

Douglas Regehr Nutrient Management Plan

2017

Prepared for:

Douglas Regehr,
5042 Schubert Road,
Armstrong BC

Prepared by:

Ruth McDougall, M.Sc., PAg.
Consulting Agrologist
Enderby BC

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1. Introduction

This is a Nutrient Management Plan (NMP) for Douglas Regehr (D Regehr), 5042 Schubert Road, Spallumcheen BC (Figure 1) for the 2017 cropping year. It contains information on all nitrogen sources on the farm, and nitrogen requirements for crops in 2017 based on estimated crop uptake and residual soil nitrate levels. It has been written as part of the requirements of Regehr's Ministry of Environment Information Order (March 2014) and is a retrospective look at 2017 nutrient management on the farm. This plan covers the period September 1 2016 to August 31 2017 because in 2016-2017 crops were planted in fall and fertilized prior to planting.

The Douglas Regehr property consists of 19.3 hectares (47.6 acres) of arable land as well as the farmstead. The farm operated a feedlot on-site from 1980 to 1997. The feedlot was depopulated in 1997. From 2002 to 2007 the feedlot was rented by H.S. Jansen who housed 1000 replacement heifers in it year-round. The farm has not had any animals on-site since 2007 when Jansen moved his replacement heifers elsewhere. The farm has been managed organically since 2012; since that time there has been no synthetic fertilizer used on the farm and all nutrients used by crops have been provided in broiler or liquid dairy manure. The land base farmed now includes the area of the old feedlot; prior to 2015 this area was not farmed.

This plan considers the agronomic balance of nitrogen only. The residual levels of phosphorus and potassium in the soil plus the amount applied in manure in fall 2016 will meet crop needs for these nutrients for 2017. The arable land base contains phosphorus in excess of agronomic levels however the fields are not linked to surface water so there is little risk of movement of soil phosphorus to surface water. See section 14 for a more thorough discussion of soil phosphorus levels and management.

All calculated values used in this plan are derived from the BC Ministry of Agriculture's Nutrient Management Planner calculator Excel spreadsheet.

2. Livestock on site 2017

D Regehr has no livestock on site. There have been no livestock on site since 2007 when the feedlot on site was depopulated.

3. Cropping report – 2014-2017

Table 1 below shows the farm's fields, acreages cropped and crops grown between 2014 and 2017. The current crop cycle at D Regehr's begins in fall with application of manure and planting of cereal crop or canola, and finishes in late summer the following year with harvest of that crop.

In 2017, D Regehr cropped 47.6 acres (19.3 hectares) of land. All land was planted to canola which was harvested in late summer 2017. The fields are listed with areas and 2017 cropping information in Table 1 below. Fields are identified on Figure 2. Site Map.

Note that the 'Horse pasture' is included with the 'Home field' for soil testing and calculation of nutrient requirements.

Table 1. Cropping Report – 2014-2017

Field ID	Area		2014 Crop	2015 Crop	2016 Crop	2017 Crop
	ha	acres				
101 Home Field	15.5	38.3	wheat	wheat	spelt	canola
102 Old Feedlot	3.1	7.7	not cropped	wheat	spelt	canola
Horse pasture	0.65	1.6	pasture	pasture	spelt	canola
Total	19.3	47.6				

4. Results of BC Ministry of Agriculture 2016 Post-harvest Soil Nitrate Study

Table 2 contains the results of the Ministry of Agriculture fall 2016 post-harvest nitrate soil testing at D Regehr for the fields that were farmed in 2017 (lab data attached). Both fields farmed by D Regehr in 2016 were included in the fall 2016 study. The fields had an agronomic rating of high to very high soil residual nitrate-N based on the BC Ministry of Agriculture (AGRI) scale that was used to assess residual soil nitrate-N levels in the Hullcar area in fall 2016. Residual soil nitrate-N was measured to 90 cm in the soil.

Note: D Regehr's fields had been manured in late summer 2016 before post-harvest nitrate sampling was done. This is because the crop cycle at D Regehr farm begins in fall with planting of crops. A small amount of manure is applied before seeding to provide nutrients for the crop. This resulted in significant nitrate-N present in the 0-30 cm zone in 101 Home Field. Field 102 Old Feedlot was not manured in 2016; the residual nitrate-N measured in fall 2016 is apparently due to release of residual N from soil organic matter.

Residual soil nitrate-N levels to 60 cm have been used to calculate manure application rates for 2017.

Residual soil ammonium-N data has not been included in residual soil nitrogen levels. There is currently no Ministry of Agriculture interpretation for residual soil ammonium-N.

Bulk density conversions: Residual soil nitrate-N was converted from mg/kg to kg/ha assuming a soil bulk density of 1470 kg/m³ to reflect the sandy texture of the soils in and around the D Regehr property.

Table 2. 2016 Post-harvest Soil Nitrate-N Data

Field ID	2016 Crops	Sampling Depth	October 2016 Nitrate-N (NO ₃ -N)	Average NO ₃ -N in 0-90 cm Depth	Ammonium-N (NH ₄ -N)
		cm	mg/kg	mg/kg	mg/kg
101 Home field (includes horse pasture)	Spelt/canola	0-15	30	10	8
		15-30	16		5
		30-60	5		4
		60-90	2		3
Total residual N (kg/ha)			131	High	NA
102 Old Feedlot	Spelt/canola	0-15	35	21.3	6
		15-30	35		10
		30-60	14		9
		60-90	15		23
Total residual N (kg/ha)			282	Very high	NA

*Ministry of Agriculture (AGRI) Agronomic Rating: 0-49 kg/ha low, 50-99 kg/ha medium, 100-199 kg/ha high, 200+ kg/ha very high. Note: Residual nitrate-N in soil was calculated at a soil BD of 1470 kg/m³.

5. Nitrogen applied to D Regehr fields from all sources in 2017

5.1 Manure application

During the 2017 cropping year no manure was applied to D Regehr's fields. A small application of manure was made in late summer 2016 to provide nutrients for establishment of the canola planted in fall 2016. This was captured in the fall 2016 post-harvest soil nitrate testing and is included in nutrient accounting as the 'residual nitrate-N'.

Post-harvest nitrate soil testing will be done in late summer 2017 once the canola crop is harvested. Based on the amount of residual nitrogen present in the soil, manure will be applied to meet the requirements of the spelt crop to be planted in fall 2017.

5.2 Other sources of nitrogen on farm

Fertilizer nitrogen: No synthetic or mineral nitrogen fertilizer was used by D Regehr in 2017 as the farm is managed organically.

Irrigation water: The farm irrigates with one well that is assumed to have the same nitrate concentration as the D Regehr irrigation well, an average nitrate-N concentration of 15.6 mg/L of nitrate (June 2017 sample). Based on approximately 5" (12.7 cm) of irrigation applied to the farm's fields per growing season, approximately 20 lb/A of nitrate is supplied in the irrigation water. This amount of nitrogen has been accounted for as fertilizer N when calculating crop nitrogen requirements

for 2017. It is recommended that irrigation water is tested once annually mid-season for nitrates for accuracy.

6. Cropping and nitrogen requirements of crops – 2016 and 2017

The canola crop grown in 2017 is estimated to require approximately 40 lb/acre of nitrogen. 2017 cropping information is found in columns B, C and D of Table 3. Crop, estimated dry yield and protein content of crop as well as 2017 nitrogen application rates have been provided by D Regehr and corroborated by reference sources. Because the amount of residual nitrogen present in fall 2016 and the amount of nitrogen expected to be released from organic matter in 2017 exceeds expected crop uptake of nitrogen, the crop is estimated to require no additional nitrogen in 2017.

Explanation of crop nitrogen requirements for 2017: Table 3, Column H contains the nitrogen application rate recommendations for 2017. This number is the estimated crop nitrogen uptake (column E) less the amount of residual nitrate in the 0 to 60 cm depth of the soil (column F, from fall 2016 PHNT results) and less the amount of nitrogen that is estimated to be released from soil organic matter in 2017 for each field (column G).

Column E contains the estimated crop nitrogen uptake values by field for 2017. These values are the product of crop dry yield by crop protein corrected for %N in protein (16% of protein is nitrogen).

Column F contains the residual soil nitrate from fall 2016 soil test results to 60 cm depth.

Column G contains the nitrogen fertility factors by field which are an estimate of the amount of nitrogen which will be released from soil organic matter over the 2017 growing season. Both fields were given a nitrogen fertility factor of 45 lb/A. Field 101 Home field has been manured regularly at or below agronomic rates. Field 102 Old feedlot has never been manured or fertilized (since the area was decommissioned as a feedlot) but the organic layer from the feedlot is still releasing a significant amount of nitrogen.

Table 3. Crop nitrogen requirement calculations -2017

Worksheet 1. Calculate the Crop Nitrogen Application Recommendations							
A	B	C	D	E	F	G	H
Field Description	Crop Information			Crop Nitrogen (N) Applicator Calculations			Crop Nitrogen Application Recommend'n
(name or number)	Crop type to be fertilized	Crop dry yield (estimated) (tons/ac) ^a	Protein content of crop ^b (estimated) (%)	Crop Nitrogen (N) Uptake (col. C x D x 1.6 x 2) (lb N/ac)	Available soil nitrogen (nitrate plus ammonia) ^c (lab report) (lb N/ac)	Nitrogen fertility factor (Table 1) (lb N/ac)	(col. E – F - G) (lb N/ac)
101 Home Field	canola	0.6	20.6	40	109	45.0	-114
102 Old Feedlot	canola	0.6	20.6	40	192	45.0	-197

7. Planned applications of manure in 2017

Canola (planted in fall 2016): no manure application planned during 2017. The soil contained sufficient residual nitrogen in fall 2016 to meet 2017 crop requirements.

8. Agronomic balance calculations – Crop requirements vs. available nutrients

Table 4 shows the nitrogen balance for each field for 2017 (3rd from last column) for the period September 2016 to August 2017. The table shows that, based on the assumptions used in the calculator, the available farm-specific data and the planned manure application rates, *both fields had more nitrogen than crop requirements in 2017.*

Note: No manure was applied in 2017. Therefore there are no manure types listed in the NMP calculator.

Note: the 20 lb/A in the fertilizer column of Table 4 (column J) represents the estimated contribution of nitrates from irrigation water.

Table 4. Agronomic balance calculations for 2017 cropping year

Worksheet 5. Estimate the Agronomic Balance for Nitrogen, Phosphorus and Potassium																			
Field Description (Worksheet 1, col. A) (name or number)	Crop type (Worksheet 1, col. B)	Field Size (ac)	Manure Source and Application Method		Manure Application Rate (tons/ac) See note below for guidance in determining rate*	Available Nutrients in the Year of Application						Crop Nutrient Recommendation (based on estimated soil nutrient supply)			Agronomic Balance (crop nutrient recommendation minus available nutrients in the year of application)				
			Show/Hide Manure Source #2	Show/Hide Manure Source #3		Manure Sources			Fertilizer			N (Worksheet 1, col. H)	P ₂ O ₅ (Worksheet 2, col. I)	K ₂ O (Worksheet 3, col. J)	N* (col. M – F – J)	P ₂ O ₅ * (col. N – H – K)	K ₂ O* (col. O – I – L)		
			Click here for help to use the show/hide buttons. (select from drop-down list)			N (Col E x Worksheet 4, col. J)	P (Col E x P availability coefficient * Worksheet 4, col. L)	K ₂ O (Col E x Worksheet 4, col. N)	N (Worksheet 4, col. J)	P ₂ O ₅ (Worksheet 4, col. L)	K ₂ O (Worksheet 4, col. N)							Sum all planned fertilizer additions for the year. Use Worksheet 6: 1 to the right to help.	
101 Home Field	canola	38.3			0	0	0.85	0	0	0	20			-114	0	0	-134	0	0
			all manures		0	0	n/a	0	0	0	20			-114	0	0	-134	0	0
102 Old Feedlot	canola	7.7			0	0	0.85	0	0	0	20			-197	0	0	-217	0	0
			all manures		0	0	n/a	0	0	0	20			-197	0	0	-217	0	0

9. Timing of manure applications

Because crops are planted in the fall, a small application of manure is made in late summer to meet crop requirements for starting the crop based on residual soil nitrate-N levels when the previous crop is removed. For the past two years a small late summer manure application has been sufficient to meet crop requirements.

10. Method of manure application

Solid manure will be applied by solid manure spreader. Liquid manure will be applied by vacuum tanker.

11. Tracking of manure applications

All manure applications made to D. Regehr's land base are tracked and recorded. All manure used at the farm is purchased and brought on to the farm by the load; total volumes used are tracked by the load.

12. Setbacks

D Regehr maintains the following setbacks when applying manure:

- 30 m (100 ft) from all domestic wells, surface water and residences
- 3.5 m (10 ft) from industrial wells (including irrigation wells), roads and other buildings

13. Other fertilizers -2017

No synthetic or mineral fertilizer is ever used at D Regehr's fields as the farm is managed organically.

14. Soil phosphorus status

Both fields farmed by D Regehr had soil available phosphorus levels in the excess range in fall 2016 (Table 5). Phosphorus from agricultural fields can move into surface water where there is hydraulic conductivity between fields and surface water such as where fields are located next to surface water or where ditches or tile drainage connects to surface water. The amount of phosphorus that can potentially move into surface water increases as soil residual phosphorus levels increase.

Deep Creek runs adjacent to Field 102 Old Feedlot in a north-south direction. Along the boundary with Deep Creek there is a > 150 m treed buffer between the field and Deep Creek which is expected to effectively slow down runoff and allow runoff water to move into the soil which will capture phosphorus. The risk of movement of phosphorus from Field 102 Old Feedlot into Deep Creek is minimal.

Steele Springs is located >50 m south of the southern boundary of the D. Regehr property. There is a >100 m buffer between D. Regehr's arable land and Steele Springs which will effectively slow down runoff and allow runoff water to move into the soil which will capture phosphorus in runoff. The risk of movement of phosphorus from D. Regehr's arable land to Steele Springs is minimal.

Table 5. Soil phosphorus status – fall 2016

Worksheet 2. Calculate the Crop Phosphorus Application Recommendation								
A	B	C	D	E	F	G	H	I
Field Description (Worksheet 1, col. A)	Crop Information		Crop Phosphorus (P) Applicator Calculations				Crop Phosphorus Application Recommendation (SEE NOTE BELOW)	
(name or number)	Crop type to be fertilized	Crop dry yield (estimated) (tons/ac)	Crop phosphorus factor (Table 2) (lb P/ton)	Crop Phosphorus Uptake (col. C x D) (lb P/ac)	Soil test phosphorus value (Kelowna method) ^a 0-15 cm depth (ppm)	Soil phosphorus status (Table 3, col. 2)	Soil phosphorus level factor (Table 3, col. 5)	(col. E x H) x 2.3 (lb P ₂ O ₅ /ac)
101 Home Field	canola	0.6	15.0	9	236	Excess	0	0
102 Old Feedlot	canola	0.6	15.0	9	570	Excess	0	0
		0		0				0

15. Irrigation rate

D Regehr's fields are situated on soils with a texture of sand, sandy loam or loamy sand. These soils are rapidly permeable and have low moisture and nutrient holding capacity. Nitrate leaching can occur easily from these soils if irrigation water moves down below the crop rooting depth. For this reason, D Regehr irrigates according to soil moisture requirements to ensure that no excess irrigation water is applied.

16. Manure storage capacity

D Regehr has no manure storage on site. Manure is not stockpiled on site. It is applied as soon as it is hauled to the farm.

17. Soil Monitoring - Post-harvest soil nitrate testing fall 2017

After crop harvest in fall 2017, soil sampling will be done in each field to 90 cm to assess the residual nitrate-N levels in the farm's two fields. This information should be used in determination of manure application requirements for 2018.

18. Groundwater Monitoring - 2017

D Regehr's domestic well is tested approximately 3 times per year (spring, summer and fall) by Steele Springs Water District (Brian Upper). In 2017, the well was tested in February and June and will be tested again in September (Table 6). Nitrate levels of 14.8 and 15.5 mg/L were measured in February and June respectively. Original lab data are found in separate pdf files.

The nitrate levels in D Regehr's well track those of Steele Springs which is located to the south west. Nitrate levels exceed the Canadian Drinking water standard of 10 mg/L and have done since June 2015. There is no indication that nitrate levels are higher from the D Regehr well than from Steele Springs at this point which suggests that the impacts to aquifer 103 (which supplies Steele Springs) originate to the northwest.

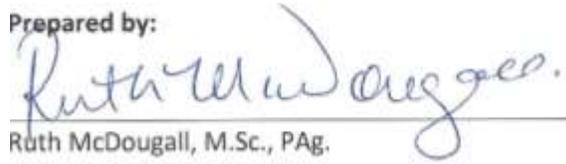
Table 6. Results of 2017 Monitoring of D Regehr Well

Sampling date	Groundwater nitrate level (mg/L)	Laboratory	Sampler
February 2 2017	14.8	Caro Analytical	Brian Upper, SSWD
June 22 2017	15.5	Caro Analytical	Brian Upper, SSWD

19. Surface water monitoring

There are no surface water sources on the D. Regehr property. There are no streams or seasonal runoff channels on the property. The nearest surface water is Steele Springs which is located > 50 m south of the south property line, and Deep Creek which is located approximately 200 metres to the east of the eastern edge of the property with a 150 m treed buffer between arable land and the creek. Therefore no surface water monitoring is being conducted as part of this Nutrient Management Plan.

Prepared by:

A handwritten signature in blue ink that reads "Ruth McDougall". The signature is written in a cursive style and is positioned above a horizontal line.

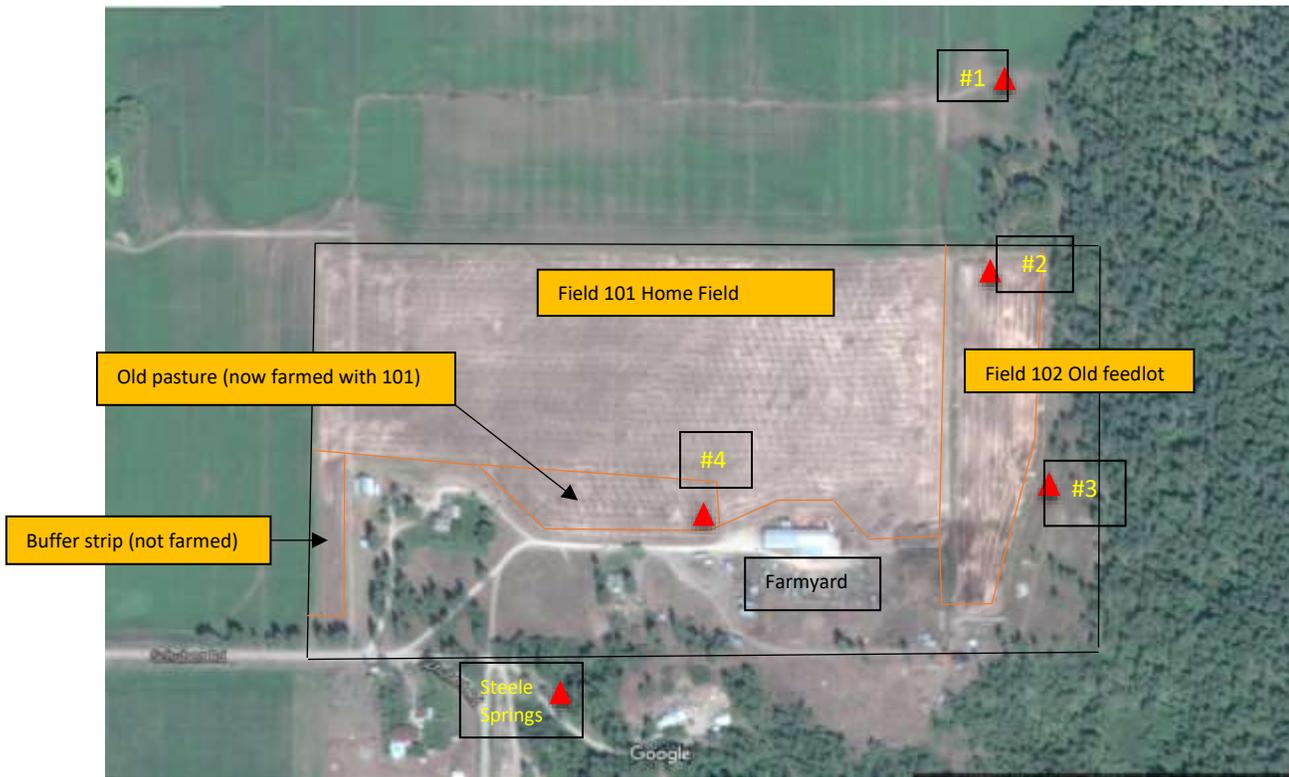
Ruth McDougall, M.Sc., PAg.
Consulting Agrologist

October 24, 2017

Figure 1. D. Regehr property at 5042 Schubert Road in relation to Knob Hill Road and Hullcar Road



Figure 2. Site map showing boundaries of Douglas Regehr property, fields and wells



Well ID:

- 1 – Irrigation well
- 2 – Domestic well
- 3 – Golder 2016 permanent monitoring well
- 4 – Golder temporary well (borehole) (filled in)

Figure 3. Soil test report – PHNT October 2016

a. Post-harvest soil test – Home field – October 2016

Report Number: C16298-10453
 Account Number: 00219
 To: EMERALD BAY AG SERVICES
 10 MARYS EMERALD BAY ROAD
 VERRON, BC V1H 2A7
 Attn: DOUG MACFARLANE
 250-546-3847

Reported Date: 2016-10-18 Printed Date: Oct 19, 2016

Grower Code: 05219011

A & L Canada Laboratories Inc.
 2136 Jetstream Road, London, Ontario, N5V 3P5
 Telephone: (519) 457-2575 Fax: (519) 457-2964

For: REGEHR DOUG
 Farm: HOME
 Field: HOUSE

CH6298-10453
 D. Regehr
 Fall 2016 PHNT
 Home field.

SOIL TEST REPORT

Sample Number	Legal Land Descript	Depth	Lab Number	Organic Matter	Phosphorus - P ppm	Potassium K ppm	Magnesium Mg ppm	Calcium Ca ppm	pH	CEC	Percent Base Saturations	Sodium Na ppm				
					Bicarb	Bray-1				meq/100g	% K % Mg % Ca % H % Na					
D391A		6	18253	5.4	118	355	552	320	2920	7.0	21.6	6.6	12.3	67.6	12.9	0.6
D391B		12	18254	2.7	86	247	568	325	2590	7.1	18.9	7.7	14.3	68.4	8.9	0.7
D391C		24	18255	1.3	39	81	369	345	2040	7.4	14.1	6.7	20.4	72.3	0.9	0.9
D391D		36	18256	0.6	23	33	248	215	1220	7.6	8.6	7.4	20.8	70.8	1.3	1.3
Sample Number	Sulfur ppm	Nitrogen ppm	Zinc ppm	Manganese Mn ppm	Iron Fe ppm	Copper Cu ppm	Boron B ppm	Molybdenum Mo ppm	Soluble Sulfate meq/soilcm	Saturation %P	Aluminum Al ppm	Saturation %Al	K/Mg	M/H4M		
D391A	37	30								85	537	0.0	0.54	8	31	
D391B	34	16								51	626	0.1	0.54	5	31	
D391C	16	5								14	721	0.1	0.33	4	28	
D391D	7	2								9	453	0.0	0.36	3	26	

SOIL FERTILITY GUIDELINES (lbs/ac)

Sample Number	Crop	Yield Goal	Lime Tons/acre	N	P2O5	K2O	Mg	Ca	S	Zn	Mn	Fa	Cu	B
D391A	Corn Silage Western	24 tons	0.0	188	20	20	10	0	0					

* Rates are based on building nutrients to a level to maintain soil health. Banding and/or precision placement techniques can be utilized to increase fertilizer efficiency.
 * If this report contains soil in excess of 7500 ppm Ca it may or may not effect the calculated Cation Exchange Capacity. Excessive seed placed fertilizer can cause injury.
 * The results of this report relate to the sample submitted and analyzed.
 * Crop yield is influenced by a number of factors in addition to soil fertility.
 * No guarantee or warranty concerning crop performance is made by A & L.
 A&L Canada Laboratories Inc. is accredited by the Standards Council of Canada for specific tests as listed on www.scca.ca and by the Canadian Association for Laboratory Accreditation as listed on www.cadl.ca

Results Authorized By:  Ian MacLachlan, Vice President

b. Post-harvest soil test – Old feedlot – October 2016

Report Number: C16286-10454
 Account Number: 05219
 TO: EMERALD BAY AG SERVICES
 10 MARYS EMERALD BAY ROAD
 VERNON, BC V1H 2A7
 Attn: DOUG MACFARLANE
 250-546-3847
 Grewer Code: 05219011
 Farm: HOME
 Field: 102 OLD FEEDLOT
 D. Regehr
 Fall 2016
 Old feedlot
 PHNT

A & L Canada Laboratories Inc.
 2130 Westburn Road, London, Ontario, N5Y 3P5
 Telephone: (519) 457-2575 Fax: (519) 457-2664
 C15286-10454



Reported Date: 2016-10-18 Printed Date: Oct 19, 2016 **SOIL TEST REPORT** Page: 1 / 1

Sample Number	Legal Land Descript	Depth	Lab Number	Organic Matter	Phosphorus - P ppm	Potassium K ppm	Magnesium Mg ppm	Calcium Ca ppm	pH	CEC	Percent Base Saturations	Sodium Na ppm		
					Bicarb	Bray P1			Buffer	meq/100g	% K % Mg % Ca % H % Na			
D401A		6	18257	6.7	285	882	1243	3280	6.8	26.1	12.2 19.8 62.9	4.3 0.7		
D401B		12	18258	4.7	174	542	1356	2350	6.6	20.3	17.2 18.5 58.0	5.7 0.7		
D401C		24	18259	0.8	72	182	1355	1420	7.3	13.2	26.4 18.7 53.9	1.3		
D401D		36	18260	0.6	65	171	1116	2010	7.4	16.0	17.9 18.8 62.9	0.7		
Sample Number	Sulfur ppm	Nitrate Nitrogen ppm	Zinc ppm	Manganese Mn ppm	Iron Fe ppm	Copper Cu ppm	Boron B ppm	Molybdenum Mo ppm	Soluble Sulfate mg/lbs/ac	Saturation %P	Aluminum Al ppm	Saturation %Al	K/Mg NH4N Ratio	Sodium Na ppm
D401A	51	35								336	337	0.0	0.62	6
D401B	29	35								147	473	0.1	0.93	10
D401C	22	14								33	701	0.1	1.41	9
D401D	18	15								42	524	0.0	0.95	23

SOIL FERTILITY GUIDELINES (lbs/ac)

Sample Number	Crop	Yield Goal Tons/Acre	Lime	N	P2O5	K2O	Mg	Ca	S	Zn	Mn	Fe	B
D401A	Canola	60 bu	0.0	0	20	0	0	0	0				
D401A	Canola build	60 bu	0.0	0	30	35	0	0	0				

* Recs are based on building nutrients to a level to maintain soil health. Banding and/or precision placement techniques can be utilized to increase fertilizer efficiency.
 * If this report contains soil in excess of 7500 ppm Ca it may or may not effect the calculated Cation Exchange Capacity. Excessive seed placed fertilizer can cause injury.
 The results of this report relate to the sample submitted and analyzed.
 * Crop yield is influenced by a number of factors in addition to soil fertility.
 No guarantee or warranty concerning crop performance is made by A & L.
 A&L Canada Laboratories Inc. is accredited by the Standards Council of Canada for specific tests as listed on www.secca and by the Canadian Association for Laboratory Accreditation as listed on www.calk.ca
 Results Authorized By:  Ian McLachlin, Vice President