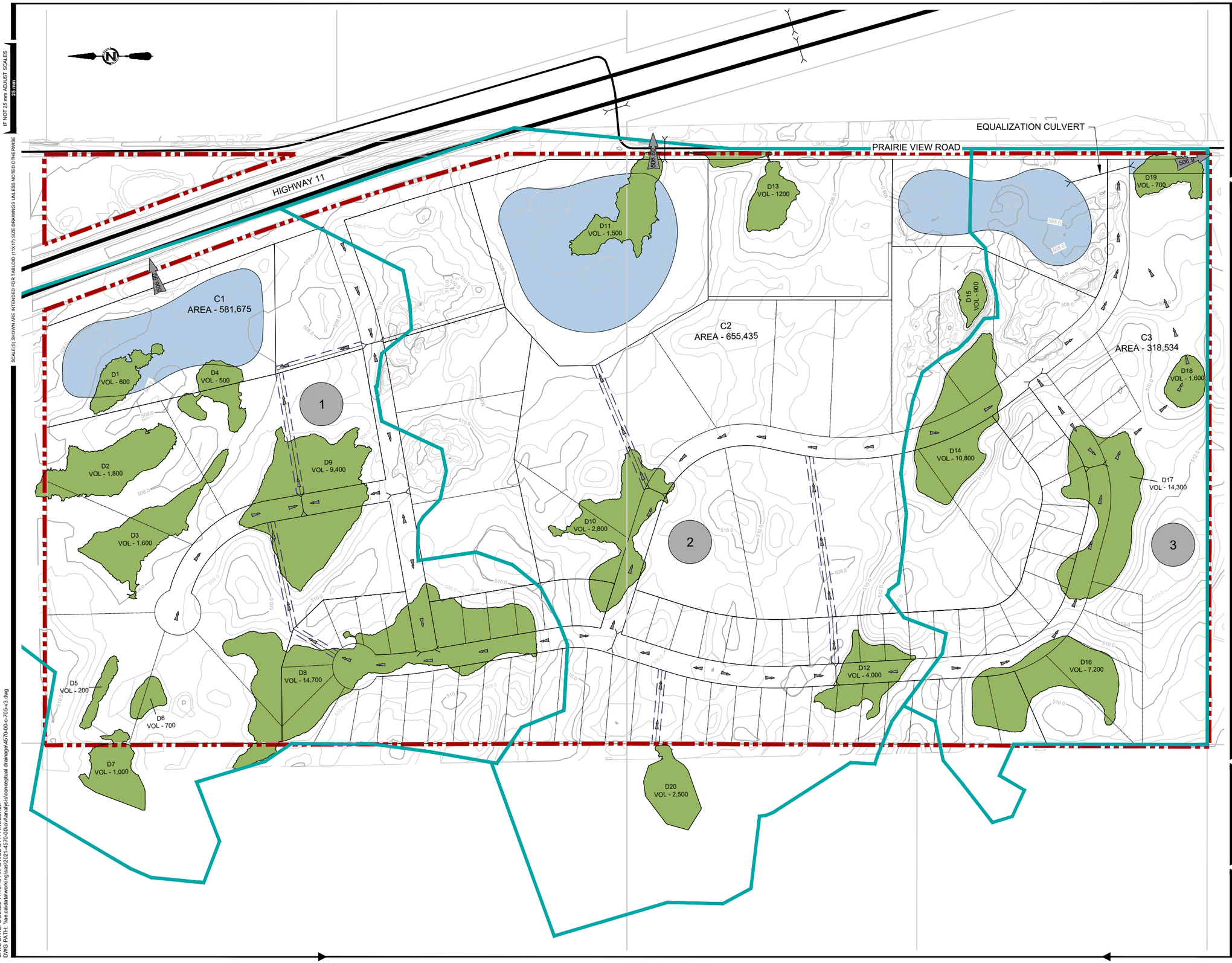
GREENVIEW ESTATES

CIVIL
PLAN
EXISTING DRAINAGE

AE PROJECT No.	20214570-00
SCALE	NTS
APPROVED	J. FOREST
DATE	2022MAR22
REV	0
DESCRIPTION	ISSUED FOR MEMO

IF NOT 25 mm ADJUST SCALES
25 mm

SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE



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LEGEND

- PROJECT AREA
- PROPOSED PONDS
- NATURAL PONDING AREAS
- WATER AT NATURAL TIPPING ELEVATION
- PROPOSED CATCHMENT BOUNDARY
- 507.50 PONDING AREA SPILL ELEVATION
- 1 CATCHMENT
- CULVERT
- PROPOSED OVERLAND FLOW DIRECTION
- PROPOSED EASEMENT

NOTES:
1. EASEMENTS TO BE VERIFIED DURING DETAIL DESIGN.

FIGURE 3

GREENVIEW ESTATES

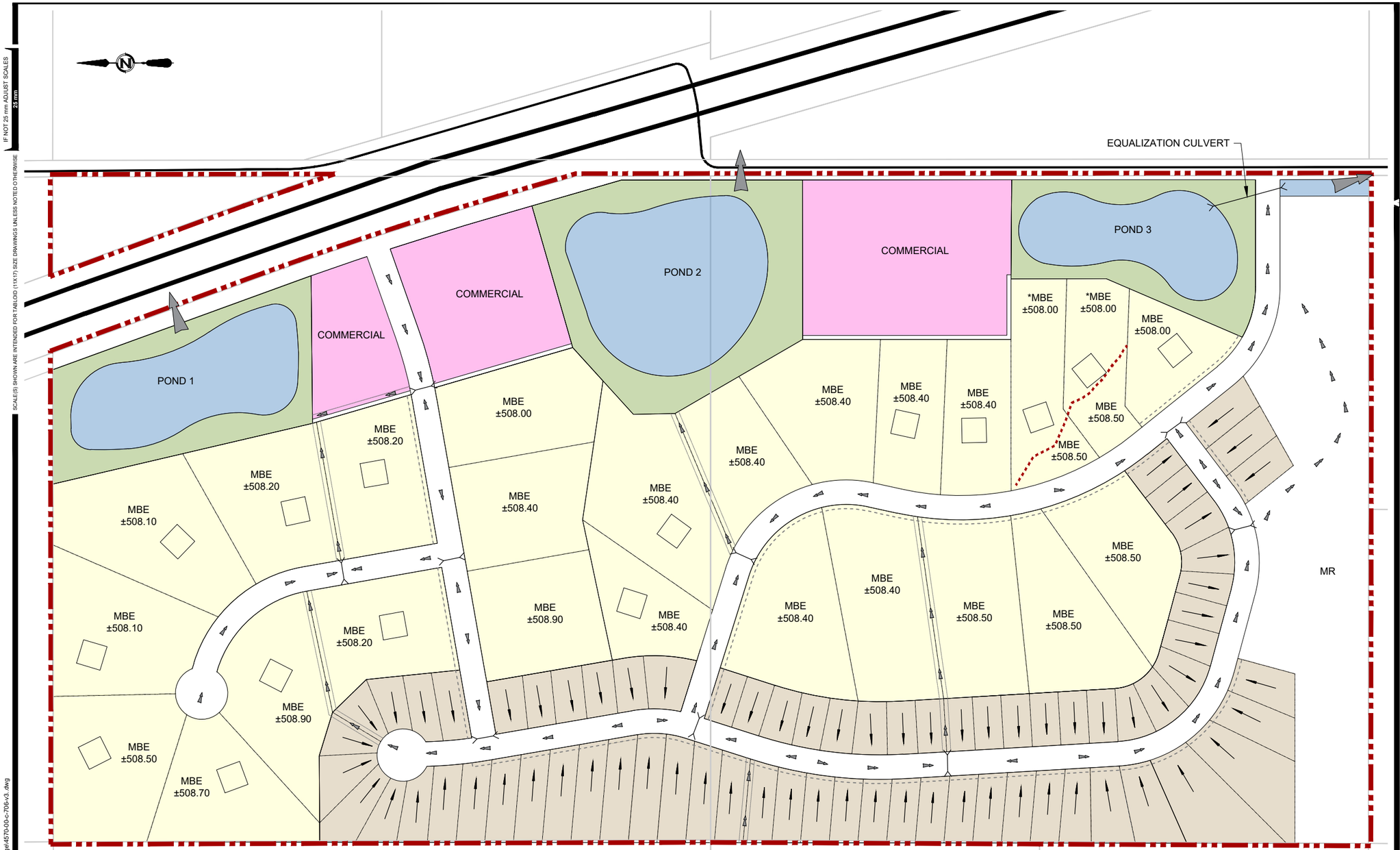
CIVIL
PLAN
EXISTING TOPOGRAPHY & CONCEPTUAL DRAINAGE

AE PROJECT No.	20214570-00
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APPROVED	J. FOREST
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IF NOT 25 mm ADJUST SCALES
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LEGEND

- PROJECT AREA
- CR1 RESIDENTIAL
- COMMERCIAL
- CR4 RESIDENTIAL
- CATCHMENT RIDGE
- LOT GRADE DIRECTION
- PROPOSED EASEMENT
- PROPOSED CULVERT
- PROPOSED OVERLAND FLOW DIRECTION
- PROPOSED BUILDING SITE

NOTES:

1. * (ASTERISK) MBE MEANS MINIMUM BUILDING ELEVATION EAST OF RIDGE; THEREFORE, MBE FOR THOSE LOTS COULD BE 508.00 AT THE BACK OF LOT.

2. LOTS BELOW THE MBE WILL REQUIRE ENGINEERED FILL TO CREATE A BUILDING SITE ABOVE THE MBE. BUILDING SITES SHOWN ARE 30 m X 30 m.

3. THE MINIMUM BUILDING ELEVATIONS WILL BE CONFIRMED DURING DETAIL DESIGN.

4. IT IS ASSUMED THE CR4 LOTS WILL BE GRADED AND RAISED ACCORDINGLY USING ENGINEERED FILL. THIS WILL WE COMPLETED DURING DETAILED DESIGN. THESE SITES NEED SPECIFIC LOT GRADING TO BE DEVELOPED AND THEREFORE, NO MBE IS PROVIDED.

5. IT IS ASSUMED THE COMMERCIAL LOTS WILL BE GRADED AND RAISED ACCORDINGLY USING ENGINEERED FILL. THIS WILL WE COMPLETED ON A LOT SPECIFIC BASIS DURING DETAILED DESIGN. THESE SITES NEED SPECIFIC LOT GRADING TO BE DEVELOPED AND THEREFORE, NO MBE IS PROVIDED.

6. SPILL ELEVATIONS ARE LOWERED AT DEPRESSIONS BY INCLUDING DITCHES AND SWALES AS SHOWN IN THE CONCEPT.

FIGURE 4

GREENVIEW ESTATES

CIVIL
PLAN
CONCEPTUAL MINIMUM BUILDING ELEVATION

AE PROJECT No.	20214570-00
SCALE	NTS
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DATE	2022MAR22
REV	0
DESCRIPTION	ISSUED FOR MEMO

APPENDIX B

Water Well
Records

Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **LEWCHUK** WWDR #: **108668**

Well Location

Land Location	**SE-26-035 -05 -W3**	Location of Well (in Quarter)	
LSD	**00**	**0** ft from N/S Boundary	
Reserve		**0** ft from E/W Boundary	
RM:	**344**		
NTS Map:	**73B02**	Major Basin:	**06**
Elevation (ft)	**1673**	SubBasin:	**30**
Aquifer			

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**1997.10.14**
Hole #	**001**
Install Method	**Bored**
Borehole Depth (ft)	**47**
Bit Dia (in)	**0**
Water Level	**8**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
49	**47**	**30**	**Fiberglass**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
27	**45**	**30**	**70**	**Fiberglass**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**0**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**20**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
18	Sand	Brown	Fine
24	Sand	Brown	Fine
35	Sand	Grey	Fine
39	Sand	Grey	Fine
44	Sand	Grey	Fine
47	Sand	Grey	Fine



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **MARANCHAS** WWDR #: **201950**

Well Location

Land Location	**SE-26-035 -05 -W3**
LSD	**00**
Reserve	
RM:	**344**
NTS Map:	**73B05**
Elevation (ft)	**1673**
Aquifer	

Location of Well (in Quarter)

0 ft from N/S Boundary

0 ft from E/W Boundary

Major Basin: **06**

SubBasin: **30**

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**2004.05.07**
Hole #	
Install Method	**Bored**
Borehole Depth (ft)	**41**
Bit Dia (in)	**42**
Water Level	**11**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
43	**41**	**30**	**Fiberglass**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
27	**38**	**30**	**70**	**Fiberglass**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**1**	hrs
Pumping Rate	**50**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**40**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
5	Sand	Brown	Silty
5	Sand	Brown	Fine
16	Sand	Brown	Fine
18	Sand	Grey	Fine
29	Clay	Grey	Silty
29	Clay	Grey	Firm
41	Sand	Grey	Fine
41	Sand	Grey	Clean



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **SOUTH POINT ESTATES** WWDR #: **108004**

Well Location

Land Location	**SE-26-035 -05 -W3**
LSD	**00**
Reserve	
RM:	**344**
NTS Map:	**73B02**
Elevation (ft)	**1673**
Aquifer	

Location of Well (in Quarter)

0 ft from N/S Boundary

0 ft from E/W Boundary

Major Basin: **06**

SubBasin: **30**

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**1997.05.01**
Hole #	**001**
Install Method	**Bored**
Borehole Depth (ft)	**48**
Bit Dia (in)	**42**
Water Level	**18**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
50	**48**	**30**	**Fiberglass**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
25	**46**	**30**	**70**	**Fiberglass**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**20**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**0**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
24	Sand	Brown	Fine
48	Sand	Grey	Fine



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **SNIDER** WWDR #: **109359**

Well Location

Land Location	**SE-26-035 -05 -W3**
LSD	**00**
Reserve	
RM:	**344**
NTS Map:	**73B02**
Elevation (ft)	**1670**
Aquifer	

Location of Well (in Quarter)

0 ft from N/S Boundary

0 ft from E/W Boundary

Major Basin: **06**

SubBasin: **30**

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**1998.03.13**
Hole #	**001**
Install Method	**Bored**
Borehole Depth (ft)	**50**
Bit Dia (in)	**42**
Water Level	**20**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
53	**50**	**30**	**Fiberglass**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
25	**48**	**30**	**70**	**Fiberglass**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**0**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**6**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
32	Sand	Brown	Fine
35	Sand	Grey	Fine
38	Sand	Grey	Silty
46	Sand	Grey	Fine
50	Sand	Grey	Fine



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **DECK** WWDR #: **031901**

Well Location

Land Location	**SE-26-035 -05 -W3**	Location of Well (in Quarter)		
LSD	**00**	**700**	ft from N/S Boundary	**S**
Reserve		**700**	ft from E/W Boundary	**E**
RM:				
NTS Map:	**73B00**	Major Basin:	**06**	
Elevation (ft)	**1675**	SubBasin:	**30**	
Aquifer				

Well Information

Driller	**PRAIRIE WATER LTD**
Completion Date	**1969.07.04**
Hole #	
Install Method	**Bored**
Borehole Depth (ft)	**34**
Bit Dia (in)	**36**
Water Level	**0**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Curbed**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
0	**34**	**36**	**Porous Concrete**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**0**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**2**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
11	Clay	Brown	Unknown
19	Sand	Brown	Silty
25	Silt	Grey	Sandy
27	Clay	Grey	Unknown
34	Silt	Grey	Sandy



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **SOUTH POINT ESTATES** WWDR #: **109360**

Well Location

Land Location	**SE-26-035 -05 -W3**
LSD	**00**
Reserve	
RM:	**344**
NTS Map:	**73B02**
Elevation (ft)	**1670**
Aquifer	

Location of Well (in Quarter)

0 ft from N/S Boundary

0 ft from E/W Boundary

Major Basin: **06**

SubBasin: **30**

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**1998.03.03**
Hole #	**001**
Install Method	**Bored**
Borehole Depth (ft)	**52**
Bit Dia (in)	**42**
Water Level	**18**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
54	**52**	**30**	**Fiberglass**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
25	**48**	**30**	**70**	**Fiberglass**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**0**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**6**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
22	Sand	Brown	Silty
26	Sand	Brown	Fine
35	Sand	Grey	Fine
40	Sand	Grey	Silty
48	Clay	Grey	Silty
52	Clay	Grey	Firm



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **SOUTH POINT ESTATES** WWDR #: **108328**

Well Location

Land Location	**SE-26-035 -05 -W3**
LSD	**00**
Reserve	
RM:	**344**
NTS Map:	**73B02**
Elevation (ft)	**1673**
Aquifer	

Location of Well (in Quarter)

0 ft from N/S Boundary

0 ft from E/W Boundary

Major Basin: **06**

SubBasin: **30**

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**1997.08.01**
Hole #	**001**
Install Method	**Bored**
Borehole Depth (ft)	**48**
Bit Dia (in)	**42**
Water Level	**6**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
50	**48**	**30**	**Fiberglass**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
35	**45**	**30**	**70**	**Fiberglass**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**20**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**0**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
11	Sand	Brown	Fine
20	Sand	Brown	Fine
24	Sand	Grey	Fine
29	Silt	Grey	Clayey
33	Sand	Grey	Fine
36	Sand	Grey	Silty
48	Sand	Grey	Fine



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **SCHROEDER** WWDR #: **113599**

Well Location

Land Location	**SE-26-035 -05 -W3**
LSD	**00**
Reserve	
RM:	**344**
NTS Map:	**73B02**
Elevation (ft)	**1673**
Aquifer	

Location of Well (in Quarter)

0 ft from N/S Boundary

0 ft from E/W Boundary

Major Basin: **06**

SubBasin: **30**

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**2001.04.30**
Hole #	**001**
Install Method	**Bored**
Borehole Depth (ft)	**45**
Bit Dia (in)	**42**
Water Level	**14**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
47	**45**	**30**	**Fiberglass**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
28	**42**	**30**	**70**	**Fiberglass**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**0**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**20**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
22	Sand	Brown	Fine
45	Sand	Grey	Unknown



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **SOUTH POINT ESTATES** WWDR #: **109358**

Well Location

Land Location	**SE-26-035 -05 -W3**
LSD	**00**
Reserve	
RM:	**344**
NTS Map:	**73B02**
Elevation (ft)	**1670**
Aquifer	

Location of Well (in Quarter)

0 ft from N/S Boundary

0 ft from E/W Boundary

Major Basin: **06**

SubBasin: **30**

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**1997.11.06**
Hole #	**001**
Install Method	**Bored**
Borehole Depth (ft)	**48**
Bit Dia (in)	**42**
Water Level	**15**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
50	**48**	**30**	**Fiberglass**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
30	**45**	**30**	**70**	**Fiberglass**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**20**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**0**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
10	Clay	Brown	Silty
34	Sand	Brown	Fine
41	Sand	Grey	Silty
48	Sand	Grey	Fine



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **D & S HOMES** WWDR #: **110027**

Well Location

Land Location	**SE-26-035 -05 -W3**	Location of Well (in Quarter)	
LSD	**00**	**0** ft from N/S Boundary	
Reserve		**0** ft from E/W Boundary	
RM:	**344**		
NTS Map:	**73B02**	Major Basin:	**06**
Elevation (ft)	**1673**	SubBasin:	**30**
Aquifer			

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**1998.10.23**
Hole #	**001**
Install Method	**Bored**
Borehole Depth (ft)	**50**
Bit Dia (in)	**42**
Water Level	**15**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
52	**50**	**30**	**Fiberglass**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
33	**48**	**30**	**70**	**Fiberglass**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**20**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**0**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
21	Sand	Brown	Fine
29	Clay	Grey	Hard
45	Sand	Grey	Fine
50	Sand	Grey	Fine



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **SOUTH POINT ESTATES** WWDR #: **108329**

Well Location

Land Location	**SE-26-035 -05 -W3**
LSD	**00**
Reserve	
RM:	**344**
NTS Map:	**73B02**
Elevation (ft)	**1673**
Aquifer	

Location of Well (in Quarter)

0 ft from N/S Boundary

0 ft from E/W Boundary

Major Basin: **06**

SubBasin: **30**

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**1997.08.01**
Hole #	**001**
Install Method	**Bored**
Borehole Depth (ft)	**48**
Bit Dia (in)	**42**
Water Level	**22**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
50	**48**	**30**	**Fiberglass**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
24	**45**	**30**	**70**	**Fiberglass**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**40**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**0**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
10	Sand	Brown	Fine
13	Sand	Brown	Silty
16	Sand	Brown	Fine
22	Sand	Brown	Fine
30	Sand	Brown	Fine
48	Sand	Grey	Fine



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **NEUFELD** WWDR #: **228859**

Well Location

Land Location	**NW-23-035 -05 -W3**	Location of Well (in Quarter)	
LSD	**00**	**0** ft from N/S Boundary	
Reserve		**0** ft from E/W Boundary	
RM:	**344**		
NTS Map:	**73B02**	Major Basin:	**06**
Elevation (ft)	**1667**	SubBasin:	**30**
Aquifer			

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**2013.06.06**
Hole #	
Install Method	**Bored**
Borehole Depth (ft)	**73**
Bit Dia (in)	**42**
Water Level	**20**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
75	**73**	**30**	**Fiberglass**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
50	**73**	**30**	**70**	**Fiberglass**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**1**	hrs
Pumping Rate	**70**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**50**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
12	Sand	Brown	Unknown
28	Silty Clay	Brown	Unknown
35	Sand	Brown	Fine
45	Silty Clay	Grey	Unknown
71	Sand	Grey	Fine
73	Sand	Grey	Silty



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **GILLINGS** WWDR #: **217625**

Well Location

Land Location	**NW-23-035 -05 -W3**
LSD	**00**
Reserve	
RM:	**344**
NTS Map:	**73B02**
Elevation (ft)	**1673**
Aquifer	

Location of Well (in Quarter)

0 ft from N/S Boundary

0 ft from E/W Boundary

Major Basin: **06**

SubBasin: **30**

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**2009.06.19**
Hole #	
Install Method	**Bored**
Borehole Depth (ft)	**50**
Bit Dia (in)	**42**
Water Level	**13**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
52	**50**	**30**	**Fiberglass**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
35	**50**	**30**	**70**	**Fiberglass**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**1**	hrs
Pumping Rate	**12**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**10**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
22	Sand	Brown	Unknown
48	Sand	Grey	Unknown
50	Sand	Grey	Silty



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **GALON** WWDR #: **231903**

Well Location

Land Location	**NW-23-035 -05 -W3**	Location of Well (in Quarter)	
LSD	**00**	**0** ft from N/S Boundary	
Reserve		**0** ft from E/W Boundary	
RM:	**344**		
NTS Map:	**73B02**	Major Basin:	**06**
Elevation (ft)	**1672**	SubBasin:	**30**
Aquifer			

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**2020.09.04**
Hole #	
Install Method	**Bored**
Borehole Depth (ft)	**0**
Bit Dia (in)	**44**
Water Level	**15**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
82	**80**	**30**	**Fiberglass**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
50	**80**	**30**	**70**	**Fiberglass**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**2**	hrs
Pumping Rate	**30**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**20**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
10	Sand	Brown	Unknown
20	Clay	Brown	Unknown
53	Clay	Grey	Unknown
60	Sand	Grey	Silty
76	Sand	Grey	Fine
78	Sand	Grey	Silty
80	Clay	Grey	Unknown



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **GREGOR** WWDR #: **224407**

Well Location

Land Location	**NW-23-035 -05 -W3**
LSD	**00**
Reserve	
RM:	**344**
NTS Map:	**73B02**
Elevation (ft)	**1667**
Aquifer	

Location of Well (in Quarter)

0 ft from N/S Boundary

0 ft from E/W Boundary

Major Basin: **06**

SubBasin: **30**

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**2012.06.07**
Hole #	**00000001**
Install Method	**Augered**
Borehole Depth (ft)	**70**
Bit Dia (in)	**6**
Water Level	**10**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Water Test Hole**
Completion Method	
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
0	**0**	**0**	
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**0**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**0**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
19	Sand	Brown	Fine
70	Clay	Grey	Firm



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **CROUCH** WWDR #: **009539**

Well Location

Land Location	**NW-23-035 -05 -W3**	Location of Well (in Quarter)	
LSD	**00**	**0** ft from N/S Boundary	
Reserve		**0** ft from E/W Boundary	
RM:	**344**		
NTS Map:	**73B02**	Major Basin:	**06**
Elevation (ft)	**1675**	SubBasin:	**30**
Aquifer			

Well Information

Driller	**WIG'S SANDPOINT DRILLING**
Completion Date	**1973.04.09**
Hole #	**00000001**
Install Method	**Jetted**
Borehole Depth (ft)	**18**
Bit Dia (in)	**1.5**
Water Level	**12**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Sand Point**
E-Log	**Unknown**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
0	**15**	**1.5**	**Plastic**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
3	**18**	**2**	**12**	**Plastic**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**10**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**10**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
3	Sandy Clay	Unknown	Unknown
5	Clay	Blue	Unknown
12	Sand	Yellow	Unknown
18	Sand	Grey	Unknown



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **SHERDAHL** WWDR #: **239781**

Well Location

Land Location	**NW-23-035 -05 -W3**
LSD	**00**
Reserve	
RM:	**344**
NTS Map:	**73B02**
Elevation (ft)	**1673**
Aquifer	

Location of Well (in Quarter)

0 ft from N/S Boundary

0 ft from E/W Boundary

Major Basin: **06**

SubBasin: **30**

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**2019.05.21**
Hole #	
Install Method	**Bored**
Borehole Depth (ft)	**60**
Bit Dia (in)	**42**
Water Level	**14**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
60	**59**	**30**	**Fiberglass**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
45	**59**	**30**	**70**	**Fiberglass**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**1**	hrs
Pumping Rate	**40**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**20**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
10	Sand	Brown	Silty
30	Sand	Brown	Fine
50	Sand	Grey	Fine
60	Sand	Grey	Silty



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **LEONARD** WWDR #: **219185**

Well Location

Land Location	**NW-23-035 -05 -W3**
LSD	**00**
Reserve	
RM:	**344**
NTS Map:	**73B02**
Elevation (ft)	**1660**
Aquifer	

Location of Well (in Quarter)

0 ft from N/S Boundary

0 ft from E/W Boundary

Major Basin: **06**

SubBasin: **30**

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**2011.05.20**
Hole #	**00000001**
Install Method	**Bored**
Borehole Depth (ft)	**65**
Bit Dia (in)	**40**
Water Level	**22**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
67	**65**	**30**	**Fiberglass**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
35	**65**	**30**	**70**	**Fiberglass**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**2**	hrs
Pumping Rate	**30**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**25**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
27	Clay	Brown	Silty
53	Sand	Grey	Fine
65	Sand	Grey	Clean
67	Clay	Grey	Unknown



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **NEUFELDT** WWDR #: **234054**

Well Location

Land Location	**NW-23-035 -05 -W3**	Location of Well (in Quarter)	
LSD	**00**	**0** ft from N/S Boundary	
Reserve		**0** ft from E/W Boundary	
RM:	**344**		
NTS Map:	**73B02**	Major Basin:	**06**
Elevation (ft)	**1666**	SubBasin:	**30**
Aquifer			

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**2014.07.05**
Hole #	
Install Method	**Bored**
Borehole Depth (ft)	**66**
Bit Dia (in)	**42**
Water Level	**0**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
68	**66**	**30**	**Fiberglass**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
50	**66**	**30**	**70**	**Fiberglass**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**2**	hrs
Pumping Rate	**40**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**30**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
10	Sand	Brown	Fine
20	Sand	Brown	Clean
30	Sand	Grey	Silty
55	Sand	Grey	Fine
66	Sand	Grey	Silty



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **SURYAVANSHI** WWDR #: **233940**

Well Location

Land Location	**NW-23-035 -05 -W3**	Location of Well (in Quarter)	
LSD	**00**	**0** ft from N/S Boundary	
Reserve		**0** ft from E/W Boundary	
RM:	**344**		
NTS Map:	**73B02**	Major Basin:	**06**
Elevation (ft)	**1666**	SubBasin:	**30**
Aquifer			

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**2014.06.03**
Hole #	
Install Method	**Bored**
Borehole Depth (ft)	**65**
Bit Dia (in)	**42**
Water Level	**17**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
67	**65**	**30**	**Fiberglass**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
50	**65**	**30**	**70**	**Fiberglass**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**2**	hrs
Pumping Rate	**60**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**60**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
26	Sand	Brown	Fine
33	Sand	Grey	Silty
44	Sand	Grey	Clean
49	Clay	Grey	Unknown
65	Sand	Grey	Unknown



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **REHMAN** WWDR #: **241260**

Well Location

Land Location	**NW-23-035 -05 -W3**	Location of Well (in Quarter)	
LSD	**00**	**0** ft from N/S Boundary	
Reserve		**0** ft from E/W Boundary	
RM:	**344**		
NTS Map:	**73B02**	Major Basin:	**06**
Elevation (ft)	**510**	SubBasin:	**30**
Aquifer			

Well Information

Driller	**MITCHELL DRILLING WATER WELLS LTD**
Completion Date	**2021.03.12**
Hole #	**00000001**
Install Method	**Drilled**
Borehole Depth (ft)	**90**
Bit Dia (in)	**5.1**
Water Level	**18**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Well Screen And Gravel Pack**
E-Log	**Yes**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
51	**49**	**5**	**P.V.C.**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
15	**64**	**5**	**12**	**Stainless Steel**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**12**	ft
Duration	**6**	hrs
Pumping Rate	**15**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**0**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
16	Sand	Brown	Unknown
64	Sand	Grey	Fine
67	Clay	Unknown	Soft
88	Sand	Grey	Fine
90	Clay	Grey	Unknown



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **STEWART** WWDR #: **229857**

Well Location

Land Location	**NW-23-035 -05 -W3**	Location of Well (in Quarter)	
LSD	**00**	**0** ft from N/S Boundary	
Reserve		**0** ft from E/W Boundary	
RM:	**344**		
NTS Map:	**73B02**	Major Basin:	**06**
Elevation (ft)	**1666**	SubBasin:	**30**
Aquifer			

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**2013.07.29**
Hole #	
Install Method	**Bored**
Borehole Depth (ft)	**73**
Bit Dia (in)	**42**
Water Level	**20**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
75	**73**	**30**	**Fiberglass**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
50	**73**	**30**	**70**	**Fiberglass**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**2**	hrs
Pumping Rate	**50**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**45**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
10	Sand	Brown	Unknown
20	Clay	Brown	Unknown
30	Clay	Grey	Unknown
47	Sand	Grey	Fine
73	Clay	Grey	Sandy



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **BUTLER** WWDR #: **092456**

Well Location

Land Location	**NW-23-035 -05 -W3**	Location of Well (in Quarter)	
LSD	**00**	**0** ft from N/S Boundary	
Reserve		**0** ft from E/W Boundary	
RM:			
NTS Map:	**73B00**	Major Basin:	**06**
Elevation (ft)	**1675**	SubBasin:	**30**
Aquifer			

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**1988.11.09**
Hole #	**1**
Install Method	**Bored**
Borehole Depth (ft)	**64**
Bit Dia (in)	**44**
Water Level	**14**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
66	**64**	**30**	**Galvanized Iron**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**15**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**0**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
20	Sand	Brown	Fine
32	Sand	Grey	Fine
46	Clay	Grey	Unknown
52	Sand	Grey	Silty
64	Sand	Grey	Fine



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **BUTLER** WWDR #: **092456**

Well Location

Land Location	**NW-23-035 -05 -W3**	Location of Well (in Quarter)	
LSD	**00**	**0** ft from N/S Boundary	
Reserve		**0** ft from E/W Boundary	
RM:			
NTS Map:	**73B00**	Major Basin:	**06**
Elevation (ft)	**1675**	SubBasin:	**30**
Aquifer			

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**1988.11.09**
Hole #	**1**
Install Method	**Bored**
Borehole Depth (ft)	**64**
Bit Dia (in)	**44**
Water Level	**14**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
66	**64**	**30**	**Galvanized Iron**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**15**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**0**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
20	Sand	Brown	Fine
32	Sand	Grey	Fine
46	Clay	Grey	Unknown
52	Sand	Grey	Silty
64	Sand	Grey	Fine



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **RASK** WWDR #: **238174**

Well Location

Land Location	**NW-23-035 -05 -W3**
LSD	**00**
Reserve	
RM:	**344**
NTS Map:	**73B02**
Elevation (ft)	**1673**
Aquifer	

Location of Well (in Quarter)

0 ft from N/S Boundary

0 ft from E/W Boundary

Major Basin: **06**

SubBasin: **30**

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**2017.10.31**
Hole #	
Install Method	**Bored**
Borehole Depth (ft)	**0**
Bit Dia (in)	**42**
Water Level	**12**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
48	**46**	**30**	**Fiberglass**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
30	**46**	**30**	**70**	**Fiberglass**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**1**	hrs
Pumping Rate	**80**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**60**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
25	Sand	Brown	Fine
43	Sand	Grey	Medium
46	Clay	Grey	Silty



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **BECK** WWDR #: **211586**

Well Location

Land Location	**NW-23-035 -05 -W3**
LSD	**00**
Reserve	
RM:	**344**
NTS Map:	**73B02**
Elevation (ft)	**1673**
Aquifer	

Location of Well (in Quarter)

0 ft from N/S Boundary

0 ft from E/W Boundary

Major Basin: **06**

SubBasin: **30**

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**2007.08.23**
Hole #	
Install Method	**Bored**
Borehole Depth (ft)	**49**
Bit Dia (in)	**42**
Water Level	**16**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
51	**49**	**30**	**Fiberglass**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
25	**47**	**30**	**70**	**Fiberglass**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**1**	hrs
Pumping Rate	**15**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**10**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
16	Clay	Brown	Unknown
26	Sand	Brown	Fine
45	Sand	Grey	Coal Streaks
49	Sand	Grey	Clayey



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **YAGANISKI** WWDR #: **241819**

Well Location

Land Location	**NW-23-035 -05 -W3**
LSD	**00**
Reserve	
RM:	**344**
NTS Map:	**73B02**
Elevation (ft)	**1673**
Aquifer	

Location of Well (in Quarter)

0 ft from N/S Boundary

0 ft from E/W Boundary

Major Basin: **06**

SubBasin: **30**

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**2020.05.29**
Hole #	
Install Method	**Bored**
Borehole Depth (ft)	**65**
Bit Dia (in)	**30**
Water Level	**8**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
67	**65**	**30**	**Fiberglass**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
53	**65**	**30**	**70**	**Fiberglass**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**1**	hrs
Pumping Rate	**55**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**20**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
25	Sand	Brown	Fine
38	Sand	Grey	Fine
61	Clay	Grey	Silty
65	Clay	Grey	Unknown



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **BUTLER** WWDR #: **009538**

Well Location

Land Location	**NW-23-035 -05 -W3**	Location of Well (in Quarter)	
LSD	**00**	**0** ft from N/S Boundary	
Reserve		**0** ft from E/W Boundary	
RM:	**344**		
NTS Map:	**73B02**	Major Basin:	**06**
Elevation (ft)	**1675**	SubBasin:	**30**
Aquifer			

Well Information

Driller	**WIG'S SANDPOINT DRILLING**
Completion Date	**1973.04.12**
Hole #	**00000001**
Install Method	**Jetted**
Borehole Depth (ft)	**21**
Bit Dia (in)	**1.5**
Water Level	**9**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Sand Point**
E-Log	**Unknown**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
0	**18**	**1.5**	**Plastic**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
3	**21**	**2**	**12**	**Plastic**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**1**	hrs
Pumping Rate	**10**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**10**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
5	Clay	Unknown	Unknown
9	Clay	Brown	Sandy
21	Sand	Brown	Unknown



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **REDL** WWDR #: **106123**

Well Location

Land Location	**NW-23-035 -05 -W3**	Location of Well (in Quarter)		
LSD	**00**	**150**	ft from N/S Boundary	**N**
Reserve		**2380**	ft from E/W Boundary	**W**
RM:	**343**			
NTS Map:	**73B02**	Major Basin:	**06**	
Elevation (ft)	**1675**	SubBasin:	**30**	
Aquifer				

Well Information

Driller	**MITCHELL DRILLING (1979) LTD**
Completion Date	**1995.05.16**
Hole #	**1-B**
Install Method	**Drilled**
Borehole Depth (ft)	**60**
Bit Dia (in)	**5.1**
Water Level	**13**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Well Screen**
E-Log	**Yes**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
47	**45**	**5**	**P.V.C.**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
10	**55**	**5**	**10**	**P.v.c.**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**16**	ft
Duration	**2**	hrs
Pumping Rate	**18**	igpm
Temperature	**44**	deg. F
Rec. Pumping Rate	**10**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
11	Silt	Brown	Unknown
28	Sand	Brown	Fine
60	Sand	Grey	Fine



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **GALON** WWDR #: **228981**

Well Location

Land Location	**NW-23-035 -05 -W3**
LSD	**00**
Reserve	
RM:	**344**
NTS Map:	**73B02**
Elevation (ft)	**1667**
Aquifer	

Location of Well (in Quarter)

0 ft from N/S Boundary

0 ft from E/W Boundary

Major Basin: **06**

SubBasin: **30**

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**2012.07.06**
Hole #	
Install Method	**Bored**
Borehole Depth (ft)	**78**
Bit Dia (in)	**42**
Water Level	**12**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
80	**78**	**30**	**Fiberglass**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
60	**78**	**30**	**70**	**Fiberglass**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**1**	hrs
Pumping Rate	**30**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**20**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
18	Sand	Brown	Unknown
27	Sand	Grey	Unknown
50	Clay	Grey	Unknown
55	Silty Clay	Grey	Unknown
70	Sand	Grey	Unknown
78	Sand	Grey	Silty



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **CAIRNS** WWDR #: **228875**

Well Location

Land Location	**SW-23-035 -05 -W3**
LSD	**00**
Reserve	
RM:	**344**
NTS Map:	**73B02**
Elevation (ft)	**1670**
Aquifer	

Location of Well (in Quarter)

0 ft from N/S Boundary

0 ft from E/W Boundary

Major Basin: **06**

SubBasin: **30**

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**2013.07.11**
Hole #	
Install Method	**Bored**
Borehole Depth (ft)	**73**
Bit Dia (in)	**42**
Water Level	**12**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
75	**73**	**30**	**Fiberglass**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
60	**73**	**30**	**70**	**Fiberglass**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**2**	hrs
Pumping Rate	**80**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**75**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
38	Sand	Brown	Fine
48	Silty Clay	Grey	Unknown
73	Sand	Grey	Fine



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **EARLE** WWDR #: **031900**

Well Location

Land Location	**SW-23-035 -05 -W3**	Location of Well (in Quarter)		
LSD	**00**	**800**	ft from N/S Boundary	**N**
Reserve		**500**	ft from E/W Boundary	**W**
RM:				
NTS Map:	**73B00**	Major Basin:	**06**	
Elevation (ft)	**1675**	SubBasin:	**30**	
Aquifer				

Well Information

Driller	**PRAIRIE WATER LTD**
Completion Date	**1970.07.26**
Hole #	
Install Method	**Bored**
Borehole Depth (ft)	**39**
Bit Dia (in)	**36**
Water Level	**0**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Curbed**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
0	**39**	**36**	**Porous Concrete**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**0**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**4**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
18	Sandy Clay	Brown	Unknown
24	Sand	Grey	Silty
32	Till	Grey	Unknown
33	Sand	Yellow	Unknown
39	Till	Grey	Silty



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **ROWE** WWDR #: **085025**

Well Location

Land Location	**NW-14-035 -05 -W3**	Location of Well (in Quarter)	
LSD	**00**	**0** ft from N/S Boundary	
Reserve		**0** ft from E/W Boundary	
RM:			
NTS Map:	**73B00**	Major Basin:	**05**
Elevation (ft)	**1675**	SubBasin:	**30**
Aquifer			

Well Information

Driller	**PRAIRIE WATER LTD**
Completion Date	**1987.05.04**
Hole #	**1**
Install Method	**Bored**
Borehole Depth (ft)	**35**
Bit Dia (in)	**36**
Water Level	**0**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Curbed**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
36	**35**	**36**	**Porous Concrete**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**0**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**0**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
1	Topsoil	Unknown	Unknown
29	Sand	Brown	Unknown
35	Sand	Grey	Unknown



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **STEWART** WWDR #: **031890**

Well Location

Land Location	**NW-14-035 -05 -W3**	Location of Well (in Quarter)		
LSD	**00**	**1150**	ft from N/S Boundary	**N**
Reserve		**500**	ft from E/W Boundary	**W**
RM:				
NTS Map:	**73B00**	Major Basin:	**06**	
Elevation (ft)	**1675**	SubBasin:	**30**	
Aquifer				

Well Information

Driller	**PRAIRIE WATER LTD**
Completion Date	**1968.11.01**
Hole #	
Install Method	**Bored**
Borehole Depth (ft)	**40**
Bit Dia (in)	**36**
Water Level	**24**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Curbed**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
0	**40**	**36**	**Porous Concrete**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**0**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**3**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
7	Clay	Brown	Unknown
26	Sand	Brown	Silty
40	Sand	Grey	Silty



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **HANBRIDGE** WWDR #: **102894**

Well Location

Land Location	**NW-14-035 -05 -W3**	Location of Well (in Quarter)	
LSD	**00**	**0** ft from N/S Boundary	
Reserve		**0** ft from E/W Boundary	
RM:			
NTS Map:	**73B02**	Major Basin:	**06**
Elevation (ft)	**1675**	SubBasin:	**30**
Aquifer			

Well Information

Driller	**PRAIRIE WATER LTD**
Completion Date	**1993.05.05**
Hole #	**1**
Install Method	**Bored**
Borehole Depth (ft)	**38**
Bit Dia (in)	**36**
Water Level	**0**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Curbed**
E-Log	**Unknown**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
40	**38**	**36**	**Porous Concrete**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**5**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**0**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
1	Topsoil	Unknown	Unknown
23	Sand	Brown	Unknown
26	Clay	Brown	Sandy
38	Sand	Grey	Unknown



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **STEWART** WWDR #: **031891**

Well Location

Land Location	**NW-14-035 -05 -W3**	Location of Well (in Quarter)		
LSD	**00**	**900**	ft from N/S Boundary	**N**
Reserve		**450**	ft from E/W Boundary	**W**
RM:				
NTS Map:	**73B00**	Major Basin:	**06**	
Elevation (ft)	**1675**	SubBasin:	**30**	
Aquifer				

Well Information

Driller	**PRAIRIE WATER LTD**
Completion Date	**1968.10.31**
Hole #	
Install Method	**Bored**
Borehole Depth (ft)	**40**
Bit Dia (in)	**42**
Water Level	**0**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Water Test Hole**
Completion Method	
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
0	**0**	**0**	
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**0**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**0**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
11	Silty Clay	Brown	Unknown
32	Sand	Yellow	Unknown
35	Silty Clay	Brown	Unknown
40	Sand	Yellow	Unknown



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **RAFFARD** WWDR #: **047128**

Well Location

Land Location	**SW-14-035 -05 -W3**	Location of Well (in Quarter)	
LSD	**00**	**0** ft from N/S Boundary	
Reserve		**0** ft from E/W Boundary	
RM:			
NTS Map:	**73B00**	Major Basin:	**06**
Elevation (ft)	**1675**	SubBasin:	**30**
Aquifer			

Well Information

Driller	**WIG'S SANDPOINT DRILLING**
Completion Date	**1976.05.25**
Hole #	**001**
Install Method	**Jetted**
Borehole Depth (ft)	**22**
Bit Dia (in)	**1.5**
Water Level	**12**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Sand Point**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
0	**24**	**1.5**	**A.B.S.**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
3	**27**	**2**	**10**	**Plastic**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**0**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**9**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
22	Sand	Unknown	Unknown



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **S W A SALES** WWDR #: **077228**

Well Location

Land Location	**NE-11-035 -05 -W3**	Location of Well (in Quarter)	
LSD	**00**	**0** ft from N/S Boundary	
Reserve		**0** ft from E/W Boundary	
RM:			
NTS Map:	**72O00**	Major Basin:	**06**
Elevation (ft)	**1675**	SubBasin:	**30**
Aquifer			

Well Information

Driller	**TWEIDT WELLBORING SERVICING LTD**
Completion Date	**1983.10.12**
Hole #	
Install Method	**Bored**
Borehole Depth (ft)	**50**
Bit Dia (in)	**48**
Water Level	**0**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Curbed**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
52	**50**	**30**	**Galvanized Iron**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

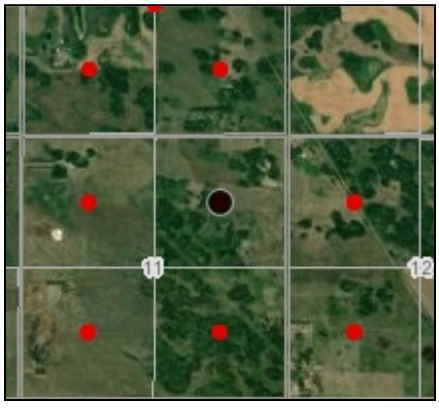
Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**10**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**0**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
1	Topsoil	Unknown	Unknown
6	Sand	Yellow	Dry
15	Sand	Yellow	Water
30	Sand	Grey	Water
50	Clay	Blue	Unknown



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **LANDRY** WWDR #: **014485**

Well Location

Land Location	**NE-11-035 -05 -W3**	Location of Well (in Quarter)		
LSD	**00**	**500**	ft from N/S Boundary	**N**
Reserve		**700**	ft from E/W Boundary	**E**
RM:	**344**			
NTS Map:	**72O15**	Major Basin:	**06**	
Elevation (ft)	**1675**	SubBasin:	**30**	
Aquifer				

Well Information

Driller	**WIG'S SANDPOINT DRILLING**
Completion Date	**1974.04.26**
Hole #	**00000001**
Install Method	**Jetted**
Borehole Depth (ft)	**24**
Bit Dia (in)	**1.5**
Water Level	**10**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Sand Point**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
0	**10**	**36**	**Corrugated Metal**
0	**24**	**1.5**	**Plastic**
0	**0**	**0**	

Well Screens

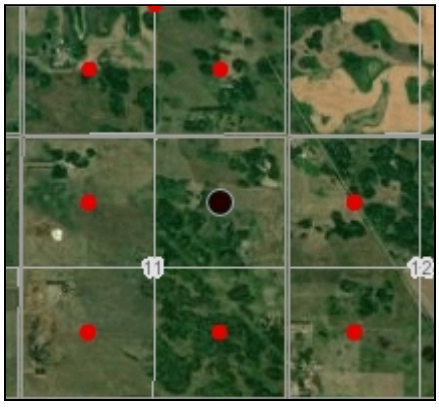
Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
3	**24**	**3**	**10**	**Plastic**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**9**	hrs
Pumping Rate	**8**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**8**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
10	Unknown	Unknown	Unknown
24	Sand	Brown	Medium



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **WELYKI** WWDR #: **047129**

Well Location

Land Location	**SW-12-035 -05 -W3**	Location of Well (in Quarter)		
LSD	**00**	**300**	ft from N/S Boundary	**N**
Reserve		**500**	ft from E/W Boundary	**E**
RM:				
NTS Map:	**72O00**	Major Basin:	**06**	
Elevation (ft)	**1675**	SubBasin:	**30**	
Aquifer				

Well Information

Driller	**MITCHELL DRILLING (1979) LTD**
Completion Date	**1976.04.12**
Hole #	**001**
Install Method	**Drilled**
Borehole Depth (ft)	**140**
Bit Dia (in)	**5.6**
Water Level	**11**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Well Screen And Gravel Pack**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
0	**124**	**4.5**	**Black Iron**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
10	**134**	**4**	**10**	**Stainless Steel**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**41**	ft
Duration	**8**	hrs
Pumping Rate	**10**	igpm
Temperature	**42**	deg. F
Rec. Pumping Rate	**5**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
32	Clay	Brown	Till Streaks
106	Sandy Clay	Grey	Unknown
114	Gravel	Unknown	Coarse
125	Sandy Clay	Grey	Till Streaks
137	Sand	Unknown	Coal Streaks
140	Clay	Blue	Unknown



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **ANDERSON** WWDR #: **080634**

Well Location

Land Location	**SW-12-035 -05 -W3**	Location of Well (in Quarter)	
LSD	**00**	**0** ft from N/S Boundary	
Reserve		**0** ft from E/W Boundary	
RM:			
NTS Map:	**72O00**	Major Basin:	**06**
Elevation (ft)	**1675**	SubBasin:	**30**
Aquifer			

Well Information

Driller	**TWEIDT WELLBORING SERVICING LTD**
Completion Date	**1985.03.26**
Hole #	**1**
Install Method	**Bored**
Borehole Depth (ft)	**50**
Bit Dia (in)	**42**
Water Level	**0**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Well Screen And Gravel Pack**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
52	**50**	**30**	**Galvanized Iron**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
30	**50**	**30**	**125**	**Galvanized Iron**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**0**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**10**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
6	Topsoil	Unknown	Unknown
16	Sand	Unknown	Dry
26	Sand	Unknown	Water
29	Sand	Unknown	Silty
50	Silty Clay	Unknown	Unknown



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **RAWLYK** WWDR #: **048798**

Well Location

Land Location	**SE-12-035 -05 -W3**	Location of Well (in Quarter)		
LSD	**00**	**200**	ft from N/S Boundary	**S**
Reserve		**700**	ft from E/W Boundary	**W**
RM:				
NTS Map:	**72O00**	Major Basin:	**06**	
Elevation (ft)	**1675**	SubBasin:	**30**	
Aquifer				

Well Information

Driller	**WIG'S SANDPOINT DRILLING**
Completion Date	**1976.11.15**
Hole #	**001**
Install Method	**Bored**
Borehole Depth (ft)	**65**
Bit Dia (in)	**30**
Water Level	**0**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Curbed**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
0	**65**	**30**	**Steel Curbing**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**0**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**3**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
1	Topsoil	Unknown	Dry
50	Clay	Unknown	Wet
52	Sand	Unknown	Wet
65	Clay	Unknown	Unknown



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **VANDERPOST** WWDR #: **241009**

Well Location

Land Location	**NE-07-035 -04 -W3**
LSD	**00**
Reserve	
RM:	**344**
NTS Map:	**72O15**
Elevation (ft)	**1682**
Aquifer	

Location of Well (in Quarter)

0 ft from N/S Boundary

0 ft from E/W Boundary

Major Basin: **06**

SubBasin: **30**

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**2018.10.22**
Hole #	
Install Method	**Bored**
Borehole Depth (ft)	**51**
Bit Dia (in)	**42**
Water Level	**13**
Flowing Head	**0**
Water Use	**Research**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
53	**51**	**30**	**Fiberglass**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
35	**51**	**30**	**70**	**Fiberglass**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**1**	hrs
Pumping Rate	**20**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**16**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
15	Sand	Brown	Silty
20	Sand	Brown	Unknown
28	Sand	Grey	Unknown
35	Silty Clay	Grey	Unknown
51	Silty Clay	Grey	Sand Streaks



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **SOULKOTTE** WWDR #: **047150**

Well Location

Land Location	**NE-07-035 -04 -W3**	Location of Well (in Quarter)	
LSD	**00**	**0** ft from N/S Boundary	
Reserve		**0** ft from E/W Boundary	
RM:			
NTS Map:	**72O00**	Major Basin:	**06**
Elevation (ft)	**1675**	SubBasin:	**30**
Aquifer			

Well Information

Driller	**PRAIRIE WATER LTD**
Completion Date	**1976.09.27**
Hole #	
Install Method	**Bored**
Borehole Depth (ft)	**34**
Bit Dia (in)	**36**
Water Level	**0**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Curbed**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
0	**0**	**36**	**Porous Concrete**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**0**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**0**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
1	Topsoil	Unknown	Unknown
16	Sand	Brown	Unknown
30	Silt	Grey	Unknown
34	Clay	Unknown	Silty



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **ANTONIUK** WWDR #: **210791**

Well Location

Land Location	**SW-17-035 -04 -W3**
LSD	**00**
Reserve	
RM:	**344**
NTS Map:	**73B02**
Elevation (ft)	**1650**
Aquifer	

Location of Well (in Quarter)

0 ft from N/S Boundary

0 ft from E/W Boundary

Major Basin: **06**

SubBasin: **30**

Well Information

Driller	**UNKNOWN**
Completion Date	**1913.01.01**
Hole #	
Install Method	**Unknown**
Borehole Depth (ft)	**0**
Bit Dia (in)	**0**
Water Level	**0**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	
E-Log	

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
0	**20**	**36**	**Concrete**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**0**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**0**	igpm

Lithology List

Depth (ft):	Material	Colour	Description



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **ANDERSON** WWDR #: **095633**

Well Location

Land Location	**NW-17-035 -04 -W3**	Location of Well (in Quarter)		
LSD	**00**	**1000**	ft from N/S Boundary	**S**
Reserve		**500**	ft from E/W Boundary	**W**
RM:				
NTS Map:	**73B00**	Major Basin:	**06**	
Elevation (ft)	**1675**	SubBasin:	**30**	
Aquifer				

Well Information

Driller	**MITCHELL DRILLING (1979) LTD**
Completion Date	**1989.08.04**
Hole #	**1**
Install Method	**Drilled**
Borehole Depth (ft)	**100**
Bit Dia (in)	**4.7**
Water Level	**39**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Well Screen And Gravel Pack**
E-Log	**SCANNED**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
74	**41**	**51**	**P.V.C.**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
5	**77**	**4**	**15**	**Stainless Steel**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**28**	ft
Duration	**2**	hrs
Pumping Rate	**10**	igpm
Temperature	**41**	deg. F
Rec. Pumping Rate	**6**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
9	Silt	Brown	Unknown
28	Sand	Brown	Fine
58	Silt	Brown	Clayey
70	Clay	Blue	Unknown
82	Sand	Grey	Fine
100	Clay	Grey	Silty



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **HOLLAND** WWDR #: **114373**

Well Location

Land Location	**SW-20-035 -04 -W3**
LSD	**00**
Reserve	
RM:	**344**
NTS Map:	**73B02**
Elevation (ft)	**1673**
Aquifer	

Location of Well (in Quarter)

0 ft from N/S Boundary

0 ft from E/W Boundary

Major Basin: **06**

SubBasin: **30**

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**2001.09.11**
Hole #	**001**
Install Method	**Bored**
Borehole Depth (ft)	**50**
Bit Dia (in)	**42**
Water Level	**25**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
51	**50**	**30**	**Fiberglass**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
23	**47**	**30**	**70**	**Fiberglass**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**1**	hrs
Pumping Rate	**10**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**8**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
8	Silt	Brown	Sandy
33	Sand	Brown	Fine
37	Sand	Brown	Silty
44	Sand	Grey	Silty
50	Sand	Grey	Fine



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **MANN** WWDR #: **104810**

Well Location

Land Location	**SW-20-035 -04 -W3**	Location of Well (in Quarter)		
LSD	**00**	**1300**	ft from N/S Boundary	**S**
Reserve		**900**	ft from E/W Boundary	**W**
RM:	**344**			
NTS Map:	**73B02**	Major Basin:	**06**	
Elevation (ft)	**1675**	SubBasin:	**30**	
Aquifer				

Well Information

Driller	**MITCHELL DRILLING (1979) LTD**
Completion Date	**1994.05.02**
Hole #	**001**
Install Method	**Drilled**
Borehole Depth (ft)	**110**
Bit Dia (in)	**4.8**
Water Level	**22**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Well Screen And Gravel Pack**
E-Log	**Yes**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
50	**48**	**5**	**P.V.C.**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
40	**88**	**5**	**10**	**P.v.c.**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**18**	ft
Duration	**2**	hrs
Pumping Rate	**16**	igpm
Temperature	**44**	deg. F
Rec. Pumping Rate	**12**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
21	Clay	Brown	Silty
33	Sand	Unknown	Fine
48	Clay	Grey	Hard
88	Sand	Blue	Clay Streaks
110	Clay	Grey	Unknown



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **FRITZ** WWDR #: **060564**

Well Location

Land Location	**NW-20-035 -04 -W3**	Location of Well (in Quarter)	
LSD	**00**	**0** ft from N/S Boundary	
Reserve		**0** ft from E/W Boundary	
RM:			
NTS Map:	**73B00**	Major Basin:	**06**
Elevation (ft)	**1700**	SubBasin:	**30**
Aquifer			

Well Information

Driller	**TWEIDT WELLBORING SERVICING LTD**
Completion Date	**1979.06.14**
Hole #	
Install Method	**Bored**
Borehole Depth (ft)	**40**
Bit Dia (in)	**42**
Water Level	**0**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Curbed**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
42	**40**	**30**	**Galvanized Iron**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**10**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**10**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
1	Topsoil	Unknown	Unknown
18	Sand	Brown	Clay Streaks
27	Sand	Brown	Water
37	Clay	Brown	Unknown
40	Clay	Blue	Hard



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **FRETZ** WWDR #: **058332**

Well Location

Land Location	**NW-20-035 -04 -W3**	Location of Well (in Quarter)	
LSD	**00**	**0** ft from N/S Boundary	
Reserve		**0** ft from E/W Boundary	
RM:			
NTS Map:	**73B00**	Major Basin:	**06**
Elevation (ft)	**1700**	SubBasin:	**30**
Aquifer			

Well Information

Driller	**TWEIDT WELLBORING SERVICING LTD**
Completion Date	**1979.06.14**
Hole #	
Install Method	**Bored**
Borehole Depth (ft)	**40**
Bit Dia (in)	**46**
Water Level	**10**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Curbed**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
42	**40**	**30**	**Galvanized Iron**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**5**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**0**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
1	Topsoil	Unknown	Unknown
10	Sandy Clay	Unknown	Dry
15	Sand	Unknown	Water
17	Clay	Blue	Unknown
19	Sand	Unknown	Water
40	Clay	Blue	Unknown



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **WALDINGER** WWDR #: **045909**

Well Location

Land Location	**SE-30-035 -04 -W3**	Location of Well (in Quarter)	
LSD	**00**	**0** ft from N/S Boundary	
Reserve		**0** ft from E/W Boundary	
RM:			
NTS Map:	**73B00**	Major Basin:	**06**
Elevation (ft)	**1650**	SubBasin:	**30**
Aquifer			

Well Information

Driller	**PRAIRIE WATER LTD**
Completion Date	**1976.04.28**
Hole #	
Install Method	**Bored**
Borehole Depth (ft)	**48**
Bit Dia (in)	**36**
Water Level	**0**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Curbed**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
0	**0**	**36**	**Porous Concrete**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**0**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**0**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
2	Topsoil	Unknown	Unknown
48	Sand	Brown	Unknown



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **WALDINGER** WWDR #: **045909**

Well Location

Land Location	**SE-30-035 -04 -W3**	Location of Well (in Quarter)	
LSD	**00**	**0** ft from N/S Boundary	
Reserve		**0** ft from E/W Boundary	
RM:			
NTS Map:	**73B00**	Major Basin:	**06**
Elevation (ft)	**1650**	SubBasin:	**30**
Aquifer			

Well Information

Driller	**PRAIRIE WATER LTD**
Completion Date	**1976.04.28**
Hole #	
Install Method	**Bored**
Borehole Depth (ft)	**48**
Bit Dia (in)	**36**
Water Level	**0**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Curbed**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
0	**0**	**36**	**Porous Concrete**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**0**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**0**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
2	Topsoil	Unknown	Unknown
48	Sand	Brown	Unknown



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **WHITEHEAD** WWDR #: **079825**

Well Location

Land Location	**SE-30-035 -04 -W3**	Location of Well (in Quarter)		
LSD	**00**	**1000**	ft from N/S Boundary	**N**
Reserve		**100**	ft from E/W Boundary	**E**
RM:				
NTS Map:	**73B00**	Major Basin:	**06**	
Elevation (ft)	**1700**	SubBasin:	**30**	
Aquifer				

Well Information

Driller	**ELSTOW WELL DRILLING**
Completion Date	**1984.08.18**
Hole #	
Install Method	**Drilled**
Borehole Depth (ft)	**180**
Bit Dia (in)	**6.3**
Water Level	**15**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Open Hole**
E-Log	**Yes**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
28	**28**	**20**	**Steel**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**0**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**0**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
15	Clay	Unknown	Oxidized
26	Quicksand	Unknown	Oxidized
42	Clay	Unknown	Unknown
63	Silt	Unknown	Unknown
94	Silt	Unknown	Soft
105	Sand	Unknown	Muddy
153	Silt	Unknown	Unknown
160	Gravel	Unknown	Muddy
180	Silt	Unknown	Unknown



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **PICHE'** WWDR #: **099578**

Well Location

Land Location	**-25-035 -05 -W3**	Location of Well (in Quarter)		
LSD	**00**	**800**	ft from N/S Boundary	**N**
Reserve		**500**	ft from E/W Boundary	**E**
RM:				
NTS Map:	**73B00**	Major Basin:	**06**	
Elevation (ft)	**1675**	SubBasin:	**30**	
Aquifer				

Well Information

Driller	**MITCHELL DRILLING (1979) LTD**
Completion Date	**1990.09.21**
Hole #	**1**
Install Method	**Drilled**
Borehole Depth (ft)	**220**
Bit Dia (in)	**4.7**
Water Level	**24**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Well Screen And Gravel Pack**
E-Log	**SCANNED**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
58	**56**	**5**	**P.V.C.**
66	**72**	**5**	**P.V.C.**
80	**88**	**5**	**P.V.C.**

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
22	**95**	**5**	**20**	**P.v.c.**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**34**	ft
Duration	**2**	hrs
Pumping Rate	**6**	igpm
Temperature	**41**	deg. F
Rec. Pumping Rate	**5**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
12	Silt	Brown	Unknown
53	Silt	Grey	Unknown
95	Sand	Unknown	Fine
126	Silt	Grey	Unknown
220	Till	Grey	Unknown



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **LAWLEY** WWDR #: **047127**

Well Location

Land Location	**NW-25-035 -05 -W3**	Location of Well (in Quarter)	
LSD	**00**	**0** ft from N/S Boundary	
Reserve		**0** ft from E/W Boundary	
RM:			
NTS Map:	**73B00**	Major Basin:	**06**
Elevation (ft)	**1675**	SubBasin:	**30**
Aquifer			

Well Information

Driller	**WIG'S SANDPOINT DRILLING**
Completion Date	**1976.05.26**
Hole #	**001**
Install Method	**Jetted**
Borehole Depth (ft)	**39**
Bit Dia (in)	**1.5**
Water Level	**23**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Sand Point**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
0	**36**	**1.5**	**A.B.S.**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
3	**39**	**2**	**10**	**Plastic**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**0**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**9**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
39	Sand	Unknown	Water



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **LAWLEY** WWDR #: **047127**

Well Location

Land Location	**NW-25-035 -05 -W3**	Location of Well (in Quarter)	
LSD	**00**	**0** ft from N/S Boundary	
Reserve		**0** ft from E/W Boundary	
RM:			
NTS Map:	**73B00**	Major Basin:	**06**
Elevation (ft)	**1675**	SubBasin:	**30**
Aquifer			

Well Information

Driller	**WIG'S SANDPOINT DRILLING**
Completion Date	**1976.05.26**
Hole #	**001**
Install Method	**Jetted**
Borehole Depth (ft)	**39**
Bit Dia (in)	**1.5**
Water Level	**23**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Sand Point**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
0	**36**	**1.5**	**A.B.S.**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
3	**39**	**2**	**10**	**Plastic**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**0**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**9**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
39	Sand	Unknown	Water



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **GROFF** WWDR #: **096278**

Well Location

Land Location	**NW-25-035 -05 -W3**	Location of Well (in Quarter)	
LSD	**00**	**0** ft from N/S Boundary	
Reserve		**0** ft from E/W Boundary	
RM:			
NTS Map:	**73B00**	Major Basin:	**06**
Elevation (ft)	**1675**	SubBasin:	**30**
Aquifer			

Well Information

Driller	**EARTH DRILLING CO LTD**
Completion Date	**1989.09.10**
Hole #	**1**
Install Method	**Bored**
Borehole Depth (ft)	**58**
Bit Dia (in)	**42**
Water Level	**13**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
60	**58**	**24**	**Fiberglass**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
40	**60**	**24**	**375**	**Fiberglass**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**2**	hrs
Pumping Rate	**10**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**5**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
1	Topsoil	Unknown	Unknown
13	Sand	Unknown	Dry
46	Sand	Grey	Medium
58	Silt	Grey	Sandy



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **MORRISON** WWDR #: **109678**

Well Location

Land Location	**SW-25-035 -05 -W3**
LSD	**00**
Reserve	
RM:	**344**
NTS Map:	**73B02**
Elevation (ft)	**1670**
Aquifer	

Location of Well (in Quarter)

0 ft from N/S Boundary

0 ft from E/W Boundary

Major Basin: **06**

SubBasin: **30**

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**1998.09.01**
Hole #	**001**
Install Method	**Bored**
Borehole Depth (ft)	**40**
Bit Dia (in)	**42**
Water Level	**10**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
42	**40**	**30**	**Fiberglass**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
26	**37**	**30**	**70**	**Fiberglass**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**15**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**0**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
25	Sand	Brown	Fine
27	Sand	Grey	Fine
36	Sand	Grey	Clean
40	Sand	Grey	Fine



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **OLESKO** WWDR #: **110605**

Well Location

Land Location	**SW-25-035 -05 -W3**
LSD	**00**
Reserve	
RM:	**344**
NTS Map:	**73B02**
Elevation (ft)	**1673**
Aquifer	

Location of Well (in Quarter)

0 ft from N/S Boundary

0 ft from E/W Boundary

Major Basin: **06**

SubBasin: **30**

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**1999.05.03**
Hole #	**001**
Install Method	**Bored**
Borehole Depth (ft)	**45**
Bit Dia (in)	**42**
Water Level	**10**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
47	**45**	**30**	**Fiberglass**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
32	**43**	**30**	**70**	**Fiberglass**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**12**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**0**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
5	Sand	Brown	Silty
16	Sand	Brown	Fine
28	Sand	Grey	Fine
35	Clay	Grey	Hard
45	Sand	Grey	Fine



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **SAUER** WWDR #: **110870**

Well Location

Land Location	**SW-25-035 -05 -W3**
LSD	**00**
Reserve	
RM:	**344**
NTS Map:	**73B02**
Elevation (ft)	**1673**
Aquifer	

Location of Well (in Quarter)

0 ft from N/S Boundary

0 ft from E/W Boundary

Major Basin: **06**

SubBasin: **30**

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**1999.08.10**
Hole #	**001**
Install Method	**Bored**
Borehole Depth (ft)	**50**
Bit Dia (in)	**42**
Water Level	**12**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
52	**50**	**30**	**Fiberglass**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
27	**47**	**30**	**70**	**Fiberglass**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**15**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**0**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
1	Topsoil	Unknown	Unknown
18	Sand	Brown	Fine
29	Sand	Brown	Silty
36	Sand	Grey	Fine
41	Sand	Grey	Fine
50	Sand	Grey	Silty



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **EICHHORN** WWDR #: **202068**

Well Location

Land Location	**SW-25-035 -05 -W3**	Location of Well (in Quarter)	
LSD	**00**	**0** ft from N/S Boundary	
Reserve		**0** ft from E/W Boundary	
RM:	**344**		
NTS Map:	**73B02**	Major Basin:	**06**
Elevation (ft)	**1673**	SubBasin:	**30**
Aquifer			

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**2005.06.01**
Hole #	**001**
Install Method	**Bored**
Borehole Depth (ft)	**48**
Bit Dia (in)	**42**
Water Level	**13**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
50	**48**	**30**	**Fiberglass**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
32	**46**	**30**	**70**	**Fiberglass**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**1**	hrs
Pumping Rate	**20**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**15**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
18	Sand	Brown	Fine
29	Sand	Grey	Unknown
32	Sand	Grey	Silty
48	Silty Clay	Grey	Soft



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **STOCKMANSKI** WWDR #: **110463**

Well Location

Land Location	**SW-25-035 -05 -W3**	Location of Well (in Quarter)	
LSD	**00**	**0** ft from N/S Boundary	
Reserve		**0** ft from E/W Boundary	
RM:	**344**		
NTS Map:	**73B02**	Major Basin:	**06**
Elevation (ft)	**1673**	SubBasin:	**30**
Aquifer			

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**1999.04.01**
Hole #	**001**
Install Method	**Bored**
Borehole Depth (ft)	**54**
Bit Dia (in)	**42**
Water Level	**15**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
56	**54**	**30**	**Fiberglass**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
34	**51**	**30**	**70**	**Fiberglass**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**20**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**0**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
6	Silt	Brown	Sandy
20	Sand	Brown	Fine
27	Sand	Brown	Clean
29	Sand	Brown	Fine
49	Sand	Grey	Fine
54	Sand	Grey	Silty



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **LEGACY HOMES** WWDR #: **110759**

Well Location

Land Location	**SW-25-035 -05 -W3**	Location of Well (in Quarter)	
LSD	**00**	**0** ft from N/S Boundary	
Reserve		**0** ft from E/W Boundary	
RM:	**344**		
NTS Map:	**73B02**	Major Basin:	**06**
Elevation (ft)	**1675**	SubBasin:	**30**
Aquifer			

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**1999.06.28**
Hole #	**001**
Install Method	**Bored**
Borehole Depth (ft)	**50**
Bit Dia (in)	**42**
Water Level	**10**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
52	**50**	**30**	**Fiberglass**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
30	**47**	**30**	**70**	**Fiberglass**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**15**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**0**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
19	Sand	Brown	Fine
21	Silt	Brown	Sandy
30	Sand	Brown	Fine
34	Sand	Grey	Fine
50	Sand	Grey	Silty



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **D & S HOMES** WWDR #: **110606**

Well Location

Land Location	**SW-25-035 -05 -W3**
LSD	**00**
Reserve	
RM:	**344**
NTS Map:	**73B02**
Elevation (ft)	**1673**
Aquifer	

Location of Well (in Quarter)

0 ft from N/S Boundary

0 ft from E/W Boundary

Major Basin: **06**

SubBasin: **30**

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**1999.05.04**
Hole #	**001**
Install Method	**Bored**
Borehole Depth (ft)	**46**
Bit Dia (in)	**42**
Water Level	**7**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
48	**46**	**30**	**Fiberglass**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
30	**43**	**30**	**70**	**Fiberglass**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**15**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**0**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
9	Sand	Brown	Fine
15	Sand	Brown	Clean
24	Sand	Grey	Fine
27	Clay	Grey	Firm
34	Clay	Grey	Silty
40	Sand	Grey	Fine
46	Sand	Grey	Silty



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **D & S HOMES** WWDR #: **110608**

Well Location

Land Location	**SW-25-035 -05 -W3**	Location of Well (in Quarter)	
LSD	**00**	**0** ft from N/S Boundary	
Reserve		**0** ft from E/W Boundary	
RM:	**344**		
NTS Map:	**73B02**	Major Basin:	**06**
Elevation (ft)	**1673**	SubBasin:	**30**
Aquifer			

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**1999.05.14**
Hole #	**001**
Install Method	**Bored**
Borehole Depth (ft)	**48**
Bit Dia (in)	**42**
Water Level	**15**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
50	**48**	**30**	**Fiberglass**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
26	**45**	**30**	**70**	**Fiberglass**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**12**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**0**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
10	Clay	Brown	Silty
15	Sand	Brown	Silty
26	Sand	Brown	Fine
28	Sand	Grey	Silty
35	Clay	Grey	Firm
38	Clay	Grey	Silty
45	Sand	Grey	Fine
48	Silt	Grey	Sandy



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
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Well Name: **LENNON** WWDR #: **110026**

Well Location

Land Location	**SW-25-035 -05 -W3**
LSD	**00**
Reserve	
RM:	**344**
NTS Map:	**73B02**
Elevation (ft)	**1673**
Aquifer	

Location of Well (in Quarter)

0 ft from N/S Boundary

0 ft from E/W Boundary

Major Basin: **06**

SubBasin: **30**

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**1998.10.21**
Hole #	**001**
Install Method	**Bored**
Borehole Depth (ft)	**50**
Bit Dia (in)	**42**
Water Level	**10**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
52	**50**	**30**	**Fiberglass**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
34	**47**	**30**	**70**	**Fiberglass**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**12**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**0**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
18	Sand	Brown	Silty
23	Sand	Grey	Silty
30	Sand	Grey	Fine
37	Silt	Grey	Sandy
48	Sand	Grey	Fine
50	Silt	Grey	Clayey



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
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Well Name: **D & S HOMES** WWDR #: **110607**

Well Location

Land Location	**SW-25-035 -05 -W3**
LSD	**00**
Reserve	
RM:	**344**
NTS Map:	**73B02**
Elevation (ft)	**1673**
Aquifer	

Location of Well (in Quarter)

0 ft from N/S Boundary

0 ft from E/W Boundary

Major Basin: **06**

SubBasin: **30**

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**1999.05.04**
Hole #	**001**
Install Method	**Bored**
Borehole Depth (ft)	**48**
Bit Dia (in)	**42**
Water Level	**12**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
50	**48**	**30**	**Fiberglass**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
30	**45**	**30**	**70**	**Fiberglass**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**8**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**0**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
5	Sand	Brown	Silty
21	Sand	Brown	Fine
26	Sand	Grey	Fine
33	Sand	Grey	Silty
44	Sand	Grey	Fine
48	Sand	Grey	Silty



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **DAY** WWDR #: **109499**

Well Location

Land Location	**SE-25-035 -05 -W3**
LSD	**00**
Reserve	
RM:	**344**
NTS Map:	**73B02**
Elevation (ft)	**1675**
Aquifer	

Location of Well (in Quarter)

0 ft from N/S Boundary

0 ft from E/W Boundary

Major Basin: **06**

SubBasin: **30**

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**1998.08.17**
Hole #	**001**
Install Method	**Bored**
Borehole Depth (ft)	**43**
Bit Dia (in)	**42**
Water Level	**20**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
45	**43**	**30**	**Fiberglass**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
20	**40**	**30**	**70**	**Fiberglass**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**2**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**0**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
12	Sand	Brown	Fine
25	Sand	Brown	Fine
29	Sand	Grey	Fine
36	Silt	Grey	Sandy
43	Silt	Grey	Soft



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **GOLDADE** WWDR #: **206470**

Well Location

Land Location	**SE-25-035 -05 -W3**
LSD	**00**
Reserve	
RM:	**344**
NTS Map:	**73B02**
Elevation (ft)	**1699**
Aquifer	

Location of Well (in Quarter)

0 ft from N/S Boundary

0 ft from E/W Boundary

Major Basin: **06**

SubBasin: **30**

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**2005.07.14**
Hole #	
Install Method	**Bored**
Borehole Depth (ft)	**38**
Bit Dia (in)	**42**
Water Level	**10**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
40	**38**	**30**	**Fiberglass**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
25	**36**	**30**	**70**	**Fiberglass**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**1**	hrs
Pumping Rate	**30**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**25**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
18	Sand	Brown	Unknown
28	Sand	Grey	Unknown
30	Silty Clay	Grey	Unknown
38	Sand	Grey	Unknown



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
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Well Name: **DAY** WWDR #: **102427**

Well Location

Land Location	**SE-25-035 -05 -W3**	Location of Well (in Quarter)	
LSD	**00**	**0** ft from N/S Boundary	
Reserve		**0** ft from E/W Boundary	
RM:			
NTS Map:	**73B02**	Major Basin:	**06**
Elevation (ft)	**1675**	SubBasin:	**30**
Aquifer			

Well Information

Driller	**EARTH DRILLING CO LTD**
Completion Date	**1991.07.08**
Hole #	**1**
Install Method	**Bored**
Borehole Depth (ft)	**48**
Bit Dia (in)	**42**
Water Level	**15**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
50	**48**	**30**	**Fiberglass**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
35	**50**	**30**	**37**	**Fiberglass**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**2**	hrs
Pumping Rate	**15**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**12**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
1	Topsoil	Unknown	Unknown
15	Sand	Unknown	Dry
30	Silt	Grey	Water
39	Sand	Grey	Water
48	Till	Grey	Unknown



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **HYDE** WWDR #: **120157**

Well Location

Land Location	**SE-25-035 -05 -W3**	Location of Well (in Quarter)	
LSD	**00**	**0** ft from N/S Boundary	
Reserve		**0** ft from E/W Boundary	
RM:	**344**		
NTS Map:	**73B02**	Major Basin:	**06**
Elevation (ft)	**1683**	SubBasin:	**30**
Aquifer			

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**2003.07.18**
Hole #	
Install Method	**Bored**
Borehole Depth (ft)	**66**
Bit Dia (in)	**42**
Water Level	**33**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
68	**66**	**30**	**Fiberglass**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
31	**63**	**30**	**70**	**Fiberglass**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**1**	hrs
Pumping Rate	**25**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**20**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
18	Sand	Brown	Fine
26	Clay	Brown	Firm
30	Clay	Brown	Silty
33	Sand	Brown	Silty
62	Sand	Grey	Fine
66	Sand	Grey	Silty



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
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Well Name: **CUNNINGHAM** WWDR #: **217623**

Well Location

Land Location	**NE-23-035 -05 -W3**
LSD	**00**
Reserve	
RM:	**344**
NTS Map:	**73B02**
Elevation (ft)	**1673**
Aquifer	

Location of Well (in Quarter)

0 ft from N/S Boundary

0 ft from E/W Boundary

Major Basin:	**06**
SubBasin:	**30**

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**2009.06.17**
Hole #	
Install Method	**Bored**
Borehole Depth (ft)	**60**
Bit Dia (in)	**42**
Water Level	**15**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
62	**60**	**30**	**Fiberglass**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
35	**60**	**30**	**70**	**Fiberglass**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**2**	hrs
Pumping Rate	**15**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**12**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
15	Sandy Clay	Brown	Unknown
20	Sand	Brown	Unknown
55	Sand	Grey	Unknown
60	Sand	Grey	Silty



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **REDL** WWDR #: **106122**

Well Location

Land Location	**NE-23-035 -05 -W3**	Location of Well (in Quarter)		
LSD	**00**	**150**	ft from N/S Boundary	**N**
Reserve		**1200**	ft from E/W Boundary	**E**
RM:	**343**			
NTS Map:	**73B02**	Major Basin:	**06**	
Elevation (ft)	**1675**	SubBasin:	**30**	
Aquifer				

Well Information

Driller	**MITCHELL DRILLING (1979) LTD**
Completion Date	**1995.05.19**
Hole #	**001**
Install Method	**Drilled**
Borehole Depth (ft)	**60**
Bit Dia (in)	**5**
Water Level	**12**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Well Screen And Gravel Pack**
E-Log	**Yes**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
45	**43**	**5**	**P.V.C.**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
10	**53**	**5**	**10**	**P.v.c.**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**16**	ft
Duration	**2**	hrs
Pumping Rate	**30**	igpm
Temperature	**44**	deg. F
Rec. Pumping Rate	**20**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
18	Silt	Brown	Unknown
26	Sand	Brown	Unknown
60	Sand	Grey	Fine



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **REDL** WWDR #: **106124**

Well Location

Land Location	**NE-23-035 -05 -W3**	Location of Well (in Quarter)		
LSD	**00**	**150**	ft from N/S Boundary	**N**
Reserve		**2600**	ft from E/W Boundary	**E**
RM:	**343**			
NTS Map:	**73B02**	Major Basin:	**06**	
Elevation (ft)	**1675**	SubBasin:	**30**	
Aquifer				

Well Information

Driller	**MITCHELL DRILLING (1979) LTD**
Completion Date	**1995.05.17**
Hole #	**2-C**
Install Method	**Drilled**
Borehole Depth (ft)	**60**
Bit Dia (in)	**5.1**
Water Level	**12**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Well Screen And Gravel Pack**
E-Log	**Yes**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
40	**38**	**5**	**P.V.C.**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
10	**48**	**5**	**10**	**P.v.c.**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**18**	ft
Duration	**2**	hrs
Pumping Rate	**14**	igpm
Temperature	**44**	deg. F
Rec. Pumping Rate	**10**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
12	Silt	Brown	Unknown
24	Sand	Brown	Fine
48	Sand	Grey	Fine
60	Silt	Grey	Unknown



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
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Well Name: **REDL** WWDR #: **106125**

Well Location

Land Location	**NE-23-035 -05 -W3**	Location of Well (in Quarter)		
LSD	**00**	**1000**	ft from N/S Boundary	**N**
Reserve		**1300**	ft from E/W Boundary	**E**
RM:	**343**			
NTS Map:	**73B02**	Major Basin:	**06**	
Elevation (ft)	**1675**	SubBasin:	**30**	
Aquifer				

Well Information

Driller	**MITCHELL DRILLING (1979) LTD**
Completion Date	**1995.05.19**
Hole #	**000005-F**
Install Method	**Drilled**
Borehole Depth (ft)	**60**
Bit Dia (in)	**5.1**
Water Level	**10**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Well Screen And Gravel Pack**
E-Log	**Unknown**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
41	**39**	**5**	**P.V.C.**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
10	**49**	**5**	**10**	**P.V.C.**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**14**	ft
Duration	**2**	hrs
Pumping Rate	**30**	igpm
Temperature	**44**	deg. F
Rec. Pumping Rate	**10**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
8	Silt	Brown	Unknown
15	Sand	Brown	Fine
60	Sand	Grey	Fine



Water Well Driller's Report

7-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **REDL** WWDR #: **092457**

Well Location

Land Location	**NE-23-035 -05 -W3**	Location of Well (in Quarter)	
LSD	**00**	**0** ft from N/S Boundary	
Reserve		**0** ft from E/W Boundary	
RM:			
NTS Map:	**73B00**	Major Basin:	**06**
Elevation (ft)	**1675**	SubBasin:	**30**
Aquifer			

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**1988.11.18**
Hole #	**1**
Install Method	**Bored**
Borehole Depth (ft)	**40**
Bit Dia (in)	**44**
Water Level	**18**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
42	**40**	**30**	**Galvanized Iron**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**12**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**0**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
16	Sand	Brown	Fine
18	Clay	Grey	Unknown
34	Sand	Grey	Fine
36	Clay	Grey	Unknown
40	Sand	Grey	Silty



Water Well Driller's Report

8-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **KRISTIANSEN** WWDR #: **043814**

Well Location

Land Location	**NW-24-035 -05 -W3**	Location of Well (in Quarter)	
LSD	**00**	**0** ft from N/S Boundary	
Reserve		**0** ft from E/W Boundary	
RM:			
NTS Map:	**73B00**	Major Basin:	**06**
Elevation (ft)	**1675**	SubBasin:	**30**
Aquifer			

Well Information

Driller	**WIG'S SANDPOINT DRILLING**
Completion Date	**1975.04.25**
Hole #	**001**
Install Method	**Jetted**
Borehole Depth (ft)	**27**
Bit Dia (in)	**1.5**
Water Level	**13**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Sand Point**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
0	**27**	**1.5**	**A.B.S.**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

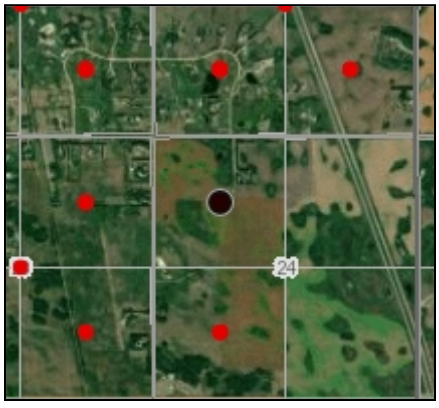
Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
0	**0**	**0**	**0**	**Plastic**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**0**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**6**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
13	Sandy Clay	Unknown	Hard
20	Sandy Clay	Brown	Unknown
27	Sand	Unknown	Unknown



Water Well Driller's Report

8-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **KRISTIANSEN** WWDR #: **077641**

Well Location

Land Location	**NW-24-035 -05 -W3**	Location of Well (in Quarter)	
LSD	**00**	**0** ft from N/S Boundary	
Reserve		**0** ft from E/W Boundary	
RM:			
NTS Map:	**73B00**	Major Basin:	**06**
Elevation (ft)	**1675**	SubBasin:	**30**
Aquifer			

Well Information

Driller	**PRAIRIE WATER LTD**
Completion Date	**1984.04.23**
Hole #	**1**
Install Method	**Bored**
Borehole Depth (ft)	**28**
Bit Dia (in)	**36**
Water Level	**0**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Curbed**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
30	**28**	**36**	**Porous Concrete**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

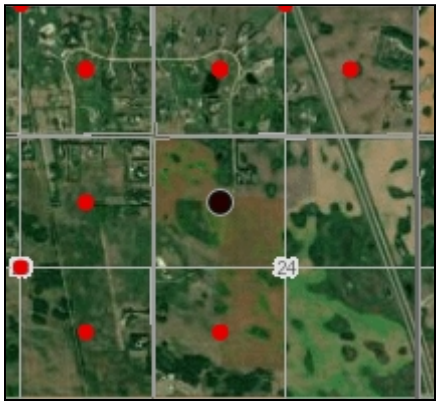
Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**0**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**0**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
1	Topsoil	Unknown	Unknown
18	Sand	Brown	Fine
28	Sand	Grey	Fine



Water Well Driller's Report

8-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **KRISTIANSEN** WWDR #: **014489**

Well Location

Land Location	**NW-24-035 -05 -W3**	Location of Well (in Quarter)	
LSD	**00**	**0** ft from N/S Boundary	
Reserve		**0** ft from E/W Boundary	
RM:			
NTS Map:	**73B00**	Major Basin:	**06**
Elevation (ft)	**1675**	SubBasin:	**30**
Aquifer			

Well Information

Driller	**WIG'S SANDPOINT DRILLING**
Completion Date	**1974.05.09**
Hole #	**001**
Install Method	**Jetted**
Borehole Depth (ft)	**28**
Bit Dia (in)	**2**
Water Level	**13**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Sand Point**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
0	**26**	**1.5**	**Plastic**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

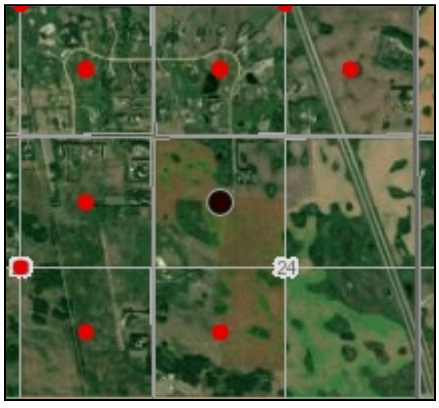
Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
3	**28**	**2**	**10**	**Plastic**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**5**	hrs
Pumping Rate	**6**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**6**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
13	Clay	Brown	Unknown
28	Sand	Grey	Medium



Water Well Driller's Report

8-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **KRISTIANSEN** WWDR #: **104120**

Well Location

Land Location	**NW-24-035 -05 -W3**	Location of Well (in Quarter)	
LSD	**00**	**0** ft from N/S Boundary	
Reserve		**0** ft from E/W Boundary	
RM:	**344**		
NTS Map:	**73B02**	Major Basin:	**06**
Elevation (ft)	**1675**	SubBasin:	**30**
Aquifer			

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**1994.05.10**
Hole #	
Install Method	**Bored**
Borehole Depth (ft)	**50**
Bit Dia (in)	**44**
Water Level	**16**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	**Unknown**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
52	**50**	**30**	**Fiberglass**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

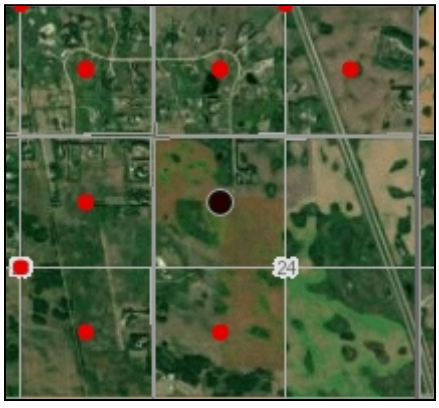
Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
30	**47**	**30**	**70**	**Fiberglass**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**12**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**0**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
21	Sand	Brown	Unknown
46	Sand	Grey	Fine
50	Sand	Grey	Silty



Water Well Driller's Report

8-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **KRISTIONSEN** WWDR #: **086177**

Well Location

Land Location	**NW-24-035 -05 -W3**	Location of Well (in Quarter)	
LSD	**00**	**0** ft from N/S Boundary	
Reserve		**0** ft from E/W Boundary	
RM:			
NTS Map:	**73B00**	Major Basin:	**06**
Elevation (ft)	**1675**	SubBasin:	**30**
Aquifer			

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**1987.07.06**
Hole #	**1**
Install Method	**Bored**
Borehole Depth (ft)	**50**
Bit Dia (in)	**44**
Water Level	**15**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
52	**50**	**30**	**Steel**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

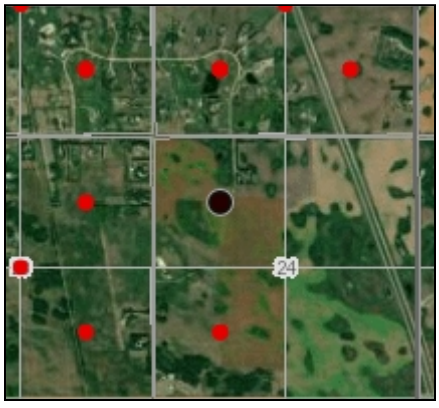
Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**0**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**0**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
1	Topsoil	Unknown	Unknown
20	Sand	Yellow	Unknown
47	Sand	Grey	Unknown
50	Clay	Unknown	Silty



Water Well Driller's Report

8-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **BOEHMER** WWDR #: **047554**

Well Location

Land Location	**NW-24-035 -05 -W3**	Location of Well (in Quarter)	
LSD	**00**	**0** ft from N/S Boundary	
Reserve		**0** ft from E/W Boundary	
RM:			
NTS Map:	**73B00**	Major Basin:	**06**
Elevation (ft)	**1675**	SubBasin:	**30**
Aquifer			

Well Information

Driller	**WIG'S SANDPOINT DRILLING**
Completion Date	**1975.05.20**
Hole #	**001**
Install Method	**Jetted**
Borehole Depth (ft)	**57**
Bit Dia (in)	**2**
Water Level	**41**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Sand Point**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
0	**54**	**2**	**A.B.S.**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

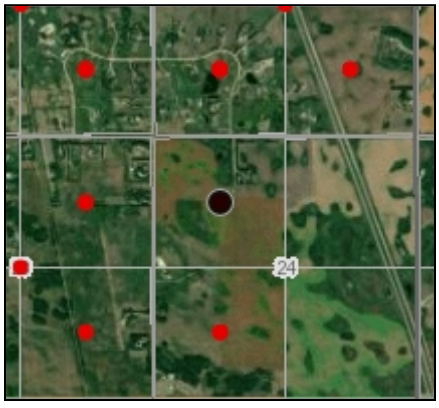
Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
3	**57**	**2**	**10**	**Plastic**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**0**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**4**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
57	Sandy Clay	Unknown	Water



Water Well Driller's Report

8-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **HANBRIDGE** WWDR #: **237148**

Well Location

Land Location	**NW-19-035 -04 -W3**	Location of Well (in Quarter)	
LSD	**00**	**0** ft from N/S Boundary	
Reserve		**0** ft from E/W Boundary	
RM:	**344**		
NTS Map:	**73B02**	Major Basin:	**06**
Elevation (ft)	**1702**	SubBasin:	**30**
Aquifer			

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**2017.05.30**
Hole #	
Install Method	**Bored**
Borehole Depth (ft)	**75**
Bit Dia (in)	**72**
Water Level	**20**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
27	**25**	**30**	**Fiberglass**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

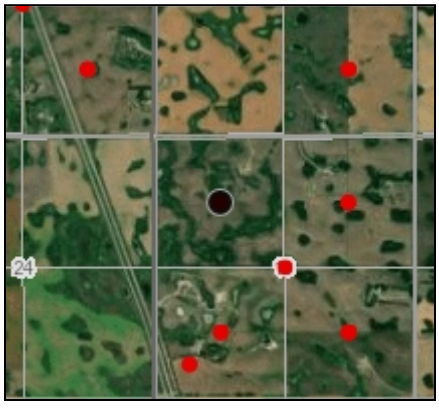
Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
50	**75**	**30**	**70**	**Fiberglass**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**1**	hrs
Pumping Rate	**30**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**20**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
30	Sand	Brown	Fine
35	Sand	Brown	Medium
38	Sand	Grey	Medium
45	Clay	Grey	Silty
75	Sand	Grey	Silty



Water Well Driller's Report

8-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **BARBER** WWDR #: **104111**

Well Location

Land Location	**NE-19-035 -04 -W3**	Location of Well (in Quarter)	
LSD	**00**	**0** ft from N/S Boundary	
Reserve		**0** ft from E/W Boundary	
RM:	**344**		
NTS Map:	**73B02**	Major Basin:	**06**
Elevation (ft)	**1700**	SubBasin:	**30**
Aquifer			

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**1994.04.25**
Hole #	
Install Method	**Bored**
Borehole Depth (ft)	**55**
Bit Dia (in)	**42**
Water Level	**22**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	**Unknown**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
58	**55**	**30**	**Fiberglass**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
25	**53**	**30**	**70**	**Fiberglass**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**20**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**0**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
18	Sand	Brown	Clayey
32	Sand	Brown	Fine
44	Sand	Grey	Silty
50	Sand	Grey	Fine
55	Clay	Grey	Unknown



Water Well Driller's Report

8-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **JANZEN** WWDR #: **104112**

Well Location

Land Location	**NE-19-035 -04 -W3**
LSD	**00**
Reserve	
RM:	**344**
NTS Map:	**73B02**
Elevation (ft)	**1700**
Aquifer	

Location of Well (in Quarter)

0 ft from N/S Boundary

0 ft from E/W Boundary

Major Basin: **06**

SubBasin: **30**

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**1994.04.26**
Hole #	
Install Method	**Bored**
Borehole Depth (ft)	**50**
Bit Dia (in)	**42**
Water Level	**23**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	**Unknown**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
52	**50**	**30**	**Fiberglass**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
25	**48**	**30**	**70**	**Fiberglass**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**0**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**10**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
32	Sand	Brown	Silty
34	Clay	Grey	Unknown
50	Sand	Grey	Fine



Water Well Driller's Report

8-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **GILLESPIE DEVELOPMENTS** WWDR #: **239802**

Well Location

Land Location	**SE-23-035 -05 -W3**
LSD	**00**
Reserve	
RM:	**344**
NTS Map:	**73B02**
Elevation (ft)	**1673**
Aquifer	

Location of Well (in Quarter)

0 ft from N/S Boundary

0 ft from E/W Boundary

Major Basin: **06**

SubBasin: **30**

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**2018.05.16**
Hole #	**00000002**
Install Method	**Augered**
Borehole Depth (ft)	**30**
Bit Dia (in)	**6**
Water Level	**7**
Flowing Head	**0**
Water Use	
Well Use	**Water Test Hole**
Completion Method	
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
0	**0**	**0**	
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**0**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**0**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
7	Sand	Brown	Fine
9	Clay	Brown	Soft
16	Sand	Grey	Fine
22	Clay	Grey	Silty
30	Clay	Grey	Unknown



Water Well Driller's Report

8-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **GILLESPIE DEVELOPMENTS** WWDR #: **239801**

Well Location

Land Location	**SE-23-035 -05 -W3**
LSD	**00**
Reserve	
RM:	**344**
NTS Map:	**73B02**
Elevation (ft)	**1673**
Aquifer	

Location of Well (in Quarter)

0 ft from N/S Boundary

0 ft from E/W Boundary

Major Basin: **06**

SubBasin: **30**

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**2018.05.16**
Hole #	**00000001**
Install Method	**Augered**
Borehole Depth (ft)	**30**
Bit Dia (in)	**6**
Water Level	**0**
Flowing Head	**0**
Water Use	
Well Use	**Water Test Hole**
Completion Method	
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
0	**0**	**0**	
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**0**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**0**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
5	Sand	Brown	Silty
12	Clay	Brown	Firm
30	Clay	Grey	Firm



Water Well Driller's Report

8-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **BOOEHMLER** WWDR #: **049257**

Well Location

Land Location	**SW-24-035 -05 -W3**	Location of Well (in Quarter)	
LSD	**00**	**0** ft from N/S Boundary	
Reserve		**0** ft from E/W Boundary	
RM:			
NTS Map:	**73B00**	Major Basin:	**06**
Elevation (ft)	**1675**	SubBasin:	**30**
Aquifer			

Well Information

Driller	**PRAIRIE WATER LTD**
Completion Date	**1977.04.14**
Hole #	
Install Method	**Bored**
Borehole Depth (ft)	**26**
Bit Dia (in)	**36**
Water Level	**0**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Curbed**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
26	**0**	**36**	**Porous Concrete**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

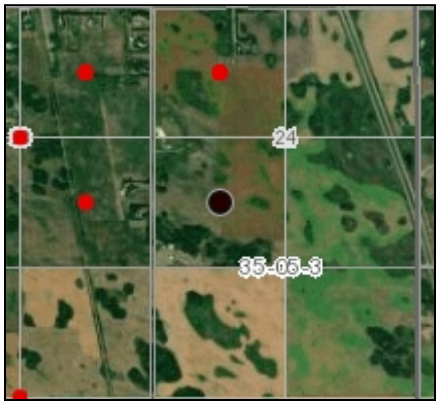
Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**0**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**0**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
8	Sandy Clay	Brown	Unknown
26	Sand	Brown	Unknown



Water Well Driller's Report

8-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **BOEHMLER** WWDR #: **014488**

Well Location

Land Location	**SW-24-035 -05 -W3**	Location of Well (in Quarter)	
LSD	**00**	**0** ft from N/S Boundary	
Reserve		**0** ft from E/W Boundary	
RM:			
NTS Map:	**73B00**	Major Basin:	**06**
Elevation (ft)	**1675**	SubBasin:	**30**
Aquifer			

Well Information

Driller	**WIG'S SANDPOINT DRILLING**
Completion Date	**1974.05.09**
Hole #	**001**
Install Method	**Jetted**
Borehole Depth (ft)	**27**
Bit Dia (in)	**1.5**
Water Level	**8**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Sand Point**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
0	**24**	**1.5**	**Plastic**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

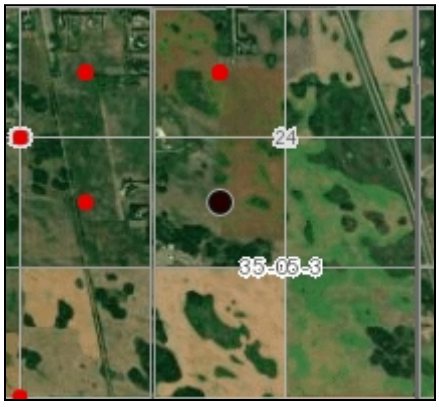
Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
3	**27**	**1.5**	**10**	**Plastic**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**0**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**10**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
8	Clay	Grey	Hard
27	Sand	Brown	Coarse



Water Well Driller's Report

8-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **LEGACY HOMES** WWDR #: **111078**

Well Location

Land Location	**SW-24-035 -05 -W3**
LSD	**00**
Reserve	
RM:	**344**
NTS Map:	**73B02**
Elevation (ft)	**1673**
Aquifer	

Location of Well (in Quarter)

0 ft from N/S Boundary

0 ft from E/W Boundary

Major Basin:	**06**
SubBasin:	**30**

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**1999.09.24**
Hole #	**001**
Install Method	**Bored**
Borehole Depth (ft)	**49**
Bit Dia (in)	**42**
Water Level	**11**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
51	**49**	**30**	**Fiberglass**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

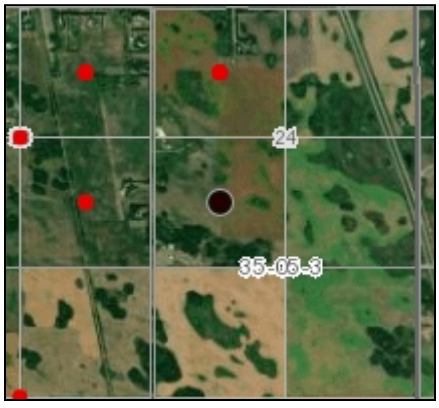
Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
33	**46**	**30**	**70**	**Fiberglass**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**15**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**0**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
20	Sand	Brown	Fine
21	Sand	Grey	Fine
28	Sand	Grey	Silty
49	Silt	Grey	Clayey



Water Well Driller's Report

8-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **UNKNOWN** WWDR #: **219553**

Well Location

Land Location	**SW-19-035 -04 -W3**	Location of Well (in Quarter)	
LSD	**04**	**0** ft from N/S Boundary	
Reserve		**0** ft from E/W Boundary	
RM:	**344**		
NTS Map:	**73B02**	Major Basin:	**06**
Elevation (ft)	**1653**	SubBasin:	**30**
Aquifer			

Well Information

Driller	**UNKNOWN**
Completion Date	
Hole #	
Install Method	
Borehole Depth (ft)	**479**
Bit Dia (in)	**0**
Water Level	**0**
Flowing Head	**0**
Water Use	
Well Use	
Completion Method	
E-Log	

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
0	**0**	**0**	
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**0**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**0**	igpm

Lithology List

Depth (ft):	Material	Colour	Description



Water Well Driller's Report

8-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **SASK HIGHWAYS & TRANS - MATERIALS BRANCH** WWDR #: **116917**

Well Location

Land Location	**SW-19-035 -04 -W3**	Location of Well (in Quarter)	
LSD	**04**	**0** ft from N/S Boundary	
Reserve		**0** ft from E/W Boundary	
RM:	**344**		
NTS Map:	**73B02**	Major Basin:	**06**
Elevation (ft)	**1670**	SubBasin:	**30**
Aquifer			

Well Information

Driller	**UNKNOWN**
Completion Date	**1991.07.03**
Hole #	**168**
Install Method	**Drilled**
Borehole Depth (ft)	**479**
Bit Dia (in)	**4.8**
Water Level	**0**
Flowing Head	**0**
Water Use	**Research**
Well Use	**Soil Test Hole**
Completion Method	
E-Log	**SCANNED**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
0	**0**	**0**	
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**0**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**0**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
3	Sand	Brown	Silty
15	Silty Clay	Grey	Calcareous
50	Clay	Grey	Calcareous
50	Silt	Grey	Sand Streaks
56	Silty Clay	Grey	Calcareous
84	Silt	Grey	Calcareous
84	Clay	Grey	Sand Streaks
92	Clay	Grey	Calcareous
103	Till	Grey	Clay Streaks
298	Till	Grey	Sandy
303	Gravel	Unknown	Unknown
453	Till	Grey	Stoney
479	Silty Clay	Grey	Noncalcareous



Water Well Driller's Report

8-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **HAGEL** WWDR #: **218798**

Well Location

Land Location	**SW-19-035 -04 -W3**
LSD	**00**
Reserve	
RM:	**344**
NTS Map:	**73B02**
Elevation (ft)	**1657**
Aquifer	

Location of Well (in Quarter)

0 ft from N/S Boundary

0 ft from E/W Boundary

Major Basin: **06**

SubBasin: **30**

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**2009.10.16**
Hole #	
Install Method	**Bored**
Borehole Depth (ft)	**33**
Bit Dia (in)	**40**
Water Level	**12**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
35	**33**	**30**	**Fiberglass**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
20	**33**	**30**	**70**	**Fiberglass**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**2**	hrs
Pumping Rate	**12**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**10**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
1	Topsoil	Unknown	Unknown
16	Sand	Brown	Fine
33	Sand	Grey	Fine



Water Well Driller's Report

8-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **SASK RESEARCH COUNCIL** WWDR #: **031757**

Well Location

Land Location	**SW-19-035 -04 -W3**	Location of Well (in Quarter)	
LSD	**00**	**0** ft from N/S Boundary	
Reserve		**0** ft from E/W Boundary	
RM:			
NTS Map:	**73B00**	Major Basin:	**06**
Elevation (ft)	**1680**	SubBasin:	**30**
Aquifer			

Well Information

Driller	**ELK POINT DRILLING CORP**
Completion Date	**1966.09.01**
Hole #	
Install Method	**Drilled**
Borehole Depth (ft)	**464**
Bit Dia (in)	**0**
Water Level	**0**
Flowing Head	**0**
Water Use	**Research**
Well Use	**Water Test Hole**
Completion Method	
E-Log	**SCANNED**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
0	**0**	**0**	
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**0**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**0**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
4	Sand	Unknown	Oxidized
87	Silty Clay	Unknown	Unoxidized
446	Till	Unknown	Unoxidized
464	Clay	Unknown	Noncalcareous



Water Well Driller's Report

8-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **HAGEL** WWDR #: **109245**

Well Location

Land Location	**SW-19-035 -04 -W3**
LSD	**00**
Reserve	
RM:	**344**
NTS Map:	**73B02**
Elevation (ft)	**1670**
Aquifer	

Location of Well (in Quarter)

0 ft from N/S Boundary

0 ft from E/W Boundary

Major Basin: **06**

SubBasin: **30**

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**1998.04.24**
Hole #	**001**
Install Method	**Bored**
Borehole Depth (ft)	**55**
Bit Dia (in)	**42**
Water Level	**21**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
56	**55**	**30**	**Fiberglass**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
28	**52**	**30**	**70**	**Fiberglass**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**0**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**0**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
26	Sand	Brown	Fine
45	Sand	Grey	Fine
55	Sand	Grey	Silty



Water Well Driller's Report

8-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **VAN LAMBALGEN** WWDR #: **051688**

Well Location

Land Location	**SE-19-035 -04 -W3**	Location of Well (in Quarter)	
LSD	**00**	**0** ft from N/S Boundary	
Reserve		**0** ft from E/W Boundary	
RM:			
NTS Map:	**73B00**	Major Basin:	**06**
Elevation (ft)	**1700**	SubBasin:	**30**
Aquifer			

Well Information

Driller	**FISHERS AUGERING & SANDPOINT**
Completion Date	**1977.09.19**
Hole #	**001**
Install Method	**Jetted**
Borehole Depth (ft)	**27**
Bit Dia (in)	**6**
Water Level	**13**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Sand Point**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
24	**24**	**1.5**	**A.B.S.**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
3	**27**	**2**	**10**	**Plastic**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**6**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**6**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
8	Sand	Brown	Unknown
12	Clay	Unknown	Seepage
16	Sand	Brown	Water
27	Sand	Brown	Coal Streaks



Water Well Driller's Report

8-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **NEUDORF** WWDR #: **106555**

Well Location

Land Location	**SE-19-035 -04 -W3**
LSD	**00**
Reserve	
RM:	**344**
NTS Map:	**73B02**
Elevation (ft)	**1675**
Aquifer	**Glac**

Location of Well (in Quarter)

0 ft from N/S Boundary

0 ft from E/W Boundary

Major Basin: **06**

SubBasin: **30**

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**1996.04.08**
Hole #	**001**
Install Method	**Bored**
Borehole Depth (ft)	**48**
Bit Dia (in)	**42**
Water Level	**18**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	**Unknown**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
50	**48**	**30**	**Fiberglass**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
22	**45**	**30**	**70**	**Fiberglass**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**15**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**0**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
11	Sand	Brown	Fine
21	Sand	Brown	Silty
26	Sand	Grey	Silty
48	Sand	Grey	Clean



Water Well Driller's Report

8-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **HODGMAN** WWDR #: **103321**

Well Location

Land Location	**SE-19-035 -04 -W3**
LSD	**00**
Reserve	
RM:	**344**
NTS Map:	**73B02**
Elevation (ft)	**1650**
Aquifer	

Location of Well (in Quarter)

0 ft from N/S Boundary **0**

0 ft from E/W Boundary **0**

Major Basin: **06**

SubBasin: **30**

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**1993.09.17**
Hole #	**1**
Install Method	**Bored**
Borehole Depth (ft)	**45**
Bit Dia (in)	**42**
Water Level	**0**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
47	**45**	**30**	**Fiberglass**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
25	**45**	**30**	**70**	**Fiberglass**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**0**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**0**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
1	Topsoil	Unknown	Unknown
23	Sand	Brown	Unknown
45	Sand	Grey	Unknown



Water Well Driller's Report

8-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **LAXDAL** WWDR #: **099861**

Well Location

Land Location	**-19-035 -04 -W3**	Location of Well (in Quarter)	
LSD	**00**	**0** ft from N/S Boundary	
Reserve		**0** ft from E/W Boundary	
RM:			
NTS Map:	**73B00**	Major Basin:	**06**
Elevation (ft)	**1675**	SubBasin:	**30**
Aquifer			

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**1990.11.21**
Hole #	**1**
Install Method	**Bored**
Borehole Depth (ft)	**54**
Bit Dia (in)	**42**
Water Level	**15**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
56	**54**	**30**	**Fiberglass**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
26	**52**	**30**	**70**	**Fiberglass**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**15**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**0**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
20	Clay	Brown	Silty
48	Sand	Grey	Fine
49	Clay	Grey	Silty
54	Sand	Grey	Silty



Water Well Driller's Report

8-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **HANBRIDGE** WWDR #: **237148**

Well Location

Land Location	**NW-19-035 -04 -W3**	Location of Well (in Quarter)	
LSD	**00**	**0** ft from N/S Boundary	
Reserve		**0** ft from E/W Boundary	
RM:	**344**		
NTS Map:	**73B02**	Major Basin:	**06**
Elevation (ft)	**1702**	SubBasin:	**30**
Aquifer			

Well Information

Driller	**WELLEN BORING LTD**
Completion Date	**2017.05.30**
Hole #	
Install Method	**Bored**
Borehole Depth (ft)	**75**
Bit Dia (in)	**72**
Water Level	**20**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Perforated Casing**
E-Log	

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
27	**25**	**30**	**Fiberglass**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

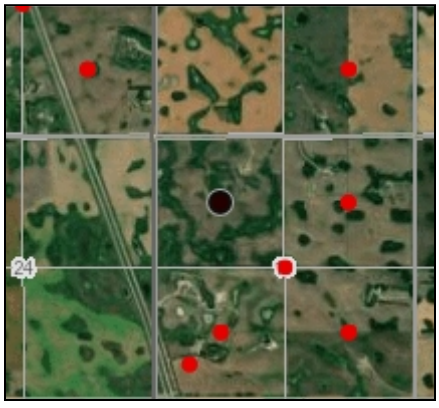
Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
50	**75**	**30**	**70**	**Fiberglass**
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**1**	hrs
Pumping Rate	**30**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**20**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
30	Sand	Brown	Fine
35	Sand	Brown	Medium
38	Sand	Grey	Medium
45	Clay	Grey	Silty
75	Sand	Grey	Silty



Water Well Driller's Report

8-Dec-2021
WSaskWWDR01
(c) Water Security Agency

Well Name: **JANTZEN** WWDR #: **031899**

Well Location

Land Location	**-23-035 -05 -W3**	Location of Well (in Quarter)	
LSD	**00**	**0** ft from N/S Boundary	
Reserve		**0** ft from E/W Boundary	
RM:			
NTS Map:	**73B00**	Major Basin:	**06**
Elevation (ft)	**1675**	SubBasin:	**30**
Aquifer	**Glac**		

Well Information

Driller	**UNKNOWN**
Completion Date	
Hole #	
Install Method	**Unknown**
Borehole Depth (ft)	**20**
Bit Dia (in)	**36**
Water Level	**0**
Flowing Head	**0**
Water Use	**Domestic**
Well Use	**Withdrawal**
Completion Method	**Curbed**
E-Log	**No**

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
0	**0**	**0**	**Concrete**
0	**0**	**0**	
0	**0**	**0**	

Well Screens

Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	
0	**0**	**0**	**0**	

Pump Test

Draw Down	**0**	ft
Duration	**0**	hrs
Pumping Rate	**0**	igpm
Temperature	**0**	deg. F
Rec. Pumping Rate	**0**	igpm

Lithology List

Depth (ft):	Material	Colour	Description
20	Sand	Unknown	Unknown



APPENDIX C

Results of Grain Size Distribution Analyses

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: April 27, 2021

Test Hole No.: 21-1

Sample No.: 76

Depth (m): 1.2

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	99.9
#60	0.25	99.6
# 100	0.15	87.3
# 200	0.075	36.4

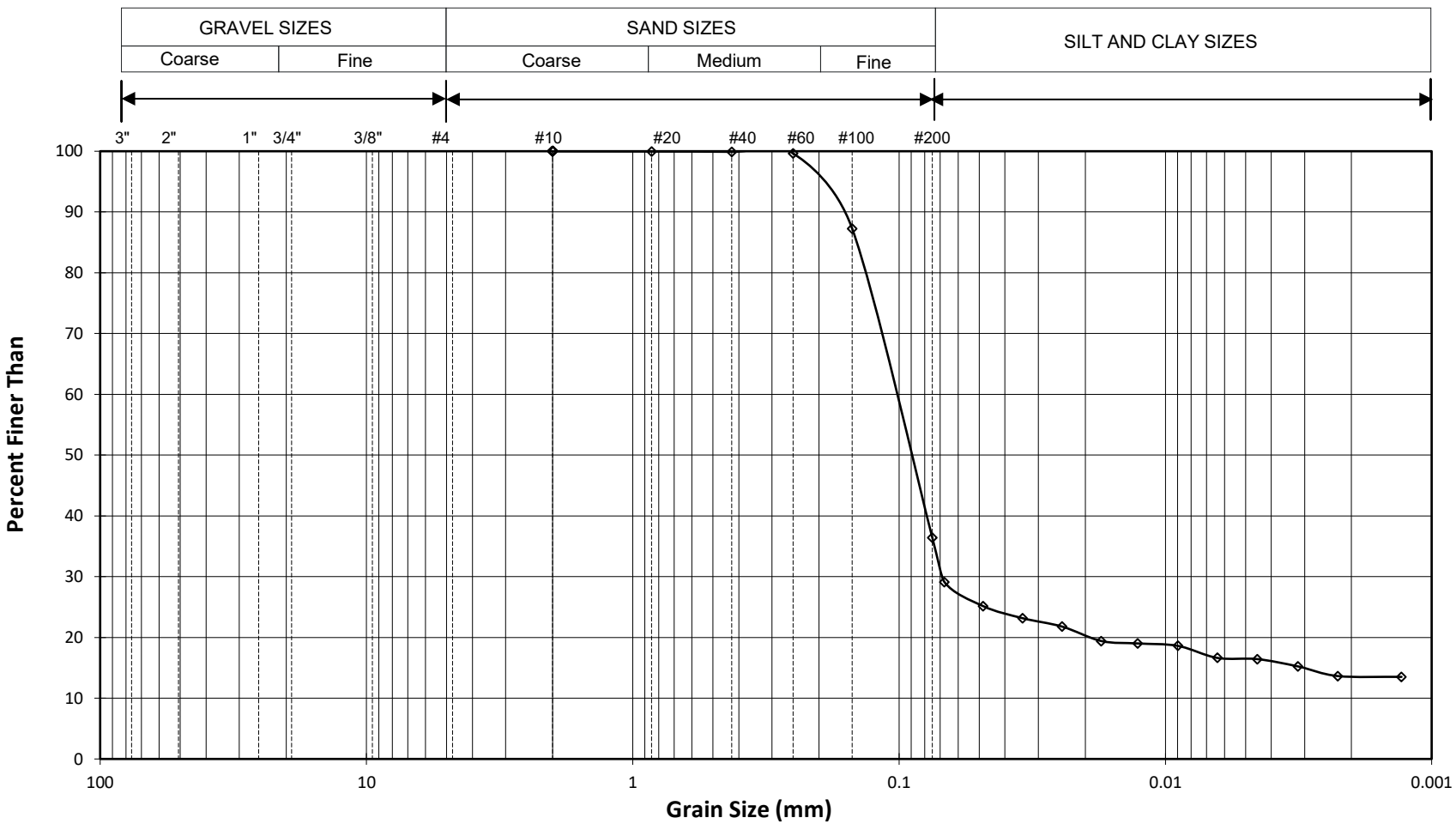
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0675	29.1
Sodium Hexametaphosphate	0.0483	25.1
	0.0344	23.2
	0.0244	21.8
	0.0174	19.4
	0.0127	19.0
	0.0090	18.6
	0.0064	16.6
	0.0045	16.4
	0.0032	15.2
	0.0022	13.6
	0.0013	13.5

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	64	22	14

Remarks:



CERTIFIED BY CCIL Canadian Council of Independent Laboratories For specific tests as listed on www.ccil.com

Drawing No.

APPENDIX C-1

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD

P. MACHIBRODA ENGINEERING LTD.

PER Preston Schergevitch

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: April 27, 2021

Test Hole No.: 21-2

Sample No.: 85

Depth (m): 0.6

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	99.9
#60	0.25	99.1
# 100	0.15	76.1
# 200	0.075	22.3

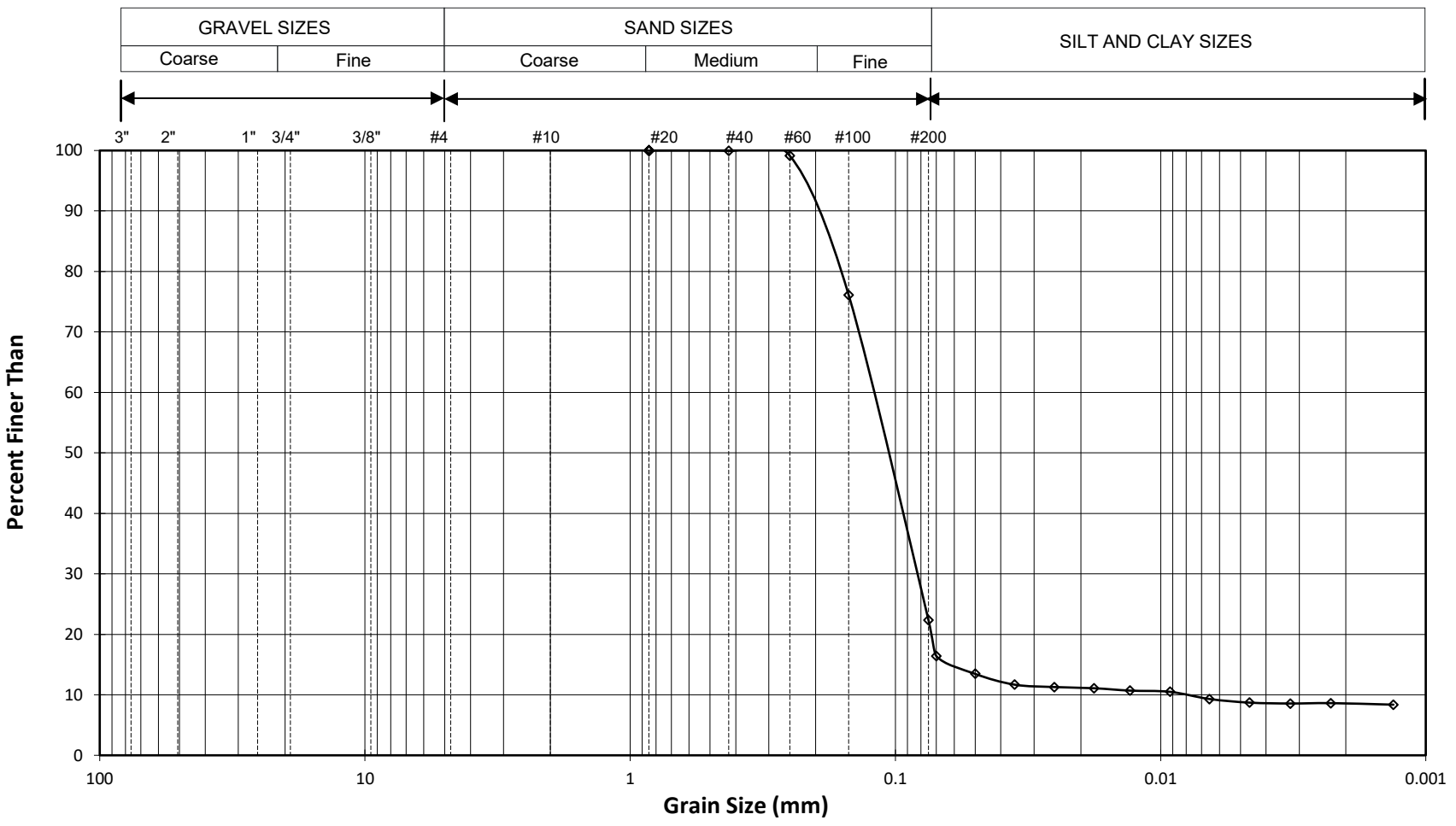
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0702	16.4
Sodium Hexametaphosphate	0.0500	13.5
	0.0356	11.7
	0.0252	11.3
	0.0178	11.1
	0.0130	10.7
	0.0092	10.5
	0.0065	9.3
	0.0046	8.7
	0.0032	8.6
	0.0023	8.6
	0.0013	8.4

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	78	13	9

Remarks:



CERTIFIED BY CCIL Canadian Council of Independent Laboratories For specific tests as listed on www.ccil.com

Drawing No.

APPENDIX C-2

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD

P. MACHIBRODA ENGINEERING LTD.

PER Preston Schergevitch

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: April 27, 2021

Test Hole No.: 21-3

Sample No.: 93

Depth (m): 1.2

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	99.9
#60	0.25	99.8
# 100	0.15	97.5
# 200	0.075	82.4

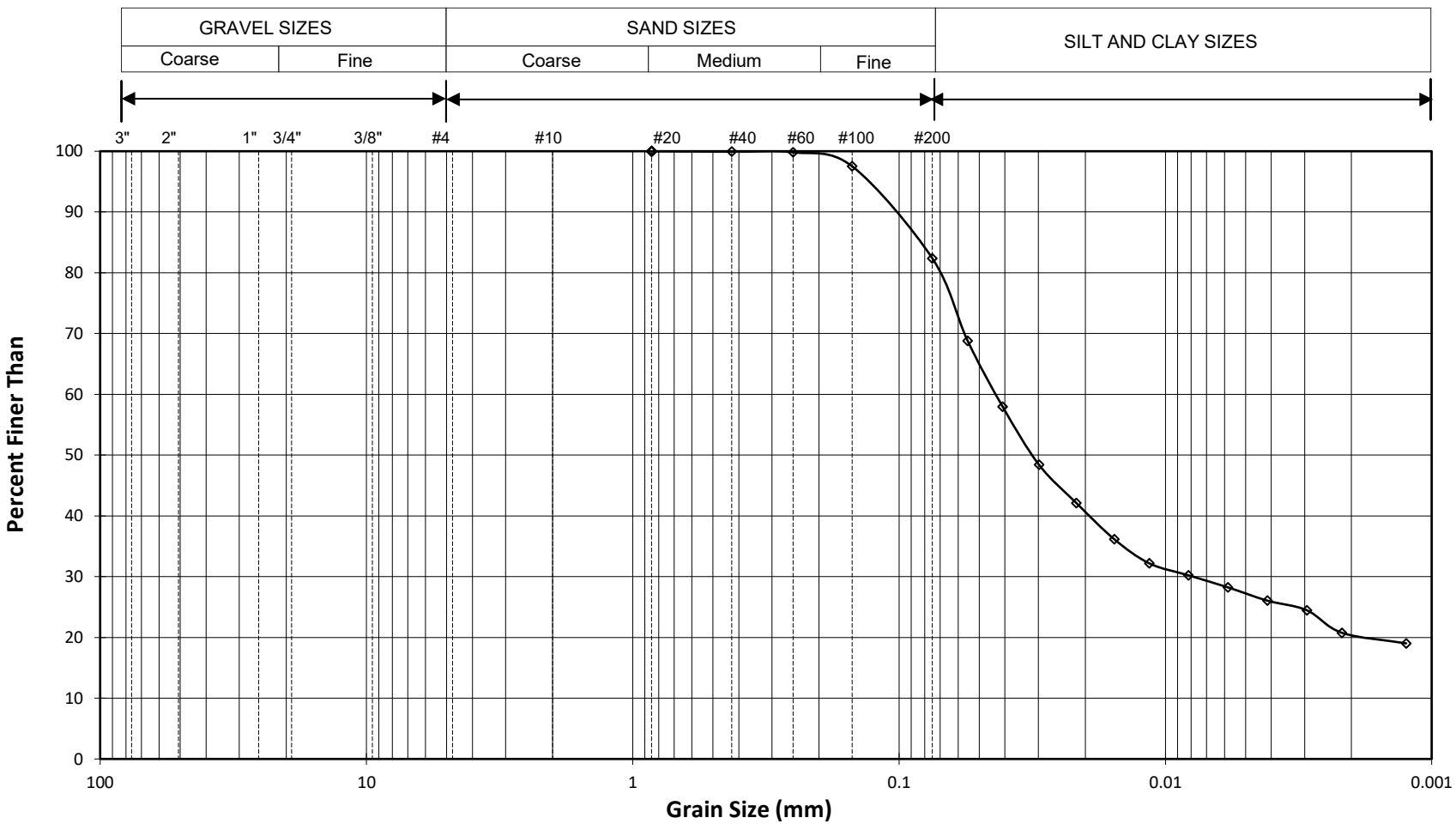
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0553	68.8
Sodium Hexametaphosphate	0.0408	57.9
	0.0298	48.4
	0.0216	42.1
	0.0155	36.2
	0.0115	32.2
	0.0082	30.2
	0.0058	28.2
	0.0041	26.1
	0.0029	24.5
	0.0022	20.7
	0.0012	19.0

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	18	61	21

Remarks:



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Drawing No.

APPENDIX C-3

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD

P. MACHIBRODA ENGINEERING LTD.

PER Preston Schergevitch

P.MACHIBRODA ENGINEERING LTD.

ASTM C136: GRAIN SIZE ANALYSIS

Project: Greenview Estates Subdivision

Location: South of Saskatoon

Project No.: 17789

Date Tested: April 22, 2021

Test Hole No: 21-3

Sample No.: 97

Depth: 6.0

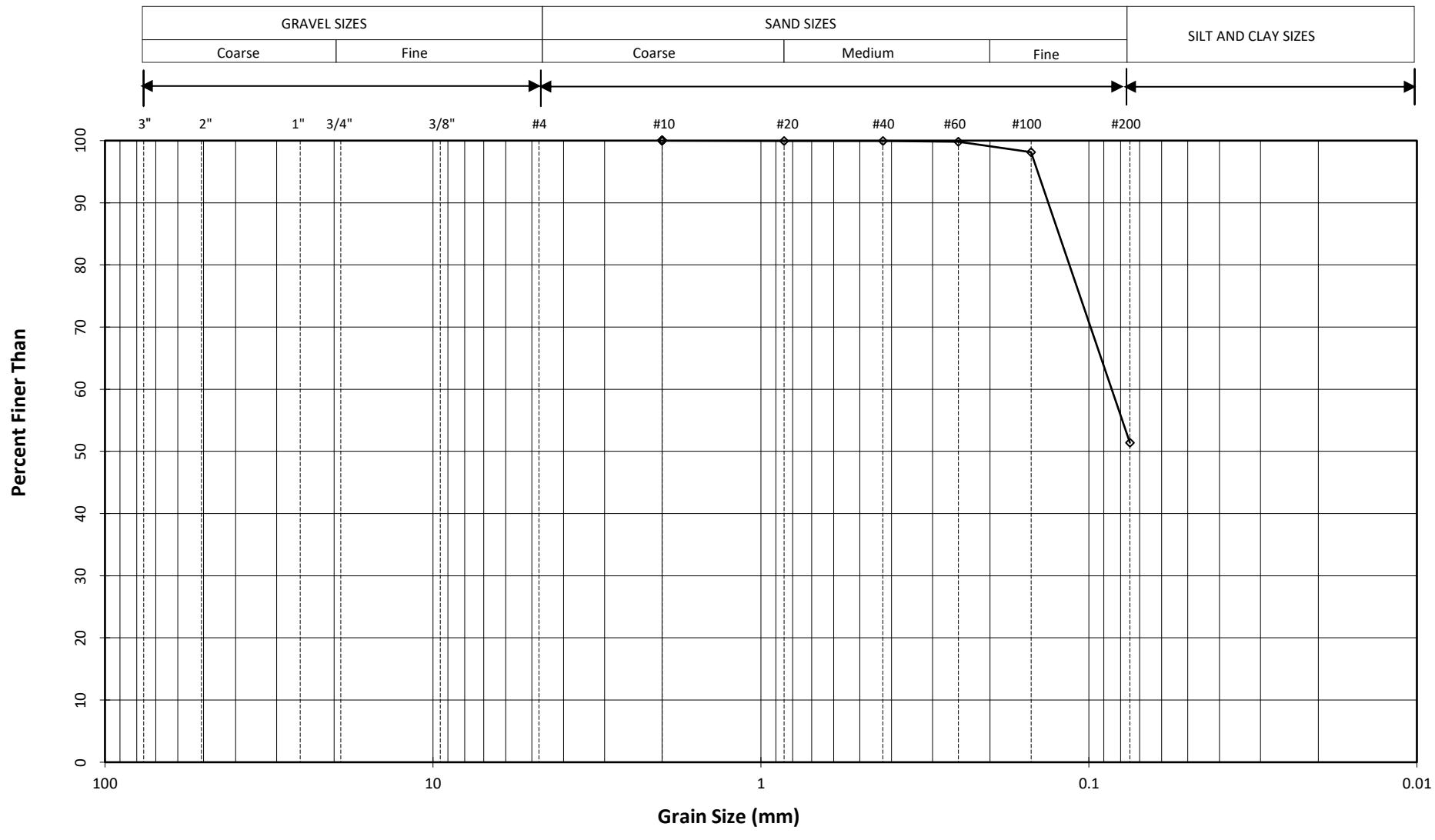
Sieve Analysis:

Sieve	Diameter mm	% 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	98
	0.075	51

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt and Clay Sizes
0	49	51

Remarks:



CERTIFIED BY CCIL Canadian Council of Independent Laboratories For specific tests as listed on www.ccil.com

DRAWING NO.

APPENDIX C-4

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH ASTM C136 AND C117 CSTANDARDS
P. MACHIBRODA ENGINEERING LTD.

PER Preston Schergevitch

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: April 27, 2021

Test Hole No.: 21-4

Sample No.: 102

Depth (m): 0.6

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	99.8
#60	0.25	99.5
# 100	0.15	84.8
# 200	0.075	38.2

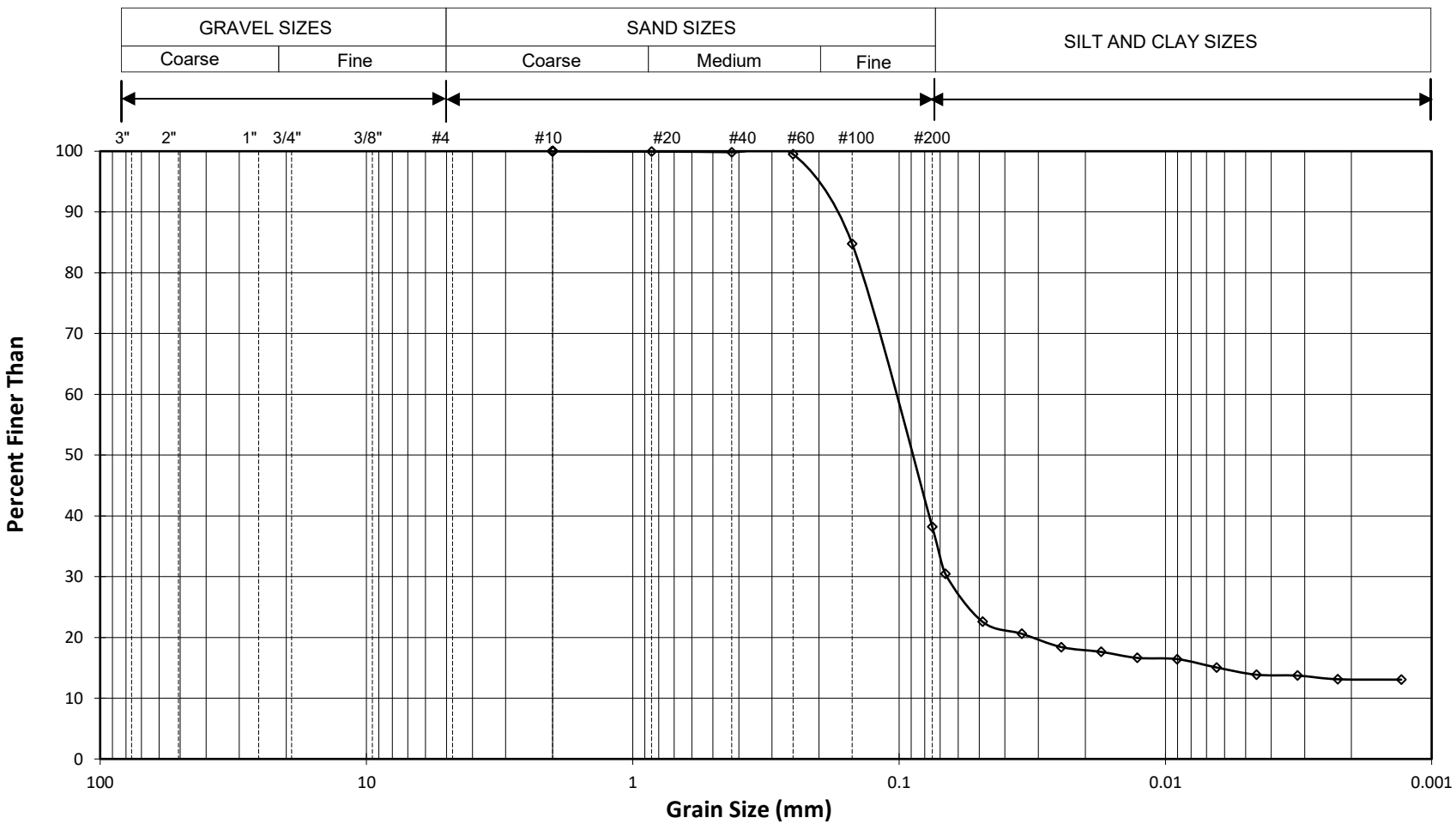
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0670	30.5
Sodium Hexametaphosphate	0.0486	22.6
	0.0346	20.6
	0.0246	18.4
	0.0174	17.6
	0.0128	16.6
	0.0090	16.4
	0.0064	15.0
	0.0045	13.9
	0.0032	13.7
	0.0023	13.1
	0.0013	13.0

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	62	25	13

Remarks:



CERTIFIED BY CCIL Canadian Council of Independent Laboratories For specific tests as listed on www.ccil.com

Drawing No.

APPENDIX C-5

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD

P. MACHIBRODA ENGINEERING LTD.

PER Preston Schergevitch

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: April 27, 2021

Test Hole No.: 21-5

Sample No.: 109

Depth (m): 0.9

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	99.9
#60	0.25	99.2
# 100	0.15	75.9
# 200	0.075	23.5

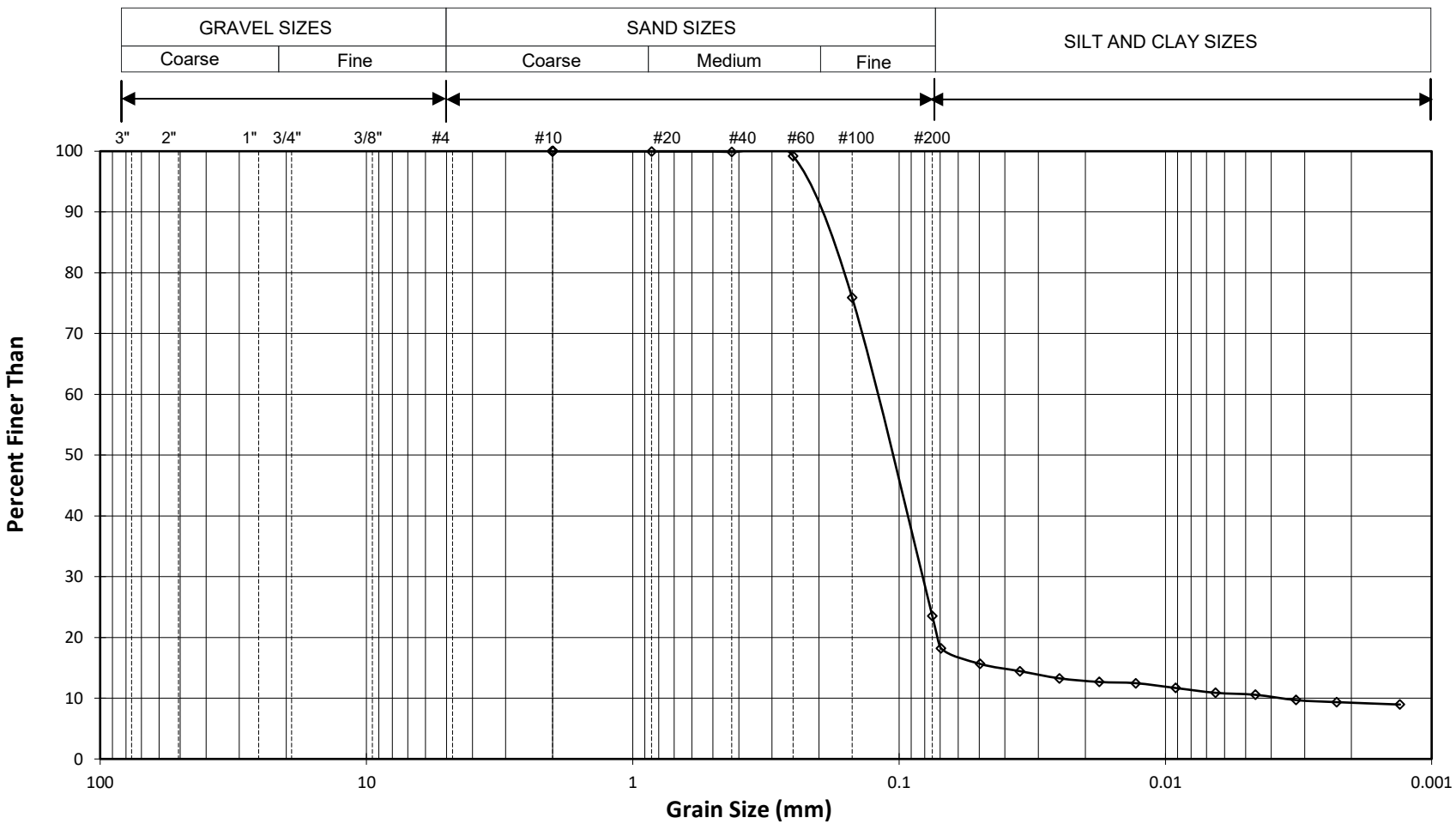
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0696	18.2
Sodium Hexametaphosphate	0.0496	15.6
	0.0352	14.5
	0.0250	13.3
	0.0177	12.7
	0.0129	12.5
	0.0092	11.7
	0.0065	10.9
	0.0046	10.6
	0.0032	9.7
	0.0023	9.4
	0.0013	9.0

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	76	15	9

Remarks:



CERTIFIED BY CCIL Canadian Council of Independent Laboratories For specific tests as listed on www.ccil.com

Drawing No.

APPENDIX C-6

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD

P. MACHIBRODA ENGINEERING LTD.

PER Preston Schergevitch

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: April 29, 2021

Test Hole No.: 21-5

Sample No.: 113

Depth (m): 4.5

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	99.9
#60	0.25	99.7
# 100	0.15	94.7
# 200	0.075	77.8

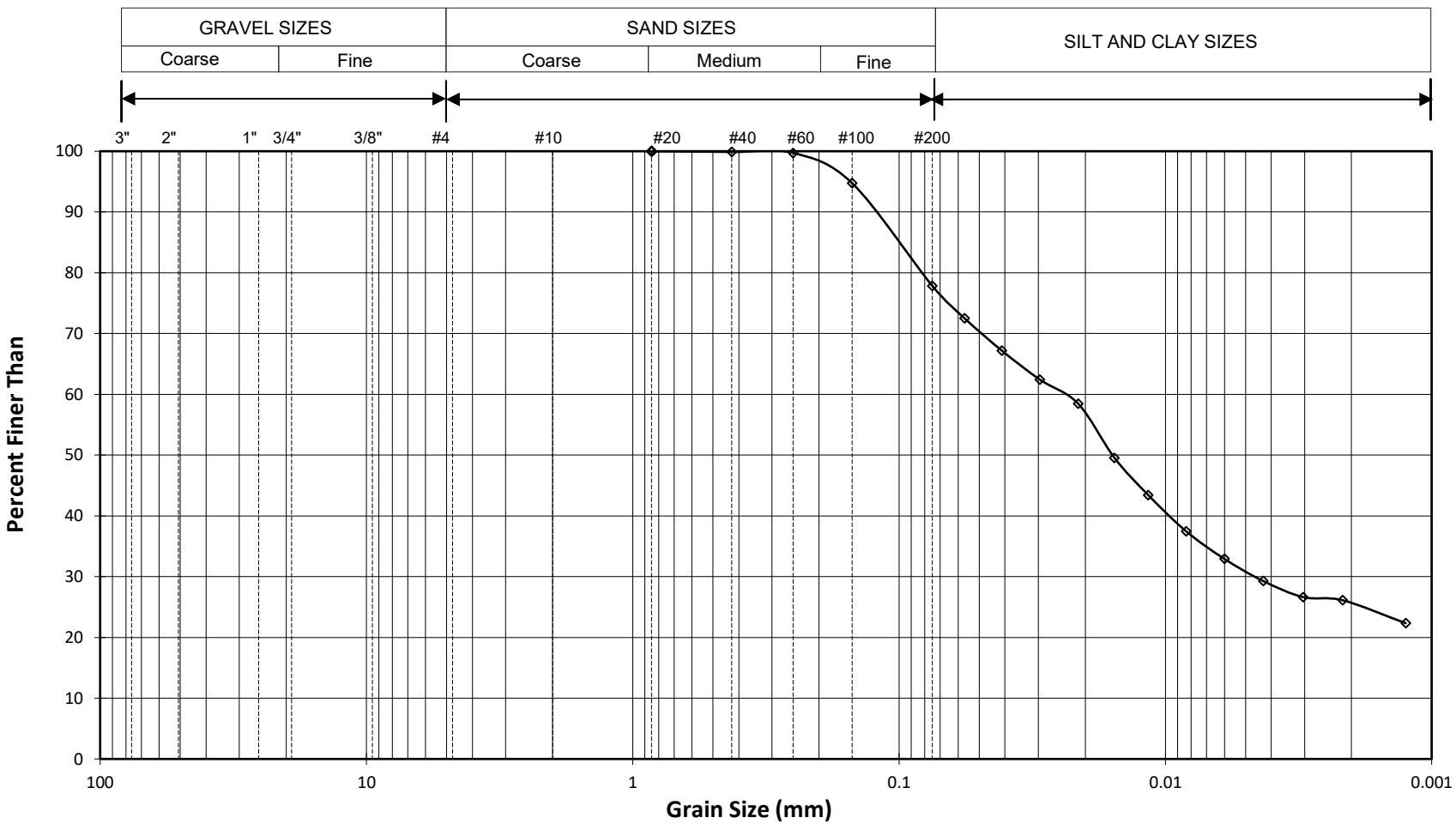
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0568	72.5
Sodium Hexametaphosphate	0.0411	67.2
	0.0296	62.4
	0.0212	58.5
	0.0155	49.5
	0.0116	43.4
	0.0084	37.5
	0.0060	32.9
	0.0043	29.3
	0.0030	26.6
	0.0022	26.1
	0.0013	22.3

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	22	52	26

Remarks:



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Drawing No.

APPENDIX C-7

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD

P. MACHIBRODA ENGINEERING LTD.

PER Preston Schergevitch

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: April 27, 2021

Test Hole No.: 21-6

Sample No.: 123

Depth (m): 1.5

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	99.8
#60	0.25	99.0
# 100	0.15	76.2
# 200	0.075	22.8

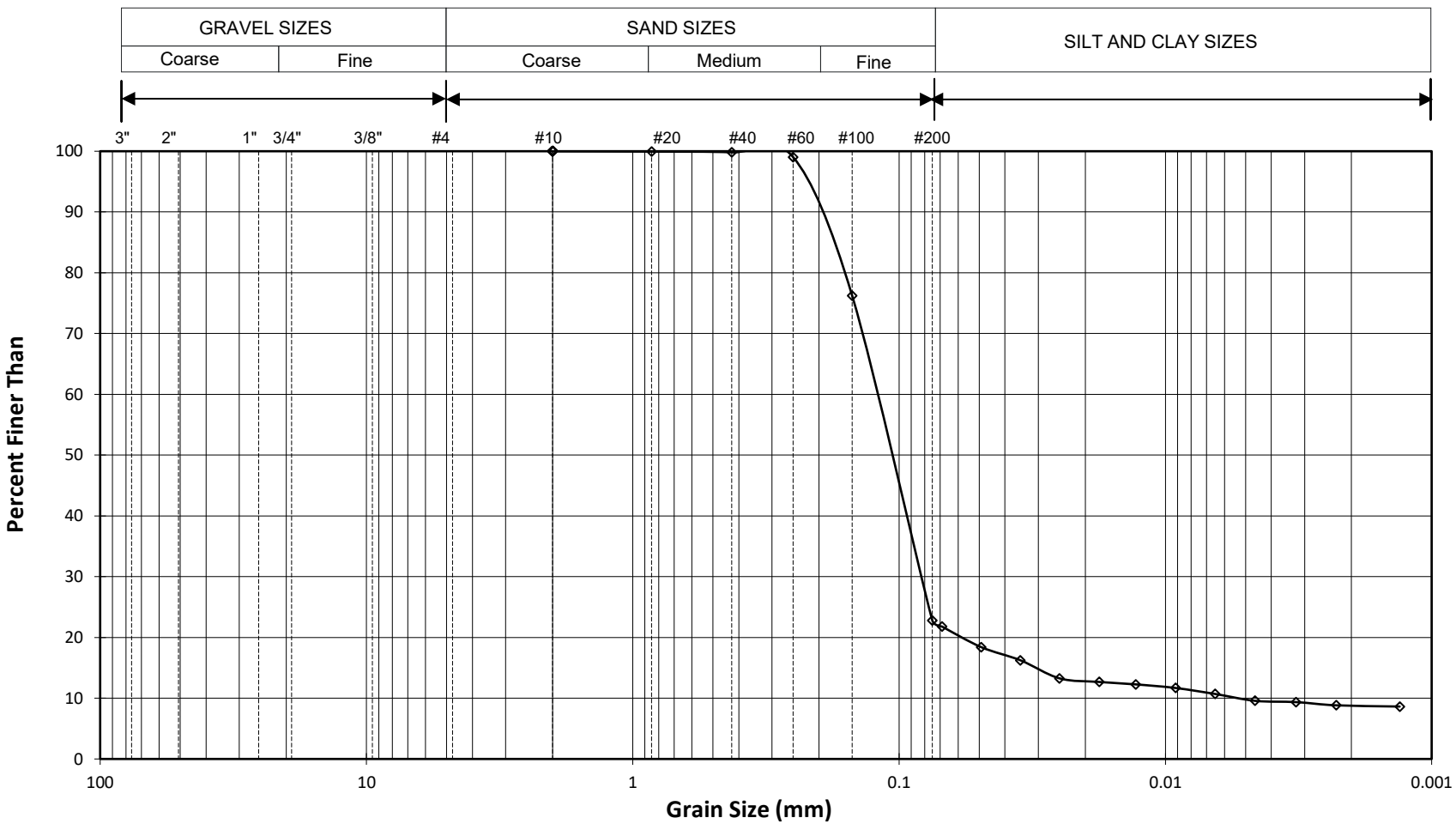
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0689	21.8
Sodium Hexametaphosphate	0.0492	18.4
	0.0350	16.2
	0.0250	13.3
	0.0177	12.7
	0.0129	12.3
	0.0092	11.7
	0.0065	10.7
	0.0046	9.6
	0.0032	9.4
	0.0023	8.8
	0.0013	8.6

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	77	14	9

Remarks:



CERTIFIED BY CCIL Canadian Council of Independent Laboratories For specific tests as listed on www.ccil.com

Drawing No.

APPENDIX C-8

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD

P. MACHIBRODA ENGINEERING LTD.

PER Preston Schergevitch

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: April 27, 2021

Test Hole No.: 21-7

Sample No.: 128

Depth (m): 0.9

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	99.8
#60	0.25	99.3
# 100	0.15	78.5
# 200	0.075	21.9

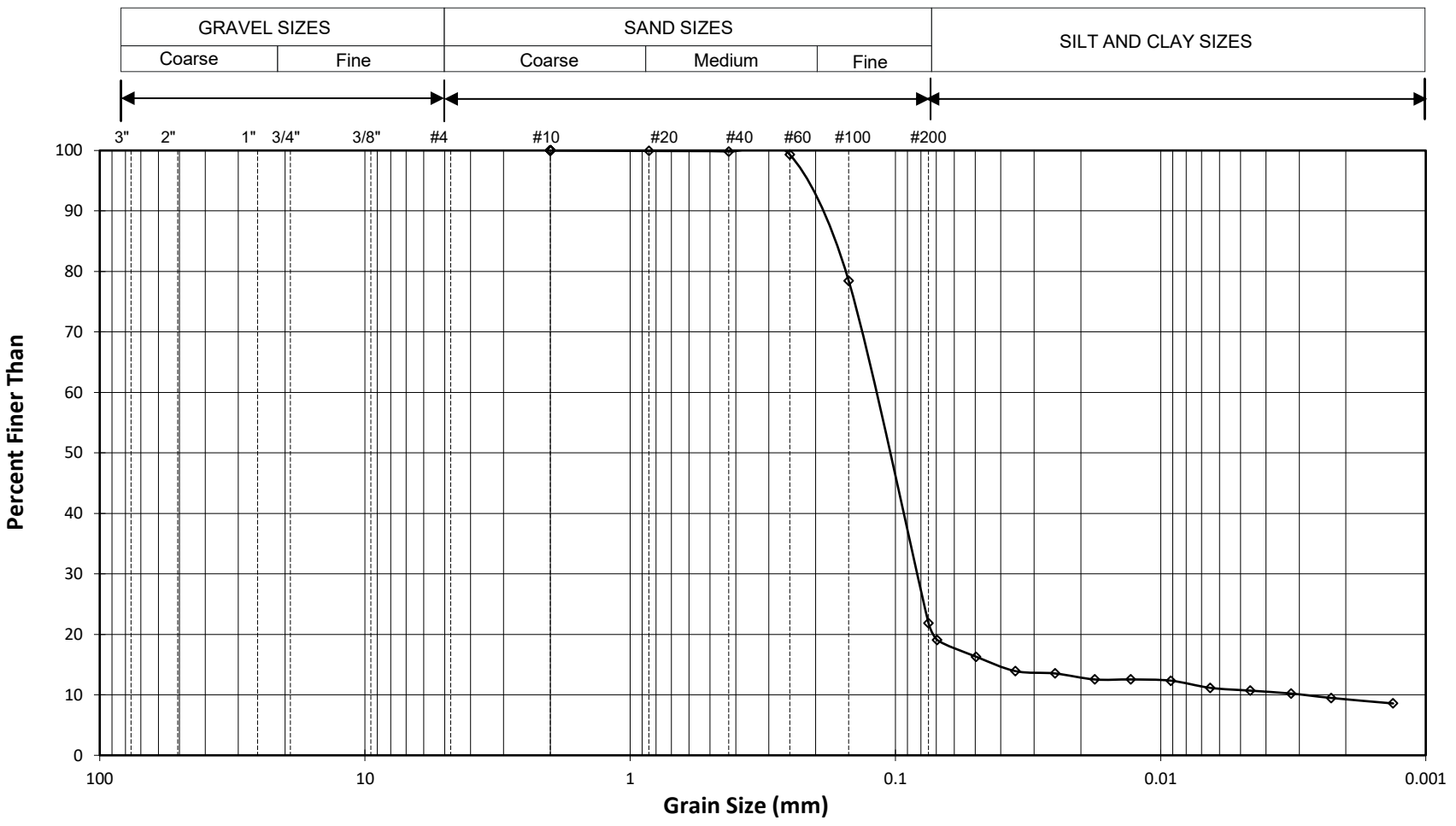
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0696	19.1
Sodium Hexametaphosphate	0.0496	16.3
	0.0353	13.9
	0.0250	13.5
	0.0177	12.5
	0.0129	12.5
	0.0092	12.3
	0.0065	11.2
	0.0046	10.7
	0.0032	10.2
	0.0023	9.5
	0.0013	8.6

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	78	12	10

Remarks:



CERTIFIED BY CCIL Canadian Council of Independent Laboratories For specific tests as listed on www.ccil.com

Drawing No.

APPENDIX C-9

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD

P. MACHIBRODA ENGINEERING LTD.

PER Preston Schergevitch

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: April 27, 2021

Test Hole No.: 21-8

Sample No.: 138

Depth (m): 0.6

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	100.0
#60	0.25	99.5
# 100	0.15	86.8
# 200	0.075	46.1

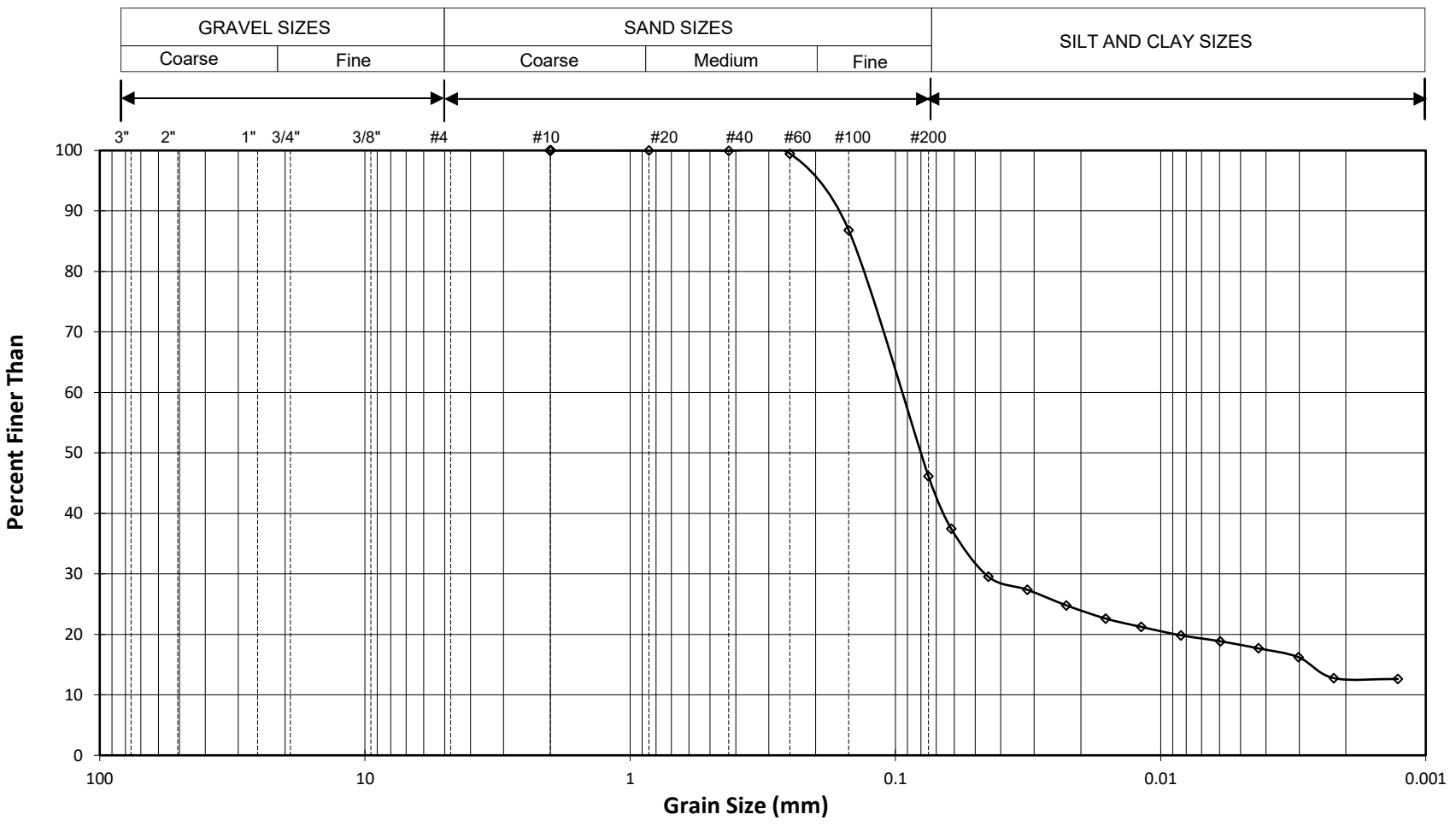
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0616	37.5
Sodium Hexametaphosphate	0.0446	29.5
	0.0318	27.4
	0.0226	24.8
	0.0161	22.6
	0.0118	21.2
	0.0084	19.8
	0.0059	18.9
	0.0043	17.7
	0.0030	16.2
	0.0022	12.8
	0.0013	12.6

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	54	33	13

Remarks:



CERTIFIED BY CCIL Canadian Council of Independent Laboratories For specific tests as listed on www.ccil.com

Drawing No.

APPENDIX C-10

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD

P. MACHIBRODA ENGINEERING LTD.

PER Preston Schergevitch

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: April 28, 2021

Test Hole No.: 21-9

Sample No.: 62

Depth (m): 0.6

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	99.8
#60	0.25	98.8
# 100	0.15	72.5
# 200	0.075	27.1

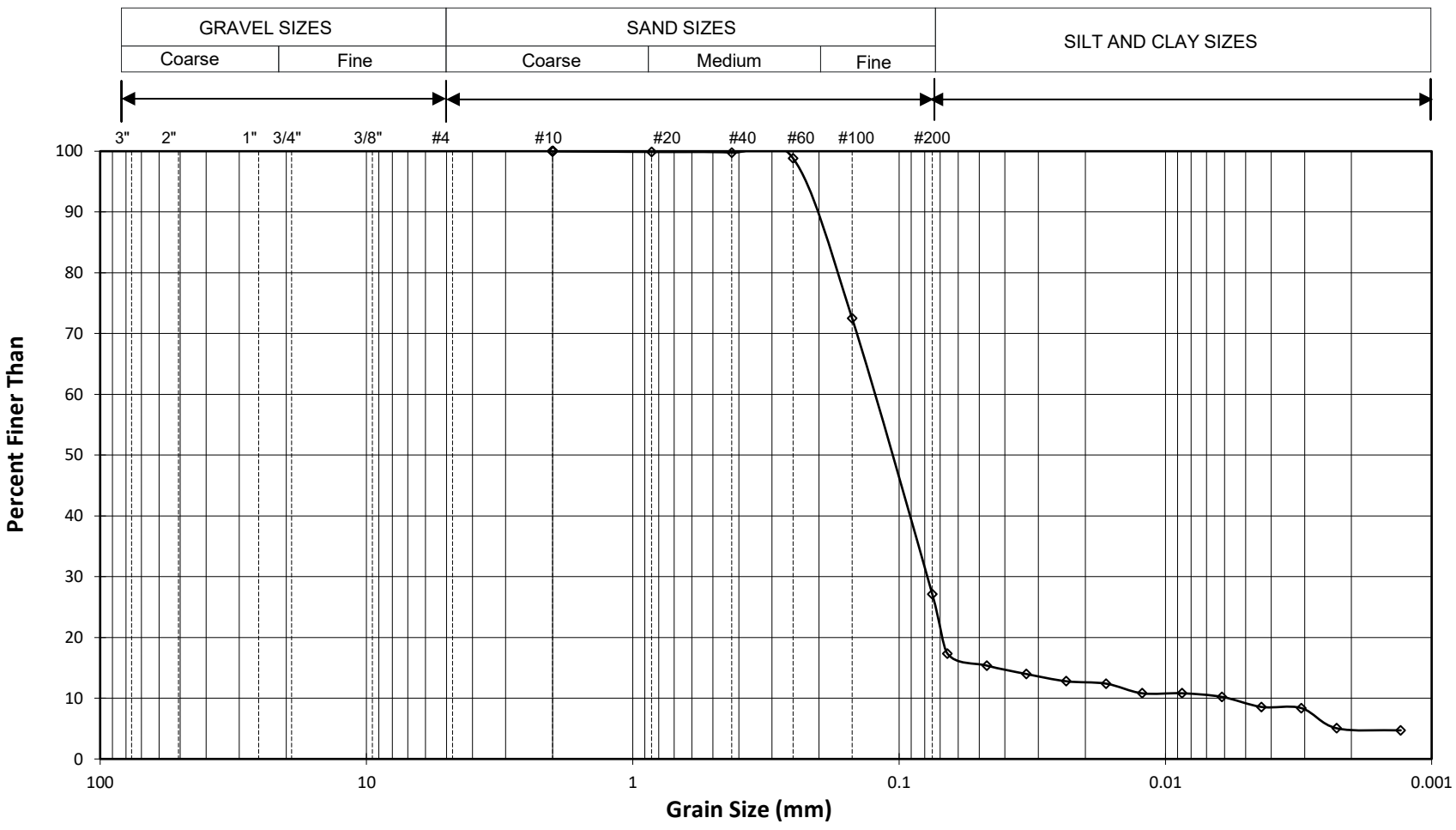
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0658	17.3
Sodium Hexametaphosphate	0.0468	15.4
	0.0332	14.0
	0.0236	12.8
	0.0167	12.4
	0.0122	10.8
	0.0087	10.8
	0.0061	10.2
	0.0044	8.6
	0.0031	8.4
	0.0023	5.0
	0.0013	4.7

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	73	22	5

Remarks:



CERTIFIED BY CCIL Canadian Council of Independent Laboratories For specific tests as listed on www.ccil.com

Drawing No.

APPENDIX C-11

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD

P. MACHIBRODA ENGINEERING LTD.

PER Preston Schergevitch

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: May 3, 2021

Test Hole No.: 21-10

Sample No.: 146

Depth (m): 0.9

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	100.0
#60	0.25	99.2
# 100	0.15	79.3
# 200	0.075	30.0

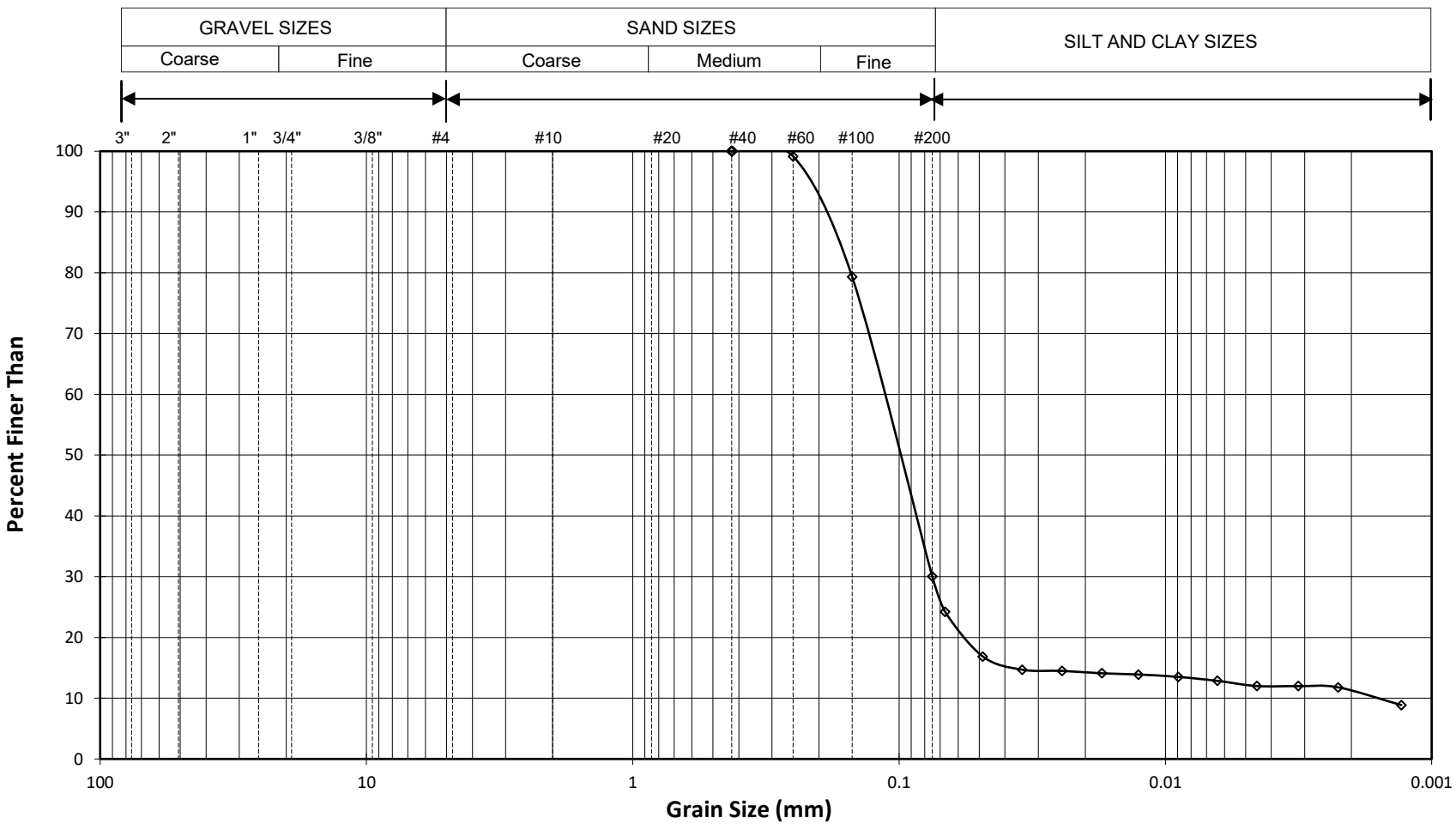
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0671	24.2
Sodium Hexametaphosphate	0.0485	16.9
	0.0345	14.7
	0.0244	14.5
	0.0173	14.1
	0.0126	13.9
	0.0089	13.5
	0.0064	12.9
	0.0045	12.0
	0.0032	12.0
	0.0022	11.8
	0.0013	8.9

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	70	18	12

Remarks:



CERTIFIED BY CCIL Canadian Council of Independent Laboratories For specific tests as listed on www.ccil.com

Drawing No.

APPENDIX C-12

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD

P. MACHIBRODA ENGINEERING LTD.

PER Preston Schergevitch

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: May 3, 2021

Test Hole No.: 21-11

Sample No.: 53

Depth (m): 1.5

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	99.8
#60	0.25	99.2
# 100	0.15	80.0
# 200	0.075	26.0

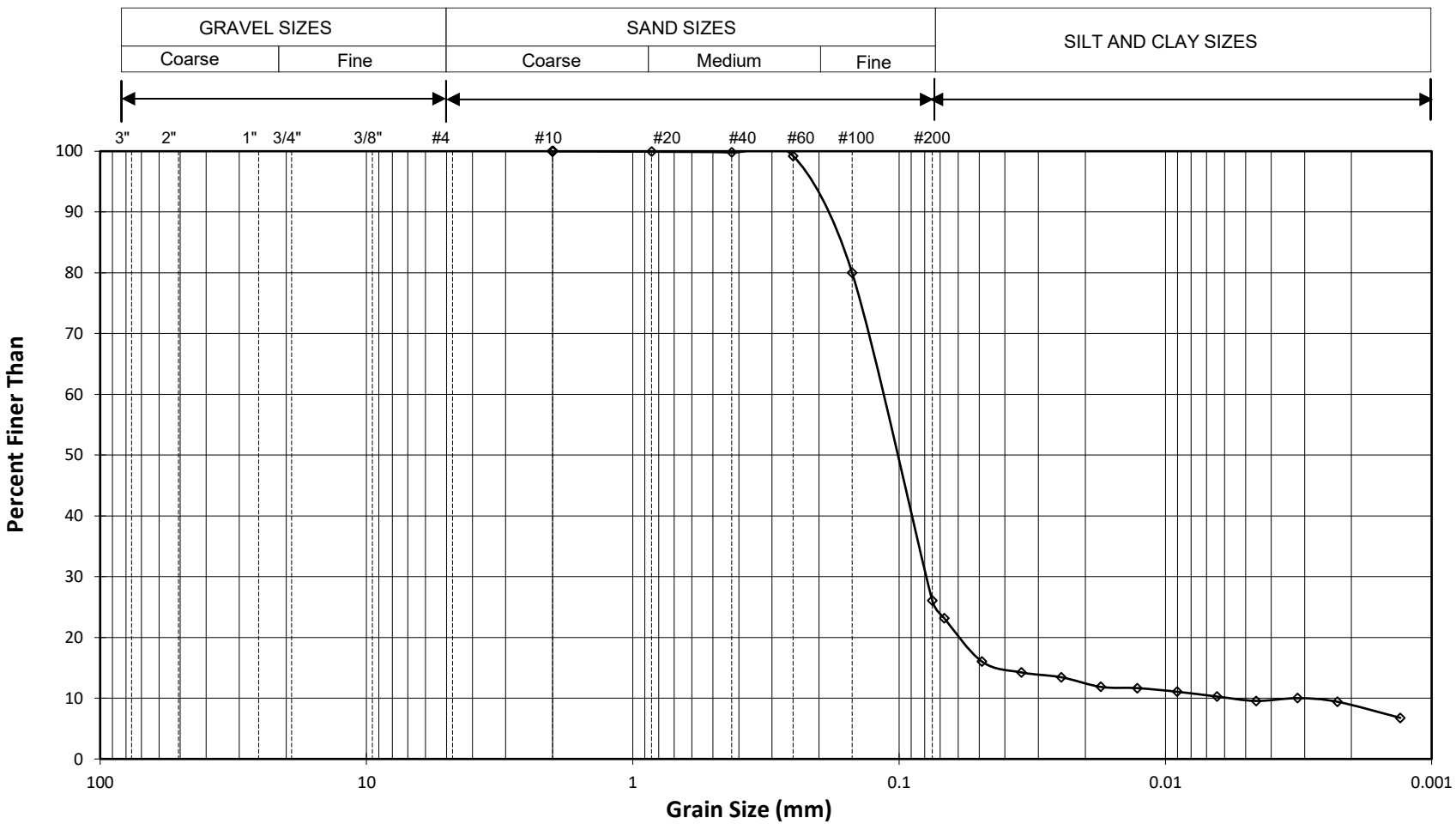
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0676	23.1
Sodium Hexametaphosphate	0.0488	16.0
	0.0347	14.2
	0.0246	13.4
	0.0175	11.9
	0.0128	11.7
	0.0090	11.1
	0.0064	10.3
	0.0046	9.6
	0.0032	10.0
	0.0023	9.4
	0.0013	6.8

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	74	17	9

Remarks:



CERTIFIED BY CCIL Canadian Council of Independent Laboratories For specific tests as listed on www.ccil.com

Drawing No.

APPENDIX C-13

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD

P. MACHIBRODA ENGINEERING LTD.

PER Preston Schergevitch

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: April 29, 2021

Test Hole No.: 21-12

Sample No.: 162

Depth (m): 0.6

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	100.0
#60	0.25	99.3
# 100	0.15	81.9
# 200	0.075	37.4

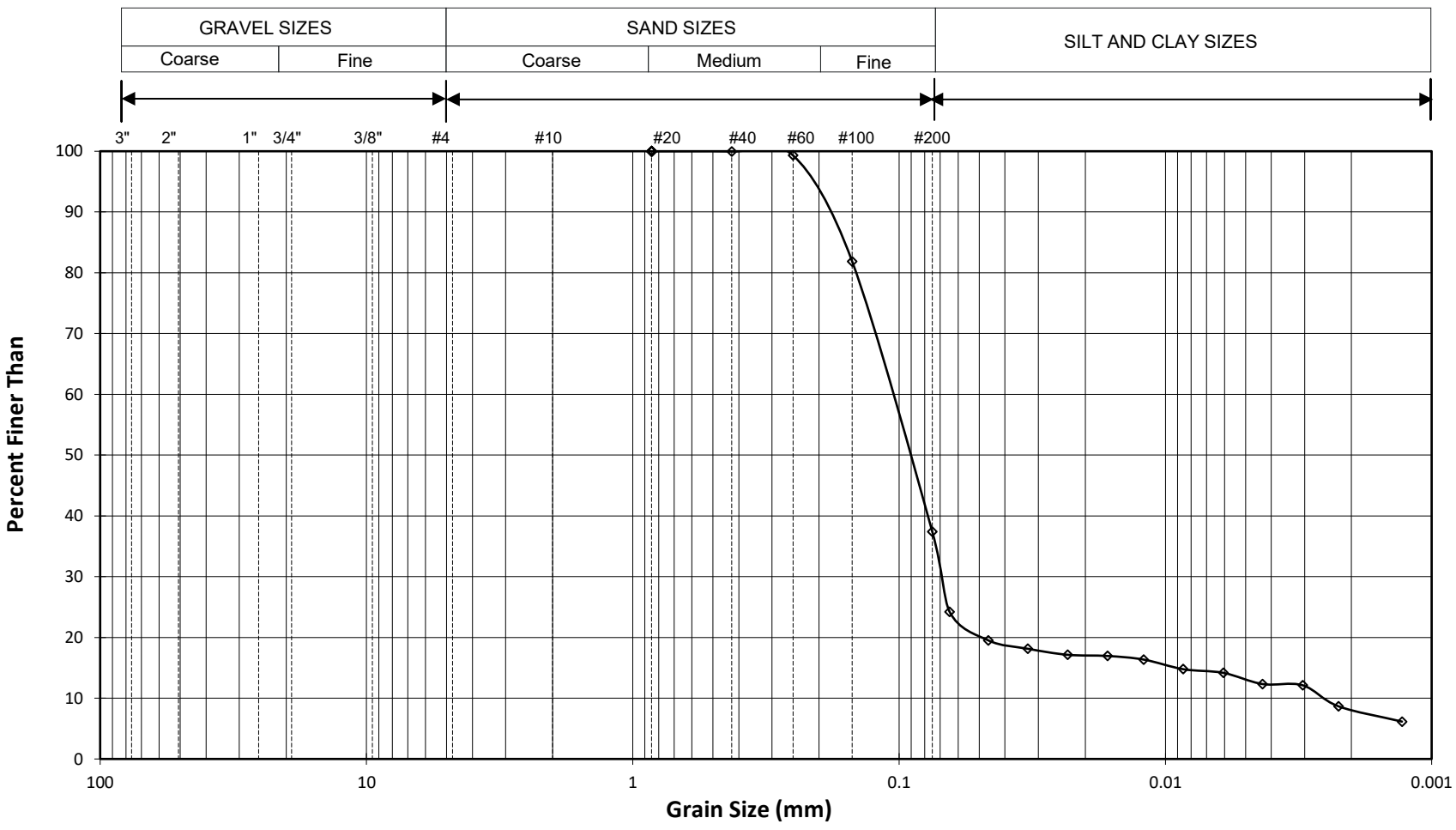
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0646	24.2
Sodium Hexametaphosphate	0.0462	19.5
	0.0328	18.1
	0.0233	17.1
	0.0165	16.9
	0.0120	16.4
	0.0086	14.8
	0.0061	14.2
	0.0043	12.3
	0.0031	12.1
	0.0022	8.7
	0.0013	6.1

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	63	28	9

Remarks:



CERTIFIED BY CCIL Canadian Council of Independent Laboratories For specific tests as listed on www.ccil.com

Drawing No.

APPENDIX C-14

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD

P. MACHIBRODA ENGINEERING LTD.

PER Preston Schergevitch

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: May 3, 2021

Test Hole No.: 21-13

Sample No.: 150

Depth (m): 0.3

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	99.9
#60	0.25	99.4
# 100	0.15	81.6
# 200	0.075	36.4

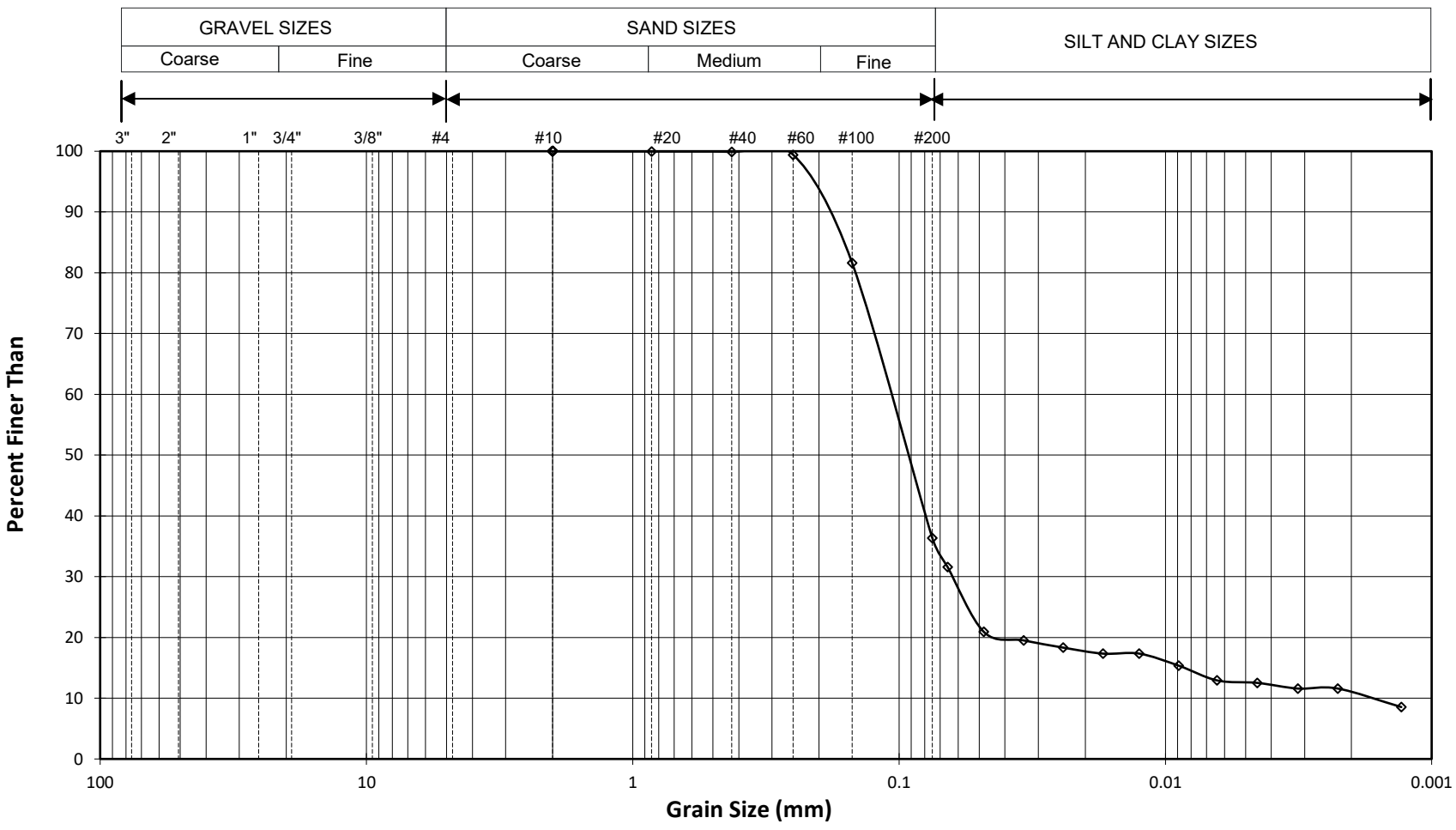
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0657	31.6
Sodium Hexametaphosphate	0.0480	20.9
	0.0341	19.5
	0.0242	18.3
	0.0172	17.3
	0.0125	17.3
	0.0089	15.4
	0.0064	12.9
	0.0045	12.5
	0.0032	11.6
	0.0023	11.6
	0.0013	8.5

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	64	24	12

Remarks:



CERTIFIED BY CCIL Canadian Council of Independent Laboratories For specific tests as listed on www.ccil.com

Drawing No.

APPENDIX C-15

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD

P. MACHIBRODA ENGINEERING LTD.

PER Preston Schergevitch

P.MACHIBRODA ENGINEERING LTD.

ASTM C136: GRAIN SIZE ANALYSIS

Project: Greenview Estates Subdivision

Location: South of Saskatoon

Project No.: 17789

Date Tested: April 22, 2021

Test Hole No: 21-13

Sample No.: 156

Depth: 4.5

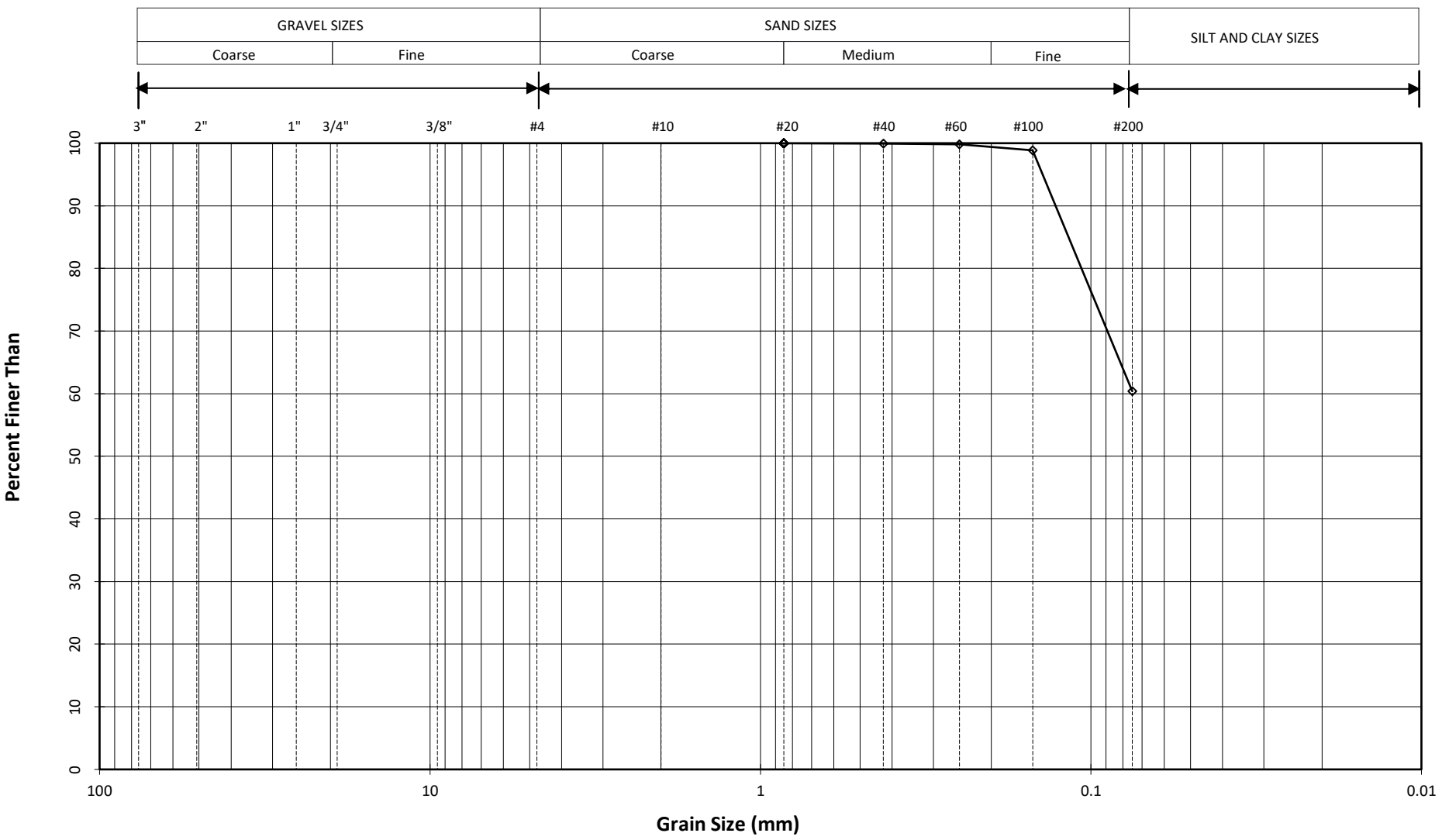
Sieve Analysis:

Sieve	Diameter mm	% 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	60

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt and Clay Sizes
0	40	60

Remarks:



CERTIFIED BY CCIL Canadian Council of Independent Laboratories For specific tests as listed on www.ccil.com

DRAWING NO.

APPENDIX C-16

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH ASTM C136 AND C117 CSTANDARDS
P. MACHIBRODA ENGINEERING LTD.

PER Preston Schergevitch

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: April 29, 2021

Test Hole No.: 21-14

Sample No.: 197

Depth (m): 1.2

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	99.8
#60	0.25	99.5
# 100	0.15	97.4
# 200	0.075	53.8

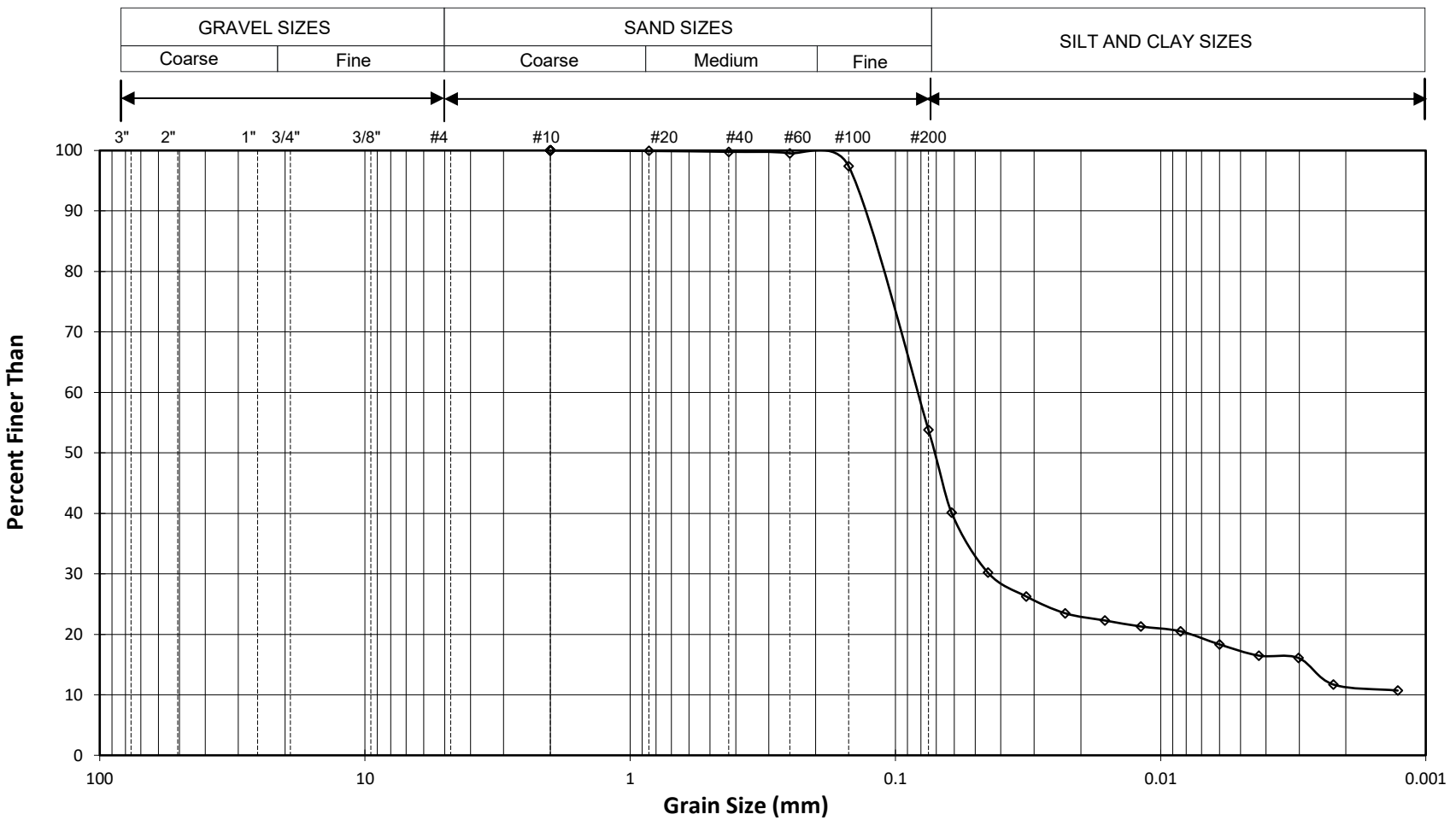
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0614	40.1
Sodium Hexametaphosphate	0.0448	30.2
	0.0321	26.3
	0.0229	23.5
	0.0162	22.3
	0.0119	21.3
	0.0084	20.5
	0.0060	18.3
	0.0043	16.5
	0.0030	16.1
	0.0022	11.7
	0.0013	10.7

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	46	42	12

Remarks:



CERTIFIED BY CCIL Canadian Council of Independent Laboratories For specific tests as listed on www.ccil.com

Drawing No.

APPENDIX C-17

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD

P. MACHIBRODA ENGINEERING LTD.

PER Preston Schergevitch

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: May 3, 2021

Test Hole No.: 21-15

Sample No.: 15

Depth (m): 0.6

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	99.5
#60	0.25	98.7
# 100	0.15	78.2
# 200	0.075	29.9

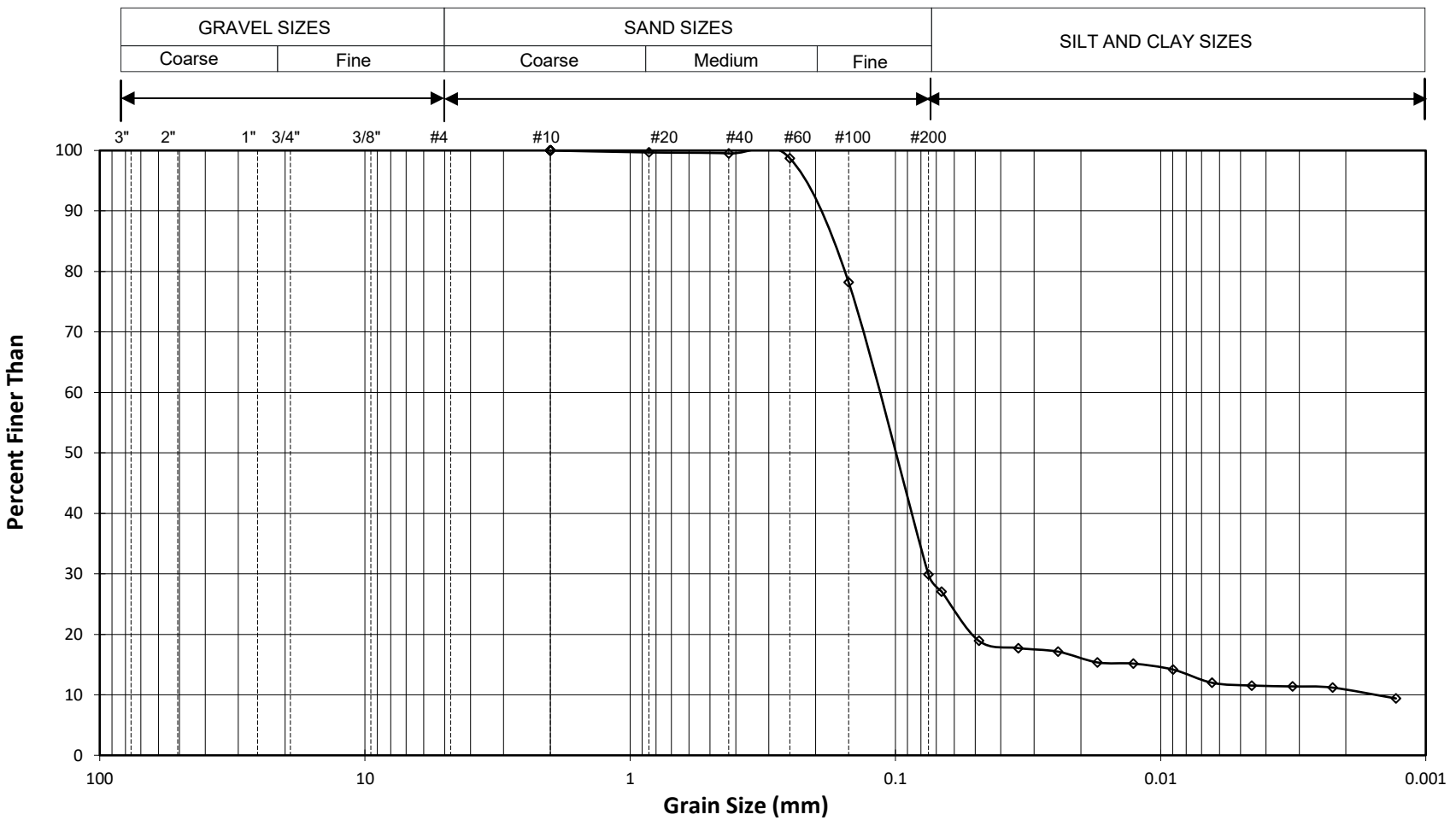
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0668	27.0
Sodium Hexametaphosphate	0.0484	18.9
	0.0344	17.7
	0.0243	17.1
	0.0173	15.4
	0.0126	15.2
	0.0090	14.2
	0.0064	12.0
	0.0045	11.5
	0.0032	11.4
	0.0022	11.2
	0.0013	9.4

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	70	19	11

Remarks:



CERTIFIED BY CCIL Canadian Council of Independent Laboratories For specific tests as listed on www.ccil.com

Drawing No.

APPENDIX C-18

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD

P. MACHIBRODA ENGINEERING LTD.

PER Preston Schergevitch

P.MACHIBRODA ENGINEERING LTD.

ASTM C136: GRAIN SIZE ANALYSIS

Project: Greenview Estates Subdivision

Location: South of Saskatoon

Project No.: 17789

Date Tested: April 19, 2021

Test Hole No: 21-15

Sample No.: 19

Depth: 3.0

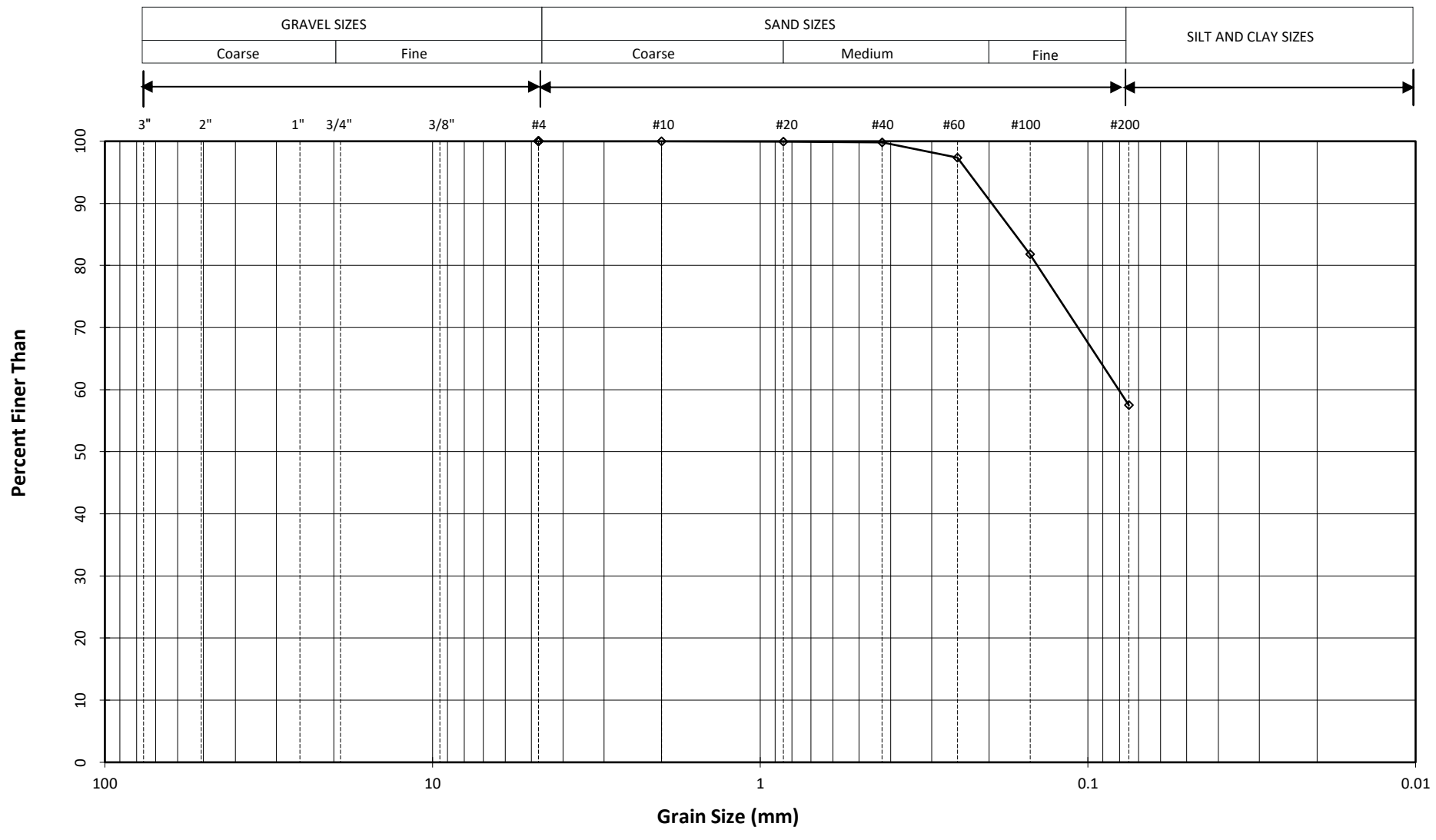
Sieve Analysis:

Sieve	Diameter mm	% 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	97
	0.150	82
	0.075	57

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt and Clay Sizes
0	43	57

Remarks:



CERTIFIED BY CCiL Canadian Council of Independent Laboratories For specific tests as listed on www.ccil.com

DRAWING NO.

APPENDIX C-19

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH ASTM C136 AND C117 CSTANDARDS
P. MACHIBRODA ENGINEERING LTD.

PER Preston Schergevitch

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: April 29, 2021

Test Hole No.: 21-16

Sample No.: 191

Depth (m): 1.5

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	99.9
#60	0.25	98.8
# 100	0.15	72.0
# 200	0.075	20.6

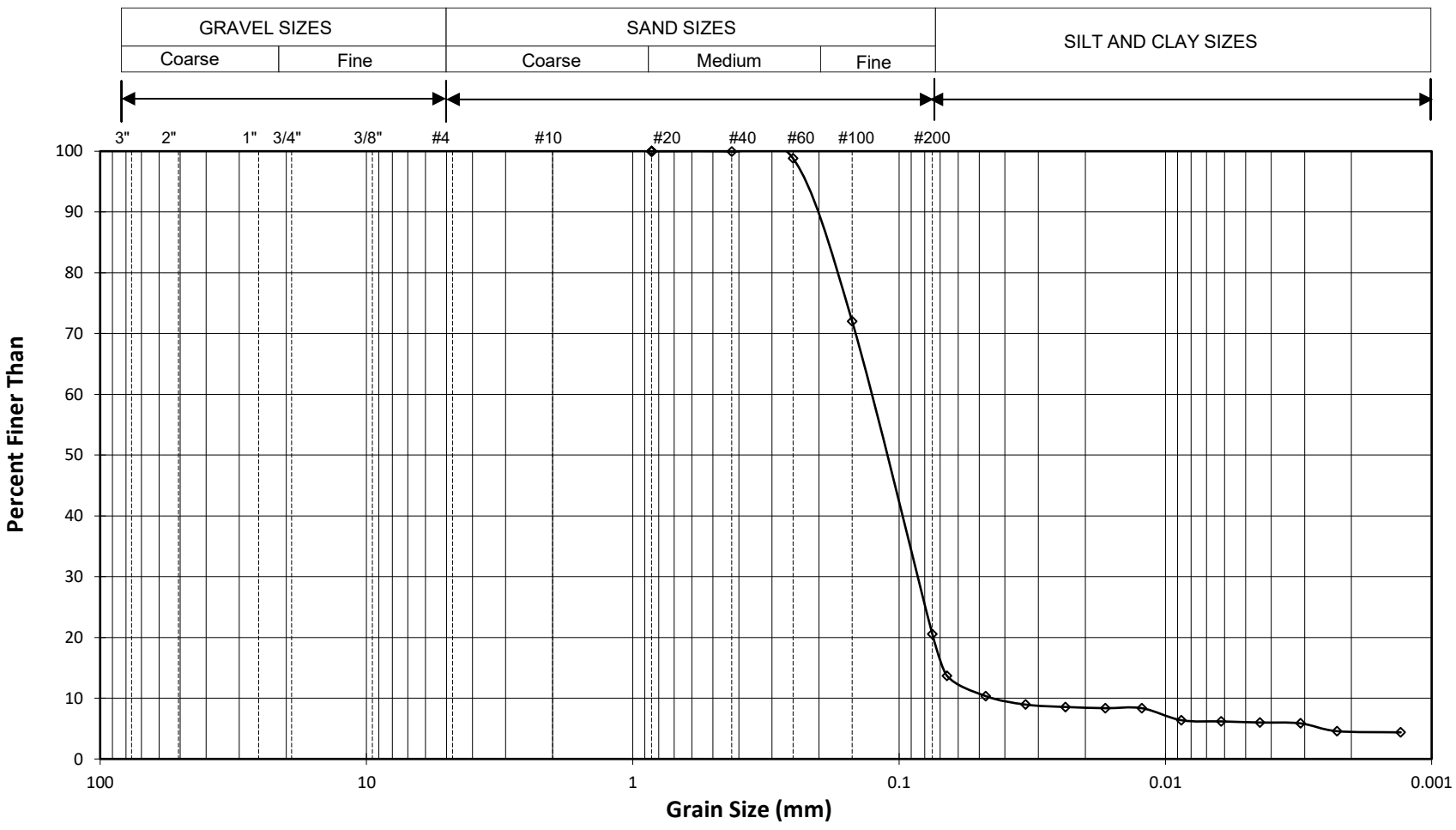
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0661	13.7
Sodium Hexametaphosphate	0.0472	10.3
	0.0335	9.0
	0.0237	8.6
	0.0168	8.4
	0.0123	8.4
	0.0087	6.4
	0.0062	6.2
	0.0044	6.0
	0.0031	5.9
	0.0023	4.6
	0.0013	4.4

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	79	16	5

Remarks:



CERTIFIED BY CCIL Canadian Council of Independent Laboratories For specific tests as listed on www.ccil.com

Drawing No.

APPENDIX C-20

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD

P. MACHIBRODA ENGINEERING LTD.

PER Preston Schergevitch

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: May 3, 2021

Test Hole No.: 21-17

Sample No.: 38

Depth (m): 0.6

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	99.8
#60	0.25	98.7
# 100	0.15	76.0
# 200	0.075	31.0

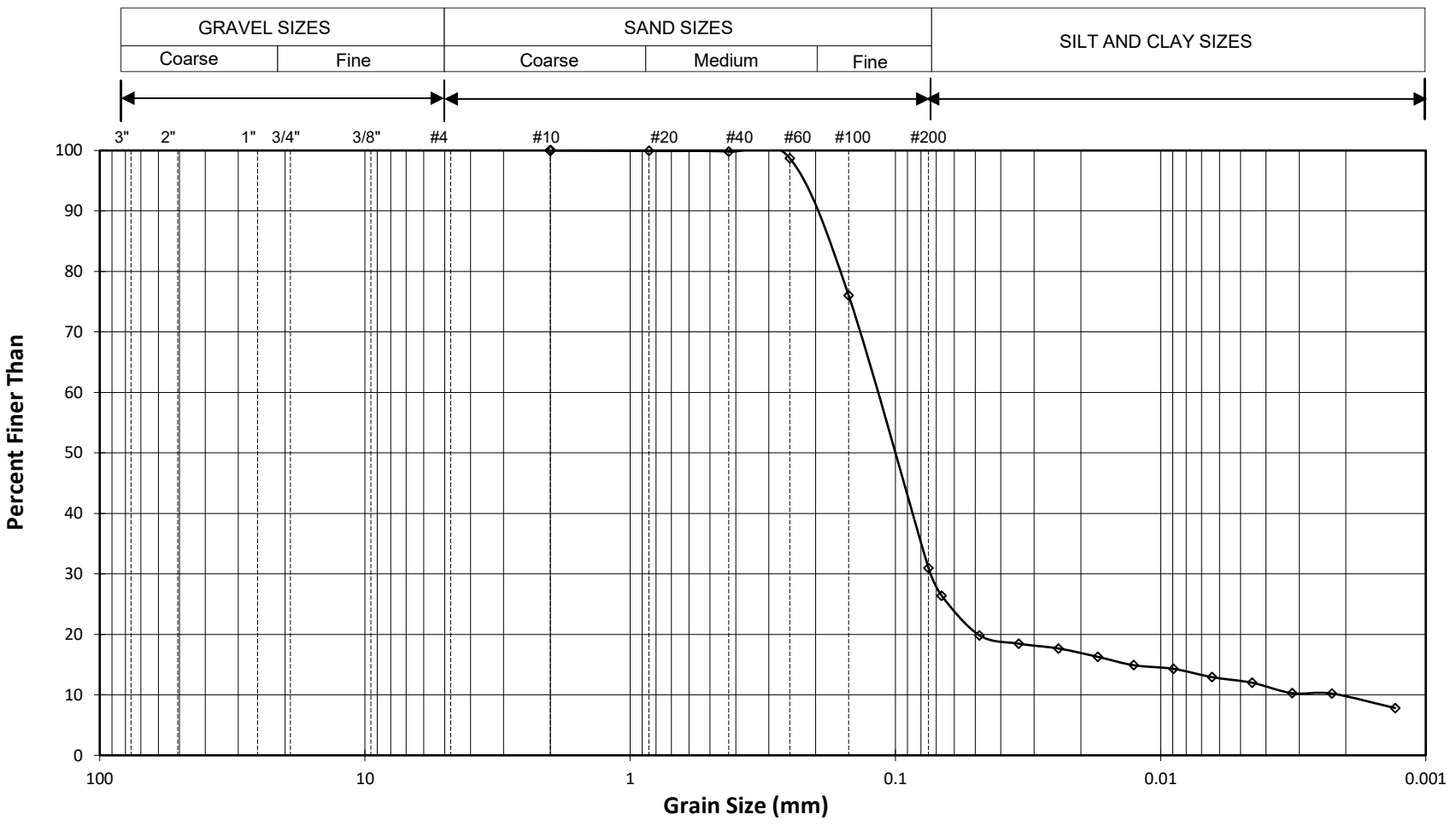
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0669	26.4
Sodium Hexametaphosphate	0.0482	19.8
	0.0342	18.5
	0.0243	17.7
	0.0172	16.3
	0.0126	14.9
	0.0089	14.3
	0.0064	12.9
	0.0045	12.0
	0.0032	10.3
	0.0023	10.2
	0.0013	7.8

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	69	21	10

Remarks:



CERTIFIED BY CCIL Canadian Council of Independent Laboratories For specific tests as listed on www.ccil.com

Drawing No.

APPENDIX C-21

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD

P. MACHIBRODA ENGINEERING LTD.

PER Preston Schergevitch

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: April 29, 2021

Test Hole No.: 21-18

Sample No.: 209

Depth (m): 1.2

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	99.1
#60	0.25	97.6
# 100	0.15	67.3
# 200	0.075	21.0

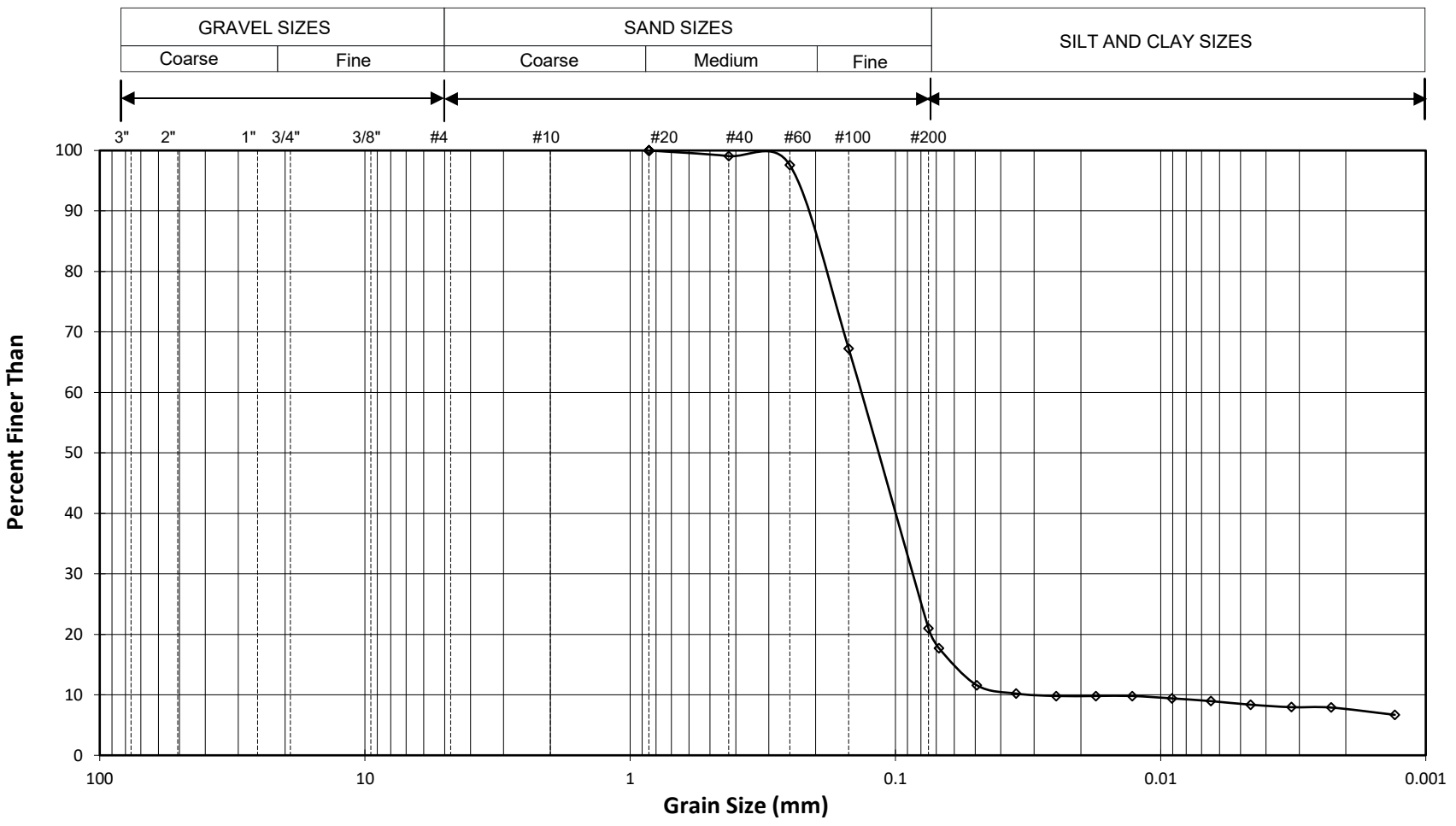
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0685	17.7
Sodium Hexametaphosphate	0.0493	11.6
	0.0350	10.2
	0.0248	9.8
	0.0175	9.8
	0.0128	9.8
	0.0091	9.4
	0.0065	9.0
	0.0046	8.4
	0.0032	8.0
	0.0023	7.9
	0.0013	6.7

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	79	13	8

Remarks:



CERTIFIED BY CCIL Canadian Council of Independent Laboratories For specific tests as listed on www.ccil.com

Drawing No.

APPENDIX C-22

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD

P. MACHIBRODA ENGINEERING LTD.

PER Preston Schergevitch

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: April 29, 2021

Test Hole No.: 21-19

Sample No.: 29

Depth (m): 1.2

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	99.9
#60	0.25	99.1
# 100	0.15	76.6
# 200	0.075	22.5

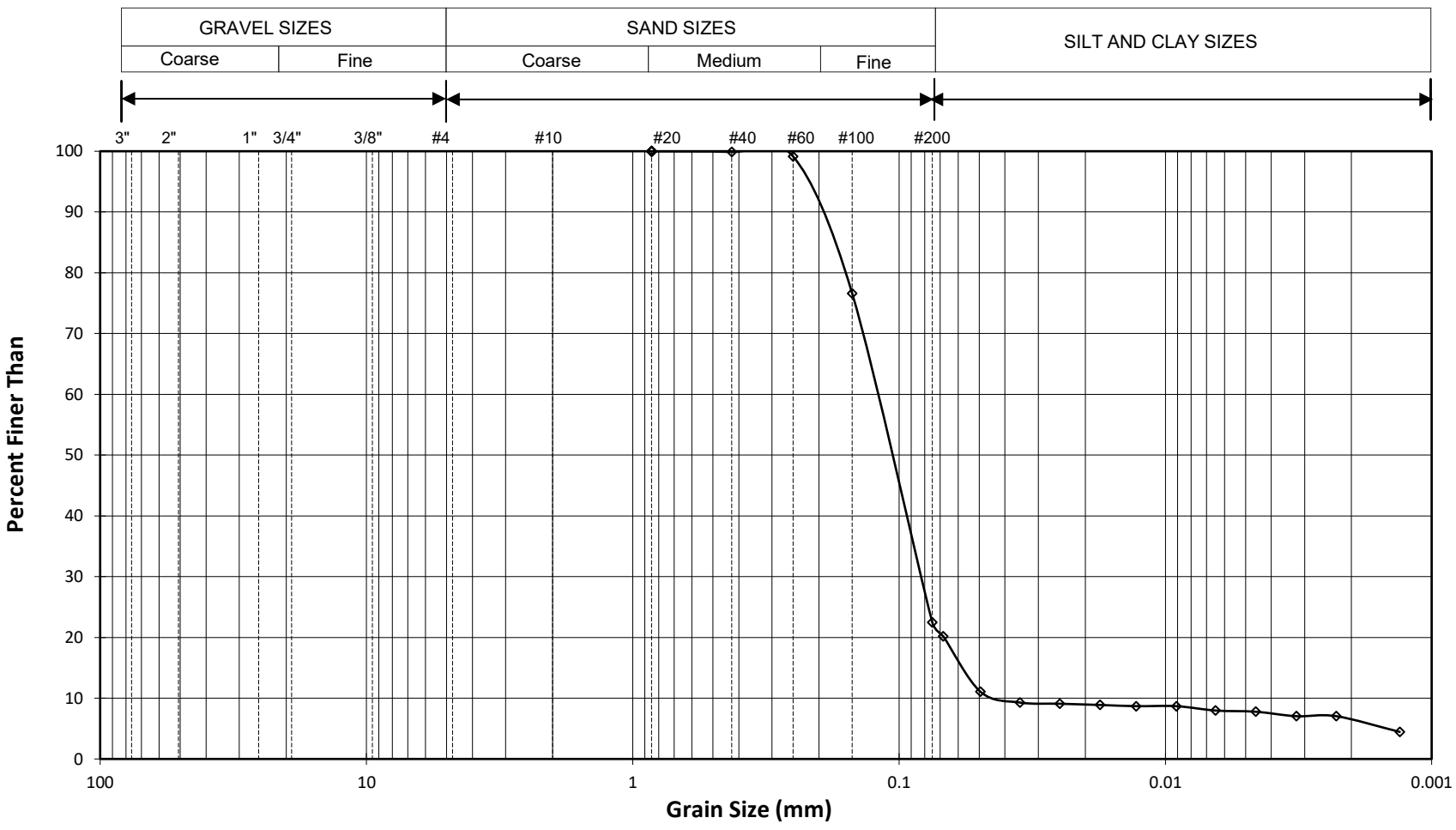
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0682	20.2
Sodium Hexametaphosphate	0.0495	11.1
	0.0352	9.3
	0.0249	9.1
	0.0176	8.9
	0.0129	8.7
	0.0091	8.7
	0.0065	8.0
	0.0046	7.8
	0.0032	7.0
	0.0023	7.0
	0.0013	4.5

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	77	16	7

Remarks:



CERTIFIED BY CCIL Canadian Council of Independent Laboratories For specific tests as listed on www.ccil.com

Drawing No.

APPENDIX C-23

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD

P. MACHIBRODA ENGINEERING LTD.

PER Preston Schergevitch

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: May 3, 2021

Test Hole No.: 21-20

Sample No.: 201

Depth (m): 0.6

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	100.0
#60	0.25	99.0
# 100	0.15	75.3
# 200	0.075	25.9

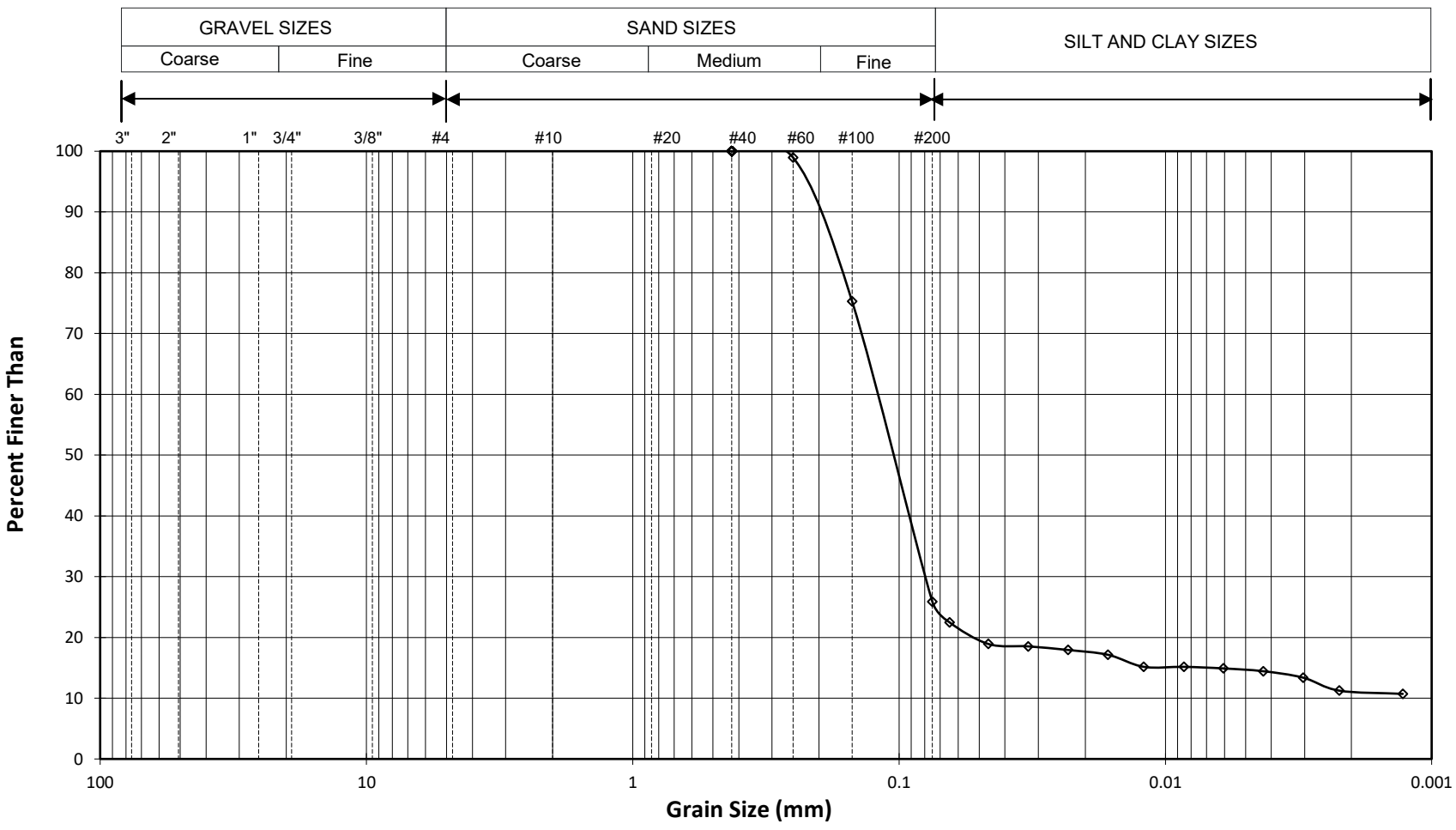
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0646	22.5
Sodium Hexametaphosphate	0.0462	18.9
	0.0327	18.5
	0.0232	17.9
	0.0164	17.1
	0.0121	15.2
	0.0085	15.2
	0.0061	14.9
	0.0043	14.4
	0.0030	13.4
	0.0022	11.2
	0.0013	10.7

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	74	15	11

Remarks:



CERTIFIED BY CCIL Canadian Council of Independent Laboratories For specific tests as listed on www.ccil.com

Drawing No.

APPENDIX C-24

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD

P. MACHIBRODA ENGINEERING LTD.

PER Preston Schergevitch

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: April 29, 2021

Test Hole No.: 21-21

Sample No.: 3

Depth (m): 0.9

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	99.8
#60	0.25	99.0
# 100	0.15	72.6
# 200	0.075	19.5

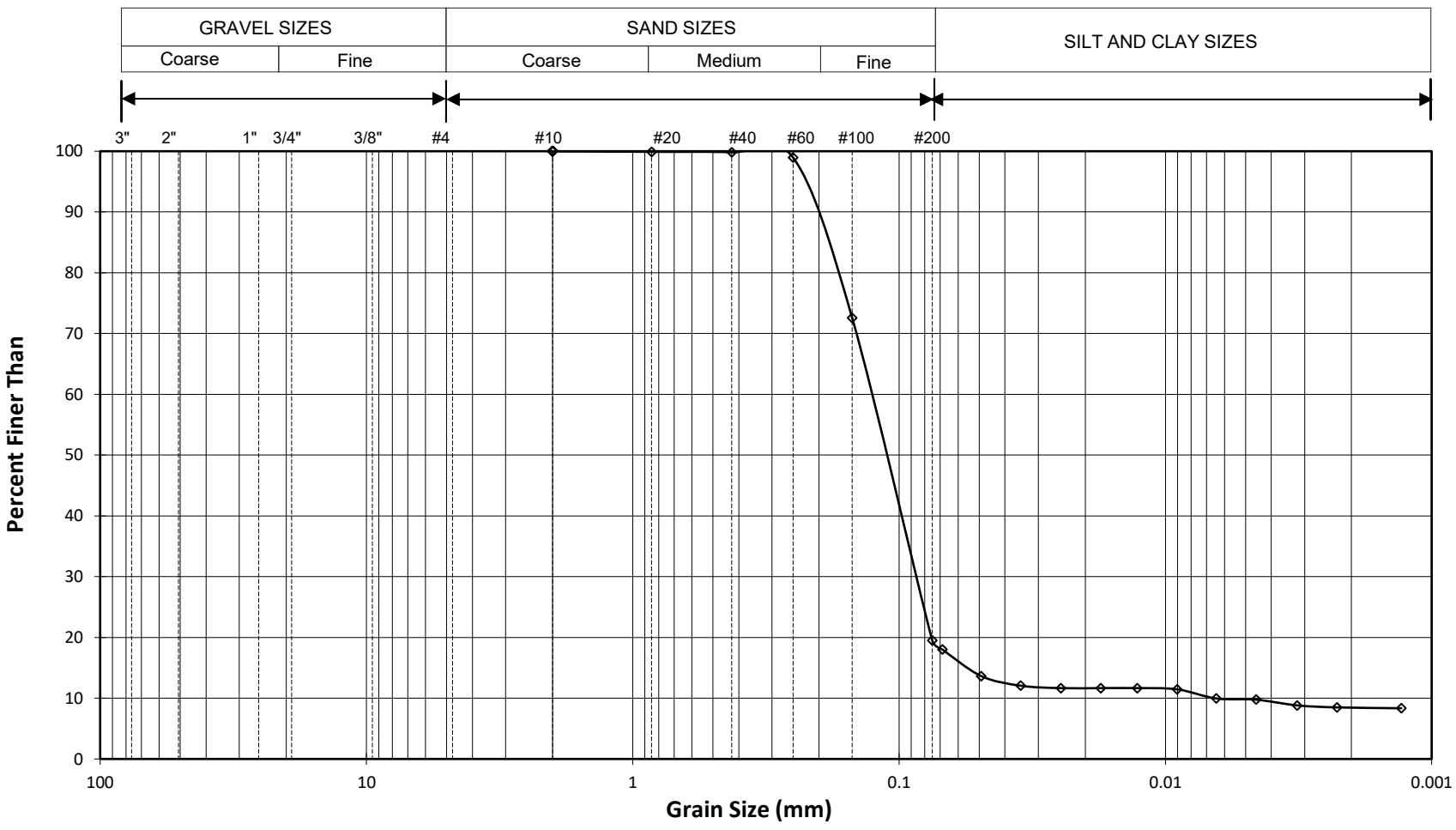
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0686	18.0
Sodium Hexametaphosphate	0.0491	13.6
	0.0349	12.1
	0.0247	11.7
	0.0175	11.7
	0.0128	11.7
	0.0090	11.5
	0.0064	10.0
	0.0046	9.8
	0.0032	8.8
	0.0023	8.5
	0.0013	8.3

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	80	11	9

Remarks:



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Drawing No.

APPENDIX C-25

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD

P. MACHIBRODA ENGINEERING LTD.

PER Preston Schergevitch

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: April 29, 2021

Test Hole No.: 21-21

Sample No.: 11

Depth (m): 9.0-9.4

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	100.0
#60	0.25	99.9
# 100	0.15	95.8
# 200	0.075	66.4

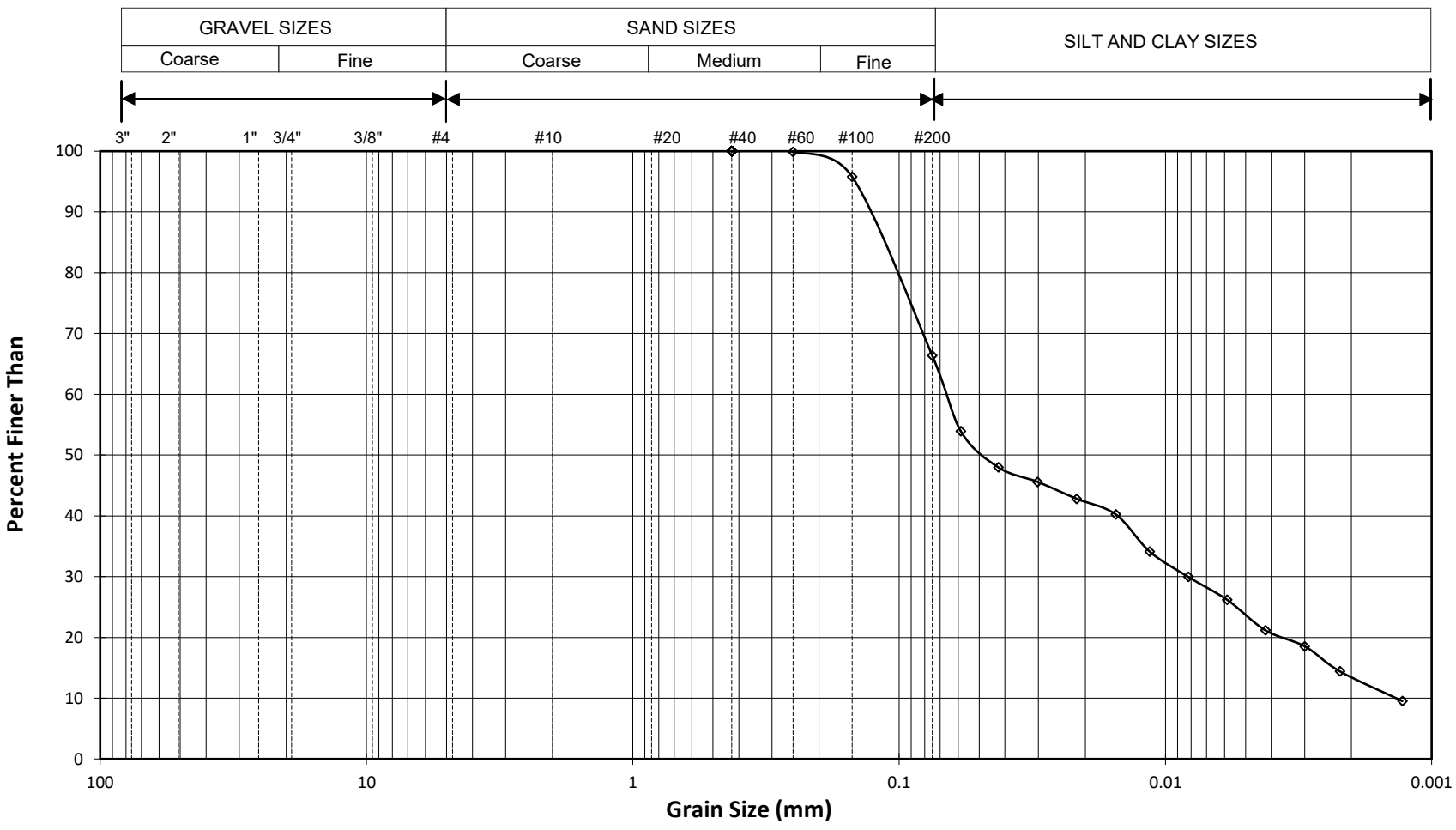
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0586	53.9
Sodium Hexametaphosphate	0.0423	48.0
	0.0302	45.6
	0.0215	42.8
	0.0154	40.2
	0.0114	34.1
	0.0082	29.9
	0.0059	26.2
	0.0042	21.2
	0.0030	18.5
	0.0022	14.4
	0.0013	9.5

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	34	52	14

Remarks:



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Drawing No.

APPENDIX C-26

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD

P. MACHIBRODA ENGINEERING LTD.

PER Preston Schergevitch

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: April 27, 2021

Test Hole No.: 21-22

Sample No.: 168

Depth (m): 0.6

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	99.9
#60	0.25	98.6
# 100	0.15	69.6
# 200	0.075	29.7

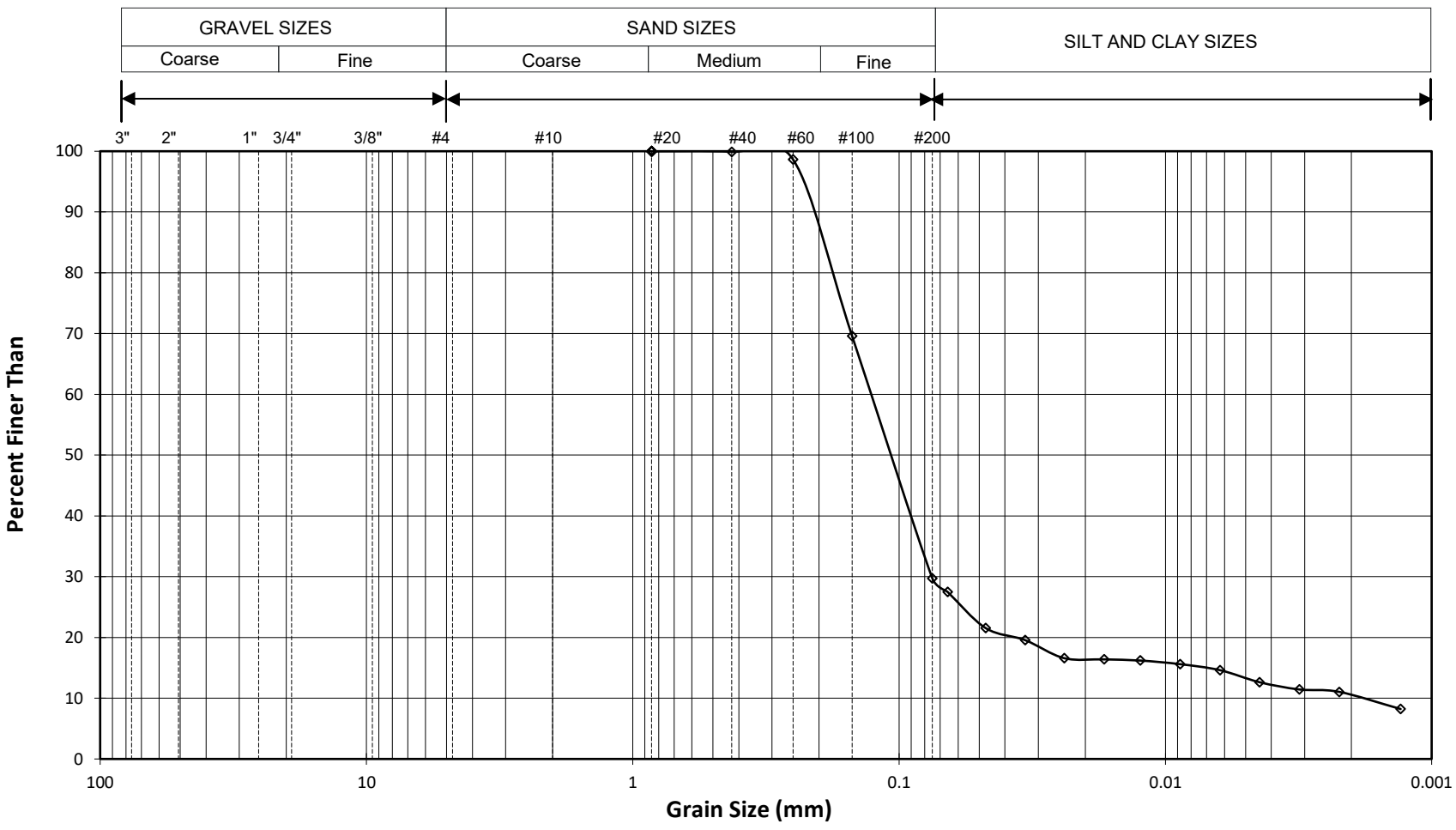
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0657	27.5
Sodium Hexametaphosphate	0.0473	21.5
	0.0336	19.6
	0.0240	16.6
	0.0170	16.4
	0.0124	16.2
	0.0088	15.6
	0.0062	14.6
	0.0044	12.6
	0.0031	11.4
	0.0022	11.0
	0.0013	8.2

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	70	19	11

Remarks:



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Drawing No.

APPENDIX C-27

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD

P. MACHIBRODA ENGINEERING LTD.

PER Preston Schergevitch

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: April 29, 2021

Test Hole No.: 21-23

Sample No.: 235

Depth (m): 1.5

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	99.9
#60	0.25	99.2
# 100	0.15	74.5
# 200	0.075	31.5

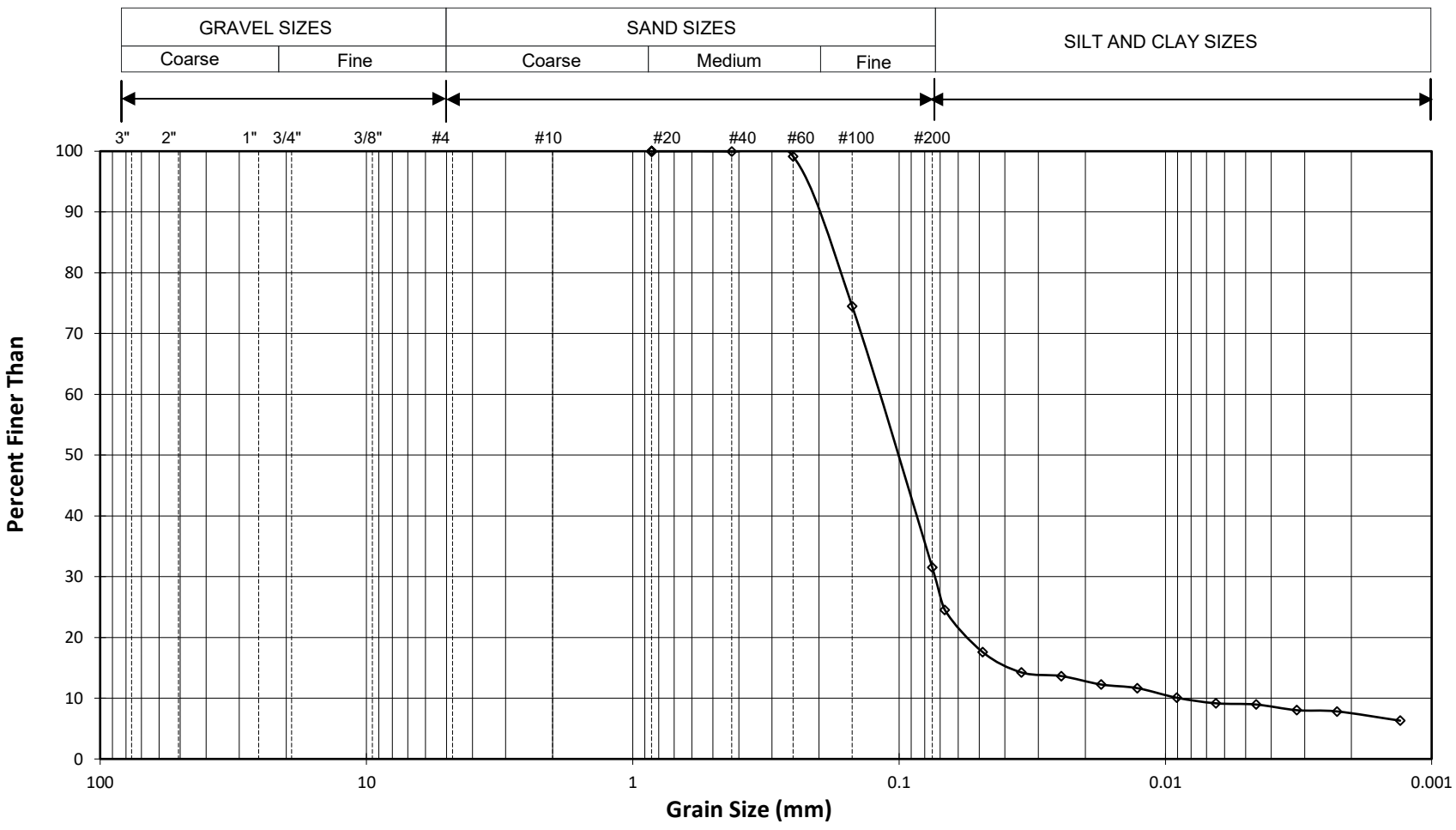
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0673	24.5
Sodium Hexametaphosphate	0.0486	17.6
	0.0347	14.2
	0.0246	13.6
	0.0174	12.3
	0.0128	11.7
	0.0091	10.1
	0.0065	9.2
	0.0046	9.0
	0.0032	8.0
	0.0023	7.8
	0.0013	6.3

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	68	24	8

Remarks:



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Drawing No.

APPENDIX C-28

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD

P. MACHIBRODA ENGINEERING LTD.

PER Preston Schergevitch

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: April 28, 2021

Test Hole No.: 21-24

Sample No.: 243

Depth (m): 1.2

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	99.6
#60	0.25	96.7
# 100	0.15	35.0
# 200	0.075	14.5

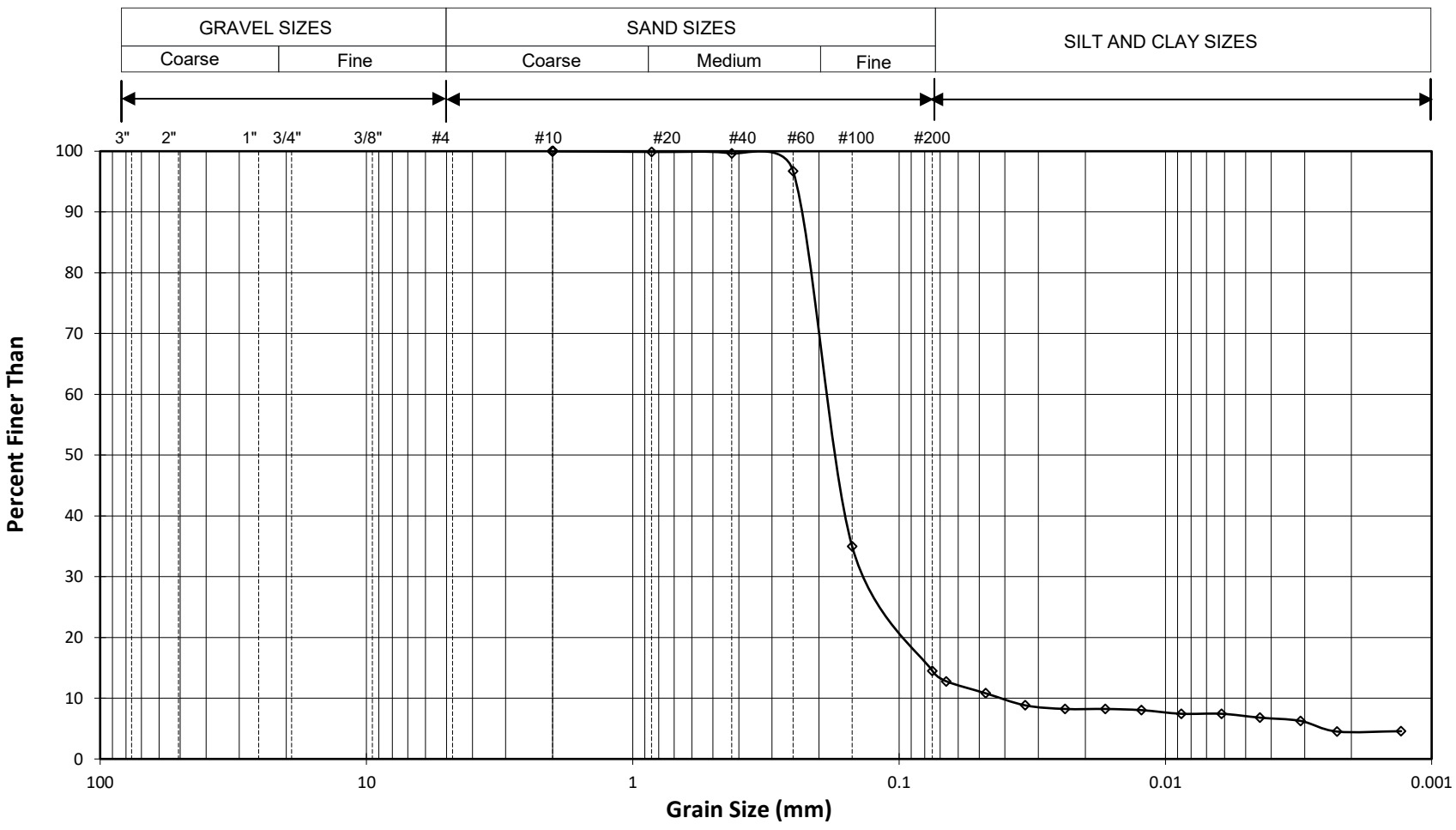
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0665	12.8
Sodium Hexametaphosphate	0.0472	10.8
	0.0336	8.8
	0.0238	8.2
	0.0168	8.2
	0.0123	8.0
	0.0087	7.4
	0.0062	7.4
	0.0044	6.8
	0.0031	6.3
	0.0023	4.5
	0.0013	4.6

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	85	10	5

Remarks:



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Drawing No.

APPENDIX C-29

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD

P. MACHIBRODA ENGINEERING LTD.

PER Preston Schergevitch

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: April 28, 2021

Test Hole No.: 21-25

Sample No.: 214

Depth (m): 0.6

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	99.9
#60	0.25	99.2
# 100	0.15	80.9
# 200	0.075	34.1

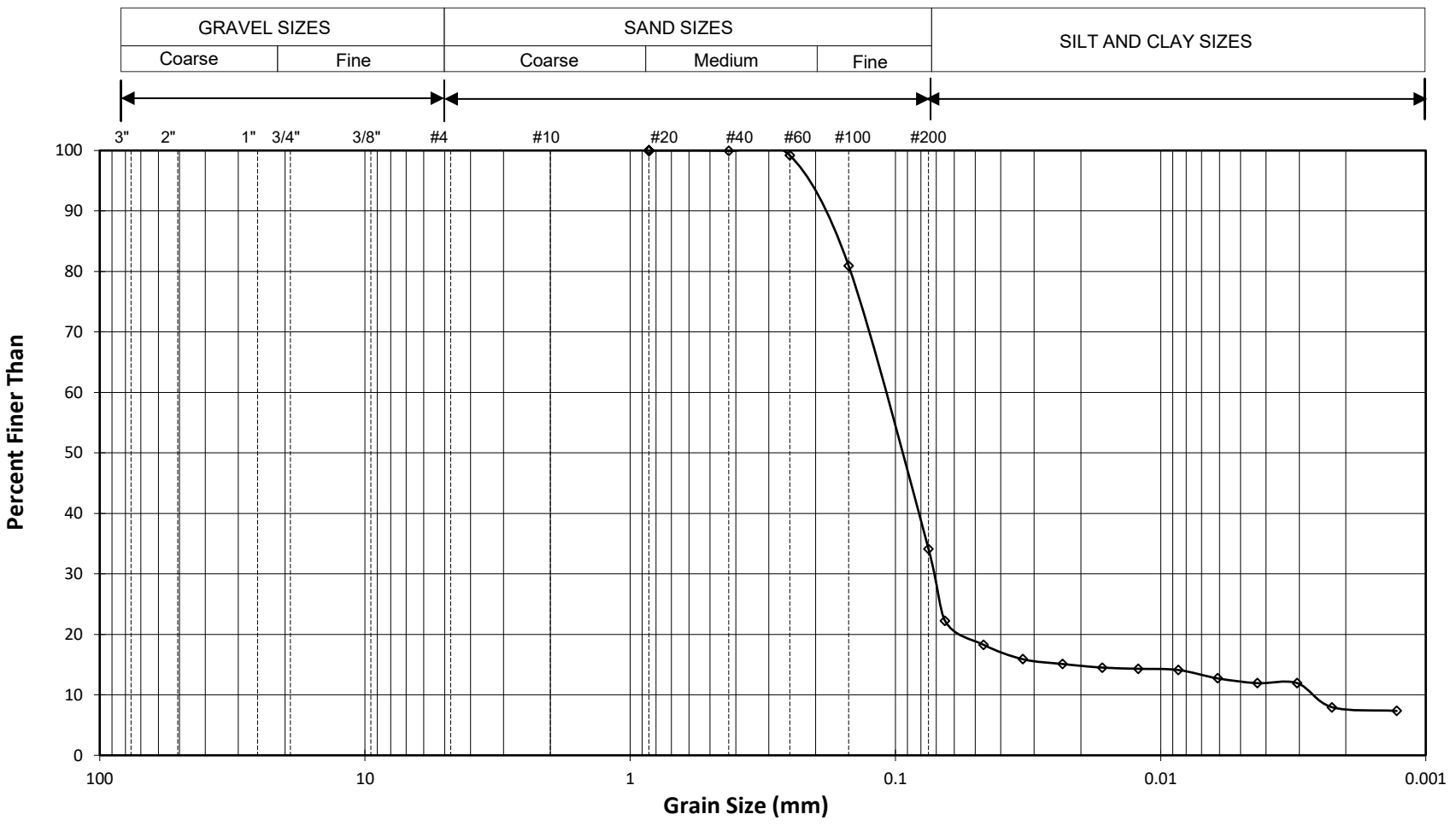
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0650	22.2
Sodium Hexametaphosphate	0.0465	18.3
	0.0331	15.9
	0.0234	15.1
	0.0166	14.5
	0.0121	14.3
	0.0086	14.1
	0.0061	12.7
	0.0043	11.9
	0.0031	11.9
	0.0023	7.9
	0.0013	7.3

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	66	26	8

Remarks:



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Drawing No.

APPENDIX C-30

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD

P. MACHIBRODA ENGINEERING LTD.

PER Preston Schergevitch

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: April 28, 2021

Test Hole No.: 21-25

Sample No.: 217

Depth (m): 3.0

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	99.8
#60	0.25	98.8
# 100	0.15	76.3
# 200	0.075	22.9

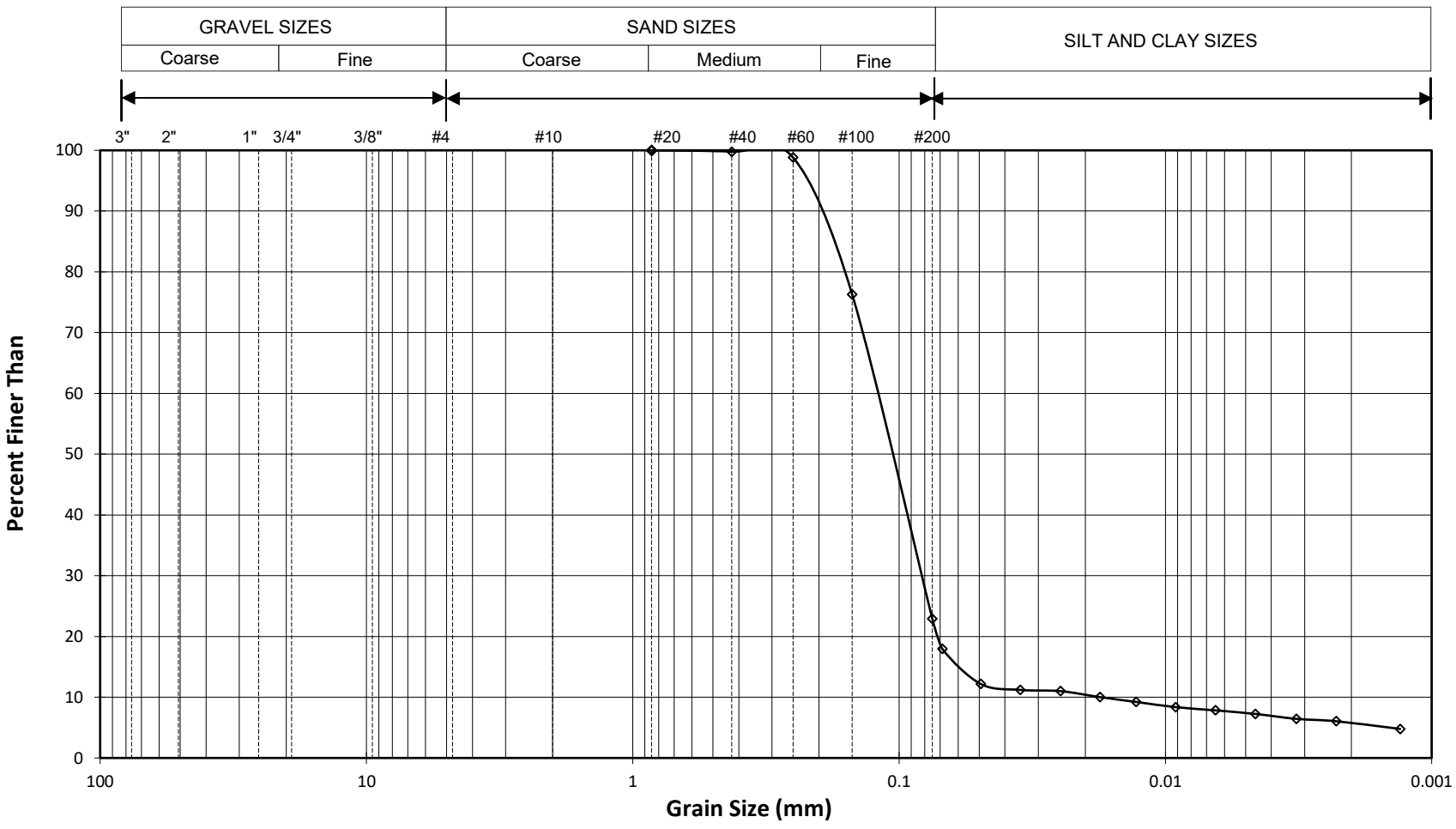
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0687	17.9
Sodium Hexametaphosphate	0.0494	12.2
	0.0350	11.2
	0.0248	11.0
	0.0176	10.0
	0.0129	9.2
	0.0091	8.4
	0.0065	7.8
	0.0046	7.2
	0.0032	6.4
	0.0023	6.0
	0.0013	4.8

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	77	17	6

Remarks:



CERTIFIED BY CCIL Canadian Council of Independent Laboratories For specific tests as listed on www.ccil.com

Drawing No.

APPENDIX C-31

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD

P. MACHIBRODA ENGINEERING LTD.

PER Preston Schergevitch

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: April 28, 2021

Test Hole No.: 21-26

Sample No.: 210

Depth (m): 0.9

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	99.9
#60	0.25	98.9
# 100	0.15	71.5
# 200	0.075	16.4

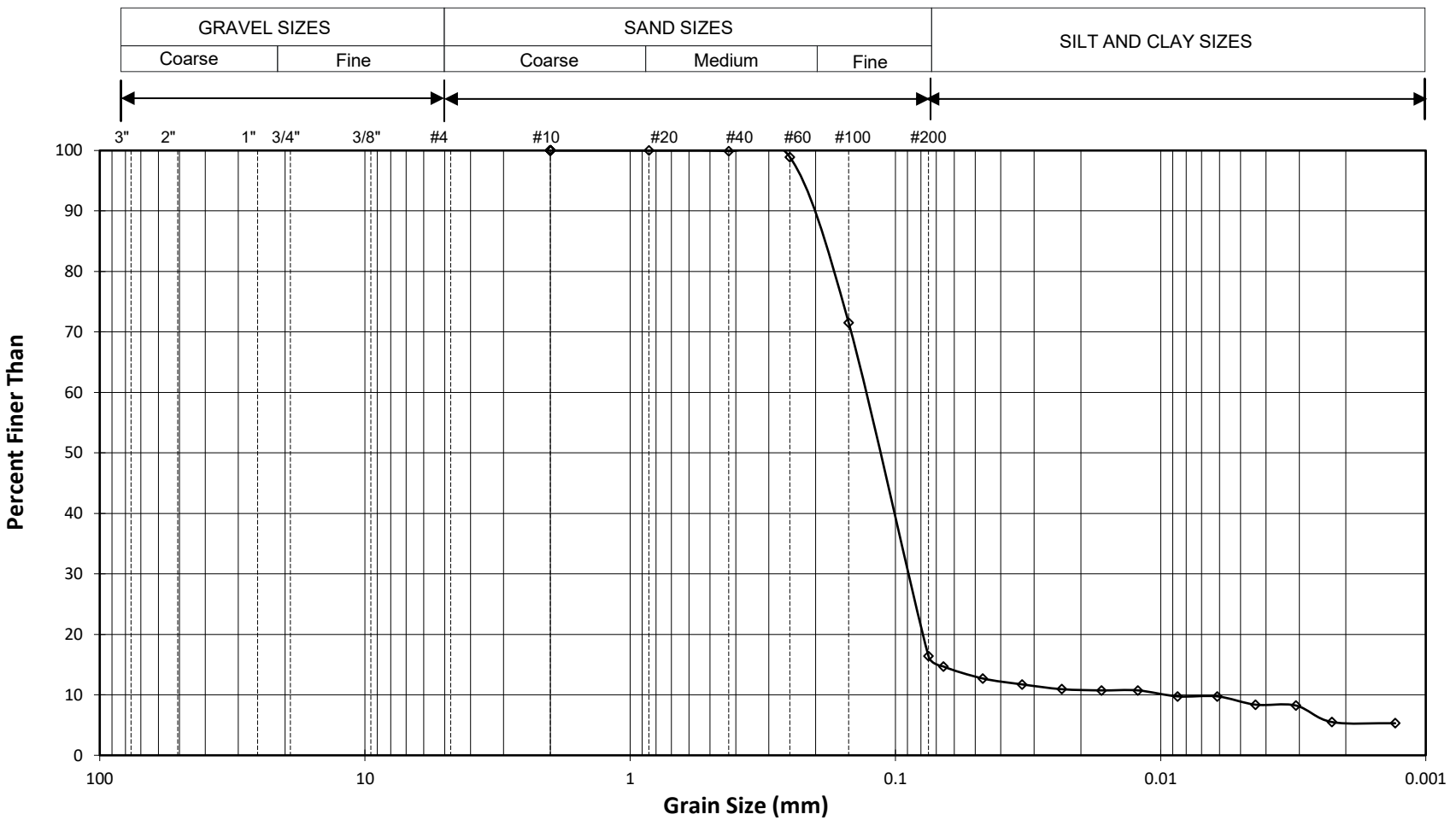
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0660	14.7
Sodium Hexametaphosphate	0.0469	12.7
	0.0333	11.7
	0.0236	10.9
	0.0167	10.7
	0.0122	10.7
	0.0086	9.7
	0.0061	9.7
	0.0044	8.4
	0.0031	8.2
	0.0023	5.5
	0.0013	5.3

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	84	11	5

Remarks:



CERTIFIED BY CCIL Canadian Council of Independent Laboratories For specific tests as listed on www.ccil.com

Drawing No.

APPENDIX C-32

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD

P. MACHIBRODA ENGINEERING LTD.

PER Preston Schergevitch

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: April 29, 2021

Test Hole No.: 21-27

Sample No.: 201

Depth (m): 0.6

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	100.0
#60	0.25	99.6
# 100	0.15	83.4
# 200	0.075	28.5

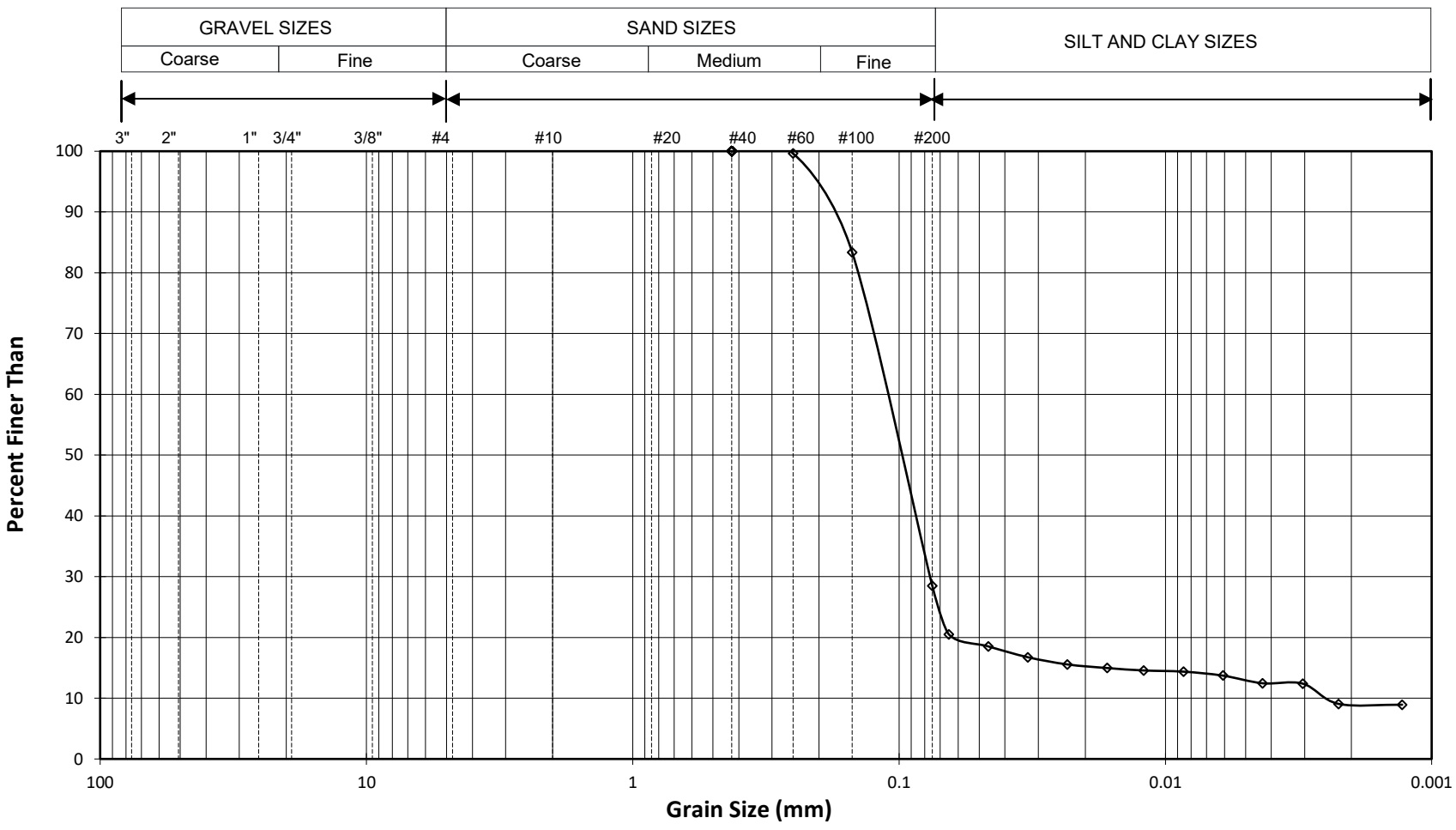
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0650	20.5
Sodium Hexametaphosphate	0.0462	18.5
	0.0329	16.7
	0.0233	15.6
	0.0165	15.0
	0.0121	14.6
	0.0085	14.4
	0.0061	13.7
	0.0043	12.5
	0.0030	12.4
	0.0022	9.1
	0.0013	8.9

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	71	20	9

Remarks:



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Drawing No.

APPENDIX C-33

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD

P. MACHIBRODA ENGINEERING LTD.

PER Preston Schergevitch

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: April 29, 2021

Test Hole No.: 21-28

Sample No.: 222

Depth (m): 1.2

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	99.9
#60	0.25	99.5
# 100	0.15	82.0
# 200	0.075	30.9

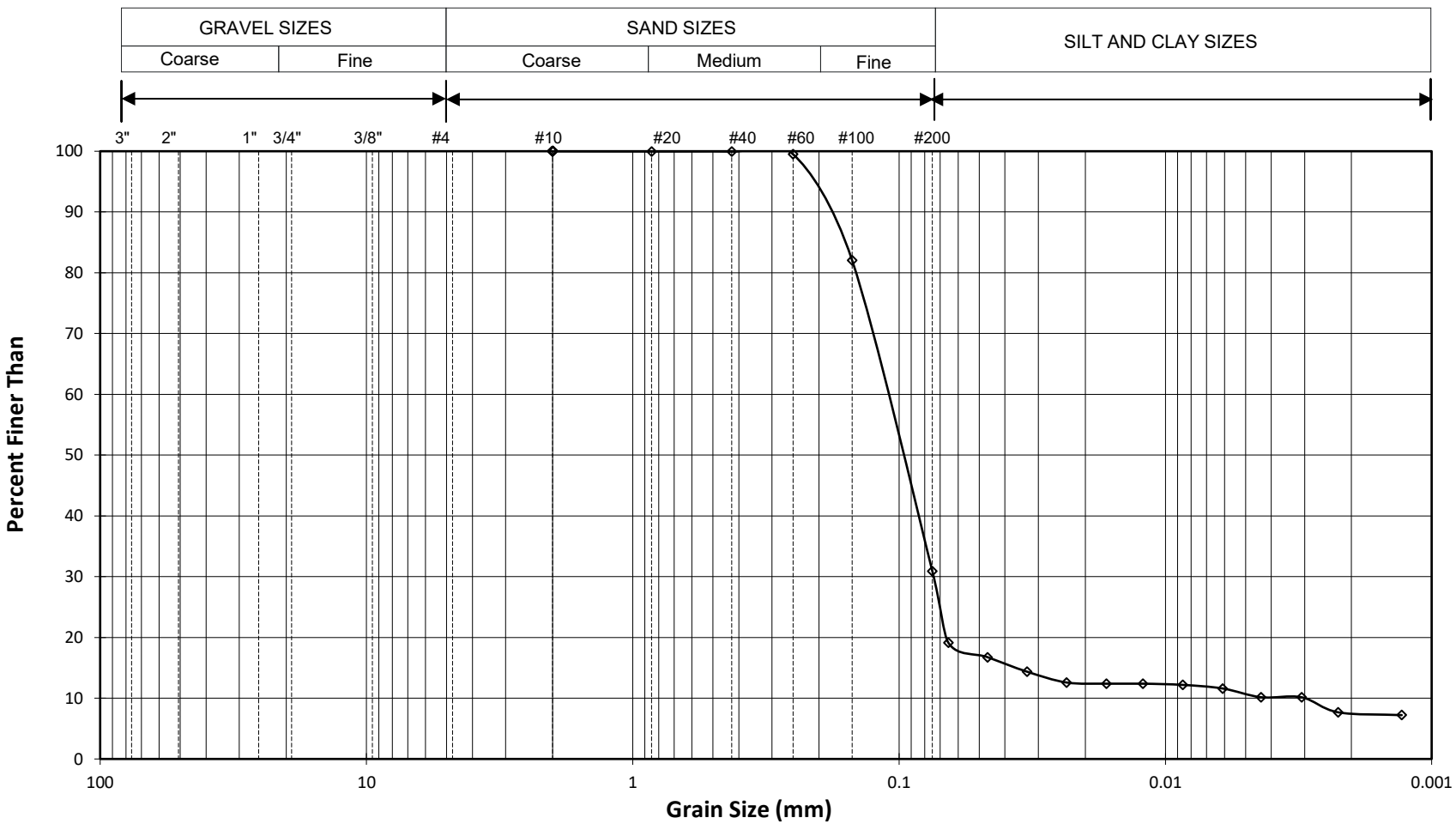
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0653	19.1
Sodium Hexametaphosphate	0.0465	16.7
	0.0331	14.4
	0.0235	12.6
	0.0166	12.4
	0.0121	12.4
	0.0086	12.2
	0.0061	11.6
	0.0044	10.2
	0.0031	10.2
	0.0022	7.7
	0.0013	7.2

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	69	23	8

Remarks:



CERTIFIED BY CCIL Canadian Council of Independent Laboratories For specific tests as listed on www.ccil.com

Drawing No.

APPENDIX C-34

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD

P. MACHIBRODA ENGINEERING LTD.

PER Preston Schergevitch

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: April 29, 2021

Test Hole No.: 21-28

Sample No.: 228

Depth (m): 9.0-9.4

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	99.6
#60	0.25	98.6
# 100	0.15	70.8
# 200	0.075	18.0

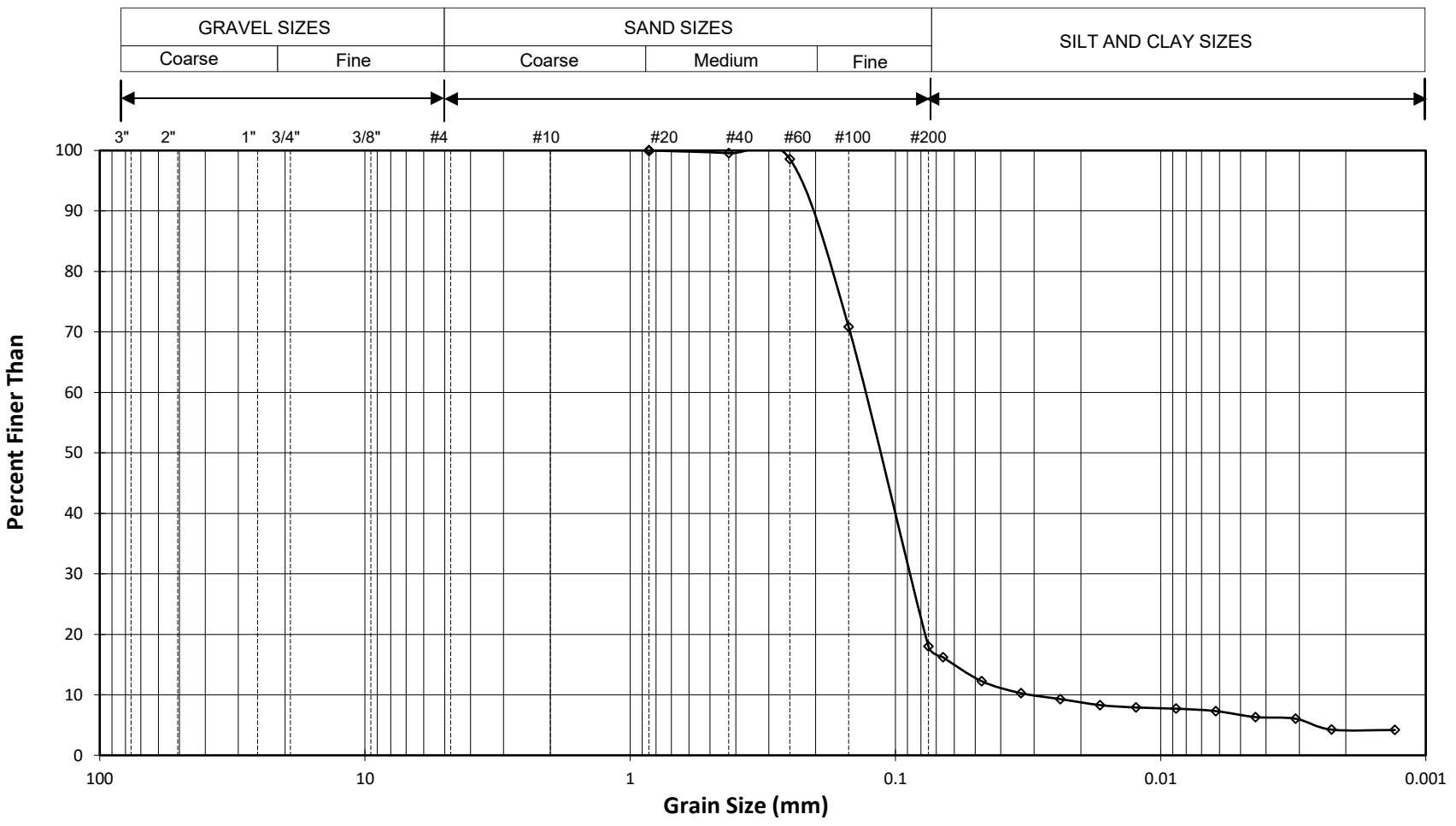
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0662	16.2
Sodium Hexametaphosphate	0.0473	12.3
	0.0336	10.3
	0.0238	9.3
	0.0169	8.3
	0.0124	7.9
	0.0087	7.7
	0.0062	7.3
	0.0044	6.3
	0.0031	6.1
	0.0023	4.2
	0.0013	4.2

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	82	14	4

Remarks:



CERTIFIED BY CCIL Canadian Council of Independent Laboratories For specific tests as listed on www.ccil.com

Drawing No.

APPENDIX C-35

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD

P. MACHIBRODA ENGINEERING LTD.

PER Preston Schergevitch

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Greenview Estates Subdivision

Location: South of Saskatoon, SK

Project No.: 17789

Date Tested: April 29, 2021

Test Hole No.: 21-29

Sample No.: 183

Depth (m): 1.5

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.1	100
1"	25.4	100
3/4"	19.1	100
1/2"	12.7	100
3/8"	9.5	100
# 4	4.75	100
# 10	2	100
# 20	0.85	100
# 40	0.425	99.9
#60	0.25	99.2
# 100	0.15	71.7
# 200	0.075	24.6

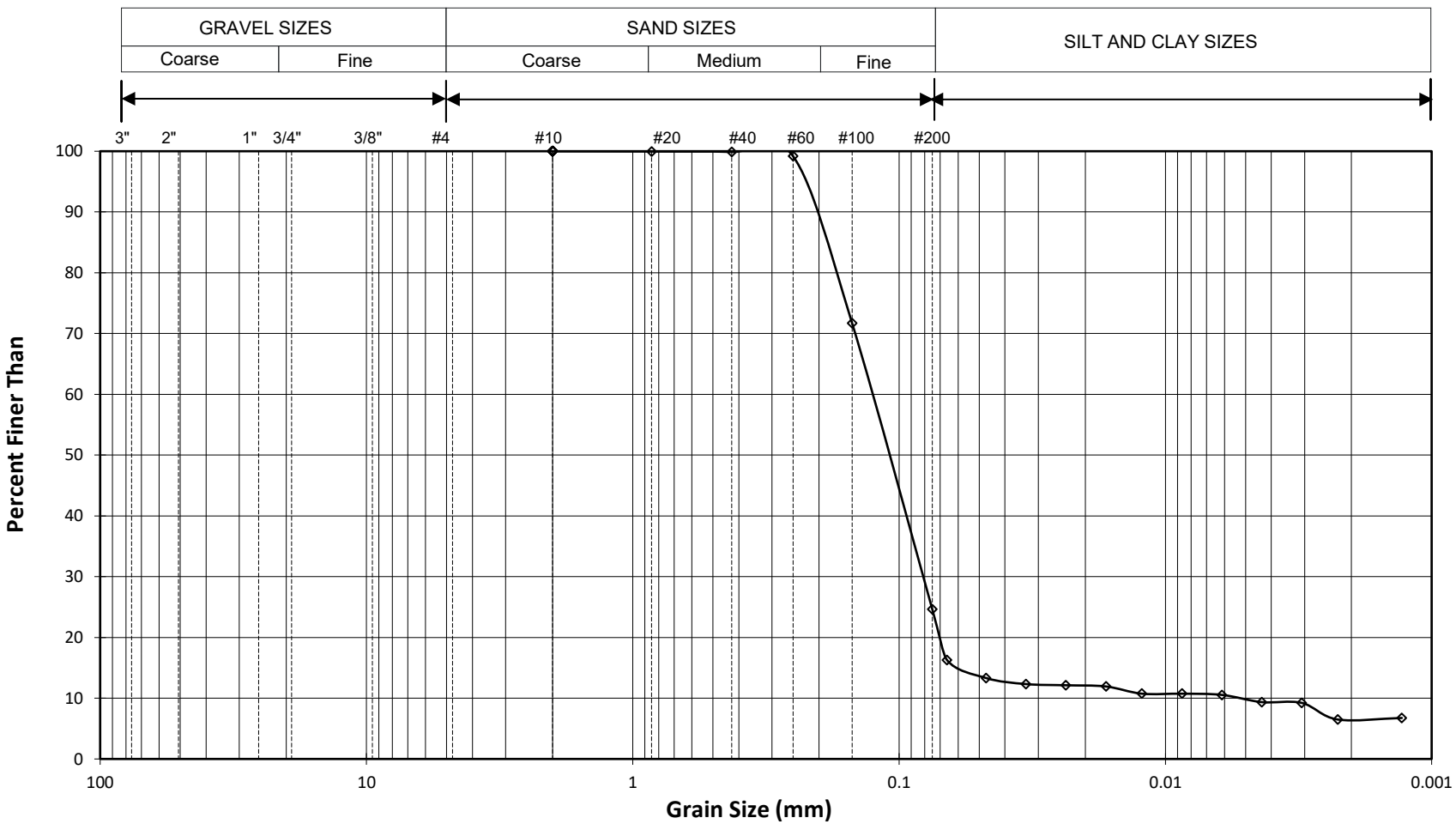
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0661	16.3
Sodium Hexametaphosphate	0.0471	13.3
	0.0334	12.3
	0.0236	12.1
	0.0167	11.9
	0.0123	10.7
	0.0087	10.7
	0.0061	10.5
	0.0043	9.4
	0.0031	9.2
	0.0023	6.5
	0.0013	6.7

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	75	18	7

Remarks:



CERTIFIED BY CCIL Canadian Council of Independent Laboratories For specific tests as listed on www.ccil.com

Drawing No.

APPENDIX C-36

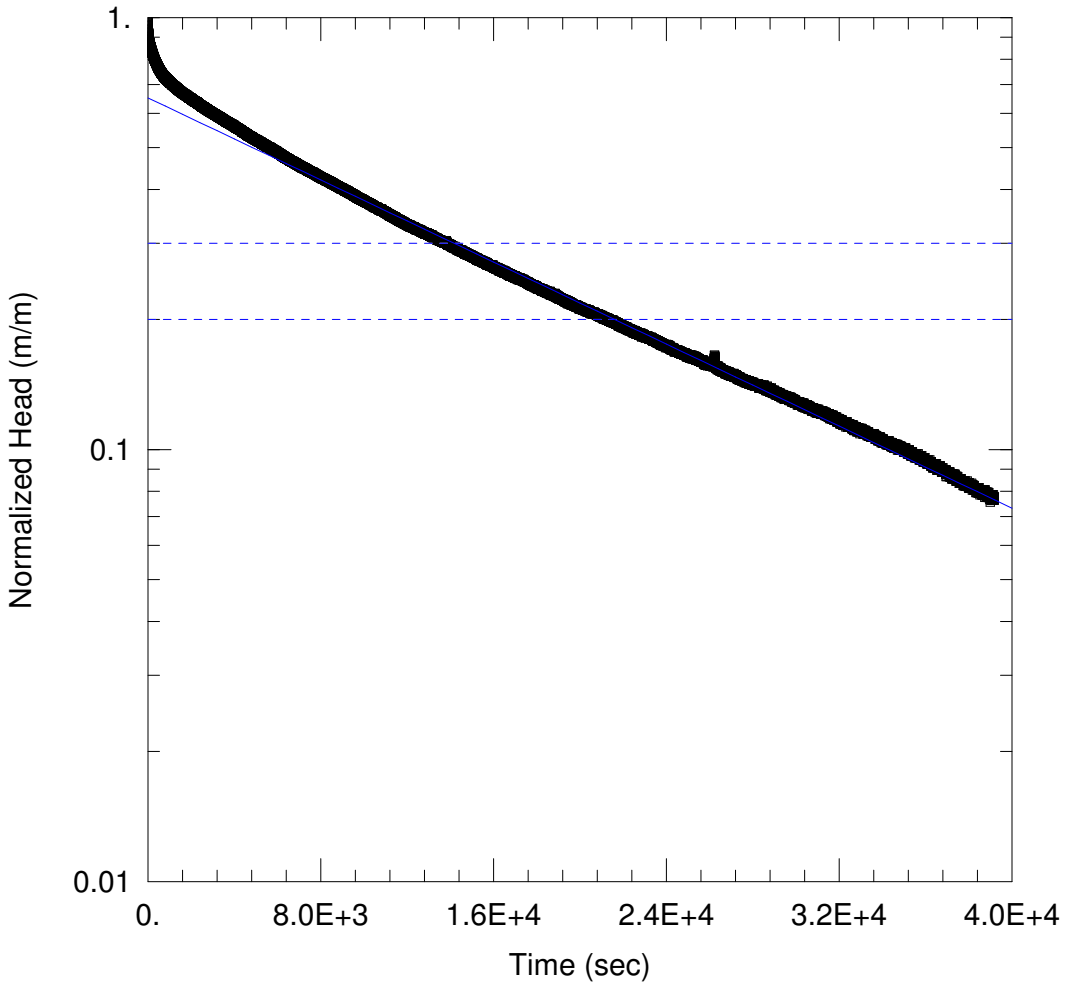
WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD

P. MACHIBRODA ENGINEERING LTD.

PER Preston Schergevitch

APPENDIX D

Field Hydraulic Conductivity
Test Results



WELL TEST ANALYSIS

Data Set: G:\17788\MW21-1.aqt
Date: 12/20/21 Time: 09:16:30

PROJECT INFORMATION

Company: PMEL
Project: 17788
Location: Greenview Estates
Test Well: MW21-1A
Test Date: May 4, 2021

AQUIFER DATA

Saturated Thickness: 1.108 m Anisotropy Ratio (Kz/Kr): 1.

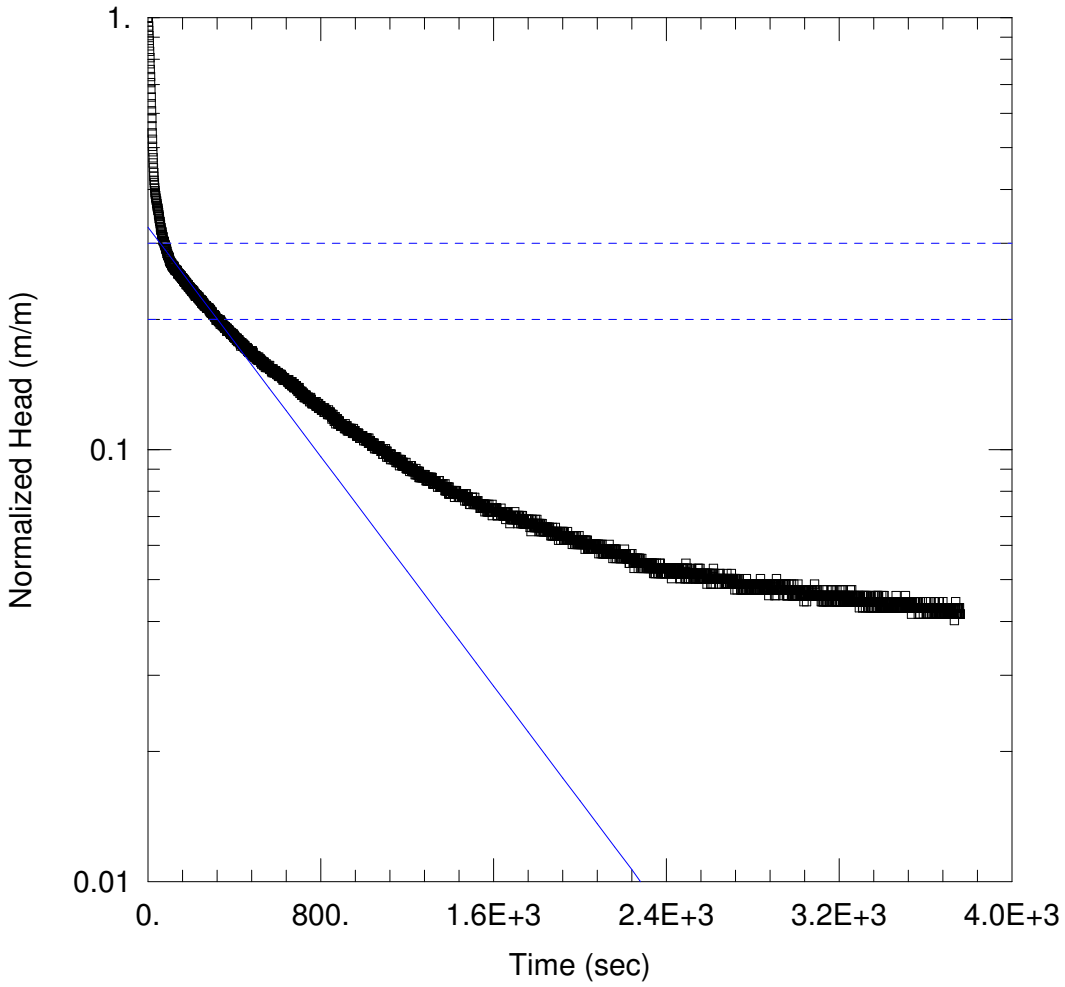
WELL DATA (MW21-1)

Initial Displacement: 0.993 m
Total Well Penetration Depth: 2. m
Casing Radius: 0.0254 m
Static Water Column Height: 1.108 m
Screen Length: 2. m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 3.629E-8 m/sec y0 = 0.6469 m



WELL TEST ANALYSIS

Data Set: G:\17788\MW21-5.aqt
Date: 12/20/21 Time: 09:46:40

PROJECT INFORMATION

Company: PMEL
Project: 17788
Location: Greenview Estates
Test Well: MW21-5
Test Date: May 4, 2021

AQUIFER DATA

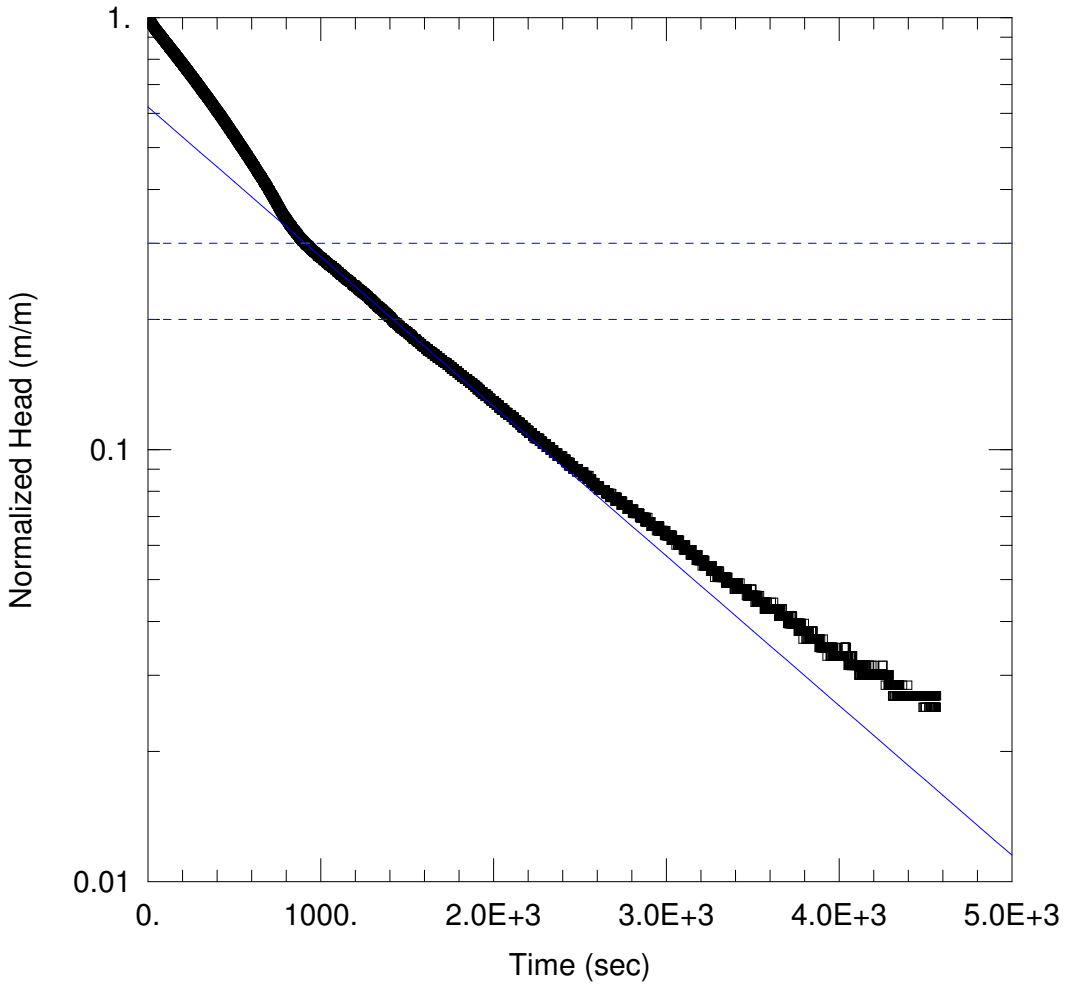
Saturated Thickness: 1.159 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW21-5)

Initial Displacement: 0.697 m Static Water Column Height: 1.159 m
Total Well Penetration Depth: 2. m Screen Length: 2. m
Casing Radius: 0.0254 m Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice
K = 9.767E-7 m/sec y0 = 0.228 m



WELL TEST ANALYSIS

Data Set: G:\17788\MW21-13.aqt
Date: 12/20/21 Time: 10:52:53

PROJECT INFORMATION

Company: PMEL
Project: 17788
Location: Greenview Estates
Test Well: MW21-13
Test Date: May 4, 2021

AQUIFER DATA

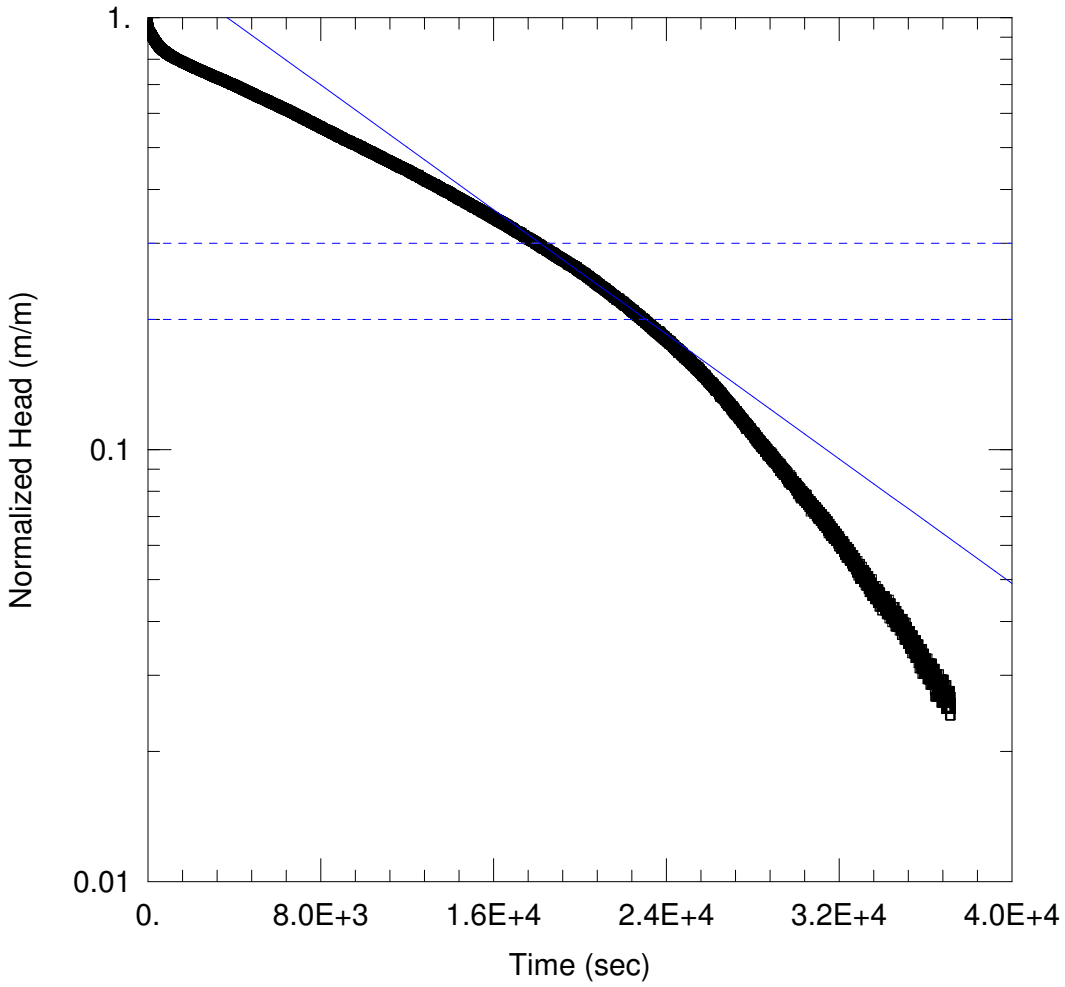
Saturated Thickness: 0.835 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW21-13)

Initial Displacement: 0.632 m
Total Well Penetration Depth: 0.835 m
Casing Radius: 0.0254 m
Static Water Column Height: 0.835 m
Screen Length: 0.835 m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 5.302E-7 m/sec
y0 = 0.3921 m



WELL TEST ANALYSIS

Data Set: G:\17788\MW21-16.aqt
Date: 12/20/21 Time: 10:41:37

PROJECT INFORMATION

Company: PMEL
Project: 17788
Location: Greenview Estates
Test Well: MW21-16
Test Date: May 4, 2021

AQUIFER DATA

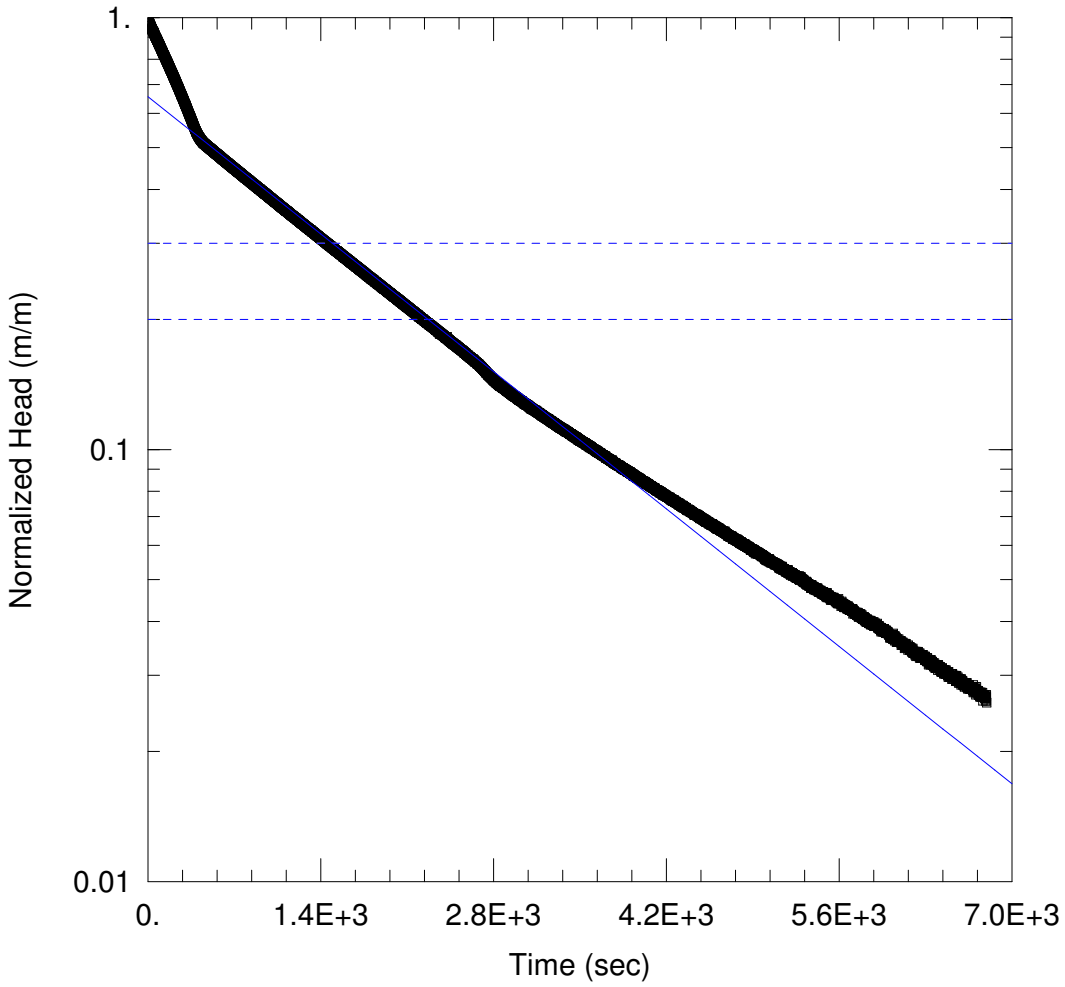
Saturated Thickness: 1.27 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW21-16)

Initial Displacement: 1.157 m
Total Well Penetration Depth: 1.27 m
Casing Radius: 0.0254 m
Static Water Column Height: 1.27 m
Screen Length: 1.27 m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 4.354E-8 m/sec
y0 = 1.569 m



WELL TEST ANALYSIS

Data Set: G:\17788\MW21-21A.aqt
Date: 12/20/21 Time: 10:25:34

PROJECT INFORMATION

Company: PMEL
Project: 17788
Location: Greenview Estates
Test Well: MW21-21A
Test Date: May 4, 2021

AQUIFER DATA

Saturated Thickness: 3.741 m Anisotropy Ratio (Kz/Kr): 1.

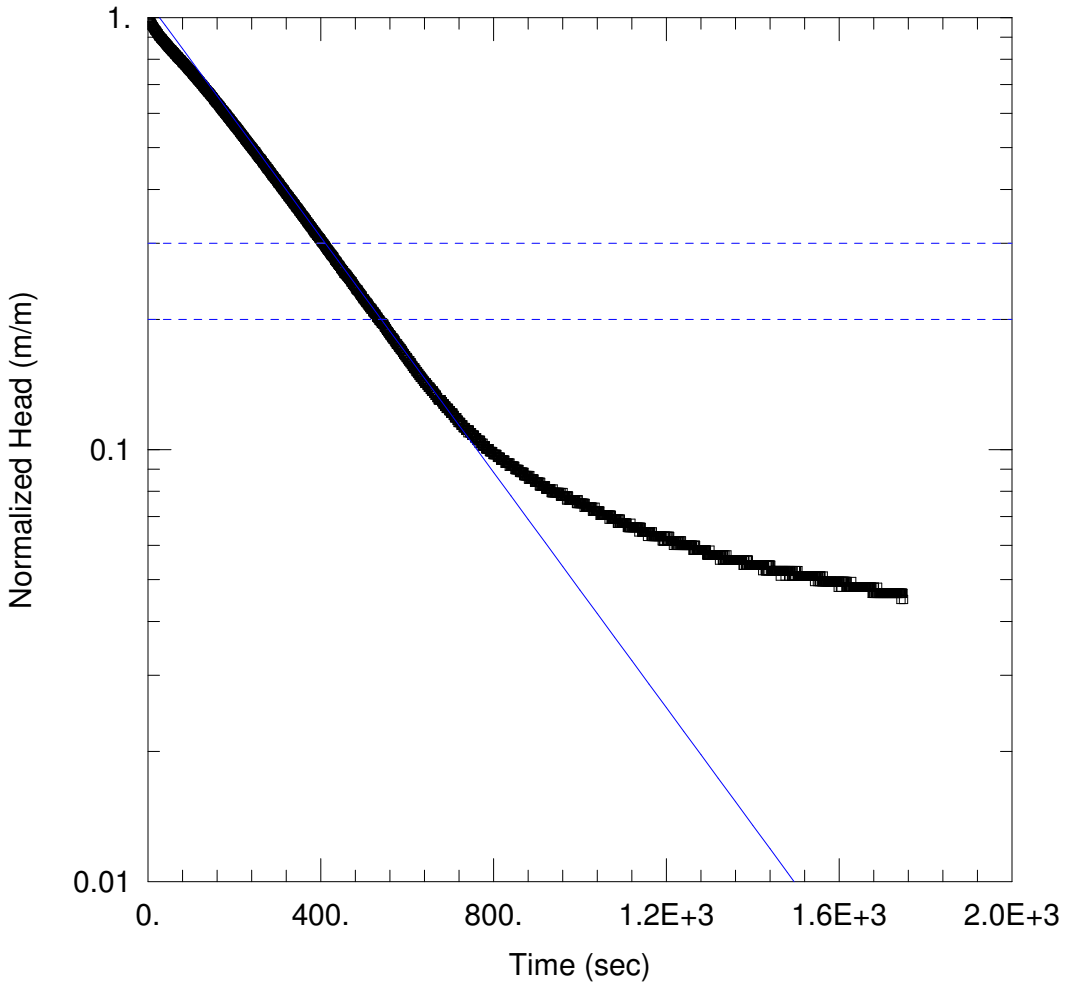
WELL DATA (MW21-21A)

Initial Displacement: 3.435 m
Total Well Penetration Depth: 3.741 m
Casing Radius: 0.0254 m
Static Water Column Height: 3.741 m
Screen Length: 2. m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 2.391E-7 m/sec y0 = 2.254 m



WELL TEST ANALYSIS

Data Set: G:\17788\MW21-22.aqt
Date: 12/20/21 Time: 10:21:38

PROJECT INFORMATION

Company: PMEL
Project: 17788
Location: Greenview Estates
Test Well: MW21-22
Test Date: May 4, 2021

AQUIFER DATA

Saturated Thickness: 0.795 m Anisotropy Ratio (Kz/Kr): 1.

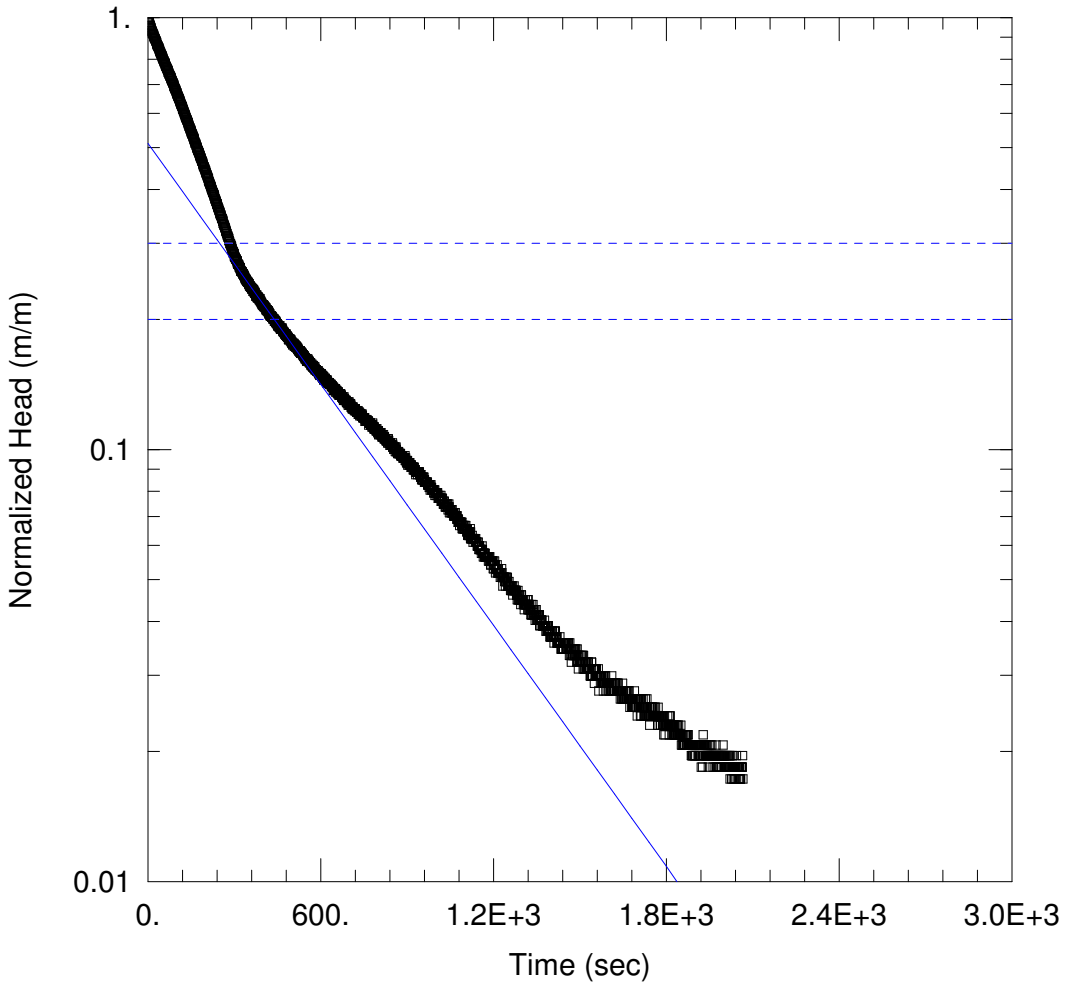
WELL DATA (MW21-22)

Initial Displacement: 0.667 m
Total Well Penetration Depth: 0.795 m
Casing Radius: 0.0254 m
Static Water Column Height: 0.795 m
Screen Length: 0.795 m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 2.141E-6 m/sec y0 = 0.7255 m



WELL TEST ANALYSIS

Data Set: G:\17788\MW21-26.aqt
Date: 12/20/21 Time: 10:15:51

PROJECT INFORMATION

Company: PMEL
Project: 17788
Location: Greenview Estates
Test Well: MW21-26
Test Date: May 4, 2021

AQUIFER DATA

Saturated Thickness: 1.06 m Anisotropy Ratio (Kz/Kr): 1.

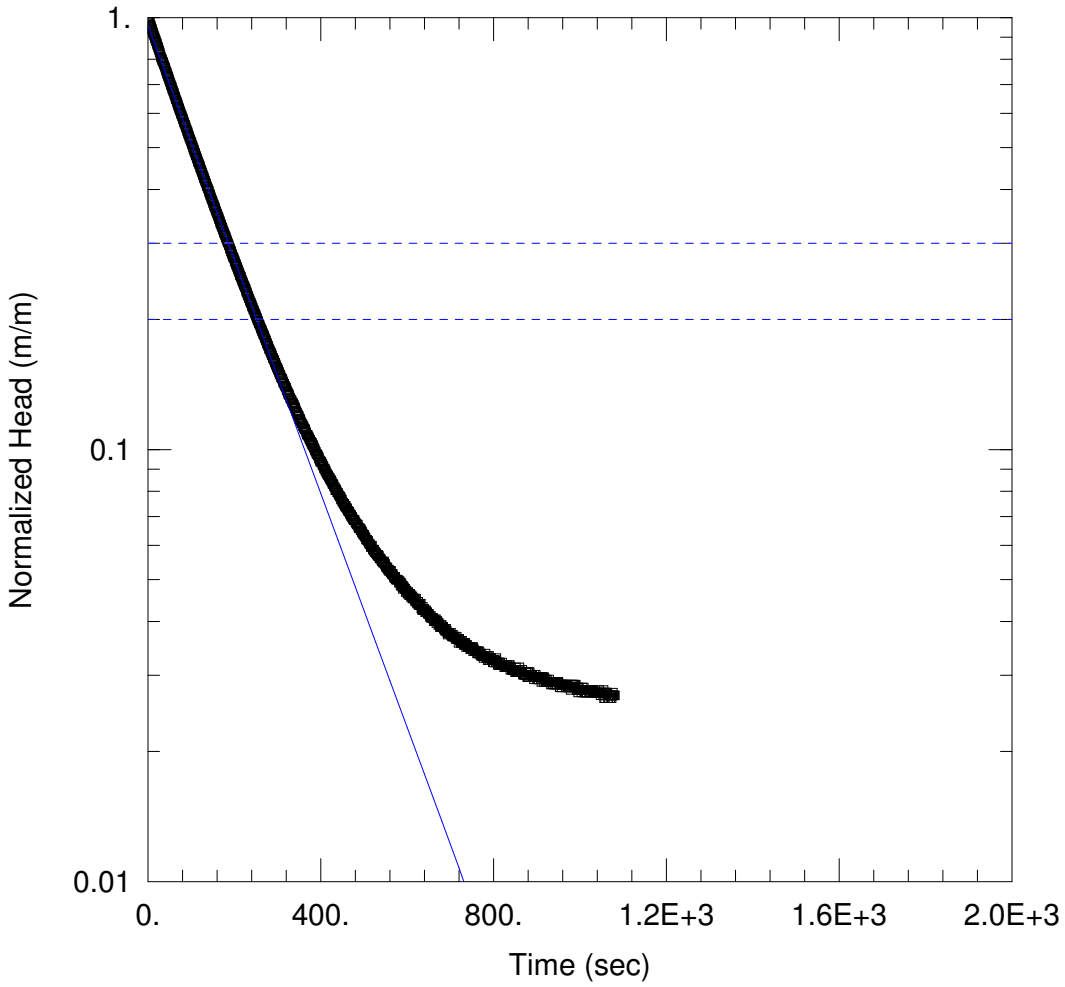
WELL DATA (MW21-26)

Initial Displacement: 0.869 m
Total Well Penetration Depth: 1.06 m
Casing Radius: 0.0254 m
Static Water Column Height: 1.06 m
Screen Length: 1.06 m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 1.247E-6 m/sec y0 = 0.4443 m



WELL TEST ANALYSIS

Data Set: G:\17788\MW21-28.aqt
Date: 12/20/21 Time: 09:58:31

PROJECT INFORMATION

Company: PMEL
Project: 17788
Location: Greenview Estates
Test Well: MW21-28
Test Date: May 4, 2021

AQUIFER DATA

Saturated Thickness: 3.155 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW21-28)

Initial Displacement: 2.522 m
Total Well Penetration Depth: 3.155 m
Casing Radius: 0.0254 m
Static Water Column Height: 3.155 m
Screen Length: 2. m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 2.747E-6 m/sec y0 = 2.415 m

APPENDIX E

Laboratory Certificate of Analysis Reports

CERTIFICATE OF ANALYSIS

Work Order	: **SK2101246**	Page	: 1 of 15
Client	: **P. Machibroda Engineering Ltd.**	Laboratory	: Saskatoon - Environmental
Contact	: Arjun Paul	Account Manager	: Kimberley Head
Address	: 806-48th STREET EAST Saskatoon SK Canada S7K 3Y4	Address	: 819 58 Street East Saskatoon SK Canada S7K 6X5
Telephone	: 306 665 8444	Telephone	: +1 306 668 8370
Project	: ----	Date Samples Received	: 05-May-2021 14:00
PO	: ----	Date Analysis Commenced	: 05-May-2021
C-O-C number	: ----	Issue Date	: 12-May-2021 15:59
Sampler	: BT		
Site	: ----		
Quote number	: SK Pricing		
No. of samples received	: 16		
No. of samples analysed	: 16		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QC Interpretive report to assist with Quality Review and Sample Receipt Notification (SRN).

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with FDA 21 CFR Part 11.

Signatories	*Position*	*Laboratory Department*
Colby Bingham	Quality Systems Coordinator	Inorganics, Saskatoon, Saskatchewan
Colby Bingham	Quality Systems Coordinator	Metals, Saskatoon, Saskatchewan
Hedy Lai	Team Leader - Inorganics	Microbiology, Saskatoon, Saskatchewan
Lian Nesbitt	Laboratory Analyst	Metals, Saskatoon, Saskatchewan
Melissa Houseman	Team Leader - Inorganics	Inorganics, Saskatoon, Saskatchewan
Nancy Cruse	Laboratory _ Supervisor	Inorganics, Saskatoon, Saskatchewan
Xihua Yao	Laboratory Analyst	Inorganics, Saskatoon, Saskatchewan
Xihua Yao	Laboratory Analyst	Microbiology, Saskatoon, Saskatchewan

General Comments

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Refer to the ALS Quality Control Interpretive report (QCI) for applicable references and methodology summaries. Reference methods may incorporate modifications to improve performance.
Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Please refer to Quality Control Interpretive report (QCI) for information regarding Holding Time compliance.

Key : CAS Number: Chemical Abstracts Services number is a unique identifier assigned to discrete substances
LOR: Limit of Reporting (detection limit).

Unit	*Description*
-	No Unit
%	percent
µS/cm	Microsiemens per centimetre
meq/L	milliequivalents per litre
mg/L	milligrams per litre
MPN/100mL	most probable number per 100 mL
pH units	pH units

>: greater than.
<: less than.

Surrogate: An analyte that is similar in behavior to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED on SRN or QCI Report, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Qualifiers

Qualifier	*Description*
DLDS	*Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.*
IB:INT	*Ion Balance Reviewed: Imbalance is due to interference or non-measured component.*
SFP	*Sample was filtered and preserved at the laboratory.*

Analytical Results

SK2101246-001

Sub-Matrix: **Water**
(Matrix: **Water**)

Client sample ID: 21-1
Client sampling date / time: 05-May-2021 12:00

Analyte	CAS Number	Result	Measurement Uncertainty	LOR	Unit	Method	Prep Date	Analysis Date	QCLot
Physical Tests									
hardness (as CaCO3), dissolved	----	2200	-	0.50	mg/L	EC100	-	10-May-2021	-
conductivity	----	3640	± 73.9	2.0	µS/cm	E100	05-May-2021	05-May-2021	191591
pH	----	7.68	± 0.04	0.10	pH units	E108	05-May-2021	05-May-2021	191590
alkalinity, bicarbonate (as HCO3)	71-52-3	389	-	1.0	mg/L	E290	05-May-2021	05-May-2021	191592
alkalinity, carbonate (as CO3)	3812-32-6	<1.0	-	1.0	mg/L	E290	05-May-2021	05-May-2021	191592
alkalinity, hydroxide (as OH)	14280-30-9	<1.0	-	1.0	mg/L	E290	05-May-2021	05-May-2021	191592
alkalinity, total (as CaCO3)	----	319	± 10.6	2.0	mg/L	E290	05-May-2021	05-May-2021	191592
solids, total dissolved [TDS], calculated	----	3400	-	1.0	mg/L	EC103	-	06-May-2021	-
Anions and Nutrients									
chloride	16887-00-6	24.7	± 1.12	10.0	mg/L	E235.Cl	05-May-2021	06-May-2021	191696
fluoride	16984-48-8	<0.400 DLDS	± 0.021	0.400	mg/L	E235.F	05-May-2021	06-May-2021	191692
nitrate (as N)	14797-55-8	7.07	± 0.228	0.400	mg/L	E235.NO3	05-May-2021	06-May-2021	191693
nitrite (as N)	14797-65-0	<0.200 DLDS	± 0.018	0.200	mg/L	E235.NO2	05-May-2021	06-May-2021	191694
sulfate (as SO4)	14808-79-8	2220	± 84.5	6.00	mg/L	E235.SO4	05-May-2021	06-May-2021	191695
nitrate + nitrite (as N)	----	7.07	-	0.447	mg/L	EC235.N+N	-	07-May-2021	-
Bacteriological Tests									
coliforms, thermotolerant [fecal]	----	12	-	1	MPN/100mL	E010.FC	-	05-May-2021	191754
coliforms, total	----	>2420	-	1	MPN/100mL	E010	-	05-May-2021	191763
coliforms, Escherichia coli [E. coli]	----	<1	-	1	MPN/100mL	E010	-	05-May-2021	191763
Ion Balance									
anion sum	----	53.8	-	0.10	meq/L	EC101	-	06-May-2021	-
cation sum	----	52.1	-	0.10	meq/L	EC101	-	06-May-2021	-
ion balance (cation-anion difference)	----	1.60	-	0.010	%	EC101	-	06-May-2021	-
ion balance (cations/anions ratio)	----	96.8	-	0.010	%	EC101	-	06-May-2021	-
Dissolved Metals									
calcium, dissolved	7440-70-2	466	± 42.9	0.100	mg/L	E421	06-May-2021	06-May-2021	192056
iron, dissolved	7439-89-6	<0.060 DLDS	± 0.006	0.060	mg/L	E421	06-May-2021	06-May-2021	192056
magnesium, dissolved	7439-95-4	251	± 23.1	0.0100	mg/L	E421	06-May-2021	06-May-2021	192056
manganese, dissolved	7439-96-5	1.70	± 0.132	0.0100	mg/L	E421	06-May-2021	06-May-2021	192056
potassium, dissolved	7440-09-7	16.3	± 1.44	0.100	mg/L	E421	06-May-2021	06-May-2021	192056
sodium, dissolved	17341-25-2	177	± 17.7	0.100	mg/L	E421	06-May-2021	06-May-2021	192056
dissolved metals filtration location	----	Laboratory SFP	-	-	-	EP421	-	06-May-2021	192056

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

SK2101246-002

Sub-Matrix: **Water**
(Matrix: **Water**)

Client sample ID: 21-2
Client sampling date / time: 05-May-2021 12:00

Analyte	CAS Number	Result	Measurement Uncertainty	LOR	Unit	Method	Prep Date	Analysis Date	QCLot
Physical Tests									
hardness (as CaCO3), dissolved	----	362	-	0.50	mg/L	EC100	-	10-May-2021	-
conductivity	----	747	± 16.0	2.0	µS/cm	E100	05-May-2021	05-May-2021	191591
pH	----	7.81	± 0.04	0.10	pH units	E108	05-May-2021	05-May-2021	191590
alkalinity, bicarbonate (as HCO3)	71-52-3	455	-	1.0	mg/L	E290	05-May-2021	05-May-2021	191592
alkalinity, carbonate (as CO3)	3812-32-6	<1.0	-	1.0	mg/L	E290	05-May-2021	05-May-2021	191592
alkalinity, hydroxide (as OH)	14280-30-9	<1.0	-	1.0	mg/L	E290	05-May-2021	05-May-2021	191592

Analytical Results

SK2101246-002

Sub-Matrix:**Water** *Client sample ID:* 21-2

(Matrix: **Water**) *Client sampling date / time:* 05-May-2021 12:00

Analyte	CAS Number	Result	Measurement Uncertainty	LOR	Unit	Method	Prep Date	Analysis Date	QCLot
Physical Tests									
alkalinity, total (as CaCO3)	----	373	± 12.3	2.0	mg/L	E290	05-May-2021	05-May-2021	191592
solids, total dissolved [TDS], calculated	----	435	-	1.0	mg/L	EC103	-	06-May-2021	-
Anions and Nutrients									
chloride	16887-00-6	3.77	± 0.21	0.50	mg/L	E235.Cl	05-May-2021	06-May-2021	191696
fluoride	16984-48-8	0.205	± 0.011	0.020	mg/L	E235.F	05-May-2021	06-May-2021	191692
nitrate (as N)	14797-55-8	0.878	± 0.030	0.020	mg/L	E235.NO3	05-May-2021	06-May-2021	191693
nitrite (as N)	14797-65-0	0.015	± 0.003	0.010	mg/L	E235.NO2	05-May-2021	06-May-2021	191694
sulfate (as SO4)	14808-79-8	30.7	± 1.19	0.30	mg/L	E235.SO4	05-May-2021	06-May-2021	191695
nitrate + nitrite (as N)	----	0.893	-	0.05	mg/L	EC235.N+N	-	07-May-2021	-
Ion Balance									
anion sum	----	8.27	-	0.10	meq/L	EC101	-	06-May-2021	-
cation sum	----	8.63	-	0.10	meq/L	EC101	-	06-May-2021	-
ion balance (cation-anion difference)	----	2.13	-	0.010	%	EC101	-	06-May-2021	-
ion balance (cations/anions ratio)	----	104	-	0.010	%	EC101	-	06-May-2021	-
Dissolved Metals									
calcium, dissolved	7440-70-2	75.5	± 6.95	0.050	mg/L	E421	06-May-2021	06-May-2021	192056
iron, dissolved	7439-89-6	<0.030	± 0.003	0.030	mg/L	E421	06-May-2021	06-May-2021	192056
magnesium, dissolved	7439-95-4	42.2	± 3.88	0.0050	mg/L	E421	06-May-2021	06-May-2021	192056
manganese, dissolved	7439-96-5	0.0163	± 0.00127	0.00500	mg/L	E421	06-May-2021	06-May-2021	192056
potassium, dissolved	7440-09-7	30.3	± 2.67	0.050	mg/L	E421	06-May-2021	06-May-2021	192056
sodium, dissolved	17341-25-2	14.2	± 1.43	0.050	mg/L	E421	06-May-2021	06-May-2021	192056
dissolved metals filtration location	----	Laboratory SFP	-	-	-	EP421	-	06-May-2021	192056

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

SK2101246-003

Sub-Matrix:**Water** *Client sample ID:* 21-5

(Matrix: **Water**) *Client sampling date / time:* 05-May-2021 12:00

Analyte	CAS Number	Result	Measurement Uncertainty	LOR	Unit	Method	Prep Date	Analysis Date	QCLot
Physical Tests									
hardness (as CaCO3), dissolved	----	215	-	0.50	mg/L	EC100	-	10-May-2021	-
conductivity	----	558	± 12.3	2.0	µS/cm	E100	05-May-2021	05-May-2021	191591
pH	----	8.08	± 0.04	0.10	pH units	E108	05-May-2021	05-May-2021	191590
alkalinity, bicarbonate (as HCO3)	71-52-3	326	-	1.0	mg/L	E290	05-May-2021	05-May-2021	191592
alkalinity, carbonate (as CO3)	3812-32-6	<1.0	-	1.0	mg/L	E290	05-May-2021	05-May-2021	191592
alkalinity, hydroxide (as OH)	14280-30-9	<1.0	-	1.0	mg/L	E290	05-May-2021	05-May-2021	191592
alkalinity, total (as CaCO3)	----	268	± 8.9	2.0	mg/L	E290	05-May-2021	05-May-2021	191592
solids, total dissolved [TDS], calculated	----	335	-	1.0	mg/L	EC103	-	06-May-2021	-
Anions and Nutrients									
chloride	16887-00-6	3.11	± 0.19	0.50	mg/L	E235.Cl	05-May-2021	06-May-2021	191696
fluoride	16984-48-8	0.211	± 0.011	0.020	mg/L	E235.F	05-May-2021	06-May-2021	191692
nitrate (as N)	14797-55-8	0.424	± 0.015	0.020	mg/L	E235.NO3	05-May-2021	06-May-2021	191693
nitrite (as N)	14797-65-0	<0.010	± 0.002	0.010	mg/L	E235.NO2	05-May-2021	06-May-2021	191694
sulfate (as SO4)	14808-79-8	40.7	± 1.57	0.30	mg/L	E235.SO4	05-May-2021	06-May-2021	191695
nitrate + nitrite (as N)	----	0.424	-	0.05	mg/L	EC235.N+N	-	07-May-2021	-
Ion Balance									

Analytical Results

SK2101246-003

Sub-Matrix:**Water** *Client sample ID:* 21-5

(Matrix: **Water**) *Client sampling date / time:* 05-May-2021 12:00

Analyte	CAS Number	Result	Measurement Uncertainty	LOR	Unit	Method	Prep Date	Analysis Date	QCLot
Ion Balance									
anion sum	----	6.33	-	0.10	meq/L	EC101	-	06-May-2021	-
cation sum	----	5.99	-	0.10	meq/L	EC101	-	06-May-2021	-
ion balance (cation-anion difference)	----	2.76	-	0.010	%	EC101	-	06-May-2021	-
ion balance (cations/anions ratio)	----	94.6	-	0.010	%	EC101	-	06-May-2021	-
Dissolved Metals									
calcium, dissolved	7440-70-2	53.8	± 4.95	0.050	mg/L	E421	06-May-2021	06-May-2021	192056
iron, dissolved	7439-89-6	<0.030	± 0.003	0.030	mg/L	E421	06-May-2021	06-May-2021	192056
magnesium, dissolved	7439-95-4	19.6	± 1.81	0.0050	mg/L	E421	06-May-2021	06-May-2021	192056
manganese, dissolved	7439-96-5	0.0149	± 0.00116	0.00500	mg/L	E421	06-May-2021	06-May-2021	192056
potassium, dissolved	7440-09-7	2.77	± 0.249	0.050	mg/L	E421	06-May-2021	06-May-2021	192056
sodium, dissolved	17341-25-2	37.2	± 3.72	0.050	mg/L	E421	06-May-2021	06-May-2021	192056
dissolved metals filtration location	----	Laboratory SFP	-	-	-	EP421	-	06-May-2021	192056

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

SK2101246-004

Sub-Matrix:**Water** *Client sample ID:* 21-8

(Matrix: **Water**) *Client sampling date / time:* 05-May-2021 12:00

Analyte	CAS Number	Result	Measurement Uncertainty	LOR	Unit	Method	Prep Date	Analysis Date	QCLot
Physical Tests									
hardness (as CaCO3), dissolved	----	335	-	0.50	mg/L	EC100	-	10-May-2021	-
conductivity	----	728	± 15.7	2.0	µS/cm	E100	05-May-2021	05-May-2021	191591
pH	----	7.79	± 0.04	0.10	pH units	E108	05-May-2021	05-May-2021	191590
alkalinity, bicarbonate (as HCO3)	71-52-3	263	-	1.0	mg/L	E290	05-May-2021	05-May-2021	191592
alkalinity, carbonate (as CO3)	3812-32-6	<1.0	-	1.0	mg/L	E290	05-May-2021	05-May-2021	191592
alkalinity, hydroxide (as OH)	14280-30-9	<1.0	-	1.0	mg/L	E290	05-May-2021	05-May-2021	191592
alkalinity, total (as CaCO3)	----	216	± 7.3	2.0	mg/L	E290	05-May-2021	05-May-2021	191592
solids, total dissolved [TDS], calculated	----	521	-	1.0	mg/L	EC103	-	06-May-2021	-
Anions and Nutrients									
chloride	16887-00-6	5.38	± 0.28	1.00	mg/L	E235.Cl	05-May-2021	06-May-2021	191696
fluoride	16984-48-8	0.124	± 0.007	0.040	mg/L	E235.F	05-May-2021	06-May-2021	191692
nitrate (as N)	14797-55-8	37.8	± 1.21	0.040	mg/L	E235.NO3	05-May-2021	06-May-2021	191693
nitrite (as N)	14797-65-0	0.173	± 0.016	0.020	mg/L	E235.NO2	05-May-2021	06-May-2021	191694
sulfate (as SO4)	14808-79-8	72.9	± 2.79	0.60	mg/L	E235.SO4	05-May-2021	06-May-2021	191695
nitrate + nitrite (as N)	----	38.0	-	0.05	mg/L	EC235.N+N	-	07-May-2021	-
Bacteriological Tests									
coliforms, thermotolerant [fecal]	----	10	-	1	MPN/100mL	E010.FC	-	05-May-2021	191754
coliforms, total	----	84	-	1	MPN/100mL	E010	-	05-May-2021	191763
coliforms, Escherichia coli [E. coli]	----	<1	-	1	MPN/100mL	E010	-	05-May-2021	191763
Ion Balance									
anion sum	----	8.70	-	0.10	meq/L	EC101	-	06-May-2021	-
cation sum	----	7.20	-	0.10	meq/L	EC101	-	06-May-2021	-
ion balance (cation-anion difference)	----	9.43	-	0.010	%	EC101	-	06-May-2021	-
ion balance (cations/anions ratio)	----	82.8	-	0.010	%	EC101	-	06-May-2021	-
Dissolved Metals									
calcium, dissolved	7440-70-2	95.7	± 8.80	0.050	mg/L	E421	06-May-2021	06-May-2021	192056

Analytical Results

SK2101246-004

Sub-Matrix:**Water** *Client sample ID:* 21-8

(Matrix: **Water**) *Client sampling date / time:* 05-May-2021 12:00

Analyte	CAS Number	Result	Measurement Uncertainty	LOR	Unit	Method	Prep Date	Analysis Date	QCLot
Dissolved Metals									
iron, dissolved	7439-89-6	<0.030	± 0.003	0.030	mg/L	E421	06-May-2021	06-May-2021	192056
magnesium, dissolved	7439-95-4	23.4	± 2.16	0.0050	mg/L	E421	06-May-2021	06-May-2021	192056
manganese, dissolved	7439-96-5	0.0366	± 0.00285	0.00500	mg/L	E421	06-May-2021	06-May-2021	192056
potassium, dissolved	7440-09-7	9.27	± 0.820	0.050	mg/L	E421	06-May-2021	06-May-2021	192056
sodium, dissolved	17341-25-2	6.06	± 0.614	0.050	mg/L	E421	06-May-2021	06-May-2021	192056
dissolved metals filtration location	----	Laboratory SFP	-	-	-	EP421	-	06-May-2021	192056

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

SK2101246-005

Sub-Matrix:**Water** *Client sample ID:* 21-10

(Matrix: **Water**) *Client sampling date / time:* 05-May-2021 12:00

Analyte	CAS Number	Result	Measurement Uncertainty	LOR	Unit	Method	Prep Date	Analysis Date	QCLot
Physical Tests									
hardness (as CaCO3), dissolved	----	314	-	0.50	mg/L	EC100	-	10-May-2021	-
conductivity	----	663	± 14.4	2.0	µS/cm	E100	05-May-2021	05-May-2021	191591
pH	----	8.11	± 0.04	0.10	pH units	E108	05-May-2021	05-May-2021	191590
alkalinity, bicarbonate (as HCO3)	71-52-3	434	-	1.0	mg/L	E290	05-May-2021	05-May-2021	191592
alkalinity, carbonate (as CO3)	3812-32-6	<1.0	-	1.0	mg/L	E290	05-May-2021	05-May-2021	191592
alkalinity, hydroxide (as OH)	14280-30-9	<1.0	-	1.0	mg/L	E290	05-May-2021	05-May-2021	191592
alkalinity, total (as CaCO3)	----	355	± 11.7	2.0	mg/L	E290	05-May-2021	05-May-2021	191592
solids, total dissolved [TDS], calculated	----	377	-	1.0	mg/L	EC103	-	06-May-2021	-
Anions and Nutrients									
chloride	16887-00-6	1.78	± 0.14	0.50	mg/L	E235.Cl	05-May-2021	06-May-2021	191696
fluoride	16984-48-8	0.391	± 0.021	0.020	mg/L	E235.F	05-May-2021	06-May-2021	191692
nitrate (as N)	14797-55-8	0.168	± 0.007	0.020	mg/L	E235.NO3	05-May-2021	06-May-2021	191693
nitrite (as N)	14797-65-0	<0.010	± 0.002	0.010	mg/L	E235.NO2	05-May-2021	06-May-2021	191694
sulfate (as SO4)	14808-79-8	25.4	± 0.99	0.30	mg/L	E235.SO4	05-May-2021	06-May-2021	191695
nitrate + nitrite (as N)	----	0.168	-	0.05	mg/L	EC235.N+N	-	07-May-2021	-
Ion Balance									
anion sum	----	7.70	-	0.10	meq/L	EC101	-	06-May-2021	-
cation sum	----	7.47	-	0.10	meq/L	EC101	-	06-May-2021	-
ion balance (cation-anion difference)	----	1.52	-	0.010	%	EC101	-	06-May-2021	-
ion balance (cations/anions ratio)	----	97.0	-	0.010	%	EC101	-	06-May-2021	-
Dissolved Metals									
calcium, dissolved	7440-70-2	46.5	± 4.28	0.050	mg/L	E421	06-May-2021	06-May-2021	192056
iron, dissolved	7439-89-6	<0.030	± 0.003	0.030	mg/L	E421	06-May-2021	06-May-2021	192056
magnesium, dissolved	7439-95-4	48.2	± 4.43	0.0050	mg/L	E421	06-May-2021	06-May-2021	192056
manganese, dissolved	7439-96-5	<0.00500	± 0.00039	0.00500	mg/L	E421	06-May-2021	06-May-2021	192056
potassium, dissolved	7440-09-7	3.40	± 0.304	0.050	mg/L	E421	06-May-2021	06-May-2021	192056
sodium, dissolved	17341-25-2	25.3	± 2.54	0.050	mg/L	E421	06-May-2021	06-May-2021	192056
dissolved metals filtration location	----	Laboratory SFP	-	-	-	EP421	-	06-May-2021	192056

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

SK2101246-006

Sub-Matrix:**Water** *Client sample ID:* 21-13

(Matrix: **Water**) *Client sampling date / time:* 05-May-2021 12:00

Analyte	CAS Number	Result	Measurement Uncertainty	LOR	Unit	Method	Prep Date	Analysis Date	QCLot
Physical Tests									
hardness (as CaCO3), dissolved	----	280	-	0.50	mg/L	EC100	-	10-May-2021	-
conductivity	----	592	± 13.0	2.0	µS/cm	E100	05-May-2021	05-May-2021	191591
pH	----	8.05	± 0.04	0.10	pH units	E108	05-May-2021	05-May-2021	191590
alkalinity, bicarbonate (as HCO3)	71-52-3	282	-	1.0	mg/L	E290	05-May-2021	05-May-2021	191592
alkalinity, carbonate (as CO3)	3812-32-6	<1.0	-	1.0	mg/L	E290	05-May-2021	05-May-2021	191592
alkalinity, hydroxide (as OH)	14280-30-9	<1.0	-	1.0	mg/L	E290	05-May-2021	05-May-2021	191592
alkalinity, total (as CaCO3)	----	231	± 7.8	2.0	mg/L	E290	05-May-2021	05-May-2021	191592
solids, total dissolved [TDS], calculated	----	346	-	1.0	mg/L	EC103	-	06-May-2021	-
Anions and Nutrients									
chloride	16887-00-6	3.94	± 0.22	0.50	mg/L	E235.Cl	05-May-2021	06-May-2021	191696
fluoride	16984-48-8	0.245	± 0.013	0.020	mg/L	E235.F	05-May-2021	06-May-2021	191692
nitrate (as N)	14797-55-8	7.68	± 0.247	0.020	mg/L	E235.NO3	05-May-2021	06-May-2021	191693
nitrite (as N)	14797-65-0	0.024	± 0.003	0.010	mg/L	E235.NO2	05-May-2021	06-May-2021	191694
sulfate (as SO4)	14808-79-8	53.2	± 2.04	0.30	mg/L	E235.SO4	05-May-2021	06-May-2021	191695
nitrate + nitrite (as N)	----	7.70	-	0.05	mg/L	EC235.N+N	-	07-May-2021	-
Ion Balance									
anion sum	----	6.40	-	0.10	meq/L	EC101	-	06-May-2021	-
cation sum	----	6.06	-	0.10	meq/L	EC101	-	06-May-2021	-
ion balance (cation-anion difference)	----	2.73	-	0.010	%	EC101	-	06-May-2021	-
ion balance (cations/anions ratio)	----	94.7	-	0.010	%	EC101	-	06-May-2021	-
Dissolved Metals									
calcium, dissolved	7440-70-2	62.7	± 5.77	0.050	mg/L	E421	06-May-2021	06-May-2021	192056
iron, dissolved	7439-89-6	<0.030	± 0.003	0.030	mg/L	E421	06-May-2021	06-May-2021	192056
magnesium, dissolved	7439-95-4	29.9	± 2.75	0.0050	mg/L	E421	06-May-2021	06-May-2021	192056
manganese, dissolved	7439-96-5	0.0706	± 0.00551	0.00500	mg/L	E421	06-May-2021	06-May-2021	192056
potassium, dissolved	7440-09-7	2.88	± 0.258	0.050	mg/L	E421	06-May-2021	06-May-2021	192056
sodium, dissolved	17341-25-2	9.02	± 0.911	0.050	mg/L	E421	06-May-2021	06-May-2021	192056
dissolved metals filtration location	----	Laboratory SFP	-	-	-	EP421	-	06-May-2021	192056

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

SK2101246-007

Sub-Matrix:**Water** *Client sample ID:* 21-15

(Matrix: **Water**) *Client sampling date / time:* 05-May-2021 12:00

Analyte	CAS Number	Result	Measurement Uncertainty	LOR	Unit	Method	Prep Date	Analysis Date	QCLot
Physical Tests									
hardness (as CaCO3), dissolved	----	370	-	0.50	mg/L	EC100	-	10-May-2021	-
conductivity	----	789	± 16.9	2.0	µS/cm	E100	05-May-2021	05-May-2021	191591
pH	----	7.98	± 0.04	0.10	pH units	E108	05-May-2021	05-May-2021	191590
alkalinity, bicarbonate (as HCO3)	71-52-3	316	-	1.0	mg/L	E290	05-May-2021	05-May-2021	191592
alkalinity, carbonate (as CO3)	3812-32-6	<1.0	-	1.0	mg/L	E290	05-May-2021	05-May-2021	191592
alkalinity, hydroxide (as OH)	14280-30-9	<1.0	-	1.0	mg/L	E290	05-May-2021	05-May-2021	191592
alkalinity, total (as CaCO3)	----	259	± 8.6	2.0	mg/L	E290	05-May-2021	05-May-2021	191592
solids, total dissolved [TDS], calculated	----	488	-	1.0	mg/L	EC103	-	06-May-2021	-
Anions and Nutrients									
chloride	16887-00-6	8.64	± 0.42	0.50	mg/L	E235.Cl	05-May-2021	06-May-2021	191696

Analytical Results

SK2101246-007

Sub-Matrix:**Water** *Client sample ID:* 21-15

(Matrix: **Water**) *Client sampling date / time:* 05-May-2021 12:00

Analyte	CAS Number	Result	Measurement Uncertainty	LOR	Unit	Method	Prep Date	Analysis Date	QCLot
Anions and Nutrients									
fluoride	16984-48-8	0.216	± 0.012	0.020	mg/L	E235.F	05-May-2021	06-May-2021	191692
nitrate (as N)	14797-55-8	19.0	± 0.611	0.020	mg/L	E235.NO3	05-May-2021	06-May-2021	191693
nitrite (as N)	14797-65-0	0.011	± 0.002	0.010	mg/L	E235.NO2	05-May-2021	06-May-2021	191694
sulfate (as SO4)	14808-79-8	77.6	± 2.97	0.30	mg/L	E235.SO4	05-May-2021	06-May-2021	191695
nitrate + nitrite (as N)	----	19.0	-	0.05	mg/L	EC235.N+N	-	07-May-2021	-
Ion Balance									
anion sum	----	8.40	-	0.10	meq/L	EC101	-	06-May-2021	-
cation sum	----	8.18	-	0.10	meq/L	EC101	-	06-May-2021	-
ion balance (cation-anion difference)	----	1.33	-	0.010	%	EC101	-	06-May-2021	-
ion balance (cations/anions ratio)	----	97.4	-	0.010	%	EC101	-	06-May-2021	-
Dissolved Metals									
calcium, dissolved	7440-70-2	99.1	± 9.12	0.050	mg/L	E421	06-May-2021	06-May-2021	192056
iron, dissolved	7439-89-6	<0.030	± 0.003	0.030	mg/L	E421	06-May-2021	06-May-2021	192056
magnesium, dissolved	7439-95-4	29.9	± 2.76	0.0050	mg/L	E421	06-May-2021	06-May-2021	192056
manganese, dissolved	7439-96-5	0.0111	± 0.00087	0.00500	mg/L	E421	06-May-2021	06-May-2021	192056
potassium, dissolved	7440-09-7	1.92	± 0.174	0.050	mg/L	E421	06-May-2021	06-May-2021	192056
sodium, dissolved	17341-25-2	16.6	± 1.67	0.050	mg/L	E421	06-May-2021	06-May-2021	192056
dissolved metals filtration location	----	Laboratory SFP.	-	-	-	EP421	-	06-May-2021	192056

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

SK2101246-008

Sub-Matrix:**Water** *Client sample ID:* 21-16

(Matrix: **Water**) *Client sampling date / time:* 05-May-2021 12:00

Analyte	CAS Number	Result	Measurement Uncertainty	LOR	Unit	Method	Prep Date	Analysis Date	QCLot
Physical Tests									
hardness (as CaCO3), dissolved	----	321	-	0.50	mg/L	EC100	-	10-May-2021	-
conductivity	----	722	± 15.6	2.0	µS/cm	E100	05-May-2021	05-May-2021	191591
pH	----	8.00	± 0.04	0.10	pH units	E108	05-May-2021	05-May-2021	191590
alkalinity, bicarbonate (as HCO3)	71-52-3	244	-	1.0	mg/L	E290	05-May-2021	05-May-2021	191592
alkalinity, carbonate (as CO3)	3812-32-6	<1.0	-	1.0	mg/L	E290	05-May-2021	05-May-2021	191592
alkalinity, hydroxide (as OH)	14280-30-9	<1.0	-	1.0	mg/L	E290	05-May-2021	05-May-2021	191592
alkalinity, total (as CaCO3)	----	200	± 6.8	2.0	mg/L	E290	05-May-2021	05-May-2021	191592
solids, total dissolved [TDS], calculated	----	511	-	1.0	mg/L	EC103	-	06-May-2021	-
Anions and Nutrients									
chloride	16887-00-6	8.71	± 0.42	1.00	mg/L	E235.Cl	05-May-2021	06-May-2021	191696
fluoride	16984-48-8	0.273	± 0.014	0.040	mg/L	E235.F	05-May-2021	06-May-2021	191692
nitrate (as N)	14797-55-8	38.0	± 1.22	0.040	mg/L	E235.NO3	05-May-2021	06-May-2021	191693
nitrite (as N)	14797-65-0	0.060	± 0.006	0.020	mg/L	E235.NO2	05-May-2021	06-May-2021	191694
sulfate (as SO4)	14808-79-8	69.4	± 2.66	0.60	mg/L	E235.SO4	05-May-2021	06-May-2021	191695
nitrate + nitrite (as N)	----	38.1	-	0.05	mg/L	EC235.N+N	-	07-May-2021	-
Bacteriological Tests									
coliforms, thermotolerant [fecal]	----	9	-	1	MPN/100mL	E010.FC	-	05-May-2021	191754
coliforms, total	----	3	-	1	MPN/100mL	E010	-	05-May-2021	191763
coliforms, Escherichia coli [E. coli]	----	<1	-	1	MPN/100mL	E010	-	05-May-2021	191763
Ion Balance									

Analytical Results

SK2101246-008

Sub-Matrix:**Water** *Client sample ID:* 21-16

(Matrix: **Water**) *Client sampling date / time:* 05-May-2021 12:00

Analyte	CAS Number	Result	Measurement Uncertainty	LOR	Unit	Method	Prep Date	Analysis Date	QCLot
Ion Balance									
anion sum	----	8.42	-	0.10	meq/L	EC101	-	06-May-2021	-
cation sum	----	6.98	-	0.10	meq/L	EC101	-	06-May-2021	-
ion balance (cation-anion difference)	----	9.35 IB:INT.	-	0.010	%	EC101	-	06-May-2021	-
ion balance (cations/anions ratio)	----	82.9 IB:INT.	-	0.010	%	EC101	-	06-May-2021	-
Dissolved Metals									
calcium, dissolved	7440-70-2	86.5	± 7.96	0.050	mg/L	E421	06-May-2021	06-May-2021	192056
iron, dissolved	7439-89-6	<0.030	± 0.003	0.030	mg/L	E421	06-May-2021	06-May-2021	192056
magnesium, dissolved	7439-95-4	25.6	± 2.35	0.0050	mg/L	E421	06-May-2021	06-May-2021	192056
manganese, dissolved	7439-96-5	0.0121	± 0.00094	0.00500	mg/L	E421	06-May-2021	06-May-2021	192056
potassium, dissolved	7440-09-7	3.72	± 0.332	0.050	mg/L	E421	06-May-2021	06-May-2021	192056
sodium, dissolved	17341-25-2	10.6	± 1.07	0.050	mg/L	E421	06-May-2021	06-May-2021	192056
dissolved metals filtration location	----	Laboratory SFP.	-	-	-	EP421	-	06-May-2021	192056

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

SK2101246-009

Sub-Matrix:**Water** *Client sample ID:* 21-21A

(Matrix: **Water**) *Client sampling date / time:* 05-May-2021 12:00

Analyte	CAS Number	Result	Measurement Uncertainty	LOR	Unit	Method	Prep Date	Analysis Date	QCLot
Physical Tests									
hardness (as CaCO3), dissolved	----	243	-	0.50	mg/L	EC100	-	10-May-2021	-
conductivity	----	529	± 11.7	2.0	µS/cm	E100	05-May-2021	05-May-2021	191591
pH	----	8.00	± 0.04	0.10	pH units	E108	05-May-2021	05-May-2021	191590
alkalinity, bicarbonate (as HCO3)	71-52-3	243	-	1.0	mg/L	E290	05-May-2021	05-May-2021	191592
alkalinity, carbonate (as CO3)	3812-32-6	<1.0	-	1.0	mg/L	E290	05-May-2021	05-May-2021	191592
alkalinity, hydroxide (as OH)	14280-30-9	<1.0	-	1.0	mg/L	E290	05-May-2021	05-May-2021	191592
alkalinity, total (as CaCO3)	----	199	± 6.8	2.0	mg/L	E290	05-May-2021	05-May-2021	191592
solids, total dissolved [TDS], calculated	----	318	-	1.0	mg/L	EC103	-	06-May-2021	-
Anions and Nutrients									
chloride	16887-00-6	11.2	± 0.53	0.50	mg/L	E235.Cl	05-May-2021	06-May-2021	191696
fluoride	16984-48-8	0.225	± 0.012	0.020	mg/L	E235.F	05-May-2021	06-May-2021	191692
nitrate (as N)	14797-55-8	1.80	± 0.059	0.020	mg/L	E235.NO3	05-May-2021	06-May-2021	191693
nitrite (as N)	14797-65-0	0.014	± 0.003	0.010	mg/L	E235.NO2	05-May-2021	06-May-2021	191694
sulfate (as SO4)	14808-79-8	60.8	± 2.33	0.30	mg/L	E235.SO4	05-May-2021	06-May-2021	191695
nitrate + nitrite (as N)	----	1.81	-	0.05	mg/L	EC235.N+N	-	07-May-2021	-
Bacteriological Tests									
coliforms, thermotolerant [fecal]	----	1	-	1	MPN/100mL	E010.FC	-	05-May-2021	191754
coliforms, total	----	3	-	1	MPN/100mL	E010	-	05-May-2021	191763
coliforms, Escherichia coli [E. coli]	----	<1	-	1	MPN/100mL	E010	-	05-May-2021	191763
Ion Balance									
anion sum	----	5.70	-	0.10	meq/L	EC101	-	06-May-2021	-
cation sum	----	5.28	-	0.10	meq/L	EC101	-	06-May-2021	-
ion balance (cation-anion difference)	----	3.82	-	0.010	%	EC101	-	06-May-2021	-
ion balance (cations/anions ratio)	----	92.6	-	0.010	%	EC101	-	06-May-2021	-
Dissolved Metals									
calcium, dissolved	7440-70-2	67.9	± 6.25	0.050	mg/L	E421	06-May-2021	06-May-2021	192056

Analytical Results

SK2101246-009

Sub-Matrix:**Water** *Client sample ID:* 21-21A

(Matrix: **Water**) *Client sampling date / time:* 05-May-2021 12:00

Analyte	CAS Number	Result	Measurement Uncertainty	LOR	Unit	Method	Prep Date	Analysis Date	QCLot
Dissolved Metals									
iron, dissolved	7439-89-6	<0.030	± 0.003	0.030	mg/L	E421	06-May-2021	06-May-2021	192056
magnesium, dissolved	7439-95-4	17.8	± 1.64	0.0050	mg/L	E421	06-May-2021	06-May-2021	192056
manganese, dissolved	7439-96-5	0.362	± 0.0282	0.00500	mg/L	E421	06-May-2021	06-May-2021	192056
potassium, dissolved	7440-09-7	2.94	± 0.263	0.050	mg/L	E421	06-May-2021	06-May-2021	192056
sodium, dissolved	17341-25-2	7.79	± 0.787	0.050	mg/L	E421	06-May-2021	06-May-2021	192056
dissolved metals filtration location	----	Laboratory SFP	-	-	-	EP421	-	06-May-2021	192056

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

SK2101246-010

Sub-Matrix:**Water** *Client sample ID:* 21-21B

(Matrix: **Water**) *Client sampling date / time:* 05-May-2021 12:00

Analyte	CAS Number	Result	Measurement Uncertainty	LOR	Unit	Method	Prep Date	Analysis Date	QCLot
Physical Tests									
hardness (as CaCO3), dissolved	----	163	-	0.50	mg/L	EC100	-	10-May-2021	-
conductivity	----	365	± 8.4	2.0	µS/cm	E100	05-May-2021	05-May-2021	191591
pH	----	8.10	± 0.04	0.10	pH units	E108	05-May-2021	05-May-2021	191590
alkalinity, bicarbonate (as HCO3)	71-52-3	157	-	1.0	mg/L	E290	05-May-2021	05-May-2021	191592
alkalinity, carbonate (as CO3)	3812-32-6	<1.0	-	1.0	mg/L	E290	05-May-2021	05-May-2021	191592
alkalinity, hydroxide (as OH)	14280-30-9	<1.0	-	1.0	mg/L	E290	05-May-2021	05-May-2021	191592
alkalinity, total (as CaCO3)	----	129	± 4.5	2.0	mg/L	E290	05-May-2021	05-May-2021	191592
solids, total dissolved [TDS], calculated	----	220	-	1.0	mg/L	EC103	-	06-May-2021	-
Anions and Nutrients									
chloride	16887-00-6	4.89	± 0.26	0.50	mg/L	E235.Cl	05-May-2021	06-May-2021	191696
fluoride	16984-48-8	0.218	± 0.012	0.020	mg/L	E235.F	05-May-2021	06-May-2021	191692
nitrate (as N)	14797-55-8	0.334	± 0.012	0.020	mg/L	E235.NO3	05-May-2021	06-May-2021	191693
nitrite (as N)	14797-65-0	<0.010	± 0.002	0.010	mg/L	E235.NO2	05-May-2021	06-May-2021	191694
sulfate (as SO4)	14808-79-8	52.8	± 2.03	0.30	mg/L	E235.SO4	05-May-2021	06-May-2021	191695
nitrate + nitrite (as N)	----	0.334	-	0.05	mg/L	EC235.N+N	-	07-May-2021	-
Bacteriological Tests									
coliforms, thermotolerant [fecal]	----	<1	-	1	MPN/100mL	E010.FC	-	05-May-2021	191754
coliforms, total	----	<1	-	1	MPN/100mL	E010	-	05-May-2021	191763
coliforms, Escherichia coli [E. coli]	----	<1	-	1	MPN/100mL	E010	-	05-May-2021	191763
Ion Balance									
anion sum	----	3.85	-	0.10	meq/L	EC101	-	06-May-2021	-
cation sum	----	3.56	-	0.10	meq/L	EC101	-	06-May-2021	-
ion balance (cation-anion difference)	----	3.91	-	0.010	%	EC101	-	06-May-2021	-
ion balance (cations/anions ratio)	----	92.5	-	0.010	%	EC101	-	06-May-2021	-
Dissolved Metals									
calcium, dissolved	7440-70-2	45.1	± 4.15	0.050	mg/L	E421	06-May-2021	06-May-2021	192056
iron, dissolved	7439-89-6	<0.030	± 0.003	0.030	mg/L	E421	06-May-2021	06-May-2021	192056
magnesium, dissolved	7439-95-4	12.2	± 1.13	0.0050	mg/L	E421	06-May-2021	06-May-2021	192056
manganese, dissolved	7439-96-5	0.237	± 0.0185	0.00500	mg/L	E421	06-May-2021	06-May-2021	192056
potassium, dissolved	7440-09-7	2.18	± 0.197	0.050	mg/L	E421	06-May-2021	06-May-2021	192056
sodium, dissolved	17341-25-2	5.62	± 0.571	0.050	mg/L	E421	06-May-2021	06-May-2021	192056
dissolved metals filtration location	----	Laboratory SFP	-	-	-	EP421	-	06-May-2021	192056

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

SK2101246-011

Sub-Matrix:**Water** *Client sample ID:* 21-22

(Matrix: **Water**) *Client sampling date / time:* 05-May-2021 12:00

Analyte	CAS Number	Result	Measurement Uncertainty	LOR	Unit	Method	Prep Date	Analysis Date	QCLot
Physical Tests									
hardness (as CaCO3), dissolved	----	309	-	0.50	mg/L	EC100	-	10-May-2021	-
conductivity	----	637	± 13.8	2.0	µS/cm	E100	05-May-2021	05-May-2021	191591
pH	----	8.05	± 0.04	0.10	pH units	E108	05-May-2021	05-May-2021	191590
alkalinity, bicarbonate (as HCO3)	71-52-3	306	-	1.0	mg/L	E290	05-May-2021	05-May-2021	191592
alkalinity, carbonate (as CO3)	3812-32-6	<1.0	-	1.0	mg/L	E290	05-May-2021	05-May-2021	191592
alkalinity, hydroxide (as OH)	14280-30-9	<1.0	-	1.0	mg/L	E290	05-May-2021	05-May-2021	191592
alkalinity, total (as CaCO3)	----	251	± 8.4	2.0	mg/L	E290	05-May-2021	05-May-2021	191592
solids, total dissolved [TDS], calculated	----	376	-	1.0	mg/L	EC103	-	06-May-2021	-
Anions and Nutrients									
chloride	16887-00-6	6.06	± 0.31	0.50	mg/L	E235.Cl	05-May-2021	06-May-2021	191696
fluoride	16984-48-8	0.310	± 0.016	0.020	mg/L	E235.F	05-May-2021	06-May-2021	191692
nitrate (as N)	14797-55-8	14.6	± 0.469	0.020	mg/L	E235.NO3	05-May-2021	06-May-2021	191693
nitrite (as N)	14797-65-0	0.019	± 0.003	0.010	mg/L	E235.NO2	05-May-2021	06-May-2021	191694
sulfate (as SO4)	14808-79-8	26.1	± 1.02	0.30	mg/L	E235.SO4	05-May-2021	06-May-2021	191695
nitrate + nitrite (as N)	----	14.6	-	0.05	mg/L	EC235.N+N	-	07-May-2021	-
Bacteriological Tests									
coliforms, thermotolerant [fecal]	----	1	-	1	MPN/100mL	E010.FC	-	05-May-2021	191754
coliforms, total	----	127	-	1	MPN/100mL	E010	-	05-May-2021	191763
coliforms, Escherichia coli [E. coli]	----	<1	-	1	MPN/100mL	E010	-	05-May-2021	191763
Ion Balance									
anion sum	----	6.79	-	0.10	meq/L	EC101	-	06-May-2021	-
cation sum	----	6.65	-	0.10	meq/L	EC101	-	06-May-2021	-
ion balance (cation-anion difference)	----	1.04	-	0.010	%	EC101	-	06-May-2021	-
ion balance (cations/anions ratio)	----	97.9	-	0.010	%	EC101	-	06-May-2021	-
Dissolved Metals									
calcium, dissolved	7440-70-2	71.8	± 6.61	0.050	mg/L	E421	06-May-2021	06-May-2021	192056
iron, dissolved	7439-89-6	<0.030	± 0.003	0.030	mg/L	E421	06-May-2021	06-May-2021	192056
magnesium, dissolved	7439-95-4	31.6	± 2.91	0.0050	mg/L	E421	06-May-2021	06-May-2021	192056
manganese, dissolved	7439-96-5	0.00574	± 0.00045	0.00500	mg/L	E421	06-May-2021	06-May-2021	192056
potassium, dissolved	7440-09-7	3.31	± 0.296	0.050	mg/L	E421	06-May-2021	06-May-2021	192056
sodium, dissolved	17341-25-2	8.85	± 0.894	0.050	mg/L	E421	06-May-2021	06-May-2021	192056
dissolved metals filtration location	----	Laboratory SFP	-	-	-	EP421	-	06-May-2021	192056

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

SK2101246-012

Sub-Matrix:**Water** *Client sample ID:* 21-24

(Matrix: **Water**) *Client sampling date / time:* 05-May-2021 12:00

Analyte	CAS Number	Result	Measurement Uncertainty	LOR	Unit	Method	Prep Date	Analysis Date	QCLot
Physical Tests									
hardness (as CaCO3), dissolved	----	387	-	0.50	mg/L	EC100	-	10-May-2021	-
conductivity	----	860	± 18.3	2.0	µS/cm	E100	05-May-2021	05-May-2021	191591
pH	----	8.02	± 0.04	0.10	pH units	E108	05-May-2021	05-May-2021	191590
alkalinity, bicarbonate (as HCO3)	71-52-3	407	-	1.0	mg/L	E290	05-May-2021	05-May-2021	191592

Analytical Results

SK2101246-012

Sub-Matrix:**Water** *Client sample ID:* 21-24

(Matrix: **Water**) *Client sampling date / time:* 05-May-2021 12:00

Analyte	CAS Number	Result	Measurement Uncertainty	LOR	Unit	Method	Prep Date	Analysis Date	QCLot
Physical Tests									
alkalinity, carbonate (as CO3)	3812-32-6	<1.0	-	1.0	mg/L	E290	05-May-2021	05-May-2021	191592
alkalinity, hydroxide (as OH)	14280-30-9	<1.0	-	1.0	mg/L	E290	05-May-2021	05-May-2021	191592
alkalinity, total (as CaCO3)	----	334	± 11.0	2.0	mg/L	E290	05-May-2021	05-May-2021	191592
solids, total dissolved [TDS], calculated	----	523	-	1.0	mg/L	EC103	-	06-May-2021	-
Anions and Nutrients									
chloride	16887-00-6	19.2	± 0.88	0.50	mg/L	E235.Cl	05-May-2021	06-May-2021	191696
fluoride	16984-48-8	0.175	± 0.010	0.020	mg/L	E235.F	05-May-2021	06-May-2021	191692
nitrate (as N)	14797-55-8	13.7	± 0.440	0.020	mg/L	E235.NO3	05-May-2021	06-May-2021	191693
nitrite (as N)	14797-65-0	0.070	± 0.007	0.010	mg/L	E235.NO2	05-May-2021	06-May-2021	191694
sulfate (as SO4)	14808-79-8	58.1	± 2.23	0.30	mg/L	E235.SO4	05-May-2021	06-May-2021	191695
nitrate + nitrite (as N)	----	13.8	-	0.05	mg/L	EC235.N+N	-	07-May-2021	-
Ion Balance									
anion sum	----	9.42	-	0.10	meq/L	EC101	-	06-May-2021	-
cation sum	----	9.02	-	0.10	meq/L	EC101	-	06-May-2021	-
ion balance (cation-anion difference)	----	2.17	-	0.010	%	EC101	-	06-May-2021	-
ion balance (cations/anions ratio)	----	95.8	-	0.010	%	EC101	-	06-May-2021	-
Dissolved Metals									
calcium, dissolved	7440-70-2	102	± 9.36	0.050	mg/L	E421	06-May-2021	06-May-2021	192056
iron, dissolved	7439-89-6	<0.030	± 0.003	0.030	mg/L	E421	06-May-2021	06-May-2021	192056
magnesium, dissolved	7439-95-4	32.2	± 2.97	0.0050	mg/L	E421	06-May-2021	06-May-2021	192056
manganese, dissolved	7439-96-5	0.0899	± 0.00701	0.00500	mg/L	E421	06-May-2021	06-May-2021	192056
potassium, dissolved	7440-09-7	6.82	± 0.605	0.050	mg/L	E421	06-May-2021	06-May-2021	192056
sodium, dissolved	17341-25-2	25.5	± 2.56	0.050	mg/L	E421	06-May-2021	06-May-2021	192056
dissolved metals filtration location	----	Laboratory SFP	-	-	-	EP421	-	06-May-2021	192056

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

SK2101246-013

Sub-Matrix:**Water** *Client sample ID:* 21-26

(Matrix: **Water**) *Client sampling date / time:* 05-May-2021 12:00

Analyte	CAS Number	Result	Measurement Uncertainty	LOR	Unit	Method	Prep Date	Analysis Date	QCLot
Physical Tests									
hardness (as CaCO3), dissolved	----	498	-	0.50	mg/L	EC100	-	10-May-2021	-
conductivity	----	1010	± 21.4	2.0	µS/cm	E100	05-May-2021	05-May-2021	191591
pH	----	8.10	± 0.04	0.10	pH units	E108	05-May-2021	05-May-2021	191590
alkalinity, bicarbonate (as HCO3)	71-52-3	532	-	1.0	mg/L	E290	05-May-2021	05-May-2021	191592
alkalinity, carbonate (as CO3)	3812-32-6	<1.0	-	1.0	mg/L	E290	05-May-2021	05-May-2021	191592
alkalinity, hydroxide (as OH)	14280-30-9	<1.0	-	1.0	mg/L	E290	05-May-2021	05-May-2021	191592
alkalinity, total (as CaCO3)	----	436	± 14.3	2.0	mg/L	E290	05-May-2021	05-May-2021	191592
solids, total dissolved [TDS], calculated	----	625	-	1.0	mg/L	EC103	-	06-May-2021	-
Anions and Nutrients									
chloride	16887-00-6	2.43	± 0.16	1.00	mg/L	E235.Cl	05-May-2021	06-May-2021	191696
fluoride	16984-48-8	0.476	± 0.025	0.040	mg/L	E235.F	05-May-2021	06-May-2021	191692
nitrate (as N)	14797-55-8	24.2	± 0.775	0.040	mg/L	E235.NO3	05-May-2021	06-May-2021	191693
nitrite (as N)	14797-65-0	0.114	± 0.011	0.020	mg/L	E235.NO2	05-May-2021	06-May-2021	191694
sulfate (as SO4)	14808-79-8	47.0	± 1.81	0.60	mg/L	E235.SO4	05-May-2021	06-May-2021	191695

Analytical Results

SK2101246-013

Sub-Matrix: **Water**
(Matrix: **Water**)

Client sample ID: 21-26
Client sampling date / time: 05-May-2021 12:00

Analyte	CAS Number	Result	Measurement Uncertainty	LOR	Unit	Method	Prep Date	Analysis Date	QCLot
Anions and Nutrients									
nitrate + nitrite (as N)	----	24.3	-	0.05	mg/L	EC235.N+N	-	07-May-2021	-
Ion Balance									
anion sum	----	11.5	-	0.10	meq/L	EC101	-	06-May-2021	-
cation sum	----	11.7	-	0.10	meq/L	EC101	-	06-May-2021	-
ion balance (cation-anion difference)	----	0.862	-	0.010	%	EC101	-	06-May-2021	-
ion balance (cations/anions ratio)	----	102	-	0.010	%	EC101	-	06-May-2021	-
Dissolved Metals									
calcium, dissolved	7440-70-2	67.3	± 6.19	0.050	mg/L	E421	06-May-2021	06-May-2021	192056
iron, dissolved	7439-89-6	<0.030	± 0.003	0.030	mg/L	E421	06-May-2021	06-May-2021	192056
magnesium, dissolved	7439-95-4	80.1	± 7.37	0.0050	mg/L	E421	06-May-2021	06-May-2021	192056
manganese, dissolved	7439-96-5	0.128	± 0.00996	0.00500	mg/L	E421	06-May-2021	06-May-2021	192056
potassium, dissolved	7440-09-7	9.28	± 0.821	0.050	mg/L	E421	06-May-2021	06-May-2021	192056
sodium, dissolved	17341-25-2	35.1	± 3.52	0.050	mg/L	E421	06-May-2021	06-May-2021	192056
dissolved metals filtration location	----	Laboratory SFP	-	-	-	EP421	-	06-May-2021	192056

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

SK2101246-014

Sub-Matrix: **Water**
(Matrix: **Water**)

Client sample ID: 21-28
Client sampling date / time: 05-May-2021 12:00

Analyte	CAS Number	Result	Measurement Uncertainty	LOR	Unit	Method	Prep Date	Analysis Date	QCLot
Physical Tests									
hardness (as CaCO3), dissolved	----	257	-	0.50	mg/L	EC100	-	10-May-2021	-
conductivity	----	625	± 13.6	2.0	µS/cm	E100	05-May-2021	05-May-2021	191591
pH	----	7.92	± 0.04	0.10	pH units	E108	05-May-2021	05-May-2021	191590
alkalinity, bicarbonate (as HCO3)	71-52-3	258	-	1.0	mg/L	E290	05-May-2021	05-May-2021	191592
alkalinity, carbonate (as CO3)	3812-32-6	<1.0	-	1.0	mg/L	E290	05-May-2021	05-May-2021	191592
alkalinity, hydroxide (as OH)	14280-30-9	<1.0	-	1.0	mg/L	E290	05-May-2021	05-May-2021	191592
alkalinity, total (as CaCO3)	----	211	± 7.1	2.0	mg/L	E290	05-May-2021	05-May-2021	191592
solids, total dissolved [TDS], calculated	----	377	-	1.0	mg/L	EC103	-	06-May-2021	-
Anions and Nutrients									
chloride	16887-00-6	24.0	± 1.09	0.50	mg/L	E235.Cl	05-May-2021	06-May-2021	191696
fluoride	16984-48-8	0.473	± 0.025	0.020	mg/L	E235.F	05-May-2021	06-May-2021	191692
nitrate (as N)	14797-55-8	0.050	± 0.004	0.020	mg/L	E235.NO3	05-May-2021	06-May-2021	191693
nitrite (as N)	14797-65-0	<0.010	± 0.002	0.010	mg/L	E235.NO2	05-May-2021	06-May-2021	191694
sulfate (as SO4)	14808-79-8	81.9	± 3.13	0.30	mg/L	E235.SO4	05-May-2021	06-May-2021	191695
nitrate + nitrite (as N)	----	0.0500	-	0.05	mg/L	EC235.N+N	-	07-May-2021	-
Bacteriological Tests									
coliforms, thermotolerant [fecal]	----	1	-	1	MPN/100mL	E010.FC	-	05-May-2021	191754
coliforms, total	----	1	-	1	MPN/100mL	E010	-	05-May-2021	191763
coliforms, Escherichia coli [E. coli]	----	<1	-	1	MPN/100mL	E010	-	05-May-2021	191763
Ion Balance									
anion sum	----	6.63	-	0.10	meq/L	EC101	-	06-May-2021	-
cation sum	----	6.30	-	0.10	meq/L	EC101	-	06-May-2021	-
ion balance (cation-anion difference)	----	2.55	-	0.010	%	EC101	-	06-May-2021	-
ion balance (cations/anions ratio)	----	95.0	-	0.010	%	EC101	-	06-May-2021	-

Analytical Results

SK2101246-014

Sub-Matrix:**Water** *Client sample ID:* 21-28

(Matrix: **Water**) *Client sampling date / time:* 05-May-2021 12:00

Analyte	CAS Number	Result	Measurement Uncertainty	LOR	Unit	Method	Prep Date	Analysis Date	QCLot
Dissolved Metals									
calcium, dissolved	7440-70-2	73.2	± 6.73	0.050	mg/L	E421	06-May-2021	06-May-2021	192056
iron, dissolved	7439-89-6	<0.030	± 0.003	0.030	mg/L	E421	06-May-2021	06-May-2021	192056
magnesium, dissolved	7439-95-4	18.0	± 1.66	0.0050	mg/L	E421	06-May-2021	06-May-2021	192056
manganese, dissolved	7439-96-5	0.558	± 0.0435	0.00500	mg/L	E421	06-May-2021	06-May-2021	192056
potassium, dissolved	7440-09-7	3.87	± 0.346	0.050	mg/L	E421	06-May-2021	06-May-2021	192056
sodium, dissolved	17341-25-2	24.2	± 2.43	0.050	mg/L	E421	06-May-2021	06-May-2021	192056
dissolved metals filtration location	----	Laboratory SFP	-	-	-	EP421	-	06-May-2021	192056

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

SK2101246-015

Sub-Matrix:**Water** *Client sample ID:* 17788-1

(Matrix: **Water**) *Client sampling date / time:* 05-May-2021 12:00

Analyte	CAS Number	Result	Measurement Uncertainty	LOR	Unit	Method	Prep Date	Analysis Date	QCLot
Physical Tests									
hardness (as CaCO3), dissolved	----	218	-	0.50	mg/L	EC100	-	10-May-2021	-
conductivity	----	560	± 12.3	2.0	µS/cm	E100	05-May-2021	05-May-2021	191591
pH	----	8.13	± 0.04	0.10	pH units	E108	05-May-2021	05-May-2021	191590
alkalinity, bicarbonate (as HCO3)	71-52-3	324	-	1.0	mg/L	E290	05-May-2021	05-May-2021	191592
alkalinity, carbonate (as CO3)	3812-32-6	<1.0	-	1.0	mg/L	E290	05-May-2021	05-May-2021	191592
alkalinity, hydroxide (as OH)	14280-30-9	<1.0	-	1.0	mg/L	E290	05-May-2021	05-May-2021	191592
alkalinity, total (as CaCO3)	----	265	± 8.9	2.0	mg/L	E290	05-May-2021	05-May-2021	191592
solids, total dissolved [TDS], calculated	----	334	-	1.0	mg/L	EC103	-	06-May-2021	-
Anions and Nutrients									
chloride	16887-00-6	3.03	± 0.18	0.50	mg/L	E235.Cl	05-May-2021	06-May-2021	191696
fluoride	16984-48-8	0.227	± 0.012	0.020	mg/L	E235.F	05-May-2021	06-May-2021	191692
nitrate (as N)	14797-55-8	0.425	± 0.015	0.020	mg/L	E235.NO3	05-May-2021	06-May-2021	191693
nitrite (as N)	14797-65-0	<0.010	± 0.002	0.010	mg/L	E235.NO2	05-May-2021	06-May-2021	191694
sulfate (as SO4)	14808-79-8	41.1	± 1.58	0.30	mg/L	E235.SO4	05-May-2021	06-May-2021	191695
nitrate + nitrite (as N)	----	0.425	-	0.05	mg/L	EC235.N+N	-	07-May-2021	-
Ion Balance									
anion sum	----	6.28	-	0.10	meq/L	EC101	-	06-May-2021	-
cation sum	----	6.04	-	0.10	meq/L	EC101	-	06-May-2021	-
ion balance (cation-anion difference)	----	1.95	-	0.010	%	EC101	-	06-May-2021	-
ion balance (cations/anions ratio)	----	96.2	-	0.010	%	EC101	-	06-May-2021	-
Dissolved Metals									
calcium, dissolved	7440-70-2	53.5	± 4.92	0.050	mg/L	E421	06-May-2021	06-May-2021	192056
iron, dissolved	7439-89-6	<0.030	± 0.003	0.030	mg/L	E421	06-May-2021	06-May-2021	192056
magnesium, dissolved	7439-95-4	20.5	± 1.88	0.0050	mg/L	E421	06-May-2021	06-May-2021	192056
manganese, dissolved	7439-96-5	0.0152	± 0.00118	0.00500	mg/L	E421	06-May-2021	06-May-2021	192056
potassium, dissolved	7440-09-7	2.89	± 0.260	0.050	mg/L	E421	06-May-2021	06-May-2021	192056
sodium, dissolved	17341-25-2	37.1	± 3.71	0.050	mg/L	E421	06-May-2021	06-May-2021	192056
dissolved metals filtration location	----	Laboratory SFP	-	-	-	EP421	-	06-May-2021	192056

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

SK2101246-016

Sub-Matrix:**Water**
(Matrix: **Water**)

Client sample ID: 17788-2 -
Client sampling date / time: 05-May-2021 12:00

Analyte	CAS Number	Result	Measurement Uncertainty	LOR	Unit	Method	Prep Date	Analysis Date	QCLot
Physical Tests									
hardness (as CaCO3), dissolved	----	246	-	0.50	mg/L	EC100	-	10-May-2021	-
conductivity	----	531	± 11.7	2.0	µS/cm	E100	06-May-2021	06-May-2021	192049
pH	----	8.05	± 0.04	0.10	pH units	E108	06-May-2021	06-May-2021	192048
alkalinity, bicarbonate (as HCO3)	71-52-3	244	-	1.0	mg/L	E290	06-May-2021	06-May-2021	192047
alkalinity, carbonate (as CO3)	3812-32-6	<1.0	-	1.0	mg/L	E290	06-May-2021	06-May-2021	192047
alkalinity, hydroxide (as OH)	14280-30-9	<1.0	-	1.0	mg/L	E290	06-May-2021	06-May-2021	192047
alkalinity, total (as CaCO3)	----	200	± 6.8	2.0	mg/L	E290	06-May-2021	06-May-2021	192047
solids, total dissolved [TDS], calculated	----	322	-	1.0	mg/L	EC103	-	06-May-2021	-
Anions and Nutrients									
chloride	16887-00-6	11.4	± 0.54	0.50	mg/L	E235.Cl	05-May-2021	05-May-2021	191723
fluoride	16984-48-8	0.227	± 0.012	0.020	mg/L	E235.F	05-May-2021	05-May-2021	191720
nitrate (as N)	14797-55-8	1.83	± 0.060	0.020	mg/L	E235.NO3	05-May-2021	05-May-2021	191724
nitrite (as N)	14797-65-0	0.019	± 0.003	0.010	mg/L	E235.NO2	05-May-2021	05-May-2021	191721
sulfate (as SO4)	14808-79-8	61.7	± 2.37	0.30	mg/L	E235.SO4	05-May-2021	05-May-2021	191722
nitrate + nitrite (as N)	----	1.85	-	0.05	mg/L	EC235.N+N	-	11-May-2021	-
Bacteriological Tests									
coliforms, thermotolerant [fecal]	----	5	-	1	MPN/100mL	E010.FC	-	05-May-2021	191754
coliforms, total	----	3	-	1	MPN/100mL	E010	-	05-May-2021	191763
coliforms, Escherichia coli [E. coli]	----	<1	-	1	MPN/100mL	E010	-	05-May-2021	191763
Ion Balance									
anion sum	----	5.75	-	0.10	meq/L	EC101	-	06-May-2021	-
cation sum	----	5.34	-	0.10	meq/L	EC101	-	06-May-2021	-
ion balance (cation-anion difference)	----	3.70	-	0.010	%	EC101	-	06-May-2021	-
ion balance (cations/anions ratio)	----	92.9	-	0.010	%	EC101	-	06-May-2021	-
Dissolved Metals									
calcium, dissolved	7440-70-2	68.4	± 6.29	0.050	mg/L	E421	06-May-2021	06-May-2021	192056
iron, dissolved	7439-89-6	<0.030	± 0.003	0.030	mg/L	E421	06-May-2021	06-May-2021	192056
magnesium, dissolved	7439-95-4	18.2	± 1.67	0.0050	mg/L	E421	06-May-2021	06-May-2021	192056
manganese, dissolved	7439-96-5	0.359	± 0.0280	0.00500	mg/L	E421	06-May-2021	06-May-2021	192056
potassium, dissolved	7440-09-7	3.08	± 0.276	0.050	mg/L	E421	06-May-2021	06-May-2021	192056
sodium, dissolved	17341-25-2	7.72	± 0.781	0.050	mg/L	E421	06-May-2021	06-May-2021	192056
dissolved metals filtration location	----	Laboratory SFP	-	-	-	EP421	-	06-May-2021	192056

Please refer to the General Comments section for an explanation of any qualifiers detected.

APPENDIX F

Nitrate Assessment Model
Results

Washington State Department of Health

Project name:	**Hydrogeological Investigation**
Address, city and county:	**SE-24-35-5-W3M and NE-13-35-5-W3M, Near Saskatoon, SK**
Completed by (name and title):	**P. Machibroda Engineering Ltd.**
Date:	**January 2022**

Input Values	Factor	Units	Values	Information Source
Nitrate concentration in precipitation	N_R	mg/L as N	1	Default
Total nitrogen concentration in wastewater	N_W	mg/L	19.0	Median value for Ecoflo Coco Filter ECDn Model or equivalent
Soil denitrification	d	unitless	0	Default
Aquifer thickness	b	m	6.1	Default or aquifer thickness if known
Drainfield area	A_D	m^2	600	Primary drainfield area
Distance from edge of drainfield to $N_{10mg/L\ conc.}$	$D_{10\ mg/L\ conc.}$	m	220	Measure in direction of GW flow
Aquifer width	W_A	m	30	Perpendicular to GW flow
Aquifer hydraulic conductivity	K	m/day	7.3E-02	Average measured conductivity
Aquifer hydraulic conductivity	K	m/s	8.5E-07	
Hydraulic gradient	i	m/m	0.0009	Measured on May 5, 2021
Recharge	R	mm/yr	53	15% of Annual Precipitation
Nitrate concentration of upgradient groundwater	N_B	mg/L	10.5	Average measured concentration
Wastewater volume	V_W	L/day	1022	
Output Values				
Groundwater nitrate value	N_{GW}	mg/L as N	18	Edge of Drainfield
Groundwater nitrate value	$N_{10\ mg/L\ conc.}$	mg/L as N	9.87	Distance from Edge of Drainfield

Washington State Department of Health

Project name:	**Hydrogeological Investigation**
Address, city and county:	**SE-24-35-5-W3M and NE-13-35-5-W3M, Near Saskatoon, SK**
Completed by (name and title):	**P. Machibroda Engineering Ltd.**
Date:	**January 2022**

Input Values	Factor	Units	Values	Information Source
Nitrate concentration in precipitation	N_R	mg/L as N	1	Default
Total nitrogen concentration in wastewater	N_W	mg/L	9.0	Median value for Bio-Microbics BioBarrier N MBR or equivalent
Soil denitrification	d	unitless	0	Default
Aquifer thickness	b	m	6.1	Default or aquifer thickness if known
Drainfield area	A_D	m^2	400	Primary drainfield area
Distance from edge of drainfield to $N_{10mg/L\ conc.}$	$D_{10\ mg/L\ conc.}$	m	5	Measure in direction of GW flow
Aquifer width	W_A	m	20	Perpendicular to GW flow
Aquifer hydraulic conductivity	K	m/day	7.3E-02	Average measured conductivity
Aquifer hydraulic conductivity	K	m/s	8.5E-07	
Hydraulic gradient	i	m/m	0.0009	Measured on May 5, 2021
Recharge	R	mm/yr	53	15% of Annual Precipitation
Nitrate concentration of upgradient groundwater	N_B	mg/L	10.5	Average measured concentration
Wastewater volume	V_W	L/day	1022	
Output Values				
Groundwater nitrate value	N_{GW}	mg/L as N	9	Edge of Drainfield
Groundwater nitrate value	$N_{10\ mg/L\ conc.}$	mg/L as N	8.48	Distance from Edge of Drainfield

Cumulative Nitrate Assessment - Illinois State Model (Wehrman, 1983)

This spreadsheet is based on the Wehrman (1983) mass balance dilution model for a representative elementary volume. This model is used to determine the number of systems that can be accomodated over the area of the proposed subdivision whilst mainting the required dilution of nitrate to below the referecnced endpoints at the downgradient boundary. Therefore, the aquifer width entered should be the distance across the entire parcel of land that is to be subdivided. Dilution is provided by rainwater, groundwater recharge, and septic effluent. Nitrates are added to the system

Analyzed By: **Arjun Paul**
Analysis Date: **January, 2022**

Scenario: Average K, average gradient, fully developed site, standard OWTS (50 mg/L), average background nitrate concentration

Mass (M_b) of nitrate (as N) in groundwater entering the property from upgradient background area

$$V_b = KiA$$

V_b (m^3) volume of groundwater entering the property from upgradient background location
K (m/s) hydraulic conductivity of the aquifer
I (m/m) hydraulic gradient
A (m^2) cross sectional area perpendicular to the GW flow direction entering from area upgradient of the site

$$A = W_P l$$

W_P (m) width of the property being assessed perpendicular to the GW flow direction
D_A (m) depth of the aquifer where mixing takes place. This is the actual thickness or 20 feet (WDOH, 2009) whichever is less.

$$M_b = V_b C$$

Input Parameters		Assumptions
K (m/s)	8.50E-07	Assumed to represent average hydraulic conductivity at the site
K (m/day)	7.34E-02	
W_P (m)	1,790	Maximum distance of a line drawn through the subdivision perpendicular to the direction of groundwater flow
W_P (ft)	5,873	
D_A (m)	6.1	The aquifer thickness estimated from drilling on site is more than the maximum depth stated by WDOH (2009), therefore 20 feet is used as aquifer thickness.
D_A (ft)	20.0	
A (m^2)	10,919	Flow recharge area
i (m/m)	0.0009	Average hydraulic gradient measured on site on May 5, 2021.
V_b (m^3/s)	8.35E-06	
V_b (Lpd)	721.7	
V_b (gpd)	190.7	
C_b (mg/L)	10.5	Assumed to be average background nitrate concentration.
M_b (mg)	7,578	Mass of nitrate entering the property from upgradient background water

Mass (M_i) of nitrate (as N) in precipitation entering the groundwater zone

$$V_i = A_i R_i$$

V_i (m^3/s)	Volume of precipitation entering the groundwater zone
A_i (m^2)	Area of the rainfall infiltration surface
R_i (m/s)	Rainfall infiltrating and recharging the underlying groundwater zone

$$M_i = V_i C_i$$

C_i (mg/L)	Concentration of nitrate (as N) in precipitation

Input Parameters		Assumptions
A_i (acres)	316	Assume that the entire subdivision is available for infiltration
Fr	1.00	Default to 1. Wehrman (1983) does not consider pervious/impervious area in the calculation
A_i (m^2)	1,278,808	
R_i (mm/year)	350	Average annual precipitation for the area
R_i (mm/year)	53	Assumed that 15% of the annual precipitation would infiltrate into the underlying soils.
R_i (m/day)	0.00014	
R_i (in/year)	2	
V_i (m^3/day)	184	
V_i (Lpd)	183,938	
V_i (gpd)	48,588	
C_i (mg/L)	1	Use 1 mg/L as specified by Wehrman (1983) . Default value from WDOH (2009) is 0.24 mg/L.
M_i (mg)	183,938.10	

Mass (M_s) volume of septic effluent entering the property from the septic system

$$V_s = PH$$

V_s (m^3/s)	Total volume of wastewater generated from the development
Q_P (m^3/s)	Average per capita waste water volumes
P	number of people per household
H	lot density

$$M_S = V_S C_S$$

C_s (mg/L)	Concentration of nitrate (as N) in wastewater

Input Parameters		Assumptions
# Bedrooms per lot	3	Assume average home has 3 bedrooms
# of persons per bedroom	1.5	Use 1.5 persons per bedroom for 3 bedroom house based on GOV (2018) guidance document
Number of people per home	4.5	
Q_P (Lpd)	227.0	Use the average daily wastewater volumes (227L/person/day) from GOV (2018) guidance document
# Lots	114	Equivalent # of lots based on 96 residential lots, 4 commercial lots
H (homes/acre)	0.36	
V_s (Lpd)	116,451	
V_s (gpd)	30,763	
V_s (gpd) - Formula Check	30,763	
C_s (mg/L)	50.0	Assumed to represent standard OWTS nitrate concentration
M_s (mg)	5,822,550	

Mass (M_p) of groundwater removed due to water well withdrawal

$$V_P = V_S$$

V_P (m^3/s) — Total volume water removed from the aquifer due to pumping from water wells. Wehrman (1983) assumes that this is equal to V_s as it is assumed that groundwater well withdrawal is non-consumptive

$$M_P = V_P C_i$$

C_P = (C_b + C_o)/2 — Concentration of nitrate in water being removed by pumping. Wehrman (1983) assumes that this is the average nitrate concentration in background groundwater and the water exiting the property

Concentration (C_o) of nitrate (as N) in groundwater exiting the property

Including Pumping	Excluding Pumping
$C_o = \frac{V_i C_i + V_S C_S + (V_b - V_s/2) C_b}{(V_b + V_i + V_s)}$ $\quad C_o = \frac{M_b + M_i + M_S - M_P}{(V_b + V_i + V_s - V_P)}$	$C_o = \frac{V_b C_b + V_i C_i + V_s C_s}{(V_b + V_i + V_s)}$ $\quad C_o = \frac{M_b + M_i + M_S}{(V_b + V_i + V_s)}$

Variable Summary

Volumes

V_b (Lpd)	722
V_i (Lpd)	183,938
V_s (Lpd)	116,451

Concentrations

C_b (mg/L)	11
C_i (mg/L)	1.00
C_s (mg/L)	50

Mass

M_b (mg)	7,578
M_i (mg)	183,938
M_s (mg)	5,822,550

Concentration of nitrate (as N) exiting the property or subdivision.

C_o (mg/L) **20.0** **Excluding pumping**

Cumulative Nitrate Assessment - Illinois State Model (Wehrman, 1983)

This spreadsheet is based on the Wehrman (1983) mass balance dilution model for a representative elementary volume. This model is used to determine the number of systems that can be accomodated over the area of the proposed subdivision whilst mainting the required dilution of nitrate to below the referecnced endpoints at the downgradient boundary. Therefore, the aquifer width entered should be the distance across the entire parcel of land that is to be subdivided. Dilution is provided by rainwater, groundwater recharge, and septic effluent. Nitrates are added to the system

Analyzed By: **Arjun Paul**
Analysis Date: **January, 2022**

Scenario: Maximum K, average gradient, fully developed site, advanced OWTS (19 mg/L), maximum measured background nitrate concentration

Mass (M_b) of nitrate (as N) in groundwater entering the property from upgradient background area

$$V_b = KiA$$

V_b (m^3) volume of groundwater entering the property from upgradient background location
K (m/s) hydraulic conductivity of the aquifer
I (m/m) hydraulic gradient
A (m^2) cross sectional area perpendicular to the GW flow direction entering from area upgradient of the site

$$A = W_P l$$

W_P (m) width of the property being assessed perpendicular to the GW flow direction
D_A (m) depth of the aquifer where mixing takes place. This is the actual thickness or 20 feet (WDOH, 2009) whichever is less.

$$M_b = V_b C$$

Input Parameters		Assumptions
K (m/s)	2.00E-06	Maximum conductivity value measured on site (Borehole Nos. 21-22 and 21-28).
K (m/day)	1.73E-01	
W_P (m)	1,790	Maximum distance of a line drawn through the subdivision perpendicular to the direction of groundwater flow.
W_P (ft)	5,873	
D_A (m)	6.1	The aquifer thickness estimated from drilling on site is more than the maximum depth stated by WDOH (2009), therefore 20 feet is used as aquifer thickness.
D_A (ft)	20.0	
A (m^2)	10,919	Flow recharge area.
i (m/m)	0.0009	Average hydraulic gradient measured on site on May 5, 2021.
V_b (m^3/s)	1.97E-05	
V_b (Lpd)	1,698.1	
V_b (gpd)	448.6	
C_b (mg/L)	38.0	Maximum measured value at the site (Borehole No. 21-16).
M_b (mg)	64,529	Mass of nitrate entering the property from upgradient background water

Mass (M_i) of nitrate (as N) in precipitation entering the groundwater zone

$$V_i = A_i R_i$$

V_i (m^3/s)	Volume of precipitation entering the groundwater zone
A_i (m^2)	Area of the rainfall infiltration surface
R_i (m/s)	Rainfall infiltrating and recharging the underlying groundwater zone

$$M_i = V_i C_i$$

C_i (mg/L)	Concentration of nitrate (as N) in precipitation

Input Parameters		Assumptions
A_i (acres)	316	Assume that the entire subdivision is available for infiltration
Fr	1.00	Default to 1. Wehrman (1983) does not consider pervious/impervious area in the calculation
A_i (m^2)	1,278,808	
R_i (mm/year)	350	Average annual precipitation for the area
R_i (mm/year)	53	Assumed that 15% of the annual precipitation would infiltrate into the underlying soils.
R_i (m/day)	0.00014	
R_i (in/year)	2	
V_i (m^3/day)	184	
V_i (Lpd)	183,938	
V_i (gpd)	48,588	
C_i (mg/L)	1	Use 1 mg/L as specified by Wehrman (1983) . Default value from WDOH (2009) is 0.24 mg/L.
M_i (mg)	183,938.10	

Mass (M_s) volume of septic effluent entering the property from the septic system

$$V_s = PH$$

V_s (m^3/s)	Total volume of wastewater generated from the development
Q_P (m^3/s)	Average per capita waste water volumes
P	number of people per household
H	lot density

$$M_S = V_S C_S$$

C_s (mg/L)	Concentration of nitrate (as N) in wastewater

Input Parameters		Assumptions
# Bedrooms per lot	3	Assume average home has 3 bedrooms
# of persons per bedroom	1.5	Use 1.5 persons per bedroom for 3 bedroom house based on GOV (2018) guidance document
Number of people per home	4.5	
Q_P (Lpd)	227.0	Use the average daily wastewater volumes (227L/person/day) from GOV (2018) guidance document
# Lots	114	Equivalent # of lots based on 96 residential lots, 4 commercial lots
H (homes/acre)	0.36	
V_s (Lpd)	116,451	
V_s (gpd)	30,763	
V_s (gpd) - Formula Check	30,763	
C_s (mg/L)	19.00	Assume 19 mg/L based on the assumption that some type of advanced treatment system will be used.
M_s (mg)	2,212,569	

Mass (M_p) of groundwater removed due to water well withdrawal

$$V_P = V_S$$

V_P (m^3/s) — Total volume water removed from the aquifer due to pumping from water wells. Wehrman (1983) assumes that this is equal to V_s as it is assumed that groundwater well withdrawal is non-consumptive

$$M_P = V_P C_i$$

C_P = (C_b + C_o)/2 — Concentration of nitrate in water being removed by pumping. Wehrman (1983) assumes that this is the average nitrate concentration in background groundwater and the water exiting the property

Concentration (C_o) of nitrate (as N) in groundwater exiting the property

Including Pumping		Excluding Pumping	
$C_o = \frac{V_i C_i + V_S C_S + (V_b - V_s/2) C_b}{(V_b + V_i + V_s)}$	$C_o = \frac{M_b + M_i + M_S - M_P}{(V_b + V_i + V_s - V_P)}$	$C_o = \frac{V_b C_b + V_i C_i + V_s C_s}{(V_b + V_i + V_s)}$	$C_o = \frac{M_b + M_i + M_S}{(V_b + V_i + V_s)}$

Variable Summary

Volumes

V_b (Lpd)	1,698
V_i (Lpd)	183,938
V_s (Lpd)	116,451

Concentrations

C_b (mg/L)	38
C_i (mg/L)	1.00
C_s (mg/L)	19

Mass

M_b (mg)	64,529
M_i (mg)	183,938
M_s (mg)	2,212,569

Concentration of nitrate (as N) exiting the property or subdivision.

C_o (mg/L) **8.1** **Excluding pumping**

Cumulative Nitrate Assessment - Illinois State Model (Wehrman, 1983)

This spreadsheet is based on the Wehrman (1983) mass balance dilution model for a representative elementary volume. This model is used to determine the number of systems that can be accomodated over the area of the proposed subdivision whilst mainting the required dilution of nitrate to below the referecnced endpoints at the downgradient boundary. Therefore, the aquifer width entered should be the distance across the entire parcel of land that is to be subdivided. Dilution is provided by rainwater, groundwater recharge, and septic effluent. Nitrates are added to the system

Analyzed By: **Arjun Paul**
Analysis Date: **January, 2022**

Scenario: Minimum K, average gradient, fully developed site, advanced OWTS (9 mg/L), minimum measured background nitrate concentration.

Mass (M_b) of nitrate (as N) in groundwater entering the property from upgradient background area

$$V_b = KiA$$

V_b (m^3)	volume of groundwater entering the property from upgradient background location
K (m/s)	hydraulic conductivity of the aquifer
I (m/m)	hydraulic gradient
A (m^2)	cross sectional area perpendicular to the GW flow direction entering from area upgradient of the site

$$A = W_P l$$

W_P (m)	width of the property being assessed perpendicular to the GW flow direction
D_A (m)	depth of the aquifer where mixing takes place. This is the actual thickness or 20 feet (WDOH, 2009) whichever is less.

$$M_b = V_b C$$

Input Parameters		Assumptions
K (m/s)	4.00E-08	Minimum conductivity value measured on site (Borehole Nos. 21-1A and 21-16).
K (m/day)	3.46E-03	
W_P (m)	1,790	Maximum distance of a line drawn through the subdivision perpendicular to the direction of groundwater flow.
W_P (ft)	5,873	
D_A (m)	6.1	The aquifer thickness estimated from drilling on site is more than the maximum depth stated by WDOH (2009), therefore 20 feet is used as aquifer thickness.
D_A (ft)	20.0	
A (m^2)	10,919	Flow recharge area.
i (m/m)	0.0009	Average hydraulic gradient measured on site on May 5, 2021.
V_b (m^3/s)	3.93E-07	
V_b (Lpd)	34.0	
V_b (gpd)	9.0	
C_b (mg/L)	0.05	Minimum measured value at the site (Borehole No. 21-28).
M_b (mg)	2	Mass of nitrate entering the property from upgradient background water

Mass (M_i) of nitrate (as N) in precipitation entering the groundwater zone

$$V_i = A_i R_i$$

V_i (m^3/s)	Volume of precipitation entering the groundwater zone
A_i (m^2)	Area of the rainfall infiltration surface
R_i (m/s)	Rainfall infiltrating and recharging the underlying groundwater zone

$$M_i = V_i C_i$$

C_i (mg/L)	Concentration of nitrate (as N) in precipitation

Input Parameters		Assumptions
A_i (acres)	316	Assume that the entire subdivision is available for infiltration
Fr	1.00	Default to 1. Wehrman (1983) does not consider pervious/impervious area in the calculation
A_i (m^2)	1,280,022	
R_i (mm/year)	350	Average annual precipitation for the area
R_i (mm/year)	53	Assumed that 15% of the annual precipitation would infiltrate into the underlying soils.
R_i (m/day)	0.00014	
R_i (in/year)	2	
V_i (m^3/day)	184	
V_i (Lpd)	184,113	
V_i (gpd)	48,634	
C_i (mg/L)	1	Use 1 mg/L as specified by Wehrman (1983) . Default value from WDOH (2009) is 0.24 mg/L.
M_i (mg)	184,112.73	

Mass (M_s) volume of septic effluent entering the property from the septic system

$$V_s = PH$$

V_s (m^3/s)	Total volume of wastewater generated from the development
Q_P (m^3/s)	Average per capita waste water volumes
P	number of people per household
H	lot density

$$M_S = V_S C_S$$

C_s (mg/L)	Concentration of nitrate (as N) in wastewater

Input Parameters		Assumptions
# Bedrooms per lot	3	Assume average home has 3 bedrooms
# of persons per bedroom	1.5	Use 1.5 persons per bedroom for 3 bedroom house based on GOV (2018) guidance document
Number of people per home	4.5	
Q_P (Lpd)	227.0	Use the average daily wastewater volumes (227L/person/day) from GOV (2018) guidance document
# Lots	114	Equivalent # of lots based on 96 residential lots, 4 commercial lots
H (homes/acre)	0.36	
V_s (Lpd)	116,451	
V_s (gpd)	30,763	
V_s (gpd) - Formula Check	30,763	
C_s (mg/L)	9.00	Assume 9 mg/L based on the assumption that some type of advanced treatment system will be used.
M_s (mg)	1,048,059	

Mass (M_p) of groundwater removed due to water well withdrawal

$$V_P = V_S$$

V_P (m^3/s) — Total volume water removed from the aquifer due to pumping from water wells. Wehrman (1983) assumes that this is equal to V_s as it is assumed that groundwater well withdrawal is non-consumptive

$$M_P = V_P C_i$$

C_P = (C_b + C_o)/2 — Concentration of nitrate in water being removed by pumping. Wehrman (1983) assumes that this is the average nitrate concentration in background groundwater and the water exiting the property

Concentration (C_o) of nitrate (as N) in groundwater exiting the property

Including Pumping	Excluding Pumping
$C_o = \frac{V_i C_i + V_S C_S + (V_b - V_s/2) C_b}{(V_b + V_i + V_s)}$ $\quad C_o = \frac{M_b + M_i + M_S - M_P}{(V_b + V_i + V_s - V_P)}$	$C_o = \frac{V_b C_b + V_i C_i + V_s C_s}{(V_b + V_i + V_s)}$ $\quad C_o = \frac{M_b + M_i + M_S}{(V_b + V_i + V_s)}$

Variable Summary

Volumes		Concentrations	
V_b (Lpd)	34	**C_b** (mg/L)	0
V_i (Lpd)	184,113	**C_i** (mg/L)	1.00
V_s (Lpd)	116,451	**C_s** (mg/L)	9

Mass	
M_b (mg)	2
M_i (mg)	184,113
M_s (mg)	1,048,059

Concentration of nitrate (as N) exiting the property or subdivision.

C_o (mg/L) **4.1** **Excluding pumping**

P.MACHIBRODA
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December 1, 2022

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RE: SUPPLEMENTAL INFORMATION
HYDROGEOLOGICAL INVESTIGATION
PROPOSED GREENVIEW ESTATES SUBDIVISION
SE-24-35-5-W3M AND NE-13-35-5-W3M
NEAR SASKATOON, SASKATCHEWAN
PMEL FILE NO. 17788

INTRODUCTION

This letter was prepared by P. Machibroda Engineering Ltd. (PMEL) to address comments and provide supplemental information in response to your email on November 10, 2022.

RESPONSE

1. ***An inventory of Onsite Wastewater Treatment System (OWTS) was deemed not necessary in the report, …..***

PMEL agrees that the Government of Saskatchewan (2012) Guidance Document states that a door-to-door inventory of wells should be included in the field program for a Level 2 Assessment. In that regard an inventory of registered water wells and houses was compiled based on a review of the Rural Municipality (RM) of Corman Park No. 344 Map, the Saskatchewan Water Security Agency (WSA) Groundwater Well Database (WSA, 2022) and ISC (Land Titles) for wells located within 1 km of the site. A summary of this additional information is presented in Table I.

TABLE I: INVENTORY OF WATER WELLS AND EXISTING HOUSES

Land Location	No. of Water Wells	No. of Existing Houses	Home Owners/Remarks
NW-24-35-05-W3M	6	1	Only one house is located within 1 km of the site is shown on the RM Map. The property where the house is located is owned by Yuguang, Xiang and Dandan Bai.
SW-24-35-05-W3M	3	2	Two houses are shown on the RM Map to be located within 1 km of the site. The properties where the houses are located are owned by: - Erwin Boehmier & Tricia Carter - Frederick & Susanne Johnson
SE-13-35-05-W3M	4	2	- Two houses are located on this quarter section within 1 km of the site. This property is owned by Brent & Neil Bly.
SW-18-35-04-W3M	0	2	- Two houses are located on this quarter section within 1 km of the site. This property is owned by Clement Farms Inc.
NW-18-35-04-W3M	1	0	- No houses are shown on the RM Map for this property
SW-19-35-04-W3M	5	2	- Two houses appear to be located on this quarter section - The properties on which The houses are located are owned by: Brenda Hagel Barry & Kim Poletz
NW-19-35-04-W3M	1	0	- This property is owned by 102001142 SK Ltd.
NE-19-35-04-W3M	2	1	- One house is located on this quarter section within 1 km of the site. This property is owned by Marian Janzen

Source: https://rmcormanpark.ca/DocumentCenter/View/1357/General-RM-344-Map (Accessed November, 2022)
https://gis.wsask.ca/Html5Viewer/index.html?viewer=WaterWells.WellsViewer/ (Accessed November, 2022)
https://www.isc.ca/SignedInHome/Pages/QuickSearch.aspx (Accessed November, 2022)

TABLE I: INVENTORY OF WATER WELLS AND EXISTING HOUSES - CONTINUED

Land Location	No. of Water Wells	No. of Existing Houses	Home Owners/Remarks
NE-19-35-04-W3M	2	1	- One house is located on this quarter section within 1 km of the site. This property is owned by Marian Janzen
SE-25-35-05-W3M	4	4	- Louis Oscar Piche and Diane J Piche - Jacquelyn Ann Bly - Darren Edward Bly - Elmer & Agnes Hyde
NE-23-35-05-W3M	5	1	- No houses appear to be located within 1 km of the site. As such it is unlikely that any of the 5 wells are located within 1 km of the site.
SE-23-35-05-W3M	3	2	- Two houses appear to be located on this quarter section - The properties on which the houses are located are owned by: Henry & Laura Dutka Jordan & Shannon Bindle
SE-14-35-05-W3M	2	2	- Two houses appear to be located on this quarter section - The properties on which the houses are located are owned by: Nicholas Dzus Blair & Jillian Holtsman
NE-11-35-05-W3M	2	1	- One house is located on this quarter section within 1 km of the site. This property is owned by Kim and Troy Lafreniere
NE-12-35-05-W3M	1	0	- No houses are located on this quarter section within 1 km of the site.
NW-12-35-05-W3M	3	2	- Two houses appear to be located on this quarter section - The properties on which The houses are located are owned by: George & Anne Musgrove Jared & Cassandra Cowen
NW-07-35-04-W3M	0	1	- One house is located on this quarter section within 1 km of the site. This property is owned by Cheryl & Don Hrapchack

Source: https://rmcormanpark.ca/DocumentCenter/View/1357/General-RM-344-Map (Accessed November, 2022)
https://gis.wsask.ca/Html5Viewer/index.html?viewer=WaterWells.WellsViewer/ (Accessed November, 2022)
https://www.isc.ca/SignedInHome/Pages/QuickSearch.aspx (Accessed November, 2022)

Examination of Table I revealed that a total of 44 water wells and 25 houses are located within a radius of approximately 1 km from the site boundaries. A review of Google Earth (November 2022) revealed that at least 5 more houses could be located within approximately 1 km of the northwest corner of the site. However, these houses were not shown on the RM Map.

Based on the May 5, 2021 groundwater monitoring results, the shallow groundwater at the site is flowing towards the southeast (approximately 100° from north) at an average gradient of 0.0009. Review of the results presented in Table I indicated that seven (7) houses and at least 13 registered wells are located with 1 km to the southeast of the site.

It is proposed to install advance treatment OWTS that discharge a nitrate effluent with a concentration of less than 10 mg/L at the property boundary. As mentioned in the Hydrogeological Investigation Report prepared by PMEL (File No. 17788 dated May 4, 2022), the following options should be considered:

- **Lots where the OWTS would be constructed within 220 m of the property boundary:** an advanced package treatment system meeting or exceeding NSF-40, NSF245, and NSF-350 standards (i.e., Bio-Microbics BioBarrier-N MBR or equivalent) with an average effluent nitrate concentration of less than or equal to 9 mg/L.
- **Lots where the OWTS would be constructed greater than 220 m from the property boundary:** an advanced package treatment system meeting or exceeding NSF-40 and NSF-245 standards (i.e., Ecoflo Coco Filter ECDn Model or equivalent) with an average effluent nitrate concentration of less than or equal to 19 mg/L.

If failure of all of the OWTS occurred at once and released an effluent concentration of 20 mg/L, the predicted cumulative nitrate concentration for the entire site would be less than 10 mg/L. Based on the above it was concluded that a field inventory of OWTS and water wells within 1 km of proposed subdivision are not deemed necessary for this site.

2. Monitoring well information was deemed as not needed in part due to the advanced treatment systems ….

As mentioned in the previous section, even if the highly unlikely failure of all the OWTS occurred, the predicted cumulative nitrate concentration prior to leaving the site boundaries will be less than the concentration for the protective of potable water (10 mg/L).

To be conservative, PMEL is in the opinion of installing three monitoring wells and/or keeping the existing monitoring wells at the downgradient of the site (southeast) to conduct future groundwater monitoring for a minimum of four events (once in a year) to perform a statistical groundwater chemistry analysis. If the results of 4 monitoring events are favourable (i.e., stable/no changes in site conditions), the frequency of the groundwater monitoring would be decreased.

3. ***In classifying the subdivision, there could've been more detail for downstream well locations and potential receptors. A theoretical diagram of OWTS plumes would help to illustrate ….***

As mentioned in Section 5.1.2, Hydrogeological Investigation Report prepared by PMEL (File No. 17788 dated May 4, 2022), although there are possible chances to reduce the percentage of plume intersecting each other, to be conservative, the OWTS were arranged on each proposed lot such that the OWTS effluent plumes migrated parallel to each other, maximizing the width of the combined nitrate plume travelling across the site. Using this approach, it was determined that the probability of the groundwater nitrate plume intersecting a downgradient water well would be over 90%. It is likely that the orientation of the OWTS on the division will cause overlapping of the plumes and thus reduce the probability of effluent plumes from the site intercepting a water well.

4. ***When advance treatment systems are mentioned does this mean NSF/ANSI – 40 Class 1 Standard as a minimum standard? Please clarify this in the report..***

Advanced treatment system should meet or exceed the NSF– 40 Class 1 Standard for the proposed residential subdivision.

5. ***Based on the recommendations for advanced package treatment plants and the need for ongoing operations, monitoring and maintenance of these systems are critical. The aim of the development is to ensure ….***

It is understood that this bullet point will be addressed by the Client in a separate letter or via email.

CLOSURE

We trust the above is the information you require at this time. If you have any questions or require additional information, please contact our office.

P. MACHIBRODA ENGINEERING LTD.



Arjun Paul, P. Eng., M.Sc.



Ray Machibroda, P.Eng., M.Sc
AP/RM:zz

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RM of Corman Park No. 344 Map Site. < https://rmcormanpark.ca/DocumentCenter/View/1357/General-RM-344-Map> [Accessed November, 2022].

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Appendix G - Policy Compliance

RM of Corman Park Official Community Plan Bylaw 8/94

Policy	Compliance	Report Reference
SECTION 4: INTENSIVE AGRICULTURAL OBJECTIVES AND POLICIES		
4.2.9. If an Intensive Livestock Operation has ceased to operate for a period of 12 months or more, other uses, as defined in Table 1, are exempt from the separation distance in order to subdivide or develop the lands. (Bylaw 31/19, Approved January 29, 2020)		The neighbouring ILO has not operated for over 10 years.
SECTION 5: COUNTRY RESIDENTIAL OBJECTIVES AND POLICIES		
5.2.1.5. Country Residential subdivisions shall not be allowed: a) within the distance of an intensive livestock operation as outlined in Section 4.2.3.; or b) on hazard lands, unless Council determines the lands are acceptable for remediation, and remedial measures and construction standards are prescribed by Council in accordance with Section 9.2.9 and registered as an interest on the title(s) to the lands. (Bylaw 08/04, Approved July 8, 2004)		The subject property does not exhibit any hazardous conditions. A minimum building elevation has been established for each property based on the high-water elevation of planned storm retention ponds.
5.2.1.6. Country Residential subdivisions should be directed to: a) locate on lands of "marginal" soil capability as defined by the Canada Land Inventory (CLI) Soil Class Rating System; b) locate contiguous to existing residential development on the quarter section to limit agricultural fragmentation and minimize the disruption of agricultural operations; and c) locations along existing municipally maintained roadways. (Bylaw 04/09, Approved April 21, 2009)		The soil capability rating for the subject property is Class 4M based upon the Canada Land Inventory Soil Capability for Agriculture maps. The "M" subclass represents lands that have a general deficiency in moisture-holding capacities and are more prone to drought. Class 4 soils are considered marginal due to the severe limitations that restrict the choice of crops or require special conservation practices and very careful management, or both. The project is situated in an area where country residential development is prominent. The site is situated along Highway 11 and adjacent to Prairie View Road.
5.2.3.5. The number and arrangement of approved lots shall be determined on a case by case basis and shall have consideration for:		A hydrogeological investigation was completed to confirm the number and distribution of

Policy	Compliance	Report Reference
a) the carrying capacity of the lands proposed for development based on site conditions, environmental considerations and potential impacts, and other factors that may warrant consideration in the design of the proposal; b) the suitability and availability of municipal and other services and infrastructure necessary to support the proposal; and c) the compatibility of the proposed subdivision design with that of the surrounding area.		development within the site based upon the use of private on-site wastewater treatment systems. A suitable source of treated water has been confirmed and a TIA confirmed the adequacy of current roads and intersections to meet the demands of the development. The subdivision concept provides a transition from highway-focused commercial, to smaller lot acreages to the west using larger residential acreages as a buffer between the uses and the activity along the highway. The layout promotes all public recreational space along the southern boundary of the property to account for the possibility that the neighbouring ILO may resume operations in the future.
5.2.3.7. The maximum size of the development area for an individual multi-parcel country residential development shall be 64.8 ha (160 acres).		The development is intended to be subdivided and developed in phases. All phases will adhere to the maximum size requirements.
5.2.3.8. Where a substantive active public recreational amenity is being proposed in conjunction with a multi-parcel country residential development, the development may exceed the maximum development area identified in Section 5.2.3.7. In considering proposals to rezone property for this use, Council shall: a) permit only those developments which exhibit significant amenities or propose substantial recreational components; b) equate the maximum number of residential lots which will be permitted with the level of investment in the recreational component; and c) consider requiring the rezoning of the residential or recreational component, or both, to be undertaken in accordance with the provisions of section 69 of The Planning and Development Act, 2007		The proposed development includes a full trail network, community centre, rink, playground and toboggan hill. The recreational areas are planned to be dedicated as a municipal reserve and developed in stages to align with development and road construction within the site.

Policy	Compliance	Report Reference
and Section 12.2.4. of this Plan. (Bylaw 39/17, Approved September 20, 2017)		
5.2.3.9. Where Council has approved a multi-parcel country residential subdivision incorporating an integrated active public recreational amenity, the amenity shall be developed concurrently with the residential component.		The recreational areas are planned to be dedicated as a municipal reserve and developed in stages to align with development and road construction within the site.
5.2.3.10. Comprehensive Development Reviews shall include a clear record of substantial public consultation including involvement in concept development, public review of the development options, and evidence of conflict resolution initiatives where necessary.		See Section 5
5.2.3.13. All new proposals for multi-parcel country residential subdivision shall be serviced by a common potable water system in a legal form that is acceptable to the Municipality.		See Section 4.1
5.2.3.17. Subdivision for a multi-parcel country residential development shall not result in the creation of any residential parcel located: (Bylaw 43/15, Approved November 23, 2015) a) within the distance of an Intensive Livestock Operation as outlined in Section 4.2.3.; b) on Hazard Land; c) within 1 km (0.6 mile) of a Hazardous Industry measured from the property boundary of the Hazardous Industry to the property boundary of the closest developable parcel; d) within 1 km (0.6 mile) of a rural industrial park measured from the property boundary of the closest developable parcel located within the rural industrial park to the closest property boundary of a multi-parcel country residential parcel; e) within 457 m (1500 ft.) of the property boundary of a Solid Waste Disposal Facility or a Liquid Waste Disposal Facility measure from the property boundary of the Solid Waste Disposal Facility or the Liquid Waste Disposal Facility to the closest property boundary of a residential parcel; and f) on conservation lands.		The proposed development is situated beyond the minimum separation distances listed.
5.2.3.18. Development must recognize and conserve areas containing significant wildlife habitat, cultural and historic resources.		The site does not contain any significant wildlife, cultural or historical resources that are impacted by development.

Policy	Compliance	Report Reference
5.2.3.19. Multi-parcel country residential subdivisions shall not be permitted on lands predominantly identified as prime agricultural lands according to the Canada Land Inventory (C.L.I) Soil Class Rating System and under agricultural production except where food production is an essential component of the development or where the development requires location on prime lands.		See Section 2.1
5.2.3.20. Multi-parcel country residential subdivisions proposed in the vicinity of a provincial highway shall consult and provide evidence of compliance with the requirements of the Saskatchewan Ministry of Highways and Infrastructure.		See Section 4.4 and Appendix E
5.2.3.21. Council shall consider the capacity of existing school and bus facilities or the feasibility of expanding this capacity to suit a development when reviewing multi- parcel country residential subdivision proposals.		See Appendix B
5.2.3.22. Approved multi-parcel developments shall be phased to ensure that roadway development and the provision of other services does not unnecessarily precede lot development. (Bylaw 23/08, Approved July 3, 2008)		The phasing of subdivision and development within the lands will take full advantage and seek to maximize the amount of development serviced by roadway construction.
SECTION 7: COMMERCIAL OBJECTIVES AND POLICIES		
7.2.1. Commercial developments shall locate at permanent access points as designated by the Department of Highways and Transportation.		The proposed commercial development is accessible from Prairie View Road and its intersection along Highway 11. The development accounts for the potential to extend a service road to the north connecting to Baker Road in the future if warranted by the Ministry of Highways.
7.2.2. Commercial developments will be encouraged to develop and locate in nodes at the intersection of highways and major municipal roads. Strip development shall be discouraged.		The commercial development is focused at the Prairie View/Highway 11 intersection. It has been situated to provide a certain amount of insulation between intensive highway activities and the less intensive residential uses within the internal area of the development.

Policy	Compliance	Report Reference
7.2.4. Commercial development shall take place in a location and form so as to minimize conflicts with adjacent land uses.		See 7.2.2. above
7.2.5. Commercial development should not take place on high quality agricultural land.		See Section 2.1
7.2.6. Commercial developments shall be in conformity with all Saskatchewan Department of Highways and Transportation regulations, specifically including building and sign regulations and 427 m (1400 ft) control radii regulations.		See Section 4.4 and Appendix E
7.2.11. Commercial development shall only occur in such a manner as not to restrict future expansion of the road system in the Municipality.		The plan of subdivision will account for the need to expand and improve Prairie View Road to an appropriate standard.
SECTION 9: LAND CONSERVATION OBJECTIVES AND POLICIES		
9.2.3. Wherever possible protection shall be afforded areas of historical and archaeological significance.		See Section 2
9.2.4. All development shall have regard to the conservation of wildlife habitat and lands recognized as having unique natural features.		The phasing of subdivision and development within the lands will take full advantage and seek to maximize the amount of development serviced by roadway construction.
SECTION 11: SERVICING OBJECTIVES AND POLICIES		
11.2.1. All new development proposals in close proximity to any road in the Municipality shall allow for expansion of those roads to standards designated by Council.		The plan of subdivision will account for the need to expand and improve Prairie View Road to an appropriate standard.
11.2.2. Any person proposing a subdivision and/or development of land shall, as a condition of approval, construct at his or her own expense and to standards established by the Council such roads as may be required by the subdivision and/or development. (Bylaw No. 3/11, Approved April 5, 2011)		See Section 4.4 and Appendix E
11.2.3. All development proposals shall have regard to existing school and school bus capacity.		See Section 4.6.1 and Appendix B

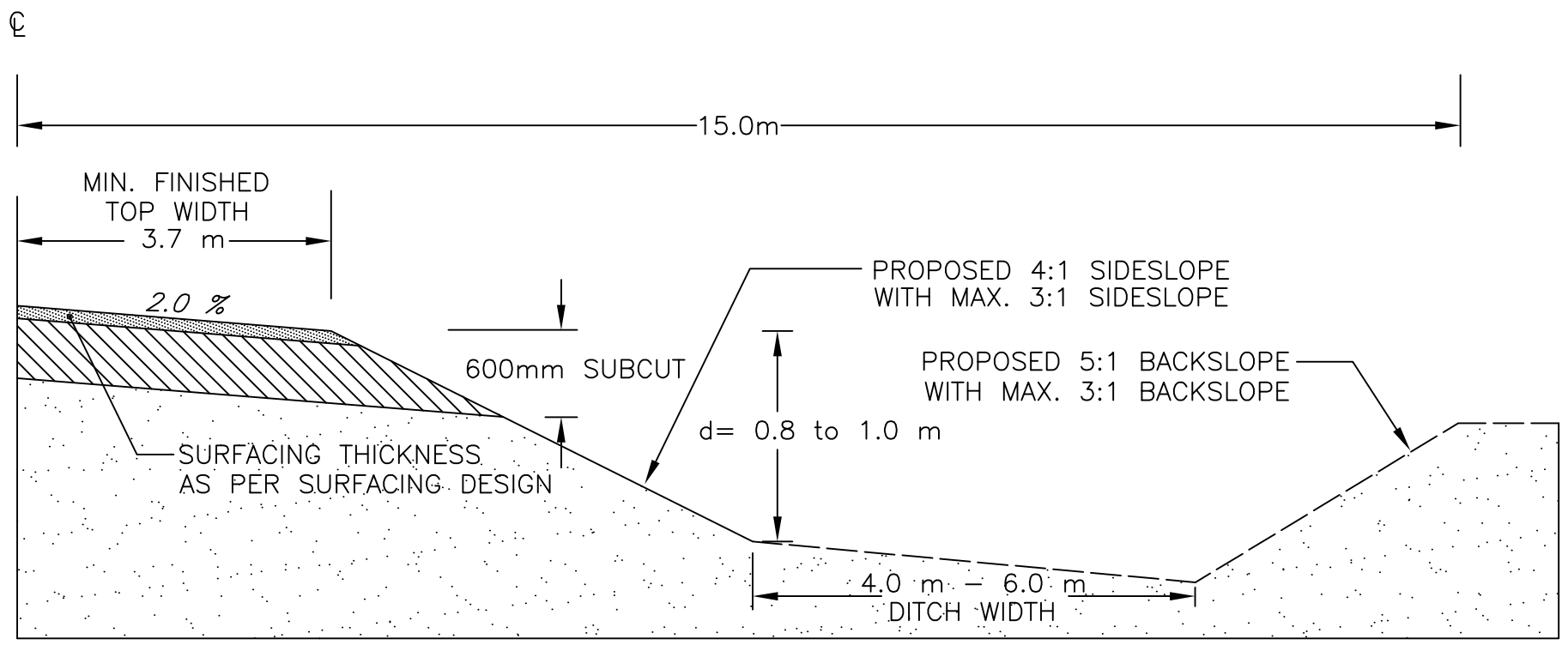
RM of Corman Park Zoning Bylaw 9/94

Regulation	Compliance	Report Reference
SECTION 3: GENERAL REGULATIONS		
6.1. Where development is proposed in an area identified as containing critical wildlife habitat or heritage sensitive areas, the Development Officer may require the applicant provide additional information as required by The Wildlife Habitat Protection Act (WHPA) and The Heritage Property Act or any other relevant provincial regulations.		The site does not contain any significant wildlife, cultural or historical resources that are impacted by development.
7.1. Development or subdivision proposed on or within 30 m (100 ft) of the crest of a slope greater than 20% shall require supporting evidence of slope stability by a Professional Engineer licensed to practice in the Province of Saskatchewan.		A geotechnical investigation of the site was completed and confirmed the suitability of the site for the proposed development. See Appendix A
7.6. All non-agricultural development proposed on flood prone lands shall be constructed at or above the 1:500 flood level as defined by the Water Security Agency, and in compliance with remedial measures and development standards prescribed by Council in consultation with the Saskatchewan Watershed Authority and the Ministry of Government Relations.		A minimum building elevation has been established for each lot based on the high-water elevation of each of the storm retention ponds. These building elevations will be registered by the Community Planning Branch onto each title.
10.1. The Development Officer, in conjunction with appropriate provincial regulatory agencies, shall determine the suitability of a site proposed for subdivision to accommodate a private wastewater treatment system within the subdivision review process.		See Appendix F
10.3. Upon receipt of an application for multi-parcel country residential subdivision, the application will be evaluated based upon the Saskatchewan Onsite Wastewater Disposal Guide (the Guide) as provided by the Saskatchewan Health Authority.		See Appendix F
13.15. Where a proposed development alters site drainage potentially affecting adjacent or downstream properties, the applicant shall be required to submit an engineered design for the proposed drainage works incorporating sufficient capacity to accommodate surface water runoff for a 1:100 year storm event with no incremental increase in offsite flows in excess of what would have been generated from the property prior to the new development.		See Appendix H
13.39. All outdoor lighting for any development shall be located and arranged so that no direct rays of light are directed at any adjoining properties; interfere with the use and enjoyment of neighbouring		The lighting of public areas within the development is planned to include LED bollards situated along the path network.

Regulation	Compliance	Report Reference
lands; or interfere with the effectiveness of any traffic control devices or the vision or safety of motorists.		Due to the short height of these bollards, the area of illumination will be limited to the path and is not expected to interfere with adjacent private properties.
16.1. Development adjacent to a provincial highway shall meet all provincial regulations respecting access to and the location of structures on the site.		See Section 4.4 and Appendix E
16.12. No development or use of land shall be permitted where the proposal will adversely affect domestic or municipal water supplies, or where a suitable, potable water supply cannot be furnished to the requirements of the Saskatchewan Health Authority and or Sask Water.		See Appendix F
16.13. All new multi-parcel country residential development shall be serviced by a centralized potable waterline administrated in a legal form acceptable to the Municipality.		See Section 4.1
SCHEDULE E - CR 1 - COUNTRY RESIDENTIAL 1 DISTRICT - LOW DENSITY		
3.1 THE AREA REQUIREMENTS FOR PERMITTED USES SHALL BE: The minimum site area shall be 0.4 ha (1 acre) and the maximum site area shall be 4.05 ha (10 acres). (Bylaw 25/08, Approved July 3, 2008)		All proposed CR1 zoned properties meet the minimum area requirement.
4.1. The maximum residential density for multi-parcel residential development shall be one residential lot per acre, maintaining an overall average minimum lot size of 2.47 acres throughout the proposed subdivision.		The average lot size for the CR1 zoned sites is 2.12 ha (5.23 acres).
4.3. The maximum size of the development area for an individual multi-parcel country residential development shall be 64.8 ha (160 acres). (Bylaw 25/08, Approved July 3, 2008)		The phased subdivision and development of the property will respect this maximum area.
5.2. The minimum frontage shall be 15 metres (49.2 ft).		All CR1 zoned sites meet the 15 m minimum frontage standard.
SCHEDULE G - CR 4 - COUNTRY RESIDENTIAL 4 DISTRICT		
3.1 THE AREA REQUIREMENT FOR PERMITTED RESIDENTIAL USES SHALL BE: The minimum site area shall be 0.2 ha (0.5 acres) and the maximum site area shall be 4.05 ha (10 acres).		All proposed CR4 zoned properties meet the minimum area requirement.
4.1. Residential lot density shall not exceed 2 lots per acre. (Bylaw 40/17, Approved September 20, 2017)		The average lot size for the CR4 zoned sites is 0.34 ha (0.84 acres).

Regulation	Compliance	Report Reference
4.2. At the time of submitting the initial development proposal, subdivision design and servicing provisions must be presented indicating development strategy for the total site.		See Section 4
4.3. Implementation of secondary stages of a development should take place according to the initial development proposal and should be staged as outlined in the initial proposal.		See Section 4.7
5.2. The minimum frontage shall be 15 metres (49.2 ft).		All CR4 zoned sites meet the 15 m minimum frontage standard.
SCHEDULE H - C - COMMERCIAL DISTRICT		
3.1. THE AREA REQUIREMENT FOR PERMITTED AND DISCRETIONARY USES SHALL BE: The minimum site area shall be 1 ha (2.47 acres).		All proposed Commercially zoned properties meet the minimum area requirement.
5.2. The minimum site frontage shall be 45 metres (147.6 ft.).		All proposed Commercially zoned properties meet the minimum frontage requirement.

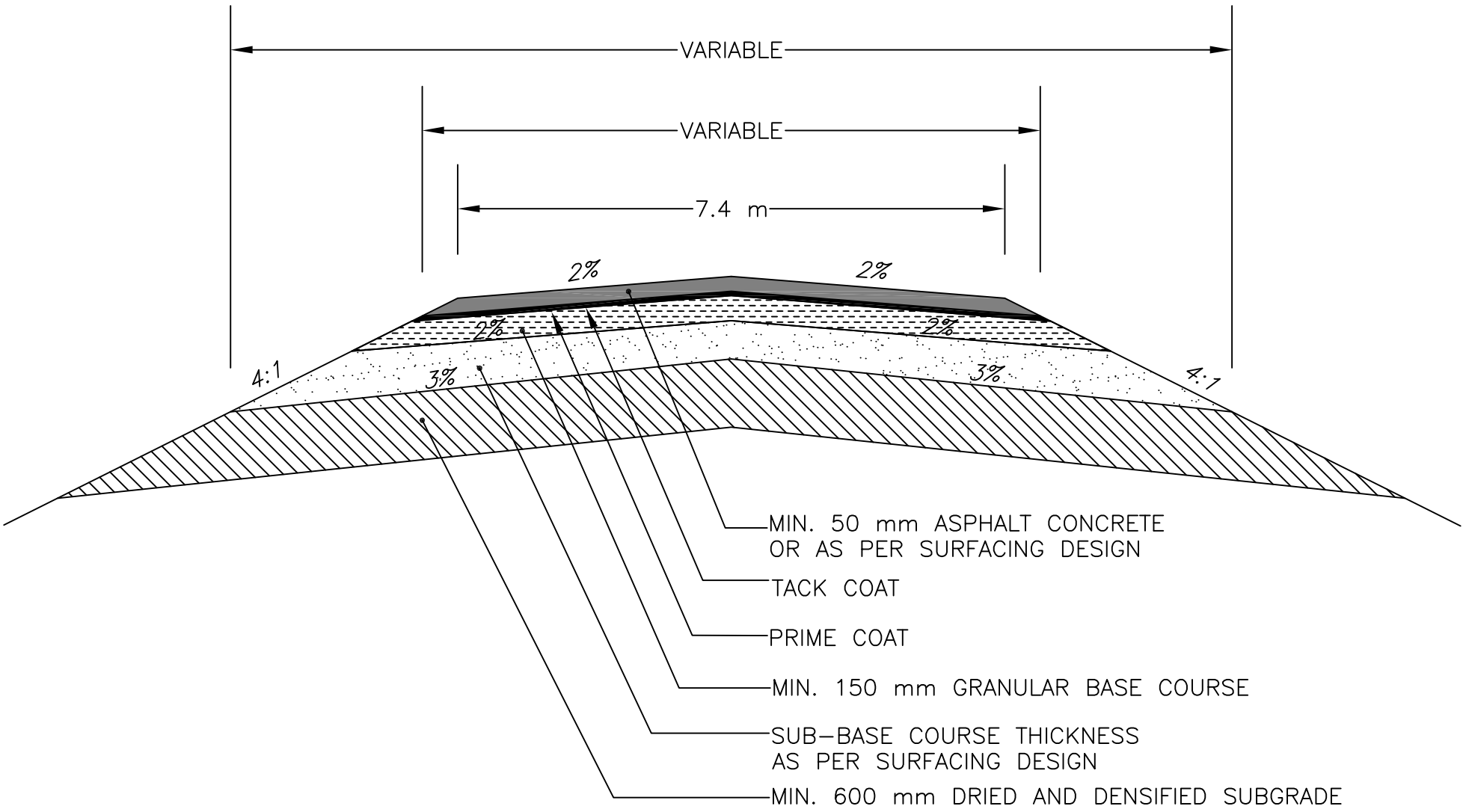
Appendix H - Conceptual Servicing



Rural Municipality of Corman Park

PUBLIC WORKS
COUNTRY RESIDENTIAL - TYPICAL CROSS SECTION SUBGRADE

DATE: 2017	SCALE: NTS	DRAWN BY: WOOD E&I



Rural Municipality of Corman Park

PUBLIC WORKS
COUNTRY RESIDENTIAL - TYP. SURFACING
ASPHALT CONCRETE

DATE: 2017	SCALE: NTS	DRAWN BY: WOOD E&I

1. Description

- Road design and construction standards for paved (asphalt concrete) subdivisions and special roads as designed within the Rural Municipality of Corman Park, No. 344 (Municipality).

2. Miscellaneous

- For the purposes of this document, the term “proponent” shall be used to address duties that shall be undertaken by the owner, developer, contractor and engineer interchangeable.
- During construction, the proponent shall be responsible for all traffic accommodation measures. This shall include but not limited to:
  - Proper signing of all access roads whereby traffic (construction or local) may access existing Municipality roads.
  - Traffic gravel shall be applied, if or as necessary for local traffic.
  - Proper measures shall be taken to ensure that local traffic can safely interact with construction equipment.
- The proponent shall ensure that all necessary Haul Road Agreements are in place including any provisions for dust control prior to the hauling of materials.
- Dust control to be applied on any approved detour routes.

3. Required Right-Of-Way Standards

- Minimum allowable Right-of-Way (ROW) purchased shall be 30.0 meters (m).
- The proponent shall be responsible for the purchase of all ROW.
- The minimum allowable ROW for cul-de-sacs and turnabouts purchased shall be 60.0 m with a minimum of 15.0 m radius for the driving surface.
- The road shall be designed and constructed in the center of the Right-Of-Way unless with special permission of the Municipality.

4. Road Widths and Geometric Standards

4.1. Finished Road Width and Height

- The finished asphalt driving surface (paved width before the start of the asphalt slope) shall be as follows:
  - For fill heights of 3.0 m or less (where the road surface is from 0.0 m to 3.0 m in height), a 7.4 m finished road top width (asphalt) shall be required.
  - For fill heights greater than 3.0 m (where the road surface is from 3.1 metres in height or more), a 8.0 m finished road top width (asphalt) shall be required.
- The road cross-fall (slope) shall be constructed to 2.0% with any curves must be constructed with the proper super-elevation.

- The average shoulder elevation of the road surface should be approximately 0.8 m to 1.0 m above the adjacent ground except in cut areas.
- The subgrade surface shall not be less than 1.5 m above high water level on the ground water table. (ie: level to which free water would rise in a hole sunk in the ground).

4.2. Surfacing and Hydraulic Design

- A grading, surfacing and hydraulic design shall be completed, signed and stamped by a Professional Engineer registered with the Association Of Professional Engineers and Geoscientists of Saskatchewan (APEGS) and licensed to practice (Permission to Consult in this field of expertise) within the Province of Saskatchewan.
- The surfacing structure shall be based upon the Saskatchewan Ministry of Highways and Infrastructure's Shell Curve method and shall be based on a 15 year design life (N_{15}).
- Soils testing shall be in accordance with the Saskatchewan Ministry of Highways and Infrastructure's Standard Test Procedures manual.
- Hydraulic structures (culverts) with significant flows shall be designed (sized) in accordance with the Saskatchewan Ministry of Highways and Infrastructures Hydraulic Manual and shall be based on a Q^{25} flow (1 in 25 year (1:25)) frequency.
  - The Municipality may request that the design be based on a Q^{50} flow (1 in 50 year (1:50)) frequency based on the location (proximity) of any residences upstream of the crossing.
  - The proponent shall apply for, and shall meet all of the listed requirements, an Aquatic Habitat Protection Permit (AHPP) from SaskWatershed Authority for hydraulic passages requiring such.

4.3. Sideslopes

- Sideslopes shall range from 3:1 to 4:1 depending upon situation and with approval from the Municipality.
  - The standard required sideslope shall be 4:1.
    - For road fills ranging from 0.0 to 3.0 m in height, the sideslope shall be 4:1.
    - For road fills ranging in height from 3.0 m to 4.0 m, the toe of slope shall be 12.0 m from shoulder of the road.
    - For road fills greater than 4 m the sideslope shall be 3:1.
  - If upon review by the Municipality, a sideslope of 3:1 may be allowed only with special permission from the Municipality.

4.4. Ditch Bottom Widths

- Ditch bottom widths shall be range from 4.0 to 6.0 m depending upon grade height and backslope requirements.
  - The desirable is 6.0 m for snow storage.

4.5. Backslopes

- Sideslopes shall range from 5:1 to 3:1 depending upon the situation and with approval from the Municipality.
  - The standard required back slope shall be 5:1.
    - A backslope of ranging from a minimum of 3:1 to the standard backslope of 5:1 will be allowed in conjunction with maximizing the ditch bottom width.

4.6. Maximum Road Gradient

- The maximum road gradient allowed shall be 5.0%.
- With special approval by the Municipality, a 6.0% gradient may be allowed.

4.7. Stopping Sight and Intersection Distances

- The stopping sight distance for intersections with any road shall be a minimum of 140 m. This is based upon the SARM guidelines for an 80 km/h road design.
  - For urban (low speed internal roads), reduced stopping sight distances will be utilized and approved based on design and operating speeds.
- The minimum length of road (constructed past an approach) shall be 100 m.
  - This is done in order to meet Stopping Sight Distances, snow and ice removal and road maintenance.
- For intersecting roads, the sight triangles shall be clear of any obstructions.
  - The sight triangle shall be a minimum of 85.0 m from the point of intersection on municipal roads and grid intersections and to a maximum of 140.0 m on primary grid roads using 80 km/h design speed.
    - For urban (low speed internal roads), the sight triangles will be utilized and approved based on design, operating speeds and applicable signing.

4.8. Existing Roads

- Consideration may be given within existing multi-parcel subdivisions for reduced finished road widths to a maximum of 7.4 m.

5. Snow Clearance Standards

- When shoulder grade elevation is 0.3 m or less above natural surface at 15.0 m to 20.0 m from center line then the backslope must be flattened using a variable slope of 5:1 to a maximum of 3:1.

6. Road Construction

6.1. Clearing and Grubbing

- Timber, brush, duff (vegetation), roots, logs and stumps shall be completely cleared from the surface of the Right-of-Way.
- Debris from clearing and grubbing operations shall not be used in the construction of embankments (any portion of the road structure).

- Debris from clearing and grubbing operations shall not be buried within the Right-Of-Way.

6.2. Removal and Replacement of Topsoil

- All topsoil within the Construction Footprint shall be removed and stockpiled.
  - The Construction Footprint is defined as the area within the cut or fill stakes.
- The Contractor shall install appropriate sediment control to ensure no sedimentation from topsoil stockpiles enters into adjacent water bodies.
- Upon completion of the construction, topsoil shall be replaced to a uniform depth over the Construction Footprint excluding the road surface.
  - The maximum compacted depth of topsoil replaced will be 100 mm.
- Stones (rocks) 75 mm or more in diameter shall be removed and disposed of from the topsoil replaced.

6.3. Drainage (culvert) Installations

- If the foundation is unsuitable, the bottom of the bed shall be sub-cut to a minimum of 0.3 m below the granular backfill layer.
- A geotextile fabric shall be installed to separate the ground surface from the granular materials.
  - A minimum 8 ounce (Geotex 801 or equivalent) nonwoven geotextile shall be used.
- The bedding line shall be shaped to fit the culvert.
- Corrugated metal pipe culverts (CSP) shall be placed with the inside circumferential laps pointing downgrade and with the longitudinal laps at the sides or quarter points. The sections of the culvert shall be firmly joined with coupling bands. Joints shall be as tight as possible.
- Culverts shall be to the following minimum sizes unless larger sizes are required to meet flow requirements:
  - Approach culverts shall be a minimum of 400 mm in diameter.
  - Through grade culverts shall be a minimum of 600 mm in diameter.
- CSP culverts shall have a minimum thickness of 2.0 mm (12 gauge).
- Granular material shall be composed of sand or gravel free from undesirable quantities of soft or flaky particles, loam, and organic or other deleterious material. Granular material shall comply with the following requirements:

Sieve Designation	Percent by Weight Passing Canadian Metric Sieve Series		
	TYPE		
	115	116	10
50 mm	100	-	100
9.0 mm	-	100	-
900 µm	-	30 - 100	-
400 µm	-	15 - 75	-
160 µm	-	0 - 10	-
71 µm	0 - 15	-	0 - 20
Plasticity Index	0 - 6	0 - 6	0 - 6

- For backfilling all types of culverts and bridge abutments, Type 115 shall be used.
- For backfilling subsurface drain pipes, Type 116 shall be used as a filter Material.
- For backfilling curbs, curbs and gutters, sidewalks, driveways, storm sewers, and manholes, catch basins, and other ancillary structures, Type 10 shall be used.
- Earth backfill under the haunches of culverts, except those in approaches not to be paved shall be compacted with mechanical impact tampers.
- After the earth backfill and granular backfill has been placed and compacted around the culvert, the remainder of the embankment shall be constructed by drying the earth material to at least the optimum moisture content and compacted to an average of not less than one-hundred (100) percent of the maximum density as determined by a Saskatchewan Ministry of Highways and Infrastructure Standard Proctor test.
- The earth material above the bedding line shall be placed, simultaneously and uniformly, in lifts on each side of the culvert. In subcut sections, the lift shall extend to the limits of the sub-cut; otherwise the lifts shall extend not less than 15 m from each side of the culvert.
- No objectionable material shall be used within that portion of the embankment above or below the bedding line on culverts through the roadbed.
- The embankment, within three diameters or three span; of the culvert barrel, shall be free from rocks having a dimension of 80 mm or greater when measured in any direction.
- Random riprap shall be installed at all culvert locations where the culvert diameter is greater than 800 mm.
    - A nonwoven geotextile shall be placed prior to the placement of the riprap material.

6.4. Subgrade Embankments

- Earth embankments shall consist of acceptable earth material and rock material free from objectionable quantities of organic matter, frozen soil, stumps, trees, moss, and other unsuitable materials.
- The embankment shall be constructed by placing the material in successive layers.
- The depth of each layer shall not be more than fifteen (15) centimetres (cm) uncompacted. The full width of each segment of each layer shall be bladed with a motor grader at least twice prior to being compacted.
- The slopes and surface of the embankment shall be shaped and trimmed to a uniform smooth surface conforming to the cross-sections shown on the plans, or as staked.
- Stones having a dimension of eight (8) cm or more when measured in any direction shall be removed from the top fifteen (15) cm of the subgrade.
- The following requirements will apply for all embankments:
    - When unsuitable material is encountered below the natural ground surface in embankment areas, the material shall be excavated and removed.
    - The embankment layer (other than at culverts including the sub-cut backfill layer) from 750 mm to 600 mm below the top of the subgrade shall be dried to within 3% of the optimum moisture content.

- Each layer of the top 600 mm of the subgrade shall be dried to at least the optimum moisture content and compacted to an average of not less than one-hundred (100) percent of the maximum density as determined by the Saskatchewan Ministry of Highways and Infrastructure Standard Proctor test. The moisture and densities will be considered satisfactory when:
  - All individual moisture test results are equal to or less than the optimum moisture content.
  - Density test results average not less than one hundred (100) percent of the maximum density.
  - All individual density tests are greater than ninety-eight (98) percent of the maximum density.
- If the moisture existing in the soil is insufficient for compacting to the specified density and for finishing, the proponent may elect to add water.
- The foregoing requirements will also apply to backfill of subcuts and the embankment required to prepare the beds and backfill drainage structures.

- Approaches to be constructed as per Municipalities Approach Construction policy.

6.5. Traffic Gravel

- Traffic gravel shall comply with Type 106.

Sieve Designation	Percent by Weight Passing Canadian Metric Sieve Series
	TYPE
	106
40.0 mm	-
31.5 mm	-
22.4 mm	100
18.0 mm	63 – 92
5.0 mm	0 – 50
2.0 mm	0 – 35
400 µm	
Fractured Faces	40% Minimum

- A tolerance of 3% in the percent by weight passing the maximum size sieve shall be permitted.

6.6. Traffic Gravel Behind Construction

- Type 106 Traffic Gravel shall be placed and spread on a newly constructed subgrade surface.
- Traffic gravel Type 106 shall not be deposited until the subgrade surface has been compacted (to the required density) and trimmed.
- Traffic gravel shall be dumped and spread uniformly on the subgrade surface as required.
- Traffic gravel shall be applied to the finished surface of all approaches.

6.7. Sub-Base Course

- Sub-base aggregate shall be composed of sound, hard, and durable particles of sand, gravel and rock free from injurious quantities of soft or flaky particles, shale, loam, clay balls and organic or other deleterious material.
- Sub-base course shall comply with the requirements listed in following table:

Sieve Designation	Percent by Weight Passing Canadian Metric Sieve Series
50 mm	100
2.0 mm	0 – 80.0
400 µm	0 – 45.0
160 µm	0 – 20.0
71 µm	0 – 8.0
Plasticity Index	0 – 6

A tolerance of 3% in the percent by weight passing the maximum size sieve shall be permitted providing 100% of the oversize passes the 63.0 mm sieve.

- The thickness of any one compacted lift of sub-base course shall not exceed 120 mm.
- Sub-base courses shall be compacted until no further settlement is apparent and the particles are well keyed into place.
- The finished surface of the sub-base course shall be true to grade and cross section and free of any surface defects, rutting or deformations the placement of the next course.

6.8. Granular Base Course

- Base aggregate shall be composed of sound, hard and durable particles of sand, gravel and rock free from injurious quantities of elongated, soft or flaky particles, shale, loam, clay balls and organic or other deleterious material.
- Base Course Mix (Type 33) shall comply with the requirements listed in following table:

Sieve Designation	Percent by Weight Passing Canadian Metric Sieve Series
18.0 mm	100
12.5 mm	75.0 – 100.0
5.0 mm	50.0 – 75.0
2.0 mm	32.0 – 52.0
900 µm	20.0 – 35.0
400 µm	15.0 – 25.0
160 µm	8.0 – 15.0
71 µm	6.0 – 11.0
Plasticity Index	0 – 6
Fractured Faces (%)	50.0% Minimum
Lightweight Pieces	5.0% Maximum

- A tolerance of 3% in the percent by weight passing the maximum size sieve shall be permitted providing 100% of the oversize passes the 22.4 mm sieve.
- Granular Base Mix shall be spread on dry and unfrozen surfaces and shall not be compacted if the atmospheric temperature is less than 2° Celsius.
- The finished surface of the Granular Base Course shall be true to grade and cross section and free of any surface defects.
- The Granular Base Course shall be considered satisfactory when:
  - It contains no surface defects.
  - The average density meets or exceeds 100% of maximum density.
  - All individual test results are greater than 98% of maximum density.
  - The moisture content is less than or equal to the optimum moisture content.
- A prime coat shall be placed on the finished final lift of Granular Base Course
  - Prime coat shall be placed within 24 hours, weather permitting.

6.9. Asphalt Prime and Tack Coat

- The proponent may elect to use MC-30, an emulsified asphalt primer, road-mixed SS-1, road-mixed SS-1H for the prime coat.
  - If using SS-1 or SS-1H, the SS-1 must be incorporated into the top 25 mm to 50 mm of the Granular Base Course.
- SS-1 or SS-1H emulsified asphalt shall be used as a tack coat.
- The tack coat shall be applied in accordance with the application rates outlined in the following table:

Surface Type	Application Rate (L/m^2)		
	Residual	Undiluted	Diluted (one part water to one part emulsified asphalt)
New Asphalt Concrete	0.14 – 0.18	0.23 – 0.32	0.45 – 0.60

- Potable water shall be used to dilute the emulsified asphalt.
- The tack coat shall be applied in a single application and uniformly across the prepared surface.
- Asphalt for prime coat and tack coat shall not be applied to a prepared surface when:
  - The surface temperature is less than 2° C.
  - The weather is misty, rainy, or if rain is impending.
- Traffic will not be permitted to travel on prime coat until 6 hours after application. After 6 hours, excess asphalt remaining on the surface shall be blotted by sand before traffic is permitted to travel on the surface.

6.10. Asphalt Concrete

- Virgin aggregate used for Asphalt Concrete shall be composed of sound, hard and durable particles of sand, gravel and rock, free from injurious quantities of elongated, soft or flaky particles, shale, clay, loam, ironstone, coal and organic or other deleterious materials.

- Type 150 – 200A asphalt shall be used as bituminous binder.
  - This material shall meet the requirements of Saskatchewan Ministry of Highways and Infrastructure's Specifications for Manufactured Materials (SMM) For Asphalt Cements.
- Hydrated-lime or liquid anti-strip shall be used as an anti-stripping agent.
  - The stripping potential shall not exceed 5% as determined by SMHI Standard Test Procedure (STP 204-15).
  - Liquid anti-stripping agent shall be added at a rate of approximately 1.0% of the weight of liquid asphalt added.
  - The amount of hydrated lime added shall be approximately 1% of the total dry aggregate by weight.
  - The Contractor shall ensure the procedures and equipment used for the addition of hydrated lime anti-stripping agent are adequate to ensure that the hydrated lime is added at a uniform consistent rate.
- Only the following Mix Design Type will be permitted:

Sieve Designation	Percent By Weight Passing Canadian Metric Sieve Series
12.5 mm	100
9.0 mm	76-89
5.0 mm	50-60
2.0 mm	30-48
900 um	19-38
400 um	10-26
160 um	3-10
71 um	2-5
Fracture Minimum %	70 (1 face)
Sand Equivalent Minimum %	45
Los Angeles Abrasion (% loss)	35 (max)
Organic Content (% passing 5 mm)	1.0
Marshal Blows	50
Marshal Stability (kN) at 60ºC min	8
Retained Stability (min %)	75
Marshal Flow Index (mm)	2-4
Air Voids in Mixture	3-5
Voids Filled With Asphalt %	70-80
Min Film Thickness	8.0

- A tack coat shall be applied and allowed to fully cure prior to the placement of the asphalt mix (paving operations).
- Asphalt concrete shall be spread on dry, clean, and unfrozen surfaces.
- Asphalt concrete shall be placed in accordance with the following temperature limitations:

  - Paving may begin, for other than the final lift, when the temperature is 0° C provided the temperature is forecast, by Environment Canada, for the closest location to the project, to reach at least 5° C that day.
  - The final lift of asphalt concrete shall not be placed if:
    - The atmospheric temperature is less than 5° C;
    - The surface temperature is less than 7° C.
- The asphalt concrete mat shall be constructed to a field density range of 97% to 98% of the Marshall Density based on readings from a correlated Nuclear Densometer gauge.
  - The proponent will develop a correlation between the results of the nuclear gauge and the results of the asphalt concrete cores obtained from the compacted lift of asphalt concrete. The density results obtained from the cores will be used to correct the Field Density results obtained from the nuclear gauge.
- The asphalt mat shall be constructed so that:
  - There are no pavement depressions.
  - Longitudinal construction joints from one lift to the next shall be separated by at least 100 mm.
- The minimum and maximum thickness of a compacted lift of asphalt concrete shall meet the following requirements:
  - Minimum asphalt mat thickness shall be 30 mm.
  - Maximum asphalt mat thickness shall be 50 mm.
- The asphalt mix temperature in the paver shall not be less than 110° C.
- Contact faces of curbs, gutters, manholes, and sidewalks shall be coated with asphalt using a hand applicator before placing the asphalt mix.
- When paving is discontinued on the roadway, the asphalt concrete shall be temporarily feathered to a slope of 10 horizontal to 1 vertical. When paving is resumed, the transverse joint shall be straight and have a vertical face when the taper is removed.
- Asphalt mix shall not be placed or allowed to fall on previously laid top lift asphalt concrete or the existing asphalt concrete.
- Transverse construction joints from one lift to the next shall be separated by at least 2.0 m.
- The proponent shall construct the asphalt mat so that there are no areas of:
  - Segregation.
  - Surface defects which may consist of:
    - Roller marks.
    - Open texture.
    - Improper matching of longitudinal and/or transverse joints.
    - Cracking or tearing.
    - Contamination by diesel, hydraulic fluids, detergent or other harmful products.
    - Foreign objects or materials that are detrimental to the asphalt concrete.
    - Clay balls or oversized materials.
  - Any repairs required shall be to the satisfaction and approval by the Municipality.

6.11. Seeding

- Prior to seeding, the area to be seeded shall be true to grade and cross section and free from irregularities.
- The proponent shall harrow the seeded areas immediately after the seeding is completed.
- The seed material shall contain the following blend of seeds:

Seed Mix Common Name	% of Mix
Sheep's Fescue	15
Canada Blue Grass	15
Blue Fescue	15
Hard Fescue	15
Chewings Fescue	15
Creeping Red Fescue	15
Perennial Rye Grass	10

- The seed application rate shall be 14 kg per hectare (31 lbs per acre).
- The Municipality may approve other grass seed mixtures having similar grass seeds or slight changes in mixture percentages.

7. Design and Construction Certification

- The Municipality reserves the right to request any and/or all test result(s) or other associated documentation at any stage of the project.
- Upon completion of the project and prior to the start of the warranty period, the proponent's Engineer and/or engineering firm shall complete and submit a signed and sealed Statutory Declaration stating that all design and construction criteria/specifications in accordance with the parameters aforementioned have been met.
    - The Engineer of Record shall be a Professional Engineer registered with the Association Of Professional Engineers and Geoscientists of Saskatchewan (APEGS) and licensed to practice (Permission to Consult) within the Province of Saskatchewan.
    - The Engineer(s) of Record shall have reviewed and/or been involved with the design and/or construction of the project and shall have firsthand knowledge of the work completed.

Associated Engineering | GLOBAL PERSPECTIVE. LOCAL FOCUS.

TECHNICAL MEMORANDUM

Issue Date:	March 22, 2022	**File No.:**	AERIS
To:	Mr. Abrametz	**Previous Issue Date:**	
From:	Jason Forest, A.Sc.T.	**Project No.:**	2021-4570-00
Client:	Johnathan Abrametz		
Project Name:	Greenview Estates - Comprehensive Development Review (Draft)		
Subject:	Conceptual Drainage Summary		

1 OVERVIEW

Associated Engineering (Sask.) Ltd. (AE) was retained by Johnathan Abrametz to provide a drainage analysis of his property located approximately 7 km south of Saskatoon, Saskatchewan, within the NE 13-35-05-W3M and SE 24-35-5-W3M. This drainage analysis is intended to support the preparation of a conceptual stormwater management strategy to accompany an application to rezone and subdivide the property.

The analysis will review the existing drainage patterns and natural topography. Natural depressions will be estimated and accounted for in design considerations for stormwater management. The site will review estimated pre-development and post-development flow/volume characteristics and recommend a stormwater management strategy for the site.

2 EXISTING DRAINAGE PATTERNS AND CONDITIONS

An independent survey company provided digital contours at 10 cm intervals. The data set covers the two-quarter sections of land proposed for development. Information beyond the development was supplemented by Global Mapper, a geographic information system software.

The terrain is flat with several depressions and hummocks with very little drainage relief. Drainage generally flows from West to East at grades ranging between 0.10% to 0.30%. There are four (4) surface discharge points from the property on the East boundary and two on the Southwest (see Figure 1) for a total of six (6) main catchment areas within the site. Stormwater within the catchments eventually flows into the Highway 11 ditch system and then spills to the outlet basin on the east side of Highway 11, as illustrated in Figure 1 – Regional Drainage.

2.1 Natural Depressions

There are 19 natural depressions that have the potential to collect stormwater before spilling over into adjacent drainage paths or depressions. Table 2-1 summarizes the estimated storage volume and the nearest spill elevation associated with each depression, while Figure 2 – Existing Drainage provides the location of each depression.

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Table 2-1
Existing Depressions

Depression	Volume (m^3)	Spill Elevation	Depression	Volume (m^3)	Spill Elevation
D1	600	507.4	D11	1,500	506.6
D2	1,800	507.6	D12	4,000	509.3
D3	1,600	507.6	D13	1,200	507.2
D4	500	507.5	D14	10,800	508.8
D5	200	508.0	D15	900	507.5
D6	700	508.2	D16	7,200	509.0
D7	1,000	508.1	D17	14,300	510.3
D8	14,700	508.7	D18	1,600	509.1
D9	9,400	508.3	D19	700	506.9
D10	2,800	508.2	-	-	-

When the natural storage ponds (depressions) are consolidated due to development, the volumes associated with the depression will need to be accounted for as part of the dead storage calculation for post-development.

It is not reasonable to assume that depressions on acreage lots will be filled in by homeowners as this would be a costly endeavour and very unlikely, however, some of the depressions will be filled in partially with the construction of access roads. We estimate that 10% of the depressions within lots will be filled in. For this reason, depressions located solely on acreage lots were not included in dead storage calculations (less than 10% for roads), as were depressions that extend beyond the development boundaries. The depressions located entirely on acreage lots and are not anticipated to change from their natural state are D2, D3, D5, D6, D7, D15, and D18. The total amount of depressional storage located entirely on acreage lots is estimated at 7,000 m^3 (7,800 m^3 less 800 m^3).

All remaining depressions are located partially on small rural residential lots, commercial lots, proposed municipal utility (MU) properties, and/or road rights of ways which will be graded and developed, therefore, depressions: D1, D4, D8, D9, D10, D11, D12, D13, D14, D16, D17, and D19 are considered lost depressional storage and will need to be accounted for in the dead storage volume estimates for pond design. The total amount of depressional storage to be accounted for in the dead storage volumes for pond design is estimated at 68,500 m^3, including the 10% (800 m^3) for access roads on acreage lots.

3 STORMWATER MANAGEMENT CONCEPT

The proposed development is intended to be a mix of acreage style development, smaller rural residential, and commercial development. Drainage will be conveyed overland through roadway ditches, swales, and easements. Stormwater retention ponds will be designed per *EPB 322 – Stormwater Guidelines, January 2014* and constructed to account for dead and active storage requirements based on pre-development conditions, post-development flows and volume estimates, and lost depressional storage due to development. Roads will be a rural type of cross-section paved following the Rural Municipality of Corman Parks design standards.

The site has six (6) catchment areas and discharge points (see Figure 2). Catchments 1 and 2 will maintain the existing discharge points with proposed intercepting stormwater ponds. Catchments 3, 4, 5, and 6 will be combined through earthworks grading of the catchments and directing stormwater to the Southeast corner of the site, where stormwater will be intercepted by a pond before being released. The release rate for each of the three (3) ponds will be controlled by limiting the outflow to the estimated pre-development rate.

The Modified Rational Method was used in estimating stormwater pre-development and post-development flow/volumes. Parameters, assumptions, and data used in the calculations are summarized below:

- Intensity duration frequency data from Atmospheric Environment Service – Environment Canada using the Saskatoon U of S station, 4057200. For this analysis i= 4.18 mm/hr.
- 1:100-year return period 24-hour storm event.
- Coefficients of permeability (C) were used in the calculations, and where ranges of C values were given, professional judgment and experience were used in selecting an appropriate C value.
- The coefficient of permeability of 0.25 was used for estimating all pre-development flows, which are classified as undeveloped land.
- Coefficient of permeability for post-development was estimated at 0.38 by calculating a weighted average on contributing areas. as shown in the following table.

Table 3-1
Coefficient of Permeability

Land Description	Contributing Area (m^2)	Coefficient (C)
Roadways	27,000	0.95
Urban Residential	230,000	0.50
Rural Residential	641,000	0.40
Commercial	100,000	0.60
Parks – Municipal Reserve (MR)	95,000	0.25
Ponds – Municipal Utility (MU)	169,000	0.25
Undeveloped	290,000	0.25
Weighted Post Development Coefficient		0.38

3.1 Post Development Catchment 1 – Conceptual Drainage Design

3.1.1 Stormwater Storage

Catchment 1 has nine (9) depressions that spill into each other, eventually draining to the Northeast corner of the site at Highway 11's ditch system. The total volume of the nine (9) depressions before spilling is estimated at 30,500 $m^{3,}$ with the point of discharge off-site in the Highway 11 ditch at an elevation of 506.9.

Depressions D2, D3, D5, D6, and D7 are located entirely on acreage lots and are not considered lost storage except for the 10% accounted for estimated storage loss due to access road construction (800 m^3 estimated). Depressions D1, D4, D8, and D9 will be developed and are considered lost storage and will be accounted for in the design of stormwater pond 1 with a total volume estimated at 26,000 m^3 (25,200 m^3 plus 800 m^3).

The estimated permanent storage required due to the increase in runoff (post-development – pre-development) is calculated at 7,600 m^3.

Active storage within the pond is required to temporarily store runoff during a storm event and slowly release this volume over time. The runoff will be released at a controlled rate equal to pre-development conditions. The pre-development 1:100-year average flow rate was estimated at 0.169 m^3/s. Based on the estimated 1:100-year storm and an allowable outflow rate limited to 0.169 m^3/s; we estimate the active storage requirement to be 17,000 m^3. Below is a summary of the storage requirements for the pond in Municipality Utility (MU) 1.

Table 1-2
Catchment 1 - Volume Summary

Catchment 1 (MU 1)	Volume (m^3)
Depressions	26,000
Change in Land Use	7,600
Required Active Storage	17,000
Total Storage Required – Pond 1 (MU1)	**50,600**

3.2 Post Development Catchment 2 – Conceptual Drainage Design

Catchment 2 has six (6) depressions that spill into each other, eventually draining to the East side of the site at the Rural Municipality (RM) of Corman Park Road and eventually into Highway 11's ditch system. One (1) depression (D20) is outside the developable property and is not considered in the dead storage requirements; however, flow from this depression spills into the proposed development and will need to be accommodated with a drainage easement between lots. The total volume of the five (5) depressions is estimated at 10,400 $m^{3,}$ with the point of discharge off-site at the RM grid road at an elevation of 506.6 m.

Depression D15 is located entirely on an acreage lot and is not considered lost storage. Depressions D10, D11, D12, and D13 are located within small residential lot development, commercial lands, road right of ways, and MU land, therefore, will be developed and are considered lost storage. These depressions will be accounted for in the design of stormwater pond 2, with a total volume estimated at 9,500 m^3.

The estimated permanent storage required due to the increase in runoff (post-development – pre-development) is calculated at 8,500 m^3.

Similar to Pond 1, active storage within the pond is required to temporarily store runoff during a storm event. The runoff will be released at a controlled rate equal to pre-development conditions. The pre-development 1:100-year flow was estimated at an average flow rate 0.190 m^3/s. Based on the estimated 1:100-year storm and an allowable outflow rate limited to 0.190 m^3/s; we estimate the active storage requirement to be 19,800 m^3. Below is a summary of the storage requirements for the pond in Municipality Utility (MU) 2.

Table 3-3
Catchment 2 - Volume Summary

Catchment 2 (MU 2)	Volume (m^3)
Depressions	9,500
Change in Land Use	8,500
Active Storage	19,800
Total Storage Required – Pond 2 (MU2)	**37,800**

3.3 Post Development Catchment 3 – Conceptual Drainage Design

Catchment 3 was combined from four (4) separate sub-catchments. Two (2) are naturally discharged to the East site boundary and two (2) discharge to the West site boundary. The combining of four (4) catchments into one (1) is recommended for controlling outflow from the property and the feasibility of collecting stormwater due to the low-lying area in the Southeast. Ultimately, the stormwater drainage pattern from the surrounding area flows from Northwest to Southeast.

There are four (4) depressions (D14, D16, D17, and D19) within catchment 3 that are located within either: small residential lot development, commercial lands, road right of ways, or MU/MR land, therefore, will be developed and are considered lost storage. Depression D18 is located on MR land and will not be developed, therefore, is not considered lost storage and will not be included in the design of stormwater pond 3.

The stormwater flow will be temporarily collected by stormwater pond 3 and discharged into the Southeast RM ditch. The RM ditch eventually connects to Highway 11's ditch system in the Southeast. The total volume of all five (5) depressions is estimated at 34,600 $m^{3,}$ with the point of discharge off-site into the RM ditch at an elevation of 506.9 m.

Depressions (D14, D16, D17, and D19) will be included in the design of pond 3, with a total estimated volume of 33,000 m^3.

The estimated permanent storage required due to the increase in runoff (post-development – pre-development) is calculated at 4,100 m^3.

Similar to Pond 1 and 2, active storage within the pond is required to temporarily store runoff during a storm event. The runoff will be released at a controlled rate equal to pre-development conditions. Due to the combining of catchments (four into one), the existing discharge at catchment 5 would not see a cumulative flow from the other pre-development catchments (Catchments 3, 4, and 6), therefore, the allowable release rate of stormwater pond 3 must be equal to or lower than the pre-development rate of sub-catchment 5 (see Figure 1 for pre-development catchment boundaries). The pre-development rate of a 1:100-year flow at catchment 5 was estimated at an average flow rate 0.015 m^3/s. Based on the estimated 1:100-year storm and an allowable outflow rate limited to 0.015 m^3/s; we estimate the active storage requirement to be 16,100 m^3. Below is a summary of the storage requirements for the pond in Municipality Utility (MU) 3.

Table 3-4
Catchment 3 - Volume Summary

Catchment 3 (MU 3)	Volume (m^3)
Depressions	33,000
Change in Land Use	4,100
Active Storage	16,100
Total Storage Required – Pond 3 (MU3)	**53,200**

4 DRAINAGE PLAN

4.1 Grading

Grading of the site will be limited to Municipal Utility parcels for the creation of stormwater ponds, road right of ways (for the creation of roads), drainage easements (where applicable), Municipal Reserves (where required to encourage drainage relief), small residential lots (located on the West and South of the property), and the development of access and a building pad (~20 m x 25 m) to provide a site that meets the minimum building elevation requirements for each lot. Material excavated from the construction of ponds will be used for fill were required to facilitate drainage and to create suitable building sites.

4.2 Minimum Building Elevation

The minimum building elevation for building construction is calculated by adding 0.5 m above the nearest downstream spill elevation. This reduces the likelihood that buildings will be impacted by potential flooding.

Ditches are proposed through several lots to lower the spill elevations and promote positive drainage through the site. The lower spill elevations provide reduced minimum building elevations that allows for more buildable areas on lots. It reduces the need to import fill on the larger contury residential acreage lots for building sites.

4.3 Stormwater Pond Design

Stormwater pond locations were strategically placed in low-lying areas. The areas dedicated to the construction of the ponds were sized based on an average pond depth of 1.5 m. The stormwater ponds will be designed per EP P322 which provides for a length-to-width ratio and side slopes ranging between 4:1 and 5:1 and a maximum depth of 3 m. Controls will be designed with ease of maintenance and erosion control considerations.

5 CLOSURE

This technical memorandum serves to inform design intent concerning stormwater management for the proposed Greenview Estates development and was prepared for the RM of Corman Park, Water Security Agency, and the land developer (Johnathan Abrametz).

Should you have any questions or comments, please feel free to contact our office.

Prepared by:

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Project Technologist

Reviewed by:

Ryan Karsgaard, P. Eng.
Project Engineer

PROFESSIONAL ENGINEER
R.T. KARSGAARD
MEMBER 14927
2022-03-23
YR. MN. DAY
SASKATCHEWAN

ASSOCIATION OF PROFESSIONAL ENGINEERS AND GEOSCIENTISTS OF SASKATCHEWAN
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Civil	09763	

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Date: March 22, 2022

IF NOT 25 mm ADJUST SCALES 25 mm

SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE



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LEGEND

- PROJECT AREA
- PONDING AREAS
- WATER AT NATURAL TIPPING ELEVATION
- CATCHMENT BOUNDARY
- SUB-CATCHMENT BOUNDARY
- PONDING AREA SPILL ELEVATION
- DRAINAGE RUN
- CULVERT

NOTES:
1. DRAINAGE RUNS AND FLOWS ARE BASED ON PROVIDED CONTOURS AND WILL BE VERIFIED DURING DETAIL DESIGN.

2. CULVERT LOCATIONS ARE ASSUMED AND WILL BE VERIFIED DURING DETAIL DESIGN.

3. CULVERTS ARE ASSUMED TO BE A MINIMUM 600 mm CSP AND WILL BE CONFIRMED DURING DETAIL DESIGN.

FIGURE 1

GREENVIEW ESTATES

CIVIL
PLAN
REGIONAL DRAINAGE

AE PROJECT No.	20214570-00
SCALE	NTS
APPROVED	J. FOREST
DATE	2022MAR22
REV	0
DESCRIPTION	ISSUED FOR MEMO

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IF NOT 25 mm ADJUST SCALES
25 mm

SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE

PRAIRIE VIEW ROAD

HIGHWAY 11

C1
AREA - 410,600

C2
AREA - 109,000

C3
AREA - 62,000

C4
AREA - 227,800

C5
AREA - 134,500

C6
AREA - 87,800

C7
AREA - 25,200

C9
AREA - 180,200

C10
AREA - 63,900

C11
AREA - 56,100

C12
AREA - 52,700

C13
AREA - 69,300

C14
AREA - 25,300

C15
AREA - 22,300

C15a
AREA - 156,900

C16
AREA - 25,200

D1 VOL - 600
D2 VOL - 1,800
D3 VOL - 1,600
D4 VOL - 500
D5 VOL - 200
D6 VOL - 700
D7 VOL - 1,000
D8 VOL - 14,700
D9 VOL - 9,400
D10 VOL - 2,800
D11 VOL - 1,500
D12 VOL - 4,000
D13 VOL - 1200
D14 VOL - 10,800
D15 VOL - 900
D16 VOL - 7,200
D17 VOL - 14,300
D18 VOL - 1,600
D19 VOL - 700
D20 VOL - 2,500

1 2 3 4 5 6

507.40 507.50 507.60 508.00 508.10 508.20 508.70 508.90 508.90 509.00 509.30 509.90 510.30 506.20 506.90 507.20 508.80

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LEGEND

- PROJECT AREA
- PONDING AREAS
- WATER AT NATURAL TIPPING ELEVATION
- CATCHMENT BOUNDARY
- SUB-CATCHMENT BOUNDARY
- PONDING AREA SPILL ELEVATION (507.50)
- DRAINAGE RUN
- 1 CATCHMENT
- CULVERT

NOTES:

1. DRAINAGE RUNS AND FLOWS ARE BASED ON PROVIDED CONTOURS AND WILL BE VERIFIED DURING DETAIL DESIGN.

2. CULVERT LOCATIONS ARE ASSUMED AND WILL BE VERIFIED DURING DETAIL DESIGN.

3. CULVERTS ARE ASSUMED TO BE A MINIMUM 600 mm CSP AND WILL BE CONFIRMED DURING DETAIL DESIGN.

FIGURE 2

GREENVIEW ESTATES

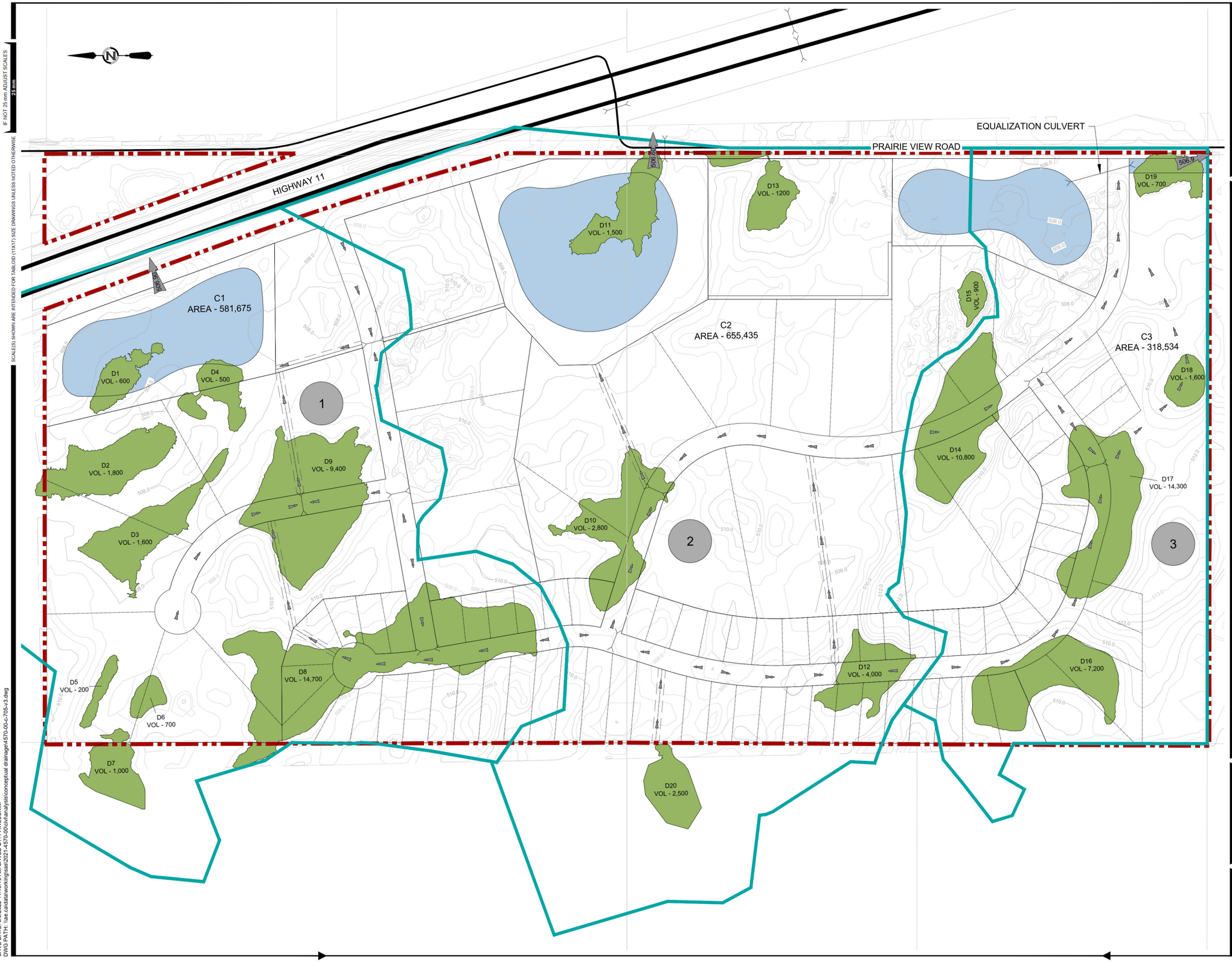
CIVIL
PLAN
EXISTING DRAINAGE

AE PROJECT No.	20214570-00
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DATE	2022MAR22
REV	0
DESCRIPTION	ISSUED FOR MEMO

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25 mm

SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE



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LEGEND

- PROJECT AREA
- PROPOSED PONDS
- NATURAL PONDING AREAS
- WATER AT NATURAL TIPPING ELEVATION
- PROPOSED CATCHMENT BOUNDARY
- 507.50 PONDING AREA SPILL ELEVATION
- 1 CATCHMENT
- CULVERT
- PROPOSED OVERLAND FLOW DIRECTION
- PROPOSED EASEMENT

NOTES:
1. EASEMENTS TO BE VERIFIED DURING DETAIL DESIGN.

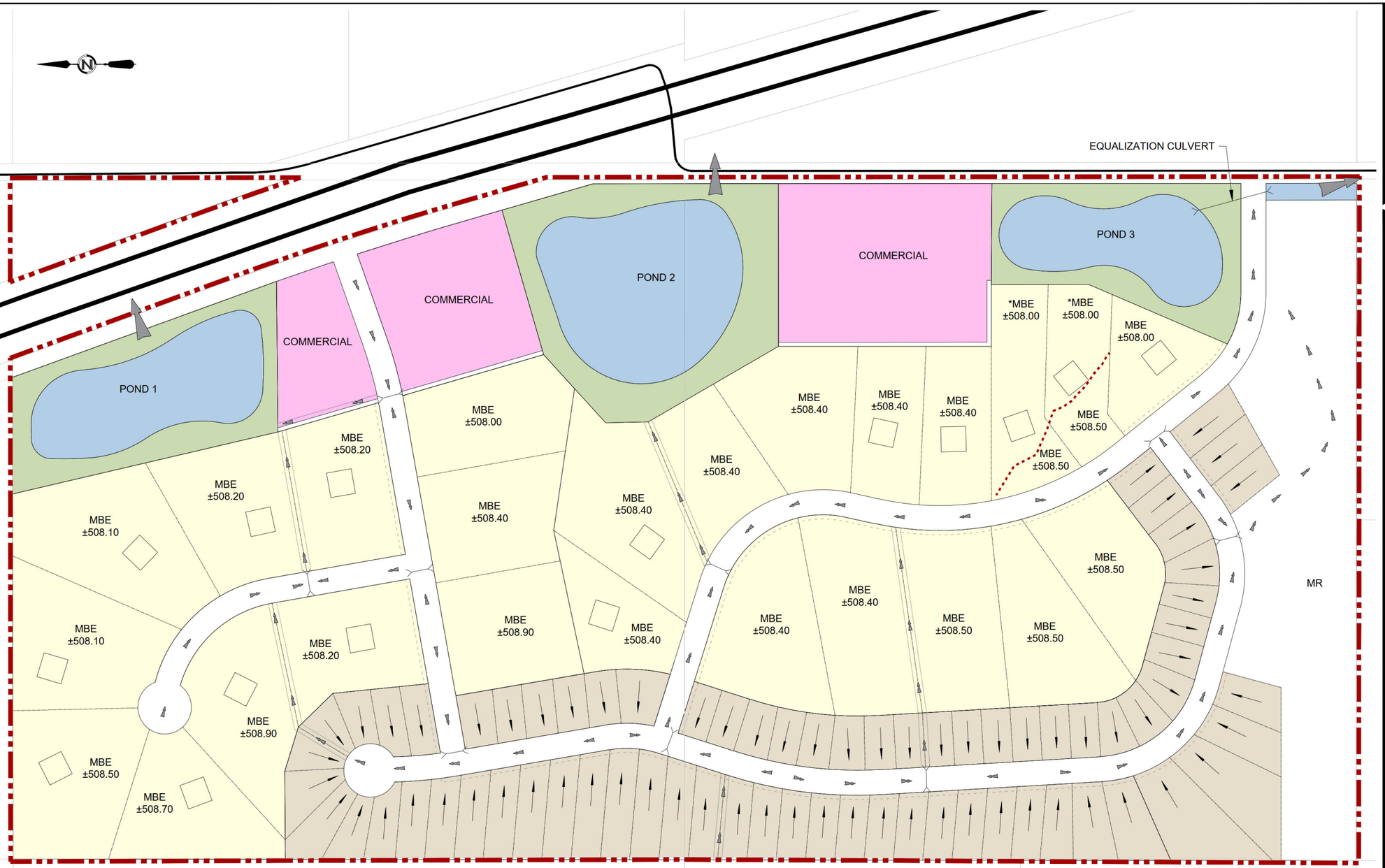
FIGURE 3

GREENVIEW ESTATES

CIVIL
PLAN
EXISTING TOPOGRAPHY & CONCEPTUAL DRAINAGE

AE PROJECT No.	20214570-00
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REV	0
DESCRIPTION	ISSUED FOR MEMO

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IF NOT 25 mm ADJUST SCALES
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LEGEND

- PROJECT AREA
- CR1 RESIDENTIAL
- COMMERCIAL
- CR4 RESIDENTIAL
- CATCHMENT RIDGE
- LOT GRADE DIRECTION
- PROPOSED EASEMENT
- PROPOSED CULVERT
- PROPOSED OVERLAND FLOW DIRECTION
- PROPOSED BUILDING SITE

NOTES:

1. * (ASTERISK) MBE MEANS MINIMUM BUILDING ELEVATION EAST OF RIDGE; THEREFORE, MBE FOR THOSE LOTS COULD BE 508.00 AT THE BACK OF LOT.

2. LOTS BELOW THE MBE WILL REQUIRE ENGINEERED FILL TO CREATE A BUILDING SITE ABOVE THE MBE. BUILDING SITES SHOWN ARE 30 m X 30 m.

3. THE MINIMUM BUILDING ELEVATIONS WILL BE CONFIRMED DURING DETAIL DESIGN.

4. IT IS ASSUMED THE CR4 LOTS WILL BE GRADED AND RAISED ACCORDINGLY USING ENGINEERED FILL. THIS WILL WE COMPLETED DURING DETAILED DESIGN. THESE SITES NEED SPECIFIC LOT GRADING TO BE DEVELOPED AND THEREFORE, NO MBE IS PROVIDED.

5. IT IS ASSUMED THE COMMERCIAL LOTS WILL BE GRADED AND RAISED ACCORDINGLY USING ENGINEERED FILL. THIS WILL WE COMPLETED ON A LOT SPECIFIC BASIS DURING DETAILED DESIGN. THESE SITES NEED SPECIFIC LOT GRADING TO BE DEVELOPED AND THEREFORE, NO MBE IS PROVIDED.

6. SPILL ELEVATIONS ARE LOWERED AT DEPRESSIONS BY INCLUDING DITCHES AND SWALES AS SHOWN IN THE CONCEPT.

FIGURE 4

GREENVIEW ESTATES

CIVIL
PLAN
CONCEPTUAL MINIMUM BUILDING ELEVATION

AE PROJECT No.	20214570-00
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DATE	2022MAR22
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DESCRIPTION	ISSUED FOR MEMO