July 8, 2024

James Capotosto
Director
Environmental Approvals Branch
Manitoba Conservation and Climate
14 Fultz Blvd
R3Y 0L6

Re: Second EAP Related to EAL 3400 - Sapphire Springs Inc Fishery – Additional Water Usage

Please find enclosed the Environmental Act Proposal for the Sapphire Springs Fish Hatchery in Rockwood, Manitoba. Sapphire Springs Inc (SSI) is reviving an existing fish hatchery and will incorporate a Recirculating Aquaculture System (RAS) to raise Arctic Char. During the 15-60% facility design process it was identified that the original designer did not include the finishing water requirements. Therefore, the overall facility water requirements increased from 3,400 lpm to 11,000 lpm, changing the facility from a Class 1 Hatchery to a Class 2 Irrigation project. This EAP is based on a Class 2 facility with water flows of 15,000 lpm including a safety factor.

In addition to the EAP, you will find our application fee and the completed Environment Act Proposal Form. In the report, SSI explains the change to their fish rearing process and its effects on the environment.

Please contact Kurt McCullagh at kmccullagh@sapphiresprings.ca or via telephone at 715-348-2310 if you have any questions regarding these documents.

Sincerely,

[redacted]

Ken Blair
President

Name of the development:
Sapphire Springs Inc

Type of development per Classes of Development Regulation (Manitoba Regulation 164/88):
Class 1 Fisheries

Legal name of the applicant:
Sapphire Springs Inc

Mailing address of the applicant: 118 - 367 Ellice Avenue

Contact Person: Kurt McCullagh

City: Winnipeg Province: Manitoba Postal Code: R0C 1H0

Phone Number: (715) 348-2310 Fax: email: kmccullagh@sapphiresprings.ca

Location of the development: 12103E Road 87 North

Contact Person: Kurt McCullagh

Street Address: 12103E

Legal Description: NE 1/4 18-15-3 EPM

City/Town: Rockwood Province: Manitoba Postal Code: R0C 1H0

Phone Number: (715) 348-2310 Fax: email: kmccullagh@sapphiresprings.ca

Name of proponent contact person for purposes of the environmental assessment:
Kurt McCullagh

Phone: (715) 348-2310
Fax:

Mailing address: 1539 Kashmir Court
Golden, BC
V0A 1H1

Email address: kmccullagh@sapphiresprings.ca

Webpage address:

Date: 2024-06-12

Signature of proponent, or corporate principal of corporate proponent:
[redacted]

Printed name: Kurt McCullagh

☑ Cover letter
☑ **Environment Act Proposal Form**
☑ **Reports/plans supporting the EAP** (see "Information Bulletin - Environment Act Proposal Report Guidelines" for required information and number of copies)
☑ **Application fee** (Cheque, payable to Minister of Finance, for the appropriate fee)

Per Environment Act Fees Regulation (Manitoba Regulation 168/96):

Class 1 Developments	$1,000
Class 2 Developments	$7,500
Class 3 Developments:	
Transportation and Transmission Lines	$10,000
Water Developments	$60,000
Energy and Mining	$120,000

[illegible]
1007 Century Street
Winnipeg, Manitoba R3H 0W4

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https://www.gov.mb.ca/sd/permits_licenses_approvals/eal/licence/index.html

Internal Use Only

ENVIRONMENTAL ACT PROPOSAL

SAPPHIRE SPRINGS INC.
Rockwood, MB

REV: 2024-06-24

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1.0 Executive Summary

Sapphire Springs Inc (SSI) raises Arctic Char using land-based facilities in Canada. SSI recently purchased property in the Stonewall, Manitoba area, formerly known as the Rockwood Aquaculture Research Facility. Renovations and expansions are planned to develop a recirculating aquaculture system (RAS) to enhance environmental control while minimizing effects on the environment. SSI has developed a design to recycle over 98% of the water resources with a filtration system that can guarantee effluent water that meets all environmental requirements. The existing buildings, water wells and discharge ditches will be repurposed and renewed to support the new process. SSI's 2022 Environmental Act Proposal resulted in License no. 3400, however the water usage requirements identified by a new process designer are greater, requiring a new EAP submittal. Updated Environmental impacts to the soil, air, and water, are explored and discussed in this report in addition to social implications of the project.

2.0 Introduction

2.1 Company Profile

Sapphire Springs Inc (SSI) has existing arctic char production capacity in the RM of Rockwood. To expand operations SSI purchased an existing DFO fishery and is in the process of renovating and adding to the DFO facility. The DFO facility consisted of several water wells, a large hatchery building and a series of lagoons draining into a municipal ditch, then into Wavey Creek.

SSI will develop this location to hatch and raise Arctic char using a recirculating aquaculture system (RAS) and aquaponics. One of the many benefits of RAS linked with on-site aquaponics is that it limits water usage and reduces the quantity of discharge water to the environment. Aquaponics is phase 2 of the project. This EAP will address phase 1 of the project which is the renovations to the existing facility and set up of the RAS and first building expansion.

2.2 Project Background and Location

Sapphire Springs (AKA 10079739 MANITOBA LTD) has purchased Parcel 'B' on Plan 64313 on NE 18-15-3 EPM. This site is 160 acres in size and is located approximately 10 miles north, and 5 miles East of Stonewall, MB on the South side of Road 87N. The parcel is south of road 87, and borders farmland to the west and south and the Rockwood National Wildlife Area to the east. The property consists of two 80-acre parcels and is the site of the former Rockwood Aquaculture Research Centre. Titles for the parcels are included in Appendix A. Built in 1971, the Rockwood facility was used to study aquaculture, fish breeding and growth and the use

of solar energy in the operation of a fish hatchery. The facility was decommissioned historically.

SSI recently purchased the facility and broodstock to upgrade, expand, improve and modernize to continue working with Arctic Char, utilizing components from the original construction in 1971. The buildings, wells and drainage system from 1971 will be infused with modern improvements.

The facility will hatch, raise and market fish to both local markets as well as worldwide exports.

3.0 Project Description

SSI will renovate the existing power building to handle electrical upgrades needed to run a highly automated system to raise Arctic Char. The wells drilled by the DFO in the 1970's and 1980's will be retrofitted with variable speed pumps and new underground water piping to the original hatchery building. The original hatchery building will receive extensive renovations including improvements to the structure, new concrete raceways and flooring. The mechanical, process, ventilation and electrical systems will be replaced, utilizing the newest energy efficient technology available to rear fish. A 550,000 sq ft addition will be added to the hatchery.

The three large existing wells will be replaced with new wells. The existing wells are shown in Photo 1.

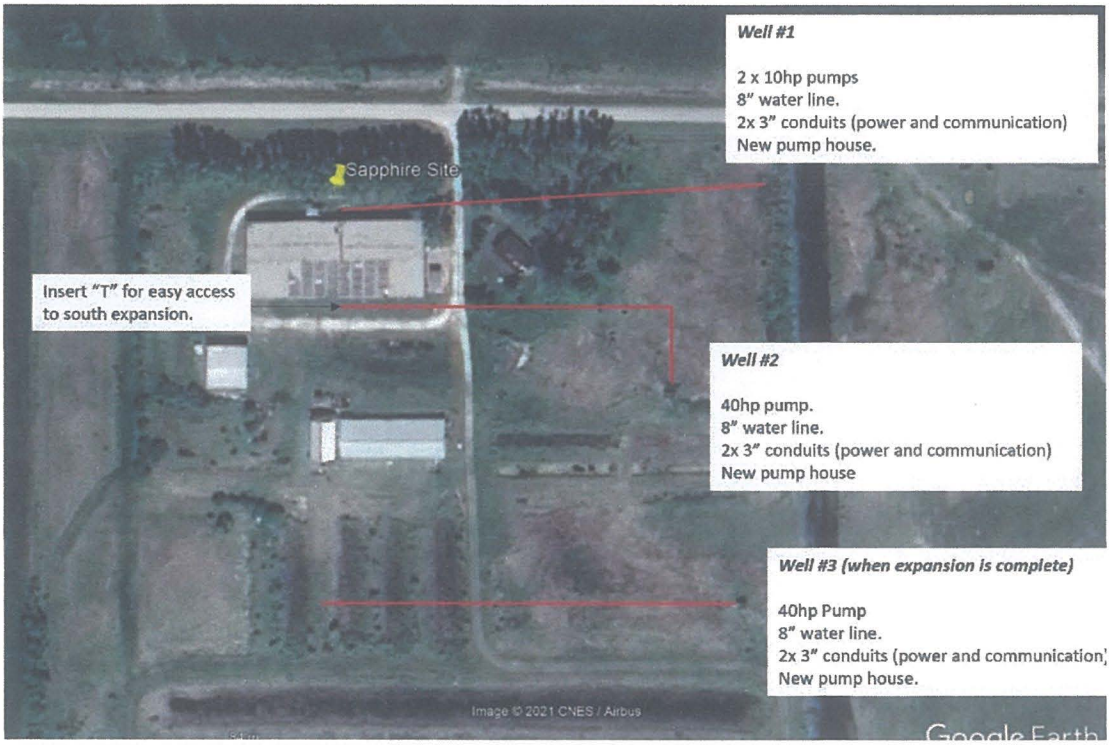


Photo 1 – Proposed Well and Raw Water Line Configuration

These well pumps will draw a maximum of 15,000 lpm (litres per minute) of water from the aquifer and send it to the hatchery. The facility is designed to operate at 11,000 lpm, the

additional 4,000lpm represents a safety factor.

The reason for the low water usage (typically 3,400 lpm to raise the fish) is the use of Recirculating Aquaculture System (RAS) technology. A typical RAS diagram is included in Appendix B.

In phase 2 the water/nitrate will be utilized in an aquaponics process to grow vegetables and green leaf plants before the water is returned to the fish. SSI will use on-site greenhouses to treat the wastewater and grow plants for export as well grow their own fish food.

The water usage is licensed through the Province of Manitoba. The previous SSI application was approved, and the facility is operating under a Temporary Permit. SSI also has a Groundwater Exploration Permit and hired Friesen Drillers to complete the well testing. These documents issued by the Manitoba Drainage and Water Rights Licensing Branch are included in Appendix C.

In January 2024, Sapphire Springs Inc (SSI) discovered that the overall facility water requirements were significantly more than anticipated when we developed our 2022 EAP (license 3400). The original Recirculating Aquaculture System (RAS) design engineers (JLH Consulting) omitted the finishing process in their design, resulting in SSI applying for a license for only the RAS portion of the facility. Now that Finishing is included, SSI's water requirements are greater than quoted in their earlier EAP. Finishing refers to the process in which the Charr are placed in a tank and large quantities of fresh water flush the fish of any off flavours accumulated during their grow out. This critical process takes 5-7 days to complete and is the last step before harvest.

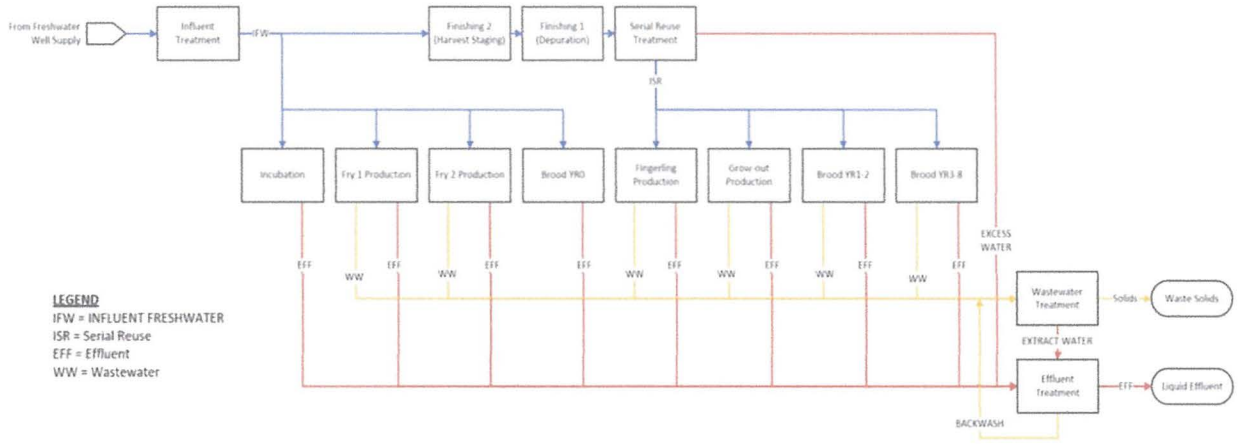
In our existing EAP the original RAS design required 3,400 lpm. Our new design firm, PRAqua (PRA) has included the Finishing process above and calculated the total water required is 11,000 lpm. During this 5-7 day finishing process, the fish are not fed so there is minimal waste and SSI will use the water downstream of this process for other facility uses. The post finishing water is used to top up the RAS system (the original 3,400lpm) and the balance of the water, approximately 7,600lpm, will be discharged to the drainage ditch identified in our license. This 7,600lpm represents the increase in water usage by SSI and it is important to note that PRA does not expect this finishing process to have any effect on the water quality. The finishing water discharge nutrient load will be slight if detectable at all. Although this is a significant change in water use, the RAS system combined with the Finishing flows is a still a fraction (approximately ½ of 1%) of a flow through system and is comparable to the original DFO operation in the 1970s and 1980s.

SSI and PRA explored reuse of the water, new technologies and current industry practices. The previously discussed finishing flows of up to 20,000lpm were found to be in excess of requirements so this amendment is based on 15,000lpm. This represents the 11,000lpm immediate requirement with a safety factor.

PRAqua has laid out the flow in this figure to better understand the routing and use of the water.

water.

Figure 1: General Water Use Strategy



The following are key features of the planned water use strategy:

· Influent water from the freshwater well supply will be treated (see Site Services point 2 below) and will then be designated as "Influent Freshwater Well (IFW)".

· The majority of IFW will be directed to the Finishing module where the fish are not fed, and high-water exchange is used to purge the fish of off-flavor compounds. The Finishing module will be operated using partial reuse aquaculture systems (PRAS) with a simplified treatment that does not employ a biofilter.

· Within the Finishing module, IFW will be directed to the tank closest to harvest (Finishing 2/harvest staging), and then to the tank that receives fish from Grow-out (Finishing 1/depuration). This strategy maximizes the concentration gradient between off-flavor compounds in the water and in the fish and minimizes the total amount of water used.

· The water discharged from Finishing is of high quality and may therefore be reused by various production modules to minimize the total amount of water demand in the facility. Finishing discharge water will be treated (see Site Services section 4 below) and is then designated as "Influent Serial Reuse (ISR)".

· ISR water will be distributed to the Fingerling and Grow-out Production modules as well as to the Brood YR1-2 and Brood YR3-8 modules. Because the immune systems of juvenile fish are under-developed, the Incubation, Fry 1, and Fry 2 Production modules, and the Brood YR0 module, will receive IFW water rather than ISR water. Excess water from Finishing that is not required to meet ISR demands will overflow directly to Effluent Treatment from upstream of the Serial Reuse Treatment system.

· All production modules except Incubation, and all brood modules except Brood YR0, are operated as recirculating aquaculture systems (RAS) which minimize water demand and maximize control over culture water quality. Within these modules, fish are being fed and

will release metabolites which will concentrate in the water. The concentrations of these metabolites are managed either through treatment or through flushing. Water demand in each module will primarily be set based on flushing of nitrate-nitrogen.

· The Incubation module is operated as a partial reuse aquaculture system (PRAS) which is a simplified version of a RAS that does not include biofiltration. Water demand within PRAS modules is based on flushing of ammonia-nitrogen.

· The Brood YR0 module is operated as a flow through aquaculture system (FTAS). As water exchange is the only means of controlling culture conditions, water demand within FTAS is based on supply of oxygen and flushing of all contaminants.

· Each production module will have both liquid effluent (EFF) and wastewater (WW) discharge streams except for Incubation and Brood YR0 which will have only an effluent discharge stream. EFF will be treated with filtration, screened to prevent fish escapement, and discharged (see Effluent Treatment below). WW will be treated with thickening technologies to reduce the volume of solid waste prior to disposal (see Wastewater Treatment below). Extract water from the thickening process will be recombined with the liquid effluent stream prior to effluent treatment.

· Advanced water treatments to allow the recycling of RAS effluent or wastewater, such as denitrification, are not currently planned for the site.

Influent Water Demand

In each of the production modules, influent flow demand is generally based on flushing flow requirements for control of various water quality parameters. The feed load conditions and the specific water quality targets for that module are key determiners of flow demand. In the Finishing module, influent flow demand is based on industry experience with flushing flow requirements to purge the fish of off-flavor compounds that have accumulated during the production cycle. The majority of the influent water is generally supplied to Finishing prior to distribution to various production modules. For the production systems, it is generally recommended that water supply systems be sized for a minimum of 150% of the normal peak influent demand to provide flows for cleaning, filling tanks, and additional flushing. Table 1 provides a summary of total influent water demand and design flow rates, by life-stage.

Table 1: Summary of Influent Demand by Life-stage

Flow (LPM)	Units	Incub-ation	Fry 1	Fry 2	Fingerl-ing	Grow-out	Finish-ing	Brood YR0	Brood YR1-2	Brood YR3-8	Facility Total [5]
Average flow [1]	LPM	73	18	80	646	3,833	10,014	152	13	37	10,336
Peak flow (bioplan) [2]	LPM	73	32	212	754	4,145	10,014	152	15	37	10,504
Peak flow (mass balance) [3]	LPM	73	65	238	871	5,068	10,014	152	18	45	10,541
Safety factor	-	-	1.5	1.5	1.5	1.5	1.0	1.5	1.5	1.5	1.0
Design flow [4]	LPM	291	97	357	1,307	7,602	10,014	228	27	68	10,986

Table Notes:

1. Average flow is calculated based on annual feed usage.

2. Peak flow (bioplan) is calculated based on weekly feed loads from the bioplan.

3. Peak flow (mass balance) is calculated based on peak design feed loads which include safety factors. Values shown assume that all similar modules are at peak demand concurrently (an unlikely scenario).

4. Design flows are set higher than calculated flows to account for instantaneous high demands, such as during tank filling or extraordinary flushing events, and are set as follows:

   a. Incubation: Based on formalin treatment flushing requirements.

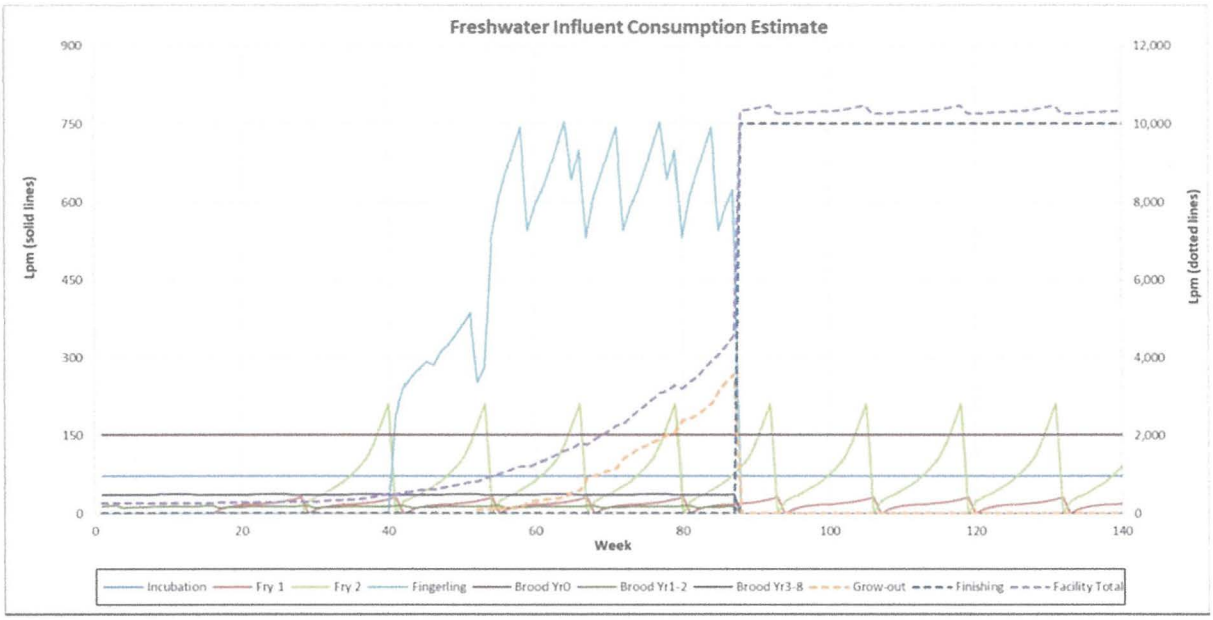
   b. Finishing: Equal to peak flow from mass balance. No safety factor recommended.

   c. All other modules: Set at 1.5x peak flow from mass balance.

5. Facility total is calculated as the maximum of either the sum of Incubation, Fry 1, Fry 2, and Finishing, or the sum of all production modules excluding Finishing.

Figure 2 below illustrates the influent use in graphical form. SSI will reach a steady state after approximately 90 weeks, after the first fish introduced to the facility reach maturity.

Figure 2: Influent Consumption Estimate



Effluent and Waste Discharge

The table below provides a summary of estimated effluent and wastewater streams from the facility based on average daily feed loads and influent flows, and an assumed treatment strategy.

Table 1: Estimated effluent and wastewater flows and quality (average).

Parameter	Units	Influent	Influent Serial Reuse	Excess Finishing Water	Effluent Filtrate	Waste-water Settling Solids	Chem/ Mech Thicken-ed Solids	Drying Solids	Blended Effluent	Waste Solids
Flow	lpm	10,336	4,530	5,485	4,787	73	65	18	10,271	18
TSS	mg/L	0.5	0.5	0.5	12.1	40,000	250,000	900,000	5.9	900,000
BOD	mg/L	0.0	0.0	0.0	78.2	19,491	21,793	78,453	36.4	78,453
TAN	mg/L	0.5	0.9	0.9	2.6	4.1	4.1	4.1	1.7	4.1
NO2-N	mg/L	0.1	0.1	0.1	0.5	0.5	0.5	0.5	0.3	0.5
NO3-N	mg/L	0.1	0.1	0.1	91.4	96.2	96.2	96.2	42.6	96.2
Organic N	mg/L	0.0	0.0	0.0	3.4	1,745.2	1,934.6	6,964.4	1.6	6,964.4
TKN	mg/L	0.5	0.9	0.9	6.0	1,749.3	1,938.6	6,968.5	3.3	6,968.5
TN	mg/L	0.7	1.1	1.1	97.9	1,846.0	2,035.3	7,065.1	46.2	7,065.1
TP	mg/L	0.0	0.0	0.0	1.2	798.5	822.2	2,959.8	0.6	2,959.8
Phosphate	mg/L	0.0	0.0	0.0	0.7	479.1	493.3	1,775.9	0.3	1,775.9
Dissolved P	mg/L	0.0	0.0	0.0	0.4	255.5	263.1	947.1	0.2	947.1

Please note the following:

· Effluent sources include overflow and drain water from the production systems, and both supernatant and extract water from wastewater treatment systems.

· Wastewater sources include filter backwash flows.

· Effluent Filtrate is effluent that has been treated with microscreen filtration.

· Blended Effluent includes the Effluent Treatment Filtrate and excess Finishing flows which are blended prior to discharge.

· Wastewater is assumed to be treated with gravity thickening, polymer addition, centrifuge, and drying, resulting in a concentrated sludge at 90% dry matter.

Note: The effluent and waste discharge analysis has been prepared with limited knowledge of site-specific water availability, effluent discharge limitations, or waste solids disposal methods. The water treatment strategy assumed will be modified once more information is made available.

Site Services

1. Site Services Overview

The various production facilities on the site will be supported by centralized services and utilities. The referenced process flow diagram in Figure 1 provides an overview of the distribution and interconnectivity of services throughout the facility.

2. Influent Treatment

The influent treatment system ensures that all flow entering the production facilities is of suitable water quality and is free of pathogens that may impact production. No other specific water quality issues have been identified and influent temperature is appropriate for use in the facility. Therefore, influent treatment processes will be limited to UV disinfection. The influent treatment module is located in the Finishing area (Area 1000) as most of the influent flow is supplied to the Finishing module.

3. Influent UV Disinfection

Influent water is the highest risk of introducing a pathogen so UV radiation on influent water will be used to prevent pathogens from entering the facility. Some pathogens may be killed outright while the DNA of other pathogens are modified so that they are unable to reproduce. Although no pathogens of concern have currently been identified, it is recommended that a safe design dosage of 150 mJ/cm2, at an assumed UV transmissivity (UVT) of 90%, be used. In-line medium pressure UV systems sized to provided validated dosages is recommended. Since the consequence of pathogens entering the facility through this water source are severe, extraordinary measures are taken to ensure that the water cannot short

circuit this disinfection process. Further, to protect against UV reactor failure caused by anything other than a power failure, a fully redundant UV reactor will be installed in series to ensure that all water is irradiated by one reactor or the other before entering the facility. Bypass piping will allow for isolation and service of an individual UV without interrupting flow.

4. Serial Reuse Treatment

All flow discharged from Finishing pass through the Serial Reuse Treatment module which will be located in the Finishing area (Area 1000).

5. Microscreen Drum Filters

Although there is no feed use in the Finishing modules, there will be some solids generated by the fish (fecal casts, scales, etc.). Therefore, all serial reuse flow will be filtered to ensure that the subsequent UV treatment is effective. One (1) micro-screen drum filter with 40-micron screens has been specified. One filter is recommended as the risk of bypassing for a short duration (due to maintenance or motor failure) is deemed low. Full flow bypass capability is integrated to ensure continuity of flow while the filter is being maintained. The filter is to be installed in a simple concrete water treatment sump that will also serve as a pump reservoir. The captured solids are to be sent to a radial flow settler for thickening and then pumped to the wastewater treatment system. Supernatant from the settler is added to effluent flows.

6. Pumping

A simple duplex pump system using centrifugal pumps will be used to pressurize flow for downstream treatments and for distribution to the production modules. Pumps are to have VFDs with pressure-based control to meet demand at the production systems. If serial reuse demand is lower than the Finishing flow, excess water will overflow from the sump to effluent. If serial reuse demand exceeds the Finishing flow, a pressure sustaining valve will be used to supplement the serial reuse flow with treated well water influent.

7. Serial Reuse UV Disinfection

As a second line of defense to limit the potential for pathogenic organisms to spread through the facility, all serial reuse water will be irradiated with UV prior to distribution to the production modules. A medium pressure UV unit, similar to that used in the influent water treatment is recommended for consistency.

8. Effluent Treatment

Overflow and drain water from all production modules, and supernatant and extract water from wastewater treatment systems, will flow to a centralized effluent treatment system which includes filtration and fish screening technologies. The effluent treatment module is located in the central Services area (Area 800).

Note: It is currently assumed that effluent discharge will be by gravity. If necessary, a pump station could be integrated. It is also currently assumed that no heat exchange is required either to recover chilling energy or to reject heat to the effluent stream.

9. Microscreen Drum Filters

Although most of the production module flows have been filtered previously, additional screening is recommended due to the discharge of untreated water from Incubation, Brood YR0, and Finishing, and the inclusion of supernatant and extract flows from wastewater treatment equipment. Two (2) micro-screen drum filters have been specified for particle removal. Filters will have 40-micron (nominal) screen pore size, with each filter sized to treat the maximum anticipated discharge flow at a maximum of 15 mg/l total suspended solids (TSS).

The captured solids are to be sent to a radial flow settler for thickening and then pumped to the wastewater treatment system. Supernatant from the settler is returned to the untreated effluent stream for processing again.

10. Fish Exclusion Screens

All discharge flow from the facility is to be screened to prevent fish escapement. The fish exclusion screen system will consist of multiple static screens. As all flow will be treated by microscreen filtration upstream, cleaning requirements for static screens are expected to be minimal. Screens are to be installed on an incline to maximize available surface area without significant water depth. Screen sizing and number will be such that one screen may be taken off-line for servicing without compromising screening capacity or the ability to meet permit requirements.

11. Wastewater Treatment

Wastewater (manure or waste solids from the production modules) will be thickened and then sent to a centralized wastewater treatment module for dewatering and drying. The wastewater treatment module is located in the central Services area (Area 800).

12. Gravity Thickening and Conveyance

Wastewater generated from drum filter backwash in each production module will be discharged into dedicated radial flow separators located within each module. The separators are used to concentrate the solids to 4-6% dry matter (40 to 50 g/L). Solids will be extracted from the separators and pumped to the Wastewater Treatment module. Extracted solids from the separator will be pumped to the wastewater treatment module using peristaltic pumps to limit particle shearing. To ensure that solids remain fluid and do not plug the pipes, pumping will be intermittent and at high velocity, and will then be chased with a flushing flow. The flushing cycle will be calibrated to the pipe length to minimize water use and dilution of solid wastes. Supernatant from the separator with the production effluent and discharged to the adjacent effluent treatment system.

13. Solids Buffering Tank

As the flow of concentrated solids from the production modules will be intermittent, a buffer tank will be used to accumulate the solids for re-pumping at a constant flow to the downstream solids thickening system.

14. Solids Dewatering

Chemical flocculation and mechanical dewatering will be applied to allow for easier storage in a cold environment, and to reduce the volume of the solids to be transported off site for upscaling/sale. Coagulants are added to optimize precipitate dissolved minerals such as phosphorus and to promote formation of dense particles. Polymers are added (complete with pH adjustments as needed) to cause the solids to clump together, creating larger particles for better performance of mechanical separation. A centrifuge is then used to separate free water from the solids. is estimated that the dried solids will contain between 15% and 30% solids after mechanical dewatering (25% assumed).

15. Drying and Disposal

Drying technologies may be used to further reduce the volume of solids. Using drying technologies, solids of 75% to 95% dry matter can be achieved (90% assumed). The duplexed drying system selected integrates a natural gas fired boiler, heat recovery system, and odor control systems. Total thermal energy requirement is 7004 MBRU/HR. If natural gas in not available, an electric heat pump system may be used as an alternative to the boiler, but there are significant additional power requirements. From the drying process, dry solids are assumed to accumulate in a series of solids handling containers. Standard solids handling containers are approximately 7 m long x 2.5 m wide x 1.3 m high and can hold up to 20 m3 of sludge. Such containers are typically fully sealed, have access hatches or lids, and rollers to facilitate removal.

Status of Work and Next Steps

SSI worked with the Province of Manitoba to obtain a Groundwater Exploration Permit (GEP) as well as a Temporary Water Use License. SSI contracted Friesen Drillers to determine the capabilities of the aquifer as well as infrastructure requirements to provide the required flows. Friesen Drillers has extensive experience with the aquifer, claiming more experience in the area than any other drilling company. Their initial comments on the January flow testing of the existing wells are very positive, already indicating aquifer capacity for the intended flows. SSI and Friesen are drilling three additional test wells to prove out the preliminary testing.

Summary

Additional testing of the aquifer water capacity and the follow-up report from Friesen's hydrogeologist will support the aquifer's capacity to supply SSI's additional water requirements.

PRAqua and SSI are aware that the current effluent and wastewater treatment design needs further study with respect to the BOD and Nitrogen parameters. Subconsultants will be used to provide solutions to these parameters. For example, Alumichem's polishing system is one of the current processes of interest. SSI will meet the effluent requirements laid out in Environmental License 3400.

The wastewater will be treated and then discharged into the existing ditches and into the RM

of Rockwood ditch which runs south to eventually enter Wavey Creek. This wastewater ditch and maintenance is licensed by the Province of Manitoba (License 2021-WCW-0444). License is attached in Appendix D.

The current phase plan will produce 5,000,000 kgs of Arctic Char annually.

The SSI project hopes to create a total of 80 jobs working two shifts in its phase 1 development.

4.0 Existing Environment in the Project Area

The SSI project requires few inputs and outputs and minimal site properties. The ideal site for an RAS-based fish rearing facility is level and clear of trees and brush. This allows SSI to develop and construct large buildings to house the fish rearing raceways, the mechanical and electrical equipment to process and pump water and greenhouses to facilitate the aquaponics portion of the fish lifecycle. The property on road 87N suits this requirement very well.

The SSI site is unique. As a site previously developed by the Department of Fisheries in the early 1970's to study raising fish, the water and waste requirements for the 2022 project with its improved technologies and processes are already in place. Previously, DFO pumped the well water continuously at high rates to provide oxygen, temperature control and flush waste from the fish rearing containers. This water was directed through underground piping and ditches to Wavey Creek. It is our understanding that the DFO used extremely high flow rates of water and wastewater to raise their fish in concrete raceways, fiberglass tanks and earthen ponds. Large water heaters were used to temper the ground water at various rates to study the effects on the health and growth rate of the fish, among other parameters.

SSI intends to utilize the same wells and wastewater discharge route however the discharge rate is expected to be 95% less than in the mid-70's operation. The existing building will be gutted including some concrete demolition to make way for newer process technology and structural improvements such as insulation and cladding plus revisions to the concrete raceways to install underdrains. The engineered flow rate calculations show a 99.68% recycle rate for the water so process water use will be minimal. Additional water will be used for cleaning the facility and cooling the grow tanks but the continuous use of raw water is minimal with the RAS technology.

The current phase consists of a 550,000sq ft expansion to the south side of the existing DFO building. Figure 2 shows the planned renovations for the existing building and Figure 3 illustrates the RAS equipment layout for the expansion.

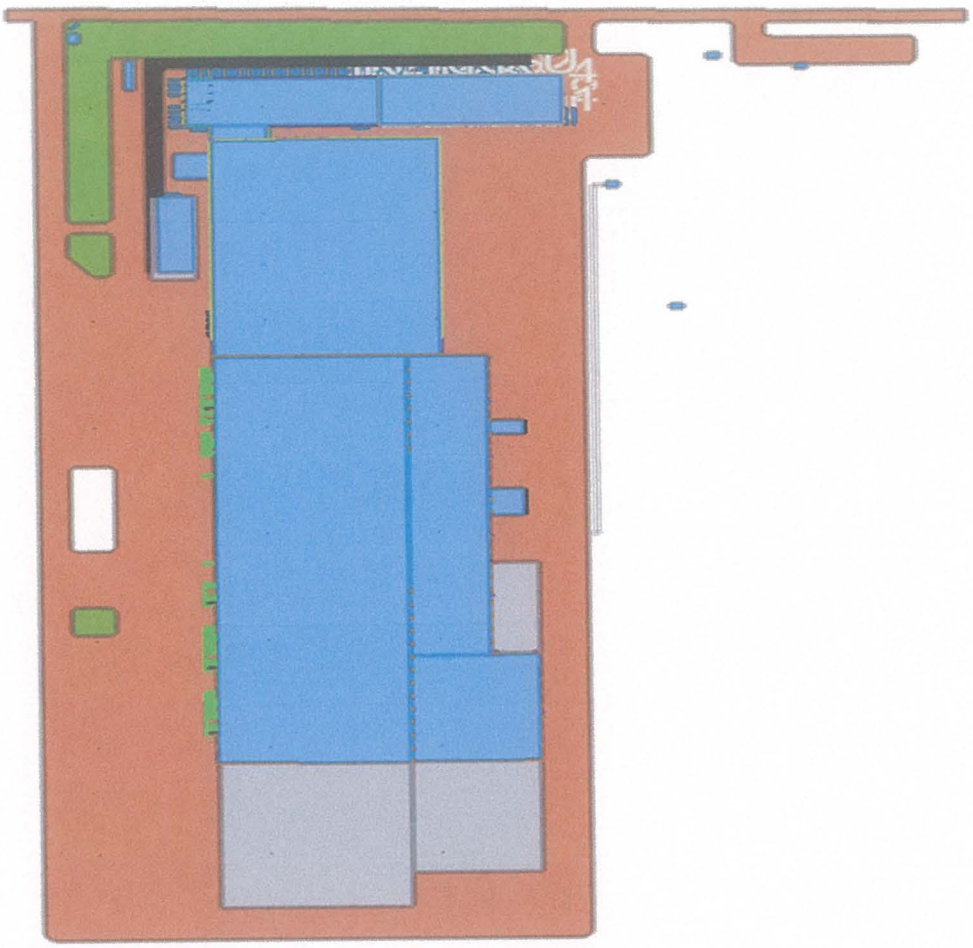


Figure 2 – Existing Building Renovation Plan

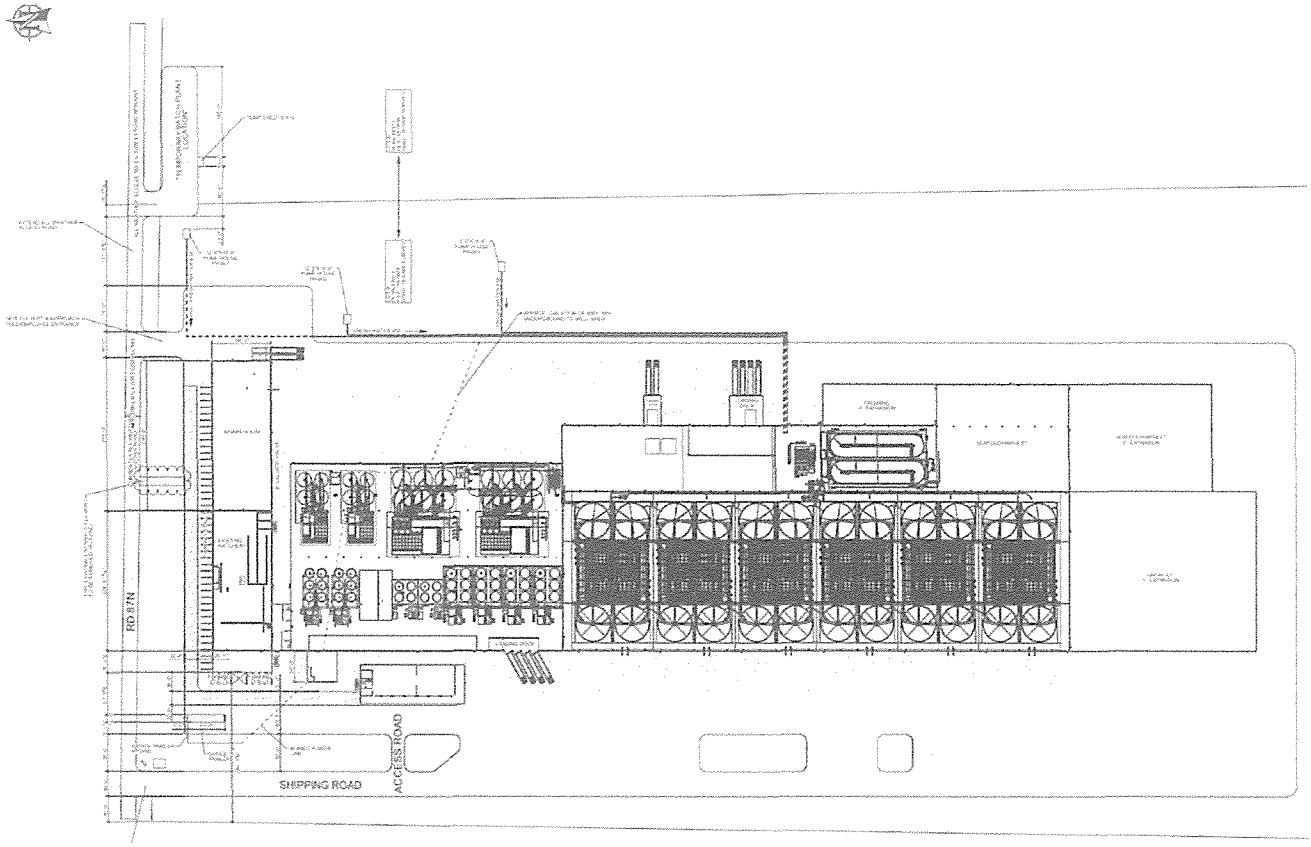


Figure 3 – 300' x 400' Addition RAS Equipment Layout

The closest weather data available is from Gunton, approximately 5.5km west and 2 km north of the SSI property. Gunton's climate is designated as a "Warm Summer Continental Climate" by the Koppen Climate Classification system. This climate is typified by warm summers and cold winters, somewhat of an extreme variation. The warmest month is July (average 19.1C) and the coldest is January (average - 17.3C). The average amount of precipitation is 523mm, with the most rain occurring in June (99mm) and the most snow in November (216mm). This data, along with additional detail is included in Appendix E. Although the SSI facility is located indoors, the climate is key for both temperature and humidity. The cool weather in the winter requires well water to add heat to the RAS process and the warm summer weather will require well water to cool the fish. It is expected that the heat produced by the fish will contribute to the building heating however no supplemental winter heat will be included in the HVAC design. The annual precipitation trends are less of a factor in the SSI process since the tanks are contained within the building, ensuring complete control of the water in the RAS system. It is noted that the wetter period in June and the typically saturated soils on this site will require attention to prevent pooling of water. Site drainage will be incorporated into the facility design.

The site soil type is mainly highly plastic inorganic clay with some areas of medium plastic inorganic clay. This is typical of the area and is known as a poor drainage type of soil, which in the case of the SSI project will help mitigate any leeching into the subgrade thus promoting flow through the ditch into Wavey Creek. This area is defined by the RM of Rockwood as a wet

region with marsh-like characteristics. Further, the RM classes this land as unimprovable, however suitable for producing native forages. It is fact that the local farmers are anxious for the SSI project to begin because they remember that the DFO facility lowered the water table, exposing more usable farmland. SSI explained to these neighbors that the water usage will be less than the past and it is not expected that SSI operations will lower the water table.

Specifically referencing the water table, it is noted that the current water level is approximately 450mm below the ground surface. Test pits dug at existing well #6 and well #4 support this information. The well piping will be linked inside the building so that either well can supply the required water. The Aski Geosciences geotechnical report is included in Appendix F.

SSI is in the East Interlake Watershed District, managed by the Gimli office. More specifically, it falls within Zone 5 of the Netley-Grassmere watershed, shown in Figure 4 below.

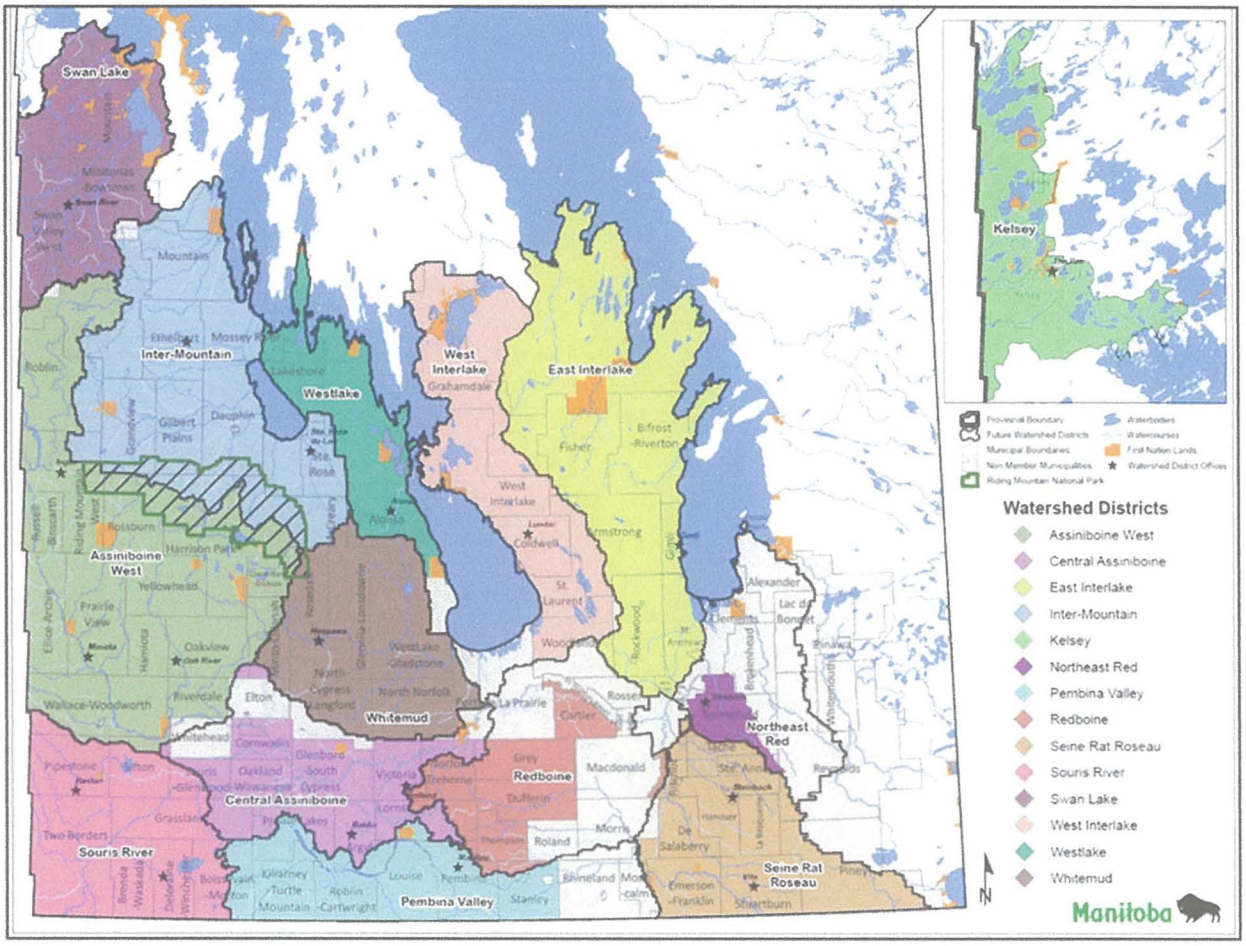


Figure 4 - East Interlake Watershed District

Zone 5 is designated as an agricultural area, relatively flat with a slight slope from west to east. SSI's property is immediately east of Zone 2 which is historically known as the St. Andrews Bog and this close proximity to the marshlands influences the groundwater level. Although there are cultivated areas around the property, it appears that this parcel of land is low and boggy. One of the characteristics of Zone 5 is that the drainage network is necessary

to remove summer runoff and prevent crop losses due to standing water. One tool to prevent these losses is to maintain the existing drainage infrastructure and the RM of Rockwood is actively maintaining the upper reaches of the Grassmere drain, part of the existing drain from the SSI parcel. This work includes surveying and removal of siltation and vegetation growth where it prohibits water flow. SSI commits to work cooperatively with the RM of Rockwood to maintain their drainage ditches and has already opened communication with their office in this regard.

The SSI wells draw water from the Carbonate aquifer, a highly productive limestone and dolostone water source underlain by the Winnipeg Formation. The wells are shallow and do not penetrate the Winnipeg formation, which ensures better quality water that the saline Winnipeg water. Two of the existing wells on the property are artesian, indicating significant pressure in the aquifer. Figure 5 illustrates the theory with the well placement within the Carbonate Aquifer.

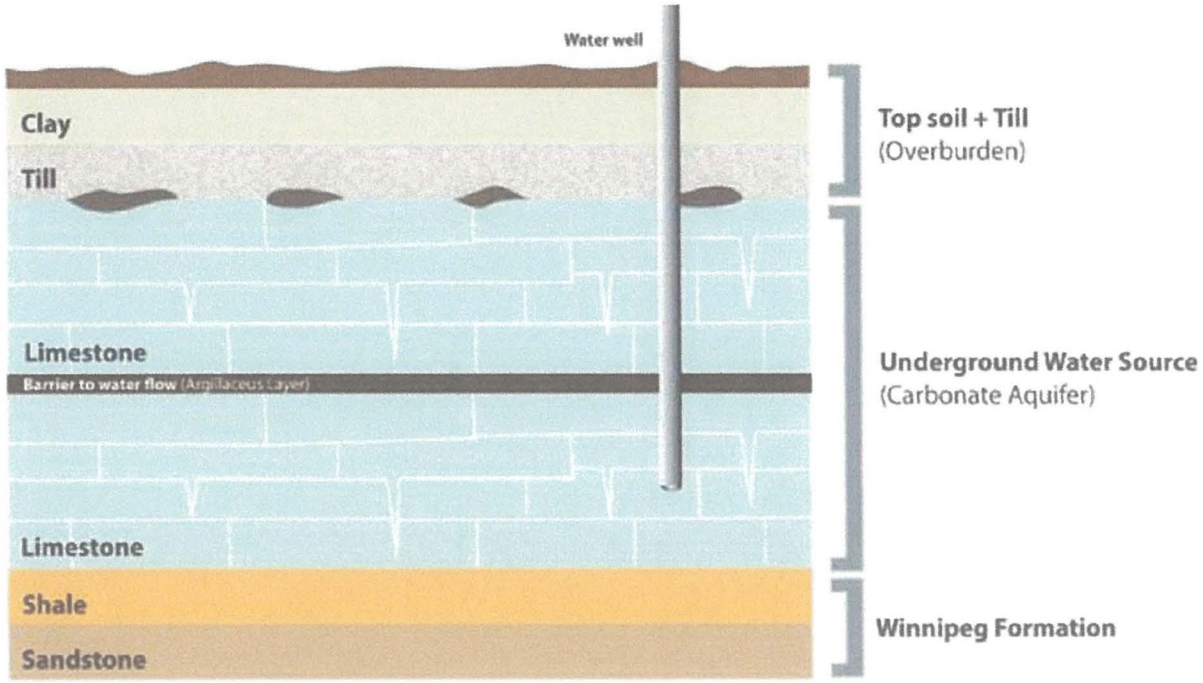


Figure 5 - Carbonate Aquifer Diagram

The property borders the Rockwood National Wildlife Area to the east as depicted in Figure 6.

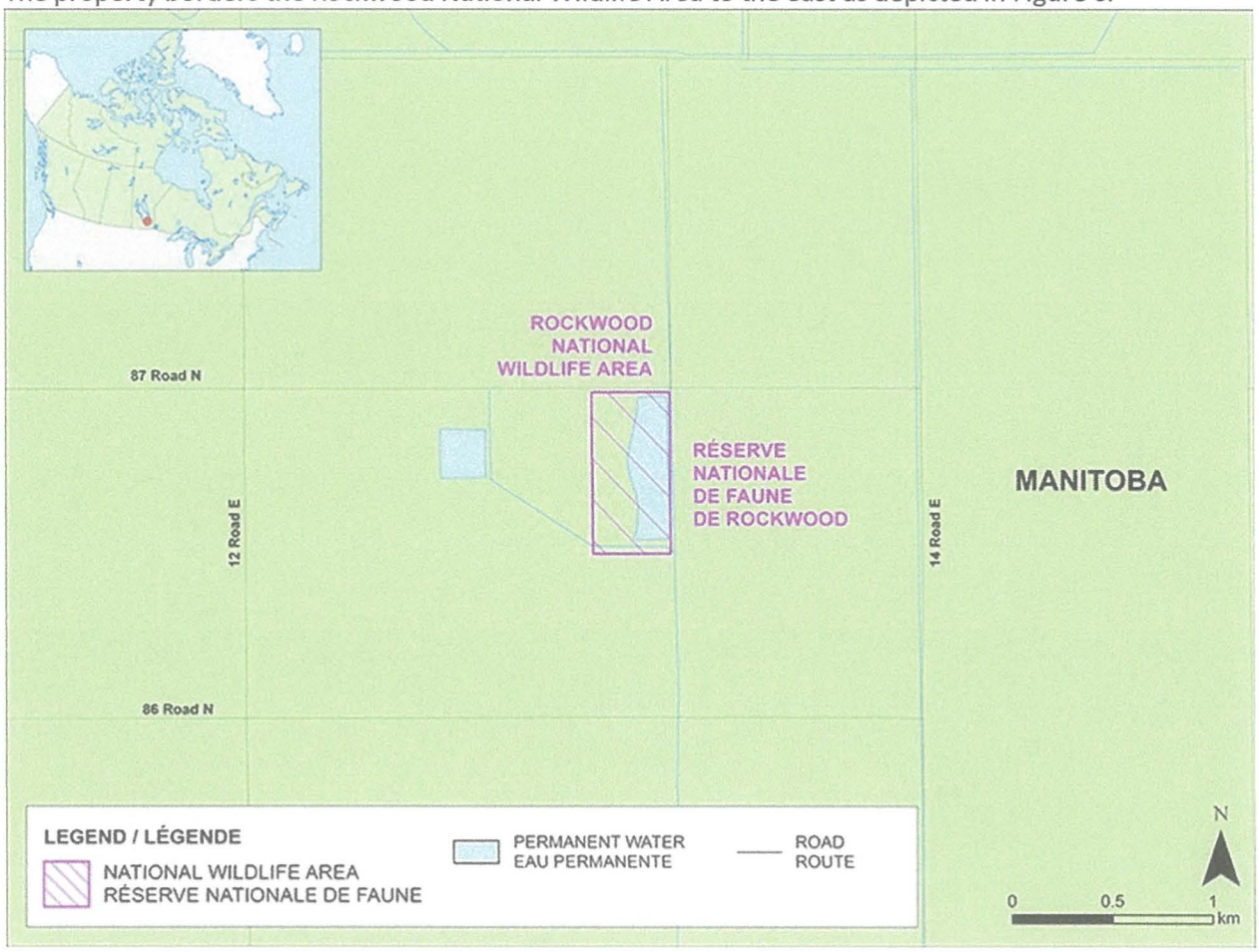


Figure 6 - SSI Proximity to Rockwood National Wildlife Area

This area is an artificial wetland, created by building dykes around all sides. This area was built to develop bird habitat and mitigate flooding on adjacent private land, such as the SSI property. It is a refuge for grassland birds, waterfowl, marsh hawks and short-eared owls. Previously, this area was impacted by the DFO hatchery operations which prompted the Canadian Wildlife Service (CWS) to work with Ducks Unlimited Canada to design and construct a dyked area to protect the natural habitat. As shown in the map above, this area is not only protected from impact from SSI, it's dykes form part of the drainage ditch established by DFO in the 1970s. The blue line running south/southeast indicates the approximate location of the ditch noted above. It is not expected that the SSI operations will impact the Rockwood Wildlife Area.

Further, it is not expected that the SSI operation will impact local wildlife significantly. The facility expansion will remove vegetation which will displace the nesting area for birds such as Meadowlarks, Killdeer and Snipes. Due to the current high water table, there are no noted ground squirrels or other burrow animals so SSI will not displace those residents. The water system is underground, and the drainage system is existing and under improvement by others, so we expect there to be minimal disruption to aquatic life due to SSI.

There are no known heritage resources or historic sites in this area and the closest Indigenous community is over 40km from the SSI property.

SSI will employ 80 people working two shifts in the phase 1 operations. Construction of the new facility will employ over 120 people for a two-year period, utilizing local contractors to the fullest extent possible. Further expansion will employ additional personnel.

5.0 Description of Environmental and Human Health Effects of the Proposed Development

The SSI project is expected to have a negligible effect on the environment in terms of wildlife or fisheries. The site does not have any current bodies of water that contain fish and physical inspection of the proposed building site does not indicate any wildlife. Mowing of the grass by previous owners in the proposed building expansion area encouraged any wildlife to seek shelter in other areas.

There are no current surface water collection areas. There are dugouts and ponds that were utilized by DFO however the drainage systems are open, draining these areas into the ditch and eventually into the creek.

The future operations will involve drawing water from the wells and discharging wastewater into the existing ditch system. The wastewater will make its way into the Wavey Creek system and eventually into the Red River. Compared to flow through, the water usage will be minimal, less than 11,000 lpm by SSI compared to 3,400,000 lpm for an equivalent flow through facility.

The current flow of the artesian wells is very close to 250gpm before operations because there are currently three flowing artesian wells on the property. This water is flowing overland into the drainage ditch which makes its way to Wavey Creek and further points before entering the Red River and Lake Winnipeg. Historical data indicates that these wells flowed less during the DFO fishery operations so it is expected that the uncontrolled flow from these wells will be reduced when SSI starts up their facility. In addition to the reduction of pressure on these wells, SSI will cap the artesian wells to control their flow, reducing their impact on the environment. This process will be closely monitored to prevent flow from the aquifer on the outside of the well casing in case there is a poor interface between the rock and the casing. Overall, the impact of the SSI operations will likely reduce the overall flow of water leaving the land based on current conditions.

SSI's RAS process will not produce hazardous waste and the fish product is not hazardous. There will be very minimal risk to human health or safety with respect to the general public. SSI will develop procedures and protocols for using potentially harmful products in construction, maintenance and operation of the facility. This system typically includes a collection of WHMIS documents and instructions on how to use and care for these materials. SSI will maintain storage of gasoline, diesel and related hydrocarbon products in locked

storage within the shop area, a separate enclosure from the main building. An external ULC listed double walled fuel tank will be located outside the powerhouse to provide fuel for the yard skid steer and mower. SSI will be quite diligent in this area, an accidental release of these types of materials could not only harm the environment, but they could also destroy the fish and contaminate the RAS equipment. Extreme care and control of all hazardous materials is the only way to mitigate these risks. Forklifts and material handling equipment will be either electric, battery or propane powered to eliminate the risk of spills or discharge of hydrocarbons at the facility.

Emergency backup power generator fuel storage will be located on the East side of the ditch, in double walled fuel tanks.

It is expected that diesel trucks will be used to supply feed to the plant as well as exporting the fish. These trucks will be equipped with particulate filters and Tier 4+ engines to minimize their effect on the air quality. Procedures for the facility include zero idling to reduce emissions and noise.

The SSI facility is located over 600 metres from the nearest residence. This buffer is in excess of the 400 metre industrial buffer required by the RM of Rockwood. Noise is not expected to be an issue with local residents since the largest source of noise will be the 7.5 HP and 30 HP blowers. These blowers will operate in excess of 100dB and will be constructed with sound-dampening enclosures and muffled to lower sound levels, both inside and outside the facility.

Construction activities will increase sound levels and emissions from the equipment on a temporary basis. To mitigate effects on the nearby residents, activities will be restricted to normal working hours (no night shifts) and newer equipment with emissions-compliant engines and exhaust will be used to the greatest extent.

6.0 Mitigation Measures and Residual Environmental Effects

One fundamental of the RAS technology in raising fish is reducing demand on the environment. Recycling the water used to raise fish is an improvement over conventional flow through fish farming and using the latest technology the recycling rate can be as high as 99%. Compared to containers submersed in natural bodies of water, the RAS is superior in controlling conditions to raise healthy fish with minimal impact on the environment. Farmers can now control all aspects of the growing conditions, not only feed rates, oxygen levels and temperature, but also the collection and responsible reuse of the waste produced by the fish.

SSI plans to utilize the newest RAS technology, specifically designed for their facility. PRAqua of Nanaimo BC designed the SSI specific system for this application, using the best products available for the Rockwood facility. SSI's own technologists designed the feed storage and distribution systems as well as the building layout and construction. SSI plans to renovate the existing building, improving the insulation and vapour barrier and have designed the new

buildings with energy efficiency as a key point.

SSI will improve the buildings and install new equipment, but the necessities were already available. The DFO facility already had an ample supply of suitable water and a well-developed drainage system.

Once the new facility is operational the management team will continually monitor the inputs and outputs of the system to fine tune the efforts required to raise the Char. This testing will not only improve the efficiency of the operation, it will also minimize the waste as part of the efforts.

7.0 Follow up Plans, including Monitoring and Reporting

While SSI optimizes the new RAS, they will also monitor the raw water flow, recycle rate, solid waste production and the wastewater discharge. The RM of Rockwood and SSI have a signed agreement (Appendix H), to work together to improve and maintain the existing drainage ditches. The managers will report water usage on an annual basis as part of the water license.

8.0 Conclusion

Sapphire Springs Inc. is one of the industry leaders in raising Arctic Char and will soon be the largest producer of land-based Char. It is SSI's goal to maximize their fish production while limiting their impact on the environment. In this renovated facility in Rockwood, SSI will utilize the newest technology in environmental control pertaining to inputs and outputs including a recirculating aquaculture system. The proposed facility will have minimal impact on the surrounding area while producing new jobs and economic opportunities for the community. SSI's plan will revitalize a decommissioned facility with a new production process which reduces water usage to a fraction of previous levels with treatment of the discharge water to bring contaminant levels well below mandated levels. SSI obtained a water license and a drainage permit in consultation with Manitoba and the RM of Rockwood to support the facility.

9.0 References

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Gunton Aquifer https://www.google.com/search?q=gunton+manitoba+aquifer&rlz=1C1GCEA_enCA975CA975&sxsrf=APq-WBv28vb7pBRSc2_4xGIhS6kRlZZVJQ:1649953140705&tbm=isch&source=iu&ictx=1&vet=1&fir=PBuCDy1-acv7oM%252Cv0j6XukhxClpHM%252C_%253BVF0Y--Z2ff3WLM%252C5yibdMtQ0IxmgM%252C_%253Ba3auwVcWbJH_MM%252Cp26aTi91MKcj8M%252C_%253BU3G6OTOeiIlTXM%252C-om_agf0Nrd1oM%252C_%253BTFx75gcl4VrQxM%252Cv9DrPdagXWreJM%252C_%253BL7htWdsEj9wXOM%252C0gVREfLKlfjlJM%252C_%253BX2TLmx_RKgegKM%252CvAanV38QKqtP6M%252C_%253BM_NkkzrTBeFpUM%252Ciuh5MaLf4hayEM%252C_%253BcLhic8pJbsi3SM%252Cv9DrPdagXWreJM%252C_%253BI_BVQj0mjgjEnM%252Camj_gxNmuxc8mM%252C_&usg=AI4_-kTfdTPD-HQ7rT5Q4IGkCo4BQ56scw&sa=X&ved=2ahUKEwiE2uO2-pP3AhUjPn0KHb-TCmwQ9QF6BAgFEAE

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Dissolved Oxygen https://www.enr.gov.nt.ca/sites/enr/files/dissolved_oxygen.pdf

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Lake Winnipeg Information – Phosphorus https://www.globalseafood.org/advocate/tan-other-water-quality-factors-affect-nitrification-rates-in-biofilters/

SAPPHIRE SPRINGS

CORPORATE OFFICE:
118-367 Ellice Ave.
Winnipeg, MB R3B 1Y1

AQUACULTURE FACILITY:
12103 East Rd. 87 North
Rockwood, MB R0C 1H0

10.0 APPENDICES

10.1 APPENDIX A – SAPPHIRE TITLE PARCEL A & B

STATUS OF TITLE

Manitoba Land Titles Registry

Title Number	**3110018/1**
Title Status	**Accepted**
Client File	0091214.7/SMN

1. REGISTERED OWNERS, TENANCY AND LAND DESCRIPTION

10079739 MANITOBA LTD.

IS REGISTERED OWNER SUBJECT TO SUCH ENTRIES RECORDED HEREON IN THE FOLLOWING DESCRIBED LAND:

PARCEL "A" PLAN 64313 WLTO
EXCEPTING ALL MINES AND MINERALS AND OTHER MATTERS AS SET FORTH IN THE CROWN LANDS ACT
IN NE 1/4 18-15-3 EPM

The land in this title is, unless the contrary is expressly declared, deemed to be subject to the reservations and restrictions set out in section 58 of *The Real Property Act*.

2. ACTIVE INSTRUMENTS

Instrument Type:	**Mortgage**
Registration Number:	**4957211/1**
Instrument Status:	**Accepted**
Registration Date:	2018-05-16
From/By:	BRADLY RICHARD MCDONALD
To:	SUNOVA CREDIT UNION LIMITED
Amount:	$86,800.00
Notes:	No notes
Description:	No description

3. ADDRESSES FOR SERVICE

10079739 MANITOBA LTD.
Suite 430, 2855 Pembina Highway, Unit 35
Winnipeg MB
R3J 2H5

4. TITLE NOTES

No title notes

5. LAND TITLES DISTRICT

Winnipeg

6. **DUPLICATE TITLE INFORMATION**

Duplicate not produced

7. **FROM TITLE NUMBERS**

2992329/1 All

8. **REAL PROPERTY APPLICATION / CROWN GRANT NUMBERS**

No real property application or grant information

9. **ORIGINATING INSTRUMENTS**

Instrument Type:	**Transfer Of Land**
Registration Number:	**5271803/1**
Registration Date:	2021-03-10
From/By:	Bradly Richard McDonald
To:	10079739 MANITOBA LTD.
Consideration:	$800,000.00

10. **LAND INDEX**

Lot A Plan 64313
EXC CLA

CERTIFIED TRUE EXTRACT PRODUCED FROM THE LAND TITLES DATA STORAGE SYSTEM OF TITLE NUMBER 3110018/1

STATUS OF TITLE

Manitoba
Land Titles Registry

Title Number	**3110019/1**
Title Status	**Accepted**
Client File	0091214.7/SMN

1. REGISTERED OWNERS, TENANCY AND LAND DESCRIPTION

10079739 MANITOBA LTD.

IS REGISTERED OWNER SUBJECT TO SUCH ENTRIES RECORDED
HEREON IN THE FOLLOWING DESCRIBED LAND:

PARCEL "B" PLAN 64313 WLTO
EXCEPTING ALL MINES AND MINERALS AND OTHER MATTERS AS SET FORTH IN THE CROWN LANDS ACT
IN NE 1/4 18-15-3 EPM

The land in this title is, unless the contrary is expressly declared, deemed to be subject to the reservations and restrictions set out in section 58 of *The Real Property Act*.

2. ACTIVE INSTRUMENTS

Instrument Type:	**Mortgage**
Registration Number:	**4957211/1**
Instrument Status:	**Accepted**
Registration Date:	2018-05-16
From/By:	BRADLY RICHARD MCDONALD
To:	SUNOVA CREDIT UNION LIMITED
Amount:	$86,800.00
Notes:	No notes
Description:	No description

3. ADDRESSES FOR SERVICE

10079739 MANITOBA LTD.
Suite 430, 2855 Pembina Highway, Unit 35
Winnipeg MB
R3J 2H5

4. TITLE NOTES

No title notes

5. LAND TITLES DISTRICT

Winnipeg

6. **DUPLICATE TITLE INFORMATION**

Duplicate not produced

7. **FROM TITLE NUMBERS**

2992331/1 All

8. **REAL PROPERTY APPLICATION / CROWN GRANT NUMBERS**

No real property application or grant information

9. **ORIGINATING INSTRUMENTS**

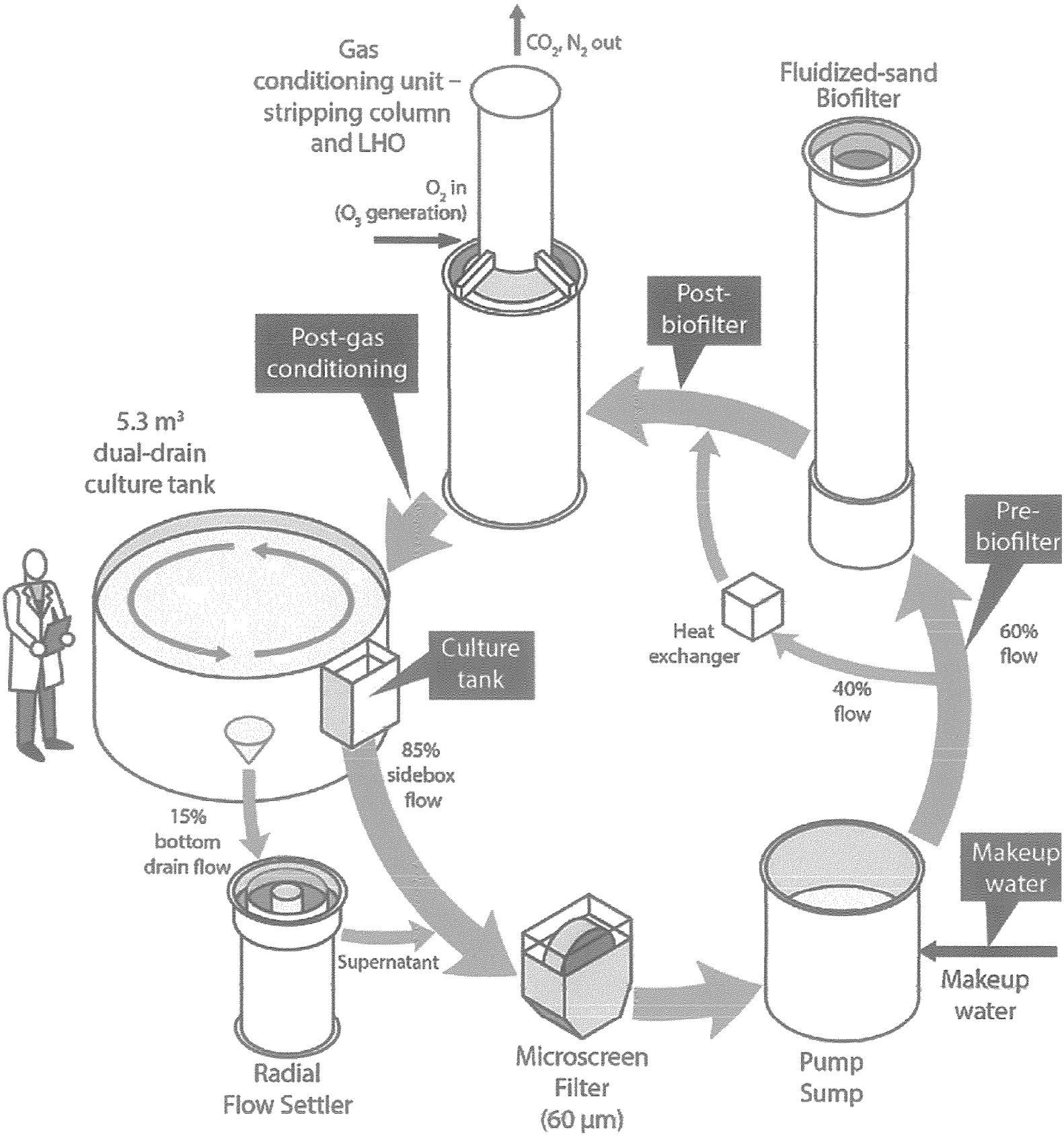
Instrument Type:	**Transfer Of Land**
Registration Number:	**5271803/1**
Registration Date:	2021-03-10
From/By:	Bradly Richard McDonald
To:	10079739 MANITOBA LTD.
Consideration:	$800,000.00

10. **LAND INDEX**

Lot B Plan 64313
EXC CLA

CERTIFIED TRUE EXTRACT PRODUCED FROM THE LAND TITLES DATA STORAGE SYSTEM OF TITLE NUMBER 3110019/1

10.2 APPENDIX B – RAS PROCESS FLOW


CO_2, N_2 out
Gas conditioning unit – stripping column and LHO
O_2 in (O_3 generation)
Fluidized-sand Biofilter
Post-biofilter
Post-gas conditioning
5.3 m³ dual-drain culture tank
Pre-biofilter
Heat exchanger
60% flow
40% flow
Culture tank
85% sidebox flow
15% bottom drain flow
Makeup water
Supernatant
Makeup water
Radial Flow Settler
Microscreen Filter (60 µm)
Pump Sump

10.3 APPENDIX C – WATER USE LICENSE CORRESPONDENCE

quarryridgeconstruction@gmail.com

From: Rob McCarthy <rmccarthy@sapphiresprings.ca>
Sent: Monday, April 4, 2022 11:43 AM
To: QRC
Cc: Ken Blair
Subject: FW: Sapphire Water License

Hey Kurt,

We are registered in the system and they are just awaiting at start date. Normally one would get the EAL, then the Water Rights License according to Kylene below....

Rob

From: Wiseman, Kylene (CC) <Kylene.Wiseman@gov.mb.ca>
Sent: April 4, 2022 11:51 AM
To: Rob McCarthy <rmccarthy@sapphiresprings.ca>
Cc: Miranda, Ronaldo (CC) <Ronaldo.Miranda@gov.mb.ca>
Subject: RE: Sapphire Water License

Hello Rob,

As stated below, we require an official start date before we can begin the process of preparing a Water Rights Licence.

We do not issue letters of intent to licence. You are presently registered in our system and we are awaiting a start date.

And please note that our process and Environment Act Licensing's (EAL) process work in parallel, but separate from each other. You will likely receive an EAL licence before you would receive a Water Rights Licence. A Water Rights Licence is not typically included in documents for an EAL – the EAL will likely include a clause stating that you must have a Water Rights Licence (not that it needs to be in place before the EAL is issued).

I hope this is helpful to you.

Thank you,

Kylene Wiseman, P.Geo.

Drainage and Water Rights Licensing Branch
Environment, Climate and Parks
Kylene.Wiseman@gov.mb.ca / Cell: 431-337-7946
Box 16 - 200 Saulteaux Crescent Winnipeg MB R3J 3W3

From: Rob McCarthy <rmccarthy@sapphiresprings.ca>
Sent: April 3, 2022 2:33 PM
To: Wiseman, Kylene (CC) <Kylene.Wiseman@gov.mb.ca>; Miranda, Ronaldo (CC) <Ronaldo.Miranda@gov.mb.ca>

Cc: QRC <quarryridgeconstruction@gmail.com>
Subject: RE: Sapphire Water License

Hi Kylene,

We are getting closer to our start date for our aquaculture operation at the old DFO site.

We are working on our environmental license currently with Bruce Webb and one of the items we need to confirm is our water license. I'm not sure what comes first here, as we need to go through the environmental licensing but require the water license to do so.

Can you please provide some guidance on this? Is there a letter that can be provided confirming that we will have our water license when required? We need something to append to the report.

On that note, we will be setting up tanks and pumps etc preparing for aquaculture in the next month or so, and the facility will be operational by early summer

Please advise.

Thanks,

Rob McCarthy – Chief Operating Officer
Cell : (204) 232-9779 | Office: (204) 560-4660
rmccarthy@sapphiresprings.ca

sapphiresprings.ca

#12103E Road 87 North | Rockwood, Manitoba, Canada R0C 1H0
Corporate Office
118 – 367 Ellice Avenue | Winnipeg, Manitoba, Canada R3B 1Y1

SAPPHIRE

From: Wiseman, Kylene (CC) <Kylene.Wiseman@gov.mb.ca>
Sent: May 11, 2021 11:47 AM
To: Rob McCarthy <rmccarthy@sapphiresprings.ca>
Subject: RE: Sapphire Water License

Ok, great.

Please let me or Ronaldo know of any questions you may have along the way.

Take care and stay safe.

Kylene Wiseman, P.Geo.

Drainage and Water Rights Licensing Branch
Conservation and Climate
Kylene.Wiseman@gov.mb.ca / Tel: 204-945-7424 / Cel: 431-337-7946
Box 16 - 200 Saulteaux Crescent Winnipeg MB R3J 3W3

From: Rob McCarthy <rmccarthy@sapphiresprings.ca>
Sent: May 11, 2021 11:44 AM
To: Wiseman, Kylene (CC) <Kylene.Wiseman@gov.mb.ca>
Subject: Re: Sapphire Water License

Hi Kylene. I understand. We will let you know when we complete the environmental work with Bruce and our actual start date.

Thanks.

> On May 11, 2021, at 11:33 AM, Wiseman, Kylene (CC) <Kylene.Wiseman@gov.mb.ca> wrote:
>
> Hi Rob,
>
> Yes, it was great to meet you all last week!
>
> We can only licence the project when the water is ready to be used for aquaculture. We cannot pre-emptively issue a licence and this project has yet to go through the Environment Act Licensing process.
>
> Please note that the facility can test it's pumps and tanks without a Water Rights Licence.
>
> And please note that we cannot guarantee a date for a Water Rights Licence, but we would do our best to have it prepared for the official start date of the operation.
>
> Cheers,
>
> Kylene Wiseman, P.Geo.
>
> Drainage and Water Rights Licensing Branch
> Conservation and Climate
> Kylene.Wiseman@gov.mb.ca / Cell: 431-337-7946

From: Rob McCarthy <rmccarthy@sapphiresprings.ca>
Sent: May 10, 2021 7:26 PM
To: Wiseman, Kylene (CC) <Kylene.Wiseman@gov.mb.ca>
Subject: Sapphire Water License

Hi Kylene,

Thanks for meeting with us last week, it was good to talk to you 'in person'!

We are hoping that we can start up our site on June 1st to test pumps and start running some tanks. Can we use June 1st as our start date and have the license start on the same date?

Thanks,

Rob McCarthy

Chief Operating Officer | Sapphire Springs Inc.
118 – 367 Ellice Ave

10.4 APPENDIX D – 2021-WCW-0444 FINAL LICENSE

Licence to Construct
Water Control Works

Manitoba

Issued in accordance with the provisions
The Water Rights Act and regulations made thereunder.

Project: Sapphire Springs
File Number: 3.30.9
Licence No.: **2021-WCW-0444**

Subject to the terms and conditions contained in this Licence, the Minister charged with administration of the Water Rights Act for the Province of Manitoba authorizes:

Sapphire Springs Inc

in the **Rural Municipality of Rockwood** in the Province of Manitoba (the 'LICENSEE') to construct drainage or other works ("the WORKS") described as follows:

Recontruct existing drain to improve local drainage conditions

And located on the following described lands:

NE-18-15-3-E

as more particularly located and shown on the attached Exhibit(s).

This Licence is issued upon the express condition that it shall be subject to the provisions of The Water Rights Act and Regulations and all amendments thereto and, without limiting the generality of the aforesaid. The WORKS shall be constructed and operated in accordance with the terms and conditions described as follows:

1. Reconstruct existing drain to a maximum depth of **1.52 metres (60 inches)** below prairie, with a **1.82 metres (6.00 feet)** base width at location(s) indicated on attached Exhibit(s). Excavated soil may be spread on adjacent lands but not to be used in the filling of seasonal, semi-permanent or permanent wetlands.

2. Additional terms and conditions include but are not limited to:

   a) All WORKS conducted or outletting outside the legal landowners property holdings may only be done with the express written permission and completed to the satisfaction of the respective landowner.

   b) The LICENSEE shall hold and maintain all other regulatory approvals that may be required and shall comply with all other regulatory requirements for the construction, operation, or maintenance of the WORKS or to divert water as provided by this Licence.

   c) Notwithstanding anything preceding in this Licence, the LICENSEE must have legal control, by ownership or by rental, lease, or other agreement, of the lands on which the WORKS shall be placed.

   d) The LICENSEE shall, within reasonable expectations, operate the WORKS in a manner so as not to cause undue damages, hardship, or inconvenience on private lands upstream and downstream of the WORKS, which are not in accordance with formal agreements that may exist between the LICENSEE and the owners of impacted lands.

   e) Construction of the WORKS are to include adequate and effective erosion and sedimentation controls (erosion control blankets, side slopes, sediment barriers, straw mulch, silt curtains, rock rip-rap at drain outlet, minimum disturbance of existing vegetation cover, seeding excavated area to ensure vegetation growth.)

   f) Manitoba reserves the right to require modifications to the WORKS identified in the attached Exhibit(s) to correct unforeseen impacts, address safety issue(s) or to ensure the WORKS are in accordance with approved watershed plans.

3. The LICENSEE does hereby remise, release and forever discharge Her Majesty the Queen in Right of the Province of Manitoba, of and from all manner of action, causes of action, claims and demands whatsoever which against Her Majesty the LICENSEE ever had, now has or may hereafter have, resulting from the construction and operation of the WORKS.

4. In the event that the rights of others are infringed upon and/or damage to the property of others is sustained as a result of the operation or maintenance of the WORKS and the rights herein granted, the LICENSEE shall be solely responsible and shall save harmless and fully indemnify Her Majesty the Queen in Right of the Province of Manitoba, from and against any liability to which Her Majesty may become liable by virtue of the issue of this Licence and anything done pursuant hereto.

5. Upon the execution of this Licence the LICENSEE hereby grants the Minister or the Minister's agents the right of ingress and egress to and from the lands on which the WORKS are located for the purpose of inspection of the WORKS and the LICENSEE shall at all times comply with such directions and/or orders that may be given by the Minister or the Minister's agents in writing from time to time with regard to the operation and maintenance of the WORKS.

6. This Licence may be amended, suspended or cancelled by the Minister in accordance with The Water Rights Act by ~~letter addressed to the LICENSEE at 35 - 2855 #310 Pembina Hwy, Winnipeg, Manitoba, R3T 2H5, Canada~~ and thereafter this Licence shall be determined to be at an end.

7. The term of this Licence shall be in **Perpetuity** and this Licence shall become effective only on the date of execution hereof by a person so authorized in the Department of Conservation and Climate.

FOR OFFICE USE ONLY

Issued at the City of Winnipeg, in the Province of Manitoba, this 07 day of December A.D. 2021.

Ginette Caillier [redacted]

Print Name Signature

Signed by the Minister charged with the administration of the Water Rights Act (or her/his designate)

Licence to Construct
Drainage or Other Works

Manitoba
Conservation and Climate

EXHIBIT "A"

This Plan is an integral part of Licence #2021-WCW-0444 issued under The Water Rights Act.

SAPPHIRE SPRINGS INC.
Licenced Water Control Works
In NE ¼ of Section
18-15-3-E

Legend

Maintain Existing Drain

Existing Waterways

N
W E
S

Date Prepared: December 7, 2021
Imagery Copyright: ESRI Digital Globe

0 0.03 0.06 0.12 0.18
Kilometers

0 0.03 0.06 0.12 0.18
Miles

10.5 APPENDIX E – LOCAL WEATHER DATA

weatherbase

GUNTON, MANITOBA

Elevation: 233 meters Latitude: 50 17N Longitude: 97 10W

Average Temperature

Years on Record: 16

	ANNUAL	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
C	2.5	-17.3	-13.8	-5.6	4.1	11.7	16.6	19.1	18.1	12	4.8	-5.6	-14.7

Average High Temperature

Years on Record: 16

	ANNUAL	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
C	8.2	-11.9	-8.5	-0.6	10.2	19	23.1	25.4	24.7	18.2	10.2	-1.4	-10

Average Low Temperature

Years on Record: 16

	ANNUAL	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
C	-3.3	-22.6	-18.9	-10.4	-2	4.4	10	12.7	11.4	5.7	-0.6	-9.8	-19.4

Average Precipitation

Years on Record: 16

	ANNUAL	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
mm	524.4	17.6	9.7	15.8	21.1	42.7	98	96.8	81.6	52.2	44.2	24.3	20.5

Highest Recorded Temperature

Years on Record: 17

	ANNUAL	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
C	37.5	7.5	7.5	14	34	36.5	37	34.5	37.5	37	29.5	17.5	7.5

Lowest Recorded Temperature

Years on Record: 17

	ANNUAL	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
C	-42.5	-41	-42.5	-36	-20	-8.5	-2.5	2.5	-0.5	-5.5	-21	-37.5	-39

Average Length of Day

Years on Record: 30

	ANNUAL	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Hours	12.9	9.3	10.7	12.5	14.4	16.2	17.1	16.6	15	13.1	11.2	9.6	8.8

Average Number of Days Below 32F/0C

Years on Record: 16

	ANNUAL	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Days	196.5	31	28.1	28.3	21.4	7.4	0.4	---	0.3	4.1	16.1	28.5	31

Average Snowfall

Years on Record: 16

	ANNUAL	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
cm	88.6	17.6	9.7	12.1	2.1	0.1	---	---	---	0.2	6.5	21.7	18.8

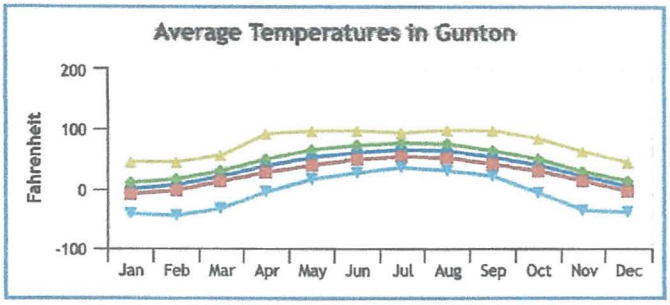
GUNTON, MANITOBA

Elevation: 233 meters Latitude: 50 17N Longitude: 97 10W

K◆ppen Classification: Warm Summer Continental Climate

WEATHER

- Monthly - Summary
  - Nearby
  - Forecast
- Monthly - All Data
- **Climate Summary**



SHARE

PRINT THIS DATA

This climate climate zone covers from about 44◆N to 50◆N latitude mostly east of the 100th meridian in North America. However, it can be found as far north as 54◆N, and further west in the Canadian Prairie Provinces and below 40◆N in the high Appalachians. In Europe this subtype reaches its most northerly latitude at nearly 61◆ N. Areas featuring this subtype of the continental climate have an average temperature in the warmest month below 22◆C (22◆F). Summer high temperatures in this zone typically average between 21-28◆C (70-82◆F) during the daytime and the average temperatures in the coldest month are generally far below the -3 ◆C (27◆F) mark.

The K◆ppen Climate Classification subtype for this climate is "Dfb". (Warm Summer Continental Climate).

The average temperature for the year in Gunton is 36.4°F (2.4°C). The warmest month, on average, is July with an average temperature of 66.3°F (19.1°C). The coolest month on average is January, with an average temperature of 0.8°F (-17.3°C).

The highest recorded temperature in Gunton is 99.5°F (37.5°C), which was recorded in August. The lowest recorded temperature in Gunton is -44.5°F (-42.5°C), which was recorded in February.

The average amount of precipitation for the year in Gunton is 20.6" (523.2 mm). The month with the most precipitation on average is June with 3.9" (99.1 mm) of precipitation. The month with the least precipitation on average is February with an average of 0.4" (10.2 mm). In Gunton, there's an average of 34.9" of snow (0 cm). The month with the most snow is November, with 8.5" of snow (21.6 cm).

10.6 APPENDIX F – GEOTECHNICAL INVESTIGATION - SSI

GEOTECHNICAL ASSESSMENT
PROPOSED SAPPHIRE SPRINGS EXPANSION PROJECT

NE ¼ Section 18, Township 15, Range 3 EPM | Rockwood, Manitoba

PREPARED FOR:

Sapphire Springs Inc.
c/o Mr. Rob McCarthy
118 – 367 Ellice Ave
Winnipeg, Manitoba
R3B 1Y1

PREPARED BY:

Aski Geosciences Ltd.
207-1555 St. James St.
Winnipeg, Manitoba
R3H 1B5

Aski File: RW1156
July 2021

July 7, 2021
Aski File: RW1156

aski

Sapphire Springs Inc.
118 – 367 Ellice Ave
Winnipeg, Manitoba
R3B 1Y1

Attention: Mr. Rob McCarthy – Chief Operating Officer

Dear Sir:

Reference:	**Geotechnical Assessment – Proposed Sapphire Springs Development** **NE ¼ Section 18, Township 15, Range 3 EPM, Rockwood, Manitoba**

Aski Geosciences Ltd. (Aski) is pleased to provide the following report detailing the findings of a Geotechnical Assessment undertaken for a proposed development at the Sapphire Springs Hatchery located at the NE ¼ Section 18, Township 15, Range 3 EPM in Rockwood, Manitoba (the Site).

The fieldwork was carried out by Aski between June 2 and 25, 2021 and consisted of advancing thirty-one (31) testholes across the Site to a maximum depth of 17.7 metres below ground level (mBGL).

Geotechnical recommendations for the proposed development are presented in this report and are based on the findings of the intrusive soils investigation and physical characteristics of the subsoils, groundwater conditions, and laboratory results.

Should you have any questions regarding the report, please do not hesitate to contact the undersigned at your convenience.

Yours truly,

[redacted]

PROVINCE OF MANITOBA
[redacted]
R.P. KUPCHAK
Member
[redacted] 7670
July 8/21
REGISTERED PROFESSIONAL ENGINEER

Robert Kupchak, P.Eng.
Principal

Attachments:

Distribution: Sapphire Springs - 1 copy
Aski - 1 copy

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1.0 INTRODUCTION

Aski Geosciences Ltd. (Aski) was retained by Mr. Rob McCarthy, Chief Operating Officer with Sapphire Springs, to conduct a geotechnical assessment for a proposed development at the Sapphire Springs Hatchery located at NE ¼ Section 18, Township 15, Range 3 EPM in Rockwood, Manitoba (the Site). Written authorization to proceed with the work was received by Mr. Rob McCarthy on May 19, 2021.

The purpose of this geotechnical assessment was to gather site specific soil and groundwater conditions across the proposed development site and based on our findings, provide geotechnical recommendations for the construction of new buildings, roads and parking areas.

1.1 Site Description

The Site is located in the NE ¼ Section 18, Township 15, Range 3 EPM in the Rural Municipality of Rockwood, Manitoba, as shown on Figure 1. Access to the Site is provided by an existing gravel driveway off Road 87 N. The Site contains several existing buildings supported by friction piles and grade supported concrete slabs. Two (2) of the existing buildings contain large, indoor concrete ponds used to grow fish. The ponds are contained by a concrete floor slab with high concrete walls open to the building airspace. They are supported directly by the subgrade soils with the concrete floor slab poured around them. The main building is known as the hatchery and was undergoing renovations at the time of the drilling program. The hatchery building is planned to be expanded on the east end of the building (referred to as the hatchery expansion). A stand of tall, mature trees occupies the separation between the hatchery and Road 87 N.

The property was first utilized by the Fisheries Research Board of Canada (Fisheries) as a research and development facility with outdoor storage lagoons controlled by a network of manholes and underground drainage piping. The land was eventually sold by the Federal Government and converted into a fish hatchery by the new owners. The fish hatchery eventually closed operations and is now undergoing renovations and reopening as Sapphire Springs. Several single-storey residences constructed over the years are located east of the hatchery building.

The existing lagoon cells are located the rear of the property and will impact the proposed development. The berms are constructed of stiff, desiccated brown clay fill and are approximately 2.0 to 2.7 metres in depth. A series of gate valves and manholes control the discharge of water from the concrete ponds and lagoon cells. Artesian water wells installed by Fisheries are currently servicing the building. The undeveloped portion of the property consists of undeveloped agricultural lands with tall grasses and mature trees. Shallow ditching east and west of the main hatchery, and ditching near the lagoon cells assist in the surface runoff during the spring melt and intense rainfall events.

1.2 Project Overview

It is our understanding that the new proposed development will consist of an expansion of the hatchery building, a grow pond building, processing and supplies area, grow-out raceways, parking areas and new main driveway off Road 87N. Initial development will consist of the renovation and expansion of the main hatchery building and construction of the main driveway and parking lot. Refer to Figure 3 for a conceptual layout of the proposed development planned across the Site.

A geotechnical investigation was undertaken across the proposed expansion and initial development areas to provide foundation alternatives for the new buildings, concrete slabs, future grow ponds, parking lot and driveway.

1.3 Methodology

The following tasks were performed by Aski in conducting the geotechnical investigation across the proposed development areas:

- Submit a site plan to the project team showing the proposed testhole locations, prior to the investigation;
- Obtained identification of buried utilities at the Site;
- Advance thirty-one (31) testholes across the Site to a maximum depth of 17.7 metres below ground level (mBGL) to visually inspect the soil and groundwater conditions;
- Log the soil lithology at each testhole location;
- Obtain soil samples at regular intervals from select testholes for soil characterization analysis, including moisture content and soil strength readings;
- Conduct Standard Penetration Testing (SPT) and recorded blow counts (N) in the dense glacial till;
- Determine Atterberg Limits on eleven (11) representative soil samples;
- Submit one (1) representative soil sample for particle size analysis (hydrometer);
- Submitted four (4) Shelby-Tube samples for undrained, unconfined compression strength (q_u) testing;
- Complete a GPS survey across the Site, marking the testhole locations and geographical features across the Site and immediate area;
- Provide geotechnical recommendations for the construction of the proposed buildings, and access road/parking lot; and
- Provide a report, complete with figures, laboratory results, lithologic logs, and site photos.

2.0 FIELD INVESTIGATION

2.1 Testhole Program and Soil Sampling

Prior to undertaking the investigation, a proposed testhole location plan was presented by Aski to Sapphire Springs for discussion and approval. Aski also arranged for buried service locates within the area of investigation. Buried services were marked and/or cleared by Manitoba Hydro and BellMTS. Buried water and sewer services were also identified by the owner's representative prior to the drilling program. Aski conducted the intrusive investigation between June 2 and 25, 2021 using a Soil Sentry drill rig owned and operated by Paddock Drilling.

The geotechnical investigation consisted of advancing seven (7) deep testholes and twenty-four (24) shallow testholes across the various areas of the proposed development to a maximum depth of 17.7 mBGL as follows:

- Testhole TH1 – North Access Road
- Testholes TH2 to TH6 – East Parking
- Testholes TH7 and TH8 – Hatchery Expansion
- Testholes TH9 to TH12 and TH15 to TH17 – South Building Expansion
- Testholes TH13 to TH14 and TH20 to TH23 – West Parking Lot
- Testholes TH18 and TH19 – Processing
- Testholes TH24 and TH26 – Supplies
- Testholes TH27 to TH31 – Grow-Out Raceways

The subsoils were visually classified to the full extent of each testhole and any soil caving or seepage conditions encountered during the drilling program were noted. Soil samples were obtained at regular intervals and placed in plastic bags for further analysis. The soil lithology at each testhole was examined and logged in general accordance with the Modified Unified Classification System (MUCS) for Soil documenting soil type, texture, colour, pocket penetrometer readings, and moisture content. A description of the surficial geology encountered at the Site is presented in Section 3.1 and illustrated on the lithologic logs, enclosed in Appendix A.

The testhole locations and surrounding topographic features were surveyed using a Leica Viva GS15 real time GPS system and electronic data collector. The location of the testholes, structures and other pertinent features across the Site are presented on Figure 2.

Soil characterization testing was conducted on representative soil samples collected during the fieldwork. The laboratory results are discussed in Section 4.0, and presented in Tables 2 to 4. Once all the necessary field sampling had been undertaken, a bentonite seal was installed at the bottom and top of each testhole. Auger cuttings were returned to the testhole between the bentonite seals. A drilling summary outlining the UTM coordinates, silt thickness, depth to till, testhole depth, and auger refusal conditions is presented in Table 1.

Table 1: Testhole Summary Results

Testhole No.	UTM Coordinates (Zone 14U)	Proposed Development	Ground Surface Elevation (m)	Depth to Silt (mBGL)	Silt Thickness (m)	Depth to Till (mBGL)	Testhole Depth /Auger Refusal (mBGL)
TH1	5571949 N, 630489 E	Access Road	231.809	1.30 m	1.37 m	N/A	EOH at 3.0 m in stiff clay
TH2	5571926 N, 630522 E	East Parking	231.909	1.22 m	0.91 m	N/A	EOH at 3.0 m in stiff clay
TH3	5571902 N, 630521 E	East Parking	231.710	0.84 m	1.30 m	N/A	EOH at 3.0 m in stiff clay
TH4	5571924 N, 630494 E	East Parking	232.498	2.29 m	≥0.76 m	N/A	EOH at 3.0 m in stiff silt
TH5	5571923 N, 630477 E	East Parking	232.506	2.59 m	≥0.46 m	N/A	EOH at 3.0 m in soft silt
TH6	5571902 N, 630480 E	East Parking	232.402	None	None	N/A	EOH at 3.0 m in stiff clay
TH7	5571925 N, 630460 E	Hatchery Expansion	232.316	2.74 m	0.61 m	14.33 m	AR at 16.8 m in hard till
TH8	5571912 N, 630451 E	Hatchery Expansion	232.334	3.05 m	1.07 m	13.72 m	AR at 17.4 m in hard till
TH9	5571896 N, 630452 E	South Expansion	232.273	3.12 m	1.52 m	11.89 m	AR at 16.8 m in hard till
TH10	5571887 N, 630414 E	South Expansion	232.144	1.37 m	0.30 m	14.63 m	AR at 16.8 m in hard till
TH10				3.51 m	1.07 m		
TH11	5571890 N, 630384 E	South Expansion	232.251	2.74 m	0.61 m	13.72 m	AR at 16.5 m in hard till
TH12	5571873 N, 630418 E	South Expansion	231.907	None	None	N/A	EOH at 4.6 m in stiff clay
TH13	5571877 N, 630364 E	West Parking	231.875	1.52 m	1.07 m	N/A	EOH at 3.0 m in stiff clay
TH14	5571876 N, 630323 E	West Parking	231.583	0.76 m	1.14 m	N/A	EOH at 3.0 m in stiff clay
TH15	5571859 N, 630391 E	South Expansion	231.990	2.59 m	0.61 m	14.33 m	AR at 16.8 m in hard till
TH16	5571856 N, 630422 E	South Expansion	232.210	2.74 m	0.61 m	N/A	EOH at 4.6 m in stiff clay
TH17	5571854 N, 630453 E	South Expansion	232.554	3.20 m	0.91 m	N/A	EOH at 4.6 m in stiff clay
TH18	5571821 N, 630450 E	Processing	232.360	2.59 m	0.91 m	15.24 m	AR at 17.7 m in hard till
TH19	5571820 N, 630387 E	Processing	232.319	2.29 m	0.91 m	N/A	EOH at 4.6 m in stiff clay
TH20	5571830 N, 630366 E	West Parking	231.505	1.45 m	1.14 m	N/A	EOH at 3.0 m in stiff clay
TH21	5571830 N, 630324 E	West Parking	231.618	1.60 m	1.35 m	N/A	EOH at 3.0 m in stiff clay
TH22	5571786 N, 630325 E	West Parking	231.551	1.83 m	≥1.22 m	N/A	EOH at 3.0 m in soft silt
TH23	5571789 N, 630366 E	West Parking	231.697	1.83 m	≥1.22 m	N/A	EOH at 3.0 m in soft silt
TH24	5571799 N, 630411 E	Supplies	232.429	2.13 m	0.99 m	N/A	EOH at 4.6 m in stiff clay
TH25	5571775 N, 630390 E	Supplies	233.070	2.97 m	0.99 m	N/A	EOH at 4.6 m in stiff clay
TH26	5571777 N, 630448 E	Supplies	233.139	3.66 m	≥0.91 m	N/A	EOH at 4.6 m in soft silt
TH27	5571760 N, 630387 E	Raceway	233.040	3.43 m	≥1.14 m	N/A	EOH at 4.6 m in soft silt
TH28	5571756 N, 630452 E	Raceway	233.194	3.81 m	≥0.76 m	N/A	EOH at 4.6 m in soft silt
TH29	5571753 N, 630416 E	Raceway	233.107	3.66 m	≥0.91 m	N/A	EOH at 4.6 m in soft silt
TH30	5571722 N, 630390 E	Raceway	232.985	3.51 m	≥0.46 m	N/A	EOH at 4.0 m in soft silt
TH31	5571723 N, 630453 E	Raceway	233.024	3.81 m	≥0.46 m	N/A	EOH at 4.2 m in soft silt

N/A = Testhole not advanced to the glacial till.
EOH = End of Testhole.
AR = Auger Refusal.

3.0 FIELD OBSERVATIONS

3.1 Soil Stratigraphy

The general soil stratigraphy encountered in the investigated area at the Site consisted of black, organic topsoil or clay fill overlying brown, silty clay of varying plasticity. A soft, wet silt unit was observed below the upper brown clay unit, and the soil profile changed to brown clay to the glacial till. The glacial till became hard and silty at power auger refusal. The silt unit separated the upper and lower clay units. Clay fill was randomly placed across low-lying areas and used to build up the berms for the outdoor clay lagoon cells, at the rear of the development. Slight caving and seepage conditions were encountered in the majority of the advanced testholes where the silt unit was encountered.

A brief description of each of the soil strata is presented in the following paragraphs. Refer to the logs in Appendix A for more detailed depths and description of the soil and groundwater conditions observed at each testhole location.

3.1.1 Topsoil

Topsoil was encountered mainly in the west and east parking areas and consisted of desiccated, stiff, black clay with some organics. It was generally 0.3 metres in thickness and was desiccated from the stand of mature trees on the east side. The topsoil on the west side was moist and exhibited abundant rootlets from the tall grasses, in the upper 0.15 metres, near the ground surface.

3.1.2 Fill

Fill material consisting mainly of stiff, brown clay was encountered within the existing development areas including, the residential houses, main hatchery, second grow pond building, and the lagoon cells. The fill material was desiccated and still to very stiff in soil strength. The moisture content of the clay fill material ranged from 6.8% to 23.5%

3.1.3 Brown Silty Clay (CH/CI)

Stiff brown, silty clay was generally noted below the surface topsoil or fill material and extended to the top of the silt unit. Below the silt unit, the brown clay was plastic, stiff and gradually changed in strength to a firm clay, below 7.0 mBGL. The brown clay became soft below 9.0 mBGL and stayed soft to the glacial till unit. The moisture content of the upper brown clay ranged from 20.0% to 40.4% and the lower brown clay unit (below 6 metres to the glacial till) ranged from 31.3% to 75.1% in moisture content.

3.1.4 Silt (ML)

Silt was encountered in all of the testholes with the exception of TH6 and TH12. The silt layer ranged in thickness from 0.46 m to 1.22 m and was observed between the upper and lower clay units, generally within the upper 3 metres. The silt unit was noted at a slightly deeper depth at the south end of the property, likely the result of the fill material placed along the berms for the clay lagoon cells. Two (2) distinct silt layers were noted in testhole TH10, beginning at 1.37 mBGL and 3.51 mBGL. The silt was tan, soft and moist and ranged in

moisture content from 21.7% to 34.4%. Groundwater seepage and caving conditions were noted at the bottom of the silt unit in the majority of the testholes.

3.1.5 Glacial Till (CI & ML)

The brown clay gradually changed to a glacial clay till with some gravel and sand. The glacial till was initially soft to very soft and changed to a tan, silt till near power auger refusal. The silt till was dense to very hard at power auger refusal and contained some sand and gravel. Power auger refusal was noted in the silt till at depths ranging from 16.5 to 17.7 metres below the ground surface. Moisture levels in the hard tills ranged from 10.1% to 13.6%.

3.2 Groundwater Conditions

It is know that artesian groundwater conditions exist in the area. Two (2) groundwater production wells installed in 1971 within the bedrock surface are still active and service the Site. Upon review of the Underwood McLellan engineering report, the upper bedrock consists of dolomitic limestone at depths ranging from 21.9 to 22.6 metres below the ground surface. Groundwater seepage form the glacial till was not observed in any of Aski's deep testholes drilled to power auger refusal.

Groundwater seepage and caving conditions were noted in the silt unit at varying depths within the upper 4.5 metres of the soil profile, and as a result, will likely have an effect on the foundation installation involving friction piles or spread bored piles.

4.0 LABORATORY ANALYSIS

4.1 Moisture Content

Moisture contents were determined on one-hundred and twenty-eight (128) soil samples collected from the Site. The moisture contents are shown alongside the soil profile in the testhole logs, included in Appendix A and in spreadsheet form in Appendix C.

Based on the moisture analysis, the clay fill material exhibited moisture contents ranging from 6.8% to 23.5% and was generally observed as desiccated. Moisture levels in the tan, soft silt ranged from 21.7% to 34.4% and were near saturation levels. Moisture levels in the brown, silty clay soils ranged from 20.0% to 75.1%. The underlying glacial till material exhibited variable moisture contents ranging from 8.4% in the hard silt till to 45.8% in the upper clay till.

4.2 Atterberg Limits

Atterberg limits define the liquid and plastic limits of a fine-grained soil which are then used to determine the moisture limits at which clay transforms from a plastic to liquid state. The limits help define the soil characteristics in construction, under different moisture conditions and also classify the soil according to soil classification standards. Atterberg limits were determined on eleven (11) representative soil samples retrieved from the Site. The laboratory results are presented in Table 2 and enclosed in Appendix C.

Table 2: Atterberg Limits

Sample Identification	Moisture Content	Liquid Limit	Plastic Limit	Plasticity Index	Classification
Parking/Driveway Areas					
TH5 @ 1.5 m (5')	32.1%	61.8%	26.7%	35.1	Highly plastic inorganic clay (CH)
TH14 @ 2.3 m (7.5')	34.4%	57.7%	26.4%	31.3	Highly plastic inorganic clay (CH)
TH21 @ 0.8 m (2.5')	40.0%	61.6%	32.5%	29.1	Organic clay of high plasticity (OH)
Buildings					
TH8 @ 2.3 m (7.5')	26.3%	52.8%	21.2%	31.6	Highly plastic inorganic clay (CH)
TH8 @ 4.6 m (15.0')	39.8%	44.4%	18.2%	26.2	Medium plastic inorganic clay (CI)
TH9 @ 7.6 m (25.0')	64.4%	83.9%	28.0%	55.9	Highly plastic inorganic clay (CH)
TH9 @ 10.7 m (35.0')	61.4%	82.1%	25.5%	56.6	Highly plastic inorganic clay (CH)
TH9 @ 13.7 m (45.0')	28.9%	38.4%	12.8%	25.6	Medium plastic inorganic clay (CI)
TH10 @ 0.8 m (2.5')	25.6%	52.5%	24.7%	27.8	Highly plastic inorganic clay (CH)
TH18 @ 6.1 m (20')	63.8%	89.7%	28.4%	61.3	Highly plastic inorganic clay (CH)
TH24 @ 4.6 m (15.0')	48.2%	92.2%	31.0%	61.2	Highly plastic inorganic clay (CH)

The soil samples collected from the upper clay unit in testholes TH5, TH8, TH10 and TH14, and lower clay unit in testholes TH9, TH14, TH18 and TH24 were found to exhibit liquid limits ranging from 52.5% to 92.2%. The plasticity indices of these samples ranged from 27.8 to 61.3. According to the modified unified classification system for soils, the soil is classified as a highly plastic (CH) inorganic, silty, stiff to firm clay. The clay material is sensitive to moisture changes; and an increase in moisture content within the clay unit will reduce the soil strength.

The surficial clay soil sample collected from testhole TH21 at 0.8 m was found to exhibit a liquid limit of 64.1% and a plasticity index of 61.3. According to the modified unified classification system for soils, the sample is considered a highly plastic (CH) organic clay. The soil samples collected from the lower clay unit at testhole TH8 and the glacial till unit at testhole TH9 were determined to exhibit liquid limits of 44.4% and 38.4%, and plasticity indices of 26.2 and 25.6 , indicative of a medium plastic, inorganic clay (CI).

4.3 Hydrometer

One (1) select soil sample from testhole TH10 was analyzed in the lab for particle size analysis (hydrometer). The hydrometer results are summarized in Table 3, with the laboratory report attached in Appendix C.

Table 3: Particle Size Analysis (Hydrometer)

Sample Identification	% Gravel	% Sand	% Silt	% Clay	Classification
TH10 @ (6.1 m to 6.9 m)	0.0%	0.2%	39.3%	60.5%	CH – silty clay of high plasticity

According to the MUCS for soil, the brown, silty clay material encountered within testhole TH10 between 6.1 m and 6.9 mBGL is categorized as inorganic, silty clay (CH) of high plasticity.

4.4 Unconfined Compression Strength (q_u)

Four (4) Shelby Tube samples were submitted to Trek Geotechnical in Winnipeg to determine the unconfined compressive strength (q_u) on the undisturbed clay soils. The results of the soil strength (q_u) analysis are presented in Table 4.

Table 4: Unconfined Compressive Strength Test Results (q_u)

Sample Identification	Bulk Unit Weight - γ_b (kN/m^3)	Pocket Pen Reading (kPa)	Undrained Shear Strength - S_u (kPa)	Unconfined Compressive Strength - q_u (kPa)
TH10 @ 3.0 m to 3.8 m	18.5	103.4	40.0	80.1
TH10 @ 6.1 m to 6.9 m	16.9	57.5	44.5	89.0
TH10 @ 9.1 m to 9.9 m	15.5	10.8	8.3	16.6
TH18 @ 6.1 m to 6.9 m	15.3	47.5	23.7	47.4

The test results presented in Table 4 indicate that the Shelby Tube soil samples collected from testholes TH10 and TH18 exhibited unconfined compressive strength values between 16.6 kPa and 89.0 kPa, indicating that the clay changes in soil strength from a stiff clay to soft clay within the upper 7 metres of the clay profile. As a result, the undrained shear strength also decreases accordingly. The bulk weight also decreases with depth, as the moisture content rises significantly. The strength of the clays at the 9 metre depth is very low, and not considered suitable for pile support.

4.5 Standard Penetration Test (SPT)

Standard Penetration Tests were undertaken in the glacial till at various depths; in testhole TH8 from 16.8 m to 17.4 mBGL. Blow counts (N) were recorded at regular intervals of 150 mm and are shown on the corresponding testhole log.

The blow counts recorded in the glacial silt till unit at testhole TH8 ranged from 21 to >50 blows for 150 mm of penetration. The higher blow count values were observed within the final 300 mm of the test, at a depth similar to power auger refusal.

5.0 GEOTECHNICAL FINDINGS & RECOMMENDATIONS

The following findings and recommendations are based on the soils and groundwater information gathered from the Site and the corresponding lab results from representative samples collected from the field. The soils information is limited to the tested areas and should be considered as general conditions for the subject area. However, they represent the soil and groundwater conditions expected during construction. Careful consideration of the underlying silt unit should be undertaken when designing the proposed development,

especially the grow ponds. Any deviation from the tested areas may exhibit different soil and groundwater conditions from those presented.

It is our understanding that the proposed development will include new singly storey structures with no basement or crawlspace. The proposed development will also include a main entrance driveway with parking available on the east and west portions of the Site. New additional grow ponds will supported by the underlying subgrade, at varying depths below the ground surface.

Aski reviewed shallow strip footings as a foundation alternative, and upon review of the fill material across the Site, silt unit thickness, and expansive clay observed in the upper 3 metres, footings were determined to be unsuitable. Differential movements associated with shallow footings would also be a concern for the development proposed across the Site.

Based on the soils information gathered from the Site, insitu testing and the laboratory results, the structures may be supported by a system of reinforced, cast-in place concrete piles, spread bores piles or driven precast piles installed into the hard glacial till.

5.1 Foundation Alternatives

Foundation alternatives considered for the new buildings include reinforced, cast in place concrete friction piles and cast in place belled piles. Belled piles are considered an alternative due to the soft clays at depths beyond 7 metres below grade. Driven precast concrete piles should also be considered to support heavier loads.

The foundation recommendations follow Limit State Design (LSD) guidelines that considers both Ultimate Limit State and Serviceable Limit State values. For pile foundation design recommendations, Limit State Design outlines a specific Geotechnical Resistance Factor (Φ) that is used in the determination of pile capacity.

5.1.1 Cast-In-Place Concrete Friction Piles

Cast-in-place concrete piles may be used to support the proposed building foundation loads. However, the soft clays at extended depths will limit the pile depth. For design purposes, the upper 2.5 metres of pile length below final ground elevation of piles potentially exposed to frost and extending through the fill material should be neglected when determining pile capacities (i.e. perimeter piles). For piles not exposed to frost (i.e. interior piles), the upper 1.5 metres of pile length below final grade should be neglected. It should be noted that this applies to piles installed in the native silty clay only, and the fill, silt or organic material should be assumed to provide little to no support. The fill material and organic clay are observed in the upper 1.5 metres, however, the silt unit varies in depth and thickness across the Site and should be reviewed by building location in determining the available shaft support for each pile. Exterior friction piles should have a minimum length of 7 metres and include full depth reinforcement to resist potential frost jacking.

Friction piles may be designed based upon the estimated Ultimate Limit State (ULS) and Serviceability Limit State (SLS) skin friction values provided in Table 5. A geotechnical resistance factor (Φ) of 0.4 has been applied to the estimated average factored resistance values. Piles that are designed to be friction piles should be designed to resist the load by shaft resistance only. The contribution from end bearing should be ignored in the pile capacity calculations as the clay becomes soft at depths greater than 7 metres and will provide very little end bearing

support at this depth. Minimum pile diameter for CIP friction piles should not be less than 450 mm.

Subject to pile inspection by qualified geotechnical personnel, cast-in-place (CIP) concrete friction piles under axial compressive loading can be designed in accordance to the current Manitoba Building Code NBC 2010 using the shear strengths recorded in the field and confirmed in the lab. Pocket pen readings were collected on the clay profile observed in all the testholes. However, the undrained shear strength of the clay soil confirmed in the lab (S_u) were determined to be low, and varied from 8.3 kPa to 44.5 kPa. The CIP concrete piles can be designed from the adhesion values presented in Table 5 with the acknowledgment that the pile length installed within the silt unit will provide no shaft support and should be ignored in the design. A geotechnical resistance factor (Φ) of 0.4 was used to calculate the factored ULS design values presented in Table 5.

Table 5: Factored ULS & SLS Design Parameters for CIP Concrete Piles

Depth Below Grade (m)	SLS Shaft Adhesion* (kPa)	Factored ULS Shaft Adhesion* (kPa)
0 to 1.5/2.5 m	0	0
1.5/2.5 to 6 m	16	17.8
6 to 9 m	6.4	7

*shaft adhesion calculations shown above for resistance to pile loading should ignore the pile length within the silt profile.

Pile settlements are expected to be less than 10 mm under SLS loading. The pile length should be limited to 7.6 metres below grade to avoid drilling into the very soft clays, as the pile holes may become "squeezed" within the very soft clays. The underlying limestone bedrock is fractured and under artesian groundwater conditions, may exhibit significant hydrostatic pressure, if encountered.

Due to caving soil and groundwater seepage expected from the silt unit, concrete should be installed in each pile hole after each pile hole is drilled to the proper depth. Potential seepage from the upper fill layer may also occur during wet periods of the year. Temporary steel sleeves will be required to case off sloughing/caving soil conditions and groundwater seepage from the silt unit. It is important to eliminate all soil sloughing and groundwater seepage during concrete installation, as these conditions can result in premature pile failure. Concrete should be poured in the centre of the hole and steel cage, and disturbance of the sidewalls during pouring should be avoided.

Piles should have a minimum diameter of 400 mm and a minimum pile spacing of 3 pile diameters, measured centre to centre, for all new piles installed for the expansion. This spacing also applies to new piles installed near existing friction piles. Small pile groups may be considered for moderate to heavy column loads.

Piles that are subjected to freezing conditions shall be protected from potential frost heave effects by installing piles with a minimum pile length of 7 metres, and with full length reinforcement. All grade beams and pile caps shall be installed with a minimum 150 mm void form below the finished concrete.

5.1.2 Cast-in-Place (CIP) Concrete Spread Bore Piles

Cast-in-place (CIP), mechanically cleaned spread bored piles provide a suitable foundation alternative to support any new structures at the Site. Geotechnically, these units shall be end bearing on the native undisturbed, brown clay at varying depths between 4.0 mBGL (in the existing building area) and 5.5 mBGL (within the clay ponds area), and a minimum separation of 0.5 metres below the top of the bell and silt unit. Subject to pile inspection by qualified geotechnical personnel, these units may be designed using a serviceable limit state (SLS) bearing resistance of 80 kPa. A geotechnical resistance factor (Φ) of 0.5 was applied to the average Ultimate Limit State (ULS) of 160 kPa determined in the brown, fissured clay. The recommended SLS value would limit potential settlement to 25 mm, and the frictional component should be ignored in the pile load calculations. Due to the existing fill unit, topsoil and silt in the upper soil profile, as well as soil shrinkage and potential frost action, the upper frictional component on the pile-shaft (outer surface) should also be ignored in the pile design.

The piles should have minimum shaft and bell diameters of 400 mm and 900 mm, respectively. Pile bells located closer than two (2) bell diameters, measured centre to centre, should not be drilled and poured consecutively and a minimum lag time of 24 hours should be maintained during installation. Full-length reinforcement shall be used for each pile. Due to the silt unit present across the site, water seepage will likely be encountered during pile installation and in this regard, temporary steel sleeves will be necessary.

All pile holes should be poured with concrete as soon as they are mechanically-cleaned, inspected and approved by qualified geotechnical personnel. The performance of spread-bored piles is dictated primarily by contractor experience, construction procedures and type of belling tool used.

5.1.3 Driven Precast Pre-stressed Concrete Piles

Precast pre-stressed concrete piles driven to practical refusal will derive a majority of their resistance in end bearing with a relatively small contribution from shaft adhesion. The piles are expected to be installed within the dense glacial silt till where power auger refusal was encountered. The recommended SLS and factored ULS capacities for PPCH piles driven to practical refusal are provided in Table 6. Pile settlements are expected to be less than 10 mm at the pile tip (bottom of pile). The elastic shortening of the pile should be added to the tip displacement to calculate the pile head settlement. Potential impacts to the existing building from pile installation will need to be evaluated if this pile option is selected. In this regard, Aski should be contacted prior to the start of pile installation to review installation methodology.

Table 6: Factored ULS & SLS Design Loading Parameters for Driven Precast Piles

Pile Size (mm)	Refusal Count (Blows/ 25mm)	Factored ULS			SLS Capacity (kN)
		Compression Capacity (kN)			
		ϕ = 0.4	ϕ = 0.5	ϕ = 0.6	
300	5	480	600	720	445
350	8	680	850	1020	620
400	12	880	1,100	1,320	800

Power auger refusal was observed from 16.8 to 17.7 metres below grade and this depth is a good indication of practical refusal depth for precast driven piles. However, the glacial till soils can vary considerably across the Site, and in this regard, the depth to practical refusal within the hard glacial till will also vary across the Site and may be deeper than the power auger refusal depths indicated on the soil logs. Driven piles should be installed in strategic areas across any new buildings to determine an optimum pile length. The piles should be driven to at least three consecutive sets of the refusal count outlined in Table 6, using a diesel hammer having a minimum rated energy of 40 kJ or a hydraulic drop hammer having a minimum rated energy of 20 kJ.

The underlying limestone bedrock is fractured and under artesian conditions, may exhibit significant hydrostatic pressure if encountered during pile driving. Driving of precast piles into the bedrock surface should be avoided. All grade beams and pile caps shall be installed with a minimum 150 mm void form below the finished concrete.

Additional design considerations and construction recommendations for installation of driven piles at this particular site include the following:

1. The precast piles should be cured for at least 7 days prior to driving.
2. The weight of the embedded portion of the pile may be neglected in the design.
3. Pile spacing should not be less than 3 pile diameters, measured centre to centre. Should a closer spacing be required, Aski should be contacted to provide an efficiency (reduction) factor to account for potential group effects.
4. Pre-boring of precast piles should be undertaken to 4.5 metres below grade to reduce ground vibrations and protect against ground heave near existing foundations. Pre-boring also promotes pile alignment and the diameter should measure no more than 50 mm larger than the pile diameter.
5. Piles should be designed to withstand design loads, driving stresses and uplift forces induced from seasonal frost.
6. The pile-driving hammer should be equipped with a pillion type cushion to protect the pile head from damage during driving. The pile cushion should consist of a minimum of 100 mm of compressible material such as fir and fit tightly inside the driving head. Any piles that are damaged, excessively out of plumb or experience premature refusal, may need to be replaced.
7. Piles should be driven to completion once driving is initiated at the required refusal criteria.
8. Should a steel follower be used to install piles below the ground surface, the refusal criteria should be increased by up to 50% to account for energy losses through the use of the follower.
9. Re-driving of all piles in groups should be specified along with the requirement to monitor for pile heave. All piles exhibiting heave should be re-driven to a minimum of one set of the practical refusal criteria.
10. Pile plumbness should be measured on all piles with adequate stick-up after practical refusal has been achieved. All piles should be installed within 2% of plumb.

5.2 Interior Concrete Floor Slab

Should some potential movements of interior floor slabs of several centimeters be tolerable by the owner, grade supported slabs can be utilized. Vertical movements of grade supported slabs should be expected due to moisture and volume changes of the underlying subsoils.

In order to minimize any differential movements of the floor slab and for optimum long term performance, removal of all organic and fill soil, silt and deleterious material is recommended. The subgrade should then be proof-rolled under the inspection of Aski to detect any soft spots or shallow silt areas. Soft areas would require further excavation and replacement with an additional 450 mm of 100 mm crushed limestone and geotextiles.

The concrete slab should be supported by an engineered granular section installed on a compacted subgrade. The subgrade should be compacted to 95% SPD followed by the installation of a mid strength non-woven geotextile (minimum 270 g/m2) and geogrid (minimum tensile strength of 24 kN/m). The engineered granular section should consist of 200 mm of C-Base material compacted to 98% SPD and followed by 100 mm of A-Base material, compacted to 100% SPD.

Alternatively, a structural floor supported by CIP concrete piles may also be utilized. This would avoid slab movements associated with typical slab on grade construction. A void form separation of 200 mm thickness, between the underside of the slab and subgrade, is recommended to protect against potential uplift from swelling soils. A concrete slab utilizing sulphate resistant (MS) cement should be considered for the main floor slab. An approved vapour barrier should be considered for the exposed subgrade soil in a structural slab scenario.

The upper clay subgrade is estimated to have a subgrade resilient modulus of 20 MPa and a California Bearing Ratio of 2 percent under soaked conditions. The subgrade reaction modulus (k) is estimated at 35 MPa/m, provided that a minimum of 1 metre of natural clay is maintained above the silt unit.

At the rear of the property, the existing clay ponds are 2.0 to 2.7 metres in depth and contain signification vegetation growth. Concrete slabs constructed over top these areas will require the removal of all organic soil and the compaction of fill material in uniform lifts. The fill material may consist of suitable clay compacted to 98% SPD or C-Base material compacted to 98% SPD, to the underside of recommended engineered granular outlined previously. Geotextiles should also be installed.

5.3 Interior Concrete Ponds

Additional concrete ponds are anticipated in the future development across the Site. It is our understanding that these concrete ponds will be supported by the underlying subgrade, and not constructed on top any interior floor slabs. Acknowledgement of the depth, thickness and soil strength of the underlying silt layer should be understood in the design of future concrete ponds. These ponds may be supported on the upper clay subsoil, provided that a minimum 1 metre of clay is present above the silt unit, or supported by the underlying clay should the floor be extended below the silt unit. Alternatively, these concrete ponds may also be structurally supported by piles should the soils be unfavorable at the desired floor depth.

The concrete ponds may be supported by a compacted subgrade followed by geotextiles and a compacted engineered granular section similar to recommendations presented for the interior floor slab.

The magnitude of lateral earth pressure from retained soil against the outside of the concrete ponds will depend on the backfill material type, methods of placement and compaction, and the magnitude of horizontal deflection of the wall after the backfill is placed. Assuming that the subsurface pond will be filled with water on the interior side during commissioning, the reservoir walls should also be designed to withstand hydrostatic water pressure at the ground surface, in addition to the later earth pressures expected along the perimeter.

The reservoir walls should be designed to resist lateral earth pressures according to the formula for below grade walls and assuming full saturation:

$$P = K \gamma D$$

Where P = lateral earth pressure at depth D (kPa)
K = earth pressure coefficient (0.5)
γ = soil/backfill unit weight (18.5 kN/m^3)
D = depth from finished grade to the bottom of perimeter wall

It is recommended that free draining granular fill material be used as backfill against the structure wall to improve drainage properties. An appropriate surface surcharge should be included in the earth pressure distribution calculations to account for surface load. Over compaction of the backfill soils against the pond walls may result in earth pressures that are considerably higher than those predicted in design. In this regard, compaction of the backfill material adjacent the pond structure within 1.0 metre of the pond should be undertaken carefully, with monitoring of the concrete walls.

5.4 Foundation Concrete

Foundation concrete should be designed, specified, and constructed in accordance with concrete exposure classifications outlined in the latest revision of CSA Standard A23.1, Concrete Materials and Methods of Concrete Construction. In addition, all concrete should be installed in accordance with current Manitoba and National Building Code requirements.

Based on the likely potential of sulphates in the clayey soil, MS concrete is recommended for all the foundation requirements and site concrete for the project. All cast-in-place piles and pile caps should have a minimum specified 28 day compressive strength of 35 MPa and class of exposure of S-2 corresponding to severe sulphate attack. A maximum water to cement ratio of 0.45 should be considered for all foundation concrete required for the project. Concrete exposed to freeze-thaw cycles should be adequately air-entrained to improve freeze/thaw durability in accordance with Table 4 of CSA-A23.1-04.

5.5 Frost Protection

Based on the freezing index for the Rockwood area, the expected frost penetration depth is calculated at approximately 2.1 metres. The depth of frost penetration is dependent on many factors including soil type,

temperature, ground cover, snow cover, type of fill material and vehicular traffic. As the drive-way and parking lot will remain cleared of snow during the winter months, the seasonal frost may extend to 3.0 metres below grade from the vehicular traffic. The upper soil stratigraphy within the upper 3.0 metres is very frost susceptible and careful considerations should be given for any piles used to support the building perimeter, entrance canopy or sign. Sewer and water services crossing the parking lot should also be designed appropriately for extended frost penetration depths. Frost penetration considerations should be acknowledged in all unheated areas and protection against adfreeze bond forces (equivalent to 65 kPa) should also be considered for all unheated areas.

5.6 Access Road/Parking Lot Considerations

An engineered access road and parking is recommended for the development. The following pavement design is intended to accommodate moderate to heavy duty traffic and should provide a suitable road section with an acceptable level of long-term performance:

1. Subgrade preparation should include the removal of organic material and any unsuitable fill soil that was noted across the Site. Excavation depths will vary across the Site due to the design grades. Additional clay soil may be required to elevate the subgrade surface to the proper design elevation.
2. Before any additional clay material is added to the subgrade, the exposed subgrade surface should be proof rolled and any soft areas should be removed and replaced with suitable clay or C-Base material.
3. The upper 150 mm of clay subgrade should be compacted to a minimum of 95% Standard Proctor maximum dry density.
4. Fill required to bring the pavement area up to the underside of the granular section should consist of stiff, inorganic clay placed in maximum 150 mm lifts and compacted to a minimum of 95% Standard Proctor maximum dry density. Alternatively, additional subgrade material may consist of crushed limestone meeting the C-Base specification. The subgrade should be sloped to provide a minimum crown of 2% grade away from the centre of all driveways.
5. On the prepared subgrade surface, a non-woven mid-strength geotextile (separation fabric weight equivalent to 272 g/m^2) should be placed over the final subgrade surface to increase the shear strength between the soil strata interface and provide constant separation. A biaxial geogrid geotextile (tensile strength of 30 kN/m or higher) geogrid with a maximum aperture of 35 mm should be placed on top the non-woven for additional support.
6. A pavement section consisting of 300 mm of well graded granular C-Base (maximum particle size of 125 mm) topped by 200 mm of crushed granular A-Base, uniformly compacted to 98% Standard Proctor maximum dry density in maximum 150 mm lifts. Specifications for the crushed rock materials are presented in Table 7.
7. The finished slope across the parking area should consist of a minimum of 2% grade towards nearby ditches.
8. A minimum thickness of 75 mm of asphalt pavement compacted to 97% of 75 blows Marshall Density should be considered for all parking areas, supported on the compacted A-Base layer. For the main driveway, a minimum thickness of 100 mm should be considered to support heavier wheel loads. The asphalt mix should meet the City of Winnipeg Type 1A paving specifications.

The above design will provide a low maintenance access road that will provide a high level of long-term performance. A thinner granular section may be utilized, however, as the granular section is reduced, the corresponding road maintenance costs will increase.

Table 7: Recommended Granular Specifications (Crushed Limestone)

Sieve Size	Percent Passing (%)	
	A - Base	C - Base
125 mm	100	90 - 100
100 mm	100	70 - 90
25 mm	100	60 - 80
19 mm	90 - 100	----
16 mm	65 - 85	----
4.75 mm	40 - 70	20 - 40
2 mm	25 - 45	----
425 μm	15 - 25	10 - 20
75 μm	3 - 6	1 - 10

Note: The base coarse and sub-base material shall be free of organic and deleterious material.

5.7 Buried Water & Sewer Alignments

Frost penetration calculations indicate a potential frost penetration depth of 2.2 mBGL at the Site. Therefore, all sewer and water lines installed without insulation would have to be buried a minimum of 2.2 metres below finished grade, and a minimum of 3.0 metres below finished grade in traffic areas.

Consideration should be given for all lateral services to the new building to be insulated, and the water line heat traced to the main line. Backfill material around the service pipes should consist of 300 mm of free draining sand bedding followed by the excavated material, compacted in 300 mm lifts to 95% Standard Proctor density to the subgrade elevation.

5.8 Site Surface Drainage & Topography

The ground surface topography is fairly flat across the site. Positive drainage should be incorporated into the proposed development plan such that precipitation and spring run-off is quickly directed away from the building foundations. Landscape areas should be sloped at 3 to 4% grade while pavements should be sloped at 2% grade. Drainage ditches should be strategically constructed to direct surface runoff to the front or rear of the property. Pavement durability is related to a stable and dry subgrade and granular section.

6.0 CLOSURE

The findings and recommendations of this report were prepared in accordance with generally accepted professional engineering principals and practice for geotechnical investigations of this nature. The findings and discussions were based on the results of the testhole information, GPS survey and laboratory analysis conducted on the soil samples. Although the testholes are location specific, they reflect the general conditions observed

across the tested area and presented in this report. The silt unit will vary in thickness and depth below grade and the foundation design for any buildings and concrete ponds should recognize the poor soil support and groundwater seepage associated with the silt unit.

This report was prepared for the exclusive use of Sapphire Springs Inc. Any use or reliance by any third party is the responsibility of such third parties. Aski Geosciences Ltd. accepts no responsibility for damages, if any, incurred by any third party as a result of the information documented in this report. Any questions arising from this report should be directed to Robert Kupchak, P.Eng.

MAPS AND FIGURES

- **Figure 1**: Site Location Plan
- **Figure 2**: Testhole Location Plan
- **Figure 3**: Conceptual Plan

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PROFESSIONAL SEALS	SCALE
	AS SHOWN

SITE LOCATION PLAN

PROJECT:
SAPPHIRE SPRINGS - GEOTECHNICAL INVESTIGATION
ROAD 87 N
ROCKWOOD, MANITOBA

DRAWN BY: JR	DESIGNED BY: JR	PROJECT NO: RW1156
DATE: 07/05/2021	CHECKED BY: RK	FIGURE: 1

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PROFESSIONAL SEALS

LEGEND

- TH — TESTHOLE LOCATION
- TBM — TEMPORARY BENCHMARK
- MH — MANHOLE
- HP — HYDROPOLE
- GV — GATE VALVE
- BUILDING
- CW — CAPPED WELL
- LP — LIGHT POST

TESTHOLE LOCATION PLAN

PROJECT:
SAPPHIRE SPRINGS - GEOTECHNICAL INVESTIGATION
ROAD 87 N
ROCKWOOD, MANITOBA

DRAWN BY: JR	DESIGNED BY: JR	PROJECT NO: RW1156
DATE: 07/05/2021	CHECKED BY: RK	FIGURE: 2

PROFESSIONAL SEALS

LEGEND

TH	TESTHOLE LOCATION		BUILDING
TBM	TEMPORARY BENCHMARK	CW	CAPPED WELL
MH	MANHOLE	LP	LIGHT POST
HP	HYDROPOLE		
GV	GATE VALVE		

CONCEPTUAL PLAN

PROJECT:
SAPPHIRE SPRINGS - GEOTECHNICAL INVESTIGATION
ROAD 87 N
ROCKWOOD, MANITOBA

DRAWN BY: JR	DESIGNED BY: JR	PROJECT NO: RW1156
DATE: 07/05/2021	CHECKED BY: RK	FIGURE: 3

APPENDIX A - LITHOLOGIC LOGS

- Testholes TH1 to TH29 (June 2 & 3, 2021)
- Testholes TH30 and TH31 (June 25, 2021)

Project: Geotechnical Investigation

Project No: RW1156

Testhole No: TH1

Site: East Parking

Location: Rockwood, Manitoba

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SUBSURFACE PROFILE

Depth (ft / m)	USCS	Symbol	Description	Elev. (m)
0 / 0			Ground Surface	231.809
0	OH		**TOPSOIL** - tan-black, desiccated, organic - stiff	231.504
1	CH		**CLAY** - brown, silty, slightly plastic - very stiff, desiccated	
4 / 1				230.514
4	ML		**SILT** - tan, soft, moist	
9 / 2				229.142
9	CH		**CLAY** - brown, silty, plastic, stiff - fissured	228.761
10 / 3			End of testhole at 3.0 mBGL in stiff clay. No caving or seepage noted. UTM: 14U 5571949 N, 630489 E.	
13 / 4				
15				

SAMPLE

Sample No.	Type	Pocket Pen kPa (100 – 300)	Moistures % (10 30 50 70 90)
TH1-1	G		
TH1-2	G		
TH1-3	G		
TH1-4	G		

Lab Analysis/ Remarks

Drilling Contractor: Paddock Drilling

Field Personnel: RP, MS, CK, MF

Checked by: RK

Drill Method: SS3 Soil Sentry

Hole Size: 125 mm

Page: 1

Elevation: 231.809 m

Drill Date: June 3, 2021

Project: Geotechnical Investigation

Project No: RW1156

Testhole No: TH3

Site: East Parking

Location: Rockwood, Manitoba

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SUBSURFACE PROFILE / SAMPLE

Depth (ft / m)	USCS	Symbol	Description	Elev. (m)	Sample No.	Type	Pocket Pen kPa (100 300)	Moistures % (10 30 50 70 90)	Lab Analysis/ Remarks
0 / 0			Ground Surface	231.710					
0	OH		**TOPSOIL** - black, dry, organic	231.457					
1	CH		**CLAY** - brown, silty, plastic, stiff						
2				230.872	TH3-1	G			
3 / 1	ML		**SILT** - tan, soft, moist						
4									
5					TH3-2	G			
6									
7 / 2				229.576					
7	CH		**CLAY** - brown, silty, plastic, stiff - fissured		TH3-3	G			
8									
9									
10 / 3				228.662	TH3-4	G			
11			End of testhole at 3.0 mBGL in stiff clay. No caving or seepage noted. UTM: 14U 5571902 N, 630521 E.						
12									
13 / 4									
14									
15									

Drilling Contractor: Paddock Drilling

Field Personnel: RP, MS, CK, MF

Checked by: RK

Drill Method: SS3 Soil Sentry

Hole Size: 125 mm

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Elevation: 231.710 m

Drill Date: June 2, 2021

Project: Geotechnical Investigation

Project No: RW1156 **Testhole No: TH2**

Site: East Parking

Location: Rockwood, Manitoba

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SUBSURFACE PROFILE / SAMPLE

Depth (ft / m)	USCS	Symbol	Description	Elev. (m)	Sample No.	Type	Pocket Pen kPa (100 300)	Moistures % (10 30 50 70 90)	Lab Analysis/ Remarks
0 / 0			Ground Surface	231.909					
	OH		**TOPSOIL** - 0.1 m topsoil over gravelly clay - desiccated, mixed structure	231.604					
1	CH		**CLAY** - brown, silty, fissured, very stiff						
2					TH2-1	G			
3 / 1									
4				230.690					
	ML		**SILT** - tan, soft, moist						
5					TH2-2	G			
6									
7 / 2				229.775					
	CH		**CLAY** - brown, silty, plastic, stiff - fissured		TH2-3	G			
8									
9									
10 / 3				228.861	TH2-4	G			
11			End of testhole at 3.0 mBGL in stiff clay. No caving or seepage noted. UTM: 14U 5571926 N, 630522 E.						
12									
13 / 4									
14									
15									

Drilling Contractor: Paddock Drilling **Field Personnel:** RP, MS, CK, MF **Checked by:** RK

Drill Method: SS3 Soil Sentry **Hole Size:** 125 mm **Page:** 2

Elevation: 231.909 m **Drill Date:** June 3, 2021

Project: Geotechnical Investigation

Project No: RW1156

Testhole No: TH4

Site: East Parking

Location: Rockwood, Manitoba

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SUBSURFACE PROFILE					SAMPLE				
Depth (ft / m)	USCS	Symbol	Description	Elev. (m)	Sample No.	Type	Pocket Pen kPa (100 – 300)	Moistures % (10 30 50 70 90)	Lab Analysis/ Remarks
0 / 0			Ground Surface	232.498					
0 – 3 / 0 – 1	FILL		**FILL** - 0.2 m of topsoil over gravelly clay - desiccated - brown, mixed structure		TH4-1	G			
3 – 7 / 1 – 2	CH		**CLAY** - brown, fissured, slightly desiccated - stiff, silty	231.507	TH4-2	G			
7 – 10 / 2 – 3	ML		**SILT** - tan, soft, moist	230.212	TH4-3	G			
10 / 3			End of testhole at 3.0 mBGL in soft silt. No caving or seepage noted. UTM: 14U 5571924 N, 630494 E.	229.450	TH4-4	G			

Drilling Contractor: Paddock Drilling

Field Personnel: RP, MS, CK, MF

Checked by: RK

Drill Method: SS3 Soil Sentry

Hole Size: 125 mm

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Elevation: 232.498 m

Drill Date: June 3, 2021

Project: Geotechnical Investigation

Project No: RW1156 **Testhole No: TH5**

Site: East Parking

Location: Rockwood, Manitoba

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SUBSURFACE PROFILE					SAMPLE				
Depth (ft / m)	USCS	Symbol	Description	Elev. (m)	Sample No.	Type	Pocket Pen kPa (100 – 300)	Moistures % (10 30 50 70 90)	Lab Analysis/ Remarks
0 ft / 0 m			Ground Surface	232.506					
0	FILL		**FILL** - 0.1 m of topsoil over gravelly clay - slightly desiccated						
2					TH5-1	G			
3 / 1				231.363					
4	CH		**CLAY** - brown, silty, plastic, stiff - fissured						
5					TH5-2	G			**Atterberg Limits** LL = 61.8% PL = 26.7%
6									
7 / 2									
8					TH5-3	G			
				229.915					
9	ML		**SILT** - tan, soft, moist						
10 / 3				229.458	TH5-4	G			
11			End of testhole at 3.0 mBGL in soft silt. No caving or seepage noted. UTM: 14U 5571923 N, 630477 E.						
12									
13 / 4									
14									
15									

Drilling Contractor: Paddock Drilling **Field Personnel:** RP, MS, CK, MF **Checked by:** RK

Drill Method: SS3 Soil Sentry **Hole Size:** 125 mm **Page:** 5

Elevation: 232.506 m **Drill Date:** June 3, 2021

Project: Geotechnical Investigation

Project No: RW1156

Testhole No: TH6

Site: East Parking

Location: Rockwood, Manitoba

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SUBSURFACE PROFILE					SAMPLE				Lab Analysis/ Remarks
Depth (ft / m)	USCS	Symbol	Description	Elev. (m)	Sample No.	Type	Pocket Pen kPa (100 – 300)	Moistures % (10 30 50 70 90)	
0 / 0			Ground Surface	232.402					
0	FILL		**FILL** - black, organic, dry - some gravel, clayey						
1									
2									
3 / 1					TH6-1	G			
				231.259					
4	CH		**CLAY** - black, stiff, fissured, some silt - trace organics - brown below 1.3 m - fissured, stiff to very stiff						
5					TH6-2	G			
6 / 2									
7					TH6-3	G			
8									
9									
10 / 3				229.354	TH6-4	G			
11			End of testhole at 3.0 mBGL in stiff clay. No caving or seepage noted. UTM: 14U 5571902 N, 630480 E.						
12									
13 / 4									
14									
15									

Drilling Contractor: Paddock Drilling

Field Personnel: RP, MS, CK, MF

Checked by: RK

Drill Method: SS3 Soil Sentry

Hole Size: 125 mm

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Elevation: 232.402 m

Drill Date: June 2, 2021

Project: Geotechnical Investigation

Project No: RW1156 **Testhole No: TH7**

Site: Hatchery Expansion

Location: Rockwood, Manitoba

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SUBSURFACE PROFILE / SAMPLE

Depth (ft / m)	USCS	Symbol	Description	Elev. (m)	Sample No.	Type	Pocket Pen kPa (100 – 300)	Moistures % (10 30 50 70 90)	Lab Analysis/ Remarks
0 / 0			Ground Surface	232.316					
0 – 2 / 0 – 1	FILL		**FILL** - crushed gravel, dry to 0.2 m - brown clay below 0.2 m - some gravel - stiff to very stiff	231.249	TH7-1 TH7-2 TH7-3	G G G			
2 – 3 / 1	CH		**CLAY** - black, silty, very stiff to stiff - fissured - brown below 1.4 m, stiff, silty - plastic, fissured	229.573 228.963	TH7-4 TH7-5	G G			
3 – 6 / 1 – 2	ML		**SILT** - tan, soft, moist - slight seepage		TH7-6	G			
6 – 14 / 2 – 4	CI		**CLAY** - brown, silty, soft, moderately plastic - trace of gravel at 13.7 m	217.990					
14 – 16 / 4 – 5	ML		**GLACIAL TILL** - grey, clayey, soft, some gravel, silty - tan below 16.2 m, dense - hard at 16.6 m	215.552	TH7-7 TH7-8	G G			
16 – 70 / 5 – 21			Auger refusal at 16.8 mBGL in hard glacial till. Slight caving and seepage noted. UTM: 14U 5571925 N, 630460 E.						

Drilling Contractor: Paddock Drilling **Field Personnel:** RP, MS, CK, MF **Checked by:** RK

Drill Method: SS3 Soil Sentry **Hole Size:** 125 mm **Page:** 7

Elevation: 232.316 m **Drill Date:** June 2, 2021

Project: Geotechnical Investigation

Project No: RW1156 **Testhole No: TH8**

Site: Hatchery Expansion

Location: Rockwood, Manitoba

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SUBSURFACE PROFILE / SAMPLE

Depth (ft / m)	USCS	Description	Elev. (m)	Sample No.	Type	Pocket Pen kPa (100 300)	Moistures % (10 30 50 70 90)	Lab Analysis / Remarks
0 / 0		Ground Surface	232.334					
0 – 3 / 0 – 1	FILL	**FILL** - 50 mm asphalt over sandy gravel to 1.1 m - tree limb at 1.1 m	231.267	TH8-1 TH8-2	G G			
3 – 8 / 1 – 2.5	CH	**CLAY** - black some organics, stiff, silty - plastic, fissured	229.286	TH8-3 TH8-4	G G			**Atterberg Limits** LL = 52.8% PL = 21.2%
8 – 12 / 2.5 – 4	ML	**SILT** - tan, soft, moist - slight to moderate seepage	228.372	TH8-5 TH8-6	G G			
12 – 45 / 4 – 13.5	CI	**CLAY** - brown, moderately plastic, soft, silty		TH8-7 TH8-8 TH8-9	G G G			**Atterberg Limits** LL= 44.4% PL= 18.2%
45 – 55 / 13.5 – 17	ML	**GLACIAL TILL** - grey, soft, clayey, some silt & gravel - dense below 15.2 m - tan, very dense to hard below 15.8 m	218.618	TH8-10 TH8-11	G G			**SPT Blow Counts** 16.76 - 16.92 m = 21 16.92 - 17.07 m = 39 17.07 - 17.22 m = 40 17.22 - 17.37 m = 50
55 – 70 / 17 – 21		Auger refusal at 17.4 mBGL in hard glacial till. Slight caving and seepage noted. UTM: 14U 5571912 N, 630451 E.	214.960					

Drilling Contractor: Paddock Drilling **Field Personnel:** RP, MS, CK, MF **Checked by:** RK

Drill Method: SS3 Soil Sentry **Hole Size:** 125 mm **Page:** 8

Elevation: 232.334 m **Drill Date:** June 2, 2021

Project: Geotechnical Investigation

Project No: RW1156

Testhole No: TH9

Site: South Expansion

Location: Rockwood, Manitoba

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SUBSURFACE PROFILE

SAMPLE

Depth (ft / m)	USCS	Symbol	Description	Elev. (m)	Sample No.	Type	Pocket Pen kPa (100 – 300)	Moistures % (10 30 50 70 90)	Lab Analysis/ Remarks
0			Ground Surface	232.273					
0 – 1	FILL		**FILL** - brown, clay, gravelly - mixed structure - desiccated, black topsoil at 1.1 m	230.901	TH9-1	G			
1 – 2	CH		**CLAY** - brown, very silty, slightly plastic - firm to stiff - stiff below 2.1 m	229.149	TH9-2	G			
2 – 3					TH9-3	G			
3 – 4	ML		**SILT** - tan, soft, moist - slight seepage and caving	227.625	TH9-4	G			
4 – 5	CH		**CLAY** - brown, firm to soft, moderately plastic - silty		TH9-5	G			
5 – 6					TH9-6	G			
6 – 7					TH9-7	G			**Atterberg Limits** LL = 83.9% PL = 28.0%
7 – 8									
8 – 9	CH		- trace of gravel below 9.1 m		TH9-8	G			
9 – 10									
10 – 11					TH9-9	G			**Atterberg Limits** LL = 82.1% PL = 25.5%
11 – 12	CI		**GLACIAL TILL** - tan-grey, soft, some silt, clayey - some gravel - medium dense at 15.2 m - tan, gravelly, hard below 16.2 m	220.386	TH9-10	G			
12 – 13									
13 – 14					TH9-11	G			**Atterberg Limits** LL = 38.4% PL = 12.8%
14 – 15									
15 – 16	ML				TH9-12	G			
16 – 17				215.509	TH9-13	G			
17 – 18			Auger refusal at 16.8 mBGL in hard glacial till. Slight caving and seepage noted. UTM: 14U 5571896 N, 630452 E.						
18 – 19									

Drilling Contractor: Paddock Drilling

Field Personnel: RP, MS, CK, MF

Checked by: RK

Drill Method: SS3 Soil Sentry

Hole Size: 125 mm

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Elevation: 232.273 m

Drill Date: June 2, 2021

Project: Geotechnical Investigation

Project No: RW1156 **Testhole No: TH10**

Site: South Expansion

Location: Rockwood, Manitoba

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SUBSURFACE PROFILE / SAMPLE

Depth (ft / m)	USCS	Symbol	Description	Elev. (m)	Sample No.	Type	Pocket Pen kPa (100 – 300)	Moistures % (10 30 50 70 90)	Lab Analysis / Remarks
0 / 0			Ground Surface	232.144					
0 – 1	FILL		**FILL** - sandy clay, desiccated		TH10-1	G			**Atterberg Limits** LL = 16.0% PL = 13.9%
1 – 2	CH		**CLAY** - brown, silty, stiff, plastic	230.772	TH10-2	G			
2 – 3	ML CH		**SILT** - tan, soft, moist		TH10-3	G			
3 – 4			**CLAY** - brown, silty, fissured, stiff, plastic - shelby tube used from 3.0 m to 3.8 m	228.639	TH10-4	G			Unconfined Compression Test at 3.0 m to 3.8 m γ_b = 18.5 kN/m³ q_u = 80.1 kPa S_u = 40.0 kPa
4 – 5	ML CI		**SILT** - tan, soft, moist, slight seepage	227.572	TH10-5	G			
5 – 6			**CLAY** - brown, silty, firm to soft, plastic - shelby tube used from 6.1 m to 6.9 m		TH10-6	G			Unconfined Compression Test at 6.1 m to 6.9 m γ_b = 16.9 kN/m³ q_u = 89.0 kPa S_u = 44.5 kPa
6 – 7					TH10-7	G			**Hydrometer** Silt = 39.3% Clay = 60.5%
7 – 8									
8 – 9			- shelby tube used from 9.1 m to 9.9 m		TH10-8	G			Unconfined Compression Test at 9.1 m to 9.9 m γ_b = 15.5 kN/m³ q_u = 16.6 kPa S_u = 8.3 kPa
9 – 10									
10 – 11									
11 – 12									
12 – 13									
13 – 14				217.514					
14 – 15	ML		**GLACIAL TILL** - brown, clayey, some gravel, soft - silty - tan below 15.2 m, dense - hard at 16.8 m		TH10-9	G			
15 – 16									
16 – 17				215.380	TH10-10	G			
17 – 18			Auger refusal at 16.8 mBGL in hard glacial till. Slight caving and seepage noted. UTM: 14U 5571887 N, 630414 E.						
18 – 19									

Drilling Contractor: Paddock Drilling **Field Personnel:** RP, MS, CK, MF **Checked by:** RK

Drill Method: SS3 Soil Sentry **Hole Size:** 125 mm **Page:** 10

Elevation: 232.144 m **Drill Date:** June 3, 2021

Project: Geotechnical Investigation

Project No: RW1156 **Testhole No: TH11**

Site: South Expansion

Location: Rockwood, Manitoba

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SUBSURFACE PROFILE / SAMPLE

Depth (ft / m)	USCS	Symbol	Description	Elev. (m)	Sample No.	Type	Pocket Pen kPa (100 300)	Moistures % (10 30 50 70 90)	Lab Analysis/ Remarks
0 / 0			Ground Surface	232.251					
0 / 0	FILL		**FILL** - 0.2 m crushed limestone over gravelly clay, desiccated	231.794	TH11-1	G			
1 / 0	CH		**CLAY** - black, stiff, fissured - brown below 0.8 m, plastic		TH11-2	G			
2 / 1					TH11-3	G			
3 / 1			- silty, very stiff at 1.5 m	229.508					
3 / 1	ML		**SILT** - tan, soft, moist	228.898	TH11-4	G			
4 / 1									
5 / 2	CI		**CLAY** - brown, firm, plastic, silty		TH11-5	G			
6 / 2					TH11-6	G			
10 / 3									
11 / 3	CI								
13 / 4				218.535	TH11-7	G			
14 / 4	CL		**GLACIAL TILL** - brown, clayey, gravelly, soft - dense below 14.9 m						
15 / 5			- tan, silty, gravelly		TH11-8	G			
16 / 5	ML		- hard at 16 m	215.792	TH11-9	G			
17 / 5			Auger refusal at 16.5 mBGL in hard glacial till. Caving and seepage noted. UTM: 14U 5571890 N, 630384 E.						
18 / 6									
19 / 6									

Drilling Contractor: Paddock Drilling **Field Personnel:** RP, MS, CK, MF **Checked by:** RK

Drill Method: SS3 Soil Sentry **Hole Size:** 125 mm **Page:** 11

Elevation: 232.251 m **Drill Date:** June 3, 2021

Project: Geotechnical Investigation

Project No: RW1156 **Testhole No: TH12**

Site: South Expansion

Location: Rockwood, Manitoba

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SUBSURFACE PROFILE					SAMPLE				
Depth (ft / m)	USCS	Symbol	Description	Elev. (m)	Sample No.	Type	Pocket Pen kPa (100 – 300)	Moistures % (10 30 50 70 90)	Lab Analysis/ Remarks
0 / 0			Ground Surface	231.907					
0	FILL		**TOPSOIL** - black, organic, some silt	231.730					
2	CH		**CLAY** - brown, stiff, plastic - very silty below 0.8 m, firm		TH12-1	G			
1			- slight seepage - caving noted		TH12-2	G			
2					TH12-3	G			
3			- plastic below 3.4 m		TH12-4	G			
4					TH12-5	G			
				227.335	TH12-6	G			
5			End of testhole at 4.6 mBGL in stiff clay. Slight caving and seepage noted. UTM: 14U 5571873 N, 630418 E.						
6									
7									

Drilling Contractor: Paddock Drilling **Field Personnel:** RP, MS, CK, MF **Checked by:** RK

Drill Method: SS3 Soil Sentry **Hole Size:** 125 mm **Page:** 12

Elevation: 231.907 m **Drill Date:** June 3, 2021

Project: Geotechnical Investigation

Project No: RW1156

Testhole No: TH13

Site: West Parking

Location: Rockwood, Manitoba

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SUBSURFACE PROFILE					SAMPLE				
Depth (ft / m)	USCS	Symbol	Description	Elev. (m)	Sample No.	Type	Pocket Pen kPa (100 – 300)	Moistures % (10 30 50 70 90)	Lab Analysis/ Remarks
0 / 0			Ground Surface	231.875					
0	FILL		**FILL** - gravelly clay, dry, crumbly, mixed structure - non-plastic - crushed limestone from 0.45 m to 0.6 m	231.241					
2	CH		**CLAY** - brown, plastic, stiff - some silt, fissured		TH13-1	G			
5 / 1				230.351	TH13-2	G			
5	ML		**SILT** - tan, soft, moist						
7 / 2					TH13-3	G			
8				229.284					
9	CH		**CLAY** - brown, silty, fissured, plastic - stiff	228.827					
10 / 3					TH13-4	G			
11			End of testhole at 3.0 mBGL in stiff clay. No caving or seepage noted. UTM: 14U 5571877 N, 630364 E.						
12									
13 / 4									
14									
15									

Drilling Contractor: Paddock Drilling

Field Personnel: RP, MS, CK, MF

Checked by: RK

Drill Method: SS3 Soil Sentry

Hole Size: 125 mm

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Elevation: 231.875 m

Drill Date: June 2, 2021

Project: Geotechnical Investigation

Project No: RW1156

Testhole No: TH14

Site: West Parking

Location: Rockwood, Manitoba

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SUBSURFACE PROFILE / SAMPLE

Depth (ft / m)	USCS	Symbol	Description	Elev. (m)	Sample No.	Type	Pocket Pen kPa (100 – 300)	Moistures % (10 30 50 70 90)	Lab Analysis/ Remarks
0 / 0			Ground Surface	231.583					
	OH		**TOPSOIL** - black, moist to dry, organic	231.382					
1	CH		**CLAY** - black-brown, very stiff, silty - fissured, plastic						
2				230.821	TH14-1	G			
3 / 1	ML		**SILT** - tan, some clay, soft, moist						
5					TH14-2	G			
6				229.678					
7 / 2	CH		**CLAY** - brown, silty, very stiff, fissured						
8					TH14-3	G			**Atterberg Limits** LL = 57.7% PL = 26.4%
9									
10 / 3				228.535	TH14-4	G			
11			End of testhole at 3.0 mBGL in stiff clay. No caving or seepage noted. UTM: 14U 5571876 N, 630323 E.						
12									
13 / 4									
14									
15									

Drilling Contractor: Paddock Drilling

Field Personnel: RP, MS, CK, MF

Checked by: RK

Drill Method: SS3 Soil Sentry

Hole Size: 125 mm

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Elevation: 231.583 m

Drill Date: June 2, 2021

Project: Geotechnical Investigation

Project No: RW1156

Testhole No: TH15

Site: South Expansion

Location: Rockwood, Manitoba

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SUBSURFACE PROFILE

SAMPLE

Depth (ft / m)	USCS	Symbol	Description	Elev. (m)	Sample No.	Type	Pocket Pen kPa (100 – 300)	Moistures % (10 30 50 70 90)	Lab Analysis/ Remarks
0 / 0	FILL		Ground Surface	231.990					
1 / 0	FILL		**FILL** - 0.4 m crushed limestone on gravelly clay		TH15-1	G			
3 / 1	CH		**CLAY** - brown, silty, fissured, stiff - plastic		TH15-2	G			
7 / 2				229.399	TH15-3	G			
9 / 3	ML		- very silty from 0.9 m to 1.4 m	228.790	TH15-4	G			
12 / 4	CH		**SILT** - tan, soft, moist - slight seepage		TH15-5	G			
16 / 5			**CLAY** - brown, silty, plastic, firm		TH15-6	G			
20 / 6									
23 / 7									
26 / 8									
30 / 9									
33 / 10									
36 / 11	CI								
39 / 12									
43 / 13									
46 / 14				217.664					
49 / 15	CL		**GLACIAL TILL** - clayey, some sand, soft - tan below 15.2 m, dense		TH15-7	G			
52 / 16	ML		- gravelly, silty - hard at 16.2 m	215.226	TH15-8	G			
56 / 17			Auger refusal at 16.8 mBGL in hard glacial till.						
59 / 18			Slight caving and seepage noted.						
62 / 19			UTM: 14U 5571859 N, 630391 E.						
65									

Drilling Contractor: Paddock Drilling

Field Personnel: RP, MS, CK, MF

Checked by: RK

Drill Method: SS3 Soil Sentry

Hole Size: 125 mm

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Elevation: 231.990 m

Drill Date: June 3, 2021

Project: Geotechnical Investigation

Project No: RW1156 **Testhole No: TH16**

Site: South Expansion

Location: Rockwood, Manitoba

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SUBSURFACE PROFILE					SAMPLE				
Depth (ft / m)	USCS	Symbol	Description	Elev. (m)	Sample No.	Type	Pocket Pen kPa (100 300)	Moistures % (10 30 50 70 90)	Lab Analysis/ Remarks
0 / 0			Ground Surface	232.210					
0	FILL		**FILL** - brown clay, some gravel, desiccated - mixed structure	231.600					
2	CH		**CLAY** - brown, silty, stiff, fissured - very silty from 0.9 m to 1.5 m - stiff at 1.8 m		TH16-1	G			
5	CI				TH16-2	G			
7 / 2					TH16-3	G			
9				229.467					
10 / 3	ML		**SILT** - tan, silty, moist, slight seepage	228.857	TH16-4	G			
12	CH		**CLAY** - brown, silty, stiff, plastic - fissured		TH16-5	G			
13 / 4									
15				227.638	TH16-6	G			
16 / 5			End of testhole at 4.6 mBGL in stiff clay. Slight caving and seepage noted. UTM: 14U 5571856 N, 630422 E.						
20 / 6									
23 / 7									
25									

Drilling Contractor: Paddock Drilling **Field Personnel:** RP, MS, CK, MF **Checked by:** RK

Drill Method: SS3 Soil Sentry **Hole Size:** 125 mm **Page:** 16

Elevation: 232.210 m **Drill Date:** June 3, 2021

Project: Geotechnical Investigation

Project No: RW1156

Testhole No: TH17

Site: South Expansion

Location: Rockwood, Manitoba

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SUBSURFACE PROFILE

Depth (ft / m)	USCS	Symbol	Description	Elev. (m)
0 / 0			Ground Surface	232.554
0	FILL		**FILL** - brown clay, desiccated - mixed structure	
3 / 1				231.487
4	CH		**CLAY** - brown, slightly desiccated - plastic, stiff to very stiff - fissured	
7 / 2				
10 / 3				229.354
11	ML		**SILT** - tan, silty, moist	
13 / 4				
14				228.134
15	CH		**CLAY** - brown, silty, stiff, plastic	
16 / 5			End of testhole at 4.6 mBGL in stiff clay. Slight caving and seepage noted. UTM: 14U 5571854 N, 630453 E.	
20 / 6				
23 / 7				
25				

SAMPLE

Sample No.	Type	Pocket Pen kPa (100 – 300)	Moistures % (10 30 50 70 90)
TH17-1	G		
TH17-2	G		
TH17-3	G		
TH17-4	G		
TH17-5	G		
TH17-6	G		

Lab Analysis/ Remarks

Drilling Contractor: Paddock Drilling

Field Personnel: RP, MS, CK, MF

Checked by: RK

Drill Method: SS3 Soil Sentry

Hole Size: 125 mm

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Elevation: 232.554 m

Drill Date: June 3, 2021

Project: Geotechnical Investigation

Project No: RW1156 **Testhole No: TH18**

Site: Building

Location: Rockwood, Manitoba

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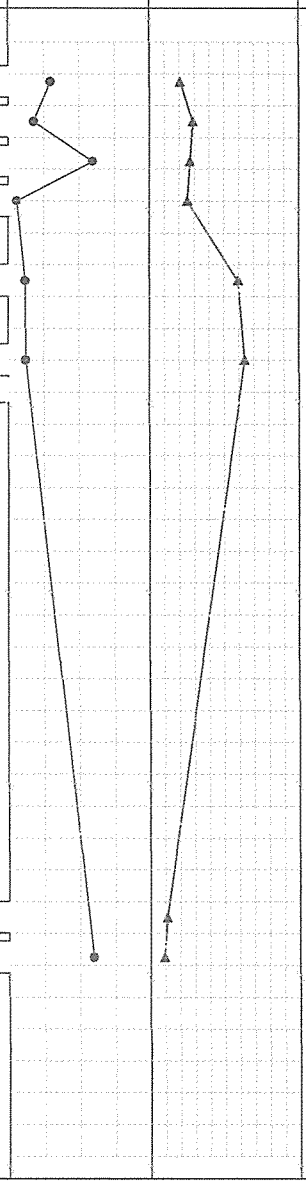
SUBSURFACE PROFILE

Depth (ft / m)	USCS	Symbol	Description	Elev. (m)
0 / 0			Ground Surface	232.360
0 / 0	FILL		**FILL** - brown clay, mixed structure, desiccated	231.446
3 / 1	CH		**CLAY** - brown, silty, stiff	229.769
8 / 2	ML		- very silty at 1.5 m, firm	228.855
10 / 3			**SILT** - tan, soft, moist	
13 / 4	CH		**CLAY** - brown, plastic, firm, silty - slight seepage - Shelby Tube sample	
33 / 10	CI			
49 / 15				217.120
51 / 16	CL		**GLACIAL TILL** - soft, clayey, gravelly - tan below 16.8 m - dense, silty	
56 / 17	ML		- hard at 17.7 m	214.682
58 / 18			Auger refusal at 17.7 mBGL in hard glacial till. Slight caving and seepage noted. UTM: 14U 5571821 N, 630450 E.	

SAMPLE

Sample No.	Type
TH18-1	G
TH18-2	G
TH18-3	G
TH18-4	G
TH18-5	G
TH18-6	G
TH18-7	G
TH18-8	G



Lab Analysis/ Remarks

Atterberg Limits
LL = 89.7%
PL = 28.4%

Unconfined Compression Test at 6.1 m to 6.9 m
γ_b = 15.3 kN/m³
q_u = 47.4 kPa
S_u = 23.7 kPa

Drilling Contractor: Paddock Drilling **Field Personnel:** RP, MS, CK, MF **Checked by:** RK

Drill Method: SS3 Soil Sentry **Hole Size:** 125 mm **Page:** 18

Elevation: 232.360 m **Drill Date:** June 3, 2021

Project: Geotechnical Investigation

Project No: RW1156 **Testhole No: TH19**

Site: West Parking

Location: Rockwood, Manitoba

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SUBSURFACE PROFILE					SAMPLE				
Depth (ft / m)	USCS	Symbol	Description	Elev. (m)	Sample No.	Type	Pocket Pen kPa (100 – 300)	Moistures % (10 30 50 70 90)	Lab Analysis/ Remarks
0 / 0			Ground Surface	232.319					
0 – 3 / 0 – 1	FILL		**FILL** - brown clay, mixed structure - desiccated	231.252	TH19-1	G			
3 – 10 / 1 – 3	CH		**CLAY** - black, fissured, silty - brown below 1.2 m - plastic	230.033	TH19-2 TH19-3	G G			
8 – 10 / 2 – 3	ML		**SILT** - tan, soft, moist - slight seepage and caving	229.119	TH19-4	G			
10 – 15 / 3 – 4.6	CH		**CLAY** - brown, plastic, stiff, fissured	227.747	TH19-5 TH19-6	G G			
15 / 4.6			End of testhole at 4.6 mBGL in stiff clay. Slight caving or seepage noted. UTM: 14U 5571820 N, 630387 E.						

Drilling Contractor: Paddock Drilling **Field Personnel:** RP, MS, CK, MF **Checked by:** RK

Drill Method: SS3 Soil Sentry **Hole Size:** 125 mm **Page:** 19

Elevation: 232.319 m **Drill Date:** June 3, 2021

Project: Geotechnical Investigation

Project No: RW1156

Testhole No: TH20

Site: West Parking

Location: Rockwood, Manitoba

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SUBSURFACE PROFILE / SAMPLE

Depth (ft / m)	USCS	Symbol	Description	Elev. (m)	Sample No.	Type	Pocket Pen kPa (100 – 300)	Moistures % (10 30 50 70 90)	Lab Analysis/ Remarks
0 / 0			Ground Surface	231.505					
0	OH		**TOPSOIL** - black, moist, organic	231.200					
1	CH		**CLAY** - black, firm, some organics, some silt - brown, very stiff, fissured below 0.9 m - plastic		TH20-1	G			
2									
3 / 1									
4				230.057					
5	ML		**SILT** - tan, soft, moist		TH20-2	G			
6									
7 / 2					TH20-3	G			
8				228.914					
9	CH		**CLAY** - brown, silty, plastic, very stiff						
10 / 3				228.457	TH20-4	G			
11			End of testhole at 3.0 mBGL in stiff clay. No caving or seepage noted. UTM: 14U 5571830 N, 630366 E.						
12									
13 / 4									
14									
15									

Drilling Contractor: Paddock Drilling

Field Personnel: RP, MS, CK, MF

Checked by: RK

Drill Method: SS3 Soil Sentry

Hole Size: 125 mm

Page: 20

Elevation: 231.505 m

Drill Date: June 2, 2021

Project: Geotechnical Investigation

Project No: RW1156 **Testhole No: TH21**

Site: West Parking

Location: Rockwood, Manitoba

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SUBSURFACE PROFILE

Depth (ft / m)	USCS	Symbol	Description	Elev. (m)
0 / 0			Ground Surface	231.618
	OH		**TOPSOIL** - black, moist to dry, organic	231.389
1	OH		**CLAY** - black, very stiff, some silt - trace organics, fissured	
2				
3 / 1	CH		- brown below 0.9 m - silty, stiff	
4				
5				230.018
6	ML		**SILT** - tan, soft, moist	
7 / 2				
8				
9				228.680
10 / 3	CH		**CLAY** - brown, silty, stiff, fissured	228.570
11			End of testhole at 3.0 mBGL in stiff clay. No caving or seepage noted. UTM: 14U 5571830 N, 630324 E.	
12				
13 / 4				
14				
15				

SAMPLE

Sample No.	Type	Pocket Pen kPa (100 – 300)	Moistures % (10 30 50 70 90)	Lab Analysis / Remarks
TH21-1	G			**Atterberg Limits** LL = 61.6% PL = 32.5%
TH21-2	G			
TH21-3	G			
TH21-4	G			

Drilling Contractor: Paddock Drilling **Field Personnel:** RP, MS, CK, MF **Checked by:** RK

Drill Method: SS3 Soil Sentry **Hole Size:** 125 mm **Page:** 21

Elevation: 231.618 m **Drill Date:** June 2, 2021

Project: Geotechnical Investigation

Project No: RW1156

Site: West Parking

Location: Rockwood, Manitoba

Testhole No: TH22

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SUBSURFACE PROFILE / SAMPLE

Depth (ft / m)	USCS	Symbol	Description	Elev. (m)	Sample No.	Type	Pocket Pen kPa (100 – 300)	Moistures % (10 30 50 70 90)	Lab Analysis/ Remarks
0 / 0			Ground Surface	231.551					
0	OH		**TOPSOIL** - black, moist, organic	231.298					
1	CH		**CLAY** - black, stiff to firm, silty - moderately plastic - very stiff, plastic below 0.9 m		TH22-1	G			
2 / 1									
5					TH22-2	G			
6	ML		**SILT** - tan, soft, moist - slight seepage	229.722					
7 / 2									
8					TH22-3	G			
9 / 3									
10				228.503	TH22-4	G			
11			End of testhole at 3.0 mBGL in soft silt. Slight caving or seepage noted. UTM: 14U 5571786 N, 630325 E.						
12 / 4									
13									
14									
15									

Drilling Contractor: Paddock Drilling

Field Personnel: RP, MS, CK, MF

Checked by: RK

Drill Method: SS3 Soil Sentry

Hole Size: 125 mm

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Elevation: 231.551 m

Drill Date: June 2, 2021

Project: Geotechnical Investigation

Project No: RW1156

Testhole No: TH23

Site: West Parking

Location: Rockwood, Manitoba

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SUBSURFACE PROFILE

Depth (ft / m)	USCS	Symbol	Description	Elev. (m)
0 / 0			Ground Surface	231.697
0	OH		**TOPSOIL** - black, moist, organic	231.392
1	CH		**CLAY** - brown to black, stiff to firm - plastic - very stiff below 0.9 m	
6 / 2	ML		**SILT** - tan, soft, moist to wet - slight seepage	229.868
10 / 3				228.649
			End of testhole at 3.0 mBGL in soft silt. Slight caving and seepage noted. UTM: 14U 5571789 N, 630366 E.	

SAMPLE

Sample No.	Type	Pocket Pen kPa (100 – 300)	Moistures % (10 30 50 70 90)
TH23-1	G		
TH23-2	G		
TH23-3	G		
TH23-4	G		

Lab Analysis/ Remarks

Drilling Contractor: Paddock Drilling

Field Personnel: RP, MS, CK, MF

Checked by: RK

Drill Method: SS3 Soil Sentry

Hole Size: 125 mm

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Elevation: 231.697 m

Drill Date: June 2, 2021

Project: Geotechnical Investigation

Project No: RW1156

Testhole No: TH24

Site: South Expansion

Location: Rockwood, Manitoba

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SUBSURFACE PROFILE

SAMPLE

Depth (ft / m)	USCS	Symbol	Description	Elev. (m)	Sample No.	Type	Pocket Pen kPa (100 – 300)	Moistures % (10 30 50 70 90)	Lab Analysis/ Remarks
0 / 0			Ground Surface	232.429					
0 – 3 / 0 – 1	FILL		**FILL** - brown clay, desiccated, mixed structure - very stiff	231.210	TH24-1	G			
4 – 7 / 1 – 2	CH		**CLAY** - brown, silty, plastic, fissured - stiff	230.295	TH24-2	G			
7 – 10 / 2 – 3	ML		**SILT** - tan, soft, moist - slight seepage	229.305	TH24-3	G			
10 – 15 / 3 – 4	CH		**CLAY** - brown, silty, plastic, stiff	227.857	TH24-4	G			
					TH24-5	G			
					TH24-6	G			**Atterberg Limits** LL = 92.2% PL = 31.0%
15 – 25 / 4 – 7			End of testhole at 4.6 mBGL in stiff clay. Slight caving and seepage noted. UTM: 14U 5571799 N, 630411 E.						

Drilling Contractor: Paddock Drilling

Field Personnel: RP, MS, CK, MF

Checked by: RK

Drill Method: SS3 Soil Sentry

Hole Size: 125 mm

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Elevation: 232.429 m

Drill Date: June 3, 2021

Project: Geotechnical Investigation

Project No: RW1156

Testhole No: TH25

Site: South Expansion

Location: Rockwood, Manitoba

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SUBSURFACE PROFILE

SAMPLE

Depth (ft / m)	USCS	Symbol	Description	Elev. (m)	Sample No.	Type	Pocket Pen kPa (100 – 300)	Moistures % (10 30 50 70 90)	Lab Analysis/ Remarks
0 / 0			Ground Surface	233.070					
0 – 2 / 0	FILL		**FILL** - brown clay, desiccated, mixed structure - silty, stiff		TH25-1	G			
3 – 5 / 1				231.546	TH25-2	G			
5 – 9 / 1 – 2	CH		**CLAY** - brown, silty, plastic, fissured - stiff		TH25-3	G			
9 – 10 / 2 – 3				230.098	TH25-4	G			
10 – 13 / 3 – 4	ML		**SILT** - tan, soft, moist	229.108	TH25-5	G			
13 – 15 / 4	CH		**CLAY** - brown, silty, plastic, stiff - fissured	228.498	TH25-6	G			
15 – 25 / 4 – 7			End of testhole at 4.6 mBGL in stiff clay. Slight caving and seepage noted. UTM: 14U 5571775 N, 630390 E.						

Drilling Contractor: Paddock Drilling

Field Personnel: RP, MS, CK, MF

Checked by: RK

Drill Method: SS3 Soil Sentry

Hole Size: 125 mm

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Elevation: 233.070 m

Drill Date: June 3, 2021

Project: Geotechnical Investigation

Project No: RW1156

Testhole No: TH26

Site: South Expansion

Location: Rockwood, Manitoba

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SUBSURFACE PROFILE

Depth (ft / m)	USCS	Symbol	Description	Elev. (m)
0 / 0			Ground Surface	233.139
0 – 5 / 0 – 1.5	FILL		**FILL** - brown clay, desiccated, very stiff - trace organics	231.615
5 – 12 / 1.5 – 3.5	CH		**CLAY** - brown, silty, plastic, fissured - stiff - very silty at 2.0 m to 2.4 m - very stiff at 3.0 m - firm at 3.5 m	229.481
12 – 15 / 3.5 – 4.6	ML		**SILT** - tan, soft, moist - slight seepage	228.567
			End of testhole at 4.6 mBGL in wet, soft silt. Slight caving and seepage noted. UTM: 14U 5571777 N, 630448 E.	

SAMPLE

Sample No.	Type	Pocket Pen kPa (100 – 300)	Moistures % (10 30 50 70 90)
TH26-1	G		
TH26-2	G		
TH26-3	G		
TH26-4	G		
TH26-5	G		
TH26-6	G		

Lab Analysis/ Remarks

Drilling Contractor: Paddock Drilling

Field Personnel: RP, MS, CK, MF

Checked by: RK

Drill Method: SS3 Soil Sentry

Hole Size: 125 mm

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Elevation: 233.139 m

Drill Date: June 3, 2021

Project: Geotechnical Investigation

Project No: RW1156

Testhole No: TH27

Site: Grow Out

Location: Rockwood, Manitoba

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SUBSURFACE PROFILE

SAMPLE

Depth (ft / m)	USCS	Symbol	Description	Elev. (m)	Sample No.	Type	Pocket Pen kPa (100 – 300)	Moistures % (10 30 50 70 90)	Lab Analysis/ Remarks
0 / 0			Ground Surface	233.040					
0 – 5 / 0 – 1.5	FILL		**FILL** - black clay, organic, desiccated - mixed structure - brown below 0.8 m, stiff	231.516	TH27-1 TH27-2	G G			
5 – 11 / 1.5 – 3.4	CH		**CLAY** - brown, silty, plastic, fissured - stiff	229.611	TH27-3 TH27-4	G G			
11 – 15 / 3.4 – 4.6	ML		**SILT** - tan, soft, moist - slight seepage	228.468	TH27-5 TH27-6	G G			
			End of testhole at 4.6 mBGL in soft silt. Slight caving and seepage noted. UTM: 14U 5571760 N, 630387 E.						

Drilling Contractor: Paddock Drilling

Field Personnel: RP, MS, CK, MF

Checked by: RK

Drill Method: SS3 Soil Sentry

Hole Size: 125 mm

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Elevation: 233.040 m

Drill Date: June 3, 2021

Project: Geotechnical Investigation

Project No: RW1156

Testhole No: TH28

Site: Grow Out

Location: Rockwood, Manitoba

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SUBSURFACE PROFILE					SAMPLE				
Depth (ft / m)	USCS	Symbol	Description	Elev. (m)	Sample No.	Type	Pocket Pen kPa (100 – 300)	Moistures % (10 30 50 70 90)	Lab Analysis/ Remarks
0 / 0			Ground Surface	233.194					
0 – 4 / 0 – 1	FILL		**FILL** - brown clay, desiccated, mixed structure - very stiff	231.822	TH28-1	G			
4 – 12 / 1 – 3	CH		**CLAY** - brown, silty, fissured, desiccated - stiff, plastic below 1.8 m	229.384	TH28-2 TH28-3 TH28-4	G			
12 – 15 / 3 – 4	ML		**SILT** - tan, soft, moist - slight seepage	228.622	TH28-5 TH28-6	G			
15 – 25 / 4 – 7			End of testhole at 4.6 mBGL in soft silt. Slight caving and seepage noted. UTM: 14U 5571756 N, 630452 E.						

Drilling Contractor: Paddock Drilling

Field Personnel: RP, MS, CK, MF

Checked by: RK

Drill Method: SS3 Soil Sentry

Hole Size: 125 mm

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Elevation: 233.194 m

Drill Date: June 3, 2021

Project: Geotechnical Investigation

Project No: RW1156

Testhole No: TH29

Site: Grow Out

Location: Rockwood, Manitoba

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SUBSURFACE PROFILE / SAMPLE

Depth (ft / m)	USCS	Symbol	Description	Elev. (m)	Sample No.	Type	Pocket Pen kPa (100 – 300)	Moistures % (10 30 50 70 90)	Lab Analysis/ Remarks
0 / 0			Ground Surface	233.107					
0 – 3 / 0 – 1	FILL		**FILL** - brown clay, desiccated, stiff - trace organics	231.964	TH29-1	G			
3 – 12 / 1 – 3	CH		**CLAY** - brown, plastic, stiff, fissured - silty, very stiff	229.449	TH29-2 TH29-3 TH29-4	G G G			
12 – 15 / 3 – 4	ML		**SILT** - tan, soft, moist - slight seepage	228.535	TH29-5 TH29-6	G G			
15 – 25 / 4 – 7			End of testhole at 4.6 mBGL in soft silt. Slight caving and seepage noted. UTM: 14U 5571753 N, 630416 E.						

Drilling Contractor: Paddock Drilling

Field Personnel: RP, MS, CK, MF

Checked by: RK

Drill Method: SS3 Soil Sentry

Hole Size: 125 mm

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Elevation: 233.107 m

Drill Date: June 3, 2021

Project: Geotechnical Investigation

Project No: RW1156

Testhole No: TH30

Site: Raceway

Location: Rockwood, Manitoba

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SUBSURFACE PROFILE					SAMPLE				
Depth (ft / m)	USCS	Symbol	Description	Elev. (m)	Sample No.	Type	Pocket Pen kPa (100 – 300)	Moistures % (10 30 50 70 90)	Lab Analysis/ Remarks
0 / 0			Ground Surface	232.985					
0 – 3 / 0 – 1	FILL		**FILL** - brown clay, desiccated, stiff - trace organics - mixed structure		TH30-1	G			
5 / 1				231.461	TH30-2	G			
5 – 10 / 1 – 3	CH		**CLAY** - brown, plastic, stiff, fissured - silty - stiff to very stiff		TH30-3 TH30-4	G G			
11 / 3				229.480					
12 / 3	ML		**SILT** - tan, soft, moist	229.023	TH30-5	G			
13 / 4			End of testhole at 4.0 mBGL in soft silt. No caving or seepage noted. UTM: 14U 5571722 N, 630390 E.						

Drilling Contractor: Aski

Field Personnel: RP, MF

Checked by: RK

Drill Method: Hand Auger

Hole Size: 75 mm

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Elevation: 232.985 m

Drill Date: June 25, 2021

Project: Geotechnical Investigation

Project No: RW1156

Testhole No: TH31

Site: Raceway

Location: Rockwood, Manitoba

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environmental & geotechnical services

SUBSURFACE PROFILE					SAMPLE				
Depth (ft / m)	USCS	Symbol	Description	Elev. (m)	Sample No.	Type	Pocket Pen kPa (100 – 300)	Moistures % (10 30 50 70 90)	Lab Analysis/ Remarks
0 / 0			Ground Surface	233.024					
0 – 3 / 0 – 1	FILL		**FILL** - brown clay, desiccated, stiff - trace organics - mixed structure		TH31-1	G			
5 / 1.5				231.500	TH31-2	G			
5 – 12 / 1.5 – 3.5	CH		**CLAY** - brown, plastic, stiff to very stiff - fissured, silty		TH31-3 TH31-4 TH31-5	G G G			
12 – 13 / 3.5 – 4	ML		**SILT** - tan, soft, moist	229.214 228.833	TH31-6	G			
13 – 25 / 4 – 7			End of testhole at 4.2 mBGL in soft silt. No caving or seepage noted. UTM: 14U 5571723 N, 630453 E.						

Drilling Contractor: Aski

Field Personnel: RP, MF

Checked by: RK

Drill Method: Hand Auger

Hole Size: 75 mm

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Elevation: 233.024 m

Drill Date: June 25, 2021

APPENDIX B - SITE PHOTOS

- **Photo B1:** Existing building to be renovated for the main hatchery (May 27, 2021).
- **Photo B2:** Drilling testhole TH8 in the hatchery expansion area (June 2, 2021).
- **Photo B3:** Soil samples collected by spilt spoons in the dense glacial till at 16.2 mBGL (June 2, 2021).
- **Photo B4:** Front driveway to the Site from PR 87 N (June 2, 2021).
- **Photo B5:** Area proposed for the west parking lot (June 2, 2021).
- **Photo B6:** Existing houses to be demolished and area converted into a parking lot (June 3, 2021).
- **Photo B7:** Tall trees to be removed from the east parking lot (June 2, 2021).
- **Photo B8:** Building containing existing concrete fish ponds (June 2, 2021).
- **Photo B9:** Concrete ponds to house mature fish (June 2, 2021).
- **Photo B10:** South view of Phase I expansion (May 27, 2021).
- **Photo B11:** Existing clay pond located in the proposed processing area. Note manhole and gate valve (May 27, 2021).
- **Photo B12:** Existing clay pond located in the proposed grow-out raceways (June 3, 2021).

Photo B1
Existing building to be renovated for the main hatchery (May 27, 2021).

Photo B2
Drilling testhole TH8 in the hatchery expansion area (June 2, 2021).

Photo B3
Soil samples collected by spilt spoons in the dense glacial till at 16.2 mBGL (June 2, 2021).

Photo B4
Front driveway to the site from PR 87 N (June 2, 2021).

Photo B5
Area proposed for the west parking lot (June 2, 2021).

Photo B6
Existing houses to be demolished and area converted into a parking lot (June 3, 2021).

Photo B7
Tall trees to be removed from the east parking lot (June 2, 2021).

Photo B8
Building containing existing concrete fish ponds (June 2, 2021).

Photo B9
Concrete ponds to house mature fish (June 2, 2021).

Photo B10
South view of Phase I expansion (May 27, 2021).

Photo B11 - Existing clay pond located in the proposed processing area. Note manhole and gate valve (May 27, 2021).

Photo B12
Existing clay pond located in the proposed grow-out raceways (June 3, 2021).

APPENDIX C - LABORATORY RESULTS

Moisture Analysis – Aski Geosciences Ltd.:

- TH1 @ 0.8 m to 3.0 m
- TH2 @ 0.8 m to 3.0 m
- TH4 @ 0.8 m to 3.0 m
- TH5 @ 0.8 m to 3.0 m
- TH6 @ 0.8 m to 3.0 m
- TH7 @ 0.8 m to 16.8 m
- TH8 @ 0.8 m to 17.4 m
- TH9 @ 0.8 m to 16.8 m
- TH10 @ 0.8 m to 16.5 m
- TH11 @ 0.8 m to 16.2 m
- TH13 @ 0.8 m to 3.0 m
- TH14 @ 0.8 m to 3.0 m
- TH15 @ 0.8 m to 16.5 m
- TH18 @ 0.8 m to 17.5 m
- TH20 @ 0.8 m to 3.0 m
- TH21 @ 0.8 m to 3.0 m
- TH22 @ 0.8 m to 3.0 m
- TH23 @ 0.8 m to 3.0 m
- TH24 @ 0.8 m to 4.6 m
- TH27 @ 0.8 m to 4.6 m
- TH28 @ 0.8 m to 4.6 m

Atterberg Limits – Aski Geosciences Ltd.:

- TH5 @ 1.5 m (5')
- TH8 @ 2.3 m (7.5')
- TH8 @ 4.6 m (15.0')
- TH9 @ 7.6 m (25.0')
- TH9 @ 10.7 m (35.0')
- TH9 @ 13.7 m (45.0')
- TH10 @ 0.8 m (2.5')
- TH14 @ 2.3 m (7.5')
- TH18 @ 6.1 m (20')
- TH21 @ 0.8 m (2.5')
- TH24 @ 4.6 m (15.0')

Particle Size Analysis – Trek Geotechnical Inc.:

- TH10 @ (6.1 m to 6.9 m)

Unconfined Compression Strength (q_u) Testing – Trek Geotechnical Inc.:

- TH10 @ 3.0 m to 3.8 m
- TH10 @ 6.1 m to 6.9 m
- TH10 @ 9.1 m to 9.9 m
- TH18 @ 6.1 m to 6.9 m

MOISTURE ANALYSIS

Geotechincal Assessment - Sapphire Springs Redevelopment Project
Rockwood, Manitoba
Project # RW1156

TESTHOLE NO.	TH1	TH1	TH1	TH1		
Tare No.	1H	3N	2N	2H		
Depth (m)	0.8	1.5	2.3	3.0		
Wt. Wet Soil + Tare (g)	59.7	70.6	64.7	50.5		
Wt. Dry Soil + Tare (g)	46.7	56.9	53	39.2		
Wt. Water (g)	13.0	13.7	11.7	11.3		
Tare Container (g)	3.2	3.2	3.1	3.1		
Wt. Dry Soil (g)	43.5	53.7	49.9	36.1		
Moisture Content (%)	**29.9%**	**25.5%**	**23.4%**	**31.3%**		

TESTHOLE NO.	TH2	TH2	TH2	TH2		
Tare No.	2A	3L	3C	4N		
Depth (m)	0.8	1.5	2.3	3.0		
Wt. Wet Soil + Tare (g)	63.6	57.3	54.4	53.4		
Wt. Dry Soil + Tare (g)	48.8	46.6	45	38.7		
Wt. Water (g)	14.8	10.7	9.4	14.7		
Tare Container (g)	3.1	3.1	3.2	3.6		
Wt. Dry Soil (g)	45.7	43.5	41.8	35.1		
Moisture Content (%)	**32.4%**	**24.6%**	**22.5%**	**41.9%**		

TESTHOLE NO.	TH4	TH4	TH4	TH4		
Tare No.	1Q	1E	3K	2Z		
Depth (m)	0.8	1.5	2.3	3.0		
Wt. Wet Soil + Tare (g)	53.1	59.4	70.3	63.6		
Wt. Dry Soil + Tare (g)	45.7	43.9	56.6	51.6		
Wt. Water (g)	7.4	15.5	13.7	12.0		
Tare Container (g)	3.0	3.2	3.1	3.0		
Wt. Dry Soil (g)	42.7	40.7	53.5	48.6		
Moisture Content (%)	**17.3%**	**38.1%**	**25.6%**	**24.7%**		

TESTHOLE NO.	TH5	TH5	TH5	TH5		
Tare No.	4S	5B	1C	4Y		
Depth (m)	0.8	1.5	2.3	3.0		
Wt. Wet Soil + Tare (g)	69.2	74.0	57.6	58.3		
Wt. Dry Soil + Tare (g)	65	56.9	46.7	48		
Wt. Water (g)	4.2	17.1	10.9	10.3		
Tare Container (g)	3.5	3.6	3.1	3.8		
Wt. Dry Soil (g)	61.5	53.3	43.6	44.2		
Moisture Content (%)	**6.8%**	**32.1%**	**25.0%**	**23.3%**		

TESTHOLE NO.	TH6	TH6	TH6	TH6		
Tare No.	3F	1X	1N	4C		
Depth (m)	0.8	1.5	2.3	3.0		
Wt. Wet Soil + Tare (g)	60.1	49.6	68.8	54.2		
Wt. Dry Soil + Tare (g)	55.8	40.8	55.2	43.3		
Wt. Water (g)	4.3	8.8	13.6	10.9		
Tare Container (g)	3.1	3.1	3.0	3.2		
Wt. Dry Soil (g)	52.7	37.7	52.2	40.1		
Moisture Content (%)	**8.2%**	**23.3%**	**26.1%**	**27.2%**		

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TESTHOLE NO.	TH7	TH7	TH7	TH7	TH7	TH7
Tare No.	1J	2Q	2Y	1V	1G	1M
Depth (m)	0.8	1.5	2.3	3.0	4.6	6.1
Wt. Wet Soil + Tare (g)	50.8	65.5	64.8	66.9	54.9	55.0
Wt. Dry Soil + Tare (g)	43.7	53.3	52.6	54.6	35.7	32.7
Wt. Water (g)	7.1	12.2	12.2	12.3	19.2	22.3
Tare Container (g)	3.1	3.0	3.1	3.0	3.0	3.0
Wt. Dry Soil (g)	40.6	50.3	49.5	51.6	32.7	29.7
Moisture Content (%)	**17.5%**	**24.3%**	**24.6%**	**23.8%**	**58.7%**	**75.1%**

TESTHOLE NO.	TH7	TH7		TH8	TH8	TH8
Tare No.	1P	3P		3E	1H	3N
Depth (m)	15.2	16.8		0.8	1.5	2.3
Wt. Wet Soil + Tare (g)	51.8	65.9		49.7	52.5	74.2
Wt. Dry Soil + Tare (g)	46.7	59.4		42.9	40.9	59.4
Wt. Water (g)	5.1	6.5		6.8	11.6	14.8
Tare Container (g)	3.0	3.1		3.0	3.1	3.1
Wt. Dry Soil (g)	43.7	56.3		39.9	37.8	56.3
Moisture Content (%)	**11.7%**	**11.5%**		**17.0%**	**30.7%**	**26.3%**

TESTHOLE NO.	TH8	TH8	TH8	TH8	TH8	TH8
Tare No.	2N	2H	2A	1E	1Q	4N
Depth (m)	3.0	4.6	6.1	7.6	9.1	15.2
Wt. Wet Soil + Tare (g)	66.6	66.7	55.8	61.6	50.1	74.7
Wt. Dry Soil + Tare (g)	51.4	48.6	37.5	37.5	30.9	68.2
Wt. Water (g)	15.2	18.1	18.3	24.1	19.2	6.5
Tare Container (g)	3.1	3.1	3.1	3.1	3.0	3.6
Wt. Dry Soil (g)	48.3	45.5	34.4	34.4	27.9	64.6
Moisture Content (%)	**31.5%**	**39.8%**	**53.2%**	**70.1%**	**68.8%**	**10.1%**

TESTHOLE NO.	TH8	TH8		TH9	TH9	TH9
Tare No.	3C	3L		3K	2Z	4S
Depth (m)	16.8	17.4		0.8	1.5	2.3
Wt. Wet Soil + Tare (g)	58.1	80.9		67.1	54.8	68.0
Wt. Dry Soil + Tare (g)	53.1	74.9		55.1	46.2	53.6
Wt. Water (g)	5.0	6.0		12.0	8.6	14.4
Tare Container (g)	3.2	3.1		3.1	3.1	3.5
Wt. Dry Soil (g)	49.9	71.8		52.0	43.1	50.1
Moisture Content (%)	**10.0%**	**8.4%**		**23.1%**	**20.0%**	**28.7%**

TESTHOLE NO.	TH9	TH9	TH9	TH9	TH9	TH9
Tare No.	5B	1C	4T	4K	4P	4X
Depth (m)	3.0	4.6	6.1	7.6	9.1	10.7
Wt. Wet Soil + Tare (g)	54.5	59.1	53.3	61.3	42.5	56.9
Wt. Dry Soil + Tare (g)	42.2	45.7	34.2	38.7	26.4	36.7
Wt. Water (g)	12.3	13.4	19.1	22.6	16.1	20.2
Tare Container (g)	3.7	3.1	3.7	3.6	3.6	3.8
Wt. Dry Soil (g)	38.5	42.6	30.5	35.1	22.8	32.9
Moisture Content (%)	**31.9%**	**31.5%**	**62.6%**	**64.4%**	**70.6%**	**61.4%**

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TESTHOLE NO.	TH9	TH9	TH9	TH9		TH10
Tare No.	4R	4J	3S	2H		4Z
Depth (m)	12.2	13.7	15.2	16.8		0.8
Wt. Wet Soil + Tare (g)	65	54.5	73	56.7		53.4
Wt. Dry Soil + Tare (g)	45.7	43.1	66.5	52		43.3
Wt. Water (g)	19.3	11.4	6.5	4.7		10.1
Tare Container (g)	3.6	3.7	3.1	3.2		3.8
Wt. Dry Soil (g)	42.1	39.4	63.4	48.8		39.5
Moisture Content (%)	**45.8%**	**28.9%**	**10.3%**	**9.6%**		**25.6%**

TESTHOLE NO.	TH10	TH10	TH10	TH10	TH10	TH10
Tare No.	4A	5I	4F	3R	4G	4L
Depth (m)	1.5	2.3	3.0	4.6	6.1	7.6
Wt. Wet Soil + Tare (g)	50.7	62.3	49.9	58.9	72.4	50.7
Wt. Dry Soil + Tare (g)	41.3	50.2	40.2	39.6	45.4	31.7
Wt. Water (g)	9.4	12.1	9.7	19.3	27.0	19.0
Tare Container (g)	3.0	3.1	3.2	3.1	3.4	3.7
Wt. Dry Soil (g)	38.3	47.1	37.0	36.5	42.0	28.0
Moisture Content (%)	**24.5%**	**25.7%**	**26.2%**	**52.9%**	**64.3%**	**67.9%**

TESTHOLE NO.	TH10	TH10	TH10		TH11	TH11
Tare No.	4V	4Q	5A		2I	2F
Depth (m)	9.1	15.2	16.5		0.8	1.5
Wt. Wet Soil + Tare (g)	64.6	72.5	60		66.7	58.1
Wt. Dry Soil + Tare (g)	42.1	65.9	55.4		52.4	47.1
Wt. Water (g)	22.5	6.6	4.6		14.3	11.0
Tare Container (g)	3.5	3.5	3.7		3.1	3.1
Wt. Dry Soil (g)	38.6	62.4	51.7		49.3	44.0
Moisture Content (%)	**58.3%**	**10.6%**	**8.9%**		**29.0%**	**25.0%**

TESTHOLE NO.	TH11	TH11	TH11	TH11	TH11	TH11
Tare No.	2J	1B	4H	3R	2T	3B
Depth (m)	2.3	3.0	4.6	6.1	15.2	16.2
Wt. Wet Soil + Tare (g)	52.6	61.6	63.5	68	68.7	70.7
Wt. Dry Soil + Tare (g)	42.5	49.8	43.1	42.5	61.5	62.9
Wt. Water (g)	10.1	11.8	20.4	25.5	7.2	7.8
Tare Container (g)	3.1	3.0	3.1	3.1	3.0	3.1
Wt. Dry Soil (g)	39.4	46.8	40.0	39.4	58.5	59.8
Moisture Content (%)	**25.6%**	**25.2%**	**51.0%**	**64.7%**	**12.3%**	**13.0%**

TESTHOLE NO.	TH13	TH13	TH13	TH13		
Tare No.	4Q	4V	4L	3Z		
Depth (m)	0.8	1.5	2.3	3.0		
Wt. Wet Soil + Tare (g)	47.3	63.6	75.5	54.1		
Wt. Dry Soil + Tare (g)	34.7	48.5	62.7	39.7		
Wt. Water (g)	12.6	15.1	12.8	14.4		
Tare Container (g)	3.5	3.5	3.7	3.1		
Wt. Dry Soil (g)	31.2	45.0	59.0	36.6		
Moisture Content (%)	**40.4%**	**33.6%**	**21.7%**	**39.3%**		

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TESTHOLE NO.	TH14	TH14	TH14	TH14		TH15
Tare No.	4M	5A	4V	3A		4J
Depth (m)	0.8	1.5	2.3	3.0		0.8
Wt. Wet Soil + Tare (g)	65.1	60.3	57.5	47.8		44.8
Wt. Dry Soil + Tare (g)	50.8	49.8	43.7	32.6		34.1
Wt. Water (g)	14.3	10.5	13.8	15.2		10.7
Tare Container (g)	3.8	3.7	3.6	3.1		3.5
Wt. Dry Soil (g)	47.0	46.1	40.1	29.5		30.6
Moisture Content (%)	**30.4%**	**22.8%**	**34.4%**	**51.5%**		**35.0%**

TESTHOLE NO.	TH15	TH15	TH15	TH15	TH15	TH15
Tare No.	4T	4P	4K	4R	2T	2J
Depth (m)	1.5	2.3	3.0	4.6	6.1	15.2
Wt. Wet Soil + Tare (g)	69.1	60.3	78.9	45.7	61.1	48.8
Wt. Dry Soil + Tare (g)	54.5	48.6	64.6	30.7	37.3	44.4
Wt. Water (g)	14.6	11.7	14.3	15.0	23.8	4.4
Tare Container (g)	3.8	3.6	3.5	3.5	3.1	3.1
Wt. Dry Soil (g)	50.7	45.0	61.1	27.2	34.2	41.3
Moisture Content (%)	**28.8%**	**26.0%**	**23.4%**	**55.1%**	**69.6%**	**10.7%**

TESTHOLE NO.	TH15		TH18	TH18	TH18	TH18
Tare No.	4W		1T	1S	1A	3U
Depth (m)	16.5		0.8	1.5	2.3	3.0
Wt. Wet Soil + Tare (g)	50.7		54.0	61.2	56.5	70.8
Wt. Dry Soil + Tare (g)	45.1		45.4	48.1	45.1	57.0
Wt. Water (g)	5.6		8.6	13.1	11.4	13.8
Tare Container (g)	3.8		3.1	3.1	3.1	3.1
Wt. Dry Soil (g)	41.3		42.3	45.0	42.0	53.9
Moisture Content (%)	**13.6%**		**20.3%**	**29.1%**	**27.1%**	**25.6%**

TESTHOLE NO.	TH18	TH18	TH18	TH18		TH20
Tare No.	3M	1K	3B	4X		2S
Depth (m)	4.6	6.1	16.8	17.5		0.8
Wt. Wet Soil + Tare (g)	64.1	54.2	57.9	76.9		59.4
Wt. Dry Soil + Tare (g)	41.3	34.3	52.4	70.7		44.6
Wt. Water (g)	22.8	19.9	5.5	6.2		14.8
Tare Container (g)	3.0	3.1	3.1	3.8		3.0
Wt. Dry Soil (g)	38.3	31.2	49.3	66.9		41.6
Moisture Content (%)	**59.5%**	**63.8%**	**11.2%**	**9.3%**		**35.6%**

TESTHOLE NO.	TH20	TH20	TH20		TH21	TH21
Tare No.	3J	2R	3U		1A	3M
Depth (m)	1.5	2.3	3.0		0.8	1.5
Wt. Wet Soil + Tare (g)	44.3	52.0	47.7		54.8	74.5
Wt. Dry Soil + Tare (g)	35.8	42.4	38.4		40	57
Wt. Water (g)	8.5	9.6	9.3		14.8	17.5
Tare Container (g)	3.1	3.0	3.1		3.0	3.1
Wt. Dry Soil (g)	32.7	39.4	35.3		37.0	53.9
Moisture Content (%)	**26.0%**	**24.4%**	**26.3%**		**40.0%**	**32.5%**

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TESTHOLE NO.	TH21	TH21		TH22	TH22	TH22
Tare No.	1K	3Y		3S	4E	2C
Depth (m)	2.3	3.0		0.8	1.5	2.3
Wt. Wet Soil + Tare (g)	64.6	42.1		59.0	49.1	52.4
Wt. Dry Soil + Tare (g)	52.7	30.2		47.9	38.8	42.6
Wt. Water (g)	11.9	11.9		11.1	10.3	9.8
Tare Container (g)	3.0	3.1		3.1	3.1	3.1
Wt. Dry Soil (g)	49.7	27.1		44.8	35.7	39.5
Moisture Content (%)	**23.9%**	**43.9%**		**24.8%**	**28.9%**	**24.8%**

TESTHOLE NO.	TH22		TH23	TH23	TH23	TH23
Tare No.	4Z		3A	3Z	1T	1S
Depth (m)	3.0		0.8	1.5	2.3	3.0
Wt. Wet Soil + Tare (g)	45.4		51.6	55.6	61.6	58
Wt. Dry Soil + Tare (g)	36.5		40.8	44.4	50.2	48.1
Wt. Water (g)	8.9		10.8	11.2	11.4	9.9
Tare Container (g)	3.8		3.1	3.1	3.0	3.0
Wt. Dry Soil (g)	32.7		37.7	41.3	47.2	45.1
Moisture Content (%)	**27.2%**		**28.6%**	**27.1%**	**24.2%**	**22.0%**

TESTHOLE NO.	TH24	TH24	TH24	TH24	TH24	TH24
Tare No.	4W	4V	2K	4G	2X	1L
Depth (m)	0.8	1.5	2.3	3.0	3.8	4.6
Wt. Wet Soil + Tare (g)	63.7	58.3	75.3	81.3	47.2	53.7
Wt. Dry Soil + Tare (g)	55.9	44	60.8	66.5	33	37.2
Wt. Water (g)	7.8	14.3	14.5	14.8	14.2	16.5
Tare Container (g)	3.8	3.5	3.1	3.5	3.1	3.0
Wt. Dry Soil (g)	52.1	40.5	57.7	63.0	29.9	34.2
Moisture Content (%)	**15.0%**	**35.3%**	**25.1%**	**23.5%**	**47.5%**	**48.2%**

TESTHOLE NO.	TH27	TH27	TH27	TH27	TH27	TH27
Tare No.	4L	4U	4K	4M	4X	4T
Depth (m)	0.8	1.5	2.3	3.0	3.8	4.6
Wt. Wet Soil + Tare (g)	69.8	72.7	73.9	65.2	54.3	79.3
Wt. Dry Soil + Tare (g)	58.8	62.6	58.2	51.1	44	64
Wt. Water (g)	11.0	10.1	15.7	14.1	10.3	15.3
Tare Container (g)	3.7	3.6	3.5	3.8	4.0	3.8
Wt. Dry Soil (g)	55.1	59.0	54.7	47.3	40.0	60.2
Moisture Content (%)	**20.0%**	**17.1%**	**28.7%**	**29.8%**	**25.8%**	**25.4%**

TESTHOLE NO.	TH28	TH28	TH28	TH28	TH28	TH28
Tare No.	3U	4J	4P	5A	4Q	4R
Depth (m)	0.8	1.5	2.3	3.0	3.8	4.6
Wt. Wet Soil + Tare (g)	47.8	57.4	79.5	73.4	58.8	89.2
Wt. Dry Soil + Tare (g)	39.3	46.6	63.4	58	47.2	71.8
Wt. Water (g)	8.5	10.8	16.1	15.4	11.6	17.4
Tare Container (g)	3.1	3.6	3.6	3.8	3.5	3.5
Wt. Dry Soil (g)	36.2	43.0	59.8	54.2	43.7	68.3
Moisture Content (%)	**23.5%**	**25.1%**	**26.9%**	**28.4%**	**26.5%**	**25.5%**

Atterberg Limits

ASKI GEOSCIENCES LTD.

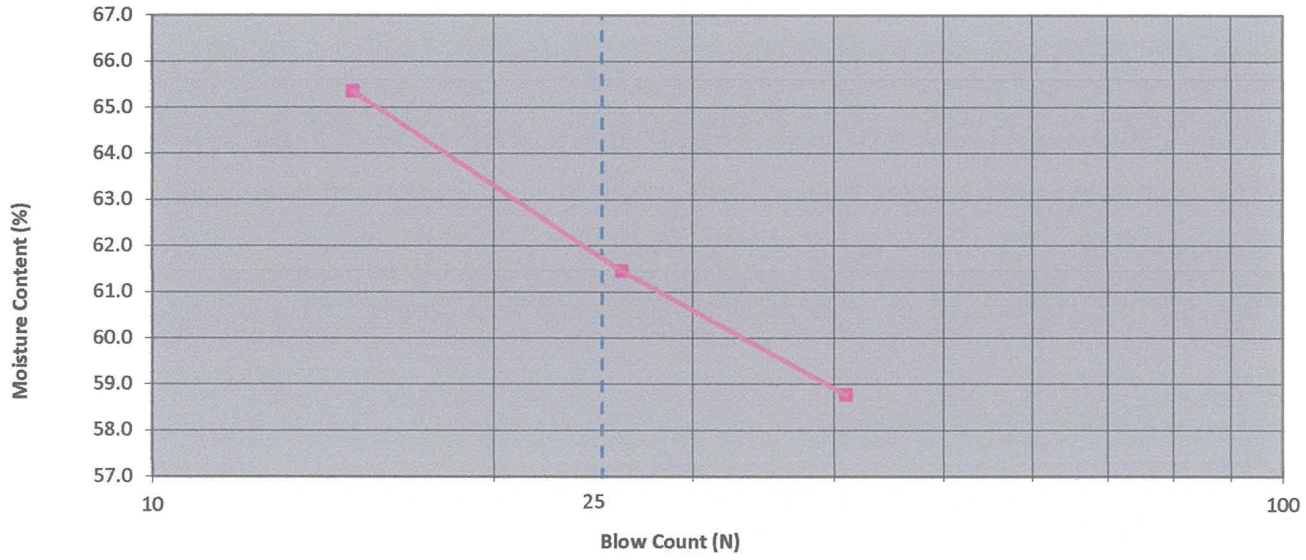
Geotechnical Assessment - Sapphire Springs

Location:	Rockwood, MB	Testhole No.:	TH5	Date:	June 15, 2021
Project No.:	RW1156	Sample Depth:	1.5 m	Time:	11:00 a.m.

Liquid Limit Determination

Test No.	1	2	3			
Tare No.	2R	2N	3J			
Wet Soil + Tare	18.5	16.5	19.8			Liquid Limit 25 Blows
Dry Soil + Tare	12.8	11.4	13.2			
Water Weight	5.7	5.1	6.6			
Tare Weight	3.1	3.1	3.1			61.8%
Dry Soil	9.7	8.3	10.1			
% Moisture	58.8	61.4	65.3			
No. of Blows	41	26	15			

Liquid Limit Graph



Plastic Limit Determination

Test No.	1	2				
Tare No.	3D	3S				
Wet Soil + Tare	24.9	24.5				Plastic Limit
Dry Soil + Tare	20.4	19.9				
Water Weight	4.5	4.6				
Tare Weight	3.1	3.1				26.7%
Dry Soil	17.3	16.8				
% Moisture	26.0	27.4				

Test Method: ASTM: D4318, D2216

Tested by: C.K.

Reviewed by: Robert Kupchak, P.Eng.

Atterberg Limits

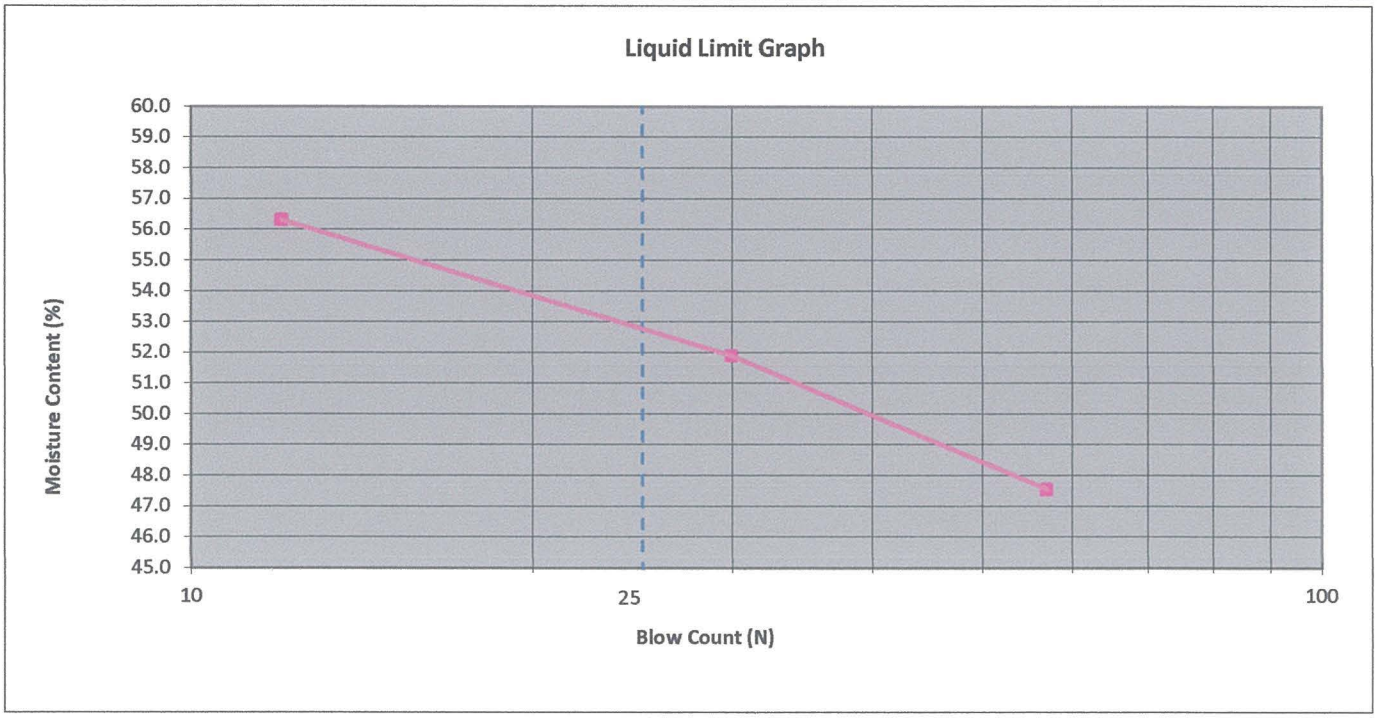
ASKI GEOSCIENCES LTD.

Geotechnical Assessment - Sapphire Springs

Location:	Rockwood, MB	Testhole No.:	TH8	Date:	June 15, 2021
Project No.:	RW1156	Sample Depth:	2.3 m	Time:	9:00 a.m.

Liquid Limit Determination

Test No.	1	2	3			
Tare No.	2K	1B	1F			
Wet Soil + Tare	21.6	19.2	21.1			Liquid Limit 25 Blows
Dry Soil + Tare	14.9	13.7	15.3			
Water Weight	6.7	5.5	5.8			
Tare Weight	3.0	3.1	3.1			52.8%
Dry Soil	11.9	10.6	12.2			
% Moisture	56.3	51.9	47.5			
No. of Blows	12	30	57			



Plastic Limit Determination

Test No.	1	2				
Tare No.	2C	3B				
Wet Soil + Tare	23.3	21.8				Plastic Limit
Dry Soil + Tare	19.8	18.5				
Water Weight	3.5	3.3				
Tare Weight	3.1	3.1				21.2%
Dry Soil	16.7	15.4				
% Moisture	21.0	21.4				

Test Method: ASTM: D4318, D2216

Tested by: C.K.

Reviewed by: Robert Kupchak, P.Eng.

Atterberg Limits

ASKI GEOSCIENCES LTD.

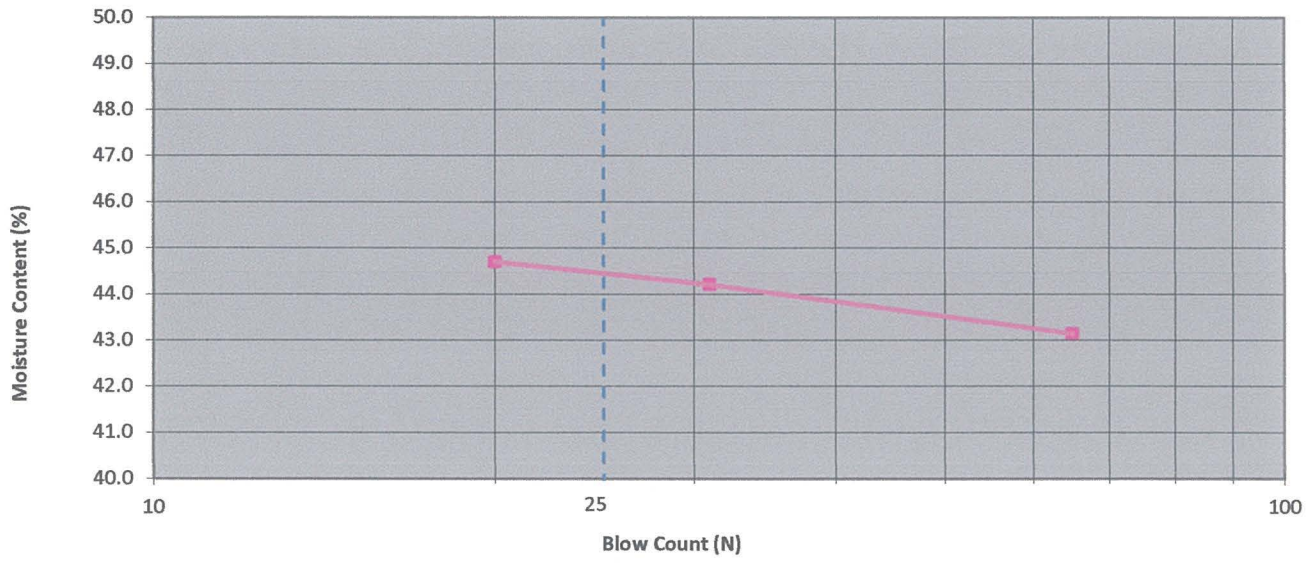
Geotechnical Assessment - Sapphire Springs

Location:	Rockwood, MB	Testhole No.:	TH8	Date:	June 10, 2021
Project No.:	RW1156	Sample Depth:	4.6 m	Time:	12:00 p.m.

Liquid Limit Determination

Test No.	1	2	3			
Tare No.	1F	2C	3S			
Wet Soil + Tare	22.2	23	17.7			Liquid Limit 25 Blows
Dry Soil + Tare	16.3	16.9	13.3			
Water Weight	5.9	6.1	4.4			
Tare Weight	3.1	3.1	3.1			44.4%
Dry Soil	13.2	13.8	10.2			
% Moisture	44.7	44.2	43.1			
No. of Blows	20	31	65			

Liquid Limit Graph



Plastic Limit Determination

Test No.	1	2				
Tare No.	2R	3D				
Wet Soil + Tare	21.3	20.0				Plastic Limit
Dry Soil + Tare	18.4	17.5				
Water Weight	2.9	2.5				
Tare Weight	3.2	3.1				18.2%
Dry Soil	15.2	14.4				
% Moisture	19.1	17.4				

Test Method: ASTM: D4318, D2216

Tested by: C.K.

Reviewed by: Robert Kupchak, P.Eng.

Atterberg Limits

ASKI GEOSCIENCES LTD.

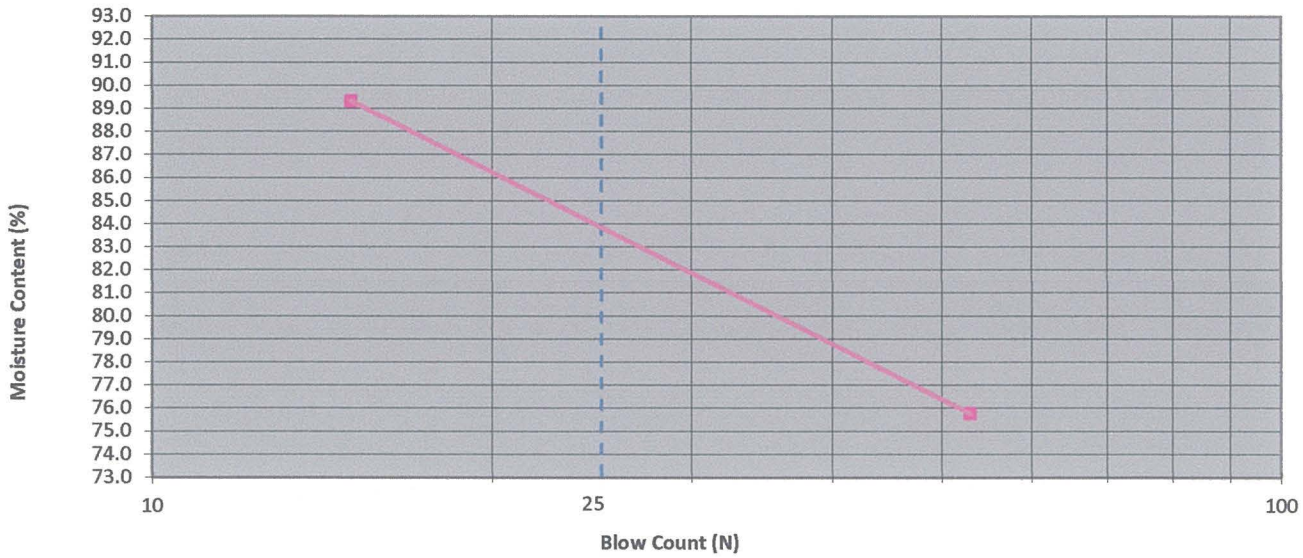
Geotechnical Assessment - Sapphire Springs

Location:	Rockwood, MB	Testhole No.:	TH9	Date:	June 16, 2021
Project No.:	RW1156	Sample Depth:	7.6 m	Time:	12:30 p.m.

Liquid Limit Determination

Test No.	1	2				
Tare No.	3K	4E				
Wet Soil + Tare	22.6	20.6				Liquid Limit 25 Blows
Dry Soil + Tare	13.4	13.1				
Water Weight	9.2	7.5				
Tare Weight	3.1	3.2				83.9%
Dry Soil	10.3	9.9				
% Moisture	89.3	75.8				
No. of Blows	15	53				

Liquid Limit Graph



Plastic Limit Determination

Test No.	1	2				
Tare No.	1L	4D				
Wet Soil + Tare	24.0	24.9				Plastic Limit
Dry Soil + Tare	19.5	20.0				
Water Weight	4.5	4.9				
Tare Weight	3.0	3.0				28.0%
Dry Soil	16.5	17.0				
% Moisture	27.3	28.8				

Test Method: ASTM: D4318, D2216

Tested by: C.K.

Reviewed by: Robert Kupchak, P.Eng.

Atterberg Limits

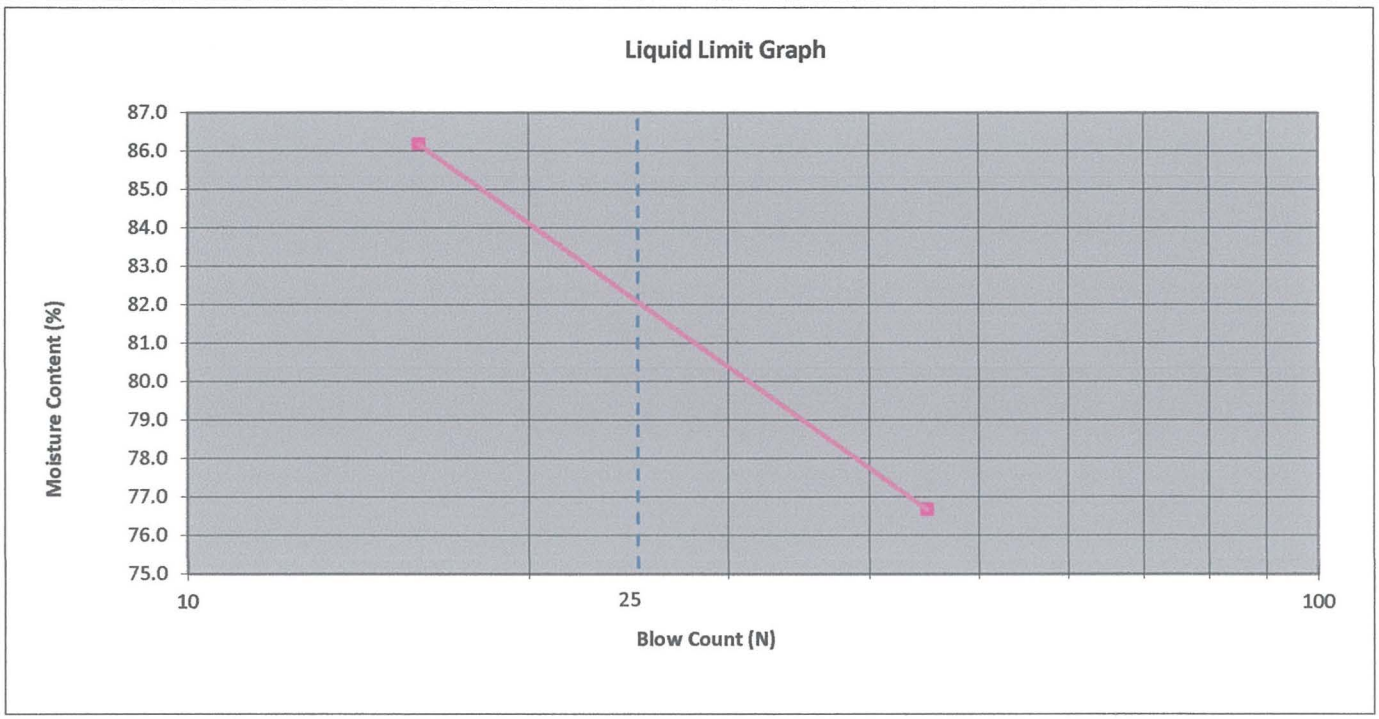
ASKI GEOSCIENCES LTD.

Geotechnical Assessment - Sapphire Springs

Location:	Rockwood, MB	Testhole No.:	TH9	Date:	June 17, 2021
Project No.:	RW1156	Sample Depth:	10.7	Time:	4:00 p.m.

Liquid Limit Determination

Test No.	1	2	3			
Tare No.	3S	1E				
Wet Soil + Tare	20.6	19				Liquid Limit 25 Blows
Dry Soil + Tare	12.5	12.1				
Water Weight	8.1	6.9				
Tare Weight	3.1	3.1				82.1%
Dry Soil	9.4	9.0				
% Moisture	86.2	76.7				
No. of Blows	16	45				



Plastic Limit Determination

Test No.	1	2				
Tare No.	2Z	3R				
Wet Soil + Tare	16.6	16.2				Plastic Limit
Dry Soil + Tare	13.8	13.6				
Water Weight	2.8	2.6				
Tare Weight	3.1	3.1				25.5%
Dry Soil	10.7	10.5				
% Moisture	26.2	24.8				

Test Method: ASTM: D4318, D2216

Tested by: C.K.

Reviewed by: Robert Kupchak, P.Eng.

Atterberg Limits

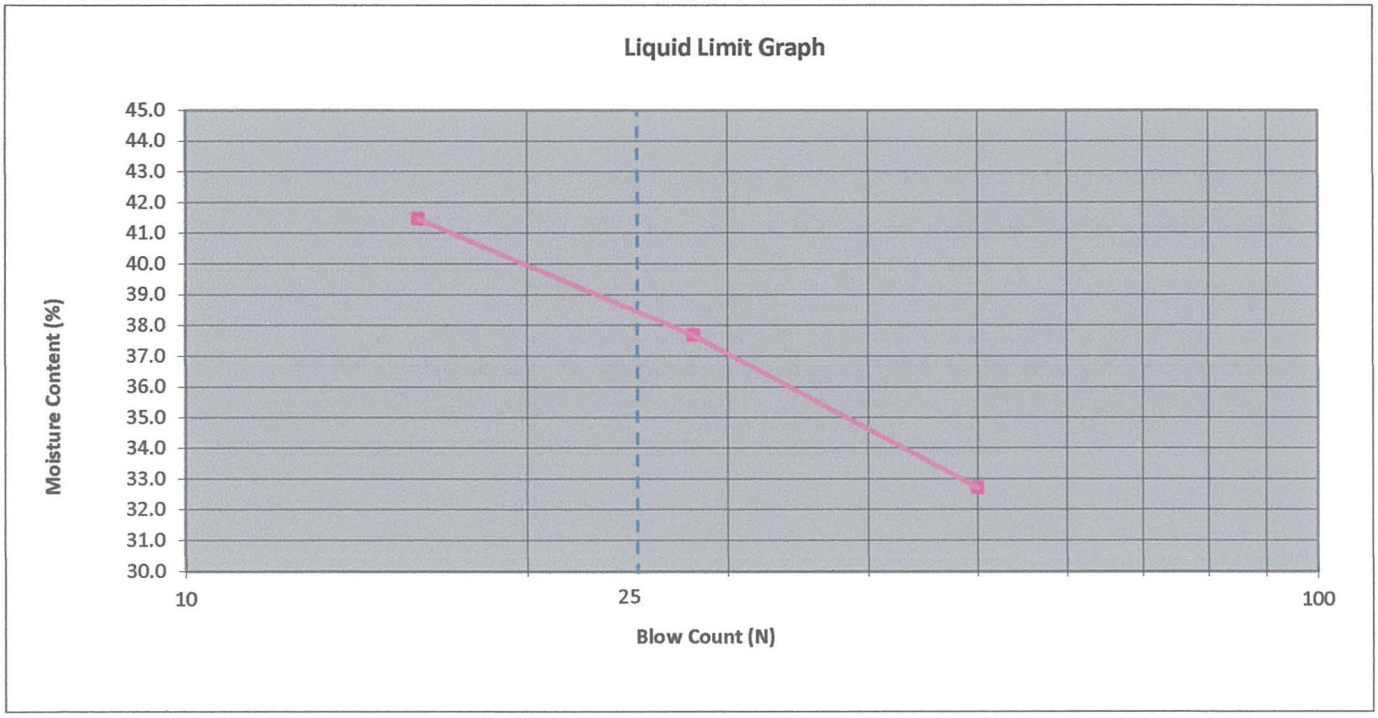
ASKI GEOSCIENCES LTD.

Geotechnical Assessment - Sapphire Springs

Location:	Rockwood, MB	Testhole No.:	TH9	Date:	June 15, 2021
Project No.:	RW1156	Sample Depth:	13.7	Time:	3:00 p.m.

Liquid Limit Determination

Test No.	1	2	3			
Tare No.	3C	2H	3K			
Wet Soil + Tare	24.7	22.1	20.5			Liquid Limit 25 Blows
Dry Soil + Tare	19.4	16.9	15.4			
Water Weight	5.3	5.2	5.1			
Tare Weight	3.2	3.1	3.1			38.4%
Dry Soil	16.2	13.8	12.3			
% Moisture	32.7	37.7	41.5			
No. of Blows	50	28	16			



Plastic Limit Determination

Test No.	1	2				
Tare No.	3R	4A				
Wet Soil + Tare	21.3	22.9				Plastic Limit
Dry Soil + Tare	19.1	20.7				
Water Weight	2.2	2.2				
Tare Weight	3.1	3.1				12.8%
Dry Soil	16.0	17.6				
% Moisture	13.0	12.5				

Test Method: ASTM: D4318, D2216

Tested by: C.K.

Reviewed by: Robert Kupchak, P.Eng.

Atterberg Limits

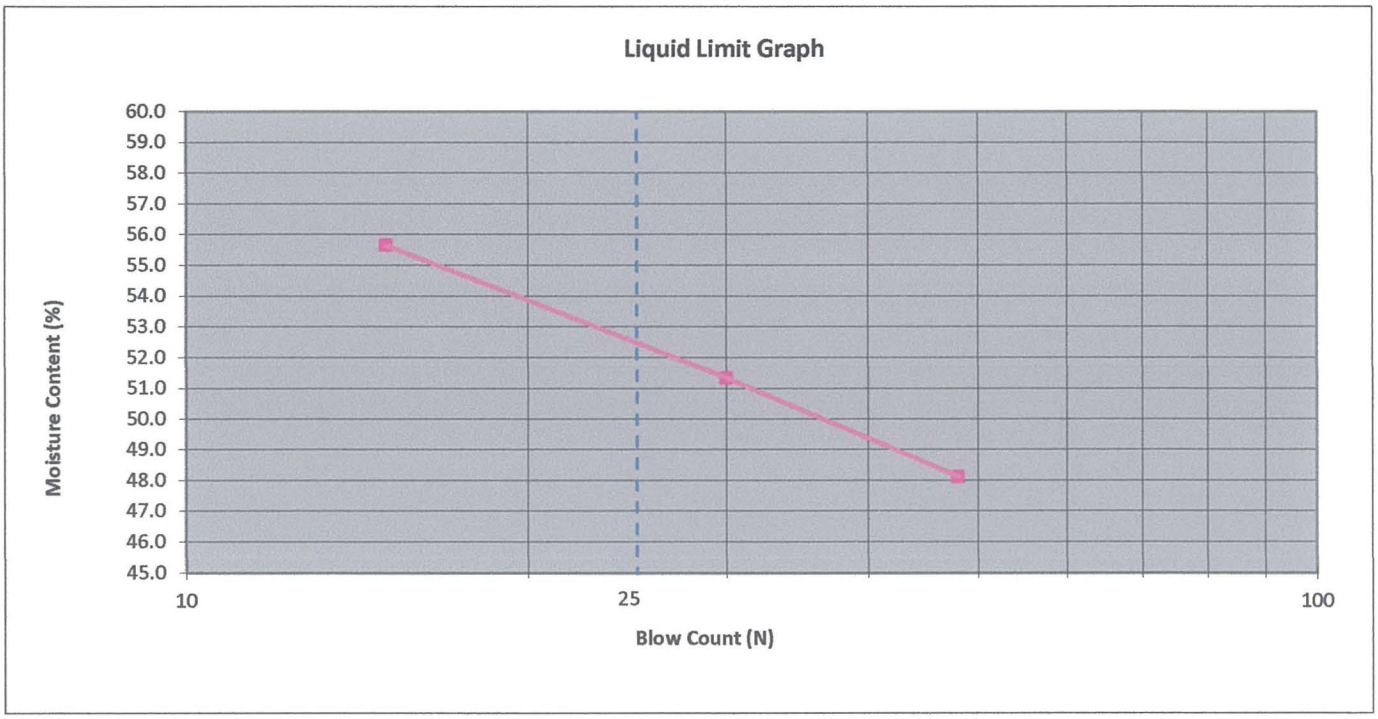
ASKI GEOSCIENCES LTD.

Geotechnical Assessment - Sapphire Springs

Location:	Rockwood, MB	Testhole No.:	TH10	Date:	June 16, 2021
Project No.:	RW1156	Sample Depth:	0.8 m	Time:	3:30 p.m.

Liquid Limit Determination

Test No.	1	2	3			
Tare No.	1B	3S	2K			
Wet Soil + Tare	21	20.2	22.8			Liquid Limit 25 Blows
Dry Soil + Tare	14.6	14.4	16.4			
Water Weight	6.4	5.8	6.4			
Tare Weight	3.1	3.1	3.1			52.5%
Dry Soil	11.5	11.3	13.3			
% Moisture	55.7	51.3	48.1			
No. of Blows	15	30	48			



Plastic Limit Determination

Test No.	1	2				
Tare No.	3R	4E				
Wet Soil + Tare	28.0	22.1				Plastic Limit
Dry Soil + Tare	23.0	18.4				
Water Weight	5.0	3.7				
Tare Weight	3.1	3.2				24.7%
Dry Soil	19.9	15.2				
% Moisture	25.1	24.3				

Test Method: ASTM: D4318, D2216

Tested by: C.K.

Reviewed by: Robert Kupchak, P.Eng.

Atterberg Limits

ASKI GEOSCIENCES LTD.

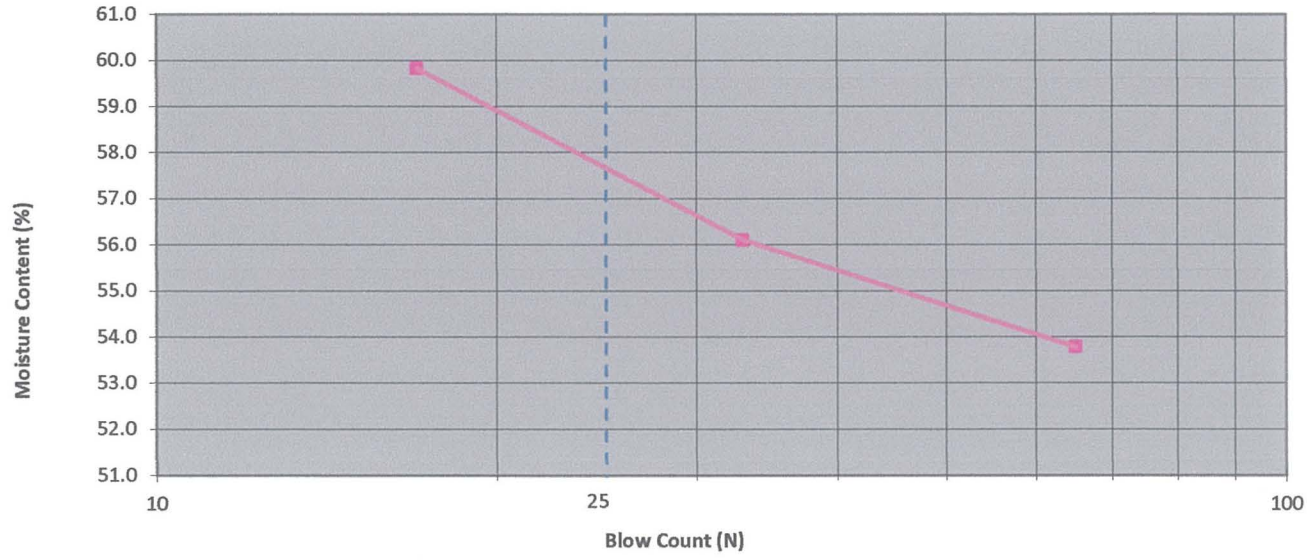
Geotechnical Assessment - Sapphire Springs

Location:	Rockwood, MB	Testhole No.:	TH14	Date:	June 10, 2021
Project No.:	RW1156	Sample Depth:	2.3 m	Time:	9:00 a.m.

Liquid Limit Determination

Test No.	1	2	3			
Tare No.	2C	1F	2R			
Wet Soil + Tare	21.1	22.3	21.4			Liquid Limit 25 Blows
Dry Soil + Tare	14.4	15.4	15.0			
Water Weight	6.7	6.9	6.4			
Tare Weight	3.2	3.1	3.1			57.7%
Dry Soil	11.2	12.3	11.9			
% Moisture	59.8	56.1	53.8			
No. of Blows	17	33	65			

Liquid Limit Graph



Plastic Limit Determination

Test No.	1	2				
Tare No.	3D	3S				
Wet Soil + Tare	20.3	21.9				Plastic Limit
Dry Soil + Tare	16.8	17.9				
Water Weight	3.5	4.0				
Tare Weight	3.1	3.2				26.4%
Dry Soil	13.7	14.7				
% Moisture	25.5	27.2				

Test Method: ASTM: D4318, D2216

Tested by: C.K.

Reviewed by: Robert Kupchak, P.Eng.

Atterberg Limits

ASKI GEOSCIENCES LTD.

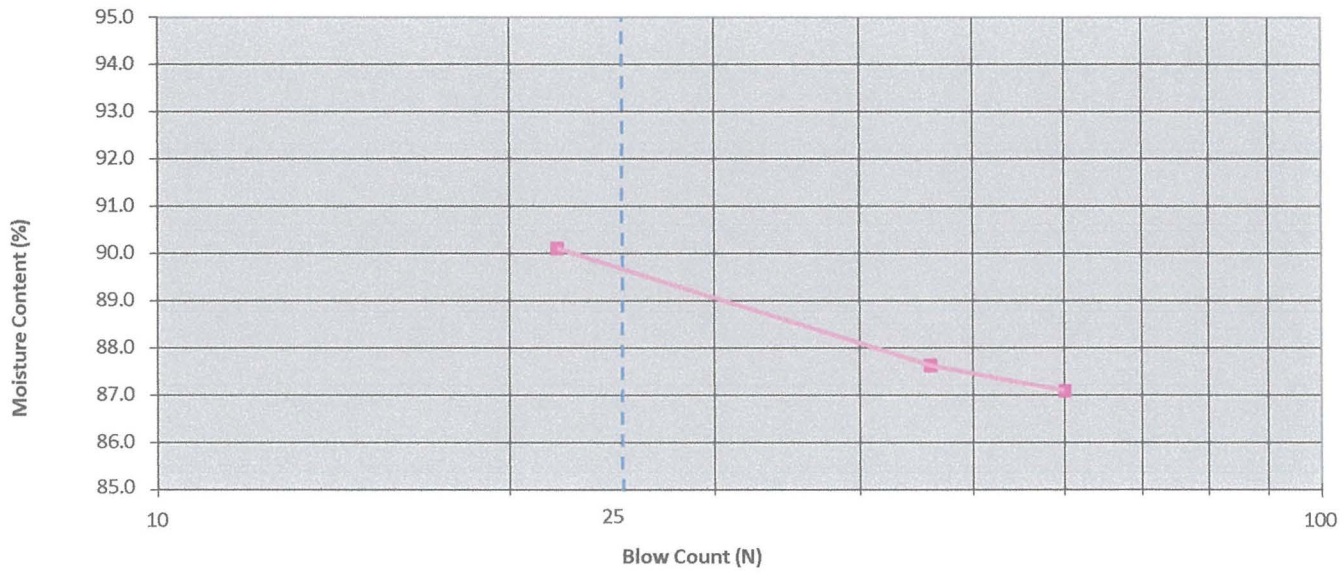
Geotechnical Assessment - Sapphire Springs

Location:	Rockwood, MB	Testhole No.:	TH18	Date:	June 16, 2021
Project No.:	RW1156	Sample Depth:	6.1 m	Time:	10:30 a.m.

Liquid Limit Determination

Test No.	1	2	3			
Tare No.	1H	1C	1B			
Wet Soil + Tare	17.88	21.3	18.5			Liquid Limit 25 Blows
Dry Soil + Tare	11.0	12.8	11.2			
Water Weight	6.9	8.5	7.3			
Tare Weight	3.1	3.1	3.1			89.7%
Dry Soil	7.9	9.7	8.1			
% Moisture	87.1	87.6	90.1			
No. of Blows	60	46	22			

Liquid Limit Graph



Plastic Limit Determination

Test No.	1	2				
Tare No.	1S	2C				
Wet Soil + Tare	23.6	20.9				Plastic Limit
Dry Soil + Tare	18.9	17.1				
Water Weight	4.7	3.8				
Tare Weight	3.0	3.2				28.4%
Dry Soil	15.9	13.9				
% Moisture	29.6	27.3				

Test Method: ASTM: D4318, D2216

Tested by: C.K.

Reviewed by: Robert Kupchak, P.Eng.

Atterberg Limits

ASKI GEOSCIENCES LTD.

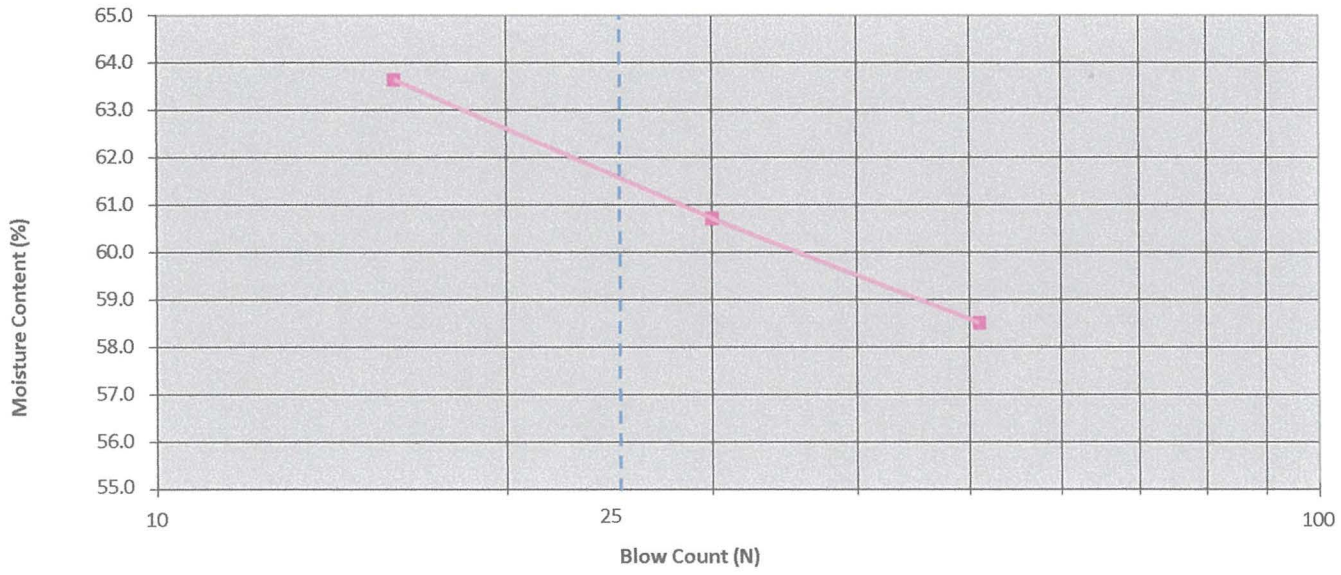
Geotechnical Assessment - Sapphire Springs

Location:	Rockwood, MB	Testhole No.:	TH21	Date:	June 10, 2021
Project No.:	RW1156	Sample Depth:	0.8 m	Time:	4:00 p.m.

Liquid Limit Determination

Test No.	1	2	3			
Tare No.	3J	4A	2S			
Wet Soil + Tare	22.8	25.5	17.9			Liquid Limit 25 Blows
Dry Soil + Tare	15.1	17.0	12.4			
Water Weight	7.7	8.5	5.5			
Tare Weight	3.0	3.0	3.0			61.6%
Dry Soil	12.1	14.0	9.4			
% Moisture	63.6	60.7	58.5			
No. of Blows	16	30	51			

Liquid Limit Graph



Plastic Limit Determination

Test No.	1	2				
Tare No.	1B	3R				
Wet Soil + Tare	27.8	21.8				Plastic Limit
Dry Soil + Tare	21.5	17.4				
Water Weight	6.3	4.4				
Tare Weight	3.1	3.1				32.5%
Dry Soil	18.4	14.3				
% Moisture	34.2	30.8				

Test Method: ASTM: D4318, D2216

Tested by: C.K.

Reviewed by: Robert Kupchak, P.Eng.

Atterberg Limits

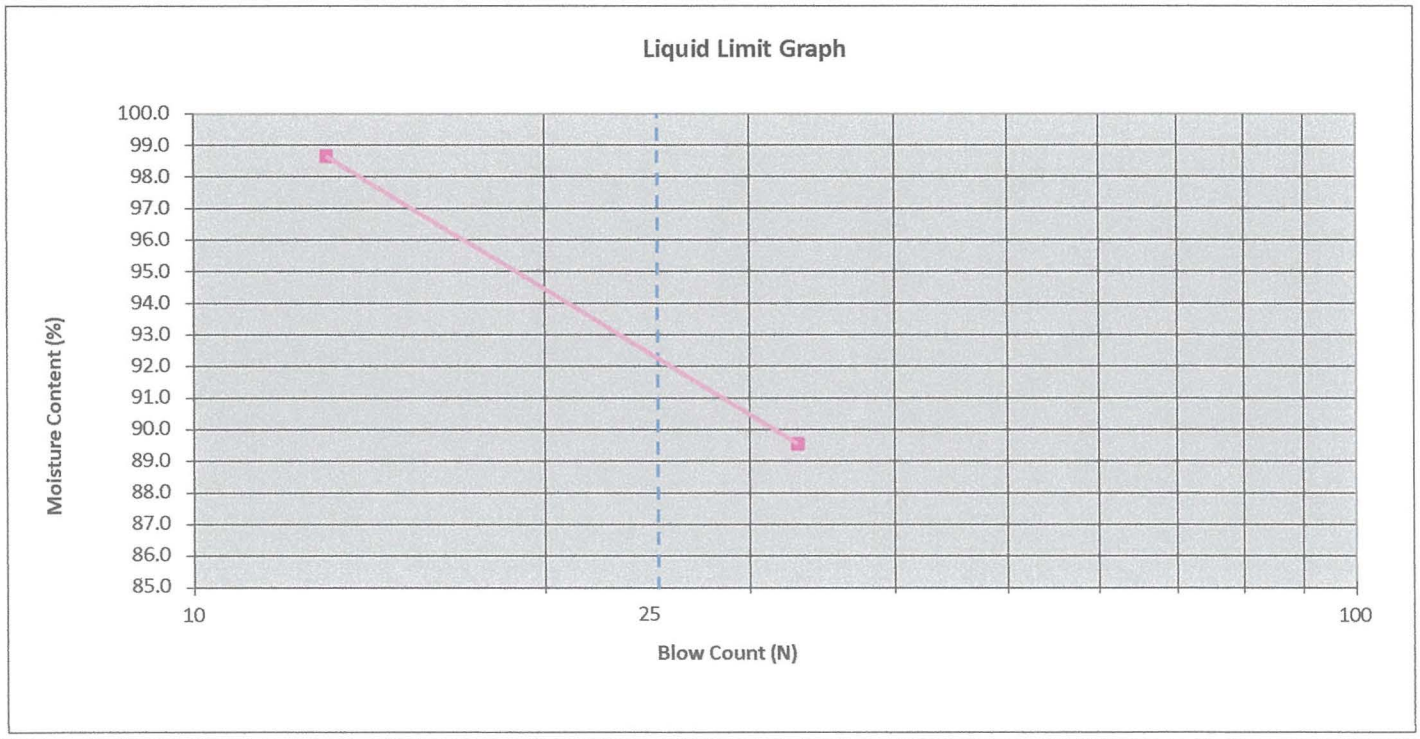
ASKI GEOSCIENCES LTD.

Geotechnical Assessment - Sapphire Springs

Location:	Rockwood, MB	Testhole No.:	TH24	Date:	June 17, 2021
Project No.:	RW1156	Sample Depth:	4.6 m	Time:	10:30 a.m.

Liquid Limit Determination

Test No.	1	2				
Tare No.	1H	1C				
Wet Soil + Tare	17.8	15.8				Liquid Limit 25 Blows
Dry Soil + Tare	10.5	9.8				
Water Weight	7.3	6.0				
Tare Weight	3.1	3.1				92.2%
Dry Soil	7.4	6.7				
% Moisture	98.6	89.6				
No. of Blows	13	33				



Plastic Limit Determination

Test No.	1	2				
Tare No.	1Q	2Z				
Wet Soil + Tare	19.8	19.8				Plastic Limit
Dry Soil + Tare	15.8	15.9				
Water Weight	4.0	3.9				
Tare Weight	3.1	3.1				31.0%
Dry Soil	12.7	12.8				
% Moisture	31.5	30.5				

Test Method: ASTM: D4318, D2216

Tested by: C.K.

Reviewed by: Robert Kupchak, P.Eng.

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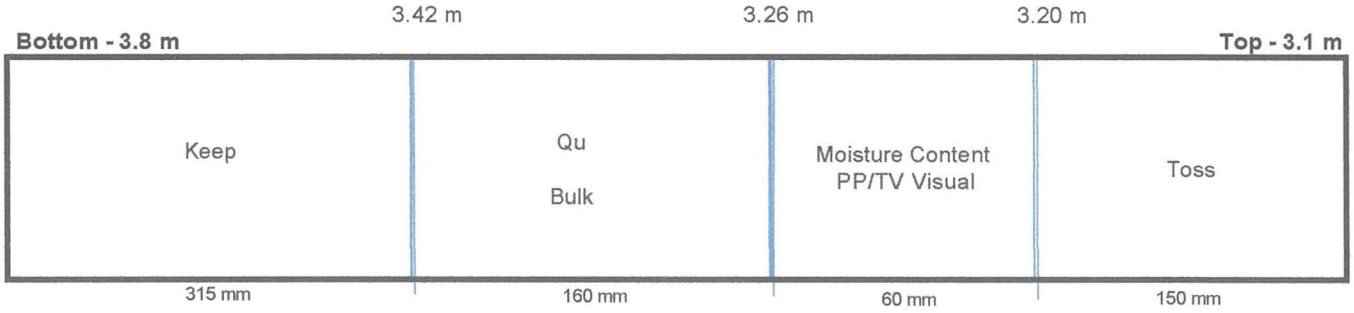
Shelby Tube Visual

Project No.	1000-013-46
Client	Aski Geosciences Ltd.
Project	RW1156
Test Hole	TH10
Sample #	-
Depth (m)	3.0 - 3.8
Sample Date	-
Test Date	08-Jun-21
Technician	RSA

Tube Extraction

Recovery (mm) 685



Visual Classification

Material	CLAY and SILT
Composition	trace sand (fine)
trace oxidation	
Color	grey mottled brown
Moisture	moist
Consistency	firm to stiff
Plasticity	high plasticity
Structure	-
Gradation	-

Torvane

Reading	0.45
Vane Size (s,m,l)	m
Undrained Shear Strength (kPa)	44.1

Pocket Penetrometer

Reading	1	1.25
	2	1.00
	3	1.00
	Average	1.08
Undrained Shear Strength (kPa)		53.1

Moisture Content

Tare ID	A105
Mass tare (g)	8.4
Mass wet + tare (g)	270.6
Mass dry + tare (g)	214.5
Moisture %	27.2%

Unit Weight

Bulk Weight (g)		1207.0
Length (mm)	1	152.46
	2	153.56
	3	153.78
	4	153.51
Average Length (m)		0.153
Diam. (mm)	1	72.87
	2	72.83
	3	72.94
	4	72.93
Average Diameter (m)		0.073
Volume (m^3)		6.40E-04
Bulk Unit Weight (kN/m^3)		18.5
Bulk Unit Weight (pcf)		117.8
Dry Unit Weight (kN/m^3)		14.5
Dry Unit Weight (pcf)		92.6

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Unconfined Compressive Strength

ASTM D2166

Project No.	1000-013-46
Client	Aski Geosciences Ltd.
Project	RW1156
Test Hole	TH10
Sample #	-
Depth (m)	3.0 - 3.8
Sample Date	-
Test Date	8-Jun-21
Technician	RSA

Unconfined Strength

	kPa	ksf
Max q_u	80.1	1.7
Max S_u	40.0	0.8

Specimen Data

Description CLAY and SILT - trace sand (fine), trace oxidation, grey mottled brown, moist, firm to stiff, high plasticity

Length	153.3	(mm)	**Moisture %**	27%	
Diameter	72.9	(mm)	**Bulk Unit Wt.**	18.5	(kN/m^3)
L/D Ratio	2.1		**Dry Unit Wt.**	14.5	(kN/m^3)
Initial Area	0.00417	(m^2)	**Liquid Limit**	-	
Load Rate	1.00	(%/min)	**Plastic Limit**	-	
			Plasticity Index	-	

Undrained Shear Strength Tests

Torvane

Reading	Undrained Shear Strength	
tsf	**kPa**	**ksf**
0.45	44.1	0.92
Vane Size		
m		

Pocket Penetrometer

	Reading	Undrained Shear Strength	
	tsf	**kPa**	**ksf**
	1.25	61.3	1.28
	1.00	49.1	1.02
	1.00	49.1	1.02
Average	**1.08**	**53.1**	**1.11**

Failure Geometry

Sketch:

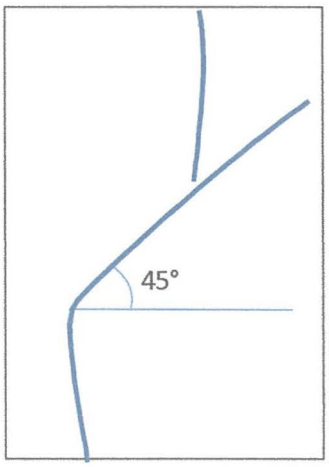
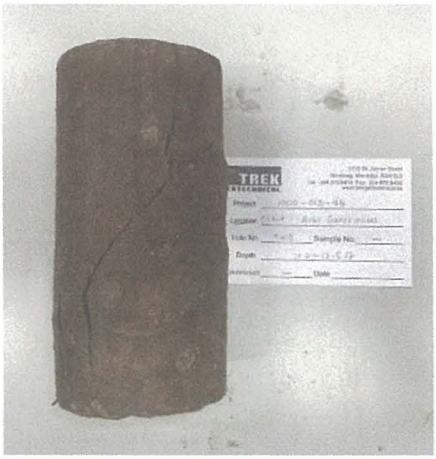


Photo:



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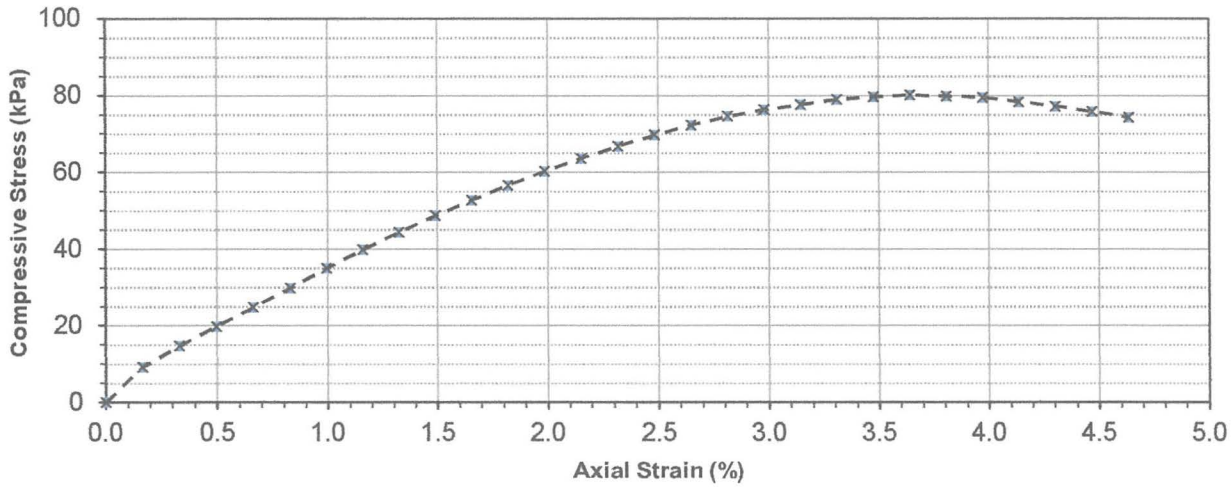
Unconfined Compressive Strength

ASTM D2166

Project No. 1000-013-46
Client Aski Geosciences Ltd.
Project RW1156

Unconfined Compression Test Graph



Unconfined Compression Test Data

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m^2)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
0	-0.23	0.0000	0.00	0.004173	0.0	0.00	0.00
10	0.54	0.2540	0.17	0.004180	38.8	9.28	4.64
20	0.99	0.5080	0.33	0.004187	61.5	14.69	7.34
30	1.42	0.7620	0.50	0.004194	83.2	19.83	9.91
40	1.84	1.0160	0.66	0.004201	104.3	24.84	12.42
50	2.26	1.2700	0.83	0.004208	125.5	29.83	14.91
60	2.69	1.5240	0.99	0.004215	147.2	34.92	17.46
70	3.11	1.7780	1.16	0.004222	168.3	39.87	19.94
80	3.49	2.0320	1.33	0.004229	187.5	44.34	22.17
90	3.86	2.2860	1.49	0.004236	206.1	48.66	24.33
100	4.21	2.5400	1.66	0.004243	223.8	52.74	26.37
110	4.54	2.7940	1.82	0.004251	240.4	56.56	28.28
120	4.86	3.0480	1.99	0.004258	256.6	60.26	30.13
130	5.15	3.3020	2.15	0.004265	271.2	63.58	31.79
140	5.43	3.5560	2.32	0.004272	285.3	66.78	33.39
150	5.69	3.8100	2.48	0.004279	298.4	69.73	34.86
160	5.92	4.0640	2.65	0.004287	310.0	72.31	36.16
170	6.12	4.3180	2.82	0.004294	320.1	74.54	37.27
180	6.28	4.5720	2.98	0.004301	328.1	76.28	38.14
190	6.41	4.8260	3.15	0.004309	334.7	77.67	38.84
200	6.53	5.0800	3.31	0.004316	340.7	78.94	39.47
210	6.60	5.3340	3.48	0.004323	344.3	79.62	39.81
220	6.65	5.5880	3.64	0.004331	346.8	80.07	40.03
230	6.64	5.8420	3.81	0.004338	346.3	79.82	39.91

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Unconfined Compressive Strength

ASTM D2166

Project No. 1000-013-46
Client Aski Geosciences Ltd.
Project RW1156

Unconfined Compression Test Data (cont'd)

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m^2)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
240	6.62	6.0960	3.98	0.004346	345.3	79.45	39.72
250	6.53	6.3500	4.14	0.004353	340.7	78.27	39.13
260	6.45	6.6040	4.31	0.004361	336.7	77.21	38.60
270	6.34	6.8580	4.47	0.004368	331.1	75.80	37.90
280	6.22	7.1120	4.64	0.004376	325.1	74.29	37.15

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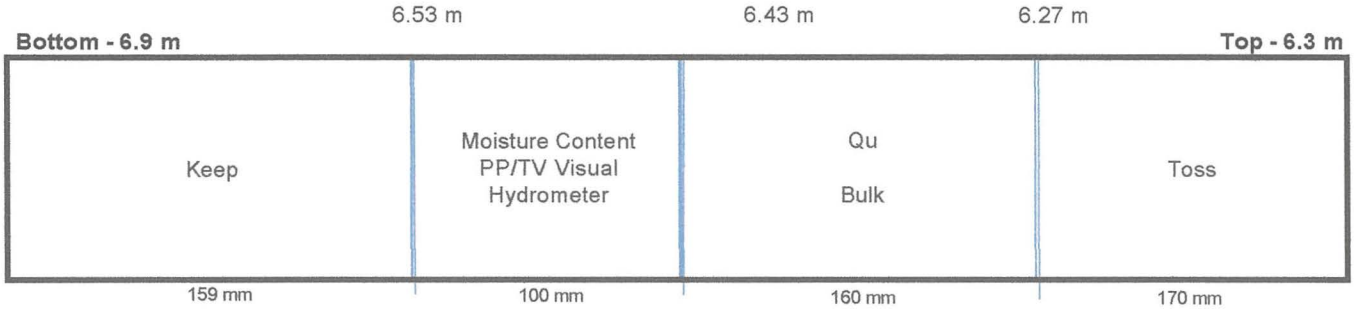
Shelby Tube Visual

Project No.	1000-013-46
Client	Aski Geosciences Ltd.
Project	RW1156
Test Hole	TH10
Sample #	-
Depth (m)	6.1 - 6.9
Sample Date	-
Test Date	08-Jun-21
Technician	RSA

Tube Extraction

Recovery (mm) 589



Visual Classification

Material	CLAY
Composition	silty
	trace silt inclusions (<10 mm diam.)
	trace sand (fine)
Color	Dark grey
Moisture	moist
Consistency	firm to stiff
Plasticity	high plasticity
Structure	-
Gradation	-

Torvane

Reading	0.30
Vane Size (s,m,l)	m
Undrained Shear Strength (kPa)	29.4

Pocket Penetrometer

Reading	**1**	0.60
	2	0.60
	3	0.60
	Average	0.60
Undrained Shear Strength (kPa)		29.4

Moisture Content

Tare ID	AB56
Mass tare (g)	6.7
Mass wet + tare (g)	466.7
Mass dry + tare (g)	288.1
Moisture %	63.5%

Unit Weight

Bulk Weight (g)		1085.8
Length (mm)	**1**	150.32
	2	151.00
	3	151.50
	4	150.93
Average Length (m)		0.151
Diam. (mm)	**1**	73.00
	2	72.43
	3	73.32
	4	73.04
Average Diameter (m)		0.073
Volume (m^3)		6.31E-04
Bulk Unit Weight (kN/m^3)		16.9
Bulk Unit Weight (pcf)		107.5
Dry Unit Weight (kN/m^3)		10.3
Dry Unit Weight (pcf)		65.7

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Unconfined Compressive Strength

ASTM D2166

Project No.	1000-013-46
Client	Aski Geosciences Ltd.
Project	RW1156
Test Hole	TH10
Sample #	-
Depth (m)	6.1 - 6.9
Sample Date	-
Test Date	8-Jun-21
Technician	RSA

Unconfined Strength

	kPa	ksf
Max q_u	89.0	1.9
Max S_u	44.5	0.9

Specimen Data

Description CLAY - silty, Dark grey, moist, firm to stiff, high plasticity

Length	150.9	(mm)	**Moisture %**	63%	
Diameter	72.9	(mm)	**Bulk Unit Wt.**	16.9	(kN/m^3)
L/D Ratio	2.1		**Dry Unit Wt.**	10.3	(kN/m^3)
Initial Area	0.00418	(m^2)	**Liquid Limit**	-	
Load Rate	1.00	(%/min)	**Plastic Limit**	-	
			Plasticity Index	-	

Undrained Shear Strength Tests

Torvane

Reading	Undrained Shear Strength	
tsf	**kPa**	**ksf**
0.30	29.4	0.61

Vane Size
m

Pocket Penetrometer

	Reading	Undrained Shear Strength	
	tsf	**kPa**	**ksf**
	0.60	29.4	0.61
	0.60	29.4	0.61
	0.60	29.4	0.61
Average	**0.60**	**29.4**	**0.61**

Failure Geometry

Sketch:

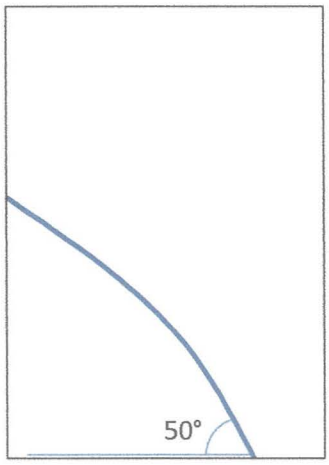

Photo:

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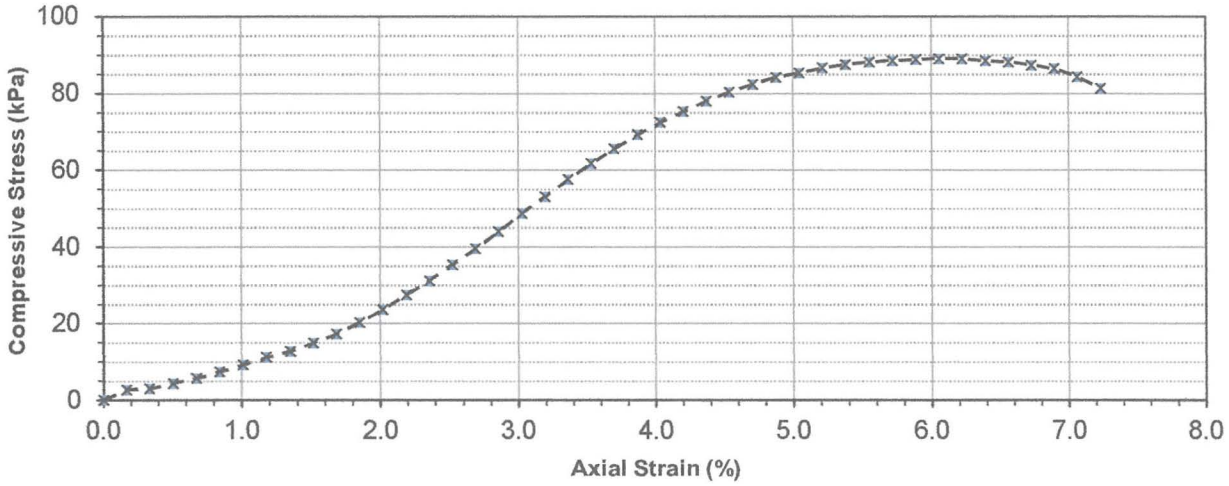
Unconfined Compressive Strength

ASTM D2166

Project No. 1000-013-46
Client Aski Geosciences Ltd.
Project RW1156

Unconfined Compression Test Graph



Unconfined Compression Test Data

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m^2)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
0	-0.19	0.0000	0.00	0.004179	0.0	0.00	0.00
10	0.04	0.2540	0.17	0.004186	11.6	2.77	1.38
20	0.06	0.5080	0.34	0.004193	12.6	3.00	1.50
30	0.18	0.7620	0.50	0.004201	18.6	4.44	2.22
40	0.29	1.0160	0.67	0.004208	24.2	5.75	2.87
50	0.43	1.2700	0.84	0.004215	31.2	7.41	3.71
60	0.58	1.5240	1.01	0.004222	38.8	9.19	4.60
70	0.75	1.7780	1.18	0.004229	47.4	11.20	5.60
80	0.88	2.0320	1.35	0.004236	53.9	12.73	6.37
90	1.07	2.2860	1.51	0.004244	63.5	14.97	7.48
100	1.27	2.5400	1.68	0.004251	73.6	17.31	8.66
110	1.52	2.7940	1.85	0.004258	86.2	20.24	10.12
120	1.81	3.0480	2.02	0.004266	100.8	23.63	11.82
130	2.14	3.3020	2.19	0.004273	117.4	27.48	13.74
140	2.46	3.5560	2.36	0.004280	133.6	31.21	15.60
150	2.82	3.8100	2.52	0.004288	151.7	35.38	17.69
160	3.17	4.0640	2.69	0.004295	169.4	39.43	19.72
170	3.57	4.3180	2.86	0.004302	189.5	44.05	22.02
180	3.98	4.5720	3.03	0.004310	210.2	48.77	24.38
190	4.36	4.8260	3.20	0.004317	229.3	53.12	26.56
200	4.75	5.0800	3.37	0.004325	249.0	57.57	28.79
210	5.11	5.3340	3.53	0.004332	267.1	61.66	30.83
220	5.46	5.5880	3.70	0.004340	284.8	65.62	32.81
230	5.78	5.8420	3.87	0.004348	300.9	69.21	34.61

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Unconfined Compressive Strength

ASTM D2166

Project No. 1000-013-46
Client Aski Geosciences Ltd.
Project RW1156

Unconfined Compression Test Data (cont'd)

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m^2)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
240	6.07	6.0960	4.04	0.004355	315.5	72.45	36.22
250	6.33	6.3500	4.21	0.004363	328.6	75.32	37.66
260	6.57	6.6040	4.38	0.004371	340.7	77.96	38.98
270	6.79	6.8580	4.54	0.004378	351.8	80.35	40.18
280	6.98	7.1120	4.71	0.004386	361.4	82.40	41.20
290	7.15	7.3660	4.88	0.004394	370.0	84.20	42.10
300	7.26	7.6200	5.05	0.004402	375.5	85.31	42.66
310	7.39	7.8740	5.22	0.004409	382.1	86.65	43.32
320	7.48	8.1280	5.39	0.004417	386.6	87.52	43.76
330	7.55	8.3820	5.55	0.004425	390.1	88.16	44.08
340	7.60	8.6360	5.72	0.004433	392.6	88.57	44.29
350	7.64	8.8900	5.89	0.004441	394.7	88.87	44.43
360	7.67	9.1440	6.06	0.004449	396.2	89.05	44.52
370	7.68	9.3980	6.23	0.004457	396.7	89.00	44.50
380	7.65	9.6520	6.39	0.004465	395.2	88.50	44.25
390	7.64	9.9060	6.56	0.004473	394.7	88.23	44.12
400	7.58	10.1600	6.73	0.004481	391.6	87.40	43.70
410	7.51	10.4140	6.90	0.004489	388.1	86.45	43.23
420	7.33	10.6680	7.07	0.004497	379.0	84.28	42.14
430	7.08	10.9220	7.24	0.004505	366.4	81.33	40.67

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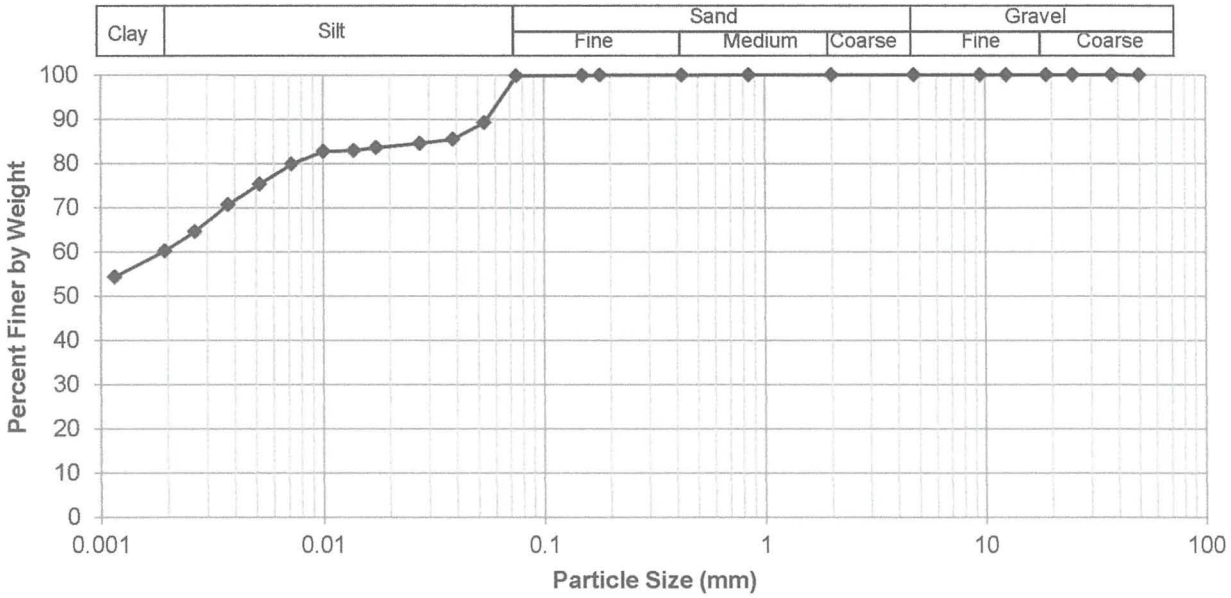
Grain Size Analysis (Hydrometer Method)
AASHTO T 88

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

Project No.	1000-013-46
Client	Aski Geosciences Ltd.
Project	RW1156
Test Hole	TH10
Sample #	-
Depth (m)	6.1 - 6.9
Sample Date	8-Jun-21
Test Date	10-Jun-21
Technician	MT

Gravel	0.0%
Sand	0.2%
Silt	39.3%
Clay	60.5%

Particle Size Distribution Curve



Gravel		Sand		Silt and Clay	
Particle Size (mm)	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**
50.0	100.00	4.75	100.00	0.0750	99.83
37.5	100.00	2.00	100.00	0.0536	89.18
25.0	100.00	0.850	99.99	0.0386	85.43
19.0	100.00	0.425	99.98	0.0274	84.49
12.5	100.00	0.180	99.94	0.0174	83.55
9.50	100.00	0.150	99.90	0.0138	82.93
4.75	100.00	0.075	99.83	0.0101	82.69
				0.0072	79.88
				0.0052	75.26
				0.0037	70.65
				0.0027	64.54
				0.0019	60.16
				0.0012	54.33

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Shelby Tube Visual

Project No.	1000-013-46
Client	Aski Geosciences Ltd.
Project	RW1156
Test Hole	TH10
Sample #	-
Depth (m)	9.1 - 9.9
Sample Date	-
Test Date	08-Jun-21
Technician	RSA

Tube Extraction

Recovery (mm) 660

9.70 m 9.54 m 9.34 m

Bottom - 9.9 m **Top - 9.2 m**

Keep	Qu Bulk	Moisture Content PP/TV Visua l	Toss
100 mm	160 mm	200 mm	200 mm

Visual Classification

Material	CLAY
Composition	silty
	trace silt inclusions (<20 mm diam.)
	trace sand (fine)
Color	dark grey
Moisture	moist to wet
Consistency	very soft
Plasticity	high plasticity
Structure	-
Gradation	-

Torvane

Reading	0.48
Vane Size (s,m,l)	l
Undrained Shear Strength (kPa)	9.4

Pocket Penetrometer (Larger Diameter)

Reading	1	1.80
	2	1.90
	3	1.90
	Average	1.87
Undrained Shear Strength (kPa)		5.70

Moisture Content

Tare ID	AB06
Mass tare (g)	6.8
Mass wet + tare (g)	474.7
Mass dry + tare (g)	272.7
Moisture %	76.0%

Unit Weight

Bulk Weight (g)		990.1
Length (mm)	1	150.87
	2	151.34
	3	150.01
	4	151.01
Average Length (m)		0.151
Diam. (mm)	1	72.05
	2	73.22
	3	72.39
	4	73.67
Average Diameter (m)		0.073
Volume (m^3)		6.28E-04
Bulk Unit Weight (kN/m^3)		15.5
Bulk Unit Weight (pcf)		98.4
Dry Unit Weight (kN/m^3)		8.8
Dry Unit Weight (pcf)		55.9

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Unconfined Compressive Strength

ASTM D2166

Project No.	1000-013-46
Client	Aski Geosciences Ltd.
Project	RW1156
Test Hole	TH10
Sample #	-
Depth (m)	9.1 - 9.9
Sample Date	-
Test Date	8-Jun-21
Technician	RSA

Unconfined Strength

	kPa	ksf
Max q_u	16.6	0.3
Max S_u	8.3	0.2

Specimen Data

Description CLAY - silty, dark grey, moist to wet, very soft, high plasticity

Length	150.8	(mm)	**Moisture %**	76%	
Diameter	72.8	(mm)	**Bulk Unit Wt.**	15.5	(kN/m^3)
L/D Ratio	2.1		**Dry Unit Wt.**	8.8	(kN/m^3)
Initial Area	0.00417	(m^2)	**Liquid Limit**	-	
Load Rate	1.00	(%/min)	**Plastic Limit**	-	
			Plasticity Index	-	

Undrained Shear Strength Tests

Torvane

Reading	Undrained Shear Strength	
tsf	**kPa**	**ksf**
0.48	9.4	0.20

Vane Size
I

Pocket Penetrometer

	Reading	Undrained Shear Strength	
	tsf	**kPa**	**ksf**
	1.80	5.5	0.11
	1.90	5.8	0.12
	1.90	5.8	0.12
Average	**1.87**	**5.7**	**0.12**

Failure Geometry

Sketch:

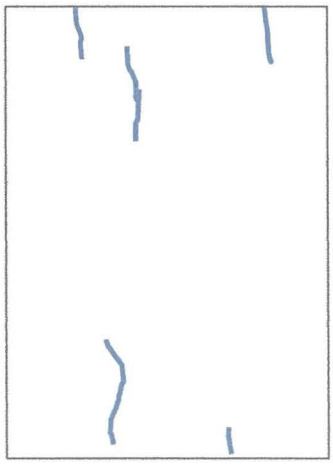
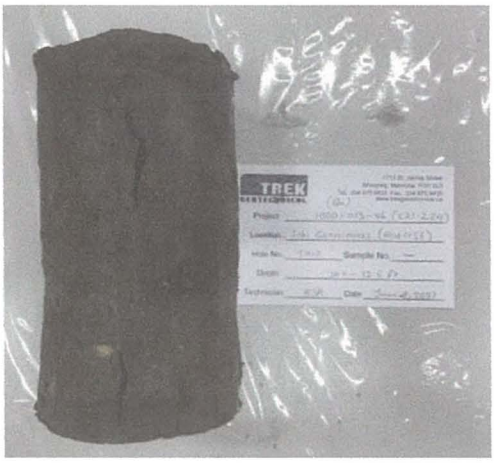


Photo:



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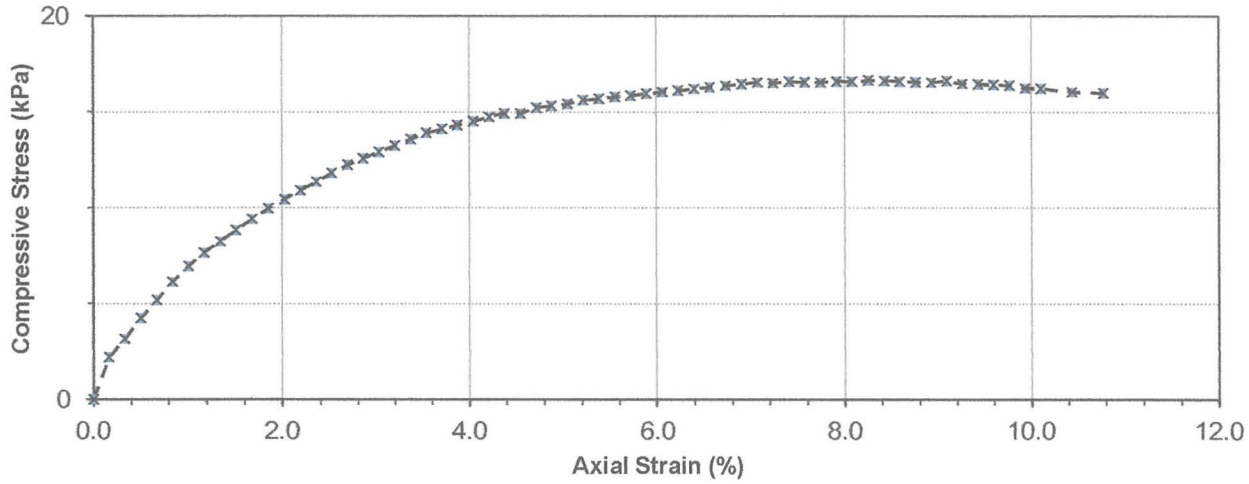
Unconfined Compressive Strength

ASTM D2166

Project No. 1000-013-46
Client Aski Geosciences Ltd.
Project RW1156

Unconfined Compression Test Graph



Unconfined Compression Test Data

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m^2)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
0	-0.20	0.0000	0.00	0.004166	0.0	0.00	0.00
10	-0.02	0.2540	0.17	0.004173	9.1	2.17	1.09
20	0.06	0.5080	0.34	0.004180	13.1	3.13	1.57
30	0.15	0.7620	0.51	0.004187	17.6	4.21	2.11
40	0.23	1.0160	0.67	0.004194	21.7	5.17	2.58
50	0.31	1.2700	0.84	0.004202	25.7	6.12	3.06
60	0.38	1.5240	1.01	0.004209	29.2	6.95	3.47
70	0.44	1.7780	1.18	0.004216	32.3	7.65	3.83
80	0.49	2.0320	1.35	0.004223	34.8	8.24	4.12
90	0.54	2.2860	1.52	0.004230	37.3	8.82	4.41
100	0.59	2.5400	1.68	0.004238	39.8	9.40	4.70
110	0.64	2.7940	1.85	0.004245	42.3	9.97	4.99
120	0.68	3.0480	2.02	0.004252	44.4	10.43	5.22
130	0.72	3.3020	2.19	0.004259	46.4	10.89	5.44
140	0.76	3.5560	2.36	0.004267	48.4	11.34	5.67
150	0.80	3.8100	2.53	0.004274	50.4	11.79	5.90
160	0.84	4.0640	2.69	0.004282	52.4	12.24	6.12
170	0.87	4.3180	2.86	0.004289	53.9	12.57	6.29
180	0.90	4.5720	3.03	0.004296	55.4	12.90	6.45
190	0.93	4.8260	3.20	0.004304	57.0	13.23	6.62
200	0.96	5.0800	3.37	0.004311	58.5	13.56	6.78
210	0.99	5.3340	3.54	0.004319	60.0	13.89	6.94
220	1.01	5.5880	3.71	0.004327	61.0	14.10	7.05
230	1.03	5.8420	3.87	0.004334	62.0	14.30	7.15

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Unconfined Compressive Strength

ASTM D2166

Project No. 1000-013-46
Client Aski Geosciences Ltd.
Project RW1156

Unconfined Compression Test Data (cont'd)

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m^2)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
240	1.05	6.0960	4.04	0.004342	63.0	14.51	7.26
250	1.07	6.3500	4.21	0.004349	64.0	14.72	7.36
260	1.09	6.6040	4.38	0.004357	65.0	14.92	7.46
270	1.09	6.8580	4.55	0.004365	65.0	14.90	7.45
280	1.12	7.1120	4.72	0.004372	66.5	15.22	7.61
290	1.13	7.3660	4.88	0.004380	67.0	15.30	7.65
300	1.14	7.6200	5.05	0.004388	67.5	15.39	7.70
310	1.16	7.8740	5.22	0.004396	68.5	15.59	7.80
320	1.17	8.1280	5.39	0.004404	69.1	15.68	7.84
330	1.18	8.3820	5.56	0.004411	69.6	15.77	7.88
340	1.19	8.6360	5.73	0.004419	70.1	15.85	7.93
350	1.20	8.8900	5.89	0.004427	70.6	15.94	7.97
360	1.21	9.1440	6.06	0.004435	71.1	16.02	8.01
370	1.22	9.3980	6.23	0.004443	71.6	16.11	8.05
380	1.23	9.6520	6.40	0.004451	72.1	16.19	8.10
390	1.24	9.9060	6.57	0.004459	72.6	16.28	8.14
400	1.25	10.1600	6.74	0.004467	73.1	16.36	8.18
410	1.26	10.4140	6.91	0.004475	73.6	16.44	8.22
420	1.27	10.6680	7.07	0.004483	74.1	16.53	8.26
430	1.27	10.9220	7.24	0.004491	74.1	16.50	8.25
440	1.28	11.1760	7.41	0.004500	74.6	16.58	8.29
450	1.28	11.4300	7.58	0.004508	74.6	16.55	8.27
460	1.28	11.6840	7.75	0.004516	74.6	16.52	8.26
470	1.29	11.9380	7.92	0.004524	75.1	16.60	8.30
480	1.29	12.1920	8.08	0.004533	75.1	16.57	8.28
490	1.30	12.4460	8.25	0.004541	75.6	16.65	8.32
500	1.30	12.7000	8.42	0.004549	75.6	16.62	8.31
510	1.30	12.9540	8.59	0.004558	75.6	16.59	8.29
520	1.30	13.2080	8.76	0.004566	75.6	16.56	8.28
530	1.30	13.4620	8.93	0.004575	75.6	16.53	8.26
540	1.31	13.7160	9.10	0.004583	76.1	16.61	8.30
550	1.30	13.9700	9.26	0.004592	75.6	16.47	8.23
560	1.30	14.2240	9.43	0.004600	75.6	16.44	8.22
570	1.30	14.4780	9.60	0.004609	75.6	16.40	8.20
580	1.30	14.7320	9.77	0.004617	75.6	16.37	8.19
590	1.29	14.9860	9.94	0.004626	75.1	16.23	8.12
600	1.29	15.2400	10.11	0.004635	75.1	16.20	8.10
620	1.28	15.7480	10.44	0.004652	74.6	16.04	8.02
640	1.28	16.2560	10.78	0.004670	74.6	15.98	7.99

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Shelby Tube Visual

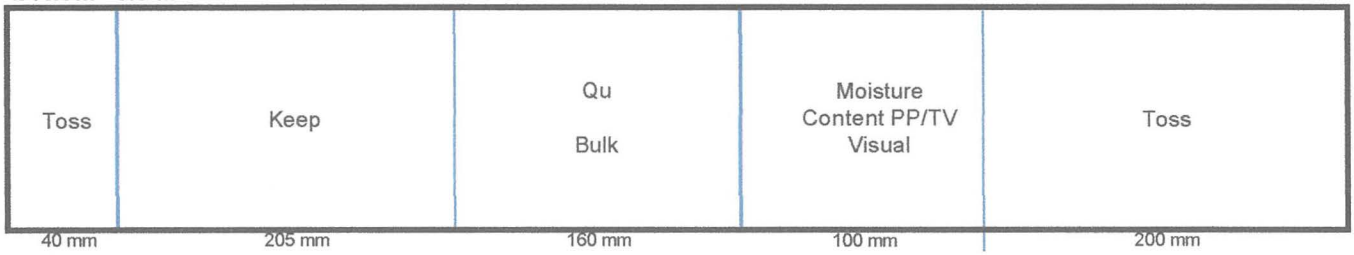
Project No.	1000-013-46
Client	Aski Geosciences Ltd.
Project	RW1156
Test Hole	TH18
Sample #	-
Depth (m)	6.1 - 6.9
Sample Date	-
Test Date	08-Jun-21
Technician	RSA

Tube Extraction

Recovery (mm) 705 (Overpushed)

6.56 m 6.40 m 6.30 m

Bottom - 6.9 m **#VALUE!**



Visual Classification

Material	CLAY
Composition	silty
	trace silt inclusions (<10 mm diam.)
Color	Dark grey
Moisture	moist to wet
Consistency	firm
Plasticity	high plasticity
Structure	-
Gradation	-

Torvane

Reading	0.30
Vane Size (s,m,l)	m
Undrained Shear Strength (kPa)	29.4

Pocket Penetrometer

Reading	1	0.50
	2	0.50
	3	0.50
	Average	0.50
Undrained Shear Strength (kPa)		24.5

Moisture Content

Tare ID	F56
Mass tare (g)	8.3
Mass wet + tare (g)	469.8
Mass dry + tare (g)	275.3
Moisture %	72.8%

Unit Weight

Bulk Weight (g)		946.1
Length (mm)	1	148.01
	2	148.60
	3	149.12
	4	149.87
Average Length (m)		0.149
Diam. (mm)	1	72.99
	2	71.24
	3	72.33
	4	71.64
Average Diameter (m)		0.072
Volume (m^3)		6.07E-04
Bulk Unit Weight (kN/m^3)		15.3
Bulk Unit Weight (pcf)		97.3
Dry Unit Weight (kN/m^3)		8.8
Dry Unit Weight (pcf)		56.3

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Unconfined Compressive Strength

ASTM D2166

Project No.	1000-013-46
Client	Aski Geosciences Ltd.
Project	RW1156
Test Hole	TH18
Sample #	-
Depth (m)	6.1 - 6.9
Sample Date	-
Test Date	8-Jun-21
Technician	RSA

Unconfined Strength

	kPa	ksf
Max q_u	47.4	1.0
Max S_u	23.7	0.5

Specimen Data

Description CLAY - silty, Dark grey, moist to wet, firm, high plasticity

Length	148.9	(mm)
Diameter	72.1	(mm)
L/D Ratio	2.1	
Initial Area	0.00408	(m^2)
Load Rate	1.00	(%/min)

Moisture %	73%	
Bulk Unit Wt.	15.3	(kN/m^3)
Dry Unit Wt.	8.8	(kN/m^3)
Liquid Limit	-	
Plastic Limit	-	
Plasticity Index	-	

Undrained Shear Strength Tests

Torvane

Reading	Undrained Shear Strength	
tsf	**kPa**	**ksf**
0.30	29.4	0.61

Vane Size
m

Pocket Penetrometer

	Reading	Undrained Shear Strength	
	tsf	**kPa**	**ksf**
	0.50	24.5	0.51
	0.50	24.5	0.51
	0.50	24.5	0.51
Average	**0.50**	**24.5**	**0.51**

Failure Geometry

Sketch:

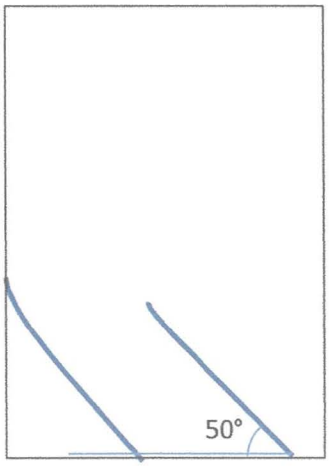
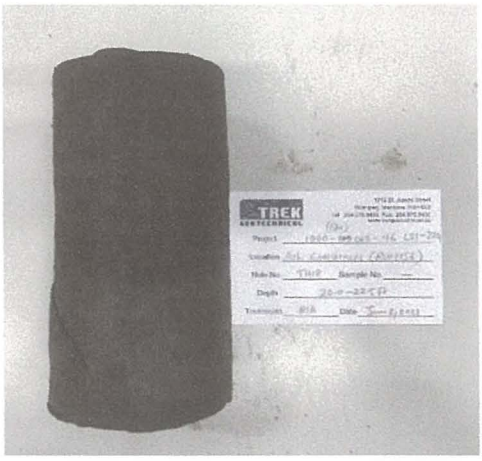


Photo:



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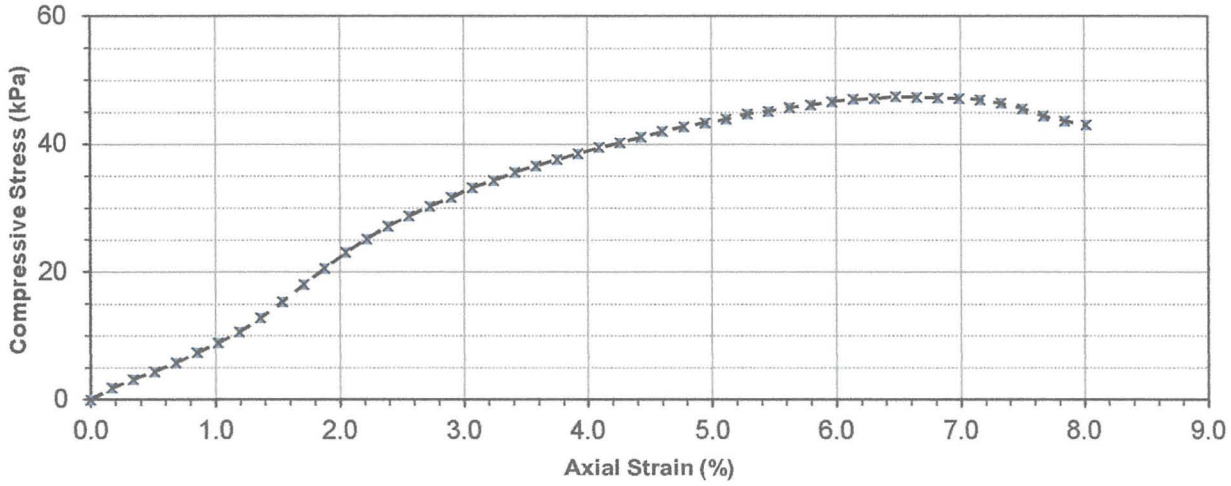
Unconfined Compressive Strength

ASTM D2166

Project No. 1000-013-46
Client Aski Geosciences Ltd.
Project RW1156

Unconfined Compression Test Graph



Unconfined Compression Test Data

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m^2)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
0	-0.20	0.0000	0.00	0.004077	0.0	0.00	0.00
10	-0.05	0.2540	0.17	0.004084	7.6	1.85	0.93
20	0.06	0.5080	0.34	0.004091	13.1	3.20	1.60
30	0.16	0.7620	0.51	0.004098	18.1	4.43	2.21
40	0.27	1.0160	0.68	0.004105	23.7	5.77	2.89
50	0.40	1.2700	0.85	0.004112	30.2	7.35	3.68
60	0.53	1.5240	1.02	0.004119	36.8	8.93	4.47
70	0.67	1.7780	1.19	0.004126	43.9	10.63	5.31
80	0.85	2.0320	1.36	0.004134	52.9	12.80	6.40
90	1.06	2.2860	1.54	0.004141	63.5	15.34	7.67
100	1.28	2.5400	1.71	0.004148	74.6	17.98	8.99
110	1.49	2.7940	1.88	0.004155	85.2	20.50	10.25
120	1.70	3.0480	2.05	0.004162	95.8	23.01	11.50
130	1.88	3.3020	2.22	0.004170	104.8	25.14	12.57
140	2.05	3.5560	2.39	0.004177	113.4	27.15	13.58
150	2.19	3.8100	2.56	0.004184	120.5	28.79	14.39
160	2.32	4.0640	2.73	0.004192	127.0	30.30	15.15
170	2.44	4.3180	2.90	0.004199	133.1	31.69	15.84
180	2.57	4.5720	3.07	0.004206	139.6	33.19	16.60
190	2.67	4.8260	3.24	0.004214	144.7	34.33	17.16
200	2.78	5.0800	3.41	0.004221	150.2	35.58	17.79
210	2.87	5.3340	3.58	0.004229	154.7	36.59	18.30
220	2.96	5.5880	3.75	0.004236	159.3	37.60	18.80
230	3.04	5.8420	3.92	0.004244	163.3	38.48	19.24

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Unconfined Compressive Strength

ASTM D2166

Project No. 1000-013-46
Client Aski Geosciences Ltd.
Project RW1156

Unconfined Compression Test Data (cont'd)

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m^2)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
240	3.13	6.0960	4.09	0.004251	167.8	39.48	19.74
250	3.20	6.3500	4.26	0.004259	171.4	40.24	20.12
260	3.28	6.6040	4.44	0.004266	175.4	41.11	20.56
270	3.36	6.8580	4.61	0.004274	179.4	41.98	20.99
280	3.43	7.1120	4.78	0.004282	183.0	42.73	21.37
290	3.49	7.3660	4.95	0.004289	186.0	43.36	21.68
300	3.54	7.6200	5.12	0.004297	188.5	43.87	21.93
310	3.62	7.8740	5.29	0.004305	192.5	44.73	22.36
320	3.66	8.1280	5.46	0.004313	194.6	45.11	22.56
330	3.72	8.3820	5.63	0.004320	197.6	45.73	22.87
340	3.76	8.6360	5.80	0.004328	199.6	46.12	23.06
350	3.81	8.8900	5.97	0.004336	202.1	46.61	23.31
360	3.85	9.1440	6.14	0.004344	204.1	46.99	23.50
370	3.87	9.3980	6.31	0.004352	205.1	47.14	23.57
380	3.90	9.6520	6.48	0.004360	206.7	47.40	23.70
390	3.90	9.9060	6.65	0.004368	206.7	47.31	23.66
400	3.90	10.1600	6.82	0.004376	206.7	47.23	23.61
410	3.90	10.4140	6.99	0.004384	206.7	47.14	23.57
420	3.89	10.6680	7.16	0.004392	206.1	46.94	23.47
430	3.85	10.9220	7.34	0.004400	204.1	46.39	23.20
440	3.78	11.1760	7.51	0.004408	200.6	45.51	22.75
450	3.69	11.4300	7.68	0.004416	196.1	44.40	22.20
460	3.63	11.6840	7.85	0.004424	193.0	43.63	21.82
470	3.58	11.9380	8.02	0.004433	190.5	42.98	21.49

10.7 APPENDIX G – Environmental License 3400

THE ENVIRONMENT ACT
LOI SUR L'ENVIRONNEMENT

Manitoba

LICENCE

File No.: 6166.00

Licence No. / Licence n°: 3400
Issue Date / Date de délivrance : June 2, 2023

In accordance with The Environment Act (C.C.S.M. c. E125)
Conformément à la Loi sur l'environnement (C.P.L.M. c. E125)

Under Sections 11(1) / Conformément au Paragraphe 11(1)

THIS LICENCE IS ISSUED TO: / CETTE LICENCE EST DONNÉÉ À:

SAPPHIRE SPRINGS INC; "the licensee"

for the construction and operation of the development being an aquaculture operation in NE 18-15-3E in the Rural Municipality of Rockwood, with the following components:

a) existing supply wells on the site supplying approximately 16 litres of water per second (1,382 cubic metres per day);
b) a hatchery, rearing and marketing operation using existing and new buildings with a capacity of 2,000,000 kg/year of arctic char;
c) a wastewater treatment system including a screen press, biofiltration and disinfection;
d) manure produced in the screen press to be applied on adjacent hayland; and
e) discharge of wastewater effluent to Wavey Creek;

in accordance with the proposal filed under The Environment Act dated August 30, 2022, and subject to the following specifications, limits, terms and conditions:

10.8 APPENDIX H – RM OF ROCKWOOD DRAINAGE AGREEMENT

DATED THE 18TH DAY OF NOVEMBER, A.D., 2021.

BETWEEN:

THE RURAL MUNICIPALITY OF ROCKWOOD
(Hereinafter called the "Municipality")

- AND -

SAPPHIRE SPRINGS

Drainage agreement

AGREEMENT # 39/21

THIS AGREEMENT made in duplicate this 18TH day of NOVEMBER, A.D., 2021.

BETWEEN:

THE RURAL MUNICIPALITY OF ROCKWOOD
(Hereinafter called the "Municipality")

- AND -

SAPPHIRE SPRINGS

WHEREAS the Municipality and Sapphire Springs's lands affected by this Agreement are situated within the boundaries of the Rural Municipality of Rockwood;

AND WHEREAS the Municipality and the Sapphire Springs desire to enter into an Agreement with respect to the drainage from the property located at 12 103 E Road 87N;

NOW THEREFORE, in consideration of the mutual covenants herein contained, and the sum of One Dollar ($1.00) and other good and valuable consideration now paid by each of the parties to the other, the receipt and sufficiency of which is hereby acknowledged, the parties hereto agree as follows:

CONDITIONS:

1. Due to the continuous discharge of water from the property problems may arise in the downstream receiving drains. If a problem is found or reported to the Municipality due to water discharging from the mentioned property, the Municipality will work with Sapphire Springs to solve the problem. This will include but not be limited to:
   a. Excessive vegetation growth causing water to backup
   b. Freezing conditions causing water to back up
   c. Any other flooding condition caused by the discharge of water from the mentioned property
2. The Municipality will be responsible for maintaining original engineered design levels. If the Municipality determines the cause to be originating from the mentioned property, the Municipality will work with Sapphire Springs to determine a solution to be implemented by Sapphire Springs with the approval of the Municipality and all costs will be paid by Sapphire Springs.
3. The drain of concern will be from where the water leaves the property to the start of Wavey Creek.
4. If the Municipality cannot recover the costs to fix the problem the total of the invoice will be added to the tax roll of the above-mentioned property.

[redacted]

This Agreement shall enure to the benefit of and be binding upon the parties hereto, their respective heirs, administrators, successors, and assigns.

IN WITNESS WHEREOF the Rural Municipality of Rockwood has hereunto caused its Corporate Seal to be affixed, attested by the proper officers in that behalf, this 24th day of November, A.D., 2021.

THE RURAL MUNICIPALITY OF ROCKWOOD

[redacted]

WES TAPLIN, REEVE

[redacted]

CHRIS LUELLMAN, CAO

IN WITNESS WHEREOF SAPPHIRE SPRINGS, have hereunto caused to affix their signatures this 18TH day of NOVEMBER, A.D., 2021.

[redacted]

WITNESS

[redacted]

IAN TERASKI

[redacted]

Sapphire Springs representative, Title

KEN BLAIR - PRESIDENT