



July 26, 2017

File No. 16-0429-004

Department of Sustainable Development  
Environmental Approvals Branch  
Government of Manitoba  
Box 80, 160-123 Main Street  
Winnipeg, Manitoba  
R3C 1A5

ATTENTION: Mr. Asit Dey  
Environmental Engineer

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

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Dear Mr. Dey:

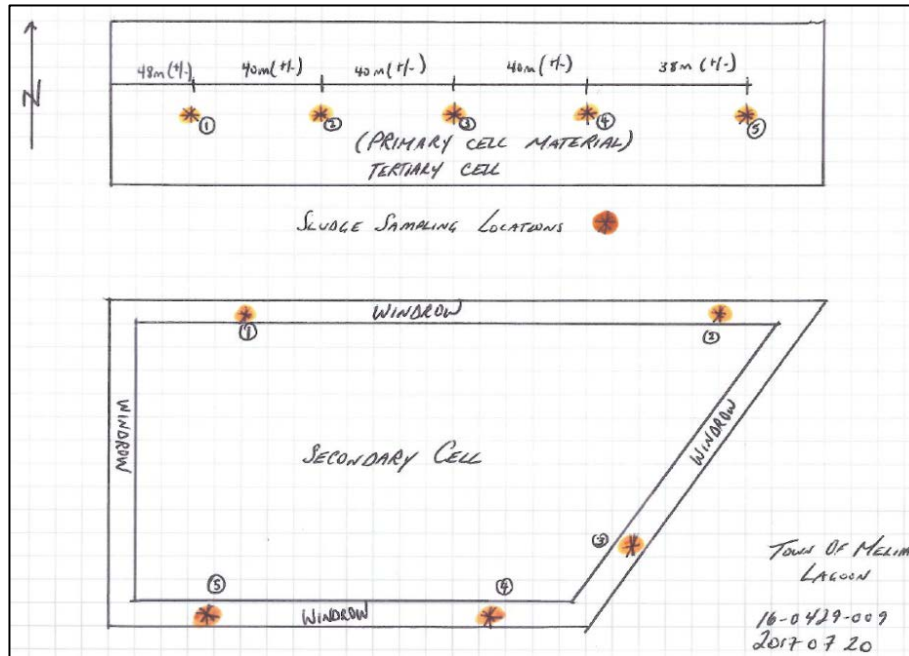
This letter outlines that proposed biosolids application rate for the sludge excavated from the Town of Melita waste water treatment lagoon. It is estimated that the lagoon contained approximately 12,000 m<sup>3</sup> of sludge and silt that was introduced to the lagoon during the 2011 flood. The application rate is based upon an agronomic assessment of the land proposed to receive the biosolids and the analysis of the sludge sampled from the lagoon on July 19, 2017. The sludge was analyzed by ALS Laboratories in July 2017 whereas the soil sample analysis was conducted in September 2016. Based on the sludge analysis and the agronomic assessment, the biosolids from the Primary and Secondary cells are proposed to be spread at a rate of 44 tons/acre and 38 tons/acre, respectively. The biosolids sampling procedure and the application rate calculations are discussed below.

### **BIOSOLIDS SAMPLING**

On July 19, 2017 KGS Group staff conducted a sludge sampling program at the Town of Melita waste water treatment lagoon. The sludge sampling program consisting of ten shallow test holes; five holes were dug in the Primary cell sludge (stockpiled in the Tertiary cell) and five in the Secondary cell sludge (stockpiled in windrows along the interior dikes of the Secondary cell). The sludge sampling was done in accordance with Schedule "A" of Manitoba Environment Act License No. 3201 and direction provided by Mr. Asit Dey at Manitoba Sustainable Development (MSD) in an email dated July 18, 2017. Sludge sampling holes were dug by hand by staff in the KGS Group Municipal Engineering Department. The approximate locations of the test holes are shown on Figure 1.

Weather conditions during sampling were quite favorable, with an overcast sky during the late morning and partly cloudy skies during the afternoon. Daytime highs during sampling were 28°C. Winds were light and from the southwest.

**FIGURE 1**  
**APPROXIMATE SLUDGE SAMPLING TEST HOLE LOCATIONS**



Representative disturbed Primary cell sludge samples were obtained from five (5) test holes at a depth of approximately 300 mm (12") below surface to obtain material not affected by exposure to sun and wind drying conditions. Sludge samples were collected directly off a clean spade to ensure representative material. The same process was used to collect material from the Secondary cell.

**PHOTO 1**  
**SLUDGE SAMPLING PRIMARY CELL MATERIAL (SAMPLE NO. 5)**



Samples from each test hole were split longitudinally on the spade and then mixed to create two composite samples. Each composite sample was placed in a sealed sampling bag to preserve moisture and in-situ material conditions. One composite sample from each cell was submitted to ALS Laboratories in Winnipeg for analysis and the second composite sample was sent to the KGS Group storage facility as a backup.

The lab analysis of the July 2017 sludge samples (Attachment 1: bulk density is reported as specific gravity measured in kg/m<sup>3</sup>) as compared to the analysis submitted with the Environment Act Proposal in 2016 indicates that there are lower levels of all parameters of concern, including phosphorus, likely due to the mixing of river silt with the biosolids. The 2016 lab results measured 8.4% and 10.1% organic content in the Primary and Secondary cell sample respectively compared to 2.7% and 2.8% organic content respectively in the July 2017 Primary and Secondary cell samples. This suggests that the 2016 samples were predominately sludge whereas the 2017 samples represent a mixture of sludge and river sediments. The biosolids characteristics based on the July 2017 composite samples are summarized in Table 1 below.

**TABLE 1**  
**BIOSOLIDS CHARACTERISTICS FOR PRIMARY AND SECONDARY CELLS BASED ON**  
**JULY 19, 2017 SLUDGE SAMPLES**

Name	Description	Unit	Primary Cell Results	Secondary Cell Results
Volume (Plus 10%)	Field	m <sup>3</sup>	20,000	10,000
Specific Gravity	As Received	Kg/L	1.77	1.76
Moisture	As Received	%	28.1	32.6
<b>NITROGEN CHARACTERISTICS</b>				
Total Kjeldahl N	% Dried Basis	%	0.201	0.169
Total Kjeldahl N	Dried Basis	mg/kg	2,010	1,690
Total Kjeldahl N	Dried Basis	kg/tonne	2.01	1.69
Ammonium N	Dried Basis	mg/kg	244	85
Ammonium N	Dried Basis	kg/tonne	0.24	0.085
Nitrate-N	Dried Basis	mg/kg	7.3	3.4
Nitrate-N	Dried Basis	kg/tonne	0.01	0.003
Organic N	Dried Basis	mg/kg	1,759	1,602
Organic N	Dried Basis	kg/tonne	1.76	1.60
Application Method			Broadcast/Incorp	Broadcast/Incorp
Anticipated Weather			Warm/Dry	Warm/Dry
Anticipated Volatilization			35%	35%
Available Organic N (25% )	Dried Basis	kg/tonne	0.44	0.40
Available Ammonium N (65%)	Dried Basis	kg/tonne	0.16	0.055
Available Nitrate-N (100%)	Dried Basis		0.01	0
Total Available N (Year 1)	Dried Basis	kg/tonne	0.61	0.46
Mineralization N (Year 2)	Dried Basis	kg/tonne	0.24	0.18
Mineralization N (Year 3)	Dried Basis	kg/tonne	0.12	0.09
<b>PHOSPHORUS CHARACTERISTICS</b>				
Total Phosphorus	Dried Basis	mg/kg	890	1,030
Total Phosphorus	Dried Basis	kg/tonne	0.89	1.03
P <sub>2</sub> O <sub>5</sub> (P * 2.3)	Dried Basis	kg/tonne	2.05	2.37
Total Available P <sub>2</sub> O <sub>5</sub> (50% available Year 1)	Dried Basis	kg/tonne	1.03	1.19

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 2016. 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 Laboratories 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 certificate of analysis for land proposed to receive the biosolids (NW-25-3-27W) is enclosed (Attachment 2).

### Proposed Application Rates

The target biosolids application rates for sludge from 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). For this calculation, the target nitrogen rate will be 150 lbs/acre in order to grow a 50 bushel canola crop. Canola removes approximately 1 lb of P2O5/bushel. Tables 2 and 3 below show the biosolids application rate on a nitrogen and phosphorus basis, respectively. The conversion factor from kg/tonne to lbs/ton is 2.

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**

Name	Unit	Primary Cell	Secondary Cell
Total Kjeldahl N	kg/tonne	2.01	1.69
Ammonium N	kg/tonne	0.24	0.085
Available Nitrate-N	kg/tonne	0.01	0.003
Organic N	kg/tonne	1.76	1.60
Application Method		Broadcast/Incorp	Broadcast/Incorp
Anticipated Weather		Warm/Dry	Warm/Dry
Anticipated Volatilization		35%	35%
Available Organic N	kg/tonne	0.44	0.40
Available Ammonium N	kg/tonne	0.16	0.055
Total Available N	kg/tonne	0.61	0.46
Total Available N	lbs/ton	1.22	0.92
N based Rate	tons/acre	<b>123</b>	<b>163</b>
Total N Applied	lbs/acre	150	150
Crop Removal Rate (P2O5)	lbs/acre	45	45
Amount of P2O5 applied using N based rate (50% available)	lbs/acre	253	388
Years to pre-application Olsen-P soil levels		6	9

**TABLE 3**  
**PHOSPHORUS BASED APPLICATION RATE CALCULATION WORKSHEET**

Name	Unit	Primary Cell	Secondary Cell
Total P2O5	kg/tonne	2.05	2.37
Total Available P2O5 (50% in Year 1)	kg/tonne	1.03	1.19
Total Available P2O5 (50% in Year 1)	lbs/acre	2.06	2.38
2X P2O5 Removal based Application Rate	tons/acre	<b>44</b>	<b>38</b>
Supplemental Nitrogen required for crop	lbs/acre	90	115
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 (123 and 163 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 on July 19, 2017, with phosphorus as the limiting factor, would be **44 tons/acre and 38 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 raised by MSD relating to phosphorus and the land application of biosolids from the Town of Melita waste water treatment lagoon.

Yours truly,



Gene Senior, M.A.  
Environmental Scientist

GS/jr  
Attachments

cc: Travis Parsons, Manitoba Water Services Board

**ATTACHMENT 1**  
**ALS ENVIRONMENTAL LABORATORIES CERTIFICATE OF ANALYSIS**  
**BIOSOLIDS SAMPLES SUBMITTED JULY 2017**



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

Date Received: 20-JUL-17  
Report Date: 26-JUL-17 13:52 (MT)  
Version: DRAFT REV. 2

Client Phone: 204-896-1209

## Certificate of Analysis

Lab Work Order #: L1961533  
Project P.O. #: NOT SUBMITTED  
Job Reference: 16-0429-004  
C of C Numbers:  
Legal Site Desc:

Comments:

26-JUL-2017 Preliminary report

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Judy Dalmaijer  
Account Manager

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ADDRESS: 1329 Niakwa Road East, Unit 12, Winnipeg, MB R2J 3T4 Canada | Phone: +1 204 255 9720 | Fax: +1 204 255 9721  
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# ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1961533-1 PRIMARY CELL							
Sampled By: CLIENT on 19-JUL-17 @ 14:00							
Matrix: SLUDGE							
<b>Miscellaneous Parameters</b>							
Total Available Nitrogen	251		20	mg/kg		25-JUL-17	
Available Phosphate-P	24.2		1.0	mg/kg	24-JUL-17	24-JUL-17	R3782039
Available Potassium	362		20	mg/kg	24-JUL-17	24-JUL-17	R3781871
Available Sulfate-S	865	DLHC	40	mg/kg	24-JUL-17	24-JUL-17	R3781399
% Moisture	28.1		0.10	%	25-JUL-17	25-JUL-17	R3781684
Specific Gravity	1.77		0.010	kg/L		21-JUL-17	R3779588
Total Carbon by Combustion	2.68		0.05	%	24-JUL-17	24-JUL-17	R3781649
Total Kjeldahl Nitrogen	0.201		0.020	%	24-JUL-17	25-JUL-17	R3782032
<b>Organic Matter by LOI at 375 deg C.</b>							
Organic Matter	2.7		1.0	%	24-JUL-17	25-JUL-17	R3782081
Loss on Ignition @ 375 C	3.1		1.0	%	24-JUL-17	25-JUL-17	R3782081
<b>Total Solids and Total Volatile Solids</b>							
Total Solids	71.4		0.10	%	24-JUL-17	24-JUL-17	R3781334
Total Volatile Solids (dry basis)	5.21		0.10	%	24-JUL-17	24-JUL-17	R3781334
<b>pH and EC (1:2 Soil:Water Extraction)</b>							
Conductivity (1:2)	1.78		0.050	dS m-1	25-JUL-17	25-JUL-17	R3781969
pH (1:2 soil:water)	7.99		0.10	pH	25-JUL-17	25-JUL-17	R3781969
<b>Metals</b>							
Aluminum (Al)	10600		5.0	mg/kg	21-JUL-17	21-JUL-17	R3780459
Antimony (Sb)	0.28		0.10	mg/kg	21-JUL-17	21-JUL-17	R3780459
Arsenic (As)	2.54		0.10	mg/kg	21-JUL-17	21-JUL-17	R3780459
Barium (Ba)	139		0.50	mg/kg	21-JUL-17	21-JUL-17	R3780459
Beryllium (Be)	0.55		0.10	mg/kg	21-JUL-17	21-JUL-17	R3780459
Bismuth (Bi)	0.537		0.020	mg/kg	21-JUL-17	21-JUL-17	R3780459
Boron (B)	15		10	mg/kg	21-JUL-17	21-JUL-17	R3780459
Cadmium (Cd)	0.385		0.020	mg/kg	21-JUL-17	21-JUL-17	R3780459
Calcium (Ca)	31500		100	mg/kg	21-JUL-17	21-JUL-17	R3780459
Chromium (Cr)	18.5		1.0	mg/kg	21-JUL-17	21-JUL-17	R3780459
Cobalt (Co)	6.22		0.020	mg/kg	21-JUL-17	21-JUL-17	R3780459
Copper (Cu)	41.1		1.0	mg/kg	21-JUL-17	21-JUL-17	R3780459
Iron (Fe)	16200		25	mg/kg	21-JUL-17	21-JUL-17	R3780459
Lead (Pb)	9.18		0.20	mg/kg	21-JUL-17	21-JUL-17	R3780459
Magnesium (Mg)	11000		10	mg/kg	21-JUL-17	21-JUL-17	R3780459
Manganese (Mn)	481		0.50	mg/kg	21-JUL-17	21-JUL-17	R3780459
Molybdenum (Mo)	0.78		0.10	mg/kg	21-JUL-17	21-JUL-17	R3780459
Nickel (Ni)	15.5		0.50	mg/kg	21-JUL-17	21-JUL-17	R3780459
Phosphorus (P)	890		100	mg/kg	21-JUL-17	21-JUL-17	R3780459
Potassium (K)	1970		25	mg/kg	21-JUL-17	21-JUL-17	R3780459
Selenium (Se)	0.69		0.50	mg/kg	21-JUL-17	21-JUL-17	R3780459
Silver (Ag)	0.74		0.10	mg/kg	21-JUL-17	21-JUL-17	R3780459
Sodium (Na)	307		10	mg/kg	21-JUL-17	21-JUL-17	R3780459
Strontium (Sr)	62.2		0.10	mg/kg	21-JUL-17	21-JUL-17	R3780459
Thallium (Tl)	0.20		0.10	mg/kg	21-JUL-17	21-JUL-17	R3780459
Tin (Sn)	<5.0		5.0	mg/kg	21-JUL-17	21-JUL-17	R3780459
Titanium (Ti)	93.4		0.50	mg/kg	21-JUL-17	21-JUL-17	R3780459
Uranium (U)	1.99		0.020	mg/kg	21-JUL-17	21-JUL-17	R3780459
Vanadium (V)	37.4		0.50	mg/kg	21-JUL-17	21-JUL-17	R3780459
Zinc (Zn)	71		10	mg/kg	21-JUL-17	21-JUL-17	R3780459
<b>Total Available N &amp; NO3-N, NO2-N &amp; NH4</b>							
<b>Available Ammonium-N</b>							
Available Ammonium-N	244	DLHC	20	mg/kg	25-JUL-17	25-JUL-17	R3781900

\* 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
L1961533-1 PRIMARY CELL Sampled By: CLIENT on 19-JUL-17 @ 14:00 Matrix: SLUDGE							
<b>Nitrate, Nitrite &amp; Nitrate+Nitrite-N(KCL)</b>							
Nitrite-N	<1.0		1.0	mg/kg	24-JUL-17	24-JUL-17	R3781853
Nitrate+Nitrite-N	7.3		2.0	mg/kg	24-JUL-17	24-JUL-17	R3781853
Nitrate-N	7.3		2.0	mg/kg	24-JUL-17	24-JUL-17	R3781853
<b>Detailed Salinity</b>							
<b>Chloride (Cl) (Saturated Paste)</b>							
Chloride (Cl)	600	DLM	250	mg/L	25-JUL-17	25-JUL-17	R3781986
<b>Detail Salinity in mg/kg</b>							
Chloride (Cl)	350		150	mg/kg		25-JUL-17	
Calcium (Ca)	327		15	mg/kg		25-JUL-17	
Magnesium (Mg)	222		15	mg/kg		25-JUL-17	
Potassium (K)	57		15	mg/kg		25-JUL-17	
Sodium (Na)	153		15	mg/kg		25-JUL-17	
Sulfur (as SO4)	2330		15	mg/kg		25-JUL-17	
<b>SAR, Cations and SO4 in saturated soil</b>							
Calcium (Ca)	554	DLDS	25	mg/L	25-JUL-17	25-JUL-17	R3781902
Potassium (K)	96	DLDS	25	mg/L	25-JUL-17	25-JUL-17	R3781902
Magnesium (Mg)	375	DLDS	25	mg/L	25-JUL-17	25-JUL-17	R3781902
Sodium (Na)	259	DLDS	25	mg/L	25-JUL-17	25-JUL-17	R3781902
SAR	2.08		0.10	SAR	25-JUL-17	25-JUL-17	R3781902
Sulfur (as SO4)	3960	DLDS	25	mg/L	25-JUL-17	25-JUL-17	R3781902
<b>Theoretical Gypsum Requirement</b>							
TGR(brine)	<0.10		0.10	t/ha		25-JUL-17	
TGR(sodic)	<0.10		0.10	t/ha		25-JUL-17	
<b>pH and EC (Saturated Paste)</b>							
% Saturation	59.0		1.0	%	24-JUL-17	25-JUL-17	R3782097
pH in Saturated Paste	7.66		0.10	pH	24-JUL-17	25-JUL-17	R3782097
Conductivity Sat. Paste	5.83		0.10	dS m-1	24-JUL-17	25-JUL-17	R3782097
L1961533-2 SECONDARY CELL Sampled By: CLIENT on 19-JUL-17 @ 14:30 Matrix: SLUDGE							
<b>Miscellaneous Parameters</b>							
Total Available Nitrogen	88		20	mg/kg		25-JUL-17	
Available Phosphate-P	30.4		1.0	mg/kg	24-JUL-17	24-JUL-17	R3782039
Available Potassium	344		20	mg/kg	24-JUL-17	24-JUL-17	R3781871
Available Sulfate-S	1010	DLHC	40	mg/kg	24-JUL-17	24-JUL-17	R3781399
% Moisture	32.6		0.10	%	25-JUL-17	25-JUL-17	R3781684
Specific Gravity	1.76		0.010	kg/L		21-JUL-17	R3779588
Total Carbon by Combustion	2.62		0.05	%	24-JUL-17	24-JUL-17	R3781649
Total Kjeldahl Nitrogen	0.169		0.020	%	24-JUL-17	25-JUL-17	R3782032
<b>Organic Matter by LOI at 375 deg C.</b>							
Organic Matter	2.8		1.0	%	24-JUL-17	25-JUL-17	R3782081
Loss on Ignition @ 375 C	3.2		1.0	%	24-JUL-17	25-JUL-17	R3782081
<b>Total Solids and Total Volatile Solids</b>							
Total Solids	70.6		0.10	%	24-JUL-17	24-JUL-17	R3781334
Total Volatile Solids (dry basis)	5.17		0.10	%	24-JUL-17	24-JUL-17	R3781334
<b>pH and EC (1:2 Soil:Water Extraction)</b>							
Conductivity (1:2)	1.68		0.050	dS m-1	25-JUL-17	25-JUL-17	R3781969
pH (1:2 soil:water)	7.84		0.10	pH	25-JUL-17	25-JUL-17	R3781969
<b>Metals</b>							
Aluminum (Al)	10700		5.0	mg/kg	21-JUL-17	21-JUL-17	R3780459
Antimony (Sb)	0.31		0.10	mg/kg	21-JUL-17	21-JUL-17	R3780459

\* 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
L1961533-2 SECONDARY CELL							
Sampled By: CLIENT on 19-JUL-17 @ 14:30							
Matrix: SLUDGE							
<b>Metals</b>							
Arsenic (As)	2.44		0.10	mg/kg	21-JUL-17	21-JUL-17	R3780459
Barium (Ba)	143		0.50	mg/kg	21-JUL-17	21-JUL-17	R3780459
Beryllium (Be)	0.54		0.10	mg/kg	21-JUL-17	21-JUL-17	R3780459
Bismuth (Bi)	0.499		0.020	mg/kg	21-JUL-17	21-JUL-17	R3780459
Boron (B)	15		10	mg/kg	21-JUL-17	21-JUL-17	R3780459
Cadmium (Cd)	0.628		0.020	mg/kg	21-JUL-17	21-JUL-17	R3780459
Calcium (Ca)	30600		100	mg/kg	21-JUL-17	21-JUL-17	R3780459
Chromium (Cr)	20.2		1.0	mg/kg	21-JUL-17	21-JUL-17	R3780459
Cobalt (Co)	6.55		0.020	mg/kg	21-JUL-17	21-JUL-17	R3780459
Copper (Cu)	36.6		1.0	mg/kg	21-JUL-17	21-JUL-17	R3780459
Iron (Fe)	16900		25	mg/kg	21-JUL-17	21-JUL-17	R3780459
Lead (Pb)	11.9		0.20	mg/kg	21-JUL-17	21-JUL-17	R3780459
Magnesium (Mg)	11200		10	mg/kg	21-JUL-17	21-JUL-17	R3780459
Manganese (Mn)	387		0.50	mg/kg	21-JUL-17	21-JUL-17	R3780459
Molybdenum (Mo)	0.84		0.10	mg/kg	21-JUL-17	21-JUL-17	R3780459
Nickel (Ni)	17.8		0.50	mg/kg	21-JUL-17	21-JUL-17	R3780459
Phosphorus (P)	1030		100	mg/kg	21-JUL-17	21-JUL-17	R3780459
Potassium (K)	2060		25	mg/kg	21-JUL-17	21-JUL-17	R3780459
Selenium (Se)	0.66		0.50	mg/kg	21-JUL-17	21-JUL-17	R3780459
Silver (Ag)	0.50		0.10	mg/kg	21-JUL-17	21-JUL-17	R3780459
Sodium (Na)	273		10	mg/kg	21-JUL-17	21-JUL-17	R3780459
Strontium (Sr)	54.8		0.10	mg/kg	21-JUL-17	21-JUL-17	R3780459
Thallium (Tl)	0.22		0.10	mg/kg	21-JUL-17	21-JUL-17	R3780459
Tin (Sn)	<5.0		5.0	mg/kg	21-JUL-17	21-JUL-17	R3780459
Titanium (Ti)	116		0.50	mg/kg	21-JUL-17	21-JUL-17	R3780459
Uranium (U)	2.38		0.020	mg/kg	21-JUL-17	21-JUL-17	R3780459
Vanadium (V)	38.3		0.50	mg/kg	21-JUL-17	21-JUL-17	R3780459
Zinc (Zn)	74		10	mg/kg	21-JUL-17	21-JUL-17	R3780459
<b>Total Available N &amp; NO3-N, NO2-N &amp; NH4</b>							
<b>Available Ammonium-N</b>							
Available Ammonium-N	85	DLHC	20	mg/kg	25-JUL-17	25-JUL-17	R3781900
<b>Nitrate, Nitrite &amp; Nitrate+Nitrite-N(KCL)</b>							
Nitrite-N	<1.0		1.0	mg/kg	24-JUL-17	24-JUL-17	R3781853
Nitrate+Nitrite-N	3.4		2.0	mg/kg	24-JUL-17	24-JUL-17	R3781853
Nitrate-N	3.4		2.0	mg/kg	24-JUL-17	24-JUL-17	R3781853
<b>Detailed Salinity</b>							
<b>Chloride (Cl) (Saturated Paste)</b>							
Chloride (Cl)	693	DLDS	25	mg/L	25-JUL-17	25-JUL-17	R3781986
<b>Detail Salinity in mg/kg</b>							
Chloride (Cl)	409		15	mg/kg		25-JUL-17	
Calcium (Ca)	353		15	mg/kg		25-JUL-17	
Magnesium (Mg)	240		15	mg/kg		25-JUL-17	
Potassium (K)	50		15	mg/kg		25-JUL-17	
Sodium (Na)	103		15	mg/kg		25-JUL-17	
Sulfur (as SO4)	2120		15	mg/kg		25-JUL-17	
<b>SAR, Cations and SO4 in saturated soil</b>							
Calcium (Ca)	599	DLDS	25	mg/L	25-JUL-17	25-JUL-17	R3781902
Potassium (K)	84	DLDS	25	mg/L	25-JUL-17	25-JUL-17	R3781902
Magnesium (Mg)	407	DLDS	25	mg/L	25-JUL-17	25-JUL-17	R3781902
Sodium (Na)	174	DLDS	25	mg/L	25-JUL-17	25-JUL-17	R3781902
SAR	1.35		0.10	SAR	25-JUL-17	25-JUL-17	R3781902
Sulfur (as SO4)	3590	DLDS	25	mg/L	25-JUL-17	25-JUL-17	R3781902

\* 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
L1961533-2 SECONDARY CELL Sampled By: CLIENT on 19-JUL-17 @ 14:30 Matrix: SLUDGE <b>Theoretical Gypsum Requirement</b> TGR(brine) <0.10 TGR(sodic) <0.10 <b>pH and EC (Saturated Paste)</b> % Saturation 59.0 pH in Saturated Paste 7.56 Conductivity Sat. Paste 5.04							
			0.10	t/ha		25-JUL-17	
			0.10	t/ha		25-JUL-17	
			1.0	%	24-JUL-17	25-JUL-17	R3782097
			0.10	pH	24-JUL-17	25-JUL-17	R3782097
			0.10	dS m-1	24-JUL-17	25-JUL-17	R3782097
L1961533-3 PRIMARY CELL Sampled By: CLIENT on 20-JUL-17 Matrix: SLUDGE <b>Miscellaneous Parameters</b> Specific Gravity 1580							
			10	kg/m3	25-JUL-17	25-JUL-17	R3782104
L1961533-4 SECONDARY CELL Sampled By: CLIENT on 20-JUL-17 Matrix: SLUDGE <b>Miscellaneous Parameters</b> Specific Gravity 1650							
			10	kg/m3	25-JUL-17	25-JUL-17	R3782104

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\* 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).
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).

### 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.			
DENSITY-REC-SK	Misc.	Density by Calibrated Cup Method	APHA 2710 F
A mud sample is placed into a 75 mL plexi-glass container, then weighed. Density is calculated as sample weight per container volume and expressed in units of kg/m <sup>3</sup> .			
ETL-N-TOT-AVAIL-SK	Soil	Available Ammonium-N - Calculation	Soil Methods of Analysis (1993) CSSS
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 colorimetrically 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

## Reference Information

## Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
		Plant available phosphorus is extracted from the sample with sodium bicarbonate. PO4-P in the filtered extract is determined colorimetrically at 880 nm.	
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/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 www.alsglobal.com. 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: L1961533

Report Date: 26-JUL-17

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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>DENSITY-REC-SK</b>		<b>Misc.</b>						
Batch	R3782104							
WG2577743-1	DUP	L1961533-4						
Specific Gravity		1650	1640		kg/m3	0.4	20	25-JUL-17
<b>C-TOT-LECO-SK</b>		<b>Soil</b>						
Batch	R3781649							
WG2575276-1	DUP	L1961533-1						
Total Carbon by Combustion		2.68	2.68		%	0.3	20	24-JUL-17
WG2575276-2	IRM	08-109_SOIL						
Total Carbon by Combustion			101.3		%		80-120	24-JUL-17
WG2575276-3	MB							
Total Carbon by Combustion			<0.05		%		0.05	24-JUL-17
<b>CL-PASTE-COL-SK</b>		<b>Soil</b>						
Batch	R3781986							
WG2576406-3	IRM	SRS 1508						
Chloride (Cl)			128.2		%		70-130	25-JUL-17
WG2576406-2	MB							
Chloride (Cl)			<5.0		mg/L		5	25-JUL-17
<b>K-AVAIL-SK</b>		<b>Soil</b>						
Batch	R3781871							
WG2575427-3	IRM	FARM2005						
Available Potassium			97.5		%		70-130	24-JUL-17
WG2575427-2	MB							
Available Potassium			<20		mg/kg		20	24-JUL-17
<b>MET-200.2-MS-WP</b>		<b>Soil</b>						
Batch	R3780459							
WG2575519-3	CRM	PACS-3						
Aluminum (Al)			97.9		%		70-130	21-JUL-17
Antimony (Sb)			95.7		%		70-130	21-JUL-17
Arsenic (As)			92.2		%		70-130	21-JUL-17
Barium (Ba)			71.1		%		70-130	21-JUL-17
Beryllium (Be)			98.9		%		70-130	21-JUL-17
Boron (B)			98.9		%		70-130	21-JUL-17
Cadmium (Cd)			88.3		%		70-130	21-JUL-17
Calcium (Ca)			92.5		%		70-130	21-JUL-17
Chromium (Cr)			97.2		%		70-130	21-JUL-17
Cobalt (Co)			95.6		%		70-130	21-JUL-17

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## Quality Control Report

Workorder: L1961533

Report Date: 26-JUL-17

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Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
<b>MET-200.2-MS-WP</b>	<b>Soil</b>							
<b>Batch</b>	<b>R3780459</b>							
<b>WG2575519-3</b>	<b>CRM</b>	<b>PACS-3</b>						
Copper (Cu)			96.7		%		70-130	21-JUL-17
Iron (Fe)			89.7		%		70-130	21-JUL-17
Lead (Pb)			84.0		%		70-130	21-JUL-17
Magnesium (Mg)			104.7		%		70-130	21-JUL-17
Manganese (Mn)			94.4		%		70-130	21-JUL-17
Molybdenum (Mo)			89.1		%		70-130	21-JUL-17
Nickel (Ni)			95.6		%		70-130	21-JUL-17
Phosphorus (P)			92.6		%		70-130	21-JUL-17
Potassium (K)			95.0		%		70-130	21-JUL-17
Selenium (Se)			0.91		mg/kg		0.51-1.51	21-JUL-17
Silver (Ag)			92.0		%		70-130	21-JUL-17
Sodium (Na)			97.3		%		70-130	21-JUL-17
Strontium (Sr)			81.6		%		70-130	21-JUL-17
Thallium (Tl)			0.38		mg/kg		0.23-0.43	21-JUL-17
Tin (Sn)			88.1		%		70-130	21-JUL-17
Titanium (Ti)			92.7		%		70-130	21-JUL-17
Uranium (U)			91.0		%		70-130	21-JUL-17
Vanadium (V)			99.2		%		70-130	21-JUL-17
Zinc (Zn)			93.0		%		70-130	21-JUL-17
<b>WG2575519-4</b>	<b>CRM</b>	<b>CANMET TILL-1</b>						
Aluminum (Al)			97.7		%		70-130	21-JUL-17
Antimony (Sb)			99.6		%		70-130	21-JUL-17
Arsenic (As)			96.0		%		70-130	21-JUL-17
Barium (Ba)			96.1		%		70-130	21-JUL-17
Beryllium (Be)			101.2		%		70-130	21-JUL-17
Bismuth (Bi)			100.6		%		70-130	21-JUL-17
Boron (B)			97.5		%		70-130	21-JUL-17
Cadmium (Cd)			96.8		%		70-130	21-JUL-17
Calcium (Ca)			98.1		%		70-130	21-JUL-17
Chromium (Cr)			100.7		%		70-130	21-JUL-17
Cobalt (Co)			99.7		%		70-130	21-JUL-17
Copper (Cu)			100.4		%		70-130	21-JUL-17
Iron (Fe)			98.7		%		70-130	21-JUL-17
Lead (Pb)			98.4		%		70-130	21-JUL-17

## Quality Control Report

Workorder: L1961533

Report Date: 26-JUL-17

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Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
<b>MET-200.2-MS-WP</b>	<b>Soil</b>							
<b>Batch</b>	<b>R3780459</b>							
<b>WG2575519-4 CRM</b>		<b>CANMET TILL-1</b>						
Magnesium (Mg)			102.2		%		70-130	21-JUL-17
Manganese (Mn)			103.6		%		70-130	21-JUL-17
Molybdenum (Mo)			101.9		%		70-130	21-JUL-17
Nickel (Ni)			101.1		%		70-130	21-JUL-17
Phosphorus (P)			98.9		%		70-130	21-JUL-17
Potassium (K)			93.5		%		70-130	21-JUL-17
Selenium (Se)			85.0		%		70-130	21-JUL-17
Silver (Ag)			100.6		%		70-130	21-JUL-17
Sodium (Na)			97.7		%		70-130	21-JUL-17
Strontium (Sr)			98.6		%		70-130	21-JUL-17
Thallium (Tl)			0.13		mg/kg		0.03-0.23	21-JUL-17
Tin (Sn)			90.9		%		70-130	21-JUL-17
Titanium (Ti)			92.7		%		70-130	21-JUL-17
Uranium (U)			102.0		%		70-130	21-JUL-17
Vanadium (V)			100.4		%		70-130	21-JUL-17
Zinc (Zn)			99.6		%		70-130	21-JUL-17
<b>WG2575519-2 LCS</b>								
Aluminum (Al)			103.1		%		80-120	21-JUL-17
Antimony (Sb)			105.1		%		80-120	21-JUL-17
Arsenic (As)			104.2		%		80-120	21-JUL-17
Barium (Ba)			104.0		%		80-120	21-JUL-17
Beryllium (Be)			104.7		%		80-120	21-JUL-17
Bismuth (Bi)			100.8		%		80-120	21-JUL-17
Boron (B)			107.0		%		80-120	21-JUL-17
Cadmium (Cd)			102.0		%		80-120	21-JUL-17
Calcium (Ca)			102.6		%		80-120	21-JUL-17
Chromium (Cr)			101.5		%		80-120	21-JUL-17
Cobalt (Co)			100.1		%		80-120	21-JUL-17
Copper (Cu)			99.4		%		80-120	21-JUL-17
Iron (Fe)			100.0		%		80-120	21-JUL-17
Lead (Pb)			101.6		%		80-120	21-JUL-17
Magnesium (Mg)			105.6		%		80-120	21-JUL-17
Manganese (Mn)			103.5		%		80-120	21-JUL-17
Molybdenum (Mo)			105.1		%		80-120	21-JUL-17



## Quality Control Report

Workorder: L1961533

Report Date: 26-JUL-17

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Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
<b>MET-200.2-MS-WP</b>		<b>Soil</b>						
<b>Batch</b>	<b>R3780459</b>							
<b>WG2575519-2</b>	<b>LCS</b>							
Nickel (Ni)			101.5		%		80-120	21-JUL-17
Phosphorus (P)			109.5		%		80-120	21-JUL-17
Potassium (K)			103.3		%		80-120	21-JUL-17
Selenium (Se)			99.1		%		80-120	21-JUL-17
Silver (Ag)			105.7		%		80-120	21-JUL-17
Sodium (Na)			106.4		%		80-120	21-JUL-17
Strontium (Sr)			103.8		%		80-120	21-JUL-17
Thallium (Tl)			103.0		%		80-120	21-JUL-17
Tin (Sn)			103.0		%		80-120	21-JUL-17
Titanium (Ti)			102.0		%		80-120	21-JUL-17
Uranium (U)			106.8		%		80-120	21-JUL-17
Vanadium (V)			104.7		%		80-120	21-JUL-17
Zinc (Zn)			98.6		%		80-120	21-JUL-17
<b>WG2575519-1</b>	<b>MB</b>							
Aluminum (Al)			<5.0		mg/kg		5	21-JUL-17
Antimony (Sb)			<0.10		mg/kg		0.1	21-JUL-17
Arsenic (As)			<0.10		mg/kg		0.1	21-JUL-17
Barium (Ba)			<0.50		mg/kg		0.5	21-JUL-17
Beryllium (Be)			<0.10		mg/kg		0.1	21-JUL-17
Bismuth (Bi)			<0.020		mg/kg		0.02	21-JUL-17
Boron (B)			<10		mg/kg		10	21-JUL-17
Cadmium (Cd)			<0.020		mg/kg		0.02	21-JUL-17
Calcium (Ca)			<100		mg/kg		100	21-JUL-17
Chromium (Cr)			<1.0		mg/kg		1	21-JUL-17
Cobalt (Co)			<0.020		mg/kg		0.02	21-JUL-17
Copper (Cu)			<1.0		mg/kg		1	21-JUL-17
Iron (Fe)			<25		mg/kg		25	21-JUL-17
Lead (Pb)			<0.20		mg/kg		0.2	21-JUL-17
Magnesium (Mg)			<10		mg/kg		10	21-JUL-17
Manganese (Mn)			<0.50		mg/kg		0.5	21-JUL-17
Molybdenum (Mo)			<0.10		mg/kg		0.1	21-JUL-17
Nickel (Ni)			<0.50		mg/kg		0.5	21-JUL-17
Phosphorus (P)			<100		mg/kg		100	21-JUL-17
Potassium (K)			<25		mg/kg		25	21-JUL-17

## Quality Control Report

Workorder: L1961533

Report Date: 26-JUL-17

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Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
<b>MET-200.2-MS-WP</b>								
<b>Soil</b>								
<b>Batch</b>	<b>R3780459</b>							
<b>WG2575519-1</b>	<b>MB</b>							
Selenium (Se)			<0.50		mg/kg		0.5	21-JUL-17
Silver (Ag)			<0.10		mg/kg		0.1	21-JUL-17
Sodium (Na)			<10		mg/kg		10	21-JUL-17
Strontium (Sr)			<0.10		mg/kg		0.1	21-JUL-17
Thallium (Tl)			<0.10		mg/kg		0.1	21-JUL-17
Tin (Sn)			<5.0		mg/kg		5	21-JUL-17
Titanium (Ti)			<0.50		mg/kg		0.5	21-JUL-17
Uranium (U)			<0.020		mg/kg		0.02	21-JUL-17
Vanadium (V)			<0.50		mg/kg		0.5	21-JUL-17
Zinc (Zn)			<10		mg/kg		10	21-JUL-17
<b>MOIST-SK</b>								
<b>Soil</b>								
<b>Batch</b>	<b>R3781684</b>							
<b>WG2576635-1</b>	<b>DUP</b>	<b>L1961533-1</b>						
% Moisture		28.1	28.7		%	2.3	20	25-JUL-17
<b>WG2576635-3</b>	<b>LCS</b>							
% Moisture			105.0		%		90-110	25-JUL-17
<b>WG2576635-2</b>	<b>MB</b>							
% Moisture			<0.10		%		0.1	25-JUL-17
<b>N-TOTKJ-COL-SK</b>								
<b>Soil</b>								
<b>Batch</b>	<b>R3782032</b>							
<b>WG2576926-1</b>	<b>DUP</b>	<b>L1961533-2</b>						
Total Kjeldahl Nitrogen		0.169	0.172		%	1.3	20	25-JUL-17
<b>WG2576926-2</b>	<b>IRM</b>	<b>08-109_SOIL</b>						
Total Kjeldahl Nitrogen			96.8		%		80-120	25-JUL-17
<b>WG2576926-3</b>	<b>MB</b>							
Total Kjeldahl Nitrogen			<0.020		%		0.02	25-JUL-17
<b>N2/N3-AVAIL-KCL-SK</b>								
<b>Soil</b>								
<b>Batch</b>	<b>R3781853</b>							
<b>WG2576652-1</b>	<b>DUP</b>	<b>L1961533-1</b>						
Nitrite-N		<1.0	<1.0	RPD-NA	mg/kg	N/A	30	24-JUL-17
Nitrate+Nitrite-N		7.3	6.7		mg/kg	7.9	30	24-JUL-17
<b>WG2576652-3</b>	<b>IRM</b>	<b>SAL814</b>						
Nitrate+Nitrite-N			105.6		%		70-130	24-JUL-17
<b>WG2576652-2</b>	<b>MB</b>							
Nitrite-N			<1.0		mg/kg		1	24-JUL-17
Nitrate+Nitrite-N			<2.0		mg/kg		2	24-JUL-17

## Quality Control Report

Workorder: L1961533

Report Date: 26-JUL-17

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Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
<b>NH4-AVAIL-SK</b>								
<b>Soil</b>								
<b>Batch</b>	<b>R3781900</b>							
<b>WG2576643-1</b>	<b>DUP</b>	<b>L1961533-1</b>						
Available Ammonium-N		244	242		mg/kg	0.7	20	25-JUL-17
<b>WG2576643-3</b>	<b>IRM</b>	<b>SAL814</b>						
Available Ammonium-N			101.6		%		70-130	25-JUL-17
<b>WG2576643-2</b>	<b>MB</b>							
Available Ammonium-N			<1.0		mg/kg		1	25-JUL-17
<b>OM-LOI-SK</b>								
<b>Soil</b>								
<b>Batch</b>	<b>R3782081</b>							
<b>WG2576789-3</b>	<b>IRM</b>	<b>SAL2001</b>						
Organic Matter			104.8		%		80-120	25-JUL-17
Loss on Ignition @ 375 C			104.8		%		80-120	25-JUL-17
<b>WG2576789-2</b>	<b>MB</b>							
Organic Matter			<1.0		%		1	25-JUL-17
Loss on Ignition @ 375 C			<1.0		%		1	25-JUL-17
<b>PH,EC-1:2-SK</b>								
<b>Soil</b>								
<b>Batch</b>	<b>R3781969</b>							
<b>WG2576919-3</b>	<b>IRM</b>	<b>SAL814</b>						
Conductivity (1:2)			1.29		dS m-1		0.92-1.38	25-JUL-17
pH (1:2 soil:water)			7.94		pH		7.65-8.25	25-JUL-17
<b>WG2576919-2</b>	<b>MB</b>							
Conductivity (1:2)			<0.050		dS m-1		0.05	25-JUL-17
<b>PO4-AVAIL-OLSEN-SK</b>								
<b>Soil</b>								
<b>Batch</b>	<b>R3782039</b>							
<b>WG2576600-1</b>	<b>DUP</b>	<b>L1961533-2</b>						
Available Phosphate-P		30.4	30.0		mg/kg	1.1	30	24-JUL-17
<b>WG2576600-3</b>	<b>IRM</b>	<b>FARM2005</b>						
Available Phosphate-P			87.7		%		80-120	24-JUL-17
<b>WG2576600-2</b>	<b>MB</b>							
Available Phosphate-P			<1.0		mg/kg		1	24-JUL-17
<b>SAR-CALC-SO4-SK</b>								
<b>Soil</b>								
<b>Batch</b>	<b>R3781902</b>							
<b>WG2576406-3</b>	<b>IRM</b>	<b>SRS 1508</b>						
Calcium (Ca)			120.7		%		70-130	25-JUL-17
Potassium (K)			101.3		%		70-130	25-JUL-17
Magnesium (Mg)			120.6		%		70-130	25-JUL-17
Sodium (Na)			118.1		%		70-130	25-JUL-17
Sulfur (as SO4)			126.4		%		70-130	25-JUL-17

## Quality Control Report

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Report Date: 26-JUL-17

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Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
<b>SAR-CALC-SO4-SK</b>								
<b>Soil</b>								
Batch	R3781902							
<b>WG2576406-2</b>	<b>MB</b>							
Calcium (Ca)			<5.0		mg/L		5	25-JUL-17
Potassium (K)			<5.0		mg/L		5	25-JUL-17
Magnesium (Mg)			<5.0		mg/L		5	25-JUL-17
Sodium (Na)			<5.0		mg/L		5	25-JUL-17
Sulfur (as SO4)			<5.0		mg/L		5	25-JUL-17
<b>SAT/PH/EC-SK</b>								
<b>Soil</b>								
Batch	R3782097							
<b>WG2576406-3</b>	<b>IRM</b>	<b>SRS 1508</b>						
% Saturation			95.1		%		80-120	25-JUL-17
pH in Saturated Paste			7.74		pH		7.43-8.03	25-JUL-17
Conductivity Sat. Paste			115.9		%		80-120	25-JUL-17
<b>WG2576406-2</b>	<b>MB</b>							
Conductivity Sat. Paste			<0.10		dS m-1		0.1	25-JUL-17
<b>SO4-AVAIL-SK</b>								
<b>Soil</b>								
Batch	R3781399							
<b>WG2576595-1</b>	<b>DUP</b>	<b>L1961533-1</b>						
Available Sulfate-S		865	791		mg/kg	9.0	40	24-JUL-17
<b>WG2576595-3</b>	<b>IRM</b>	<b>SAL814</b>						
Available Sulfate-S			100.0		%		70-130	24-JUL-17
<b>WG2576595-2</b>	<b>MB</b>							
Available Sulfate-S			<4.0		mg/kg		4	24-JUL-17
<b>SPECGRAV-CL</b>								
<b>Soil</b>								
Batch	R3779588							
<b>WG2575570-2</b>	<b>DUP</b>	<b>L1961533-1</b>						
Specific Gravity		1.77	1.80		kg/L	1.7	20	21-JUL-17
<b>WG2575570-1</b>	<b>IRM</b>	<b>SAL-STD9</b>						
<b>SOLIDS-TOT/TOTVOL-SK</b>								
<b>Manure</b>								
Batch	R3781334							
<b>WG2575376-3</b>	<b>DUP</b>	<b>L1961533-1</b>						
Total Solids		71.4	71.9		%	0.6	25	24-JUL-17
Total Volatile Solids (dry basis)		5.21	5.05		%	3.2	25	24-JUL-17

# Quality Control Report

Workorder: L1961533

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## 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).
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

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# Quality Control Report

Workorder: L1961533

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## Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
<b>Plant Available Nutrients</b>							
Nitrate, Nitrite & Nitrate+Nitrite-N(KCL)							
	1	19-JUL-17 14:00	24-JUL-17 18:20	3	5	days	EHT
	2	19-JUL-17 14:30	24-JUL-17 18:20	3	5	days	EHT

## Legend & Qualifier Definitions:

- EHTR-FM: Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
- EHTR: Exceeded ALS recommended hold time prior to sample receipt.
- EHTL: Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
- EHT: Exceeded ALS recommended hold time prior to analysis.
- Rec. HT: ALS recommended hold time (see units).

## Notes\*:

Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.  
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L1961533 were received on 20-JUL-17 08:56.

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.

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.



L1961533-COFC

L1961533

<b>Report To</b> Contact and company name below will appear on the final report		<b>Report Format /</b> Please confirm all E&P TATs with your AM - surcharges will apply				
Company: <b>KGS GROUP</b>	Select Report Format: <input checked="" type="checkbox"/> PDF <input checked="" type="checkbox"/> EXCEL <input type="checkbox"/> EDD (DIGITAL)	Regular [R] <input type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply				
Contact: <b>GENE SENIOR</b>	Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	4 day [P4] <input type="checkbox"/>	1 Business day [E1] <input type="checkbox"/>			
Phone: <b>204 218 3285</b>	<input type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked	3 day [P3] <input checked="" type="checkbox"/>	Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/>			
Company address below will appear on the final report		2 day [P2] <input type="checkbox"/>	EMERGENCY			
Street: <b>3rd Floor, 865 Waverley St.</b>	Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX	Date and Time Required for all E&P TATs: _____				
City/Province: <b>Winnipeg, MB</b>	Email 1 or Fax: <b>ASENIOR@KSGROUP.COM</b>	For tests that can not be performed according to the service level selected, you will be contacted.				
Postal Code: <b>R3T5P4</b>	Email 2: <b>PPAWLUK@KSGROUP.COM</b>	<b>Analysis Request</b>				
Invoice To: Same as Report To <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	Email 3: _____	Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below				
Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO	Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX	<div style="border: 2px solid black; border-radius: 50%; width: 100px; height: 100px; display: flex; align-items: center; justify-content: center; margin: 0 auto;"> <span style="font-size: 2em; font-weight: bold;">RUSH</span> </div>				
Company: <b>KGS GROUP</b>	Email 1 or Fax: <b>WMAQUARRIE@KSGROUP.COM</b>					
Contact: <b>BILL MAQUARRIE</b>	Email 2: _____					
<b>Project Information</b>						
ALS Account # / Quote #: <b>063324</b>	<b>Oil and Gas Required Fields (client use)</b>					
Job #: <b>16-0729-004</b>	AFE/Cost Center: _____ PO#: _____					
PO / AFE: _____	Major/Minor Code: _____ Routing Code: _____					
LSD: _____	Requisitioner: _____					
ALS Lab Work Order # (lab use only): _____	Location: _____					
ALS Contact: _____	Sampler: _____					
ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type		
	Primary cell	19-07-17	14:00	sludge	AS PER QUOTE	
	Secondary cell	19-07-17	14:30	sludge	AS PER QUOTE	
	PRIMARY cell	20-07-17			BULK DENSITY	
	Secondary cell	20-07-17			BULK DENSITY	
<b>Drinking Water (DW) Samples<sup>1</sup> (client use)</b>		<b>Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)</b>			<b>SAMPLE CONDITION AS RECEIVED (lab use only)</b>	
Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input type="checkbox"/> NO					Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/>	
Are samples for human drinking water use? <input type="checkbox"/> YES <input type="checkbox"/> NO					Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/>	
					Cooling Initiated <input type="checkbox"/>	
					INITIAL COOLER TEMPERATURES °C: <b>19.6</b> FINAL COOLER TEMPERATURES °C: _____	
<b>SHIPMENT RELEASE (client use)</b>		<b>INITIAL SHIPMENT RECEPTION (lab use only)</b>			<b>FINAL SHIPMENT RECEPTION (lab use only)</b>	
Released by: <b>[Signature]</b>	Date: _____	Time: _____	Received by: <b>David I.</b>	Date: <b>20-7-17</b>	Time: <b>8:36</b>	Received by: _____

Number of Containers

**ATTACHMENT 2**

**ALS ENVIRONMENTAL LABORATORIES CERTIFICATE OF ANALYSIS**

**SOIL SAMPLES SUBMITTED SEPTEMBER 2016**





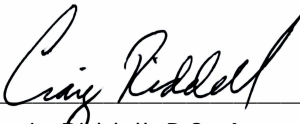
Tone Ag Consulting (St. Pierre-Jolys)  
ATTN: Shannon Wiebe  
31022 Rat River Rd  
St. Pierre-Jolys Manitoba ROA 1V0

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

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 1329 Niakwa Road East, Unit 12, Winnipeg, MB R2J 3T4 Canada | Phone: +1 204 255 9720 | Fax: +1 204 255 9721  
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 <sup>-1</sup>	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  
**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                       
                      
                      
 N  
 A  
 T  
 P  
 L1836271-GOFC    **IOV:**                     

**DATE RECEIVED:** 29.9.16 12:30PM

SAMPLE IDENTIFICATION NUMBER	SAMPLE IDENTIFICATION NUMBER	SAMPLE IDENTIFICATION NUMBER	SAMPLE IDENTIFICATION NUMBER
<b>1437293</b>	<b>1437294</b>	<b>1437295</b>	<b>1437296</b>

**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).

**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).

**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).

**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).

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

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

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

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

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

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

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

**CROP OPTIONS:** Yield/Protein Goal  
 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

**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

**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

**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