Alberta Offset System
Offset Project Report for XYZ Inc.'s Nitrous Oxide Emission Reductions (NERP) Aggregation Project - Protocol Validation Study
(June 2014)

Disclaimers

This document has been produced independently by The Prasino Group at the request of the Climate Change Emissions Management (CCEMC) Corporation as specified under contract for the Protocol Validation Studies. It was produced according to the requirements in the Alberta Offset System's Nitrous Oxide Emissions Reduction in Agriculture Quantification Protocol v 1.0 October 20131. The views expressed in this report are not necessarily the views of the Climate Change Emissions Management (CCEMC) Corporation.

Note to Reader:

This document is a sample Offset Project Report (OPR) produced as part of the larger Protocol Validation Study. It is meant to provide guidance to project developers on applying the OPR template (http://environment.gov.ab.ca/info/library/8523.pdf) to a Nitrous Oxide Emission Reductions Offset Project under the Alberta Offset System. Any reference to farm information, or offset credit information contained within this document is fictitious and intended for illustrative purposes only.

[1] See http://environment.gov.ab.ca/info/library/8294.pdf

1 Project Document Information

Project Developer: XYZ Inc.

Date: June 3, 2014

Reporting Period: January 1, 2011 – December 31, 2011

2 Project Scope and Site Description

2.1 Project Scope

Table 1 below provides details on the projects scope, ownership, reporting plans, verification details and registration.

Table 1: Project Details	
Project Title:	Offset Project Plan for XYZ Inc.'s Nitrous Oxide Emission Reductions (NERP) Aggregation Project - Protocol Validation Study
Project Purpose and Objective(s):	The purpose of this project is to reduce emissions of nitrous oxide (N_2O) related to direct losses (nitrification/ denitrification losses), indirect losses (through nitrate leaching), and/or volatilization and redeposition of ammonia gas. Specifically, N_2O emissions will be reduced through the use of beneficial management practices (BMPs) called the 4R's – right rate, right place, right time and right source. These practices are defined under a 4R Nitrogen Stewardship Plan. Five farms, representing approximately 15,000 cultivated hectares, will be aggregated for this project by XYZ Inc. The broader goal of the Protocol Validation Study is to identify barriers that currently exist in implementing projects under the NERP protocol and design scalable approaches to adopting this protocol.
Project Start Date:	e.g. January 1, 2011
Credit Start Date:	N/A – the NERP Protocol Validation Study is a non-commercial exercise (e.g. January 1, 2011)
Reporting Period:	January 1, 2011 - December 31, 2011

Table 1: Project Details	
Expected Lifetime of the Project:	N/A - The NERP Protocol Validation Study is a non-commercial exercise. Commercial offset projects may have a lifetime of up to 13 years for all participating farms as per the protocol, although the activity itself can be continued indefinitely.
Actual Emission Reductions/Removals Achieved:	January 1 - December 31, 2011: 2337 t CO_2e
Applicable Quantification Protocol(s):	Government of Alberta Quantification Protocol for Agricultural Nitrous Oxide Emissions Reductions, Version 1.0, October 2010
Protocol(s) Justification:	All participating project sites are based in Alberta and have implemented a 4R Plan. The 4R plan includes an integrated set of BMPs for either annual or perennial cropping. It has been designed and implemented in consultation with an Accredited Professional Advisor, at the basic performance level. The practices employed in this project are not required by law and go beyond business as usual practices. As a result, the project is additional. The Project and all aggregated sites also align with all applicability requirements stated in the Protocol. Refer to Section 2.3 for Project Eligibility Criteria.
Other Environmental Attributes:	This project will not generate any other environmental credits/benefits. However, more efficient crop production will result in less nitrogen being used and as a result lower associated impacts to water quality, etc.
Legal Land Description of the Project and/or Other Unique Site Descriptions:	Farm #1: 01-01-010-01W4 Farm #2: 02-01-010-01W4 Farm #3: 03-01-010-01W4 Farm #4: 04-01-010-01W4 Farm #5: 05-01-010-01W4
Ownership:	As described in the Protocol, ownership of offset credits generated under this protocol is assigned to the land manager/farmer. Since this is an emission reduction protocol, no accumulation of soil organic carbon is accounted for, and no carbon sink is attributed. As such, the land manager/farmer creates the reduction through implementing the improved nitrogen management practices

Table 1: Project Details	
	prescribed through the 4R Nitrogen Stewardship Plan. Proof of ownership over emission reductions is provided in the form of land title certificates for each field, in addition to agreements between the participating farmers and XYZ Inc. XYZ Inc. is the aggregator of all offsets arising from this project. XYZ Inc. must negotiate contractual agreements for the purchase of carbon offset credits with each of the land managers/farmers.
Reporting and Verification Details:	N/A – this document is an example of an Offset Project Report for the Protocol Validation Study. This is the first mock-verification for this project. A second mock-verification will be completed by a qualified third party validator in Late Fall 2014. The verifier has no actual or perceived conflicts of interest associated with this project. This is the first project report for this project. Verification is expected to occur on an annual basis, although the verification of smaller tonnes may occur every second year.
Project Registration:	N/A – the NERP Protocol Validation Study is a non-commercial exercise. Therefore, the project will not be registered in Alberta or in any other jurisdiction. However, it will be implemented according to ministerial guidelines.

2.2 Site Description - Legal Land Description of the Project and/or Other Unique Site Descriptions

This project is an aggregation of emission reductions across five farms in Alberta. The location of these farms is provided below[1]:

Table 2: Farm Coordinates			
Farm	Legal Land Description	**Latitude**	**Longitude**
Farm #1	01-01-010-01W4	53.521479	-112.015915
Farm #2	02-01-010-01W4	53.447117	-111.923904
Farm #3	03-01-010-01W4	49.387617	-112.438202
Farm #4	04-01-010-01W4	49.301725	-111.471405
Farm #5	05-01-010-01W4	49.214875	-111.631052

Note: the above coordinates are fictitious

2.3 Project Activity and Eligibility

This project activity meets all the eligibility criteria for the Alberta Offset System and has been completed in accordance with the most recent version of the Technical Guidance for Offset Project Developers (Version 4.0, February 2013)[2]. The Project complies with the Specified Gas Emitters Regulation Quantification Protocol for Quantification Protocol for Agricultural Nitrous Oxide Emissions Reductions, Version 1.0, October 2010.

Table 3: Alberta Offset System Eligibility

Criteria	How this Project Meets the Requirement
Start Date after Jan 1, 2002	The 4R Plans were implemented in January 2011.
Real, Demonstrable, and Quantifiable	The project offset credits were generated from activities that go beyond business as usual practices, producing quantifiable emission reductions under the Nitrous Oxide Emission Reductions Protocol.
Not Required By Law	The changes in practices were not required by law or regulation.
Clearly Established Ownership	Legal contracts between the land manager and XYZ Inc. exist. Within the contract, XYZ Inc. and the land manager have an agreement clearly establishing the XYZ Inc. as the owner of the credits.
Counted Once for Compliance Purposes	Any carbon offset credits generated in this project will be serialized on the registry for use in the Alberta Offset System only and will not be used or counted in any other jurisdiction. Note: The offsets generated from this project report are not intended for use.
Verified by a Third Party	This project will be verified by a verifier meeting the requirements of the Alberta Specified Gas Emitters Regulation.
Have occurred in Alberta	All aspects of the Project occur in Alberta.
Be implemented according to a government approved quantification protocol (ministerial guidelines).	The activities are implemented under the Quantification Protocol for Agricultural Nitrous Oxide Emissions Reductions, V 1.0, October 2010
Be registered on the registry.	This document supports the registration of tonnes serialized by XYZ Inc. on the registry.

[2] http://environment.gov.ab.ca/info/library/8525.pdf

3 Project Contact Information

Project Developer Contact Information	XYZ Inc. John Abbott; President 1234 Main Street Red Deer, Alberta T4N 3T2 Canada 403-747-1234 403-747-5678 jabbott@xyzinc.com www.xyzinc.com	XYZ Inc. Michelle Abbott; Project Manager 1234 Main Street Red Deer, Alberta T4N 3T2 Canada 403-747-1234 403-747-5678 mabbott@xyzinc.com www.xyzinc.com
Authorized Project Contact	Optional depending on commercial arrangement	
Verifier:	ABC Consulting Inc. Jennifer Smith, Manager 789 Main Street Calgary, Alberta T3B 2P6, Canada 858.444.3906 jsmith@abc.com www.abcinc.com	

4 Project Description

XYZ Inc. is a local project aggregator located in Red Deer, Alberta. XYZ Inc. aggregates GHG emission reductions created by multiple farmers in order to provide the volume of GHG reductions typically required by interested buyers. In this case, the Nitrous Oxide Emission Reduction Protocol Validation Study is an aggregation of five participating farms. Each of these farms has implemented a set of beneficial nitrogen management practices that reduce direct (nitrification/denitrification losses) and indirect (losses through nitrate leaching and/or volatilization and redeposition of ammonia gas) emissions of nitrous oxide through a 4R Consistent Nitrogen Stewardship Plan. All of the farms included in the project are located in Alberta.

The GHG emission reductions have been generated in accordance with the Nitrous Oxide Emission Reductions Protocol. Each participating farm has provided information on their nitrogen management practices on a field by field basis. This data was then entered into XYZ Inc.'s software and reviewed by the data management team. Evidence has also been collected from each farm to confirm their eligibility to participate in the project.

5 Project Implementation and Variances

Implementation of the project followed the project plan. No modifications were made to the calculation procedures, data collection and/or record keeping procedures, or to the legal requirements of the project.

6 Greenhouse Gas Calculations

The greenhouse gas reductions/removals from this aggregated project were calculated on a crop by crop basis for each of the five farms. The methodology used follows the methodology described in the protocol and outlined in the offset project plan. The project quantification applied three flexibility mechanisms (Flexibility mechanism number two which excludes on-site fertilizer and lime distribution and two other mechanisms proposed by XYZ Inc. These two additional flexibility mechanisms included excluding fields/acres due to catastrophic events and using the ecodistrict with the most conservative emissions where a field bisected an ecodistrict boundary). As a result of the application of these flexibility mechanisms, SS B7 and P7 On-Site Fertilizer and Lime Distribution were excluded from the quantification.

6.1 Summary of Equations

$$Emission\ Reduction_{Crop\ i} = \sum [Emissions\ Baseline_{Crop\ i} - (Emissions\ Project_{Crop\ i,\ Zone\ j} * RM_{PL}) * Area_{Crop\ i,\ Zone\ j} * Crop\ Production_{Crop\ i,\ Zone\ j}] - Emissions_{Project,\ Fert\ Dist}$$

$$Emissions\ Baseline_{Crop\ i} = CO_2e \text{ Baseline Intensity}_{\text{Crop i}}$$

$$Emissions\ Project_{Crop\ i} = \sum CO_2e \text{ Baseline Intensity}_{\text{Crop i}}$$

Where:

- $Emissions\ Baseline_{Crop\ i}$ = Average emissions over the three year baseline condition for $crop_i$ (kg CO_2e kg^{-1} of crop produced)
- $N_2O\ Baseline_{Crop\ i}$ = Component of emissions under SS B8 Fertilizer and Lime Use & B13 Soil Crop Dynamics for crop $event_i$ (kg N_2O kg^{-1} of crop produced)

- $Emission\ Project_{Crop\ i}$ = Sum of the emissions under the project condition for crop I from zones 1 through j (kg CO_2e kg^{-1} of crop produced)
- $N_2O\ Project_{Crop\ i}$ = Component of emissions under SS P8 Fertilizer and Lime Use & P13 Soil Crop Dynamics for crop $event_i$ (kg N_2O kg^{-1} of crop produced)
- $Area_{Crop\ i,\ zone\ j}$ = The area of the crop management zone in the project condition for crop event I as defined in Table 4.2 of the protocol (ha).
- $Crop\ Production_{Crop\ i,\ Zone\ j}$ = The production from the crop in the project condition for crop I in management zone j, expressed as dry matter, as defined in Table 4.2 of the protocol (kg).
- RM_{PL}= The emission reduction modifier as defined in Table 4.2 of the protocol, associated with the selected performance level.
- $Emissions_{Project,Fertilizer\ Dist}$ = Sum of the emissions under the project condition SS P7 Fertilizer and Lime Distribution

6.2 Sample Calculation

An example calculation for spring wheat grown on Farm #4 is provided below. In this example the farm has implemented the basic performance level, involving (1) design and use of the 4R Plan; and (2) use of spring-banded instead of fall broadcast application of fertilizer. The farm is located in ecodistrict 737.

In the 2011 project year, 500 ha of spring wheat were grown using 55 kg of fertilizer N/ha to produce a yield of 3550 kg DM/ha. The dry matter crop yield was calculated using the water content of the crop at the time of sale. No manure or other sources of nitrogen were applied and the crop was not irrigated. Furthermore, no summerfallow was used on this farm in the baseline or in the project.

Baseline emissions were found to be an average of 0.229 kg CO_2/kg crop from 2008 to 2010.

The step by step procedure for estimating emissions from spring wheat for Farm #4 is provided below.

1. Calculating Nitrogen Inputs

In addition to the 55 kg of fertilizer N/ha applied, above and below ground crop residue N was calculated on a per hectare basis using the following formulas:

$N_{AG,wheat}$ = Yield $_{Wheat}$ * 1/Yield_ratio * AGresidue_ratio *AGresidue_N_conc
= 3550 kg DM ha^{-1} * 1/0.34 * 0.51 * 0.006 kg N kg^{-1}DM
= **31.950 kg N ha^{-1}**

$N_{BG,wheat}$ = Yield $_{Wheat}$ * Yield_ratio * BGresidue_ratio * BGresidue_N_conc
= 3550 kg DM ha^{-1} * 1/0.34 * 0.15 * 0.01 kg N kg^{-1}DM
= **15.662 kg N ha^{-1}**

$N_{res, wheat}$ = $N_{AG,wheat} + N_{BG,wheat}$
= 31.950 kg N ha^{-1} + 15.662 kg N ha^{-1}
= **47.612 kg N ha^{-1}**

2. Calculating Direct N_2O Emissions for Each Crop on an Area Basis

a. Direct Emissions from Fertilizer

The amount of fertilizer N applied to the crop was multiplied by the emission factor for the soil (EF_{ECO}). EF_{ECO} is an ecodistrict-specific factor which integrates the average F_{TOPO}, F_{TILL}, F_{IRRI}, and F_{TEXT} for the ecodistrict.

$N_2O_{FN,wheat}$ = N_{Wheat} * EF_{ECO} * 44/28
= 55 kg N ha^{-1} wheat* 0.009 kg N_2O-N kg N * 44/28
= **0.778 kg N_2O ha^{-1} wheat**

b. Direct Emissions from Crop Residue

The amount of crop residue N accumulated from the crop was multiplied by the emission factor for the soil (EF_{ECO}).

$N_2O_{res,wheat}$ = $N_{res,Wheat}$ * EF_{SOIL} * 44/28
= 47.612 kg N ha^{-1} wheat* 0.009 kg N_2O-N kg N * 44/28
= **0.673 kg N_2O ha^{-1} wheat**

c. Direct Emissions from Manure

No manure was used on the farm and therefore there were no direct emissions from manure.

d. Total Direct Emissions from Spring Wheat

The direct emissions from fertilizer, crop residues and manure were then summed to get total direct emissions.

$N_2O_{D,wheat}$ = $N_2O_{FN,wheat} + N_2O_{res,wheat}$

= 0.778 kg N_2O ha^{-1} wheat + 0.673 kg N_2O ha^{-1} wheat

= **1.451 kg N_2O ha^{-1} wheat**

3. Calculating Indirect N_2O Emissions from Volatilization for Each Crop on an Area Basis

a. Volatilization Emissions from Fertilizer

The amount of fertilizer N applied to the crop was multiplied by the appropriate coefficient of volatilization ($FRAC_f$ for fertilizer and $FRAC_m$ for manure) and the emission factor for volatilized N (EF_{VD}). The values for $FRAC_f$ and EF_{VD} are constant across Canada.

$N_2O_{VD,wheat}$ = $N_{Wheat} * FRAC_f * EF_{VD} * 44/28$

= ((55 kg N ha^{-1} wheat* 0.1) + (0.00*0.2)) * 0.01 kg N_2O-N kg N * 44/28

= **0.086 kg N_2O ha^{-1} wheat**

b. Volatilization Emissions from Crop Residue

Not included in the calculation of indirect N_2O emissions as per IPCC convention.

c. Volatilization Emissions from Manure

No manure was used on the farm and therefore there were no volatilization emissions from manure.

d. Total Volatilization Emissions from Crop

The volatilization emissions from fertilizer and manure were then summed to get total direct emissions.

$N_2O_{VD,wheat}$ = 0.086 kg N_2O ha^{-1} wheat + 0 kg N_2O ha^{-1} wheat

= **0.086 kg N_2O ha^{-1} wheat**

4. Calculating Indirect N2O Emissions from Leaching for Each Crop on an Area Basis

a. Leaching Emissions from Fertilizer

The amount of fertilizer N applied to the crop was multiplied by the appropriate coefficient of leaching ($FRAC_L$) and the emission factor for volatilized N (EF_L). The

values for $FRAC_L$ are calculated for each ecodistrict in Canada, and are provided in Appendix B of the protocol. The value for EF_L is a constant of 0.025 kg N_2O-N kg N.

$N_2O_{L,F,wheat}$ = $N_{F,Wheat} * FRAC_L * EF_L * 44/28$
= 55 kg N ha^{-1} wheat* 0.190 * 0.025 kg N_2O-N kg N * 44/28
= **0.411 kg N_2O ha^{-1} wheat**

b. Leaching Emissions from Crop Residue

$N_2O_{L,Res\ wheat}$ = $N_{res,Wheat} * FRAC_L * EF_L * 44/28$
= 47.612 kg N ha^{-1} wheat* 0.190 * 0.025 kg N_2O-N kg N * 44/28
= **0.355 kg N_2O ha^{-1} wheat**

c. Leaching Emissions from Manure

No manure was used on the farm and therefore there were no leaching emissions.

d. Total Leaching Emissions from Crop

The leaching emissions from fertilizer and manure were then summed to get total leaching emissions.

$N_2O_{L,wheat}$ = $N_2O_{L,F,wheat} + N_2O_{LF,manure}$
= 0.411 kg N_2O ha^{-1} wheat + 0.355 kg N_2O ha^{-1} wheat
= **0.766 kg N_2O ha^{-1} wheat**

5. Calculating Total CO2e Emissions for Each Crop on an Area Basis

a. Total N_2O Emissions from Crop

The direct and indirect N_2O emissions from fertilizer, crop residues and manure were then summed to get total N_2O emissions from the crop.

N_2O_{wheat} = $N_2O_{D,wheat} + N_2O_{VD,wheat} + N_2O_{L,wheat}$
= 1.451 kg N_2O ha^{-1} + 0.086 kg N_2O ha^{-1} + 0.766 kg N_2O ha^{-1}
= **2.303 kg N_2O ha^{-1} wheat**

b. Convert to Total N_2O Emissions per Kilogram of Crop

The total emissions for the crop were divided by yield.

$N_2O_{wheat/crop}$ = (2.303 kg N_2O ha^{-1} wheat) / (3550 kg DM ha^{-1})
= **0.00064 kg N_2O kg^{-1} crop**

c. Convert to CO_2e Emissions per Kilogram of Crop

Emissions for the crop were multiplied by the global warming potential of N_2O.

$CO_2e_{wheat/crop}$ = 0.00064 kg N_2O kg^{-1} crop x 310 kg CO_2e kg^{-1} N_2O

= **0.198 kg CO_2e kg^{-1} crop**

d. Multiply by the Reduction Modifier and Calculate the Emission Reduction on a Kilogram of Crop Basis

The emissions were multiplied by the reduction modifier for the basic performance level (0.85). This value was then subtracted this from the baseline emissions* (on a crop basis).

Emission Reduction = 0.226 kg CO_2e kg^{-1} crop* - (0.198 kg CO_2e kg^{-1} crop x 0.85)

= **0.058 kg CO_2e kg^{-1} crop**

***Note:** Baseline emissions were calculated using the same general process, except the reduction modifier is not applied. For this project 2008-2010 data were used for the baseline.

e. Determine Total Credits in CO_2e

Finally, total credits were calculated by multiplying by the yield and crop area and then converting to tonnes.

Credits = 0.058 kg CO_2e kg^{-1} crop x 3550 kg DM ha^{-1} x 0.001 t/kg x 500 ha

= **102 t CO_2e**

The same method was used across all fields and farms in the aggregated project. In those cases where a field was bi-sected by an ecodistrict boundary, the ecodistrict that had the most conservative emissions reduction estimate was applied for the entire field.

7 Greenhouse Gas Assertion

The total GHG emissions reductions reported here reflect the cumulative reduction of all five farms included in this project. The reporting period is January 1 – December 31, 2011.

Table 4: Total Emissions

Year	Farm	N_20 (t CO_2e)	Total (t CO_2e)
2011	Farm #1	545.00	545
2011	Farm #2	301.16	301
2011	Farm #3	466.00	466
2011	Farm #4	373.66	373
2011	Farm #5	652.00	652
		Total	**2337**

Note: the above values and farms are fictitious

8 Project Developer Signature

I am a duly authorized corporate officer of the project developer mentioned above and have personally examined and am familiar with the information submitted in this offset project report including the accompanying greenhouse gas assertion on which it is based. Based upon reasonable investigation, including my inquiry of those individuals responsible for obtaining the information, I hereby warrant that the submitted information is true, accurate and complete to the best of my knowledge and belief, and that all matters affecting the validity of the emission reduction claim or the protocol(s) upon which it is based have been fully disclosed. I understand that any false statement made in the submitted information may result in de-registration of credits and may be punishable as a criminal offence in accordance with provincial or federal statutes.

The project developer has executed this offset project report as of the _____ day of _____, 20_____.

Enter name of project as being registered

Enter name of project developer(s)

Signature: _____

Date: Enter date

Name: Enter Name

Title: Enter Title