



July 14, 2017

File No. 16-0429-004

Department of Sustainable Development  
Environmental Approvals Branch  
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ATTENTION: Mr. Asit Dey  
Environmental Engineer

RE: Town of Melita Land Application of Biosolids - File 108.30

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Dear Mr. Dey:

Over the past several weeks, KGS Group has been discussing the Town of Melita Land Application of Biosolids Project (Project) with Manitoba Sustainable Development (MSD) and with Jordan Karpinchik at Tone Ag. Tone Ag was responsible for the agronomic assessment for the Project and for determining the appropriate rate to apply the biosolids. A meeting was held at the KGS Group office at 865 Waverley Street on Thursday, July 13, 2017 to discuss the Project and specifically the biosolid application rate. Those in attendance included Asit Dey (MSD), Robert Boswick (MSD), Brian Wiebe (MSD), Roy Houston (KGS), Phil Pawluk (KGS), Gene Senior (KGS) and Jordan Karpinchik (Tone Ag).

Based on the sludge sample analysis conducted in June 2017 and the soil sample analysis conducted in September 2016, the biosolids from the Primary and Secondary cells are proposed to be spread at a rate of 56 tons/acre and 30 tons/acre, respectively. The biosolids sampling procedure and the application rate calculations are discussed below.

On June 9, 2016 KGS Group conducted sludge sampling from the Primary and Secondary cells. Field notes indicate that the primary cell water level was at or above normal operating levels and the secondary cell water level was 2 to 3 feet below normal levels. Samples were collected from a boat utilizing an Ekman Dredge and collected from the estimated central line of the lagoon. Firm sludge samples were obtained at 2 to 2.5 feet below water surface in the Primary cell and from 1 to 2 feet below water surface in the Secondary cell. Samples were collected at four locations in a uniform pattern across each cell and combined in a container in order to obtain a composite sample for each cell. Visual inspection of the samples indicated that the materials collected were primarily organic sludge with little to no river sediment deposits. The composite samples were submitted to ALS Environmental Ltd. in Winnipeg and the certificate of analysis was submitted with the original Environment Act Proposal in August 2016.

During the excavation of the Primary and Secondary cells in spring 2017, it was observed that a large amount of river silt was in the matrix, below a layer of organic sludge. This was a result of the 2011 flooding which caused the lagoon to be completely inundated for a period of 30 days. The silt could not be separated from the biosolids during the excavation such that the silt and biosolids were thoroughly mixed and integrated during the biosolids handling and moving for stockpiling.

In June 2017, KGS Group submitted one sample of this mixed silt/biosolids from the Primary cell and two samples from the Secondary cell to ALS Environmental for analysis. The samples from the Secondary cell were obtained from the east and west sides of the cell. The lab analysis of June 2017 samples (Attachment 1) shows lower levels of all parameters of concern, including phosphorus, likely due to the mixing of the river silt with the biosolids. The 2016 lab results measured 8.4% organic content compared to 1.8% from the 2017 samples indicating that the 2016 samples were predominately sludge whereas the 2017 samples represent the mixed sludge and river sediments. The biosolids characteristics based on the June 2017 composite samples are summarized in Table 1 below.

**TABLE 1**  
**BIOSOLID CHARACTERISTICS (NITROGEN AND PHOSPHORUS)**  
**FOR PRIMARY AND SECONDARY CELLS**

Name	Description	Unit	Primary Cell Results	Secondary Cell Results (WEST)	Secondary Cell Results (EAST)
Volume (Plus 10%)	Field	m3	20,000	5,000	5,000
Specific Gravity	As Received	Kg/L	1.78	1.62	1.68
Moisture	As Received	%	19.5	22.1	24.1
<b>NITROGEN CHARACTERISTICS</b>					
Total Kjeldahl N	% Dried Basis	%	0.128	0.149	0.146
Total Kjeldahl N	Dried Basis	mg/kg	1,280	1,490	1,460
Total Kjeldahl N	Dried Basis	kg/tonne	1.28	1.49	1.46
Ammonium N	Dried Basis	mg/kg	83	75	106
Ammonium N	Dried Basis	kg/tonne	0.083	0.075	0.106
Nitrate-N	Dried Basis	mg/kg	142	0	0
Nitrate-N	Dried Basis	kg/tonne	0.14	0	0
Organic N	Dried Basis	mg/kg	1,055	1,415	1,354
Organic N	Dried Basis	kg/tonne	1.06	1.42	1.35
Application Method			Broadcast / Incorporate	Broadcast / Incorporate	Broadcast / Incorporate
Anticipated Weather			Cool/Dry	Cool/Dry	Cool/Dry
Anticipated Volatilization			35%	35%	35%
Available Organic N (25% )	Dried Basis	kg/tonne	0.27	0.36	0.34
Available Ammonium N (65%)	Dried Basis	kg/tonne	0.05	0.05	0.07
Available Nitrate-N (100%)	Dried Basis		0.14	0	0
Total Available N (Year 1)	Dried Basis	kg/tonne	0.46	0.41	0.41
Mineralization N (Year 2)	Dried Basis	kg/tonne	0.18	0.16	0.16
Mineralization N (Year 3)	Dried Basis	kg/tonne	0.09	0.08	0.08
<b>PHOSPHORUS CHARACTERISTICS</b>					
Total Phosphorus	Dried Basis	mg/kg	690	1,270	1,150
Total Phosphorus	Dried Basis	kg/tonne	0.69	1.27	1.15
P2O5 (P * 2.3)	Dried Basis	kg/tonne	1.59	2.92	2.65
Total Available P2O5 (50% available Year 1)	Dried Basis	kg/tonne	0.8	1.46	1.33

Source: Tri-Provincial Manure Application and Use Guidelines, 2004 and MMM Group, 2013.

Benchmark random composite soil sampling was conducted on the fields proposed for biosolids application immediately after harvest in September 2017. One composite sample was taken from both the 0-15 cm (0-6") and 15-60 cm (6-24") depths. The samples were sent to ALS Environmental Labs in Saskatoon and were measured for nitrate-nitrogen, phosphorus, potassium, sulfate-sulphur, pH, E.C., and heavy metals. The target biosolids application rate was calculated based on the results of the soil tests. The sample analysis for the proposed field (NW-25-3-27W) is enclosed (Attachment 2).

The target biosolids application rates for the Primary and Secondary cells will be based on either the nitrogen requirement or phosphorus removal rate of either a cereal or oilseed crop (ie. spring wheat or canola). To determine the target application rate, the target nitrogen rate will be 150 lbs/acre in order to grow a 50 bushel canola crop. Canola removes approximately 1 lb of P<sub>2</sub>O<sub>5</sub>/bushel. Tables 2 and 3 below show the biosolids application rate based on a nitrogen and phosphorus basis, respectively. The biosolids will be broadcast and immediately incorporated into the soil. The anticipated volatilization of the ammonia portion of the biosolids is 35% due to handling, storage and anticipated weather during application

**TABLE 2**  
**NITROGEN BASED APPLICATION RATE CALCULATION WORKSHEET**  
**(METRIC/IMPERIAL UNITS)**

Name	Unit	Primary Cell	Secondary Cell
Total Kjeldahl N	kg/tonne	1.28	1.49
Ammonium N	kg/tonne	0.083	0.075
Available Nitrate-N	kg/tonne	0.14	0
Organic N	kg/tonne	1.06	1.42
Application Method		Broadcast/Incorp	Broadcast/Incorp
Anticipated Weather		Cool/Dry	Cool/Dry
Anticipated Volatilization		35%	35%
Available Organic N	kg/tonne	0.27	0.36
Available Ammonium N	kg/tonne	0.05	0.05
Total Available N	kg/tonne	0.46	0.41
Total Available N	lbs/ton	0.92	0.82
N based Rate	tons/acre	<b>163</b>	<b>183</b>
Total N Applied	lbs/acre	150	150
Crop Removal Rate (P <sub>2</sub> O <sub>5</sub> )	lbs/acre	45	45
Amount of P <sub>2</sub> O <sub>5</sub> applied using N based rate (50% available)	lbs/acre	259	534
Years to pre-application Olsen-P soil levels		6	12



**TABLE 3  
PHOSPHORUS BASED APPLICATION RATE CALCULATION WORKSHEET  
(METRIC/IMPERIAL UNITS)**

Name	Unit	Primary Cell	Secondary Cell
Total P2O5	kg/tonne	1.59	2.92
Total Available P2O5 (50% in Year 1)	kg/tonne	0.8	1.46
Total Available P2O5 (50% in Year 1)	lbs/acre	1.6	2.92
2X P2O5 Removal based Application Rate	tons/acre	<b>56</b>	<b>30</b>
Supplemental Nitrogen required for crop	lbs/acre	90	120
Amount of Available P2O5 applied (50% in Year 1)	lbs/acre	90	90
Crop Removal Rate	lbs/acre	45	45
Years to pre-application Olsen-P soil levels		2	2

Based on the application rates outlined in Tables 2 and 3, the nitrogen based application rates for both Primary and Secondary cells (163 and 183 tons/acre, respectively) are too high for the receiving land within the project area. This is due to the restrictions listed in the *Manitoba Water Quality Standards, Objectives and Guidelines* for phosphorus loading with municipal biosolids. Thus, the recommended rates, based on the sludge samples taken in June 2017, would be **56 tons/acre and 30 tons/acre from the Primary and Secondary cells** of the lagoon, respectively.

Assuming 25 lbs of phosphate increases the Olsen P level in soil by 1 ppm, there will be an increase of approximately 4 ppm on the receiving land base within the project area over a two year period. The soils in the PPA are rated very low to low in phosphorus and would benefit greatly from an application of biosolids with minimal agronomic and environmental risk.

We hope that the explanation and the information provided in this letter and in previous correspondence sufficiently addresses the concerns that Sustainable Development has raised relating to the biosolids application rate and phosphorus.

Yours truly,

Gene Senior, M.A.  
Environmental Scientist

GS/jr  
Attachments

cc: Travis Parsons, Manitoba Water Services Board

**ATTACHMENT 1**



KGS Group Consultants (Winnipeg)  
ATTN: GENE SENIOR  
865 Waverly Street - 3rd Floor  
Winnipeg MB R3T 5P4

Date Received: 29-JUN-17  
Report Date: 13-JUL-17 06:58 (MT)  
Version: FINAL

Client Phone: 204-896-1209

## Certificate of Analysis

Lab Work Order #: L1950655  
Project P.O. #: NOT SUBMITTED  
Job Reference: 16-0429-004  
C of C Numbers:  
Legal Site Desc:

Hua Wo  
Chemistry Laboratory Manager

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## ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1950655-1 PRIMARY							
Sampled By: CLIENT on 27-JUN-17 @ 14:15							
Matrix: SLUDGE							
<b>Miscellaneous Parameters</b>							
Total Available Nitrogen	225		14	mg/kg		06-JUL-17	
Available Phosphate-P	26.4		1.0	mg/kg	10-JUL-17	10-JUL-17	R3768861
Available Potassium	276		20	mg/kg	12-JUL-17	12-JUL-17	R3770437
Available Sulfate-S	949	DLHC	40	mg/kg	07-JUL-17	07-JUL-17	R3767556
Mercury (Hg)	0.0256		0.0050	mg/kg	04-JUL-17	05-JUL-17	R3766329
% Moisture	19.5		0.10	%	08-JUL-17	08-JUL-17	R3767954
% Saturation	53.0		1.0	%	06-JUL-17	07-JUL-17	R3767462
Specific Gravity	1.78		0.010	kg/L		11-JUL-17	R3769521
Total Carbon by Combustion	2.01		0.05	%	07-JUL-17	07-JUL-17	R3767606
Total Kjeldahl Nitrogen	0.128		0.020	%	07-JUL-17	10-JUL-17	R3769643
<b>Organic Matter by LOI at 375 deg C.</b>							
Organic Matter	1.8		1.0	%	07-JUL-17	08-JUL-17	R3768694
Loss on Ignition @ 375 C	1.9		1.0	%	07-JUL-17	08-JUL-17	R3768694
<b>Total Solids and Total Volatile Solids</b>							
Total Solids	80.7		0.10	%	07-JUL-17	07-JUL-17	R3767521
Total Volatile Solids (dry basis)	3.85		0.10	%	07-JUL-17	07-JUL-17	R3767521
<b>pH and EC (1:2 Soil:Water Extraction)</b>							
Conductivity (1:2)	2.18		0.050	dS m-1	10-JUL-17	10-JUL-17	R3768774
pH (1:2 soil:water)	7.66		0.10	pH	10-JUL-17	10-JUL-17	R3768774
<b>Metals</b>							
Aluminum (Al)	10400		5.0	mg/kg	04-JUL-17	04-JUL-17	R3764801
Antimony (Sb)	0.26		0.10	mg/kg	04-JUL-17	04-JUL-17	R3764801
Arsenic (As)	0.90		0.10	mg/kg	04-JUL-17	04-JUL-17	R3764801
Barium (Ba)	134		0.50	mg/kg	04-JUL-17	04-JUL-17	R3764801
Beryllium (Be)	0.53		0.10	mg/kg	04-JUL-17	04-JUL-17	R3764801
Bismuth (Bi)	0.264		0.020	mg/kg	04-JUL-17	04-JUL-17	R3764801
Boron (B)	15		10	mg/kg	04-JUL-17	04-JUL-17	R3764801
Cadmium (Cd)	0.255		0.020	mg/kg	04-JUL-17	04-JUL-17	R3764801
Calcium (Ca)	31600		100	mg/kg	04-JUL-17	04-JUL-17	R3764801
Chromium (Cr)	17.7		1.0	mg/kg	04-JUL-17	04-JUL-17	R3764801
Cobalt (Co)	5.62		0.020	mg/kg	04-JUL-17	04-JUL-17	R3764801
Copper (Cu)	20.5		1.0	mg/kg	04-JUL-17	04-JUL-17	R3764801
Iron (Fe)	14700		25	mg/kg	04-JUL-17	04-JUL-17	R3764801
Lead (Pb)	7.56		0.20	mg/kg	04-JUL-17	04-JUL-17	R3764801
Magnesium (Mg)	11600		10	mg/kg	04-JUL-17	04-JUL-17	R3764801
Manganese (Mn)	379		0.50	mg/kg	04-JUL-17	04-JUL-17	R3764801
Molybdenum (Mo)	0.39		0.10	mg/kg	04-JUL-17	04-JUL-17	R3764801
Nickel (Ni)	14.1		0.50	mg/kg	04-JUL-17	04-JUL-17	R3764801
Phosphorus (P)	690		100	mg/kg	04-JUL-17	04-JUL-17	R3764801
Potassium (K)	1850		25	mg/kg	04-JUL-17	04-JUL-17	R3764801
Selenium (Se)	0.54		0.50	mg/kg	04-JUL-17	04-JUL-17	R3764801
Silver (Ag)	0.19		0.10	mg/kg	04-JUL-17	04-JUL-17	R3764801
Sodium (Na)	231		10	mg/kg	04-JUL-17	04-JUL-17	R3764801
Strontium (Sr)	64.7		0.10	mg/kg	04-JUL-17	04-JUL-17	R3764801
Thallium (Tl)	0.19		0.10	mg/kg	04-JUL-17	04-JUL-17	R3764801
Tin (Sn)	<5.0		5.0	mg/kg	04-JUL-17	04-JUL-17	R3764801
Titanium (Ti)	125		0.50	mg/kg	04-JUL-17	04-JUL-17	R3764801
Uranium (U)	1.70		0.020	mg/kg	04-JUL-17	04-JUL-17	R3764801
Vanadium (V)	37.6		0.50	mg/kg	04-JUL-17	04-JUL-17	R3764801
Zinc (Zn)	52		10	mg/kg	04-JUL-17	04-JUL-17	R3764801
<b>Total Available N &amp; NO3-N, NO2-N &amp; NH4</b>							

\* Refer to Referenced Information for Qualifiers (if any) and Methodology.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1950655-1 PRIMARY Sampled By: CLIENT on 27-JUN-17 @ 14:15 Matrix: SLUDGE							
<b>Available Ammonium-N</b>							
Available Ammonium-N	83	DLHC	10	mg/kg	06-JUL-17	06-JUL-17	R3766789
<b>Nitrate, Nitrite &amp; Nitrate+Nitrite-N(KCL)</b>							
Nitrite-N	<1.0		1.0	mg/kg	10-JUL-17	10-JUL-17	R3768837
Nitrate+Nitrite-N	142	DLHC	10	mg/kg	10-JUL-17	10-JUL-17	R3768837
Nitrate-N	142	DLHC	10	mg/kg	10-JUL-17	10-JUL-17	R3768837
<b>Detailed Salinity</b>							
<b>Chloride (Cl) (Saturated Paste)</b>							
Chloride (Cl)	55	DLDS	10	mg/L	07-JUL-17	07-JUL-17	R3767621
<b>Detail Salinity in mg/kg</b>							
Chloride (Cl)	29.4		5.3	mg/kg		08-JUL-17	
Calcium (Ca)	373		27	mg/kg		08-JUL-17	
Magnesium (Mg)	244		27	mg/kg		08-JUL-17	
Potassium (K)	35		27	mg/kg		08-JUL-17	
Sodium (Na)	79		27	mg/kg		08-JUL-17	
Sulfur (as SO4)	1410		27	mg/kg		08-JUL-17	
<b>SAR, Cations and SO4 in saturated soil</b>							
Calcium (Ca)	704	DLDS	50	mg/L	07-JUL-17	07-JUL-17	R3767742
Potassium (K)	65	DLDS	50	mg/L	07-JUL-17	07-JUL-17	R3767742
Magnesium (Mg)	461	DLDS	50	mg/L	07-JUL-17	07-JUL-17	R3767742
Sodium (Na)	149	DLDS	50	mg/L	07-JUL-17	07-JUL-17	R3767742
SAR	1.07		0.10	SAR	07-JUL-17	07-JUL-17	R3767742
Sulfur (as SO4)	2650	DLDS	50	mg/L	07-JUL-17	07-JUL-17	R3767742
<b>Theoretical Gypsum Requirement</b>							
TGR(brine)	<0.10		0.10	t/ha		08-JUL-17	
TGR(sodic)	<0.10		0.10	t/ha		08-JUL-17	
<b>pH and EC (Saturated Paste)</b>							
% Saturation	53.0		1.0	%	06-JUL-17	07-JUL-17	R3767462
pH in Saturated Paste	7.40		0.10	pH	06-JUL-17	07-JUL-17	R3767462
Conductivity Sat. Paste	6.02		0.10	dS m-1	06-JUL-17	07-JUL-17	R3767462
L1950655-2 SECONDARY EAST Sampled By: CLIENT on 27-JUN-17 @ 14:15 Matrix: SLUDGE							
<b>Miscellaneous Parameters</b>							
Total Available Nitrogen	106		10	mg/kg		06-JUL-17	
Available Phosphate-P	12.6		1.0	mg/kg	10-JUL-17	10-JUL-17	R3768861
Available Potassium	306		20	mg/kg	12-JUL-17	12-JUL-17	R3770437
Available Sulfate-S	518		4.0	mg/kg	07-JUL-17	07-JUL-17	R3767556
Mercury (Hg)	0.0503		0.0050	mg/kg	04-JUL-17	05-JUL-17	R3766329
% Moisture	24.1		0.10	%	08-JUL-17	08-JUL-17	R3767954
% Saturation	52.0		1.0	%	06-JUL-17	07-JUL-17	R3767462
Specific Gravity	1.68		0.010	kg/L		11-JUL-17	R3769521
Total Carbon by Combustion	1.99		0.05	%	07-JUL-17	07-JUL-17	R3767606
Total Kjeldahl Nitrogen	0.146		0.020	%	07-JUL-17	10-JUL-17	R3769643
<b>Organic Matter by LOI at 375 deg C.</b>							
Organic Matter	1.7		1.0	%	07-JUL-17	08-JUL-17	R3768694
Loss on Ignition @ 375 C	1.8		1.0	%	07-JUL-17	08-JUL-17	R3768694
<b>Total Solids and Total Volatile Solids</b>							
Total Solids	74.3		0.10	%	07-JUL-17	07-JUL-17	R3767521
Total Volatile Solids (dry basis)	3.52		0.10	%	07-JUL-17	07-JUL-17	R3767521
<b>pH and EC (1:2 Soil:Water Extraction)</b>							

\* Refer to Referenced Information for Qualifiers (if any) and Methodology.



## ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1950655-2 SECONDARY EAST							
Sampled By: CLIENT on 27-JUN-17 @ 14:15							
Matrix: SLUDGE							
<b>pH and EC (1:2 Soil:Water Extraction)</b>							
Conductivity (1:2)	1.51		0.050	dS m-1	10-JUL-17	10-JUL-17	R3768774
pH (1:2 soil:water)	8.20		0.10	pH	10-JUL-17	10-JUL-17	R3768774
<b>Metals</b>							
Aluminum (Al)	10500		5.0	mg/kg	04-JUL-17	04-JUL-17	R3764801
Antimony (Sb)	0.17		0.10	mg/kg	04-JUL-17	04-JUL-17	R3764801
Arsenic (As)	<0.10		0.10	mg/kg	04-JUL-17	04-JUL-17	R3764801
Barium (Ba)	102		0.50	mg/kg	04-JUL-17	04-JUL-17	R3764801
Beryllium (Be)	0.54		0.10	mg/kg	04-JUL-17	04-JUL-17	R3764801
Bismuth (Bi)	0.240		0.020	mg/kg	04-JUL-17	04-JUL-17	R3764801
Boron (B)	13		10	mg/kg	04-JUL-17	04-JUL-17	R3764801
Cadmium (Cd)	0.316		0.020	mg/kg	04-JUL-17	04-JUL-17	R3764801
Calcium (Ca)	28300		100	mg/kg	04-JUL-17	04-JUL-17	R3764801
Chromium (Cr)	18.5		1.0	mg/kg	04-JUL-17	04-JUL-17	R3764801
Cobalt (Co)	6.09		0.020	mg/kg	04-JUL-17	04-JUL-17	R3764801
Copper (Cu)	22.5		1.0	mg/kg	04-JUL-17	04-JUL-17	R3764801
Iron (Fe)	15000		25	mg/kg	04-JUL-17	04-JUL-17	R3764801
Lead (Pb)	8.22		0.20	mg/kg	04-JUL-17	04-JUL-17	R3764801
Magnesium (Mg)	11400		10	mg/kg	04-JUL-17	04-JUL-17	R3764801
Manganese (Mn)	217		0.50	mg/kg	04-JUL-17	04-JUL-17	R3764801
Molybdenum (Mo)	0.58		0.10	mg/kg	04-JUL-17	04-JUL-17	R3764801
Nickel (Ni)	14.9		0.50	mg/kg	04-JUL-17	04-JUL-17	R3764801
Phosphorus (P)	1150		100	mg/kg	04-JUL-17	04-JUL-17	R3764801
Potassium (K)	1840		25	mg/kg	04-JUL-17	04-JUL-17	R3764801
Selenium (Se)	0.80		0.50	mg/kg	04-JUL-17	04-JUL-17	R3764801
Silver (Ag)	0.50		0.10	mg/kg	04-JUL-17	04-JUL-17	R3764801
Sodium (Na)	230		10	mg/kg	04-JUL-17	04-JUL-17	R3764801
Strontium (Sr)	46.0		0.10	mg/kg	04-JUL-17	04-JUL-17	R3764801
Thallium (Tl)	0.19		0.10	mg/kg	04-JUL-17	04-JUL-17	R3764801
Tin (Sn)	<5.0		5.0	mg/kg	04-JUL-17	04-JUL-17	R3764801
Titanium (Ti)	98.1		0.50	mg/kg	04-JUL-17	04-JUL-17	R3764801
Uranium (U)	3.36		0.020	mg/kg	04-JUL-17	04-JUL-17	R3764801
Vanadium (V)	35.6		0.50	mg/kg	04-JUL-17	04-JUL-17	R3764801
Zinc (Zn)	58		10	mg/kg	04-JUL-17	04-JUL-17	R3764801
<b>Total Available N &amp; NO3-N, NO2-N &amp; NH4</b>							
<b>Available Ammonium-N</b>							
Available Ammonium-N	106	DLHC	10	mg/kg	06-JUL-17	06-JUL-17	R3766789
<b>Nitrate, Nitrite &amp; Nitrate+Nitrite-N(KCL)</b>							
Nitrite-N	<1.0		1.0	mg/kg	10-JUL-17	10-JUL-17	R3768837
Nitrate+Nitrite-N	<2.0		2.0	mg/kg	10-JUL-17	10-JUL-17	R3768837
Nitrate-N	<2.0		2.0	mg/kg	10-JUL-17	10-JUL-17	R3768837
<b>Detailed Salinity</b>							
<b>Chloride (Cl) (Saturated Paste)</b>							
Chloride (Cl)	500	DLDS	130	mg/L	07-JUL-17	07-JUL-17	R3767621
<b>Detail Salinity in mg/kg</b>							
Chloride (Cl)	262		65	mg/kg		08-JUL-17	
Calcium (Ca)	271		13	mg/kg		08-JUL-17	
Magnesium (Mg)	192		13	mg/kg		08-JUL-17	
Potassium (K)	41		13	mg/kg		08-JUL-17	
Sodium (Na)	81		13	mg/kg		08-JUL-17	
Sulfur (as SO4)	1730		13	mg/kg		08-JUL-17	
<b>SAR, Cations and SO4 in saturated soil</b>							
Calcium (Ca)	522	DLDS	25	mg/L	07-JUL-17	07-JUL-17	R3767742

\* Refer to Referenced Information for Qualifiers (if any) and Methodology.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1950655-2 SECONDARY EAST Sampled By: CLIENT on 27-JUN-17 @ 14:15 Matrix: SLUDGE							
<b>SAR, Cations and SO4 in saturated soil</b>							
Potassium (K)	78	DLDS	25	mg/L	07-JUL-17	07-JUL-17	R3767742
Magnesium (Mg)	370	DLDS	25	mg/L	07-JUL-17	07-JUL-17	R3767742
Sodium (Na)	156	DLDS	25	mg/L	07-JUL-17	07-JUL-17	R3767742
SAR	1.28		0.10	SAR	07-JUL-17	07-JUL-17	R3767742
Sulfur (as SO4)	3330	DLDS	25	mg/L	07-JUL-17	07-JUL-17	R3767742
<b>Theoretical Gypsum Requirement</b>							
TGR(brine)	<0.10		0.10	t/ha		08-JUL-17	
TGR(sodic)	<0.10		0.10	t/ha		08-JUL-17	
<b>pH and EC (Saturated Paste)</b>							
% Saturation	52.0		1.0	%	06-JUL-17	07-JUL-17	R3767462
pH in Saturated Paste	7.94		0.10	pH	06-JUL-17	07-JUL-17	R3767462
Conductivity Sat. Paste	4.89		0.10	dS m-1	06-JUL-17	07-JUL-17	R3767462
L1950655-3 SECONDARY WEST Sampled By: CLIENT on 27-JUN-17 @ 14:15 Matrix: SLUDGE							
<b>Miscellaneous Parameters</b>							
Total Available Nitrogen	75		10	mg/kg		06-JUL-17	
Available Phosphate-P	16.5		1.0	mg/kg	10-JUL-17	10-JUL-17	R3768861
Available Potassium	216		20	mg/kg	12-JUL-17	12-JUL-17	R3770437
Available Sulfate-S	755	DLHC	40	mg/kg	07-JUL-17	07-JUL-17	R3767556
Mercury (Hg)	0.0569		0.0050	mg/kg	04-JUL-17	05-JUL-17	R3766329
% Moisture	22.1		0.10	%	08-JUL-17	08-JUL-17	R3767954
% Saturation	45.0		1.0	%	06-JUL-17	07-JUL-17	R3767462
Specific Gravity	1.62		0.010	kg/L		11-JUL-17	R3769521
Total Carbon by Combustion	2.16		0.05	%	07-JUL-17	07-JUL-17	R3767606
Total Kjeldahl Nitrogen	0.149		0.020	%	07-JUL-17	10-JUL-17	R3769643
<b>Organic Matter by LOI at 375 deg C.</b>							
Organic Matter	2.0		1.0	%	07-JUL-17	08-JUL-17	R3768694
Loss on Ignition @ 375 C	2.2		1.0	%	07-JUL-17	08-JUL-17	R3768694
<b>Total Solids and Total Volatile Solids</b>							
Total Solids	78.2		0.10	%	07-JUL-17	07-JUL-17	R3767521
Total Volatile Solids (dry basis)	3.38		0.10	%	07-JUL-17	07-JUL-17	R3767521
<b>pH and EC (1:2 Soil:Water Extraction)</b>							
Conductivity (1:2)	1.93		0.050	dS m-1	10-JUL-17	10-JUL-17	R3768774
pH (1:2 soil:water)	7.95		0.10	pH	10-JUL-17	10-JUL-17	R3768774
<b>Metals</b>							
Aluminum (Al)	8150		5.0	mg/kg	04-JUL-17	04-JUL-17	R3764801
Antimony (Sb)	0.21		0.10	mg/kg	04-JUL-17	04-JUL-17	R3764801
Arsenic (As)	<0.10		0.10	mg/kg	04-JUL-17	04-JUL-17	R3764801
Barium (Ba)	89.3		0.50	mg/kg	04-JUL-17	04-JUL-17	R3764801
Beryllium (Be)	0.39		0.10	mg/kg	04-JUL-17	04-JUL-17	R3764801
Bismuth (Bi)	0.350		0.020	mg/kg	04-JUL-17	04-JUL-17	R3764801
Boron (B)	13		10	mg/kg	04-JUL-17	04-JUL-17	R3764801
Cadmium (Cd)	0.286		0.020	mg/kg	04-JUL-17	04-JUL-17	R3764801
Calcium (Ca)	29900		100	mg/kg	04-JUL-17	04-JUL-17	R3764801
Chromium (Cr)	15.0		1.0	mg/kg	04-JUL-17	04-JUL-17	R3764801
Cobalt (Co)	4.66		0.020	mg/kg	04-JUL-17	04-JUL-17	R3764801
Copper (Cu)	33.8		1.0	mg/kg	04-JUL-17	04-JUL-17	R3764801
Iron (Fe)	11700		25	mg/kg	04-JUL-17	04-JUL-17	R3764801
Lead (Pb)	7.57		0.20	mg/kg	04-JUL-17	04-JUL-17	R3764801

\* Refer to Referenced Information for Qualifiers (if any) and Methodology.

## ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1950655-3 SECONDARY WEST							
Sampled By: CLIENT on 27-JUN-17 @ 14:15							
Matrix: SLUDGE							
<b>Metals</b>							
Magnesium (Mg)	9340		10	mg/kg	04-JUL-17	04-JUL-17	R3764801
Manganese (Mn)	201		0.50	mg/kg	04-JUL-17	04-JUL-17	R3764801
Molybdenum (Mo)	0.84		0.10	mg/kg	04-JUL-17	04-JUL-17	R3764801
Nickel (Ni)	10.5		0.50	mg/kg	04-JUL-17	04-JUL-17	R3764801
Phosphorus (P)	1270		100	mg/kg	04-JUL-17	04-JUL-17	R3764801
Potassium (K)	1700		25	mg/kg	04-JUL-17	04-JUL-17	R3764801
Selenium (Se)	1.18		0.50	mg/kg	04-JUL-17	04-JUL-17	R3764801
Silver (Ag)	0.81		0.10	mg/kg	04-JUL-17	04-JUL-17	R3764801
Sodium (Na)	199		10	mg/kg	04-JUL-17	04-JUL-17	R3764801
Strontium (Sr)	54.3		0.10	mg/kg	04-JUL-17	04-JUL-17	R3764801
Thallium (Tl)	0.16		0.10	mg/kg	04-JUL-17	04-JUL-17	R3764801
Tin (Sn)	<5.0		5.0	mg/kg	04-JUL-17	04-JUL-17	R3764801
Titanium (Ti)	153		0.50	mg/kg	04-JUL-17	04-JUL-17	R3764801
Uranium (U)	4.37		0.020	mg/kg	04-JUL-17	04-JUL-17	R3764801
Vanadium (V)	28.9		0.50	mg/kg	04-JUL-17	04-JUL-17	R3764801
Zinc (Zn)	54		10	mg/kg	04-JUL-17	04-JUL-17	R3764801
<b>Total Available N &amp; NO3-N, NO2-N &amp; NH4</b>							
<b>Available Ammonium-N</b>							
Available Ammonium-N	75	DLHC	10	mg/kg	06-JUL-17	06-JUL-17	R3766789
<b>Nitrate, Nitrite &amp; Nitrate+Nitrite-N(KCL)</b>							
Nitrite-N	<1.0		1.0	mg/kg	10-JUL-17	10-JUL-17	R3768837
Nitrate+Nitrite-N	<2.0		2.0	mg/kg	10-JUL-17	10-JUL-17	R3768837
Nitrate-N	<2.0		2.0	mg/kg	10-JUL-17	10-JUL-17	R3768837
<b>Detailed Salinity</b>							
<b>Chloride (Cl) (Saturated Paste)</b>							
Chloride (Cl)	365	DLDS	25	mg/L	07-JUL-17	07-JUL-17	R3767621
<b>Detail Salinity in mg/kg</b>							
Chloride (Cl)	164		11	mg/kg		08-JUL-17	
Calcium (Ca)	257		11	mg/kg		08-JUL-17	
Magnesium (Mg)	189		11	mg/kg		08-JUL-17	
Potassium (K)	35		11	mg/kg		08-JUL-17	
Sodium (Na)	69		11	mg/kg		08-JUL-17	
Sulfur (as SO4)	1580		11	mg/kg		08-JUL-17	
<b>SAR, Cations and SO4 in saturated soil</b>							
Calcium (Ca)	570	DLDS	25	mg/L	07-JUL-17	07-JUL-17	R3767742
Potassium (K)	78	DLDS	25	mg/L	07-JUL-17	07-JUL-17	R3767742
Magnesium (Mg)	420	DLDS	25	mg/L	07-JUL-17	07-JUL-17	R3767742
Sodium (Na)	154	DLDS	25	mg/L	07-JUL-17	07-JUL-17	R3767742
SAR	1.20		0.10	SAR	07-JUL-17	07-JUL-17	R3767742
Sulfur (as SO4)	3510	DLDS	25	mg/L	07-JUL-17	07-JUL-17	R3767742
<b>Theoretical Gypsum Requirement</b>							
TGR(brine)	<0.10		0.10	t/ha		08-JUL-17	
TGR(sodic)	<0.10		0.10	t/ha		08-JUL-17	
<b>pH and EC (Saturated Paste)</b>							
% Saturation	45.0		1.0	%	06-JUL-17	07-JUL-17	R3767462
pH in Saturated Paste	7.64		0.10	pH	06-JUL-17	07-JUL-17	R3767462
Conductivity Sat. Paste	5.06		0.10	dS m-1	06-JUL-17	07-JUL-17	R3767462

\* Refer to Referenced Information for Qualifiers (if any) and Methodology.

## Reference Information

### Sample Parameter Qualifier Key:

Qualifier	Description
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
DLHC	Detection Limit Raised: Dilution required due to high concentration of test analyte(s).

### Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
C-TOT-LECO-SK	Soil	Total Carbon by combustion method	CSSS (2008) 21.2
The sample is ignited in a combustion analyzer where carbon in the reduced CO <sub>2</sub> gas is determined using a thermal conductivity detector.			
CL-PASTE-COL-SK	Soil	Chloride (Cl) (Saturated Paste)	CSSS 15.2.1/ APHA 4500-Cl E
A soil extract produced by the saturated paste extraction procedure is analyzed for Chloride by Colourimetry.			
ETL-N-TOT-AVAIL-SK	Soil	Available Ammonium-N - Calculation	Soil Methods of Analysis (1993) CSSS
HG-200.2-CVAF-WP	Soil	Mercury in Soil by CVAFS	EPA 200.2/1631E (mod)
Soil samples are digested with nitric and hydrochloric acids, followed by analysis by CVAFS.			
K-AVAIL-SK	Soil	Available Potassium	Comm. Soil Sci. Plant, 25 (5&6)
Plant available potassium is extracted from the soil using Modified Kelowna solution. Potassium in the soil extract is determined by flame emission at 770 nm.			
MET-200.2-MS-WP	Soil	Metals	EPA 200.2/6020A
Samples for analysis are homogenized, dried at 60 degrees Celsius, sieved through a 2 mm (10 mesh) sieve, and a representative subsample of the dry material is weighed. The sample is then digested by block digester (EPA 200.2). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).			
Method Limitation: This method is not a total digestion technique. It is a very strong acid digestion that is intended to dissolve those metals that may become "environmentally available." By design, elements bound in silicate structures are not normally dissolved by this procedure as they are not usually mobile in the environment.			
MOIST-SK	Soil	Moisture Content	ASTM D2216-80
The weighed portion of soil is placed in a 105°C oven overnight. The dried soil is allowed to cooled to room temperature, weighed and the % moisture is calculated.			
Reference: ASTM D2216-80			
N-TOTKJ-COL-SK	Soil	Total Kjeldahl Nitrogen	CSSS (2008) 22.2.3
The soil is digested with sulfuric acid in the presence of CuSO <sub>4</sub> and K <sub>2</sub> SO <sub>4</sub> catalysts. Ammonia in the soil extract is determined colrimetrically at 660 nm.			
N2/N3-AVAIL-KCL-SK	Soil	Nitrate, Nitrite & Nitrate+Nitrite-N(KCL)	CSSS (1993) p. 26-28
Plant available nitrate and nitrite are extracted from the sample with 2N KCl. Nitrate and Nitrite in the filtered extract are determined colorimetrically by Technicon auto-analyzer or flow injection analyzer at 520 nm.			
NH4-AVAIL-SK	Soil	Available Ammonium-N	Comm Soil Sci 19(6)
Ammonium (NH <sub>4</sub> -N) is extracted from the soil using 2 N KCl. Ammonium in the extract is mixed with hypochlorite and salicylate to form indophenol blue, which is determined colorimetrically by auto analysis at 660 nm.			
OM-LOI-SK	Soil	Organic Matter by LOI at 375 deg C.	CSSS (1978) p. 160
The dry-ash method involves the removal of organic matter by combustion at 375 degrees C for a minimum of 16 hours. Samples are dried prior to combustion.			
Reference: McKeague, J.A. Soil Sampling and Methods of Analysis. Can. Soc. Soil Sci.(1978) method 4.23			
PH,EC-1:2-SK	Soil	pH and EC (1:2 Soil:Water Extraction)	AB Ag (1988) p.7
1 part dry soil and 2 parts de-ionized water (by volume) is mixed. The slurry is allowed to stand with occasional stirring for 30 - 60 minutes. After equilibration, pH of the slurry is measured using a pH meter. Conductivity of the filtered extract is measured by a conductivity meter.			
PO4-AVAIL-OLSEN-SK	Soil	Available Phosphate-P by Olsen	CSSS (2008) 8.2
Plant available phosphorus is extracted from the sample with sodium bicarbonate. PO <sub>4</sub> -P in the filtered extract is determined colorimetrically at 880 nm.			

## Reference Information

### Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
SAL-MG/KG-CALC-SK	Soil	Detail Salinity in mg/kg	Manual Calculation
SALINITY-INTCHECK-SK	Soil		CSSS 18.4-Calculation
SAR-CALC-SO4-SK	Soil	SAR, Cations and SO4 in saturated soil	APHA 3120B
Ca, Mg, Na, K and SO4 in a saturated soil extract are determined by ICP-OES.			
SAT-PCNT-SK	Soil	Saturated Paste	CSSS (1993) 18.2.2
SAT/PH/EC-SK	Soil	pH and EC (Saturated Paste)	CSSS 18.2.2/CSSC 3.14/CSSS 18.3.1
pH of a saturated soil paste is measured using a pH meter. After equilibration, an extract is obtained by vacuum filtration with conductivity of the extract measured by a conductivity meter.			
SO4-AVAIL-SK	Soil	Available Sulfate-S	REC METH SOIL ANAL - AB. AG(1988)
Plant available sulfate in the soil is extracted using a weak calcium chloride solution. Sulfate in the extract is determined by ICP-OES. This extraction may also produce organic sulfur in the extracts when organic soils are analyzed.			
SOLIDS-TOT/TOTVOL-SK	Manure	Total Solids and Total Volatile Solids	APHA 2540G
A well-mixed sample is evaporated in a weighed dish and dried to constant weight in an oven at 103-105°C. The increase in weight over that of the empty dish represents the Total Solids. The crucible is then ignited at 550°–10°C for 1 hour. The remaining solids represent the Total Fixed Solids, while the weight lost on ignition represents the Total Volatile Solids.			
SPECGRAV-CL	Soil	Specific Gravity	ASTM D 5057 - 90
A portion of sample is weighed in a container that is calibrated for volume. Specific Gravity is reported as the mass of sample per mass of an equal volume of pure water, where the density of pure water is taken to be 1.00 g/mL.			
TGR2-CALC-SK	Soil	Theoretical Gypsum Requirement	J. Ashworth et al (1999)
Theoretical Gypsum Requirement is an estimate of the gypsum amendment required to remediate brine-contaminated or sodic soils, and is provided in units of tonnes per hectare (t/ha) for a treatment depth of 15cm. TGR(brine), intended for brine-contaminated soils, is calculated using Method A from "A Comparison of Methods for Gypsum Requirement of Brine-Contaminated Soils", by J. Ashworth (Cdn J. of Soil Science, 1999), available at <a href="http://www.alsglobal.com">www.alsglobal.com</a> . TGR(sodic), intended for naturally sodic soils, uses the Oster and Frenkel method (Method B) from the same paper. Reported TGR values are capped at 50 t/ha, considered the maximum practical gypsum amendment. To convert TGR from t/ha to tons/acre, multiply by 0.446. To determine a TGR value for an alternate treatment depth, multiply by [desired treatment depth (cm) / 15 cm].			

\*\* ALS test methods may incorporate modifications from specified reference methods to improve performance.

*The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:*

Laboratory Definition Code	Laboratory Location
SK	ALS ENVIRONMENTAL - SASKATOON, SASKATCHEWAN, CANADA
WP	ALS ENVIRONMENTAL - WINNIPEG, MANITOBA, CANADA
CL	ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA

### Chain of Custody Numbers:

### GLOSSARY OF REPORT TERMS

*Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.*

*mg/kg - milligrams per kilogram based on dry weight of sample*

*mg/kg wwt - milligrams per kilogram based on wet weight of sample*

*mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight*

*mg/L - unit of concentration based on volume, parts per million.*

*< - Less than.*

*D.L. - The reporting limit.*

*N/A - Result not available. Refer to qualifier code and definition for explanation.*

*Test results reported relate only to the samples as received by the laboratory.*

*UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.*

*Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.*



## Quality Control Report

Workorder: L1950655

Report Date: 13-JUL-17

Page 1 of 9

Client: KGS Group Consultants (Winnipeg)  
865 Waverly Street - 3rd Floor  
Winnipeg MB R3T 5P4

Contact: GENE SENIOR

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
<b>C-TOT-LECO-SK</b>								
	Soil							
Batch	R3767606							
<b>WG2563700-2</b>	<b>IRM</b>	<b>08-109_SOIL</b>						
Total Carbon by Combustion			102.3		%		80-120	07-JUL-17
<b>WG2563700-3</b>	<b>MB</b>							
Total Carbon by Combustion			<0.05		%		0.05	07-JUL-17
<b>CL-PASTE-COL-SK</b>								
	Soil							
Batch	R3767621							
<b>WG2563708-3</b>	<b>IRM</b>	<b>SRS 1508</b>						
Chloride (Cl)			118.5		%		70-130	07-JUL-17
<b>WG2563708-2</b>	<b>MB</b>							
Chloride (Cl)			<5.0		mg/L		5	07-JUL-17
<b>HG-200.2-CVAF-WP</b>								
	Soil							
Batch	R3766329							
<b>WG2562561-3</b>	<b>CRM</b>	<b>PACS-3</b>						
Mercury (Hg)			96.3		%		70-130	05-JUL-17
<b>WG2562561-5</b>	<b>DUP</b>	<b>L1950655-1</b>						
Mercury (Hg)		0.0256	0.0239		mg/kg	6.8	40	05-JUL-17
<b>WG2562561-2</b>	<b>LCS</b>							
Mercury (Hg)			111.0		%		80-120	05-JUL-17
<b>WG2562561-1</b>	<b>MB</b>							
Mercury (Hg)			<0.0050		mg/kg		0.005	05-JUL-17
<b>K-AVAIL-SK</b>								
	Soil							
Batch	R3770437							
<b>WG2565988-1</b>	<b>DUP</b>	<b>L1950655-3</b>						
Available Potassium		216	233		mg/kg	7.6	30	12-JUL-17
<b>WG2565988-3</b>	<b>IRM</b>	<b>FARM2005</b>						
Available Potassium			96.1		%		70-130	12-JUL-17
<b>WG2565988-2</b>	<b>MB</b>							
Available Potassium			<20		mg/kg		20	12-JUL-17
<b>MET-200.2-MS-WP</b>								
	Soil							
Batch	R3764801							
<b>WG2562556-3</b>	<b>CRM</b>	<b>CANMET TILL-1</b>						
Aluminum (Al)			103.5		%		70-130	04-JUL-17
Antimony (Sb)			103.1		%		70-130	04-JUL-17
Arsenic (As)			87.1		%		70-130	04-JUL-17
Barium (Ba)			101.3		%		70-130	04-JUL-17
Beryllium (Be)			106.4		%		70-130	04-JUL-17
Bismuth (Bi)			105.5		%		70-130	04-JUL-17

## Quality Control Report

Workorder: L1950655

Report Date: 13-JUL-17

Page 2 of 9

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
<b>MET-200.2-MS-WP</b>	<b>Soil</b>							
<b>Batch</b>	<b>R3764801</b>							
<b>WG2562556-3</b>	<b>CRM</b>	<b>CANMET TILL-1</b>						
Boron (B)			106.8		%		70-130	04-JUL-17
Cadmium (Cd)			105.7		%		70-130	04-JUL-17
Calcium (Ca)			103.1		%		70-130	04-JUL-17
Chromium (Cr)			105.5		%		70-130	04-JUL-17
Cobalt (Co)			103.3		%		70-130	04-JUL-17
Copper (Cu)			103.0		%		70-130	04-JUL-17
Iron (Fe)			104.3		%		70-130	04-JUL-17
Lead (Pb)			108.8		%		70-130	04-JUL-17
Magnesium (Mg)			112.6		%		70-130	04-JUL-17
Manganese (Mn)			106.6		%		70-130	04-JUL-17
Molybdenum (Mo)			106.1		%		70-130	04-JUL-17
Nickel (Ni)			102.8		%		70-130	04-JUL-17
Phosphorus (P)			104.3		%		70-130	04-JUL-17
Potassium (K)			102.4		%		70-130	04-JUL-17
Selenium (Se)			87.1		%		70-130	04-JUL-17
Silver (Ag)			109.5		%		70-130	04-JUL-17
Sodium (Na)			104.2		%		70-130	04-JUL-17
Strontium (Sr)			104.2		%		70-130	04-JUL-17
Thallium (Tl)			0.13		mg/kg		0.03-0.23	04-JUL-17
Tin (Sn)			100.4		%		70-130	04-JUL-17
Titanium (Ti)			99.4		%		70-130	04-JUL-17
Uranium (U)			106.5		%		70-130	04-JUL-17
Vanadium (V)			103.5		%		70-130	04-JUL-17
Zinc (Zn)			102.3		%		70-130	04-JUL-17
<b>WG2562556-4</b>	<b>CRM</b>	<b>PACS-3</b>						
Aluminum (Al)			119.6		%		70-130	04-JUL-17
Antimony (Sb)			112.9		%		70-130	04-JUL-17
Arsenic (As)			90.8		%		70-130	04-JUL-17
Barium (Ba)			83.7		%		70-130	04-JUL-17
Beryllium (Be)			100.5		%		70-130	04-JUL-17
Boron (B)			115.7		%		70-130	04-JUL-17
Cadmium (Cd)			101.5		%		70-130	04-JUL-17
Calcium (Ca)			110.7		%		70-130	04-JUL-17
Chromium (Cr)			109.2		%		70-130	04-JUL-17



## Quality Control Report

Workorder: L1950655

Report Date: 13-JUL-17

Page 3 of 9

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
<b>MET-200.2-MS-WP</b>								
	<b>Soil</b>							
<b>Batch</b>	<b>R3764801</b>							
<b>WG2562556-4</b>	<b>CRM</b>	<b>PACS-3</b>						
Cobalt (Co)			107.7		%		70-130	04-JUL-17
Copper (Cu)			106.4		%		70-130	04-JUL-17
Iron (Fe)			106.1		%		70-130	04-JUL-17
Lead (Pb)			105.1		%		70-130	04-JUL-17
Magnesium (Mg)			111.8		%		70-130	04-JUL-17
Manganese (Mn)			106.1		%		70-130	04-JUL-17
Molybdenum (Mo)			105.3		%		70-130	04-JUL-17
Nickel (Ni)			107.5		%		70-130	04-JUL-17
Phosphorus (P)			110.2		%		70-130	04-JUL-17
Potassium (K)			110.8		%		70-130	04-JUL-17
Selenium (Se)			0.93		mg/kg		0.51-1.51	04-JUL-17
Silver (Ag)			105.3		%		70-130	04-JUL-17
Sodium (Na)			109.7		%		70-130	04-JUL-17
Strontium (Sr)			95.7		%		70-130	04-JUL-17
Thallium (Tl)			0.32		mg/kg		0.23-0.43	04-JUL-17
Tin (Sn)			98.7		%		70-130	04-JUL-17
Titanium (Ti)			109.2		%		70-130	04-JUL-17
Uranium (U)			109.1		%		70-130	04-JUL-17
Vanadium (V)			113.7		%		70-130	04-JUL-17
Zinc (Zn)			102.6		%		70-130	04-JUL-17
<b>WG2562556-2</b>	<b>LCS</b>							
Aluminum (Al)			104.3		%		80-120	04-JUL-17
Antimony (Sb)			105.6		%		80-120	04-JUL-17
Arsenic (As)			91.3		%		80-120	04-JUL-17
Barium (Ba)			101.3		%		80-120	04-JUL-17
Beryllium (Be)			103.3		%		80-120	04-JUL-17
Bismuth (Bi)			104.0		%		80-120	04-JUL-17
Boron (B)			102.4		%		80-120	04-JUL-17
Cadmium (Cd)			100.9		%		80-120	04-JUL-17
Calcium (Ca)			100.9		%		80-120	04-JUL-17
Chromium (Cr)			102.2		%		80-120	04-JUL-17
Cobalt (Co)			99.98		%		80-120	04-JUL-17
Copper (Cu)			98.2		%		80-120	04-JUL-17
Iron (Fe)			98.6		%		80-120	04-JUL-17



## Quality Control Report

Workorder: L1950655

Report Date: 13-JUL-17

Page 4 of 9

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
<b>MET-200.2-MS-WP</b>		<b>Soil</b>						
<b>Batch</b>	<b>R3764801</b>							
<b>WG2562556-2</b>	<b>LCS</b>							
Lead (Pb)			104.4		%		80-120	04-JUL-17
Magnesium (Mg)			106.9		%		80-120	04-JUL-17
Manganese (Mn)			103.2		%		80-120	04-JUL-17
Molybdenum (Mo)			102.4		%		80-120	04-JUL-17
Nickel (Ni)			99.0		%		80-120	04-JUL-17
Phosphorus (P)			106.8		%		80-120	04-JUL-17
Potassium (K)			102.3		%		80-120	04-JUL-17
Selenium (Se)			97.8		%		80-120	04-JUL-17
Silver (Ag)			106.0		%		80-120	04-JUL-17
Sodium (Na)			103.6		%		80-120	04-JUL-17
Strontium (Sr)			99.4		%		80-120	04-JUL-17
Thallium (Tl)			102.8		%		80-120	04-JUL-17
Tin (Sn)			101.6		%		80-120	04-JUL-17
Titanium (Ti)			98.5		%		80-120	04-JUL-17
Uranium (U)			107.0		%		80-120	04-JUL-17
Vanadium (V)			103.7		%		80-120	04-JUL-17
Zinc (Zn)			95.2		%		80-120	04-JUL-17
<b>WG2562556-1</b>	<b>MB</b>							
Aluminum (Al)			<5.0		mg/kg		5	04-JUL-17
Antimony (Sb)			<0.10		mg/kg		0.1	04-JUL-17
Arsenic (As)			<0.10		mg/kg		0.1	04-JUL-17
Barium (Ba)			<0.50		mg/kg		0.5	04-JUL-17
Beryllium (Be)			<0.10		mg/kg		0.1	04-JUL-17
Bismuth (Bi)			<0.020		mg/kg		0.02	04-JUL-17
Boron (B)			<10		mg/kg		10	04-JUL-17
Cadmium (Cd)			<0.020		mg/kg		0.02	04-JUL-17
Calcium (Ca)			<100		mg/kg		100	04-JUL-17
Chromium (Cr)			<1.0		mg/kg		1	04-JUL-17
Cobalt (Co)			<0.020		mg/kg		0.02	04-JUL-17
Copper (Cu)			<1.0		mg/kg		1	04-JUL-17
Iron (Fe)			<25		mg/kg		25	04-JUL-17
Lead (Pb)			<0.20		mg/kg		0.2	04-JUL-17
Magnesium (Mg)			<10		mg/kg		10	04-JUL-17
Manganese (Mn)			<0.50		mg/kg		0.5	04-JUL-17

## Quality Control Report

Workorder: L1950655

Report Date: 13-JUL-17

Page 5 of 9

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
<b>MET-200.2-MS-WP</b>								
	<b>Soil</b>							
<b>Batch</b>	<b>R3764801</b>							
<b>WG2562556-1</b>	<b>MB</b>							
Molybdenum (Mo)			<0.10		mg/kg		0.1	04-JUL-17
Nickel (Ni)			<0.50		mg/kg		0.5	04-JUL-17
Phosphorus (P)			<100		mg/kg		100	04-JUL-17
Potassium (K)			<25		mg/kg		25	04-JUL-17
Selenium (Se)			<0.50		mg/kg		0.5	04-JUL-17
Silver (Ag)			<0.10		mg/kg		0.1	04-JUL-17
Sodium (Na)			<10		mg/kg		10	04-JUL-17
Strontium (Sr)			<0.10		mg/kg		0.1	04-JUL-17
Thallium (Tl)			<0.10		mg/kg		0.1	04-JUL-17
Tin (Sn)			<5.0		mg/kg		5	04-JUL-17
Titanium (Ti)			<0.50		mg/kg		0.5	04-JUL-17
Uranium (U)			<0.020		mg/kg		0.02	04-JUL-17
Vanadium (V)			<0.50		mg/kg		0.5	04-JUL-17
Zinc (Zn)			<10		mg/kg		10	04-JUL-17
<b>MOIST-SK</b>								
	<b>Soil</b>							
<b>Batch</b>	<b>R3767954</b>							
<b>WG2564760-1</b>	<b>DUP</b>	<b>L1950655-2</b>						
% Moisture		24.1	25.0		%	3.6	20	08-JUL-17
<b>WG2564760-3</b>	<b>LCS</b>							
% Moisture			102.3		%		90-110	08-JUL-17
<b>WG2564760-2</b>	<b>MB</b>							
% Moisture			<0.10		%		0.1	08-JUL-17
<b>N-TOTKJ-COL-SK</b>								
	<b>Soil</b>							
<b>Batch</b>	<b>R3769643</b>							
<b>WG2560149-2</b>	<b>IRM</b>	<b>08-109_SOIL</b>						
Total Kjeldahl Nitrogen			106.3		%		80-120	10-JUL-17
<b>WG2560149-3</b>	<b>MB</b>							
Total Kjeldahl Nitrogen			<0.020		%		0.02	10-JUL-17
<b>N2/N3-AVAIL-KCL-SK</b>								
	<b>Soil</b>							
<b>Batch</b>	<b>R3768837</b>							
<b>WG2564740-3</b>	<b>IRM</b>	<b>SAL814</b>						
Nitrate+Nitrite-N			104.6		%		70-130	10-JUL-17
<b>WG2564740-2</b>	<b>MB</b>							
Nitrite-N			<1.0		mg/kg		1	10-JUL-17
Nitrate+Nitrite-N			<2.0		mg/kg		2	10-JUL-17



## Quality Control Report

Workorder: L1950655

Report Date: 13-JUL-17

Page 6 of 9

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
<b>NH4-AVAIL-SK</b>								
Batch	R3766789							
<b>WG2563673-3</b>	<b>IRM</b>	<b>SAL814</b>						
Available Ammonium-N			88.2		%		70-130	06-JUL-17
<b>WG2563673-2</b>	<b>MB</b>							
Available Ammonium-N			<1.0		mg/kg		1	06-JUL-17
<b>OM-LOI-SK</b>								
Batch	R3768694							
<b>WG2564714-3</b>	<b>IRM</b>	<b>SAL2001</b>						
Organic Matter			82.0		%		80-120	08-JUL-17
Loss on Ignition @ 375 C			80.5		%		80-120	08-JUL-17
<b>WG2564714-2</b>	<b>MB</b>							
Organic Matter			<1.0		%		1	08-JUL-17
Loss on Ignition @ 375 C			<1.0		%		1	08-JUL-17
<b>PH,EC-1:2-SK</b>								
Batch	R3768774							
<b>WG2565989-1</b>	<b>DUP</b>	<b>L1950655-3</b>						
Conductivity (1:2)		1.93	1.85		dS m-1	4.4	20	10-JUL-17
pH (1:2 soil:water)		7.95	7.99	J	pH	0.04	0.3	10-JUL-17
<b>WG2565989-3</b>	<b>IRM</b>	<b>SAL814</b>						
Conductivity (1:2)			1.37		dS m-1		0.92-1.38	10-JUL-17
pH (1:2 soil:water)			7.94		pH		7.65-8.25	10-JUL-17
<b>WG2565989-2</b>	<b>MB</b>							
Conductivity (1:2)			<0.050		dS m-1		0.05	10-JUL-17
<b>PO4-AVAIL-OLSEN-SK</b>								
Batch	R3768861							
<b>WG2565984-1</b>	<b>DUP</b>	<b>L1950655-2</b>						
Available Phosphate-P		12.6	12.9		mg/kg	2.0	30	10-JUL-17
<b>WG2565984-3</b>	<b>IRM</b>	<b>FARM2005</b>						
Available Phosphate-P			97.7		%		80-120	10-JUL-17
<b>WG2565984-2</b>	<b>MB</b>							
Available Phosphate-P			<1.0		mg/kg		1	10-JUL-17
<b>SAR-CALC-SO4-SK</b>								
Batch	R3767742							
<b>WG2563708-3</b>	<b>IRM</b>	<b>SRS 1508</b>						
Calcium (Ca)			111.8		%		70-130	07-JUL-17
Potassium (K)			100.4		%		70-130	07-JUL-17
Magnesium (Mg)			109.3		%		70-130	07-JUL-17
Sodium (Na)			109.9		%		70-130	07-JUL-17



## Quality Control Report

Workorder: L1950655

Report Date: 13-JUL-17

Page 7 of 9

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
<b>SAR-CALC-SO4-SK</b>								
Batch	R3767742							
<b>WG2563708-3</b>	<b>IRM</b>	<b>SRS 1508</b>						
Sulfur (as SO4)			117.3		%		70-130	07-JUL-17
<b>WG2563708-2</b>	<b>MB</b>							
Calcium (Ca)			<5.0		mg/L		5	07-JUL-17
Potassium (K)			<5.0		mg/L		5	07-JUL-17
Magnesium (Mg)			<5.0		mg/L		5	07-JUL-17
Sodium (Na)			<5.0		mg/L		5	07-JUL-17
Sulfur (as SO4)			<5.0		mg/L		5	07-JUL-17
<b>SAT-PCNT-SK</b>								
Batch	R3767462							
<b>WG2563708-3</b>	<b>IRM</b>	<b>SRS 1508</b>						
% Saturation			95.1		%		80-120	07-JUL-17
<b>SAT/PH/EC-SK</b>								
Batch	R3767462							
<b>WG2563708-3</b>	<b>IRM</b>	<b>SRS 1508</b>						
% Saturation			95.1		%		80-120	07-JUL-17
pH in Saturated Paste			7.92		pH		7.43-8.03	07-JUL-17
Conductivity Sat. Paste			112.3		%		80-120	07-JUL-17
<b>WG2563708-2</b>	<b>MB</b>							
Conductivity Sat. Paste			<0.10		dS m-1		0.1	07-JUL-17
<b>SO4-AVAIL-SK</b>								
Batch	R3767556							
<b>WG2564738-3</b>	<b>IRM</b>	<b>SAL814</b>						
Available Sulfate-S			93.3		%		70-130	07-JUL-17
<b>WG2564738-2</b>	<b>MB</b>							
Available Sulfate-S			<4.0		mg/kg		4	07-JUL-17
<b>SPECGRAV-CL</b>								
Batch	R3769521							
<b>WG2567751-2</b>	<b>DUP</b>	<b>L1950655-3</b>						
Specific Gravity		1.62	1.62		kg/L	0.0	20	11-JUL-17
<b>WG2567751-1</b>	<b>IRM</b>	<b>DI_H2O</b>						
Specific Gravity			96.0		%		90-110	11-JUL-17
Specific Gravity			96.0		%		90-110	11-JUL-17
<b>SOLIDS-TOT/TOTVOL-SK</b>		<b>Manure</b>						



## Quality Control Report

Workorder: L1950655

Report Date: 13-JUL-17

Page 8 of 9

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
<b>SOLIDS-TOT/TOTVOL-SK Manure</b>								
Batch	R3767521							
WG2564122-1	DUP	L1950655-2						
Total Solids		74.3	75.7		%	1.9	25	07-JUL-17
Total Volatile Solids (dry basis)		3.52	3.51		%	0.1	25	07-JUL-17

# Quality Control Report

Workorder: L1950655

Report Date: 13-JUL-17

Page 9 of 9

## Legend:

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Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

## Sample Parameter Qualifier Definitions:

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Qualifier	Description
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
DLHC	Detection Limit Raised: Dilution required due to high concentration of test analyte(s).
J	Duplicate results and limits are expressed in terms of absolute difference.

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## Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

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The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.





**ATTACHMENT 2**



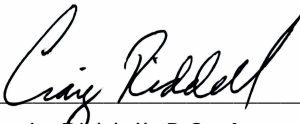
Tone Ag Consulting (St. Pierre-Jolys)  
ATTN: Shannon Wiebe  
31022 Rat River Rd  
St. Pierre-Jolys Manitoba ROA 1V0

Date Received: 29-SEP-16  
Report Date: 11-OCT-16 09:38 (MT)  
Version: FINAL REV. 2

Client Phone: 204-433-7189

## Certificate of Analysis

Lab Work Order #: L1836271  
Project P.O. #: NOT SUBMITTED  
Job Reference: PT 1/2-36-3-27W  
C of C Numbers:  
Legal Site Desc:

  
\_\_\_\_\_  
Craig Riddell, B.Sc.Ag  
Account Manager

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ALS CANADA LTD Part of the ALS Group A Campbell Brothers Limited Company

## ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1836271-1 1437293 - FIELD #1 Sampled By: CLIENT on 27-SEP-16 Matrix: SOIL							
<b>Miscellaneous Parameters</b>							
Mercury (Hg)	0.0214		0.0050	mg/kg	03-OCT-16	04-OCT-16	R3563579
<b>Metals in Soil by CRC ICPMS</b>							
Aluminum (Al)	12100		50	mg/kg	03-OCT-16	03-OCT-16	R3562810
Antimony (Sb)	0.20		0.10	mg/kg	03-OCT-16	03-OCT-16	R3562810
Arsenic (As)	4.10		0.10	mg/kg	03-OCT-16	03-OCT-16	R3562810
Barium (Ba)	147		0.50	mg/kg	03-OCT-16	03-OCT-16	R3562810
Beryllium (Be)	0.48		0.10	mg/kg	03-OCT-16	03-OCT-16	R3562810
Boron (B)	12.3		5.0	mg/kg	03-OCT-16	03-OCT-16	R3562810
Bismuth (Bi)	<0.20		0.20	mg/kg	03-OCT-16	03-OCT-16	R3562810
Cadmium (Cd)	0.275		0.020	mg/kg	03-OCT-16	03-OCT-16	R3562810
Calcium (Ca)	26600		50	mg/kg	03-OCT-16	03-OCT-16	R3562810
Chromium (Cr)	21.5		0.50	mg/kg	03-OCT-16	03-OCT-16	R3562810
Cobalt (Co)	5.86		0.10	mg/kg	03-OCT-16	03-OCT-16	R3562810
Copper (Cu)	11.5		0.50	mg/kg	03-OCT-16	03-OCT-16	R3562810
Iron (Fe)	15500		50	mg/kg	03-OCT-16	03-OCT-16	R3562810
Lead (Pb)	6.14		0.50	mg/kg	03-OCT-16	03-OCT-16	R3562810
Lithium (Li)	9.9		2.0	mg/kg	03-OCT-16	03-OCT-16	R3562810
Magnesium (Mg)	9980		20	mg/kg	03-OCT-16	03-OCT-16	R3562810
Manganese (Mn)	578		1.0	mg/kg	03-OCT-16	03-OCT-16	R3562810
Molybdenum (Mo)	0.19		0.10	mg/kg	03-OCT-16	03-OCT-16	R3562810
Nickel (Ni)	17.2		0.50	mg/kg	03-OCT-16	03-OCT-16	R3562810
Phosphorus (P)	412		50	mg/kg	03-OCT-16	03-OCT-16	R3562810
Potassium (K)	1940		100	mg/kg	03-OCT-16	03-OCT-16	R3562810
Selenium (Se)	<0.20		0.20	mg/kg	03-OCT-16	03-OCT-16	R3562810
Silver (Ag)	<0.10		0.10	mg/kg	03-OCT-16	03-OCT-16	R3562810
Sodium (Na)	192		50	mg/kg	03-OCT-16	03-OCT-16	R3562810
Strontium (Sr)	50.2		0.50	mg/kg	03-OCT-16	03-OCT-16	R3562810
Thallium (Tl)	0.204		0.050	mg/kg	03-OCT-16	03-OCT-16	R3562810
Tin (Sn)	<1.0		1.0	mg/kg	03-OCT-16	03-OCT-16	R3562810
Titanium (Ti)	137		1.0	mg/kg	03-OCT-16	03-OCT-16	R3562810
Uranium (U)	0.784		0.050	mg/kg	03-OCT-16	03-OCT-16	R3562810
Vanadium (V)	40.3		0.20	mg/kg	03-OCT-16	03-OCT-16	R3562810
Zinc (Zn)	48.5		2.0	mg/kg	03-OCT-16	03-OCT-16	R3562810
Zirconium (Zr)	3.0		1.0	mg/kg	03-OCT-16	03-OCT-16	R3562810
<b>Available N,P,K &amp; S plus pH, EC(AG) &amp; B</b>							
<b>Available Boron, Hot Water</b>							
Boron (B), Hot Water Ext.	1.20		0.20	mg/kg	03-OCT-16	03-OCT-16	R3563273
<b>Available Nitrate-N</b>							
Available Nitrate-N	2.7		1.0	mg/kg	04-OCT-16	04-OCT-16	R3563810
<b>Available Phosphate-P by Olsen</b>							
Available Phosphate-P	20.3		1.0	mg/kg	04-OCT-16	04-OCT-16	R3564786
<b>Available Potassium</b>							
Available Potassium	268		20	mg/kg	04-OCT-16	04-OCT-16	R3564737
<b>Available Sulfate-S</b>							
Available Sulfate-S	22.7		4.0	mg/kg	04-OCT-16	04-OCT-16	R3564368
<b>pH &amp; EC 1:2 soil to water (Ag. Method)</b>							
pH (1:2 soil:water)	7.68		0.10	pH	03-OCT-16	03-OCT-16	R3562690
Conductivity (1:2)	0.353		0.050	dS m-1	03-OCT-16	03-OCT-16	R3562690
L1836271-2 1437294 - FIELD #2 Sampled By: CLIENT on 27-SEP-16 Matrix: SOIL							

\* Refer to Referenced Information for Qualifiers (if any) and Methodology.

## ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1836271-2 1437294 - FIELD #2 Sampled By: CLIENT on 27-SEP-16 Matrix: SOIL							
<b>Miscellaneous Parameters</b>							
Mercury (Hg)	0.0357		0.0050	mg/kg	03-OCT-16	04-OCT-16	R3563579
<b>Metals in Soil by CRC ICPMS</b>							
Aluminum (Al)	17600		50	mg/kg	03-OCT-16	03-OCT-16	R3562810
Antimony (Sb)	0.26		0.10	mg/kg	03-OCT-16	03-OCT-16	R3562810
Arsenic (As)	6.70		0.10	mg/kg	03-OCT-16	03-OCT-16	R3562810
Barium (Ba)	216		0.50	mg/kg	03-OCT-16	03-OCT-16	R3562810
Beryllium (Be)	0.74		0.10	mg/kg	03-OCT-16	03-OCT-16	R3562810
Boron (B)	14.1		5.0	mg/kg	03-OCT-16	03-OCT-16	R3562810
Bismuth (Bi)	<0.20		0.20	mg/kg	03-OCT-16	03-OCT-16	R3562810
Cadmium (Cd)	0.411		0.020	mg/kg	03-OCT-16	03-OCT-16	R3562810
Calcium (Ca)	16000		50	mg/kg	03-OCT-16	03-OCT-16	R3562810
Chromium (Cr)	32.1		0.50	mg/kg	03-OCT-16	03-OCT-16	R3562810
Cobalt (Co)	9.93		0.10	mg/kg	03-OCT-16	03-OCT-16	R3562810
Copper (Cu)	20.2		0.50	mg/kg	03-OCT-16	03-OCT-16	R3562810
Iron (Fe)	24600		50	mg/kg	03-OCT-16	03-OCT-16	R3562810
Lead (Pb)	9.71		0.50	mg/kg	03-OCT-16	03-OCT-16	R3562810
Lithium (Li)	13.8		2.0	mg/kg	03-OCT-16	03-OCT-16	R3562810
Magnesium (Mg)	11200		20	mg/kg	03-OCT-16	03-OCT-16	R3562810
Manganese (Mn)	807		1.0	mg/kg	03-OCT-16	03-OCT-16	R3562810
Molybdenum (Mo)	0.28		0.10	mg/kg	03-OCT-16	03-OCT-16	R3562810
Nickel (Ni)	27.5		0.50	mg/kg	03-OCT-16	03-OCT-16	R3562810
Phosphorus (P)	609		50	mg/kg	03-OCT-16	03-OCT-16	R3562810
Potassium (K)	2860		100	mg/kg	03-OCT-16	03-OCT-16	R3562810
Selenium (Se)	0.24		0.20	mg/kg	03-OCT-16	03-OCT-16	R3562810
Silver (Ag)	<0.10		0.10	mg/kg	03-OCT-16	03-OCT-16	R3562810
Sodium (Na)	269		50	mg/kg	03-OCT-16	03-OCT-16	R3562810
Strontium (Sr)	35.7		0.50	mg/kg	03-OCT-16	03-OCT-16	R3562810
Thallium (Tl)	0.295		0.050	mg/kg	03-OCT-16	03-OCT-16	R3562810
Tin (Sn)	<1.0		1.0	mg/kg	03-OCT-16	03-OCT-16	R3562810
Titanium (Ti)	91.3		1.0	mg/kg	03-OCT-16	03-OCT-16	R3562810
Uranium (U)	0.906		0.050	mg/kg	03-OCT-16	03-OCT-16	R3562810
Vanadium (V)	58.9		0.20	mg/kg	03-OCT-16	03-OCT-16	R3562810
Zinc (Zn)	82.0		2.0	mg/kg	03-OCT-16	03-OCT-16	R3562810
Zirconium (Zr)	4.6		1.0	mg/kg	03-OCT-16	03-OCT-16	R3562810
<b>Available N,P,K &amp; S plus pH, EC(AG) &amp; B</b>							
<b>Available Boron, Hot Water</b>							
Boron (B), Hot Water Ext.	1.31		0.20	mg/kg	03-OCT-16	03-OCT-16	R3563273
<b>Available Nitrate-N</b>							
Available Nitrate-N	2.7		1.0	mg/kg	04-OCT-16	04-OCT-16	R3563810
<b>Available Phosphate-P by Olsen</b>							
Available Phosphate-P	7.3		1.0	mg/kg	04-OCT-16	04-OCT-16	R3564786
<b>Available Potassium</b>							
Available Potassium	328		20	mg/kg	04-OCT-16	04-OCT-16	R3564737
<b>Available Sulfate-S</b>							
Available Sulfate-S	23.9		4.0	mg/kg	04-OCT-16	04-OCT-16	R3564368
<b>pH &amp; EC 1:2 soil to water (Ag. Method)</b>							
pH (1:2 soil:water)	8.04		0.10	pH	03-OCT-16	03-OCT-16	R3562690
Conductivity (1:2)	0.323		0.050	dS m-1	03-OCT-16	03-OCT-16	R3562690
L1836271-3 1437295 - FIELD #3 Sampled By: CLIENT on 27-SEP-16 Matrix: SOIL							

\* Refer to Referenced Information for Qualifiers (if any) and Methodology.

## ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1836271-3 1437295 - FIELD #3 Sampled By: CLIENT on 27-SEP-16 Matrix: SOIL							
<b>Miscellaneous Parameters</b>							
Mercury (Hg)	0.0312		0.0050	mg/kg	03-OCT-16	04-OCT-16	R3563579
<b>Metals in Soil by CRC ICPMS</b>							
Aluminum (Al)	9990		50	mg/kg	03-OCT-16	03-OCT-16	R3562810
Antimony (Sb)	0.31		0.10	mg/kg	03-OCT-16	03-OCT-16	R3562810
Arsenic (As)	6.19		0.10	mg/kg	03-OCT-16	03-OCT-16	R3562810
Barium (Ba)	114		0.50	mg/kg	03-OCT-16	03-OCT-16	R3562810
Beryllium (Be)	0.44		0.10	mg/kg	03-OCT-16	03-OCT-16	R3562810
Boron (B)	11.0		5.0	mg/kg	03-OCT-16	03-OCT-16	R3562810
Bismuth (Bi)	<0.20		0.20	mg/kg	03-OCT-16	03-OCT-16	R3562810
Cadmium (Cd)	0.289		0.020	mg/kg	03-OCT-16	03-OCT-16	R3562810
Calcium (Ca)	40900		50	mg/kg	03-OCT-16	03-OCT-16	R3562810
Chromium (Cr)	24.0		0.50	mg/kg	03-OCT-16	03-OCT-16	R3562810
Cobalt (Co)	5.97		0.10	mg/kg	03-OCT-16	03-OCT-16	R3562810
Copper (Cu)	11.1		0.50	mg/kg	03-OCT-16	03-OCT-16	R3562810
Iron (Fe)	13800		50	mg/kg	03-OCT-16	03-OCT-16	R3562810
Lead (Pb)	5.70		0.50	mg/kg	03-OCT-16	03-OCT-16	R3562810
Lithium (Li)	9.8		2.0	mg/kg	03-OCT-16	03-OCT-16	R3562810
Magnesium (Mg)	11400		20	mg/kg	03-OCT-16	03-OCT-16	R3562810
Manganese (Mn)	633		1.0	mg/kg	03-OCT-16	03-OCT-16	R3562810
Molybdenum (Mo)	0.65		0.10	mg/kg	03-OCT-16	03-OCT-16	R3562810
Nickel (Ni)	20.6		0.50	mg/kg	03-OCT-16	03-OCT-16	R3562810
Phosphorus (P)	397		50	mg/kg	03-OCT-16	03-OCT-16	R3562810
Potassium (K)	1790		100	mg/kg	03-OCT-16	03-OCT-16	R3562810
Selenium (Se)	0.21		0.20	mg/kg	03-OCT-16	03-OCT-16	R3562810
Silver (Ag)	<0.10		0.10	mg/kg	03-OCT-16	03-OCT-16	R3562810
Sodium (Na)	201		50	mg/kg	03-OCT-16	03-OCT-16	R3562810
Strontium (Sr)	44.7		0.50	mg/kg	03-OCT-16	03-OCT-16	R3562810
Thallium (Tl)	0.232		0.050	mg/kg	03-OCT-16	03-OCT-16	R3562810
Tin (Sn)	<1.0		1.0	mg/kg	03-OCT-16	03-OCT-16	R3562810
Titanium (Ti)	168		1.0	mg/kg	03-OCT-16	03-OCT-16	R3562810
Uranium (U)	0.882		0.050	mg/kg	03-OCT-16	03-OCT-16	R3562810
Vanadium (V)	40.9		0.20	mg/kg	03-OCT-16	03-OCT-16	R3562810
Zinc (Zn)	41.0		2.0	mg/kg	03-OCT-16	03-OCT-16	R3562810
Zirconium (Zr)	2.8		1.0	mg/kg	03-OCT-16	03-OCT-16	R3562810
<b>Available N,P,K &amp; S plus pH, EC(AG) &amp; B</b>							
<b>Available Boron, Hot Water</b>							
Boron (B), Hot Water Ext.	1.24		0.20	mg/kg	03-OCT-16	03-OCT-16	R3563273
<b>Available Nitrate-N</b>							
Available Nitrate-N	2.7		1.0	mg/kg	04-OCT-16	04-OCT-16	R3563810
<b>Available Phosphate-P by Olsen</b>							
Available Phosphate-P	5.1		1.0	mg/kg	04-OCT-16	04-OCT-16	R3564786
<b>Available Potassium</b>							
Available Potassium	293		20	mg/kg	04-OCT-16	04-OCT-16	R3564737
<b>Available Sulfate-S</b>							
Available Sulfate-S	57.9		4.0	mg/kg	04-OCT-16	04-OCT-16	R3564368
<b>pH &amp; EC 1:2 soil to water (Ag. Method)</b>							
pH (1:2 soil:water)	7.88		0.10	pH	03-OCT-16	03-OCT-16	R3562690
Conductivity (1:2)	0.290		0.050	dS m-1	03-OCT-16	03-OCT-16	R3562690
L1836271-4 1437296 - FIELD #4 Sampled By: CLIENT on 27-SEP-16 Matrix: SOIL							

\* Refer to Referenced Information for Qualifiers (if any) and Methodology.



## ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1836271-4 1437296 - FIELD #4							
Sampled By: CLIENT on 27-SEP-16							
Matrix: SOIL							
<b>Miscellaneous Parameters</b>							
Mercury (Hg)	0.0196		0.0050	mg/kg	03-OCT-16	04-OCT-16	R3563579
<b>Metals in Soil by CRC ICPMS</b>							
Aluminum (Al)	7640		50	mg/kg	03-OCT-16	03-OCT-16	R3562810
Antimony (Sb)	0.17		0.10	mg/kg	03-OCT-16	03-OCT-16	R3562810
Arsenic (As)	3.91		0.10	mg/kg	03-OCT-16	03-OCT-16	R3562810
Barium (Ba)	89.0		0.50	mg/kg	03-OCT-16	03-OCT-16	R3562810
Beryllium (Be)	0.33		0.10	mg/kg	03-OCT-16	03-OCT-16	R3562810
Boron (B)	7.6		5.0	mg/kg	03-OCT-16	03-OCT-16	R3562810
Bismuth (Bi)	<0.20		0.20	mg/kg	03-OCT-16	03-OCT-16	R3562810
Cadmium (Cd)	0.224		0.020	mg/kg	03-OCT-16	03-OCT-16	R3562810
Calcium (Ca)	25000		50	mg/kg	03-OCT-16	03-OCT-16	R3562810
Chromium (Cr)	17.1		0.50	mg/kg	03-OCT-16	03-OCT-16	R3562810
Cobalt (Co)	5.29		0.10	mg/kg	03-OCT-16	03-OCT-16	R3562810
Copper (Cu)	7.82		0.50	mg/kg	03-OCT-16	03-OCT-16	R3562810
Iron (Fe)	11400		50	mg/kg	03-OCT-16	03-OCT-16	R3562810
Lead (Pb)	4.69		0.50	mg/kg	03-OCT-16	03-OCT-16	R3562810
Lithium (Li)	6.3		2.0	mg/kg	03-OCT-16	03-OCT-16	R3562810
Magnesium (Mg)	7010		20	mg/kg	03-OCT-16	03-OCT-16	R3562810
Manganese (Mn)	405		1.0	mg/kg	03-OCT-16	03-OCT-16	R3562810
Molybdenum (Mo)	0.30		0.10	mg/kg	03-OCT-16	03-OCT-16	R3562810
Nickel (Ni)	15.3		0.50	mg/kg	03-OCT-16	03-OCT-16	R3562810
Phosphorus (P)	341		50	mg/kg	03-OCT-16	03-OCT-16	R3562810
Potassium (K)	1600		100	mg/kg	03-OCT-16	03-OCT-16	R3562810
Selenium (Se)	<0.20		0.20	mg/kg	03-OCT-16	03-OCT-16	R3562810
Silver (Ag)	<0.10		0.10	mg/kg	03-OCT-16	03-OCT-16	R3562810
Sodium (Na)	104		50	mg/kg	03-OCT-16	03-OCT-16	R3562810
Strontium (Sr)	26.9		0.50	mg/kg	03-OCT-16	03-OCT-16	R3562810
Thallium (Tl)	0.151		0.050	mg/kg	03-OCT-16	03-OCT-16	R3562810
Tin (Sn)	<1.0		1.0	mg/kg	03-OCT-16	03-OCT-16	R3562810
Titanium (Ti)	148		1.0	mg/kg	03-OCT-16	03-OCT-16	R3562810
Uranium (U)	0.542		0.050	mg/kg	03-OCT-16	03-OCT-16	R3562810
Vanadium (V)	28.6		0.20	mg/kg	03-OCT-16	03-OCT-16	R3562810
Zinc (Zn)	36.6		2.0	mg/kg	03-OCT-16	03-OCT-16	R3562810
Zirconium (Zr)	1.9		1.0	mg/kg	03-OCT-16	03-OCT-16	R3562810
<b>Available N,P,K &amp; S plus pH, EC(AG) &amp; B</b>							
<b>Available Boron, Hot Water</b>							
Boron (B), Hot Water Ext.	1.07		0.20	mg/kg	03-OCT-16	03-OCT-16	R3563273
<b>Available Nitrate-N</b>							
Available Nitrate-N	2.9		1.0	mg/kg	04-OCT-16	04-OCT-16	R3563810
<b>Available Phosphate-P by Olsen</b>							
Available Phosphate-P	10.2		1.0	mg/kg	04-OCT-16	04-OCT-16	R3564786
<b>Available Potassium</b>							
Available Potassium	315		20	mg/kg	04-OCT-16	04-OCT-16	R3564737
<b>Available Sulfate-S</b>							
Available Sulfate-S	49.8		4.0	mg/kg	04-OCT-16	04-OCT-16	R3564368
<b>pH &amp; EC 1:2 soil to water (Ag. Method)</b>							
pH (1:2 soil:water)	7.80		0.10	pH	03-OCT-16	03-OCT-16	R3562690
Conductivity (1:2)	0.300		0.050	dS m-1	03-OCT-16	03-OCT-16	R3562690

\* Refer to Referenced Information for Qualifiers (if any) and Methodology.

## Reference Information

### Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
B-HOTW-SK	Soil	Available Boron, Hot Water	CSSS (2008) Ch.9
Hot water is used to extract the plant-available and potentially plant-available boron from soil. Boron in the extract is determined by ICP-OES.			
HG-200.2-CVAF-SK	Soil	Mercury in Soil by CVAFS	EPA 200.2/1631E (mod)
Soil samples are digested with nitric and hydrochloric acids, followed by analysis by CVAFS.			
K-AVAIL-SK	Soil	Available Potassium	Comm. Soil Sci. Plant, 25 (5&6)
Plant available potassium is extracted from the soil using Modified Kelowna solution. Potassium in the soil extract is determined by flame emission at 770 nm.			
MET-200.2-CCMS-SK	Soil	Metals in Soil by CRC ICPMS	EPA 200.2/6020A (mod)
Soil samples are digested with nitric and hydrochloric acids, followed by analysis by CRC ICPMS.			
Method Limitation: This method is not a total digestion technique. It is a very strong acid digestion that is intended to dissolve those metals that may be environmentally available. This method does not dissolve all silicate materials and may result in a partial extraction. depending on the sample matrix, for some metals, including, but not limited to Al, Ba, Be, Cr, Sr, Ti, Tl, and V.			
NO3-AVAIL-SK	Soil	Available Nitrate-N	Method = Alberta Ag (1988)
Available Nitrate and Nitrite are extracted from the soil using a dilute calcium chloride solution. Nitrate is quantitatively reduced to nitrite by passage of the sample through a copperized cadmium column. The nitrite (reduced nitrate plus original nitrite) is then determined by diazotizing with sulfanilamide followed by coupling with N-(1-naphthyl) ethylenediamine dihydrochloride. The resulting water soluble dye has a magenta color which is measured at colorimetrically at 520nm.			
Reference: Recommended Methods of Soil Analysis for Canadian Prairie Agricultural Soils. Alberta Agriculture (1988) p. 19 and 28			
PH,EC-AG-SK	Soil	pH & EC 1:2 soil to water (Ag. Method)	CSSS 16.3,18.3.1 - 1:2 water extract
PO4-AVAIL-OLSEN-SK	Soil	Available Phosphate-P by Olsen	CSSS (1993) 7.2,7.3.1
Plant available phosphorus is extracted from the sample with sodium bicarbonate. PO4-P in the filtered extract is determined colorimetrically at 880 nm.			
SO4-AVAIL-SK	Soil	Available Sulfate-S	REC METH SOIL ANAL - AB. AG(1988)
Plant available sulfate in the soil is extracted using a weak calcium chloride solution. Sulfate in the extract is determined by ICP-OES. This extraction may also produce organic sulfur in the extracts when organic soils are analyzed.			

\*\* ALS test methods may incorporate modifications from specified reference methods to improve performance.

*The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:*

Laboratory Definition Code	Laboratory Location
SK	ALS ENVIRONMENTAL - SASKATOON, SASKATCHEWAN, CANADA

### Chain of Custody Numbers:

### GLOSSARY OF REPORT TERMS

*Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.*

*mg/kg - milligrams per kilogram based on dry weight of sample*

*mg/kg wwt - milligrams per kilogram based on wet weight of sample*

*mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight*

*mg/L - unit of concentration based on volume, parts per million.*

*< - Less than.*

*D.L. - The reporting limit.*

*N/A - Result not available. Refer to qualifier code and definition for explanation.*

*Test results reported relate only to the samples as received by the laboratory.*

*UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.*

*Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.*



# Soil Test

**ALS Quote #** Q56352  
**BILL TO:**  
 PHONE (204) 433-7189  
 DEALER CODE: \_\_\_\_\_ FAX (204) 433-3335  
 NAME: Tone Ag Consulting Ltd  
 ADDRESS: Box 333  
 TOWN: St. Pierre PROV: MB POSTAL CODE: R0A1W0  
 EMAIL: ranton@toneag.com

**MAIL RESULTS TO:** (Check ONE Box Only) L1836271  
 1.  SAME AS "BILL TO" ADDRESS 2.  SAME AS "BILL TO", BUT IDENTIFY CUSTOMER NAME ON REPORT AS:  
 3.  NAME AND ADDRESS BELOW melita  
 N  
 A  
 T  
 P  
 L1836271-GOFC

DATE RECEIVED: 29.9.16 12:30PM

SAMPLE IDENTIFICATION NUMBER	SAMPLE IDENTIFICATION NUMBER	SAMPLE IDENTIFICATION NUMBER	SAMPLE IDENTIFICATION NUMBER
1437293	1437294	1437295	1437296

**FIELD INFORMATION:**  
 Date Sampled: Sep 27/16  
 Field Name: Field #1 Acres: 134  
 Legal Location MUST be completed:  
P1E1/2 3b 3 27  or E \_\_\_\_\_  
 Qtr Sec Twp Range Meridian R.M.  
 GPS: \_\_\_\_\_

**FIELD INFORMATION:**  
 Date Sampled: Sep 27/16  
 Field Name: Field #2 Acres: 98  
 Legal Location MUST be completed:  
NW 25 3 27  or E \_\_\_\_\_  
 Qtr Sec Twp Range Meridian R.M.  
 GPS: \_\_\_\_\_

**FIELD INFORMATION:**  
 Date Sampled: Sep 27/16  
 Field Name: Field #3 Acres: 220  
 Legal Location MUST be completed:  
NW 26 3 27  or E \_\_\_\_\_  
 Qtr Sec Twp Range Meridian R.M.  
 GPS: \_\_\_\_\_

**FIELD INFORMATION:**  
 Date Sampled: Sep 27/16  
 Field Name: Field #4 Acres: 163  
 Legal Location MUST be completed:  
SW 26 3 27  or E \_\_\_\_\_  
 Qtr Sec Twp Range Meridian R.M.  
 GPS: \_\_\_\_\_

**CROP TO BE SEEDED ON:** (Check ONE Box)  
 Fallow  Chemical Fallow  Established Forage  
 Legume/Pulse  Cereal, Oilseed or Other Crop Stubble  
 (if not fallow)  
 Last Crop: \_\_\_\_\_ Yield: \_\_\_\_\_

**CROP TO BE SEEDED ON:** (Check ONE Box)  
 Fallow  Chemical Fallow  Established Forage  
 Legume/Pulse  Cereal, Oilseed or Other Crop Stubble  
 (if not fallow)  
 Last Crop: \_\_\_\_\_ Yield: \_\_\_\_\_

**CROP TO BE SEEDED ON:** (Check ONE Box)  
 Fallow  Chemical Fallow  Established Forage  
 Legume/Pulse  Cereal, Oilseed or Other Crop Stubble  
 (if not fallow)  
 Last Crop: \_\_\_\_\_ Yield: \_\_\_\_\_

**CROP TO BE SEEDED ON:** (Check ONE Box)  
 Fallow  Chemical Fallow  Established Forage  
 Legume/Pulse  Cereal, Oilseed or Other Crop Stubble  
 (if not fallow)  
 Last Crop: \_\_\_\_\_ Yield: \_\_\_\_\_

**ROTATION:**  
 Continuous Cropping (3rd Consecutive Year)  
 Crop/Fallow, or Crop/Crop/Fallow

**STUBBLE MANAGEMENT:**  
 Baled  Spread  
 Other: \_\_\_\_\_

**ROTATION:**  
 Continuous Cropping (3rd Consecutive Year)  
 Crop/Fallow, or Crop/Crop/Fallow

**STUBBLE MANAGEMENT:**  
 Baled  Spread  
 Other: \_\_\_\_\_

**ROTATION:**  
 Continuous Cropping (3rd Consecutive Year)  
 Crop/Fallow, or Crop/Crop/Fallow

**STUBBLE MANAGEMENT:**  
 Baled  Spread  
 Other: \_\_\_\_\_

**ROTATION:**  
 Continuous Cropping (3rd Consecutive Year)  
 Crop/Fallow, or Crop/Crop/Fallow

**STUBBLE MANAGEMENT:**  
 Baled  Spread  
 Other: \_\_\_\_\_

**SAMPLING DEPTH:** (Check ONE Box)  
 0-12"  0-6, 0-24"  
 0-6, 6-12"  0-12, 0-24"  
 0-6, 6-12, 12-24"  ODD DEPTH  
 0-6, 6-24" 0- \_\_\_\_\_ OR 0-6, 6- \_\_\_\_\_  
 0-12, 12-24" 6- \_\_\_\_\_  
 0-6"  
 (Double Depths must include a 0-6" sample; Triple Odd Depths are not allowed).

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Check if crop is:  Irrigated  Spring Sampling Only:  Depth of Moist Soil = \_\_\_\_\_ in.

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**CROP OPTIONS:** Yield/Protein Goal  
 Crop \_\_\_\_\_ / \_\_\_\_\_  
 1. \_\_\_\_\_ / \_\_\_\_\_  
 2. \_\_\_\_\_ / \_\_\_\_\_

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 Crop \_\_\_\_\_ / \_\_\_\_\_  
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 Crop \_\_\_\_\_ / \_\_\_\_\_  
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 Crop \_\_\_\_\_ / \_\_\_\_\_  
 1. \_\_\_\_\_ / \_\_\_\_\_  
 2. \_\_\_\_\_ / \_\_\_\_\_

**TESTS REQUIRED:** (Circle ONE Package)  
 Package 1 2 3 4  
 Phosphorus Method (MB Only)  Organic Matter   
 If required please check:  Colourimetric method   
 Sodium Bicarbonate (Olsen)  Walkley-Black method  
 Other test(s): Quote # Q56352

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